

Introduction to Supply Chain Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

- Define “supply chain management” and explain the activities involved.
- Identify the flows through a supply chain and explain the bullwhip effect.
- Describe the rise of supply chain management and its global implications.
- Describe characteristics of a competitive supply chain.
- Identify and explain key trends that drive today's supply chains.

CHAPTER OUTLINE

■ What Is Supply Chain Management (SCM)?

SCM Activities

Managing Flows Through the Supply Chain

The Bullwhip Effect

Customer Focus

The Service Supply Chain

■ The Boundary-Spanning Nature of SCM

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Cross-Enterprise Integration

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Reliability

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Postponement

The Lean Supply Chain
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- **Discussion Questions**
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Most of us have had the experience of sitting at a Starbucks coffee shop enjoying a cup of coffee, a frappuccino, or perhaps a pumpkin spice latte. We have enjoyed the “Starbucks experience,” sipping a beverage, lounging in one of the many chairs, and perhaps reading a newspaper or a good book. We may have briefly noticed that Starbucks’ coffee beans come from all across the globe, including Rwanda, Timor, Guatemala, Sumatra, Brazil, Kenya, Mexico, and Ethiopia. However, we have probably not given much thought to the complexity of decisions and coordination required to make sure that we, the customers, receive the beverages we are enjoying as we sit in the café.

In fact, for Starbucks to be able to deliver such a high-quality, consistent, and broad product offering to more than 29,000 store locations worldwide, it must manage an extensive global network of trading partners, from coffee growers to roasting plants to coffee distributors. It must manage relationships, ensure the highest quality, and guarantee product availability at each store location, all the while maintaining efficiency and keeping costs as low as possible. So while we, the customers, sit in the dimly lit and hip café enjoying the “Starbucks experience,” behind the scenes is a company that is managing one of the biggest global supply chains in the world.

Supply chain management (SCM) is the fastest-growing area of business today. In fact, it is at the core of the success of such companies as Amazon, Nike, Toyota, Wal-Mart, P&G, Zara, PepsiCo, BMW, L’Oréal, and McDonalds, as well as Starbucks, and countless others. These companies have achieved world-class status in large part due to a strong focus on SCM.

Most people assume that they have some idea of what SCM is about. They usually think it is part of logistics and distribution, or purchasing, or perhaps marketing. It is likely, however, that you do not yet know the full complexity and broad reach of this rapidly evolving business concept. At a recent conference Paul Mathews, Executive VP of Supply Chain for the Limited, joked that people still think of SCM as “kicking boxes and licking labels.” He wanted to highlight the misunderstanding of SCM many people still have.

The purpose of this book is to help you develop a comprehensive understanding of SCM. This includes understanding the key issues involved and becoming familiar with the very latest business thinking. This will prepare for you for a successful career in a new and exciting business field.

Today's business environment has forced companies to compete in very different ways from just a few years ago. In addition to competing on traditional dimensions such as quality, time, cost, and customization, companies must be rapid innovators. They must stay abreast of quickly changing customer demands and increasing global competition. Advances in technology, the Internet, big data analytics, and unprecedented threats to security are forcing companies to be flexible and responsive. At the same time, a globally connected economy has created tremendous financial pressures. SCM is the business concept through which companies can achieve this level of competitiveness while maintaining costs, and it is intertwined with today's best business practices. Companies understand that they cannot achieve the needed level of competitiveness in the current global economy without SCM.

Knowledge of SCM will give you the skills needed to help your organization gain a competitive advantage in the marketplace. It will also help you move into one of the fastest-growing career fields today.

What Is Supply Chain Management (SCM)?

Supply chain management (SCM) is the design and management of flows of products, information, and funds throughout the supply chain. It involves the coordination and management of all the activities of a supply chain. As such, SCM may appear deceptively simple. In fact, it is a complex business concept that is far reaching in the nature and type of decisions involved. Before we can begin to look at the full complexity of SCM, it is important to first understand the meaning of the term *supply chain*.

A **supply chain** is the network of all entities involved in producing and delivering a finished product to the final customer. This includes sourcing raw materials and parts; manufacturing, producing, and assembling the products; packaging and labeling; storing goods in warehouses; order entry and tracking; distribution; and delivery to the final customer. A simple supply chain is illustrated in Figure 1.1.

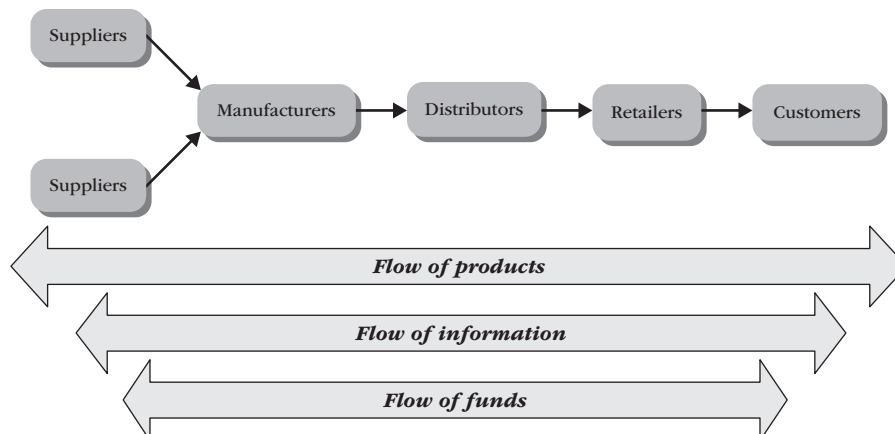


FIGURE 1.1
A simple supply chain.

The flows through the supply chain begin with suppliers who supply and transport raw materials and components to producers or manufacturers. Manufacturers transform these materials into finished products that are then shipped either to the manufacturers' own distribution centers or to wholesalers. Next, the products are shipped to retailers who sell the product to final customers. Consider the Starbucks supply chain we just discussed. At the beginning of the supply chain are coffee farmers at various locations across the globe that grow the coffee beans. The coffee beans are picked, packaged in burlap bags, and transported to coffee roasters, entities that roast the beans. The roasted beans are then sent to coffee distributors, who then sort, package, and move the beans to retailer outlets such as Starbucks cafés, to be purchased by the consumer.

A typical supply chain may involve many different trading partners, called stages. These supply chain stages may include the following:

- Suppliers
- Producers
- Wholesalers/Distributors
- Retailers
- Customers

Note that every supply chain is different and that these stages are a generic representation of a supply chain. In fact, each stage may not be present in every supply chain. The number of stages that are part of a supply chain and its appropriate design will depend on both the customer's needs, the roles of the stages involved, and the value each stage provides.

Supply chains are under increasing financial pressure, and stages that do not add value to the supply chain are quickly bypassed or eliminated. For this reason, a supply chain is often called a **value chain** or a **value network**. Today's concept of the supply chain comes from the concept of a "value chain" that was introduced by a Harvard Business School professor, Michael Porter, in the 1980s. Michael Porter explained that a company's competitive advantage cannot be understood by looking at a firm as a whole. Rather, its competitive advantage comes from the many discrete activities that a firm performs and that each of these activities contributes to the firm's total cost position. This concept of each activity contributing to the total value has now been extended to the entire supply chain. In fact, it has been often said that it is not companies that compete. Rather, it is their supply chains that compete.

As we look at a supply chain it is important to point out some common terminology used to describe the relationships of supply chain stages to one another. Each company in a supply chain has its suppliers and customers. The stages of the supply chain that comprise the inbound direction toward the company, or the "focal firm," are called the "upstream" part of the supply chain.

The stages of the supply chain away from the "focal firm" are termed "downstream." This is shown in Figure 1.2. For example, if the focal firm was a manufacturer, all inbound suppliers would be considered "upstream," whereas distributors/wholesalers and retailers/customers would comprise the "downstream" part of the supply chain. Being able to refer to parts of the supply chain as either "upstream" or "downstream" provides a convenient point of reference. Similarly, suppliers that directly supply goods or services to a company are termed "first-tier suppliers." Suppliers that supply to a company's "first-tier suppliers" are termed "second-tier suppliers," and so on moving up the chain. This provides a common terminology for companies to understand which suppliers are being referenced.

The term *supply chain* implies a linear chain of participants from suppliers to final customers. A true supply chain is actually more like a complex network, as shown in Figure 1.3. A producer may receive materials from multiple suppliers. Many distributors and wholesalers receive inventory from many manufacturers, and most retailers receive products from many different

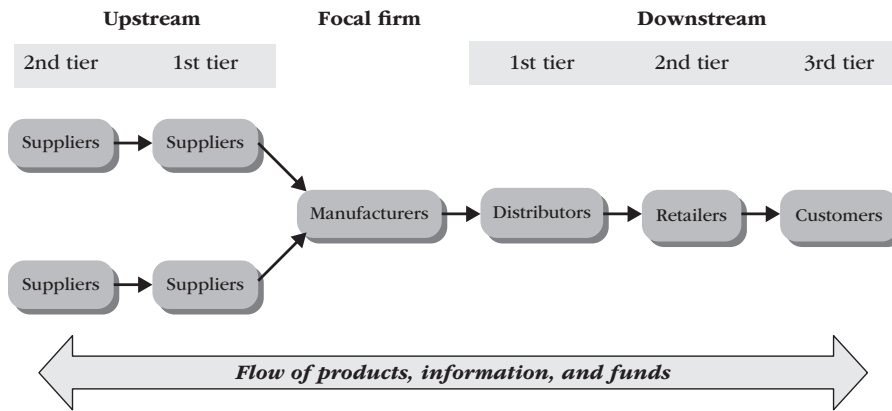


FIGURE 1.2 Stages of the supply chain.

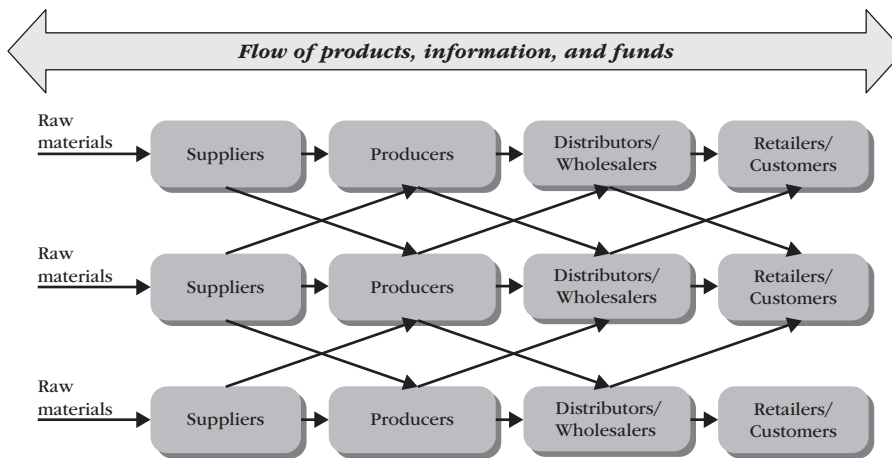


FIGURE 1.3 The supply chain network.

distributors. For this reason a supply chain is often referred to as a supply chain network or supply web, to more accurately describe the nature of these relationships. In fact, many companies are part of multiple supply chains.

The supply chain network can actually take on many different shapes. Some are linear, as shown in Figure 1.3. Others take on the form of hub-and-spoke or a web. Often the type of network can be related to the number of suppliers, their locations, and the type of product being produced. For example, Dell Computer Corporation became famous for mandating that all its first-tier suppliers must be within a 15-minute radius anywhere around its Austin, Texas, manufacturing facility. This is an example of a hub-and-spoke supply network, with the focal firm in the center of the design, and a model that has been followed by many other manufacturers.

SCM Activities

Now that we understand what constitutes a supply chain or supply network, we can look at the issues involved in managing it. Recall that SCM involves the coordination and management of *all* the activities of a supply chain. It is responsible for managing the system of flows between the different entities of a supply chain to satisfy the final customer and maximize total supply chain profitability. SCM is a dynamic and ever-changing process that requires coordinating all activities among members of the supply chain.

SCM activities include the following:

- **Coordination:** SCM involves coordinating the movement of goods and services through the supply chain, from suppliers to manufacturers to distributors to final customers; it also includes movement of goods back up the supply chain, as products may be returned. Coordination also involves the movement of funds through the supply chain as products are purchased and sold. This includes various financial arrangements and terms of purchase between buyers and suppliers.
- **Information Sharing:** SCM requires sharing relevant information among members of the supply chain. This includes sharing demand and sales forecasts, point-of-sale data, promotional campaigns planned, and inventory levels. Consider that a manufacturer must know if a retailer is planning an advertising campaign to ensure that enough of the product is being produced. Otherwise, the retailer may run out of stock. Similarly, the manufacturer's suppliers must be aware of increased production plans to provide sufficient component parts. Sharing this information enables the entire chain to work in unison.
- **Collaboration:** SCM requires collaboration between supply chain members so that they jointly plan, operate, and execute business decisions as one entity. This is important for decisions that range from product design and process improvement to implementing business initiatives or following a particular business strategy. For example, this may include collaborating on ways to cut costs or improve quality standards throughout the entire supply chain.

Managing Flows Through the Supply Chain

Recall that many flows move through a supply chain network. The first is the flow of **products** through the supply chain, from the beginning of the chain through various stages of production, to the final customer. However, goods also flow back through the chain. This is in the form of returned products that are unacceptable to customers for a variety of reasons, such as damaged or obsolete goods. This is an area of SCM called *reverse logistics* because the direction of product flow is reversed. The increased focus on customer accommodation has resulted in an increase in the amount of goods returned from customers.

The second important flow through the supply chain is that of **information** that is shared between members of the supply chain. Many simplified supply chains view the product flowing from suppliers to customers and information flowing in the opposite direction, from point-of-sale back to suppliers. In this simplified case, the primary information is demand or sales data, which is used to trigger replenishment and serves as the basis for forecasting. In a more realistic case, sales information is shared on a real-time basis, which leads to less uncertainty and less safety stock. The sharing of real-time information serves to compress or shorten the supply chain from a time standpoint. The result of this more timely and accurate information is a reduction in the amount of inventory carried throughout the supply chain.

The third important flow through the supply chain is that of **funds**. In a simplified supply chain, financial flow is often viewed as one directional, flowing backward in the supply chain as payment for products and services received. However, as products flow in both directions so does the transfer of funds. A major impact on fund transfer and the financials of companies has been supply chain compression. A shorter order cycle time means that customers receive their orders faster. It means that they are billed sooner and that companies receive payment sooner. This speeding up of the money collection process has had a huge impact on the profitability of certain firms. Consider Dell Computer Corporation, a company that has gained much from the compressed supply chain. Dell turns over its inventory roughly every four days. However, they

often receive payment a week in advance, well before Dell pays its suppliers, providing a large financial benefit to Dell.

The key to successful SCM is the management of these flows through the chain. SCM is a dynamic process and provides many opportunities to reduce the cost of doing business and improve customer service. At the same time, the challenges of SCM are often underestimated. In fact, the reason for the failure of many online businesses is due to their inability to manage supply chain flows effectively. Many have excellent business concepts and marketing strategies but are unable to make products available to customers in a cost-effective manner. For example, Webvan was an online grocery delivery company that failed a few years ago as it was unable to bring the cost of grocery picking and delivery to a competitive level. The success of Internet retailers such as Amazon.com has been primarily driven by the improvements in their supply chains.

The Bullwhip Effect

A supply chain is composed of many different companies, or stages, each with their own objectives. For a supply chain to be highly competitive, it is critical that its members engage in the activities of coordination, information sharing, and collaboration. Otherwise, each stage of the supply chain will have differing and possibly conflicting objectives and may focus on simply maximizing their own profits. Similarly, if information is not shared between stages, but is delayed or distorted, each stage may have a distorted view of final customer demand. As a result, they will likely not produce the right quantities of items needed, resulting in either shortages or excess inventory. Both situations result in lowered profitability of the entire supply chain.

It has been observed that fluctuation and distortion of information increases as it moves up the supply chain, from retailers, to manufacturers, and to suppliers. This is called the **bullwhip effect**, as inaccurate and distorted information travels up the chain like a bullwhip uncoiling. In response, each stage of the chain carries progressively more inventory to compensate for the lack of information. The bullwhip effect has been well documented in many industries and is costly for all supply chain members.

One of the best-known examples of the bullwhip effect was observed by Proctor & Gamble (P&G) in the supply chain of its Pampers diapers. The company discovered that even when demand for diapers was stable at the retail store level, orders for diapers from P&G fluctuated significantly. Even greater fluctuation was observed in orders for raw materials from suppliers over time. Although consumption of the final product was stable, orders for raw materials were highly variable.

A similar example was observed at Hewlett Packard (HP). HP observed that fluctuations of orders increased significantly as they moved from the resellers up the supply chain to the printer division to the integrated circuit division. Like P&G, HP observed that although final product demand was fairly stable, orders placed at every stage up the supply chain significantly increased in variability. Both P&G and HP found that the result of the bullwhip effect was an increase in cost and difficulty in filling orders on time.

The longer the supply chain, the greater the opportunity for the bullwhip effect, as manufacturers and suppliers are further away from final customer demand. If there is no coordination or sharing of information, these stages do not know final customer demand or when a replenishment order might arrive. As a result of this higher uncertainty, they stockpile inventory. The way to combat the bullwhip effect is to share point-of-sale information, available from most cash registers, with all members of the supply chain. This allows all stages of the supply chain to make replenishment decisions from the same information source. In addition to information sharing, coordination and collaboration will enable stages of the supply chain to work toward the same goals.

Customer Focus

The final customer is the driving force of the supply chain. In fact, the primary purpose for the existence of a supply chain is to respond to customer demands and generate profits for companies that are members of the chain. Therefore, meeting customer demands is the primary objective. The process is driven by a customer having a particular product need. The retailer tries to satisfy the customer by ensuring that the product is available. As customers continue to purchase products, the retailer requests additional products from its suppliers to replenish those sold. These suppliers then purchase materials from their suppliers, and the process “pulls” raw materials through the rest of the chain needed to produce more quantities of the product.

Consider a customer walking into a Wal-Mart store to buy laundry detergent, as shown in Figure 1.4. The process that drives the supply chain starts with the need of the customer to buy detergent. The customer visiting Wal-Mart takes detergent off the shelf that Wal-Mart stocked from inventory supplied from its finished-goods warehouse or by a distributor. Sales of the detergent trigger the warehouse or distribution center to replenish the sold items. The items “pulled” out of the warehouse or distribution center trigger the manufacturer, such as Proctor & Gamble (P&G), to produce more and fill the warehouse with more items. To produce more items, in turn, P&G has to request more raw materials from their suppliers, such as those that supply packaging and chemical components. As P&G requests more raw materials from their suppliers, their first-tier suppliers request more material from lower-tier suppliers. In this manner products are moved through the supply chain.

SCM is a dynamic process and involves the constant flow of information, products, and funds between different entities of the supply chain. To see how this works, once again consider the example of Wal-Mart. Wal-Mart provided the product (detergent in this case) to the customer, and the customer transferred their funds to Wal-Mart. Using point-of-sales data, Wal-Mart then conveyed the need to replenish orders to the warehouse or distributor, who transferred the replenishment order via trucks back to the store. After the replenishment was made, Wal-Mart transferred funds to the distributor. Wal-Mart, the distributor, and the manufacturer shared pricing information, delivery schedules, and forecasts of future sales. This type of flow of information, products, and funds takes place across the entire supply chain.

This example illustrates that to provide timely product availability, all the participants in the chain need to coordinate their plans and respond to the same information. Also, notice that there are many flows moving through the supply chain. The process is driven by a customer order and ends when a customer has paid for their purchase. SCM is the coordination and orchestration of all the activities necessary for this process to occur in the most efficient, cost-effective, and timely manner.

The Service Supply Chain

SCM is just as relevant to companies in the service industry, ranging from healthcare to real estate to banking, as it is to manufacturing companies that produce tangible products. However,

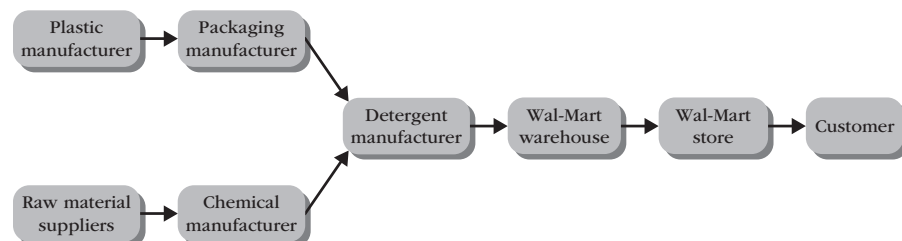


FIGURE 1.4
Products are
“pulled” through the
supply chain.

service supply chains differ from manufacturing in the role of the customer and the direction of flow of the delivery process. Unlike manufacturing supply chains that focus on the production and delivery of a tangible product, service supply chains tend to focus more on the interaction between the customer and provider. For this reason, the role of the customer is even greater in driving the service supply chain than it is in manufacturing. In service organizations the customer is also a supplier of inputs and information, which can change the service delivery. Consider the legal environment, where the course of legal action greatly depends on information provided by the client to the attorney. Similarly, a university student may have the option to conduct an independent study under the supervision of a faculty member, changing the set course of study.

Service supply chains tend to be considerably shorter than manufacturing supply chains. The provider typically interacts directly with customers, without the buffer of retailers and distributors, enabling easier sharing of information. Service supply chains also tend to look more like hubs than chains. One of the disadvantages is that they do not have the buffers of inventory as seen in manufacturing. This means that they need to have other organizational mechanisms that give them flexibility when handling the variation of customer-supplied inputs and demands. This also makes information sharing with customers much more critical.

Even service companies that provide pure content to customers, such as those in the entertainment industry, rely heavily on their supply chains to deliver customer value and remain competitive. This includes industries such as film, computer games, and sports and includes companies such as Disney, Warner Bros., and Ticketmaster. These companies are increasingly relying on SCM process and technology improvements to ensure coordination of information and maintain competitiveness.

Supply Chain Leader's Box

■ AMAZON.COM

The largest Internet-based retailer in the world, Amazon.com, has sought to make itself a customer-centric company from its beginning in July 1995. Amazon.com is a service company that is a leading merchandiser of everything from gourmet food to apparel to electronics, in addition to books and music. From the very beginning, Amazon understood that its focus must be on satisfying the customer by providing the highest levels of service. Rather than focusing on marketing or advertising, Amazon placed its focus on having a superior supply chain that provides uncompromised delivery to customers. In addition, Amazon conducts business on an international scale, with 235 countries and territories eligible to shop on Amazon. Coordinating and orchestrating this range of product offerings to so many global locations with perfect deliveries is a daunting task. To achieve this, Amazon has built an impressive logistics network that includes its own fleet of jets, automated

warehouses, robots, drones, and a digitally driven supply chain. For Amazon, logistics, shipping, and a super SCM have combined to give the company its stellar reputation.

Part of Amazon's supply chain proficiency is based on its strict operations philosophy, which focuses on lean systems, quality, and efficiency. It is more reminiscent of industrial manufacturing than traditional retail practices. For instance, Amazon takes a Six Sigma¹ approach to its distribution operations and applies lean manufacturing and total quality management (TQM) methodologies to its processes. Amazon's online proficiency is such that many brick-and-mortar retailers, such as Target, use the Amazon website for their e-commerce efforts. However, recognizing the importance of supply chain management, some retailers are moving away from Amazon's platform, where unauthorized sellers can undercut prices. Retailers, such as Nike, have tried Amazon and ultimately decided to develop their own online platform to serve the customer directly.

¹Six Sigma performance is characterized by 3.4 defects per million, or 99.99966% perfect. We will discuss this in detail later in the text.

The Boundary-Spanning Nature of SCM

To orchestrate and optimize all flows from source to consumption, SCM must take a total systems viewpoint. SCM must ensure that the needs of final customers are satisfied through the coordination of materials and information flows that extend from the marketplace, through the firm and its operations to all its suppliers.

SCM is unique, as it is truly boundary spanning. First, it spans and integrates functions and processes within the enterprise, called *intraorganizational* coordination. Second, it spans and integrates functions and processes between enterprises of the supply chain, called *cross-enterprise* coordination. In essence, a supply chain needs to function as an extended enterprise. To achieve this, supply chain management has to cross over the boundaries of individual firms and integrate business functions and processes across enterprises.

Intraorganizational Integration

SCM requires participation and coordination of activities between different organizational functions. The relationship between the functions of marketing, operations, sourcing, and logistics is particularly important. For an organization to be effectively integrated with other members of its supply chain, it must have internal coordination. This means that the various functions must share information and conduct coordinated activities. The relationship between the various functions is shown in Figure 1.5.

Marketing is the function responsible for linking the organization to its customers and identifying what customers want in products and services. It is the function that interfaces with the customer. **Operations** ensures that the exact products customers want are produced efficiently and in a cost-effective manner. It is the function whose job is to organize the transformation of raw materials into finished products. **Sourcing** is the function responsible for linking the organization to its suppliers and ensuring an efficient supply of materials. **Logistics** is responsible for moving and positioning inventory throughout the supply chain and ensuring that the right products are delivered to the right place at the right time. SCM would not be possible without the support of these functions.

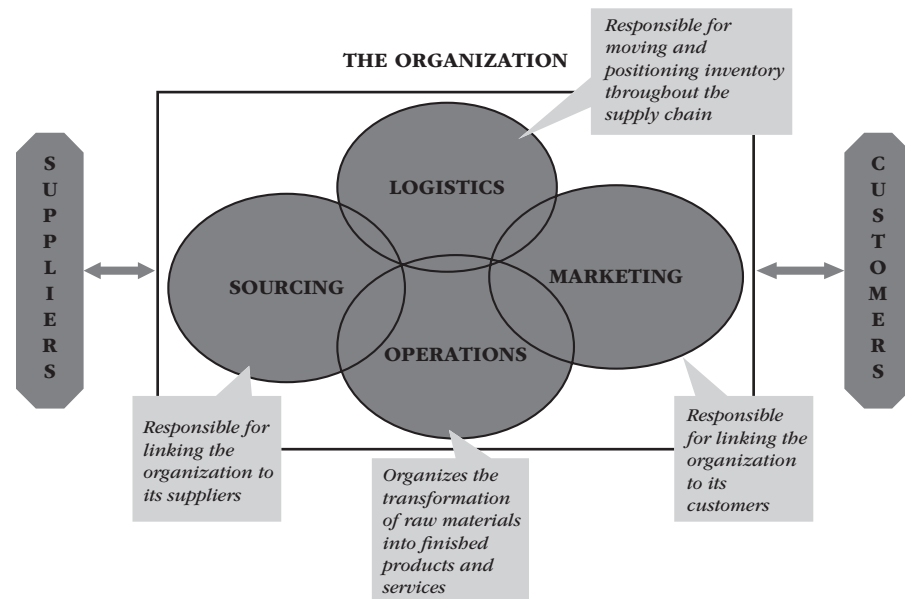


FIGURE 1.5 Organizational integration of enterprise functions.

To support SCM, each individual function must also have a systems viewpoint. This type of effort requires company-wide integration and a way of organizational thinking that is different from the traditional “silo” mentality, where each organizational function operates independently. Creating systems thinking can be a big challenge for many companies.

The classic illustration of the “silo” mentality can be seen between the marketing and operations functions of an organization. Historically, the operations function was focused on improving the efficiency of the operating system, through proper scheduling, minimization of setup times, and achieving product standardization. The lexicon of the operations manager, as a result, had focused on operating measures of performance such as productivity measures, units produced, and number of defects. On the other hand, marketing focused on achieving a competitive advantage through expanding market share, creating new market opportunities, offering product variety, and responding to market changes. The lexicon of the marketing manager, by contrast, has focused on sales, profitability, and market share. As a result, often operations and marketing managers were not able to communicate and had different goals.

Today’s highly competitive business environment is not forgiving to this type of segmented approach between organizational functions. The need to understand and meet customer requirements is a prerequisite for supply chain competitiveness and survival and is the responsibility of marketing. At the same time, economic competitiveness has placed great pressure on cost competition, improvements in quality, and response time, placing the operations function in the limelight. SCM is dependent on operations and marketing working together, sharing information, and making joint decisions.

Another organizational function that has gained increasing appreciation for its critical role in SCM is procurement or purchasing, also known as sourcing. Historically, procurement was concerned with purchasing issues of a primarily transactional nature. Today, leading-edge companies place great focus on the supply side of the chain, which is the domain of purchasing. Not only is the cost of purchased materials and supplies a large part of the total cost of most companies, but also purchasing creates an opportunity to integrate the capabilities of the supplier with producers. Therefore, whereas marketing focuses on the customer side of the organization, procurement focuses on the supply side.

Finally, the function of logistics coordinates the materials and information flows that extend from the marketplace, through the firm and its operations and beyond that of the suppliers to ensure that goods are delivered to the right place. Therefore, like SCM, logistics is an integrative function that has a systems-wide view of the organization, from the customer or market side, to the supply side. It has a critical responsibility to ensure that the demands of the marketplace are passed on from marketing to manufacturing and then are linked to purchasing and distribution.

Cross-Enterprise Integration

The management of a supply chain as an extended enterprise involves coordinating two-way flows of goods and services, information, and funds. The integration across the boundaries of several organizations means that the supply chain should function like one organization in satisfying the final customer. In fact, the ultimate goal of a supply chain is to operate as a single entity. Information technology is the key enabler of this capability, without which cross-enterprise integration would not be possible.

This integration can be difficult, as real-world supply chains are usually complex and have many supply chain participants. Achieving integration and coordination of activities in the supply chain is predicated on relationship management. Concepts such as partnerships and alliances

have become a part of the SCM vocabulary. Traditional adversarial relationships with suppliers have given way to long-term partnering. However, supply chain relationships need to incorporate more than shared information and a focus on total supply chain cost. Supply chains need to achieve a level of integration that involves collaboration among partners in developing strategic plans and joint setting of long-term goals. An important factor to achieving this level of integration is for companies to have an internal, cross-functional team that engages in ongoing external efforts with suppliers, transportation carriers, and distributors. Toyota is a good example of successful supplier collaboration. Toyota engages in collaboration with suppliers from the earliest stages of product design—a system called “early supplier involvement.” This has led to a significant cost reduction in producing its cars.

In addition to collaborative planning, achieving full cross-enterprise integration requires the sharing of risks and rewards. Most organizations still function in a way that minimizes their own risk and maximizes their own rewards. This strategy may mean that outcomes they achieve are at the expense of other companies. The cooperative and collaborative approach of SCM is predicated on the win-win outcome. Although adversarial relationships can provide financial gain, the win-win strategy has shown to be the best strategy over the long run.

SCM versus Logistics

Many people confuse SCM with logistics. Therefore, it is important to clarify their different roles in developing a competitive advantage. SCM is about the collaboration between supply chain partners in a strategic effort to achieve superior competitiveness. Therefore, SCM requires managing different aspects of the coordination process, such as information, technology, distribution, products, raw materials, finances, and most of all, relationships. The relationships involved in SCM are complex and require coordinating managerial processes within firms (intraorganizational) and between firms (cross-enterprise).

Logistics, in contrast to SCM, consists of the tasks involved in moving and positioning inventory throughout the supply chain, as shown in Figure 1.6. Logistics is a function that supports SCM on par with marketing, operations, and sourcing. SCM, on the other hand, is a strategic and managerial concept. The function of logistics involves order processing and tracking, inventory management, transportation, warehousing, material handling, and packaging. These activities need to be coordinated and integrated throughout all entities of the chain. Without logistics there would be inventory stock-outs at some locations and too much inventory at others. Consequently, logistics is a function that supports SCM.

Notice that SCM is about managing and coordinating many flows, including inventory. Logistics, on the other hand, is the part of SCM that is concerned with managing the flow of inventory.

Logistics is vital to SCM as it is a key supporting function. Logistics must plan and coordinate all material flow from source to users as one integrated system, rather than a series of independent activities as has been done in the past. Logistics is the function that is basically responsible for linking the marketplace with the manufacturing process, sourcing activities, and the distribution network to provide high customer service at lower costs. In essence, logistics is the link between the marketplace and the operating activities of the business. The scope of logistics spans from management of raw materials through the delivery of the final product.



FIGURE 1.6 The logistics function.

The Rise of SCM

To fully appreciate SCM, it is important to look at its rapid rise as a critical business concept. SCM evolved in the 1990s and ushered in a new era of business competition. This was a direct result of great economic changes of the time for the global economy and an increasingly uncertain business environment. Leading-edge companies, such as Amazon, demonstrated that reduction in order fulfillment time coupled with customization can be a competitive advantage that the supply chain can provide. In fact, SCM enables companies to significantly reduce the time required to design, process, and deliver products to customers, at a lower cost. This allows for greater responsiveness and has evolved into a major strategic tool for companies.

Interest in SCM has rapidly grown over the years, as it has proven to be a necessary ingredient for successful global competition. A number of forces have contributed to this trend. First, in recent years many companies have discovered the large magnitude of savings that can be achieved by planning and managing their supply chain more effectively. Second, advances in information technologies have provided access to comprehensive data from all components of the supply chain. Finally, improvement in transportation methods has led to a reduction in transportation costs, while significantly increasing speed of delivery to multiple locations. One of the most striking examples of this is Wal-Mart's success, which is primarily attributed to mastery of its supply chain. Wal-Mart is highly successful in collaborating with their suppliers, using the latest available technology for data gathering and transfer, and implementing the latest transportation techniques.

Prior to the SCM revolution, order processing was a long process and prone to errors. In the 1980s and 1990s, for example, the average time to process and deliver an order to a customer ranged from weeks to months. There were many steps in the order-to-delivery cycle that had to be completed for the customer to receive the order. Also, many of the steps were performed inefficiently. The customer initiated the order process through telephone, fax, or mail. This order was then processed either manually or using a computer system. The process involved credit authorization, order placement to a warehouse or distribution center, and the arrangement of product delivery by shipper. Often mistakes were made in this process, such as inventories being out-of-stock. This resulted in expediting orders at extra cost when goods finally arrived. Shipments were often sent to the wrong location, and mistakes were made in the manual processing of forms. To help guard against these problems, companies began to stock large amounts of inventories in warehouses to ensure that they had stock available. Duplicate inventories were often held in different warehouses. The result was a higher cost that was ultimately passed on to the customer. The larger amounts of inventories, however, still did not guarantee no stock-outs, and many firms found themselves having too much of the "wrong" inventory and not enough of what the customer wanted. All this made companies less competitive.

This changed in the 1990s when leading-edge companies such as Dell Computer Corporation began offering highly customized products with a significantly reduced customer response time. Suddenly, other companies had to follow suit or risk going out of business. The result was that historical management of order fulfillment suddenly became obsolete. Companies found that they had to go beyond their own organizations and design competitive supply chains.

One factor driving the growth of SCM has been the massive change in the capability and availability of information technology. The economy of the 1990s was forever changed by information availability through the Internet and computerization. These technologies provided rapidly accessible information to all parties. They created the foundation for rapid and economical methods of doing business, such as business-to-business (B2B) and business-to-consumer (B2C), from which the new economy quickly emerged.

Another significant factor was greater customer affluence and sophistication, resulting in greater customer demand for a wide choice of quality goods and services. The Internet and other information technologies accelerated this change by empowering consumers. Customers suddenly shifted from being passive and powerless participants to drivers of the new economy. Customers today demand customized products with high quality delivered at record speed.

Supply Chain Leader's Box

■ DELL COMPUTER CORPORATION

Dell Computer Corporation made its reputation as an icon of how a company can design and manage their supply chain to reduce customer response time, while still offering product customization at a price lower than competitors. This provided Dell with a clear competitive advantage and a model that others tried to emulate. Dell has focused on the final build of computers using an “assemble and configure to order” strategy. Dell requires its suppliers of variant modules to be in geographically close proximity to produce and deliver overnight for next-day assembly. Suppliers of standard modules, such as processors and memory systems, are in many lower labor cost countries. This enables Dell's supply chain to flow end to end in 11 days or less yet still be cost competitive. Such a quick response enabled Dell to reduce its inventory levels compared to the industry

standard. Dell has been able to achieve success due to its agile, adaptable, and short supply chain. The system has been set up so that suppliers automatically restock warehouses as needed, and Dell is billed for items only after they are shipped. The result is better value for the customer and less cost for Dell.

Dell's supply chain model was the industry norm for many years. However, as other companies began to emulate this model it was no longer an industry differentiator. To remain competitive Dell has used the strength of its supply chain to shift focus on providing broad IT solutions to different industry segments, such as healthcare, education, and the military. In 2016 the company officially changed its name to Dell Technologies. It is due to the iconic supply chain that the company has been able to be limber and easily adapt to changing markets.

Advances in information technology, transportation methods, and greater customer empowerment created a rise in SCM. The 1990s witnessed SCM becoming a part of the standard vocabulary of corporate presidents and CEOs. SCM has become a new order of business and a tool for companies to survive and thrive. Managers are now focusing on improving all aspects of the process from product design to product delivery, focusing on improving customization, speed of delivery, and a commitment to a concept of zero defects called Six Sigma performance.

Characteristics of a Competitive Supply Chain

There are three key characteristics of a competitive supply chain: responsiveness, reliability, and relationship management. We discuss these here.

Responsiveness

The ability to respond to customers' requirements in ever-shorter time frames has become critical. Today customers want shorter lead times, greater flexibility, and greater product choice. This means that the supplier and manufacturer have to be able to meet the precise demands of the customer in a shorter amount of time than ever before. The ability for a supply chain to have this level of responsiveness is often described as “agility,” which is the ability to move quickly to meet customer demands. In fact, in rapidly changing environments, agility is more important than long-term strategy, as there is no “long term.” Agility will come from short supply chains that are much more demand driven—responding to what the customer “demands”—rather than forecast driven.

Reliability

Uncertainty is a fact of life for most businesses, such as uncertainty about future demands, uncertainty about a supplier's ability to meet deadlines, or uncertainty about the quality of component materials. In fact, uncertainty is the main reason why companies carry safety stock inventories—to

guard against this uncertainty—which then results in higher costs. The best way to reduce uncertainty is by increasing reliability through the redesign of processes that impact performance.

One factor that greatly improves reliability in supply chains is improved visibility. Typically, the further one goes up the supply chain, the more limited the “visibility” of downstream activities. Organizations that are further up the chain have typically relied on demand from their immediate customer in the chain to forecast demand. This lack of coordination has resulted in the classic “bullwhip” effect. Supply chain coordination and sharing of real-time data and information through information technology has permitted visibility to all entities in the chain. This results in greatly improved visibility and, consequently, supply chain reliability.

Relationship Management

An important characteristic of competitive supply chains is their focus on relationship building and collaboration, rather than the arm’s-length adversarial relationships that had been dominant in the past. In many industries, for example, the practice of “single-sourcing” is widespread. It has been documented that such practices improve quality, product innovation, and design while reducing costs and improving overall responsiveness. Underlying this idea is that the buyer–supplier relationship should be based on a partnership of trust, commitment, and fairness. There are numerous advantages to such relationships that can be long term and mutually beneficial. The competitive advantage of companies such as Toyota and Honda over their competitors in the auto industry comes from the collaborative relationships they have developed with their suppliers. As we have seen thus far, SCM is primarily about the management of relationships across complex networks of companies. Successful supply chains will be those that are governed by a constant search for win–win relationships based on reciprocity of trust.

Global Insights Box

■ ZARA

The Spanish retailer Zara exemplifies that to operate a successful global operation a company may have to defy most of the current conventional wisdom about how supply chains should be run. Zara has adapted numerous best practices to create its own brand of global SCM that may seem unorthodox to some. For example, Zara has been known to send a half-empty truck across Europe, pay to airfreight costs to Japan twice a week, move unsold items out of its retail stores after only two weeks, or run factories for only one shift. For most observers, this would be no way to run a supply chain. Of course, none of these tactics are especially effective by themselves. Rather, they stem from a holistic approach to SCM that optimizes the entire chain instead of focusing on individual parts.

In today’s economy, where most companies have rushed to outsource, Zara keeps almost half of its production in-house. Rather than pushing its factories to maximize output, the company focuses capital on building extra capacity to give it flexibility. Also, Zara manufactures and distributes products in small batches, rather than

chasing economies of scale. To ensure top performance, the company manages all design, warehousing, distribution, and logistics functions itself. The result is a super-responsive supply chain uniquely tailored to fully support Zara’s business model. Zara can design, produce, and deliver a new garment to its 2,200-plus stores worldwide in just a few days. However, Zara keeps a limited amount of inventory. In a Zara shop, customers can always find new products but know that supply is limited. This creates a sense of urgency for the customer to purchase rather than waiting for a markdown, translating into high profit margins and a consistent yearly growth. More recently Zara has noticed growth in online sales and is shifting more inventory to be available online. To further implement its strategy, Zara is increasingly relying on information technology, such as radio frequency identification technology (RFID), using cutting-edge systems to track the location of garments instantly and making high-demand items quickly available to customers. Zara offers a model where profits are gained through controlling the entire end-to-end supply chain.

Trends in SCM

Today's organizations face a number of trends that impact the way supply chains are designed and managed. These trends are a result of a fast-changing global and technologically connected economy that creates unique challenges companies must address. We look at these here.

Globalization

In the eyes of the economist Thomas Friedman, globalization has replaced the so-called Cold War of the post–World War II era as the dominant driving force of world economics.² The concept of the “global marketplace” has changed the meaning of how and where business is conducted, for all enterprises and for individual customers. Changes in information technology, transportation, and government policies have made the concept of the global economy a fact of life. A number of countries have aggressively pursued opening up international trade. This has served to open new markets and sources of supply for most companies, both large and small. Further, these opportunities have been made possible through information technology, which has helped break the distance barrier. Companies have benefited from a larger choice of product sources. Consumers have also benefited due to greater product choice, higher quality, and lower cost.

Managing global supply chains, however, has a number of challenges. The distance factor can become a significant barrier when shipments move thousands of miles from suppliers to customers. In an environment of reduced cycle times, expected higher levels of reliability, and emphasis on efficiency, the distance factor presents special challenges to supply chain managers.

Outsourcing

Outsourcing is hiring a third party to perform a set of tasks for a fee. Companies have historically and routinely outsourced certain activities, such as janitorial services, records management, or uniform cleaning. The difference today is that companies are outsourcing almost all activities and on a much larger scale.

Increased competitive pressure has forced companies to recognize that they compete through their **core competencies** (sometimes termed “distinctive competencies”). This means that an organization creates superior value for customers by managing their core competencies better than competitors. To be able to focus on core competencies, many companies outsource other activities to those that can do them better. Outsourcing can involve hiring out one aspect of the operation, such as shipping, to outsourcing an entire part of the manufacturing process. The practice has rapidly grown in recent years and has helped companies be more efficient by focusing on what they do best.

The convergence of technologies at the turn of this century has taken the concept of outsourcing to a new level. Massive investments in technology, such as worldwide broadband connectivity, the increasing availability of lower-cost computers, and the development of software such as e-mail, search engines, and other software have allowed individuals to work together in real time from anywhere in the world. The result has been the outsourcing of virtually any job imaginable. Manufacturers have outsourced software development and product design to engineers in India, accounting firms have outsourced tax preparation to India, and even some hospitals have outsourced the reading of CAT scans to doctors in India and Australia. In fact, India is now the leading country in offshore business services.

²Thomas L. Friedman, *The Lexus and the Olive Tree* (New York: Farrar, Straus and Giroux, 2000), 1–25.

Supply Chain Leader's Box

■ WAL-MART

Even some of the most successful companies have encountered difficulties in managing their global supply chains. For example, Wal-Mart encountered large problems when entering the Brazilian market. Wal-Mart quickly found that they needed to adapt product offerings to local tastes, such as replacing footballs with soccer balls and offering deli counter items that included sushi. Changing product lines, however, was the easy part. There were other aspects of Wal-Mart operations that caused greater problems. The logistical aspects of operating in the South American markets have been especially challenging. For example, rapid

order fulfillment time is not nearly as easy to accomplish in Brazil as in the United States, where Wal-Mart has easy access to suppliers and transportation companies.

São Paulo is characterized by bumper-to-bumper traffic, which impedes timely delivery and smooth replenishment for Wal-Mart stores. Further, there are occasional mysterious “disappearances” of shipments that create significant delivery problems. Finally, large stores in Brazil have difficulty achieving the economies of scale of their U.S. counterparts. Still, Wal-Mart believed in the potential for growth and expansion, and it understood that it needed to adjust to be successful. Today there are almost 470 Wal-Mart stores in Brazil.

Information Technology

An important driver of supply chain management is technology. Technological advances have enabled companies to produce products faster, with better quality, at a lower cost, and this trend will continue. Many processes that were not imaginable only a few years ago have been made possible through the use of information technology.

Advancements in **information technology** have in particular had the greatest impact on SCM. Information technology is technology that enables storage, processing, and communication within and between firms. In fact, information technology can be viewed as an enabler of SCM, as without it coordination between supply chain members would not be possible. The most popular type of information technology, and most familiar to all, is the Internet, which has had the greatest impact on the way companies conduct business. The Internet has linked trading partners—customers, buyers, and suppliers—and has enabled electronic commerce and the virtual marketplace. This is one of the greatest forces that has made information sharing along the supply chain possible.

Another powerful information technology is enterprise software, such as **enterprise resource planning (ERP)**. These are large software programs used for planning and coordinating all resources throughout the entire enterprise. They allow data sharing and communication within and outside the firm, enabling collaborative decision making.

Other examples of information technologies that have impacted the supply chain include **wireless communication technologies**. We are all familiar with cellular phones and pagers from everyday life. However, these technologies can also significantly improve business operations. For example, wireless homing devices and wearable computers are being used in warehouses to quickly guide workers to the locations of goods. This serves to significantly improve warehouse operations and logistics. Wireless technologies, enhanced by satellite transmission, can rapidly transmit information from one source to another. For example, Wal-Mart uses company-owned satellites to automatically transmit point-of-sale data to computers at its warehouses for replenishment.

Global positioning systems (GPS) are another type of wireless technology that uses satellite transmissions to communicate exact locations and have dramatically improved logistics transportation. GPS has numerous logistics applications such as in distribution, where trucking companies use GPS technology to identify the exact location of their vehicles.

Radio frequency identification (RFID) is yet another wireless technology that is dramatically changing supply chain operations. RFID uses memory chips equipped with tiny radio antennas that can be attached to objects to transmit streams of data about the object. For example, RFID can be used to identify any product movement, reveal a missing product's location, or have a shipment of products "announce" their arrival. Empty store shelves can signal that it is time for replenishment using RFID, or low inventories can signal the vendor that it is time to order more products. In fact, RFID has the potential to become the backbone of logistics, as it can identify and track billions of individual objects all over the world, in real time.

These information technologies collectively provide access to data never before available. This information has changed how products are bought and sold and has changed the modus operandi of the marketplace. Buyers no longer have to go to the seller's place of business to view and buy products. Rather, consumers can complete purchases seven days a week, 24 hours a day. IT has changed how buyers and sellers interact in the marketplace, both **business-to-business (B2B)** and **business-to-consumer (B2C)**.

Big Data Analytics

Big data analytics has had one of the biggest impacts on supply chain management. **Big data** refers to large datasets whose size is so large that the quantity can no longer fit into the memory that computers use for processing. Businesses are awash in data captured from every source imaginable, which can be structured or unstructured. This data includes point-of-sale (POS), radio-frequency identification (RFID), or global positioning systems (GPS) data, or it can be in the form of Twitter feeds, Facebook, call center data, or consumer blogs. This data can be captured, stored, communicated, aggregated, and analyzed. **Analytics** is applying math and statistics to these large datasets. Many of these statistical tools, such as correlation and regression analysis, have been around for decades. What is different is the combination of big data with statistical algorithms—or analytics—fueled by today's computing power. This combination creates the ability to extract meaningful insights and turn information into intelligence. Further, advancements in machine learning and artificial intelligence (AI) have created significant new opportunities to use big data and develop new and more powerful algorithms.

Few areas of business have been transformed by big data analytics as much as supply chain management. Technology has enabled physical objects to be embedded with electronics, such as sensors and software, enabling these objects to collect and exchange data. These objects can be buildings, vehicles, machines, and all other entities that make up the supply chain. The connectivity of these physical objects with electronic devices is called the **Internet of Things (IoT)**.

Big Data Analytics Box

■ TESCO

Consider the supply chain of Tesco, the British multinational grocery and general merchandise retailer. The company uses its loyalty program to create big data by tracking all sales and linking them to customer information. The data is then mined to inform a variety of decisions, such as best ways to microsegment its customer base, targeting promotions, optimizing product mix, and pricing. Based on data analysis, the company then aligns organizational efforts toward each segment, such as tailoring store formats to

particular locations, ranging from convenience stores to online stores. As a result, Tesco can determine exactly what types of customers buy from each store format, determine what products they buy, and ensure availability. These insights are digitally linked to sourcing, transportation, distribution, and all areas of the supply chain. This ensures the supply chain is responding to customer availability of these products when and where customers want them. This is a strategy used by almost all major retailers, from Amazon to Wal-Mart to CVS. This is the digital supply chain.

As consumers, we are all accustomed to same-day retail deliveries and the ability to quickly find and purchase items online. However, achieving such high responsiveness requires a data-driven, end-to-end, supply chain system.

3-D Printing, Additive Manufacturing, and Robotics

Research conducted by IBM has identified three emerging and transformative manufacturing technologies: three-dimensional (3-D) printing, a new generation of intelligent assembly robots, and the rise of open-source hardware. Each of these trends taken alone is transformative. However, their power is multiplied when they are combined together with big data analytics.

The first of these trends is **3-D printing** or **additive manufacturing**, a technology that is changing the way manufacturing is being conducted. In fact, forecasts expect the market for this technology to reach \$35.6 billion in 2024 from \$15.8 billion in 2020. This technology is similar to ink-jet and laser-jet printers we are familiar with, except that these are three-dimensional printers. These printers work by depositing thick layers of materials one on top of the other, such as layers of plastics and metals. The layering of these materials gradually builds up until the object is produced. The final creation is a solid object from a software design. This process has enabled desktop manufacturing of one object at a time and does not require economies of scale. Additive manufacturing is just an industrial version of 3-D printing. This technology is already being used to make items such as medical implants, and to produce plastic prototypes for engineers and designers. A number of manufacturers, such as General Electric, are already developing plans to implement 3-D printing on a broader scale.

The second of these trends is a new generation of **intelligent assembly robots**. These robots have greater capabilities than in the past, while the cost and installation requirements of these technologies have made them broadly accessible. Unlike past robotic systems that required large complex installations and typically started at around \$250,000 per assembly station, the new generation costs a fraction of that price, and can be installed in a day. These advancements have made state-of-the-art automation within reach of even small manufacturing companies.

The third of these trends is **open-source hardware**. In the past, design information for electronic or computer hardware was copyrighted or licensed. Often companies engaged in reverse engineering to learn how the product was made. The new trend in open-source hardware allows electronic and computer hardware design to be made available for use at no charge. This allows sharing of all the information needed to build the product—such as documentation, schematic diagrams, construction details, parts lists, and logic designs. This will significantly accelerate design and creation of new products.

Collectively these trends and technologies are removing the physical constraints historically associated with manufacturing, such as building molds, ordering parts, and reconfiguring assembly machinery. The manufacturing process can now be run through software. Driven by big data analytics, it drives the **digital supply chain**.

Postponement

Companies are continually struggling to reach global markets, while providing local customization. Even in a geographically compact area like Europe there are still significant needs for local customization. For example, consider differences in preferences for washing machines in different European countries. The French, for example, prefer top-loading machines, whereas the British prefer front-loaders. The Germans prefer high-speed spins, but the Italians prefer a lower speed. Similar differences occur with other products, such as soft drinks, requiring the Coca-Cola Corporation to offer many different soft-drink flavors to cater to the unique local tastes. These differences significantly affect SCM.

The challenge for a global company is to achieve the cost advantage of standardization while still catering to local taste. This is essentially mass customization coupled with rapid delivery. One way a company can achieve this is to seek standardized parts, components, and modules, and then, through flexible manufacturing and logistics, provide specific product demands to each market. This is sometimes called **postponement**, where completion of the final product is postponed to the last possible moment until local demands are known with greater certainty. Hewlett-Packard (HP) was known for this in the production and distribution of their printers in the European market. The company completed the manufacture of the product, storing it in a central location, then waited to finalize packaging and specific country/language labeling until local demand was known. Postponement is an important strategy for companies to reach diverse geographic areas while still providing customization.

The Lean Supply Chain

The lean philosophy has been of great importance in business as it has focused on the elimination of waste and has helped numerous companies become more competitive. The importance of lean thinking has now been extended to the supply chain. It has been recognized that although individual firms can become lean by themselves, waste anywhere in the supply chain is passed on to the customer, and ultimately everyone in the supply chain pays for it. For example, shifting inventories to suppliers is ultimately passed on to the customer in the form of higher cost and makes the entire supply chain less competitive.

The lean supply chain can be defined as the set of all organizations directly linked by upstream and downstream flows of products, services, finances, and information that collaboratively work to reduce cost and waste. As such, a lean supply chain requires all supply chain organizations to work together. It requires a coordinated effort among partners to eliminate waste across the entire supply chain by analyzing processes and identifying areas for improvement.

Managing Supply Chain Disruptions

SCM and global sourcing have lowered purchase prices and expanded market access. This wide reach, however, has increased the level of supply chain risk. There is an increased risk of product and service flow disruptions and in the magnitude of these disruptions. Supply chain disruptions are a significant corporate crisis and can be very costly. Imagine, for example, a producer of an influenza vaccine suddenly not being able to receive its key ingredients from a supplier during peak flu season. Production may be halted, the company's survival may be of serious concern, and the welfare of customers might be jeopardized.

Managing supply chain risks is challenging because disruptions can occur for a wide variety of reasons. This can include transportation delays; industrial plant fires; work slowdowns or stoppages; natural disasters, such as earthquakes or hurricanes; and man-made disasters, such as the 9/11 terrorist attacks. As companies have increasingly focused on lean operations, they no longer have the inventory or excess capacity to make up for production losses caused by such disruptions. As a result, they are highly vulnerable to even a short material-flow problem. The vulnerability of lean supply chains was felt globally during the COVID-19 outbreak in 2020. Global supply chains had become increasingly dependent on China for sourcing and manufacture, and the global epidemic left many companies without sources of supply.

Companies are continuing to look for ways to guard their supply chains against disruptions. Some strategies include having access to backup suppliers, building excess capacity into the system, screening and monitoring suppliers for supply chain risks, requiring suppliers of critical items to develop detailed disruption plans, and including the expected costs of disruptions in the total cost of sourcing.

Supply Chain Security

Related to supply chain disruption is the study of supply chain security and maintaining product integrity as goods are moved across the globe between borders. Today's strict security initiatives make supply chain relationships much more complex, and the study of ways to protect security while maintaining efficiency is now a key issue. This is particularly critical when dealing with international freight movement. Tighter security and inspection at ports can significantly increase transit time and increase costs. Government regulations aimed at preventing terrorist threats, such as Customs-Trade Partnership Against Terrorism (C-TPAT) and the Container Security Initiative (CSI), require companies to engage in high levels of compliance. Although these measures are necessary, companies are working to find ways to comply while still engaging in outsourcing, offshoring, and global sourcing on a cost-efficient scale.

Other concerns are theft and product tampering. This is especially true for high-valued goods and pharmaceuticals, although anything that has intrinsic value can potentially be stolen. Supply chain security looks at different ways to protect the product, from using electronic seals to prevent tampering, to using RFID and GPS technologies to track product location.

Sustainability and the “Green” Supply Chain

Environmental concerns, including climate change, energy use, environmental contamination, and resource depletion, are here to stay. Consider that the economies of India and China are growing at high rates, and the population of the world continues to grow, creating shortages of many resources that we used to take for granted. Corporations are increasingly aware that they must design their supply chains for sustainability. This means designing processes to use environmentally friendly inputs and creating outputs that can be recycled and that do not contaminate the environment.

Sources of supply and movement of goods are huge factors in ensuring sustainability. Consider that Starbucks selects and manages their growers to ensure integrity of their environment. Starbucks mandates harvesting practices of their growers that do not damage rainforests.

Other aspects of the supply chain are also important to sustainability, such as packaging and transportation to reduce environmental impacts. Changes such as reducing the amount of cardboard or filler by designing “smart packages” can save companies money. McDonald's has recently introduced new packaging with the goal to source 100% of all fiber-based packaging from recycled or certified sources. Coca-Cola has been producing a partially bio-based PlantBottle and is working toward a 100% bio-based PlantBottle, whereas PepsiCo is experimenting with edible packaging. In transportation, companies are working to optimize delivery strategies that reduce the carbon footprint. For example, 3M has developed an innovative system to install adjustable decks in trucks, allowing placement of pallets on two levels, thus reducing the number of daily truckloads. Companies are also realizing that these types of measures are not only important to compliance with environmental regulation and consumer demand, but they are also good business practices. Starbucks, for example, realized that by working with growers to protect the environment, they are assured of a consistent and reliable source of supply.

Innovation

Innovation is increasingly becoming a critical capability for companies across the globe. This can include designing new products that satisfy customer demands, designing new cost-cutting production processes, or coming up with more efficient product delivery mechanisms. For example, consider a pharmaceutical company recently involved in developing the flu vaccine for the recent outbreak of H1N1. Innovation involves identifying the vaccine components and

doing clinical trials, as well as production, packaging, and distribution. This must be done efficiently, ensuring the highest security, all the while doing it as expediently as possible to reach the market quickly.

Companies that compete on innovation realize that their entire supply chain must be designed to support their efforts and are designing them accordingly. These chains are typically shorter to reduce time to market. Also, innovative products need greater protection from copying and tampering, and security issues become critical. The role of suppliers is especially important in these supply chains. Suppliers need to be involved early in the product design process to shorten the design time. Also, suppliers are an excellent source of product ideas and process improvements. As competitive pressures increase, continuing to find ways to manage supply chains for innovations will remain an important issue. This means coming up with new ideas and being able to produce and deliver products faster than competitors.

Managerial Insights Box—Outsourcing Innovation

■ GOLDCORP INC.

Goldcorp Inc., one of the world's top gold producers, was facing a big problem a few years ago. Some of its mines were consistently performing below standard, and the mining engineers were at a loss on how to increase production. Finally, Robert McEwen, the CEO of Goldcorp at the time, decided to try an unusual strategy. He decided to offer \$575,000 in prize money, with a top award of \$105,000, to the person or company that would find a way for Goldcorp to mine more gold.

The challenge, which was broadcast via the Internet, paid off for Goldcorp. Two Australian companies collaborated to come up with a three-dimensional (3-D) depiction of Red Lake mine, which was especially problematic. The 3-D graphical depiction produced a surprise breakthrough in terms of how to approach and mine more gold at the Red Lake facility. With the new process, the mine produced 504,000 ounces at a production cost of \$59 an

ounce, compared to 53,000 ounces at a production cost of \$360 an ounce.

Goldcorp showed that the traditional procurement activity can be used in many different ways, even for innovation. The company had effectively outsourced part of its engineering activity to a supplier. More significantly, this was not one of its preferred or even regular suppliers, but one that they had not known previously. Rather than being found and evaluated by Goldcorp's procurement group in the context of predetermined supplier criteria, the supplier had offered their services in innovation through competitive motivation. Goldcorp had moved beyond seeking innovation from its own staff and even its own "local" suppliers and has shown that sources of innovation can be found anywhere in the supply chain.

Adapted from: Weiss, Madeline and Drewry, June. "Outsourcing in the 21st Century Ambient Organization." *CIO Magazine*, June 14, 2016.

The Financial Supply Chain

The financial supply chain is intimately tied to SCM and managing the flow of funds is an essential ingredient for its success. In the interconnected global economy companies are under greater financial pressures than ever before to cut costs. The result has been a push to redesign entire supply chains and search for less-costly sources of supply. This includes strategies such as global sourcing and production outsourcing, trying to achieve labor cost advantages by pushing operations offshore, and outsourcing noncore activities. As companies send operations offshore, however, there are significant financial implications. These include masked hidden costs, such as managing more expensive plants and equipment in emerging countries. Pushing inventory downstream to suppliers often means higher inventory costs, as these suppliers typically have a higher cost of capital. Also, global operations can wreak havoc on the financial supply chain, as the longer chain has a higher amount tied up in working capital.

Another area of interest for management is the “**cash-to-cash cycle**,” which is the time it takes to convert an order into cash. Although management has long recognized the competitive impact of shorter order cycles, it has recently seen the impact the total order process has on working capital. This is another financial supply chain issue that companies are trying to closely manage.

Technology is having a particularly significant impact on supply chain finance. Just a few years ago FnConn, a subsidiary of FoxConn, partnered with a lender to launch Chained Finance, a blockchain-based supply chain finance platform. The goal was to create transparency and easy authentication of every payment and every supply chain transaction. Today, more companies are incorporating blockchain technology into supply chain finance to create a trusted network of vendors. Other technologies are also having a significant impact. The Internet of Things (IoT), machine learning (ML), and artificial intelligence (AI) are rapidly being used on issues such as developing credit scores and presenting companies with the best financial proposal for each supplier.

As the supply chain provides a significant cost-cutting opportunity, the trend of managing finances and identifying the risks and challenges of the financial supply chain will continue to be a significant trend in the future.

Empowering Entrepreneurs Box

In entrepreneurship there is a saying: “Ideas are easy; execution is everything.” Supply chain management is about execution. It is about how products are made, where materials come from, where manufacturing happens, quality control of products, and how the products are eventually delivered to customers. It is taking an idea and making all the decisions involved in creating the actual product. SCM is particularly important for entrepreneurs. Most entrepreneurs have great ideas and understand financing and marketing. However, they are often thrown into dealing with SCM without understanding its full scope.

Entrepreneurs manage supply chains that are much smaller compared to that of large global supply chains.

That creates greater opportunities but also requires special understanding. It requires end-to-end SCM knowledge and how the elements of the supply chain are interrelated. Entrepreneurs often have visibility into their suppliers' suppliers and their customers' customers. They have choices and control over a complete set of SCM decisions and need to understand how the entire system works from end to end. They also have great potential to scale up, create disruptive innovation, and build long-term value for customers, investors, and employees. Anyone who wants to create a successful company needs to understand the full scope of SCM.

Careers in SCM and Professional Organizations

SCM has become an essential competency for corporate executives and managers. According to the Council of Supply Chain Management Professionals (www.cscmp.org), corporate spending on SCM is growing faster than the overall economy, creating tremendous job opportunities for business professionals. As SCM is boundary spanning, it enables business professionals to touch and see every aspect of the product and provides exceptional upward mobility.

There are many routes to success in SCM. The career path can take an individual to many types of organizations, require them to conduct a variety of tasks, and take them to virtually any location in the world, if they so desire. Potential employers range from traditional manufacturers and retailers to service organizations that are increasingly relying on SCM. They also include specialty organizations such as consulting firms and transportation service providers.

Entry-level management positions in SCM can include titles such as Demand Planner, Vendor Management Inventory (VMI) Analyst, or Consultant. Duties may include conducting product

evaluation, product planning, generating forecast reports, managing product investment targets, and performing online replenishment. Middle-level management positions include titles such as Sourcing Management, Director of SCM, or Director of Operations. They are responsible for all aspects of product flow and accurate and timely product movement throughout the facility and supply chain. Finally, senior executive positions include VP of SCM or VP of Global Logistics. These are prominent organizational positions that command top salaries. Duties here include managing and optimizing the global supply chain network with multiple distribution centers. The individual is responsible for documenting and executing a global and comprehensive SCM plan that optimizes customer services and profitability.

Careers in SCM abound, offering individuals opportunities in a great variety of positions and providing the chance to have a high impact on the business as a whole.

CHAPTER HIGHLIGHTS

1. SCM is the design and management of flows of products, information, and funds throughout the supply chain. A supply chain is the network of all entities involved in producing and delivering a finished product to the final customer.
2. The bullwhip effect is the fluctuation and distortion of information as it moves up the supply chain, from retailer, to manufacturer, and to supplier.
3. SCM activities involve coordination, information sharing, and collaboration.
4. Intraorganizational integration is participation and coordination of activities between different organizational functions within the organization.
5. Cross-enterprise integration is the participation and coordination of activities between different organizations that comprise the supply chain.
6. Logistics, in contrast to SCM, consists of the tasks involved in moving and positioning inventory throughout the supply chain.
7. Competitive supply chains are responsive, are reliable, and engage in relationship management with members of the supply chain.
8. Trends that impact today's supply chain include globalization, outsourcing, information technology, big data analytics, 3-D printing, additive manufacturing, robotics, postponement, lean supply chain, supply chain disruptions, security, sustainability or "green" supply chain, innovation, and the financial supply chain.

KEY TERMS

Supply chain management (SCM)	Bullwhip effect	Enterprise resource planning (ERP)	Business-to-business (B2B)	Digital supply chain
Supply chain	Marketing	Wireless communication technologies	Business-to-consumer (B2C)	3-D printing
Value chain	Operations	Global positioning systems (GPS)	Big data analytics	Additive manufacturing
Value network	Sourcing	Radio frequency identification (RFID)	Big data	Intelligent assembly robots
Products	Logistics		Analytics	Open-source hardware
Information	Outsourcing		Internet of Things (IoT)	Postponement
Funds	Core competencies			Cash-to-cash cycle
	Information technology			

DISCUSSION QUESTIONS

1. Identify the primary ways in which SCM has improved the order fulfillment process. What other benefits has SCM provided to businesses?
2. Explain the relationship between SCM and logistics. Identify the differences and similarities. Is one a part of the other? How does one support the other?
3. Identify two competing enterprises and their supply chains (e.g., Dell Computer versus Apple; Amazon versus Wal-Mart; Toyota versus GM; UPS versus FedEx). Identify the elements of each chain from source of supply to final customer, and explain how the two chains are meeting (or not meeting) business objectives. Which supply chain appears longer? Does the structure of one appear simpler than the other?

4. Identify the primary flows in a supply chain. Explain why there is flow in both directions, and provide examples of each.
5. Identify key activities of SCM. Identify other drivers not mentioned in the text.
6. Identify at least three trends that impact SCM. Identify other trends not discussed in the text.

Case Study || McNulty's Muscular Materials (MMM)

Clayton McNulty, owner of McNulty's Muscular Materials (MMM), is sitting in his dim office located at the top of an old brown brick building, in an industrial area of South Boston. Clayton had just gotten off the phone with Sarah Holden, his longtime friend and sole supplier of his most popular fabric, when his telephone rings again. This call is from John Master-son, his number-one client.

"Clay Buddy," John says. "Just got off the phone with the owner of Southside Sluggers. Guess who got the New Jersey contract? That's right, pal, and I want you to get 'em to me. That'll be 10,000 jerseys, and I need them by the end of the month. How much do you love me, Clay baby? I'll get you the designs by Monday. Ciao."

Clayton hangs up the phone, stares out of his small, double-paned office window and watches the rain slide down the glass. Sure, Clayton was excited about the large bid, but how was he to produce the baseball jerseys in time? The season was to start in three months. The one-month deadline was dead-locked, and there was no room for negotiation. The fans will want the new merchandise before the season gets under way.

MMM was a small sports attire manufacturer that primarily focused on making jerseys for local sports teams. Luckily, the factory had been set up for expansion and was capable of handling a production of this magnitude. But where would he get the needed fabric to produce such a large volume? The most he had ever had to produce was one-tenth of the size that John had just ordered. A big order like this means big publicity, and more orders were sure to start rolling in over the next few months.

A call to Sarah confirms his suspicions. She can't produce that much fabric in such a short amount of time. He needs another supplier, and he needs one fast. It's a rainy day in South Boston, and Clayton McNulty has some tough decisions to make.

Case Questions

1. What potential options does Clayton have to procure the needed volume of fabrics to meet the deadline?
2. What are the trade-offs for each of these potential options?
3. What should Clayton do?
4. What lessons can be learned from Clayton's situation?

Case Study || Making Decisions with Data Analytics: FutureChain

You graduated with a business degree and followed your dream to become an entrepreneur. Since then you have started seven different businesses, and today each of those businesses generates many millions of dollars in revenue. You have marketed all your businesses under the brand name of **FutureChain**.

Spotting a trend in data analytics, you recently began exploring the possibility of a new business in this space. After talking with the business community, you have identified the need of small and medium-sized firms for analytics services in analyzing web traffic on their websites. Given your successful track record as an entrepreneur, a number of businesses have already expressed their willingness to sign a service

contract with you, and you have provisioned financing for the new startup.

With financing and clients lined up, you are planning to begin operating your new organization, called **FutureChain Analytics**, in three months.

Case Questions

1. Identify the supply chain management decision you need to make in order to begin operating.
2. One of your seven ventures, branded as FutureChain Robotics, makes industrial robots. How should its customer contract differ from that of FutureChain Analytics? (**Tip:** One business is a service, the other manufacturing).

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