



## **CHAPTER 2 ROLE OF LOGISTICS IN SUPPLY CHAINS**

### **LEARNING OBJECTIVES**

After reading this chapter, you should be able to do the following:

- Understand the role and importance of logistics in private and public organizations.
- Discuss the impact of logistics on the economy and how effective logistics management contributes to the vitality of the economy.
- Understand the value-added roles of logistics on both a macro and micro level.
- Explain logistics systems from several perspectives.
- Understand the relationship between logistics and other important functional areas in an organization, including manufacturing, marketing, and finance.
- Discuss the importance of management activities in the logistics function.
- Analyze logistics systems from several different perspectives to meet different objectives.
- Determine the total costs and understand the cost tradeoffs in a logistics system.

### **CHAPTER OVERVIEW**

#### Introduction

Logistics is misunderstood and often overlooked with the excitement surrounding supply chain management and all of the related technology that has been developed to support the supply chain. The glamour associated with the e-supply chain, e-tailing, e-business, and so on, seems to overshadow the importance of logistics in an organization and the need for efficient and effective logistics support in a supply chain.

The concepts of supply chain management and logistics must be compared or, more appropriately, related to each other. Supply chain management has been defined using a pipeline analogy with the start of the pipeline representing the initial supplier and the end of the pipeline representing the ultimate customer.

What is Logistics?

The term logistics has become much more widely recognized by the general public in the last 20 years. Television, radio, and print advertising have lauded the importance of logistics. Another factor contributing to the recognition of logistics has been increased customer sensitivity to not only product quality but also to the associated service quality.

Even with increased recognition of the term logistics, however, there is still confusion about its definition. Some of the confusion can be traced to the fact that a number of terms are used by individuals when they refer to what has been described as logistics.

For example, consider the following list of terms:

- Logistics management
- Business logistics management
- Integrated logistics management
- Materials management
- Physical distribution management
- Marketing logistics
- Industrial logistics
- Distribution

Logistics management is the most widely accepted term and encompasses logistics not only in the private business sector but also in the public/government and nonprofit sectors.

For the purposes of this text, the definition offered by the Council of Supply Chain Management Professionals (formerly the Council of Logistics Management) is utilized: “The art and science of management, engineering, and technical activities concerned with requirements, design, and supplying and maintaining resources to support objectives, plans, and operations.”

The logistics concept began to appear in the business-related literature in the 1960s under the label of physical distribution, which had a focus on the outbound side of the logistics system. During the 1960s, military logistics began to focus on engineering dimensions of logistics—reliability, maintainability, configuration management, life cycle management, and so on—with increased emphasis on modeling and quantitative analysis.

In the twenty-first century, logistics should be viewed as a part of management and has four subdivisions:

- Business logistics: That part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, service, and related information from point of use or consumption in order to meet customer requirements.
- Military logistics: The design and integration of all aspects of support for the operational capability of the military forces (deployed or in garrison) and their equipment to ensure readiness, reliability, and efficiency.

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- Event logistics: The network of activities, facilities, and personnel required to organize, schedule, and deploy the resources for an event to take place and to efficiently withdraw after the event.
- Service logistics: The acquisition, scheduling, and management of the facilities/ assets, personnel, and materials to support and sustain a service operation or business.

### Value-Added Roles of Logistics

Five principle types of economic utility add value to a product or service. Included are form, time, place, quantity, and possession. Generally, production activities are credited with providing form utility; logistics activities with time, place, and quantity utilities; and marketing activities with possession utility. Each will be discussed briefly.

**Form Utility:** Form utility refers to the value added to goods through a manufacturing or assembly process.

**Place Utility:** Logistics provides place utility by moving goods from production surplus points to points where demand exists.

**Quantity Utility:** Today's business environment demands that products not only be delivered on time to the correct destination but also be delivered in the proper quantities.

**Possession Utility:** Possession utility is primarily created through the basic marketing activities related to the promotion of products and services.

### Logistical Activities

The responsibility of the logistics manager includes a number of activities. The number and importance of these activities to the business varies according to the particular emphasis placed on the logistics function.

- Traffic and Transportation involves the physical movement or flow of raw materials or finished goods and involves the transportation agencies that provide service to the firm.
- Warehousing and Storage involves two closely related activities: inventory management and warehousing. A direct relationship exists between transportation and the level of inventory and number of warehouses required. It is important to examine the trade-offs related to the various alternatives in order to optimize the overall logistics system.
- Industrial Packaging involves the necessary packaging needed to move the product to the market. Logistics managers must analyze the tradeoffs between the type of transportation selected and its packaging requirements.
- Materials Handling is important to efficient warehouse operation and concerns the mechanical equipment for short-distance movement of goods through the warehouse.
- Order Fulfillment consists of the activities involved with completing customer orders. Order fulfillment concerns the total lead time from when the order is placed to actual delivery in satisfactory condition.

- Demand Forecasting involves the prediction of inventory requirement and materials and parts essential to effective inventory control.
- Production Planning concerns the determination of the number of units necessary to provide market coverage. The integration of production planning into logistics has become increasingly popular in large companies to effectively forecast and control inventory.
- Purchasing concerns the availability for production of needed parts, components, and materials in the right quantity, at the right time, at the right place, and at the right cost including within the logistics area if it more effectively coordinates and lowers costs for the firm.
- Customer Service levels play an important part in logistics by ensuring the customer gets the right product, at the right time and place. Logistics decisions about product availability and inventory lead time are critical to customer service.
- Plant and Warehouse Site location is concerned with creating the time and place relationships between plants and markets, or between supply points and plants. Site location impacts transportation rates and service, customer service, inventory requirements, and possible other areas.
- Parts and Service Support is concerned with maintaining an adequate channel to anticipated repair needs.
- Salvage and Scrap Disposal deals with reverse logistics systems and channels in order to effectively and efficiently dispose of containers and other scrap at the end of the distribution channel.

### Logistics in the Economy: A Macro Perspective

The overall, absolute cost of logistics on a macro basis will increase with growth in the economy. In other words, if more goods and services are produced, logistics costs will increase. To determine the efficiency of the logistics system, total logistics costs need to be measured in relationship to gross domestic product (GDP), which is a widely accepted barometer used to gauge the rate of growth in the economy.

Some additional understanding of logistics costs can be gained by examining the three major cost categories included in this cost—warehousing and inventory costs, transportation costs, and other logistics costs.

The declining trend for logistics cost relative to GDP is very important to recognize.

In addition to the managerial focus on managing inventory and transportation more efficiently, the total logistics system has received increased attention.

### Logistics in the Firm: The Micro Dimension

Another dimension of logistics is the micro perspective that examines the relationships between logistics and other functional areas in an organization—marketing, manufacturing/operations, finance and accounting, and others. Logistics, by its nature, focuses on processes that cut across traditional functional boundaries, particularly in

today's environment with its emphasis on the supply chain. Consequently, logistics interfaces in many important ways with other functional areas.

**Logistics Interfaces with Operations/Manufacturing:** Length of the production run is a classic interface area between logistics and manufacturing management. Other operational areas of interface include the effects of product seasonal demand, supply-side interfaces, protective packaging, and foreign and third-party alternative sources of production inputs.

**Logistics Interfaces with Marketing:** Logistics is often referred to as the other half of marketing and plays an important role through the physical movement and storage of goods in selling a product. Interfaces with marketing are discussed in terms of price, product, promotion, and place elements of the marketing mix. Logistics pricing decisions concern carrier pricing, matching discount schedules to transportation rates, and volume relationships affecting the ability to move and store products.

**Price:** From a logistics perspective, adjusting quantity prices to conform to shipment sizes appropriate for transportation organizations might be quite important.

**Product:** Another decision frequently made in the marketing area concerns products, particularly their physical attributes.

**Promotion:** Firms often spend millions of dollars on national advertising campaigns and other promotional practices to improve sales. An organization making a promotional effort to stimulate sales should inform its logistics manager so that sufficient quantities of inventory will be available for distribution to the customer. Marketing can either “push” the product through the distribution channel to the customer or “pull” it through.

**Place:** The place decision refers to the distribution channels decision, and thus involves both transactional and physical distribution channel decisions.

**Recent Trends:** Perhaps the most significant trend is that marketers have begun to recognize the strategic value of place in the marketing mix and the increased revenues and customer satisfaction that might result from excellent logistics service.

While manufacturing and marketing are probably the two most important internal, functional interfaces for logistics in a product-oriented organization, there are other important interfaces. The finance area has become increasingly important during the last decade.

### Logistics in the Firm: Factors Affecting the Cost and Importance of Logistics

This section deals with specific factors relating to the cost and importance of logistics. Emphasizing some of the competitive, product, and spatial relationships of logistics can help explain the strategic role of an organization's logistics activities.

**Competitive Relationships:** Frequently, competition is narrowly interpreted only in terms of price competition. While price is certainly important, in many markets, customer service can be a very important form of competition.

**Order Cycle:** A well-accepted principle of logistics management is that order cycle length directly affects inventory levels. Stated another way, the shorter the order cycle, the less inventory required to be held by the customer. Order cycle can be defined as the time that elapses from when a customer places an order until the order is received.

**Substitutability:** Substitutability very often affects the importance of customer service.

**Inventory Effect:** By increasing inventory costs (either by increasing the inventory level or by increasing reorder points), organizations can usually reduce the cost of lost sales. In other words, an inverse relationship exists between the cost of lost sales and inventory cost.

**Transportation Effect:** Organizations can usually trade off increased transportation costs against decreased lost sales costs.

### Product Relationships

A number of product-related factors affect the cost and importance of logistics. Among the more significant of these are dollar value, density, susceptibility to damage, and the need for special handling.

**Dollar Value:** Several product aspects have a direct bearing on logistics costs.

**Density:** Another factor that affects logistics cost is density, which refers to the weight/space ratio of the product.

**Susceptibility to Damage:** The third product factor affecting logistics cost is susceptibility to damage. The greater the risk of damage to a product, the higher the transportation and warehousing cost.

**Special Handling Requirements:** Some products might require specifically designed equipment, refrigeration, heating, or strapping, which entail higher costs.

### Spatial Relationships

A final topic that is extremely significant to logistics is spatial relationships, the location of fixed points in the logistics system with respect to demand and supply points. Spatial relationships are very important to transportation costs, since these costs tend to increase with distance.

Techniques of Logistics System Analysis

In this section, total cost analysis techniques for logistics are discussed. Only the more basic models are examined; more sophisticated techniques of total cost analysis are discussed later in the text.

Short-Run/Static Analysis

One general approach to total cost analysis for logistics is known as short-run analysis. In a short-run analysis, a specific point in time or level of production is chosen, and costs are developed for the various logistics cost centers described previously.

Long-Run/Dynamic Analysis

While short-run analysis concentrates on specific time or level of output, dynamic analysis examines a logistics system over a long time period or range of output.

Approaches to Analyzing Logistics Systems

The analysis of logistics systems frequently requires different views or perspectives of logistics activities. The best perspective to take depends on the type of analysis that is needed. For example, if an organization wants to analyze the long-run design of its logistics system, a view of logistics that focuses on the organization's network of node and link relationships would probably be most beneficial. On the other hand, if an organization is evaluating a change in a carrier or mode of transportation, it should probably analyze the logistics system in terms of cost centers. In this section, four approaches to analyzing logistics systems are discussed: (1) materials management versus physical distribution, (2) cost centers, (3) nodes versus links, and (4) logistics channels.

Materials Management versus Physical Distribution

The classification of logistics into materials management and physical distribution (inbound and outbound logistics) is very useful to logistics management or control in an organization. Frequently, the movement and storage of raw materials in an organization is different from the movement and storage of finished goods.

**Balanced System:** Some organizations have a reasonably balanced flow on the inbound and outbound sides of their logistics systems.

**Heavy Inbound:** Some organizations have a very heavy inbound flow and a very simple outbound flow.

**Heavy Outbound:** A chemical company like ExxonMobil offers a good example of a logistics system with a heavy outbound flow.

**Reverse Systems:** Some organizations have reverse flows on the outbound side of their logistics systems.

Cost Centers

A previous discussion mentioned the management activities that many organizations include in the logistics area, namely, transportation, warehousing, inventory, materials handling, and industrial packaging. The breakdown of logistics into various cost centers represents a second approach to logistics system analysis.

### Nodes versus Links

A third approach to analyzing logistics systems in an organization is in terms of nodes and links. The nodes are fixed spatial points where goods stop for storage or processing. Links represent the transportation network and connect the nodes in the logistics system.

### Logistics Channels

A final approach to logistics system analysis is the study of the logistics channel, or the network of intermediaries engaged in transfer, storage, handling, communication and other functions that contribute to the efficient flow of goods. The logistics channel can be viewed as part of the total distribution channel, which includes both the logistics flow as well as the transaction flow which would be of specific interest to the marketing manager. The logistics channel can be simple or complex

### Logistics and Systems Analysis

An earlier section pointed out that improvements in analyses and methodologies have facilitated the development of logistics. One such improvement was systems analysis, or the systems concept. Essentially, a system is a set of interacting elements, variables, parts, or objects that are functionally related to one another and that form a coherent group. The systems concept is something to which most individuals have been exposed at an early educational stage.

### Cost Perspective

The preceding engine analogy provides insight into business system characteristics. If efficiency is measured in costs, an individual part of the system not operating at its lowest cost might contribute to the system's overall efficiency

### Levels of Optimality

Another aspect of the systems concept is that levels of optimality exist in an organization. At the same time, logistics is only one subsystem in an organization and, therefore, the organization should not optimize it at another area's expense.

At optimality level I (optimizing the organization), an organization should not optimize transportation at the expense of related logistics areas such as warehousing and packaging.

Optimality level II consists of other organizations within the supply chain. These other supply chain members include suppliers (raw materials, components, and transportation providers) and customers (other manufacturers, wholesalers, and retailers).

Optimality level III involves the various constraints imposed by society and includes social, political, and economic influences.

**SUMMARY**

- Logistics has developed as an important area or function of business since World War II. It has gone through several phases of development in achieving its present status.
- Logistics is a critical part of supply chain management. The coordination and, perhaps, integration of the logistics systems of all the organizations in a supply chain are necessary requirements for successful management of the supply chain.
- Logistics has a number of different definitions because of the broad-based interest in its activities and the recognition of its importance. The definition developed by the Council of Supply Chain Management Professionals is the primary definition used in this text.
- Logistics is an area of management that has four sub-disciplines: business, military, service, and event.
- On a macro basis, logistics-related costs have been decreasing on a relative basis, which has helped the U.S. economy regain its competitive position on a global basis.
- Logistics adds place, time, and quantity utilities to products and enhances the form and possession utilities added by manufacturing and marketing.
- Logistics has an important relationship to manufacturing, marketing, finance, and other areas of the organization.
- Logistics managers are responsible for a number of important activities, including transportation, inventory, warehousing, materials handling, industrial packaging, customer service, forecasting, and others.
- Logistics systems can be viewed or approached in several different ways for analysis purposes, including materials management versus physical distribution, cost centers, nodes versus links, and channels. All four approaches are viable for different purposes.
- Logistics systems are frequently analyzed from a systems approach, which emphasizes total cost and tradeoffs when changes are proposed. Either a short- or a long run perspective can be used.
- The cost of logistics systems can be affected by a number of major factors, including competition in the market, the spatial relationship of nodes, and product characteristics.

**ANSWERS TO STUDY QUESTIONS**

1. Compare and contrast the four subdivisions of logistics management.

Answer: In the 21st century, Logistics should be viewed as a part of management that has four subdivisions:

Business logistics: That part of the supply chain that plans, implements, and controls the effective, efficient forward and reverse flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customer requirements.

**Military logistics:** The design and integration of all aspects of support for the operational capability of the military forces [deployed or in garrison] and their equipment to ensure readiness, reliability, and efficiency.

**Event Logistics:** The network of activities, facilities, and personnel required to organize, schedule, and deploy the resources for an event to take place and to efficiently withdraw after the event.

**Service Logistics:** The acquisition, scheduling, and management of the facilities/assets, personnel, and materials to support to sustain a service operation or business.

## 2. Compare and contrast logistics management with supply chain management.

**Answer:** The concepts of supply chain management and logistics must be compared or, more appropriately, related to each other. Supply chain management is defined using a pipeline analogy with the start of the pipeline representing the initial supplier and the end of the pipeline representing the ultimate customer. In other words, it was an extended set of enterprises from the supplier's supplier to the customer's customer.

Another perspective on supply chain management views it as a network of the logistics systems and related activities of all the individual organizations that are a part of a particular supply chain. The individual logistics systems obviously play a role in the success of the overall supply chain. The coordination or integration of the logistics systems in a supply chain is a challenge; no logistics system operates in a vacuum. For example, the inbound part of a manufacturer's logistics system interfaces with the outbound side of the supplier's logistics system. The outbound portion of the manufacturer's logistics system interfaces with the inbound side of its customer's logistics system.

## 3. On a macro-economic basis, the ratio of inventory to sales has declined over the last 20 years. Is this good or bad? Why? What factors have contributed to this trend? Is this trend likely to continue in the future? Why or why not?

**Answer:** The overall, absolute cost of logistics on a macro basis will increase with growth in the economy. In other words, if we produce and consume more goods and services, there will be increased total costs associated with all of the logistical activities of each and every organization. To determine the efficiency of the logistics system, we need to measure total logistics cost in terms of gross domestic product, which is a widely accepted barometer or metric used to gauge the rate of growth in the economy.

Logistics costs as a percentage of gross domestic product (GDP) have declined since 1980 from about 16 percent down to under 10 percent. In fact, logistics costs were closer to 20 percent of GDP in the early to mid-1970s. This indicates a significant improvement in the efficiency of the overall logistics systems of the various companies operating in the economy. This reduction in relative cost allows companies to be more competitive since it directly impacts the cost of producing goods (COGS). It can be argued that the

turnaround that has occurred in the United States' global, economic viability is due in part to the improvement in the logistics cost.

The declining trend for logistics cost relative to gross domestic product is very important to note. The decline started in the early 1980s and was closely related to the deregulation of transportation, which permitted much more flexibility for carriers to adjust their rates and service in response to competition. Overall, transportation rates/prices declined in response to the then new, less regulated environment. A second factor contributing to the trend has been the improved management of inventory levels. This has been the result of more attention being focused upon the investment in inventory and the associated better management tools and techniques for more effective decisions.

On a macro basis, the Federal Reserve publishes data on the ratio of inventory to sales. In other words, how much inventory do companies carry to support sales? Typically, one might expect inventory to increase with increased sales, but overall, companies have been supporting growing sales levels with a much lower level of inventory on a relative basis.

4. Logistics costs as a percentage of GDP have been decreasing in recent years. What factors have contributed to this relative decline? What does the future hold for logistics costs?

Answer: On a macro basis, data are published on the ratio of inventory to GDP in the U.S. economy. From 1985 through 2006, nominal GDP increased by 212.3 percent, while the value of all business inventories increased by 119.2 percent for the same period. This is a measure of efficiency and clearly indicates that organizations are improving in managing their inventory.

5. Discuss the ways in which logistics contributes to economic value in the economy and in an organization. Pick one of the ways and discuss in more detail

Answer: Five principles types of economic utility add value to a product or service. Included are form, time, place, quantity, and possession. Generally, production activities are credited with providing form utility; logistics activities with time, place, and quantity utilities; and marketing activities with possession utility. *Specific answers will vary.*

6. Manufacturing organizations have traditionally used long production runs as a means to gain a cost advantage in the marketplace. What is the impact of long production runs on logistics? The current approach to manufacturing is to have shorter production runs and more setups. What impact does this approach have on logistics costs? Manufacturing costs? What are the tradeoffs?

Answer: A classic interface between logistics and manufacturing relates to the length of the production run. Manufacturing economies are typically associated with long production runs with infrequent manufacturing line setups or changeovers. These long runs, however, easily result in higher inventory levels of certain finished products and limited supplies of others. Thus, the ultimate manufacturing decision requires managers

to carefully weight the advantages and disadvantages of long versus short production runs and their impacts on inventories. Many organizations today tend toward shorter production runs and doing whatever it takes to reduce the time and expense normally associated with changing production lines from one product to another. This is especially true for firms employing JIT or “lean” approaches to inventory and scheduling.

The trend today is toward “pull” systems, manufacturing/logistics systems where the product is “pulled” in response to demand as opposed to being “pushed” in advance of demand. This practice lowers inventory levels which can lower total logistics costs.

7. Physical distribution has a special relationship to marketing. Why is this relationship so special? What is the nature of the overall relationship between logistics and marketing? Is the relationship becoming more or less important?

Answer: Logistics is sometimes referred to as the other half of marketing. The rationale for this definition is that the physical distribution or outbound side of an organization’s logistics system is responsible for the physical movement and storage of products for customers and thus plays an important role in selling a product. In some instances, physical distribution and order fulfillment might be the key variables in selling a product; that is, the ability to provide the product at the right time to the right place in the right quantities might be the critical element in making a sale. Today, logistics is related to all four Ps of marketing—price, product, promotion, and place.

8. Logistics comprises a relatively large number of managerial activities. Discuss five of these activities and why they are important to logistics systems.

Answer: Transportation involves the physical movement or flow of raw materials or finished goods and involves the transportation agencies that provide service to the firm.

Storage involves two closely related activities: inventory management and warehousing. A direct relationship exists between transportation and the level of inventory and number of warehouses required. It is important to examine the trade-offs related to the various alternatives in order to optimize the overall logistics system.

Packaging involves the necessary packaging needed to move the product to the market. Logistics managers must analyze the trade-offs between the type of transportation selected and its packaging requirements.

Materials handling is important to efficient warehouse operation and concerns the mechanical equipment for short-distance movement of goods through the warehouse.

Order fulfillment consists of the activities involved with completing customer orders. Order fulfillment concerns the total lead time from when the order is placed to actual delivery in satisfactory condition.

Forecasting involves the prediction of inventory requirement and materials and parts essential to effective inventory control.



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Production planning concerns the determination of the number of units necessary to provide market coverage. The integration of production planning into logistics has become increasingly popular in large companies to effectively forecast and control inventory.

Purchasing concerns the availability for production of needed parts, components, and materials in the right quantity, at the right time, at the right place, and at the right cost. Purchasing is included within the logistics area if it more effectively coordinates and lowers costs for the firm.

Customer service plays an important part in logistics by ensuring the customer gets the right product at the right time and place. Logistics decisions about product availability and inventory lead time are critical to customer service.

Site location is concerned with creating the time and place relationships between plants and markets, or between supply points and plants. Site location impacts transportation rates and service, customer service, inventory requirements, and possible other areas.

### 9. Compare and contrast the static analysis of logistics systems with dynamic analysis.

Answer: Costs are developed associated with the various logistics cost centers in short-run/static analysis. Cost information is developed for each alternative system considered, and the system with the lowest overall cost is selected, provided it was consistent with constraints imposed by the firm on the logistics area. This is static analysis because costs are analyzed at one point in time or at one output level.

Long-run/dynamic analysis projects the optimum system by mathematically calculating the point of equality between proposed systems. A graph is used to determine the equality point. The total cost for each proposed system is plotted using the equation for a straight line ( $y = a + bx$ ). At some level of output, the two systems are equal, and a point of indifference exists between the two systems.

### 10. What product characteristics affect logistics costs? Discuss the effects of these characteristics on logistics costs.

Answer: A number of product-related factors affect the cost and importance of logistics. Among the more significant of these are dollar value, density, susceptibility to damage, and the need for special handling.