PART 1

Supply Chain Logistics Management

Part 1 establishes the strategic importance of logistics to achieving business success by creating value throughout domestic and global supply chains. The initial chapter scopes the current business attention to supply chain management. The supply chain provides the framework within which logistical strategies are developed and executed. Logistics, the primary topic of this book, is introduced in Chapter 2. The concept of integrated logistics is developed by discussing the ways specific work tasks combine to support customer relationship management, manufacturing, and procurement. Chapter 3 describes the importance of customer relationship management to successful logistics. The value created by logistics can serve as a powerful driver of customer success. Chapter 4 discusses procurement. Chapter 5 provides an overview of 21st century manufacturing. The combination of customer accommodation, procurement, and manufacturing represents the supply chain operational areas that are linked and supported by logistics. Chapter 6 presents an overview of information technology that is specifically applicable to supply chain logistics. One of the key challenges in integrated supply chain management is cross-functional and cross-enterprise planning and operational implementation.

CHAPTER 1

21st-Century Supply Chains

Chapter Outline

As recently as the 1990s, the average time required for a company to process and deliver merchandise to a customer from warehouse inventory ranged from 15 to 30 days, sometimes even longer. The typical order-to-delivery process involved order creation and transfer, which was usually via telephone, fax, electronic data interchange (EDI), or public mail; followed by order processing, which involved the use of manual or computer systems, credit authorization, and order assignment to a warehouse for processing; followed by shipment to a customer. When everything went as planned, the average time for a customer to receive items ordered was lengthy. When something went wrong, as it often did, such as inventory out-of-stock, a lost or misplaced work order, or a misdirected shipment, total time to service customers escalated rapidly.

To support this lengthy and unpredictable time to market, it became common practice to accumulate inventory. For example, duplicate inventories were typically stocked by multiple supply chain members. Despite such extensive inventory, out-of-stocks and delayed deliveries were common due in part to the large number of product and process variations.

These accepted business practices of the 20th century, as well as the distribution channel structure used to complete delivery, evolved from years of experience dating from the industrial revolution. Such long-standing business practices remained in place and unchallenged because no clearly superior alternative existed. The traditional distribution process was designed to overcome challenges and achieve benefits that long ago ceased to be important. The industrialized world is no longer characterized by scarcity. Consumer affluence and desire for wide choice of products and services continue to grow. In fact, today's consumers want a wide range of product and source options they can configure to their unique specifications. Given the rapid growth of information technology and the accessibility of the Internet, consumer desires have shifted from passive acceptance to active involvement in the design and delivery of specific products and services. Transportation capacity and operational performance have increasingly become more economical and reliable. Today's transportation is supported by sophisticated information systems that facilitate predictable and precise delivery. The capability to continuously track shipments and receive near instant notification of delayed delivery is common practice.

Massive change has occurred as a result of available information technology. During the decade of the 1990s, the world of commerce was irrevocably impacted by computerization, the Internet, and a range of inexpensive information transmission capabilities. Information characterized by speed, accessibility, accuracy, and most of all relevancy are now the norm. The Internet is a common and economical way to complete business-to-business (B2B) transactions. An increasing number of consumers are directly connected to firms via the Internet. Driven by these fundamental forces, a global economy has emerged.

What began during the last decade of the 20th century and will continue to unfold well into the 21st century is what historians are increasingly characterizing as the dawning of the **information** or **digital age.** In the information age the reality of connectivity among collaborating business organizations continues to drive a new order of relationships called **supply chain management.** Managers are increasingly improving and integrating traditional marketing, manufacturing, purchasing and logistics practices. In this new order of affairs, products can be manufactured to exact specifications and rapidly delivered to customers at locations throughout the globe. Logistical systems exist that have the capability to deliver products at precise times. Customer order and delivery of product assortments can be performed in hours. The frequent occurrence of service failures that characterized the past is increasingly being replaced by a growing managerial commitment to zero defect or what is commonly called **six-sigma** performance.[1] **Perfect orders**—delivering the desired assortment and quantity of products to the right location on time, damage-free, and correctly invoiced—once the exception, are now becoming the expectation. Perhaps most important is the fact that such high-level performance is being achieved at lower total cost and with the commitment of fewer financial resources than common in the past. All of this fundamental change in business enterprise structure and strategy is primarily being driven by information technology.

In this initial chapter, the supply chain management business model and value proposition are introduced as a growing strategic commitment of contemporary firms. The chapter reviews the development of the supply chain revolution in business practice that has

[1] Six-sigma performance reflects a level of achievement having an error rate of 3.4 defects per million, or 99.99966 percent perfect.

resulted in a generalized supply chain model. Next, the supply chain concept is presented in a strategic framework. The following section discusses the importance of information systems functionality and the modules that support supply chain operations. The chapter then examines integrative management, responsiveness, financial sophistication, and globalization as forces driving the emergence of supply chain logic. The overall objective of Chapter 1 is to position the logistical challenges of supporting a 21st century supply chain strategy. The supply chain is positioned as the strategic framework within which logistical requirements are identified and related operations managed.

The Supply Chain Revolution

What managers are experiencing today we choose to describe as the **supply chain revolution** and a related **logistical renaissance.** These two massive shifts in expectation and practice concerning best-practice performance of business operations are highly interrelated. However, supply chain and logistics are significantly different aspects of contemporary management.

Supply chain management consists of multiple firms collaborating to leverage strategic positioning and to improve operating efficiency. For each firm involved, the supply chain relationship reflects a strategic choice. A supply chain strategy is a channel and business organizational arrangement based on **acknowledged dependency** and **collaboration.** Supply chain operations require managerial processes that span traditional functional areas within individual firms and link suppliers, trading partners, and customers across business boundaries.

Within a firm's supply chain management, **logistics** is the work required to move and geographically position inventory. As such, logistics is a subset of and occurs within the broader framework of a supply chain. Logistics is the process that creates value by timing and positioning inventory. Logistics is the combination of a firm's order management, inventory, transportation, warehousing, materials handling, and packaging as integrated throughout a facility network. Integrated logistics serves to link and synchronize the overall supply chain as a continuous process and is essential for effective supply chain connectivity. While the purpose of logistical work has remained essentially the same over the decades, the way the work is performed continues to radically change.

The fundamental focus of this book is integrated logistics management. However, to study logistics, a reader must have a basic understanding of supply chain management. Supply chain strategy establishes the operating framework within which logistics is performed. As will be reviewed shortly, dramatic change continues to evolve in supply chain practice. Accordingly, logistics best practice, as described in this book, is presented as a work in progress, subject to continuous change based on the evolving nature of supply chain structure and strategy. Chapter 2, Logistics, examines the renaissance taking place in logistics best practice and sets the stage for chapters that follow.

At first glance, supply chain management may appear to be a vague concept. A great deal has been written on the subject without much concern for basic definition, structure, or common vocabulary. Confusion exists concerning the appropriate scope of what constitutes a supply chain, to what extent it involves integration with other companies as contrasted to integrating a firms internal operations, and how to best implement a strategy concerning competitive practices and legal constraints. For most managers, the supply chain concept has intrinsic appeal because it envisions new business arrangements offering the potential to improve competitiveness. The concept also implies a highly effective network business relationships that serve to improve efficiency by eliminating duplicate and nonproductive work. Understanding more specifically what constitutes the supply chain revolution starts with a review of traditional distribution channel practice.

To overcome challenges of commercial trading, firms developed business relationships with other product and service companies to jointly perform essential activities. Such acknowledged dependency was necessary to achieve benefits of specialization. Managers, following the early years of the industrial revolution, began to strategically plan core competency, specialization, and economy of scale. The result was realization that working closely with other businesses was essential for continued success. This understanding that no firm could be totally self-sufficient contrasted to some earlier notions of vertical integration.[2] Acknowledged dependence between business firms created the study of what became known as **distribution** or **marketing channels.**

Because of the high visibility of different types of businesses, the early study of channel arrangements was characterized by classification based on specific roles performed during the distribution process. For example, a firm may have been created to perform the value-added services called wholesaling. Firms doing business with a wholesaler had expectations concerning what services they would receive and the compensation they would be expected to pay. In-depth study of specific activities quickly identified the necessity for leadership, a degree of commitment to cooperation among all channel members, and means to resolve conflict. Scholars who conduct research in channel structure and strategy developed typologies to classify observable practice ranging from a single transaction to highly formalized continuous business relationships.

The bonding feature of channel integration was a rather vague concept that all involved would enjoy benefits as a result of cooperating. However, primarily due to a lack of high-quality information, the overall channel structure was postured on an adversarial foundation. When push came to shove, each firm in the channel would first and foremost focus on achieving its individual goals. Thus, in final analysis, channel dynamics were more often than not characterized by a dog-eat-dog competitive environment.

During the last decade of the 20th century, channel strategy and structure began to shift radically. Traditional distribution channel arrangements moved toward more integration and collaboration. Prior to reviewing the generalized supply chain model, it is important to understand why integration creates value.

Why Integration Creates Value

To explain the basic benefits and challenges of integrated management, it is useful to point out that customers have at least three perspectives of value.

The traditional perspective is **economic value.** Economic value builds on economy of scale in operations as the source of efficiency. Economy of scale seeks to fully utilize fixed assets to achieve the lowest, total landed cost. The focus of economic value is efficiency of product/service creation. Economic value is all about doing things as well as possible. The customer take-away of economic value is **high quality at a low price.**

A second value perspective is **market value.** Market value is about presenting an attractive assortment of products at the right time and place to realize effectiveness. Market value focuses on achieving economy of scope in product/service presentation. The creation of multimerchant shopping malls, large-scale mass-merchandising retail stores, and multivendor Internet fulfillment operations are all initiatives to achieve **market value.** The customer's take-away in terms of market value is **convenient product/service assortment and choice.**

Realization of both economic and market value is important to customers. However, increasingly firms are recognizing that business success also depends upon a third perspective

[2] Henry Ford, *Today and Tomorrow* (New York: Doubleday, Page, and Company, 1926). Reprinted by Productivity Press (Portland, OR, 1988).

TABLE 1.1
Integrative Management Value Proposition

Economic Value	Market Value	Relevancy Value
• Lowest total cost • Economy-of-scale efficiency • Product/service creation	• Attractive assortment • Economy-of-scope effectiveness • Product/service presentation	• Customization • Segmental diversity • Product/service positioning
Procurement/Manufacturing Strategy	**Market/Distribution Strategy**	**Supply Chain Strategy**

of value, referred to as **relevancy value.** Relevancy value involves customization of value-adding services, over and above basic product characteristics and physical location, that make a real difference to customers. Relevancy value means the right products and services, as reflected by market value, at the right price, as reflected by economic value, modified, sequenced, synchronized, and positioned in a manner that creates customer-specific value. In a consumer context, for example, relevancy means transforming ingredients into ready-to-eat meals. In general merchandise retailing, relevancy means transforming products into fashionable apparel. In manufacturing and assembly, relevancy is achieved by integrating specific components into products to increase functionality desired by a specific customer. The customer's take-away in terms of relevancy is a unique product/service bundle.

The simultaneous achievement of economic value, market value, and relevancy value requires total integration of the overall business process and is known as the integrative management value proposition, as illustrated in Table 1.1.

Generalized Supply Chain Model

The general concept of an integrated supply chain is often illustrated by a line diagram that links participating firms into a coordinated competitive unit. Figure 1.1 illustrates a generalized model adapted from the supply chain management program at Michigan State University.

The context of an integrated supply chain is multifirm collaboration within a framework of key resource flows and constraints. Within this context, supply chain structure and strategy results from efforts to operationally align an enterprise with customers as well as the supporting distributive and supplier networks to gain competitive advantage. Business operations are ideally integrated from initial material purchase to delivery of finished products and services to customers.[3]

Value results from the synergy among firms constituting a supply chain as a result of five critical flows: information, product, service, financial, and knowledge (see the bidirectional arrow at the top of the Figure 1.1). Logistics is the primary conduit of product and service flow within a supply chain arrangement. Each firm engaged in a supply chain is involved in performing some aspects of overall logistics. Achievement of logistical integration and efficiency across the supply chain is the focus of this text. The generalized supply chain arrangement illustrated in Figure 1.1 logically and logistically links a firm and its distributive and supplier network to customers. The message conveyed by the figure is that the integrated value-creation process must be aligned and managed from material procurement to end-customer product/service delivery in order to achieve effectiveness, efficiency, relevancy, and sustainability.

[3] Customers are defined as destination points in a supply chain. Customers either consume a product or use it as an integral part or component of an additional process or product. The essential point is that the original product loses its unique configuration when consumed. Business entities that purchase products from manufacturers for resale, for example, wholesalers and retailers, are referred to as *intermediate customers.*

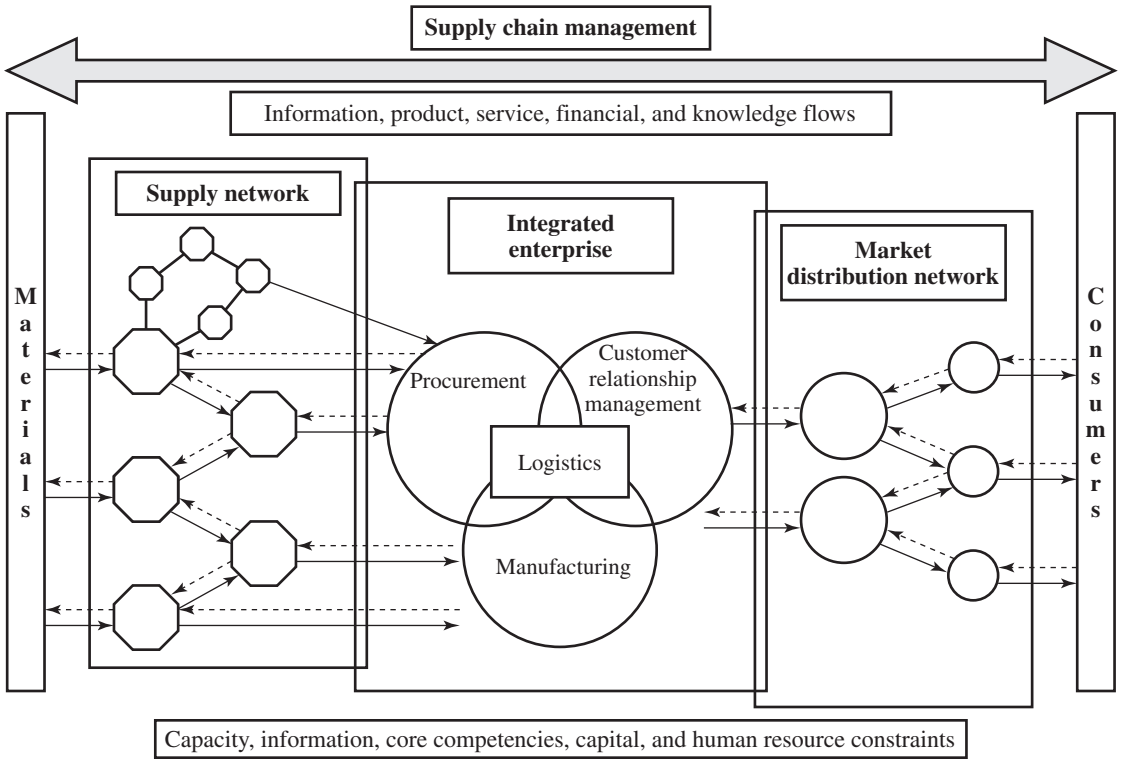


FIGURE 1.1 The Integrated Supply Chain Framework

The integrated supply chain perspective shifts traditional channel arrangements from loosely linked groups of independent businesses that buy and sell inventory to each other toward a managerially coordinated initiative to increase market impact, overall efficiency, continuous improvement, and competitiveness. In practice, many complexities serve to cloud the simplicity of illustrating supply chains as directional line diagrams. For example, many individual firms simultaneously participate in multiple and competitive supply chains. To the degree that a supply chain becomes the basic unit of competition, firms participating in multiple arrangements may confront loyalty issues related to confidentiality and potential conflict of interest.

Another factor that serves to add complexity to understanding supply chain structure is the high degree of mobility and change observable in typical arrangements. It's interesting to observe the fluidity of supply chains as firms enter and exit without any apparent loss of essential connectivity. For example, a firm and/or service supplier may be actively engaged in a supply chain structure during selected times, such as a peak selling season, and not during the balance of a year. During the 2010 Christmas season, Toys R Us added 600 temporary or pop-up express stores to accommodate demand. An estimated 10,000 positions were required to staff these stores. In total, some 45,000 employees were added across the nation to meet seasonal demand projections.

Information System Functionality

The overarching enabler of supply chain management is information technology. Supply chain technology systems initiate activities and track information regarding processes, facilitate information sharing both within the firm and between supply chain partners, and

assist in management oversight and decision making. Comprehensive information systems are a combination of transaction, decision support, and communication sub-systems.

From its inception, logistics focused on product storage and flow through the supply chain. Information flow and accuracy were often overlooked because they was not viewed as being critical to customers. In addition, information transfer rates were limited to manual processes. There are four reasons why timely and accurate information has become more critical in supply chain design and operations. First, customers perceive information regarding order status, product availability, delivery tracking, and invoices as necessary dimensions of day-to-day business operations. Customers demand real-time information. Second, with the goal of managing total supply chain assets, managers realize that information can be used to reduce inventory and human resource requirements. In particular, requirements planning based on timely information can reduce inventory by minimizing demand uncertainty. Third, information increases flexibility with regard to how, when, and where resources may be utilized to achieve competitive advantage. Finally, enhanced information transfer and exchange utilizing the Internet is facilitating collaboration and redefining supply chain relationships. A common example of comprehensive information systems driving better supply chain utilization can be found in today's international shipping arena. It is common for a firm to re-direct a container mid-transit based on real time feedback from local markets. This change, enabled by information technology results in higher service levels and simultaneously improved asset utilization.

Supply chain information systems (SCIS) are the thread linking logistical activity into an integrated process. Integration builds on four levels of functionality: (1) transaction systems, (2) management control, (3) decision analysis, and (4) strategic planning. Figure 1.2 illustrates logistics activities and information required at each level. As the pyramid shape

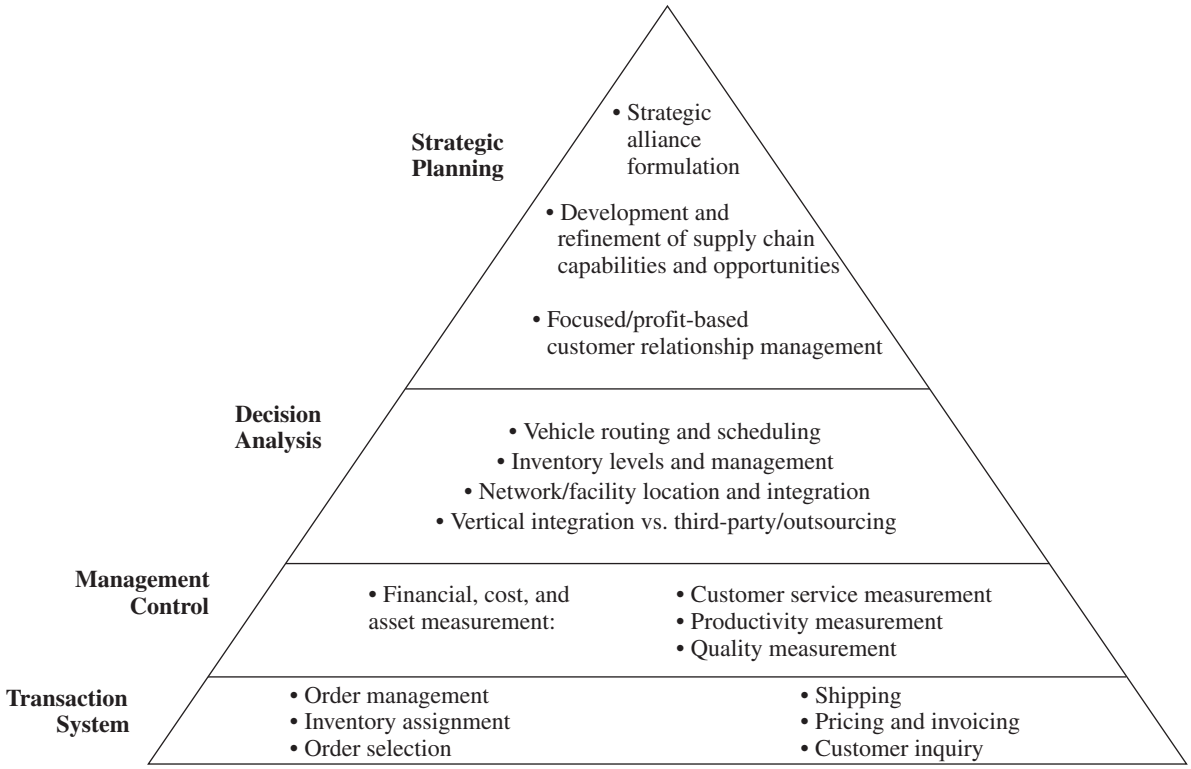


FIGURE 1.2 Supply Chain Information System Functionality

suggests, management control, decision analysis, and strategic planning enhancements require a strong transaction system foundation.

A **transaction system** is characterized by formalized rules, procedures, and standardized communications; a large volume of transactions; and an operational, day-to-day focus. The combination of structured processes and large transaction volume places a major emphasis on information system efficiency. At the most basic level, transaction systems initiate and record individual logistics activities and their outcomes. Typical transaction functionality includes order entry, inventory assignment, order selection, shipping, pricing, invoicing, and customer inquiry. For example, customer order entry represents a customer request for products into the information system. Order entry transaction initiates a second transaction as inventory is assigned to the order. A third transaction is then generated to direct warehouse operations to select the order. A fourth transaction initiates order shipment to the customer. A final transaction creates the invoice and a corresponding account receivable. Throughout the process, the firm and customer expect real-time information regarding order status. Thus, the customer order performance cycle is completed through a series of information system transactions.

The second SCIS level, **management control,** focuses on performance measurement and reporting. Performance measurement is necessary to provide feedback regarding supply chain performance and resource utilization. Common performance dimensions include cost, customer service, productivity, quality, and asset management measures. As an example, specific performance measures include transportation and warehousing cost per hundredweight, inventory turnover, case fill rate, cases per labor hour, and customer service perception.

While it is necessary that SCIS report historical system performance, it is also necessary for the system to identify operational exceptions. Exception information is useful to highlight potential customer or operational problems. For example, proactive SCIS should be capable of avoiding future inventory shortages based on forecast requirements and planned inventory. Exception reporting should also identify potential transportation, warehouse, or labor constraints. While some control measures, such as cost, are well defined, other measures, such as service and quality, may be less specific. For example, customer service can be measured internally, from the enterprise's perspective, or externally, from the customer's perspective. While internal measures are relatively easy to track, information concerning external measures is more difficult to obtain, since it involves the customer or other external partners.

The third SCIS level, **decision analysis,** focuses on software tools to assist managers in identifying, evaluating, and comparing strategic and tactical alternatives to improve performance. Typical analyses include supply chain design, inventory management, resource allocation, transportation routing, and customer segment profitability. Decision analysis SCIS should ideally include database maintenance, modeling, analysis, and reporting. Like management control, decision analysis may include operational considerations such as vehicle routing and warehouse planning. Decision analysis is also being used to manage customer relationships by determining the trade-offs associated with having satisfied and successful customers.

Strategic planning, the final SCIS level, organizes and synthesizes transaction data into a relational database that assists in strategy formation and evaluation. Essentially, strategic planning focuses on information to evaluate and refine supply chain and logistics strategy. Examples of strategic planning include the desirability and scope of strategic alliances, development and refinement of supply chain capabilities, and opportunities related to customer relationship management. The relative shape of Figure 1.3 illustrates SCIS development characteristics and justification. Development and maintenance costs include hardware, software, communications, and human resources. In the past, most systems development focused on improving transaction system efficiency. While these investments originally offered returns in terms of speed and lower operating costs, there are now fewer

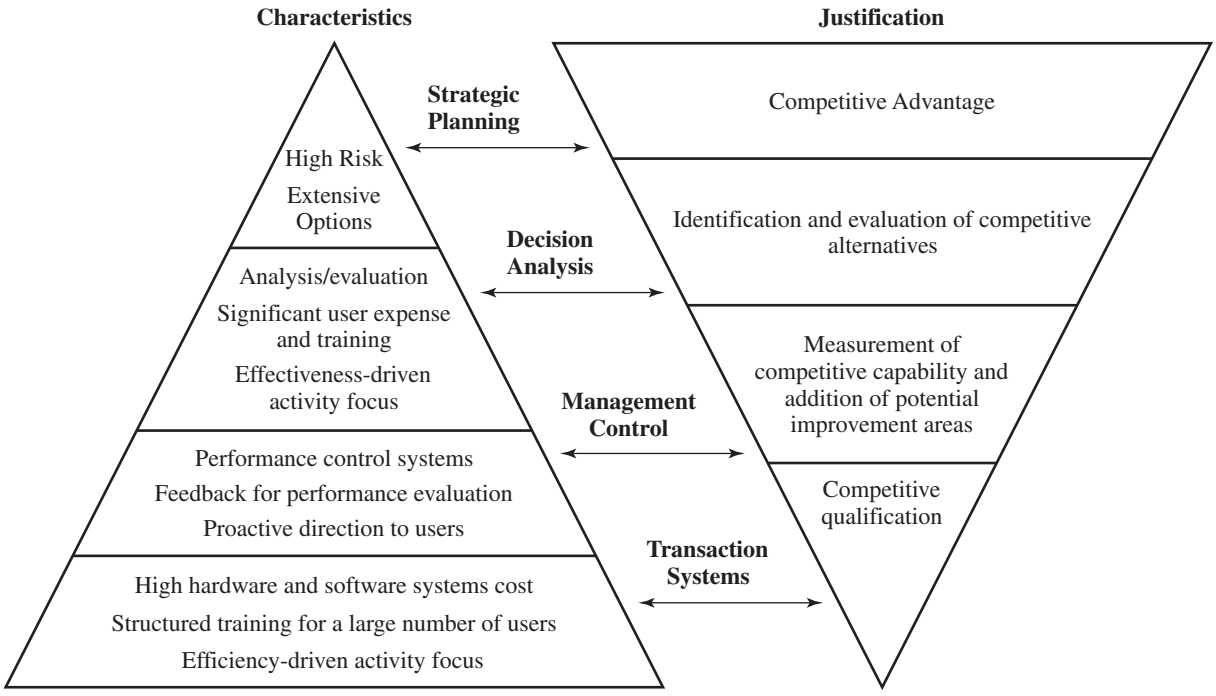


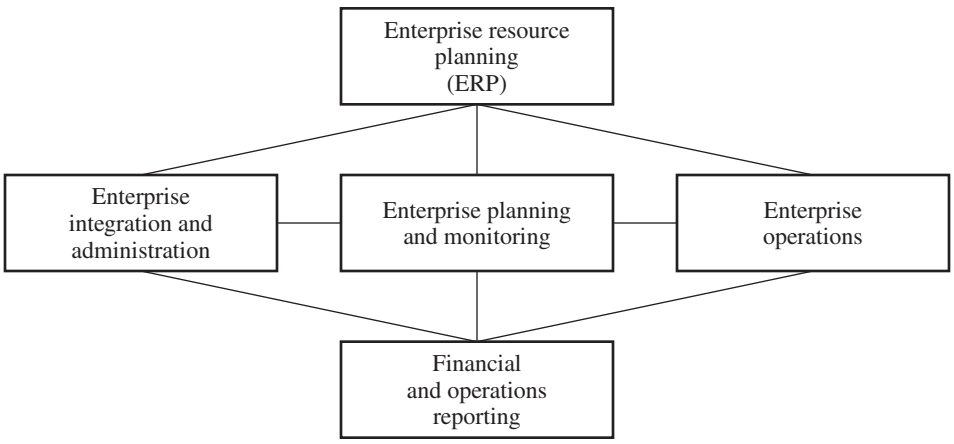
FIGURE 1.3 SCIS Usage, Decision Characteristics, and Justification

improvement opportunities. Most SCIS development and implementation is now focused on enhanced supply chain system integration and improved decision making.

Supply Chain Information System Modules

A comprehensive SCIS initiates, monitors, assists in decision making, and reports on activities required for completion of supply chain operations and planning. The major system modules and their interfaces are: (1) **Enterprise Resource Planning (ERP),** (2) communication systems, (3) execution systems, and (4) planning systems. Figure 1.4 illustrates a more application-oriented perspective. This application perspective is used to discuss each module's specific characteristics and functionality.

FIGURE 1.4
Application-Oriented SCIS Framework



The ERP systems in Figure 1.4 are the backbone of most firms' logistics information system. This backbone maintains current and historical data and processes to initiate and monitor performance. During the 1990s, many firms began to replace self-developed functional modules (called "legacy systems") with ERP systems designed as integrated transaction modules and processes with a common and consistent database. The database includes information storage capability for both operations (i.e., product and activity based) and financial (i.e., monetary based) transactions. ERP systems facilitate integrated operations and reporting to initiate, monitor, and track critical activities such as order fulfillment and replenishment. ERP systems also incorporate an integrated corporatewide database, sometimes referred to as a data warehouse, along with appropriate transactions to facilitate logistics and supply chain planning and operations. Supply chain transactions facilitated by ERP systems include order entry and management, inventory assignment, and transportation. Beyond these supply chain applications, ERP systems typically include financial, accounting, and human resource capability. Data mining, knowledge management, and other enterprise integration applications operate using the ERP backbone to develop and organize insight regarding customers, products, and operations.

Enterprise Integration and Administration

Enterprise integration and administration are ERP modules that are not specifically supply chain applications. However, supply chain operations do have substantial interaction with these ERP components. Figure 1.5 illustrates the major enterprise integration and administration components. They are (1) general administration, (2) accounts receivable and payable, (3) financial inventory accounting, (4) general ledger, and (5) human resources.

General administration includes the various transactions to structure the firm and define transaction process flows. Supply chain operations use these modules to define reporting, functional, and organizational structures as well as to define process flows such as customer and replenishment order fulfillment. Accounts receivable and payable represent the functions for invoice collection from customers and invoice payment to suppliers. While these are typically acknowledged as accounting functions, there is a significant interaction with supply chain operations since accounts payable is influenced by materials and services acquisition and accounts receivable is influenced by delivery and invoicing of complete orders. Financial inventory accounting relates to the tracking of value-added processes through the supply chain to facilitate financial and tax reporting. The timing and location of supply chain value-added processes (e.g., production, inventory control, and packaging) can have a significant influence regarding what can be reported to the treasury (for taxation purposes) and the financial markets (for stock valuation purposes). General ledger relates to the structure of the detailed accounts for monitoring and reporting

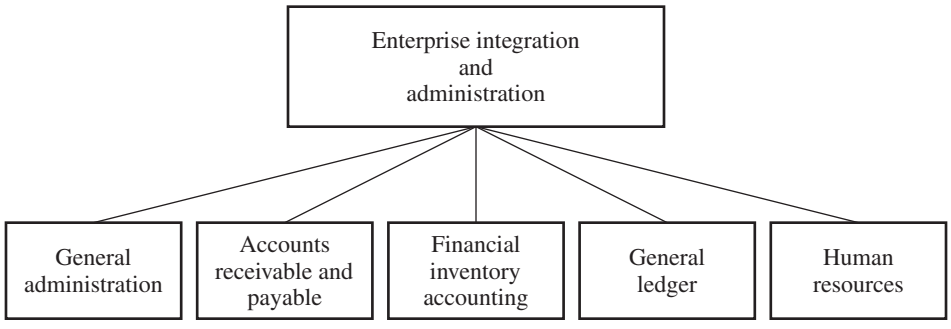


FIGURE 1.5
Enterprise Integration and Administration Components

revenues and accounts. Since supply chain involves substantial interaction with firm and external processes, the structure of the general ledger accounts significantly influences the supply chain's ability to measure, monitor, and report cost related to delivering product or serving customers. The human resource module of the ERP systems tracks personnel profiles and their activity levels. Since most firms have a large number of individuals involved in supply chain operations (e.g., manufacturing, distribution, and purchasing) and often in different global environments, the ability to track pay scales and activity levels is critical to make effective supply chain personnel decisions.

Enterprise Supply Chain Operations

Enterprise operations include the SCIS modules required to support day-to-day supply chain operations. Figure 1.6 illustrates the specific modules including: (1) customer relationship management, (2) logistics, (3) manufacturing, (4) purchasing, and (5) inventory deployment. Enterprise operations systems work in conjunction with the firm's ERP system to provide specific functionality to support supply chain operations. While some ERP systems support required supply chain functionality, others lack some functionality such as that required to support warehouse and transportation operations.

Customer accommodation systems, also known as **customer relationship management (CRM)** systems, are relatively new applications designed to facilitate information sharing between customers, sales force, and operations management. The logistics module directs and monitors logistics activities including finished goods inventory management,

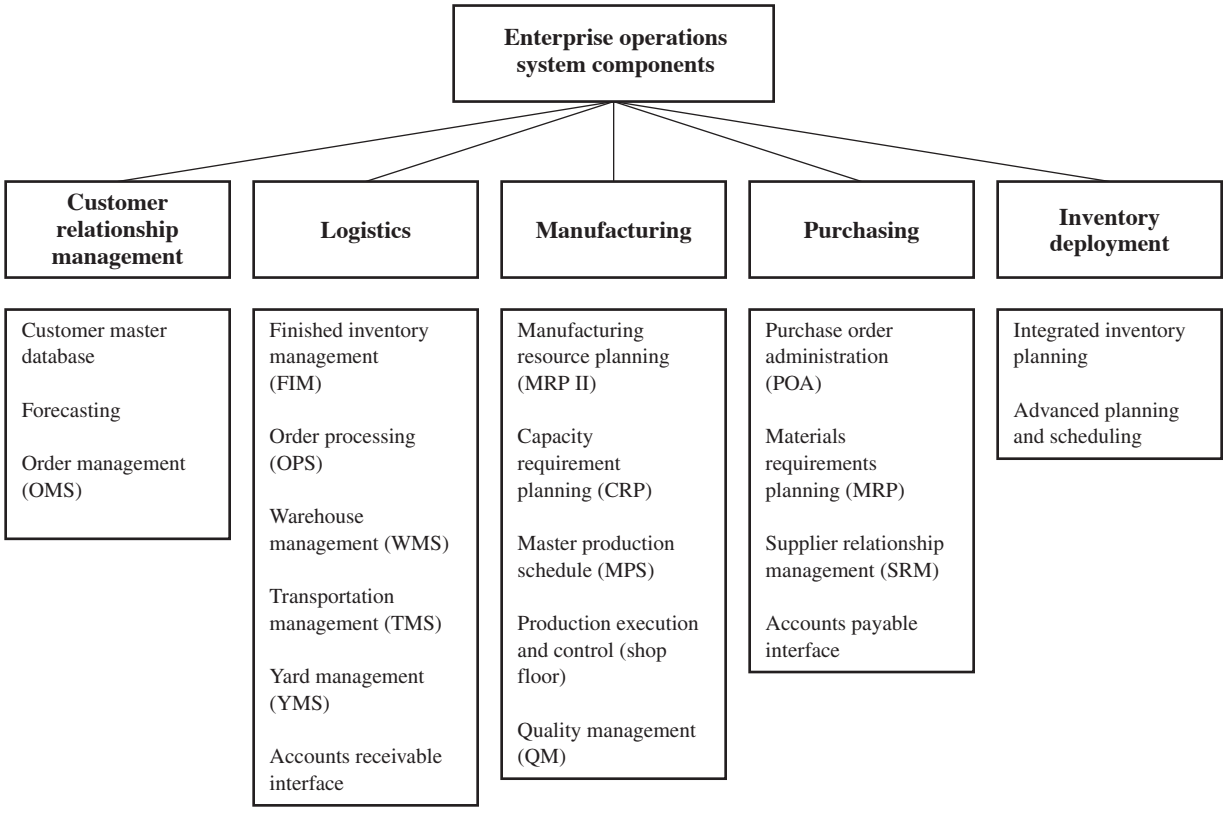


FIGURE 1.6 Enterprise Operations Modules

warehouse management, transportation management, and yard management. The manufacturing module schedules and allocates production resources and determines component requirements. The purchasing module initiates and tracks procurement activities including purchase order initiation, expediting, and supplier management. The inventory deployment system module schedules and monitors material flows to meet production and deployment requirements. Typical operational applications included in each module are listed. These applications are discussed throughout the text in conjunction with operational topics.

The traditional information technology delivery method has been for companies to operate and maintain private computer capabilities. Large mainframe computer capacity is essential to operate the varied information technology systems necessary to guide supply chain operations. This commitment to internal computing has rapidly changed in the 21st century. Increasingly firms are purchasing supply chain information technology support in the form of externally hosted systems. A wide variety of systems, such as **warehouse management (WMS)**, **transportation management (TMS)**, and **yard management (YMS)**, are available from technology application companies that specialize in providing and maintaining state-of-the-art performance systems. Typically referred to as **Software as a Service (SaaS)**, these application-specific software packages can be purchased for either internal use or on a hosted basis. When hosted by specialized service firms that provide the application using the capabilities of large computer resources, the application is referred to as **cloud computing.**

Enterprise Planning and Monitoring

Enterprise planning and monitoring are the processes and technologies that facilitate exchange of planning and coordinating information both within the firm and between supply chain partners. Figure 1.7 illustrates the major enterprise planning and monitoring components. The modules include (1) sales and operations planning, (2) supply chain visibility and event management, and (3) supply chain compliance. Since many of these activities involve interaction with other members of the supply chain, effective applications require substantial standardization with other firm functions and supply chain partners.

Sales and operations planning (S&OP), which is discussed further in Chapter 6, describes the process used to balance demand requirements and supply capabilities of the firm and its supply chain partners. While S&OP itself is a process requiring functional coordination and integration, it requires information technology to evaluate the demand, supply, and resource trade-offs. This technology is generally characterized as planning and scheduling applications. Supply chain visibility and event management tracks shipments

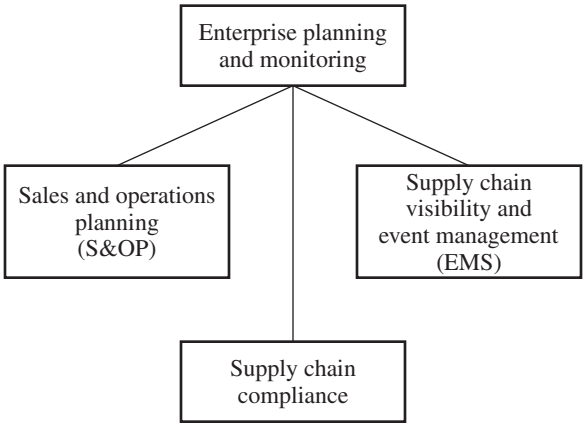


FIGURE 1.7
Enterprise Planning and Monitoring Modules

while they are in-transit and are increasingly capable of proactively suggesting changes in supply chain flows to minimize the potential of manufacturing shutdowns or service failures. Supply chain compliance systems monitor component and product flow information to make sure they comply with government and regulatory requirements for label, taxation, and security restrictions.

Communication Technology

Communication technology is the hardware and technical software that facilitates information exchange between the systems and physical infrastructure within the firm and between supply chain partners. The real-time information interchange between functions and supply chain partners facilitate coordination of inbound material, production, inventory, customer orders, and customer shipment. From a supply chain perspective, the availability of common and consistent requirements, activity, and performance information between supply chain partners enhances operational effectiveness, efficiency, relevancy, and sustainability.

Consumer Connectivity

The rapid development and deployment of the Internet has added a new dimension to the interface between firms and their customers. Both retailers and manufacturers are increasingly in direct Internet contact with the end consumers. This connectivity has developed along two main dimensions of communication—ordering and after-sale connectivity. Each has supply chain implications.

In terms of ordering, the Internet offers a way for consumers to facilitate and maintain direct contact with retailers and manufacturers. In essence this form of two-way connectivity is an expansion of traditional mail ordering. Empowered with the speed and flexibility of Internet connectivity, the interactive communications during ordering, determination of inventory status, processing time and location, and product delivery detail can be more diverse and comprehensive. For example, complete order-to-delivery tracking is a common feature. With the ease and speed of Internet connectivity, information concerning the total order to home delivery or retail pickup can be monitored.

With respect to product returns, or what is commonly called **reverse logistics,** the Internet offers a fast and accurate way to facilitate and track the product repair or replacement process. In addition, the existence of direct connectivity between the end consumer and the product manufacturer facilitates the rapid resolution of customer service issues related to product use and warranty.

In addition to information technology, the rapid emergence of supply chain relationships is being driven by four related forces: (1) integrated management and supply chain processes, (2) responsiveness, (3) financial sophistication, and (4) globalization. These forces will continue to drive supply chain structure and strategy initiatives across most industries for the foreseeable future. A brief discussion of each supply chain driver provides a foundation for understanding the challenges supply chain management places on exacting logistical performance.

Integrative Management and Supply Chain Processes

Across all aspects of business operations, attention is focused on achieving improved integrative management. The challenge to achieving integrated management results from the long-standing tradition of performing and measuring work on a functional basis. Since the

industrial revolution, achieving best practice has focused managerial attention on functional specialization.[4] The prevailing belief was the better the performance of a specific function, the greater the efficiency of the overall process. For well over a century, this fundamental commitment to functional efficiency has driven best practice in organization structure, performance measurement, and accountability.

In terms of management, firms have traditionally been structured into departments to facilitate work focus, routinization, standardization, and control. Accounting practices were developed to measure departmental performance. Most performance measurement focused on individual functions. Two examples of common functional measurement are the cost per unit to manufacture and the cost per hundredweight to transport. Cross-functional measurements and allocations were typically limited to costs common to all functional areas of work, such as overhead, labor, utilities, insurance, interest, and so on.

Excellence in supply chain performance requires the simultaneous achievement of eight key processes. Table 1.2 identifies the eight key processes and provides a brief description of each. Although these integrative processes are not the exclusive domain of supply chain logistics, some critical elements of each are integral to a firm achieving high-level operational success. Therefore, supply chain structure, strategy, and continuous operational execution must be focused on achieving and continuously improving these essential eight processes. Simultaneous operational achievement of these eight processes forms the essence of achieving both operational integration and performance excellence.

The fundamental challenge of integrated management is to redirect traditional emphasis on functionality in an effort to focus on process achievement. Over the past few decades, it has become increasingly apparent that functions, individually performed best in class, do not necessarily combine or aggregate to achieve lowest total cost or highly effective processes. Integrative management seeks to identify and achieve lowest total process cost by capturing trade-offs that exist between functions. To illustrate, in terms of logistics, a firm might be able to reduce total cost to serve a customer as a result of spending more for faster, dependable transportation if the overall cost of inventory associated with the process can be reduced by an amount greater than that being spent for premium transportation. The

[4] Frederick W. Taylor, *Scientific Management* (New York: W. W. Norton, 1967).

TABLE 1.2
Eight Supply Chain Integrative Processes

Process	Description
Demand planning responsiveness	The assessment of demand and strategic design to achieve maximum responsiveness to customer requirements.
Customer relationship collaboration	The development and administration of relationships with customers to facilitate strategic information sharing, joint planning, and integrated operations.
Order fulfillment/service delivery	The ability to execute superior and sustainable order-to-delivery performance and related essential services.
Product/service development launch	The participation in product service development and lean launch.
Manufacturing customization	The support of manufacturing strategy and facilitation of postponement throughout the supply chain.
Supplier relationship collaboration	The development and administration of relationships with suppliers to facilitate strategic information sharing, joint planning, and integrated operations.
Life cycle support	The repair and support of products during their life cycle, including warranty, maintenance, and repair.
Reverse logistics	The return and disposition of inventories in a cost-effective and secure manner.

focus of integrated management is **lowest total process cost,** which is not necessarily the achievement of the lowest cost for each function included in the process.

The concept of trade-off and the goal of lowest total cost have logical appeal. While deceptively simple, managers continue to find the identification, measurement, and implementation of a process to minimize total cost a difficult task in day-to-day operations. The unavailability of focus on functional goals and the cost measures capable of quantifying cross-functional trade-offs served to stimulate development of such integrative tools as Total Cost Analysis, Process Engineering, and Activity-Based Costing (ABC).

Three important facets of supply chain logic resulted from increased managerial attention to: (1) collaboration, (2) enterprise extension, and (3) integrated service providers.

Collaboration

As discussed earlier, the history of business has been dominated by a desire to cooperate but always presented within a competitive framework. Whereas competition remains the dominant model guiding free market economies, the increasing importance of collaboration has positioned the supply chain as a primary unit of competition. In today's global economy, supply chain arrangements compete with each other for customer loyalty. Supply chains dominated by Sears Holding, Target, and Walmart are direct competitors in many markets. Similar supply chain alignments can be observed in industries ranging from entertainment to food to automobiles to chemicals. The global strategic reach of Limited Logistics Services is an example of the complexity of modern supply chain management. Garments manufactured throughout the world are delivered direct to retail stores, and are sold in all fashion seasons to worldwide consumers.

The general impetus to institutionalized collaborative working arrangements was the 1984 enactment of the National Cooperative Research and Development Act, which was expanded in scope by further legislation in 1993 and 2004.[5] This national legislation and its subsequent modification signaled fundamental change in traditional Justice Department antitrust philosophy. The basic legislation, as supplemented by administrative rulings, encouraged firms to develop collaborative initiatives in an effort to increase the global competitiveness of U.S.-based firms. Widespread realization that cooperation is both permissible and encouraged served to stimulate formation of supply chain arrangements.

While all forms of price collusion remain illegal, the collaborative legislation served to facilitate cross-organizational sharing of operating information, technology, and risk as ways to increase competitiveness. The response was a wide variety of new and innovative operating arrangements. One such development was the growing vision of enterprise extension.

[5] On October 11, 1984, President Reagan signed into law the National Cooperative Research Act of 1984 (Public Law 98-462) in an effort "to promote research and development, encourage innovation, stimulate trade, and make necessary and appropriate modifications in the operation of the antitrust laws." This law enables research and development activities to be jointly performed up to the point where prototypes are developed. The law further determined that antitrust litigation would be based on the rule of reason, taking into account all factors affecting competition. An extension to this act was signed into law by President Clinton on June 10, 1993. The extension, National Cooperative Production Amendments of 1993 (Public Law 103-42), allows joint ventures to go beyond just research to include the production and testing of a product, process, or service. This created a new act called the National Cooperative Research and Production Act of 1993 to replace the 1984 act. Furthermore, this new act established a procedure for businesses to notify the Department of Justice and the Federal Trade Commission of their cooperative arrangement in order to qualify for "single-damages limitation on civil antitrust liability." In 2004 President Bush signed into law the Standards Development Organization Advancement Act (SDOAA, H. R. 1086) which amended the 1993 act to include immunity for standards development organizations and thereby further validated the collaborative doctrine.

Enterprise Extension

The central thrust of enterprise extension is to expand managerial influence and control beyond the ownership boundaries of a single enterprise to facilitate joint planning and operations with customers and suppliers. The fundamental belief is that collaborative behavior to integrate processes between firms will improve impact, reduce overall risk, and greatly improve efficiency. Enterprise extension builds on two basic paradigms: information sharing and process specialization.

The **information sharing paradigm** is the widespread belief that achieving a high degree of cooperative behavior requires that supply chain participants voluntarily share operating information and jointly plan strategies. The scope of cross-enterprise collaboration should span beyond sales data to include plans detailing promotion, new product introduction, and day-to-day operations. It's important to emphasize that information sharing to support collaboration must not be limited to historical or even accurate current sales data. Of greater importance is a willingness to share information about future strategic initiatives to facilitate joint operations. The guiding principle is that information sharing is essential among supply chain participants to collectively meet customer demand faster and more efficiently.

The **process specialization paradigm** is the commitment to focusing collaborative arrangements on planning joint operations with a goal of eliminating nonproductive or non-value-adding redundancy by firms in a supply chain. The basic idea is to design the overall supply chain processes in a manner that facilitates a specific firm's competencies along with the responsibility and accountability to perform each element of essential work in a manner that maximizes overall results.

Firms participating in a supply chain have specific roles to perform within the context of shared strategic goals. Sharing information and joint planning can reduce risk related to inventory positioning. Collaboration can eliminate duplicative or redundant work, such as repetitive quality inspection, by designating and empowering a specified member of the supply chain to be fully responsible and accountable. Such extended enterprise integration introduces new challenges regarding measurement, benefit and risk sharing, trust, leadership, and conflict resolution. It is clear that the challenges of collaboration and enterprise extension constitute new managerial horizons. A third contributing force to supply chain development is the rapidly changing managerial attitude toward integrated service providers.

Integrated Service Providers (ISPs)

As noted earlier, the origins of contemporary business were grounded in functional specialization. It is not surprising that firms developed the practice of **outsourcing** work to businesses that are specialists in the performance of specific functions. The two traditional logistics service providers are transportation and warehousing specialists.

The for-hire transportation industry consists of thousands of carriers who specialize in product movement between geographic locations. Over the years, a comprehensive carrier network has emerged, providing shippers a broad assortment of services, utilizing all available forms, called **modes,** of transportation and related technology. The value proposition of for-hire transportation is based on specialization, efficiency, and scale economies. Value is generated by a carrier's capability to provide shared transportation services for multiple shippers. The transport alternatives for shippers are either to invest capital in transportation equipment and operations or to engage the services of for-hire carriers. Naturally, a large number of firms develop transportation solutions that combine benefits of these alternatives.

In addition to transportation, a large number of service companies have traditionally provided warehouse services. Traditionally called **public warehouses,** these firms provide product storage supplemented with other specialized services. Two significant benefits are gained when shippers use public warehouses. First is elimination of capital investment in

warehouse buildings. The second is the ability to consolidate small shipments for combined delivery with products of other firms that use the same public warehouse. Such multishipper consolidation achieves transportation efficiency not typically available when firms ship from their own warehouses. Many firms combine private and public warehouses into go-to-market and product supply networks.

An example of integrated service provider collaboration is the distribution service offered by Kane Is Able Inc. Kane Is Able offers its distribution center clients a shared warehouse and delivery service. Small shipments from several different food manufacturing and processing companies that are being distributed to a single customer are combined into one consolidated delivery using a shared distribution process. The results of sharing infrastructure are fewer trucks, greater utilization, fewer deliveries, and handling efficiencies.

In 1980 the landscape of for-hire services in the United States changed dramatically. Within a few short months, the economic and political regulatory infrastructure of transportation in the United States shifted from economic to social regulation as a result of the passage of the Motor Carrier Regulatory Reform and Modernization Act (MCA-80) and the Staggers Rail Act.[6] These regulatory changes, as amended, served to support an open transportation market involving less government economic regulation for all forms of transportation. Over time, this trend extended worldwide to deregulate transportation in most free-market industrialized nations.

In contrast to transportation, firms engaged in public warehousing were not operationally regulated by federal or state governments. In an effort to avoid regulation most warehouse firms did not offer transportation services. However, with the deregulation of transportation, that practice soon changed. Overnight, warehousing firms began to offer transportation services. Likewise, many transport carriers began to offer customers warehouse services.

What occurred in the logistics service industry was a radical shift from single function to multifunctional outsourcing. **Integrated service providers (ISPs)** began to market a range of logistics services that included all work necessary to accommodate customers, ranging from order entry to product delivery. In many situations the foundation of transportation and warehouse services was augmented by the performance of a wide range of special services. These customized services are typically described as **value-added services (VAS).** For example, United Parcel Service (UPS) stocks Nike shoes and warm-ups at its Louisville warehouse and processes orders hourly. All related communication and financial administration are handled by a UPS call center. Thus, Nike has effectively outsourced basic logistics and related value-added service to UPS.

The common name used throughout industry to describe ISPs is **third-party and fourth-party service providers.** In a general sense, ISPs are commonly classified as being either **asset- or nonasset-based,** the distinction being that asset-based (third-party) firms own and operate transportation equipment and warehousing buildings. In contrast, nonasset service (fourth-party) firms specialize in providing comprehensive information services that facilitate supply chain arrangements. Such fourth-party service providers arrange services, often integrating third-party asset operators on behalf of their customers.

The 2010 U.S. third-party contract logistics market was estimated to be $160 billion.[7] The growth of integrated service providers makes both the formation and dismantling of supply chain arrangements easier. As an organization's need for speed and operational flexibility change, ISPs can be utilized as needed. Supply chain participants have the opportunity to engage the capabilities of what amounts to a virtual logistics network. Such outsourcing helps facilitate process-focused integrative management.

[6] Public Laws 96-296 and 96-488, respectively. These laws, as well as others briefly noted here, are discussed in greater detail in Chapter 8.

[7] "U.S. 3PL/Contract Logistics Market," Armstrong & Associates, Inc., 2009.

As discussed, the advent of collaboration, extended enterprise visioning, and the increased availability of integrated service providers combined to drive radically new supply chain solutions. The notion of shared and synergistic benefits served to solidify the importance of relationships between firms collaborating in a supply chain. The extended enterprise logic stimulated visions of increased efficiency, effectiveness, relevancy, and sustainability as a result of sharing information, planning, and operational specialization between supply chain participants. The deregulation of transportation served as a catalyst for the rapid expansion of integrated service providers. This development served to redefine and expand the scope of specialized services available to facilitate supply chain operations. In combination, these drivers helped create integrated supply chain management. They served to identify and solidify the strategic benefits of integrated management. They combined to reinforce the value of core-competence specialization and cast the challenges and opportunity of creating virtual supply chains.

Responsiveness

One could argue that the challenges and benefits of integrative management offered sufficient reason for the supply chain revolution. However, other basic drivers continue to make supply chain arrangements even more appealing. A fundamental paradigm shift in strategic thinking occurred as a direct impact of information technology. Information connectivity created the potential for developing responsive business models. To elaborate the far-reaching implications of this major development, it is useful to contrast traditional (**push**) or **anticipatory** business practice to the emerging time-based **responsive** (or **pull**) business model. The responsive business model is also referred to as **demand driven.**

Anticipatory Business Model (Push)

Since the industrial revolution, the dominant business model has required anticipation of what customers will demand in the future. Because information concerning purchase behavior was not readily available and firms loosely linked together in a channel of distribution did not feel compelled to share their plans, business operations were driven by forecasts. The typical manufacturer produced products based on market forecast. Likewise, wholesalers, distributors, and retailers purchased inventory based on their unique forecasts and promotional plans. Since the forecast results were typically wrong, considerable differences existed between what firms planned to do and what they in fact ended up doing. Such variation typically resulted in unplanned inventory. Because of high cost and risk associated with conducting business on an anticipatory basis, the prevailing relationship between trading partners was often adversarial; each firm needed to protect its own interest.

Figure 1.8 illustrates the typical stages in a single firm's implementation of the anticipatory business model: forecast, purchase materials, manufacture, warehouse, sell, and then deliver. In retail and wholesale enterprises, operations involved anticipatory purchase of inventory assortments to accommodate expected sales. The key point is that almost all

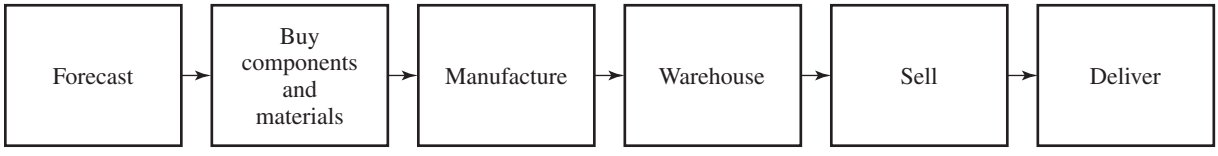


FIGURE 1.8 Anticipatory Business Model

essential work has been traditionally performed in *anticipation* of future requirements. The likelihood of misgauging customer requirements rendered the anticipatory business model highly risky. In addition, each firm in the distribution channel duplicated a similiar anticipatory process.

Responsive Business Model (Pull)

The fundamental difference between anticipatory and responsive supply chain arrangements is timing. The responsive business model seeks to reduce or eliminate forecast reliance by joint planning and rapid exchange of information between supply chain participants.

The availability of low-cost information has created **time-based competition.** Managers are increasingly sharing information to improve both the speed and accuracy of supply chain logistics. To illustrate, managers may share information to improve forecasting accuracy or even eliminate forecasts in an effort to reduce anticipatory inventory deployment. This transformation from anticipatory toward responsive business is possible because today's managers have sense and response information technology to rapidly obtain and share accurate sales data and exercise improved operational control. When all members of the supply chain synchronize their operations, opportunities exist to reduce overall inventory and eliminate costly duplicate practices. More important, customers can be provided with products they want, fast.

Figure 1.9 illustrates a responsive business model that manufactures or assembles products to customer order. The fundamental difference in responsive models is the sequence of events that drive business practice. Also notable, in comparison to Figure 1.8, are the fewer steps required to complete the responsive process. Fewer steps typically equate to less cost and less elapsed time from order commitment to delivery. The responsive sequence is initiated by a sale followed by a sequence of material purchase, custom manufacturing, and direct customer delivery.

In many ways, the responsive business model is similar to the traditional build-to-order manufacturing. The primary difference between modern responsive operations and traditional build-to-order are the time to execute and the degree of potential customization. In terms of time to execute the order to delivery, the contemporary responsive system is substantially faster than the traditional build-to-order manufacturing. It is becoming common practice to replenish retail store inventories of consumer products on a daily basis. Custom-built automobiles are being promised for delivery within ten working days, with the goal to even further reduce the order-to-delivery cycle. Such compressed order-to-delivery cycles were not even imaginable a few years ago.

Perhaps an even more appealing attribute of responsive supply chains is their potential to uniquely customize products on smaller orders than was typical of traditional build-to-order lot size manufacturing. Direct connectivity with customers via the Internet is accelerating customization. In most traditional anticipatory distribution systems, the customer is a passive participant. About the only power the customer has in the traditional process is the decision to buy or not buy. Direct connectivity of customers in a responsive process has at least three benefits. First, involvement provides comprehensive search capabilities that serve to expand the range of sources and choices a customer can consider when selecting a product or service. Second, customers can be better informed about prices and, in

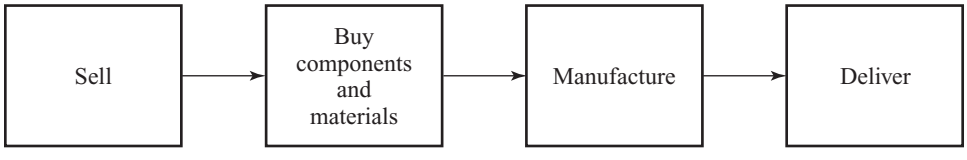


FIGURE 1.9
Responsive Business Model

some situations, are able to drive price advantage by virtue of bids and/or auctions. Finally, information-intense responsive systems provide innovation such as a **customer choice-board** wherein customers design or customize their own product configuration.

Postponement

At the heart of time-based competition is the capability to postpone customization and the timing of logistical fulfillment. The concept of **postponement** has long been discussed in business literature.[8] However, practical examples involving postponement are directly related to advancements in information technology. Postponement strategies and practices serve to reduce the anticipatory risk of supply chain performance. As noted earlier, anticipatory arrangements require most inventory to be produced to final product state and deployed on the basis of forecasts or planned requirements. Working arrangements, which allow postponement of final manufacturing, customization, or distribution of a product until receipt of a customer order, reduce the incidence of wrong manufacturing or incorrect inventory deployment. Two types of postponement are common in highly responsive supply chain operations: (1) manufacturing, or form postponement; and (2) geographic, or logistics postponement.

Manufacturing Postponement

The global competitive climate of the 21st century is facilitating the development of new manufacturing techniques designed to increase flexibility and responsiveness while maintaining unit cost and quality. Traditional practice has focused on achieving economy of scale by planning extensive manufacturing runs. In contrast, flexible manufacturing logic is typically driven by a desire to increase responsiveness to customer requirements.

The vision of **manufacturing,** or **form, postponement** is one of products being manufactured one order at a time with no preparatory work or component procurement until exact customer specifications are fully known and purchase confirmation is received. This dream of building to customer order is not new. What is new is the expectation that flexible manufacturing can achieve such responsiveness without sacrificing efficiency. To the degree technology can support market-paced flexible manufacturing strategies, firms are to a degree freed from the risk associated with forecast-driven anticipatory operations.

In practice, manufacturing lot size economics cannot be ignored. The challenge is to quantify cost trade-offs between procurement, manufacturing, and logistics. At this point, it is sufficient to understand that the trade-off is between the cost and risk associated with anticipatory manufacturing and the loss of economy of scale resulting from introducing flexible procedures. Manufacturing lot size reduction requires a trade-off between line setup, switchover, and associated procurement expense balanced against cost and risk associated with stockpiling finished inventory. In the traditional functional style of management, manufacturing schedules were established to realize the lowest unit cost of production. From an integrative management perspective, the goal is to achieve desired customer satisfaction at the lowest total cost. This may require manufacturing postponement at some per-unit-cost sacrifice to achieve overall supply chain efficiency.

The operative goal of manufacturing postponement is to maintain products in a neutral or noncommitted status as long as possible. The ideal application of form postponement is to manufacture a standard or base product in sufficient quantities to realize economy of scale while deferring finalization of features, such as color or accessories, until customer commitment is received. Given a postponement-driven manufacturing scenario, economy

[8] Wroe Alderson, *Marketing Behavior and Executive Action* (Homewood, IL: Richard D. Irwin, Inc., 1957), p. 426.

of scope is introduced into the logistics equation by producing a standard or base product to accommodate a wide range of different customers. One of the first commercially viable examples of manufacturing postponement was mixing paint color at retail stores to accommodate individual customer request. Perfecting the in-store mixing process dramatically reduced the number of stockkeeping units required at retail paint stores. Instead of trying to maintain inventories of premixed color paint, retail stores stock a base paint and customize the color to accommodate specific orders. Some believe this relatively simple application of form postponement in the paint industry was a major factor facilitating the birth of the consumer-driven home improvement industry. Overnight, retail paint stores went from excessive stock-outs to being fully in stock. Plus, while consumers waited for paint to be custom color-mixed, they were exposed to a wide variety of do-it-yourself painting accessories available for purchase.

In other industries, manufacturing practice is to process and store product in bulk, postponing final packaging configuration until customer orders are received. In some situations products are processed and packed in cans with brand identification labeling being postponed until specific customer orders are received. Other examples of manufacturing postponement include the increased practice of installing accessories at automobile, appliance, and motorcycle dealerships, thereby customizing products to customer request at the time of purchase.

These manufacturing postponement examples have one thing in common: They reduce the number of stockkeeping units in logistical inventory while supporting a broad-line marketing effort and retaining mass manufacturing economies of scale. Until the product is customized, it has the potential to serve many different customers.

The impact of manufacturing postponement is twofold. First, the variety of differentiated products, moved in anticipation of sale, can be reduced, and therefore the risk of logistical operational malfunction is lower. The second, and perhaps the more important, impact is the increased use of logistical facilities to perform light manufacturing and final assembly. To the extent that a degree of specialized talent or highly restrictive economy of scale does not exist in manufacturing, product customization may be best delegated and performed near the customer destination market. This form of manufacturing postponement is often called **late customization.** The traditional mission of logistical warehouses in some industries has changed significantly to accommodate manufacturing postponement. For example, Kohler Co. does a significant amount of product customization in integrated service provider-run distribution centers.

Geographic Postponement

In many ways **geographic,** or **logistics, postponement** is the exact opposite of manufacturing postponement. The basic notion of geographic postponement is to build and stock a full-line inventory at one or a limited number of strategic locations. Forward deployment of inventory is postponed until customer orders are received. Once the logistical process is initiated, every effort is made to accelerate the economic movement of products directly to customers. Under the concept of geographic postponement, the anticipatory risk of inventory deployment is partially eliminated while manufacturing economy of scale is retained.

Many applications of geographic postponement involve service supply parts. Critical and high-cost parts are maintained in a central inventory to assure availability for all potential users. When demand occurs, orders are electronically transmitted to the central service center and expedited shipments are made directly to the forward service center, using fast, reliable transportation. The end result is highly reliable customer service with reduced overall inventory investment.

The potential for geographic postponement has been facilitated by increased logistical system capability to process, transmit, and deliver precise order requirements with a high

degree of accuracy and speed. Geographic postponement substitutes accelerated delivery of precise order requirements for the anticipatory deployment of inventory to local market warehouses. Unlike manufacturing postponement, systems utilizing geographic postponement retain manufacturing economies of scale while meeting customer service requirements by accelerating direct shipments.

In combination, manufacturing and geographic postponement offer alternative ways to reduce risk associated with anticipatory distribution. Both postpone risk until customer commitments are received. The factors favoring one or the other form of postponement hinge on volume, value, competitive initiatives, economies of scale, and desired customer delivery speed and consistency. In a growing number of supply chains, both types of postponement are combined to create a highly flexible strategy.

Barriers to Implementing Responsive Systems

In reality, today's best supply chain practices do not reflect either extreme anticipatory or responsive design. Most established firms remain, to a significant degree, committed to anticipatory practices. However, responsive strategies are rapidly emerging. Perhaps the greatest barrier to adopting responsive arrangements is the need for publicly held corporations to maintain planned quarterly profits. This accountability creates expectations concerning continued sales and financial results. Such expectations often drive promotional and pricing strategies to "load the channel" with inventory to create timely sales. Conversely, it is never timely to make a major reduction in channel inventory. Efforts to lean or deload inventory to implement a more responsive operating posture require the ability to absorb a one-time sale reduction among supply chain partners. Start-up ventures are ideally positioned to implement responsive fulfillment systems because they do not face the challenge of taking inventory out of an existing channel.

A second barrier to implementing responsive operations is the need to establish and sustain collaborative relationships. Most business managers simply do not have training or experience in how to develop and implement collaborative arrangements designed to share benefits and risks. While managers generally express a high degree of belief in the long-term potential for responsive alliances, they typically confront considerable frustration concerning how to implement such supply chain arrangements.

For the foreseeable future, most firms will continue to implement strategies that combine anticipatory and responsive supply chain arrangements. The trend toward increased involvement in responsive arrangements with specific customers and suppliers will continue to expand as the full advantage of Web-based operations materializes.

Financial Sophistication

Few managers question the benefits of applying the time-based strategies discussed above to supply chain operations. However, a valid question is, How fast is fast enough? Speed simply for the sake of being fast has little, if any, enduring value.[9] The answer concerning how much speed is desirable is found in understanding the financial impact. The process of creating value dictates that faster, more flexible, and more precise ways of servicing customers are justified as long as they can be provided at competitive prices. A third force driving competitive supply chain strategy is the ability to manage in a more timely manner to achieve financially attractive working arrangements.

[9] George Stalk Jr. and Alan M. Webber, "Japan's Dark Side of Time," *Harvard Business Review* (July/August 1993), pp. 93–102.

The financial benefits of timely response are straightforward. Fast delivery within the supply chain translates to less inventory and reduced need for distribution facilities. Faster delivery to customers means less working capital is required to support supply chain operations. Three aspects of financial sophistication are cash-to-cash conversion, dwell time minimization, and cash spin.

Cash-to-Cash Conversion

The time required to convert raw material or inventory purchases into sales revenue is referred to as **cash-to-cash conversion.** Cash conversion is generally related to inventory turn: The higher the inventory turn, the quicker the cash conversion. A goal of supply chain design is to control and reduce order receipt-to-delivery time in an effort to accelerate inventory turns.

In traditional business arrangements, benefits related to cash-to-cash conversion have typically been enjoyed at the expense of business partners. Given typical purchase discounts and invoicing practices, it is operationally possible for firms to rapidly sell merchandise and still qualify for prompt payment discounts. To illustrate, terms of sale offering a 2 percent discount net 10-day payment (2% net 10) means that a prompt payment discount is earned if the invoice is paid within 10 days from confirmed time of delivery. Thus, if the invoice is $1000, a payment made within 10 days will earn a $20 discount. If the firm sells the product for cash before the invoice payment date, it in effect enjoys free inventory and may even earn interest by investing cash while awaiting the payment date.

In responsive systems, cash-to-cash conversion benefits can be shared by managing inventory velocity across the supply chain. This ability to manage inventory velocity from origin to final destination has the potential to achieve greater overall efficiencies than are attainable by a single firm. Coordinated operations may require that a designated firm in the supply chain serve as the principal inventory stocking location. Such practice means that risks and benefits related to inventory need to be shared by participating firms. To facilitate such arrangements, supply chain members often replace traditional discounts with **dead net pricing.**

Dead net pricing means that all discounts and allowances are factored in the selling price. Thus, incentives for timely payment are replaced by detailed performance commitments at a specified net price. Invoice payment, based on negotiated net price, is completed upon verification of physical receipt. Such payment is typically in the form of Electronic Funds Transfer (EFT), thereby streamlining both the flow of physical goods and cash among supply chain partners. Managing supply chain logistics as a continuous synchronized process also serves to reduce dwell time.

Dwell Time Minimization

Traditional distribution arrangements typically involve independent business units loosely linked together on a transaction-to-transaction basis. Such traditional business operations are driven by a series of **independent** transactions buffered by inventory. In contrast, a supply chain has the potential to function as a synchronized series of **interdependent** business units.

At the heart of supply chain operating leverage is the willingness to transfer inventory on an as-needed basis, taking advantage of as much collaboration and information as possible. Such collaboration and information can be focused on maintaining the continued flow and velocity of inventory moving throughout the supply chain. The potential of such synchronization is one key benefit of supply chain connectivity.

A significant measure of supply chain productivity is **dwell time.** Dwell time is the ratio of time that an asset sits idle to the time required to satisfy its designated supply chain

mission. For example, dwell time would be the ratio of the time a unit of inventory is in storage compared to the time that it is moving or otherwise contributing to achieving sales or operational objectives.

To reduce dwell time, firms collaborating in a supply chain need to be willing to eliminate duplicate inventory and non-value-added work. For example, if three different firms perform identical processes as a product flows along a supply chain, dwell times will accumulate. Designating a specific firm to perform and be accountable for the value-added work can serve to reduce overall dwell.

Likewise, timely arrival and continuous inventory flow between supply chain partners reduces dwell time. When a product flows from a supplier through a retailer's cross-dock sortation process without coming to rest or being diverted to warehouse storage, overall dwell time is minimized. A collateral benefit of reducing dwell time and the associated logistics cost is the ability to reduce investment in inventory and related assets.

Cash Spin

A popular term for describing the potential benefits of reducing assets across a supply chain is **cash spin,** sometimes referred to as **free cash spin.**[10] The concept is to reduce overall assets committed to supply chain performance. Thus, a dollar of inventory or the investment in a warehouse, if eliminated by a reengineered supply chain, spins cash for redeployment. Such free capital can be reinvested in projects that might otherwise have been considered too risky.

Naturally, cash spin opportunity is not unique to the supply chain. The potential to spin cash applies to all areas of a firm. What makes the potential of supply chain cash spin so attractive is the opportunity to collaborate between firms.

The benefits flowing from fast cash-to-cash conversion, reduced dwell time, and cash spin combine to increase the financial attractiveness of effective collaboration. Another major force driving expansion of supply chain management is the growing involvement of most firms in global operations.

Globalization

A conservative estimate is that as much as 90 percent of global demand is not fully satisfied by local supply. Current demand coupled with a world population projected to increase by an average of over 200,000 persons per day for the next decade equates to substantial market opportunity. The range of product/service growth potential varies greatly between industrialized and emerging economies. In industrialized sectors of the global economy, opportunities focus on upscale consumer products. These more advanced economies offer substantial opportunities for the sale of products combined with value-added services. While it is true that consumers in developing nations enjoy relatively less purchasing power than those in their industrialized counterparts, demand in such economies for basic products and necessities is huge. Consumers in developing nations are more interested in quality of basic life than in fashion or technology. For example, the growing populations of India and China offer huge market opportunities for basic products like food, clothing, and consumer durables such as refrigerators, washing machines, and automobiles. Firms with aggressive growth goals cannot neglect the commercialization of the global marketplace.

In addition to sales potential, involvement in global business is being driven by significant opportunities to increase operating efficiency. Such operational efficiencies are

[10] Gene Tyndall et al., *Supercharging Supply Chains* (New York: John Wiley & Sons, 1988), p. 1.

attainable in at least three areas. First, the global marketplace offers significant opportunity to strategically source raw material and components. Second, significant labor advantages can be gained by locating manufacturing and distribution facilities in developing nations. Third, favorable tax laws can make the performance of value-adding operations in specific countries highly attractive.

The decision to engage in global operations to achieve market growth and enjoy operational efficiency follows a natural path of business expansion. Typically, firms enter the global marketplace by conducting import and export operations. Such import and export transactions constitute a significant portion of global international business. The second stage of internationalization involves a firm's establishment of local presence in foreign nations and trading areas. Such presence can range from franchise and licensing of local businesses to the establishment of manufacturing and distribution facilities. The important distinction between import/export involvement and establishment of local presence is the degree of investment and managerial involvement characteristic of stage 2. The third stage of internationalization is the full-fledged conduct of business operations within and across international boundaries. This most advanced phase of international engagement is typically referred to as **globalization.**

The logistics of internationalization involves four significant differences in comparison to national or even regional operations. First, the **distance** of typical order-to-delivery operations is significantly longer in international as contrasted to domestic business. Second, to accommodate the laws and regulations of all governing bodies, the required **documentation** of business transactions is significantly more complex. Third, international logistics operations must be designed to deal with significant **diversity** in work practices and local operating environment. Fourth, accommodation of cultural variations in how consumers **demand** products and services is essential for successful logistical operations.

Finally, 21st-century commerce is conducted within a constant threat of terrorism, which requires increased security. The intensity and severity of terrorist disruption involves both the shipment itself and the exposure to using the logistics infrastructure as a means to deliver explosive and chemical devices. The security aspects of global logistics are further discussed in Chapter 16. It is important to understand that successfully going supply chain global requires mastering the associated logistical challenges.

While logistics principles and the ideals of supply chain integration are essentially the same globally as they are domestically, the above characteristics make operating environments more complex and costly. The cost of logistics on a global basis is estimated to exceed $9 trillion a year.[11] Such expenditure is required to support internal market expansion and global commerce between both developed and emerging nations. Risk exposure related to capitalizing on international supply chain management and its logistical components requires integrated operating strategies and tactics.

Summary

The development of integrated management skill is critical to continued productivity improvement. Such integrative management must focus on quality improvement at both functional and process levels. In terms of functions, critical work must be performed to the highest degree of efficiency. Processes that create value occur both within individual firms and between firms linked together in collaborative supply chains. Each type of process must be continuously improved.

[11] Roger J. Calantone, "Estimation of Global Logistics Expenditures Using Neural Networks," unpublished research, Michigan State University (2011), and global.msu.edu.

The idea that all or even most firms will link together to form highly collaborative end-to-end supply chain initiatives at any time in the foreseeable future is quite unlikely. The dynamics of a free competitive market system will serve to harness such an end state. However, initiatives aimed at cross-enterprise integration along the supply chain are increasingly occurring and, to the extent successfully implemented, offer new and exciting business models for gaining competitive advantage. Once achieved, such supply chain integration is hard to maintain and requires continuous redefinition. What works today may not work tomorrow. Conversely, what won't work today may work tomorrow.

Thus, supply chain collaborations must be viewed as highly dynamic. Such collaborations are attractive because they offer new horizons for achieving market share and operating efficiency. Supply chain opportunities are challenges that 21st-century logistics managers must explore and exploit. However, supply chain integration is a means to increased profitability and growth and not an end in itself.

From the perspective of integrated logistics management, supply chain strategies define the relevant operating framework. What must be logistically accomplished is directly linked to supply chain structure and strategy. When such structure and strategy are internationally positioned, logistics performance must embrace challenges related to globalization. In short, the supply chain strategy or lack of strategy and its related structure serve to shape the framework for logistical requirements. Chapter 2 presents logistics in greater detail.

Study Questions

1. Compare the concept of a modern supply chain with more traditional distribution channels. Be specific regarding similarities and differences.
2. What specific role does logistics play in supply chain operations?
3. Describe and illustrate an integrated service provider. How does the concept of integrated service provider differ from traditional service providers, such as for-hire transportation and warehousing?
4. Compare and contrast anticipatory and responsive business models. Why has responsiveness become popular in supply chain strategy and collaboration?
5. Compare and contrast manufacturing and geographic postponement.
6. Define and illustrate cash-to-cash conversion, dwell time minimization, and cash spin. How do supply chain strategy and structure impact each?

Challenge Questions

1. What are the operating challenges related to the Toys R Us plan to establish 600 temporary or pop-up seasonal retail outlets? Be specific concerning the supply chain challenges leading into, during, and after the Christmas selling season.
2. How do the concepts of SaaS and cloud computing differ from the services offered by traditional data processing service centers?
3. Discuss how reverse logistics can create value.
4. What is the primary value proposition of Kane Is Able's collaborative distribution service? Be specific concerning how this collaborative distribution service differs from traditional services offered by 3PLs.