



МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ  
"ХАРКІВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ"

**МІЖНАРОДНА ЛОГІСТИКА  
ТЕКСТ ЛЕКЦІЙ**

для студентів спеціальностей  
073 «Менеджмент»  
076 «Підприємництво, торгівля та біржова діяльність»

**INTERNATIONAL SUPPLY CHAIN MANAGEMENT  
LECTURE NOTES**

International Logistics Course  
for undergraduate students. Majors: 073 "Management"  
076 «Entrepreneurship, Trade and Exchange Activity»

Харків 2020

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Текст лекцій містить теоретичні засади курсу «Міжнародна логістика», включаючи роль логістики в економіці та менеджменті, управління ланцюгами поставок, управління матеріальним потоком, постачання, транспортування, системи обробки замовлень та інформаційні системи, управління запасами, складування, вантажопереробка, обслуговування споживачів. Наведено запитання для самостійної роботи студентів.

Розраховано для студентів спеціальностей 073 «Менеджмент», 076 «Підприємництво, торгівля та біржова діяльність».

**Ширяєва Н.В., Макаренко А.Б., Білоцерківський О.Б.**

**Б 78** Міжнародна логістика : текст лекцій для студентів спеціальностей 073 «Менеджмент», 076 «Підприємництво, торгівля та біржова діяльність» / Н.В. Ширяєва, А.Б. Макаренко, О.Б. Білоцерківський. – Харків : НТУ «ХПІ», 2020. – 126 с.

**Shyriaieva N., Makarenko A., Bilotserkivskyi O.**

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ISBN

The lectures cover foundations of the International Supply Chain Management course, including the role of logistics in economy and management, supply chain management, material flow management, supply, transportation, order processing and information systems, inventory management, warehousing, cargo handling, customer service. Questions for independent study are included.

The lectures are developed for students of 073 “Management”, 076 “Entrepreneurship, trade and exchange activity” majors.

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## **PREFACE**

The competitive environment requires new approaches to cost cutting. So there is an increasing need for specialists who can use supply chain systems. International Logistics course helps students to form systemic knowledge and understanding of the conceptual basics of supply chain as a tool of market economy, to learn theory and practice and to acquire skills of effective material flow management.

After studying logistics, students should know the basic supply chain management concepts and definitions; functions and tasks, peculiarities of material flow management; approaches to assessment of logistics system effectiveness.

Students should be able to develop a logistics strategy for production management; substantiate the need of the enterprise in parts and raw materials, including inventories and stock; to develop measures to reduce inventories, to maintain them at optimum levels; to determine the optimal amount of stock, to regulate work in progress; to justify the choice of warehouse types and transport for the enterprise; to choose types of warehouses for storing different kinds of products and materials; to calculate technical and economic indicators in the field of logistics; to determine the cost of storage of materials and products; to improve the delivery of products to consumers and other.

This study guide outlines the theoretical foundations of the international logistics (supply chain management). The tutorial contains problem solving section. In order to consolidate the knowledge and to acquire the skills necessary for material flow management, students should study graphical part and go over self-study tests of the course.

This study guide is designed for students of 073 “Management” major taking International Logistics (Supply Chain Management) course. It will also be useful for other economics majors.

# 1. THE ROLE OF LOGISTICS IN THE ECONOMY AND ORGANIZATION

## 1.1. Definition of Logistics Management

Logistics has been called by many names, including the following:

- ✓ Business logistics
- ✓ Channel management
- ✓ Distribution
- ✓ Industrial logistics
- ✓ Logistical management
- ✓ Materials management
- ✓ Physical distribution
- ✓ Quick-response systems
- ✓ Supply chain management
- ✓ Supply management.

What these terms have in common is that they deal with the management of the flow of goods or materials from point of origin to point of consumption, and in some cases, even to the point of disposal. The Council of Logistics Management (CLM), one of the leading professional organizations for logistics personnel, uses the term in **logistics management** to describe:

*the process of planning, implementing and controlling the effective flow and storage of goods, services, and related information from point of consumption for the purpose of conforming to customer requirements.*

This definition includes the flow of materials and services in both the manufacturing and service sectors. The service sector includes entities such as the government, hospitals, banks, retailers and wholesalers. In addition, the ultimate disposal, recycling, and reuse of the products need to be considered because logistics is becoming increasingly responsible for issues such as removing packaging materials once a product is delivered and removing old equipment.

Logistics is relevant to all enterprises, including government, institutions such as hospitals and schools, and service organizations such as retailers, banks and financial organizations. Some of the many activities encompassed under the logistics umbrella are given in Figure 1.1, which illustrates that logistics is de-

pend upon natural, human, financial, and information resources for input. Suppliers provide raw materials which logistics manages in the form of raw materials, in process inventory, and finished goods. Management actions provide the framework for logistics activities through the process of planning, implementation, and control. The outputs of the logistics system are competitive advantage, time and place utility, efficient movement to the customer, and providing a logistics service mix such that logistics becomes a proprietary asset of the organization. These outputs are made possible by the effective and efficient performance of the logistics activities shown at the bottom of Figure 1.1.

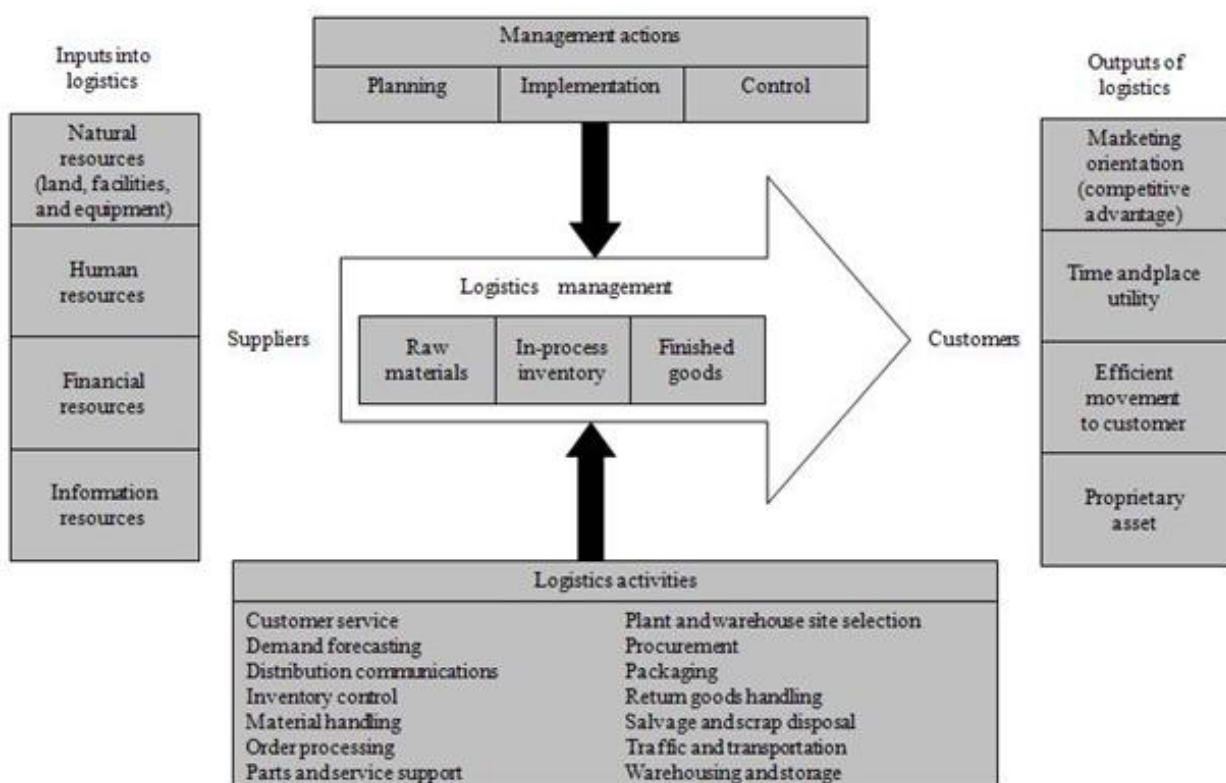


Figure 1.1 – Components of logistics management

## 1.2. Systems Approach / Integration

The systems approach is a critical concept in logistics. Logistics is, in itself, a system; it is a network of related activities with the purpose of managing the orderly flow of material and personnel within the logistics channel.

The systems approach is a simplistic yet powerful paradigm for understanding interrelationships. The *systems approach* simply states that all functions or activities need to be understood in terms of how they affect, and are affected

by, other elements and activities with which they interact. The idea is that if one looks at actions in isolation, he or she will not understand the big picture or how such actions affect or are affected by, other activities. In essence, the sum of outcome of a series of activities is greater than its individual parts.

The systems approach is a key to understanding the role of logistics in the economy, its role in the organization, including its interface with marketing, the total cost concept, and logistics strategy.

### **1.3. The Role of Logistics in the Economy**

#### *Logistics is an important Component of GDP*

Logistics plays a key role in the economy in two significant ways. *First*, logistics is one of the major expenditures for businesses, thereby affecting and being affected by other economic activities. In the United States, for example, logistics contributed approximately 10.3 percent of GDI in 2015. U.S. industry spent approximately \$451 billion on transportation of freight and about \$311 billion on warehousing, storage and carrying inventory. These and other logistics expenses added up to about \$797 billion.

*Second*, logistics supports the movement and flow of many economic transactions; it is an important activity in facilitating the sale of virtually all goods and services. To understand this role from a systems perspective, consider that if goods do not arrive on time, customers cannot buy them. If goods do not arrive in the proper place, or in the proper condition, no sale can be made. Thus, all economic activity throughout the supply chain will suffer.

One of the fundamental ways that *logistics adds value is by creating utility*. From an economic standpoint, *utility* represents the value or usefulness that an item or service has in fulfilling a want or need. There are *four types of utility: form, possession, time, and place*. The latter two, *time* and *place utility*, are intimately supported by logistics.

While form and possession utility are not specifically related to logistics, neither would be possible without getting the right items needed for consumption or production to the right place at the right time and in the right condition at the right cost. These "*five rights of logistics*" credited to K. Grosvenor Plowman, are

the essence of the two utilities provided by logistics: time and place utility.

#### 1.4. The Role of Logistics in the Organization

##### *Logistics Support Marketing*

The *marketing concept* is a "marketing management philosophy" which holds that achieving organizational goals depends on determining the needs and wants of target markets and delivering the desired satisfactions more effectively and efficiently than competitors. Thus, the marketing concept is a "customer-driven" perspective which holds that a business exists to meet customer needs. The relationships between logistics and the three critical elements of the marketing concept (customer satisfaction, integrated effort/systems approach, and adequate corporate profit), are shown in Figure 1.2. Logistics plays a key role in each of these elements in several ways.

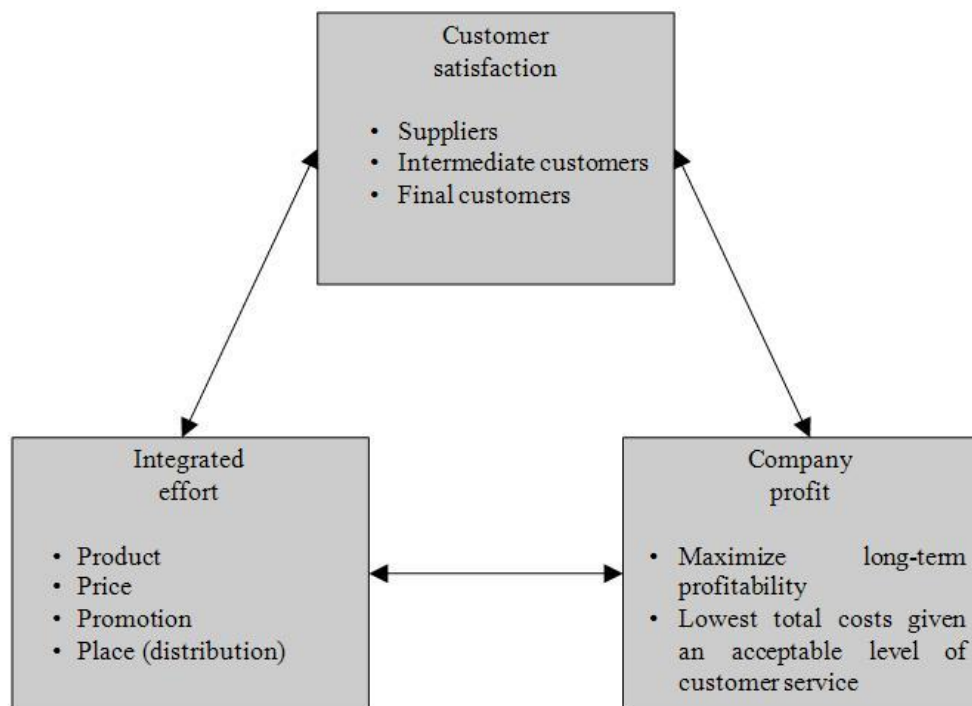


Figure 1.2 – Relationships between logistics and elements of the marketing concept

The "four P's" of the marketing mix require that for a firm to be successful, any marketing effort must integrate the ideas of having the right product, at the right price, publicized with the proper promotion, and available in the right place. Logistics plays a critical role particularly in support of getting the product to the right place.



Figure 1.3 summarizes the trade-offs required between and among the major elements of the marketing mix and logistics.

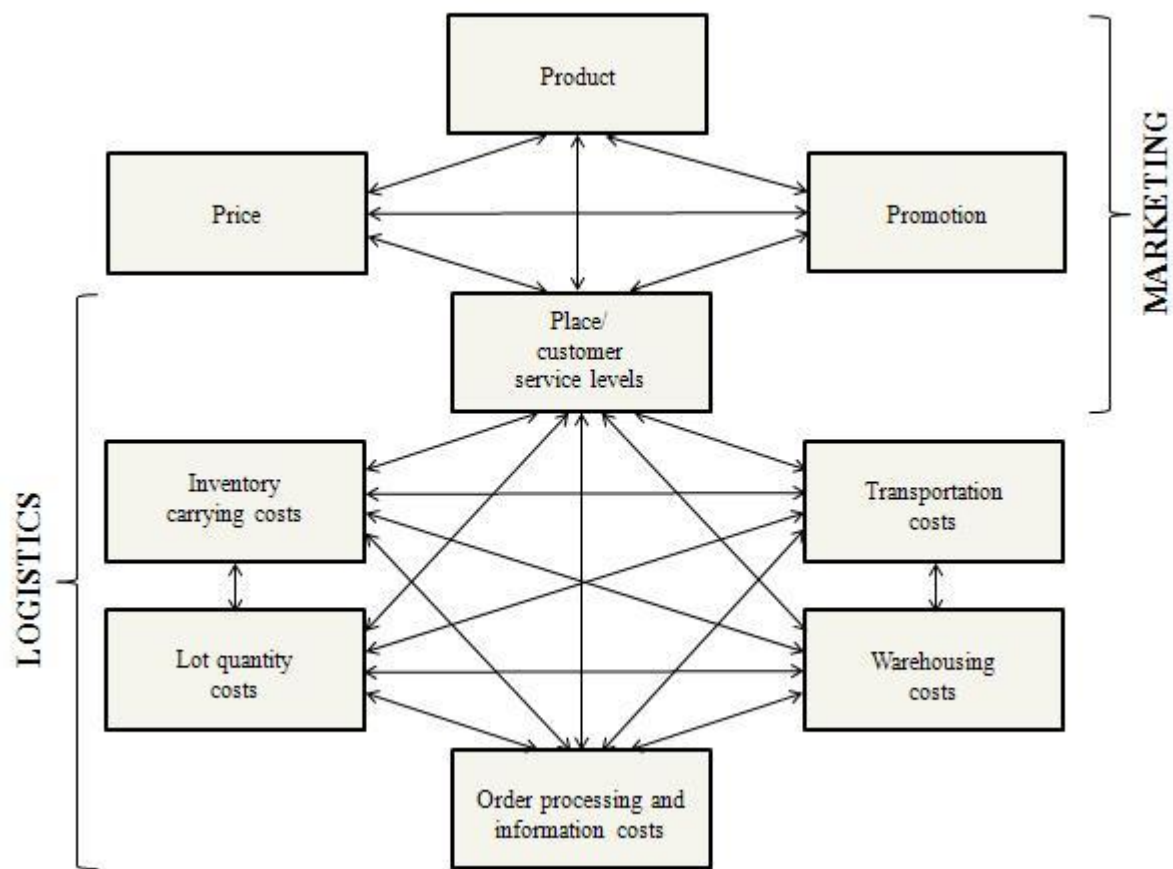


Figure 1.3 – Cost trade-offs required in marketing and logistics

To better understand Figure 1.3, the sections below explore the manner in which each of the major elements of the marketing mix interact and are affected by logistics operations.

### 1. Product

Product refers to the set of utilities/characteristics that a customer receives as a result of a purchase.

### 2. Price

Price is the amount of money that a customer pays for the product or service offering. Some of the Items that should be factored into price include discounts for buying in quantities or for belonging to a certain class of customers, discounts for prompt payment, rebates, whether inventory is offered on consign-

ment, and who pays delivery costs.

### **3. Promotion**

Promotion of a product or service encompasses both personal selling and advertising. Whereas increasing advertising expenditures or the size of the direct sales force can have a positive impact on sales, there is a point of diminishing returns. A point exists where the extra money being spent does not yield sufficiently high increases in sales or profits to justify the added expense.

### **4. Place**

Place is the key element of the marketing mix with which logistics interfaces directly. Place expenditures support the levels of customer service provided by the organization. This includes on-time delivery, high order fill rates, consistent transit times, and similar issues. Customer service is an output of the logistics system. On the other hand, when the organization performs well on all the elements of the marketing mix, customer satisfaction occurs,

## **1.5. Total Cost Concept**

The *total cost concept* is the key to effectively managing logistics processes. The goal of the organization should be to reduce the total cost of logistics activities, rather than focusing on each activity in isolation. Reducing costs in one area, such as transportation, may drive up inventory carrying costs as more inventory is required to cover longer transit times, or to balance against greater uncertainty in transit times.

## **1.6. Key Logistics Activities**

Outlined below are the key activities required to facilitate the flow of a product from point of origin to point of consumption. All of these activities, listed alphabetically below, may be considered part of the overall logistics process.

### **✓ Customer service**

Customer service has been defined as "a customer-oriented philosophy which integrates and manages all elements of the customer interlace within a pre-determined optimum cost-service mix. Customer service is the output of the logistics system. It involves getting the right product to the right customer at the

right place, in the right condition and at the right time, at the lowest total cost possible, Good customer service supports customer satisfaction, which is the output of the entire marketing process.

✓ *Demand forecasting/planning*

There are many types of demand forecasts. Marketing forecasts customer demand based on promotions, pricing, competition, and so on. Manufacturing forecasts production requirements based on marketing's sales demand forecasts and current inventory levels. Logistics usually becomes involved in forecasting in terms of how much should be ordered from its suppliers (through purchasing), and how much of finished product should be transported or held in each market that the organization serves. In some organizations, logistics may even plan production. Thus, logistics needs to be linked to both marketing and manufacturing forecasting and planning.

✓ *Inventory management*

Inventory management involves trading off the level of inventory held to achieve high customer service levels with the cost of holding inventory, including capital tied up in inventory, variable storage costs, and obsolescence. These costs can range from 14 to over 50 percent of the value of inventory on an annual basis! With high costs for items such as high-tech merchandise, automobiles, and seasonal items that rapidly become/obsolete, many organizations, including Hewlett Packard, Xerox, and Sears, are giving inventory management much more attention.

✓ *Logistics communications*

Communications are becoming increasingly automated, complex, and rapid. Logistics interfaces with a wide array of functions and organizations in its communication processes. Communication must occur between:

1. The organization and its suppliers and customers.
2. The major functions within the organization, such as logistics, engineering, accounting, marketing, and production.
3. The various logistics activities listed previously.
4. The various aspects of each logistics activity, such as coordinating warehousing of material, work in process, and finished goods.
5. Various members of the supply chain, such as intermediaries and secondary customers or suppliers who may not be directly linked to the firm.

Communication is key to the efficient functioning of any system, whether it be the distribution system of an organization or the wider supply chain.

✓ *Material handling*

Materials handling is a broad area that encompasses virtually all aspects of all movements of raw materials, work in process, or finished goods within a plant or warehouse. Because an organization incurs costs without adding value each time an item moves or is handled, a primary objective of materials management is to eliminate handling wherever possible. That includes minimizing travel distance, bottlenecks, inventory levels, and loss due to waste, mishandling, pilferage, and damage. Thus, by carefully analyzing material flows, materials management can save the organization significant amounts of money.

✓ *Order processing*

Order processing entails the systems that an organization has for getting orders from customers, checking on the status of orders and communicating to customers about them, and actually filling the order and making it available to the customer. Part of the order processing includes checking inventory status, customer credit, invoicing, and accounts receivable. Thus, order processing is a broad, highly automated area. Because the order processing cycle is a key area of customer interface with the organization, it can have a big impact on a customer's perception of service and, therefore, satisfaction.

✓ *Packaging*

Packaging is valuable both as a form of advertising/marketing, and for protection and storage from a logistical perspective. Packaging can convey important information to inform the consumer. Aesthetically pleasing packaging also can attract the consumer's attention. Logistically, packaging provides protection during storage and transport. This is especially important for long distances over multiple transportation modes such as international shipping.

Packaging can ease movement and storage by being properly designed for the warehouse configuration and materials handling equipment.

✓ *Parts and service support*

In addition to supporting production through the movement of materials, work in process and finished goods, logistics also is responsible for providing after-sale service support. This may include delivery of repair parts to dealers, stocking adequate spares, picking up defective or malfunctioning products from

customers, and responding quickly to demands for repairs.

✓ *Plant and warehouse site selection*

Determining the location of the company's plant(s) and warehouse(-s) is a strategic decision that affects not only the costs of transporting raw materials inbound and finished goods outbound, but also customer service levels and speed of response.

✓ *Procurement*

Procurement is the purchase of materials from outside organizations to support the firm's operations from production to marketing, sales, and logistics. Procurement, also referred to as purchasing, supply management, and by a number of other names, includes activities such as supplier selection, negotiation of price, terms and quantities, and supplier quality assessment.

✓ *Return goods handling*

Returns may take place because of a problem with the performance of the item or simply because the customer changed his or her mind. Return goods handling is complex because it involves moving small quantities of goods back from the customer rather than to the customer as the firm is accustomed. Many logistics systems have a difficult time handling this type of movement. Costs tend to be very high. The cost of moving a product backward through the channel from the consumer to the producer may be as much as nine times as high as moving the same product forward from the producer to the customer.

✓ *Reverse logistics*

Logistics is also involved in removal and disposal of waste materials left over from the production, distribution, or packaging processes. There could be temporary storage followed by transportation to the disposal, reuse, reprocessing, or recycling location. As the concern for recycling and reusable packaging grows, this issue will increase in importance.

✓ *Traffic and transportation*

A key logistics activity is to actually provide for the movement of materials and goods from point of origin to point of consumption, and perhaps to its ultimate point of disposal as well. Transportation involves selection of the mode (e.g., air, rail, water, truck, or pipeline), the routing of the shipment, assuring of

compliance with regulations in the region of the country where shipment is occurring, and selection of the carrier. It is frequently the largest single cost among logistics activities.

✓ *Warehousing and storage*

Warehousing supports time and place utility by allowing an item to be produced and held for later consumption. It can be held near the location where it will be needed, or transported later. Warehousing and storage activities relate to warehouse layout, design, ownership, automation, training of employees, and related issues.

### **Chapter Checklist**

1. How do improvements in logistics productivity affect the economy as a whole, as well as the position of individual consumers?
2. How is logistics related to the marketing effort? Be sure to discuss customer service/ customer satisfaction, integration of efforts, and cost and performance outputs.
3. What are the different types of utility? How does logistics directly or indirectly affect each one?
4. Why has logistics recently been receiving more attention as a strategic function of the organization?
5. What is meant by the profit leverage effect of logistics? What are the greatest cost savings opportunities for logistics?
6. Discuss the key challenges facing logistics today. What do you see as the greatest area of opportunity for logistics? Why?
7. Of the 14 areas of logistics responsibility, which do you believe will experience the most change the next five years or so? Why?

## 2. MANAGING MATERIALS FLOW

### 2.1. Introduction

An integral part of the logistics management process is *materials management*, which encompasses the administration of raw materials, subassemblies, manufactured parts, packing materials, and in-process inventory. In a formal sense, implementation of a materials management organization will have “a single manager responsible for the planning, organizing, motivating, and controlling of all those activities and principally concerned with the flow of materials into an organization.”

*Materials management* is critical to the total logistics process. Although materials management does not directly interface with the final customer, decisions made in its portion of the logistics process will directly affect the level of customer service offered. The ability of the firm to compete with other companies, and the level of sales and profits the firm is able to achieve in the marketplace.

### 2.2. Scope of Materials Management

**Materials management** is typically comprised of four basic activities:

1. Anticipating materials requirements.
2. Sourcing and obtaining materials.
3. Introducing materials into the organization.
4. Monitoring the status of materials as a current asset.

Functions performed by materials managers include purchasing, inventory control of raw materials and finished goods, receiving, warehousing, production scheduling, and transportation. The definition of materials management views the activity as an organizational system with the various functions as interrelated, interactive, subsystems.

**The objectives of materials management** *are to solve materials problems from a total company viewpoint [optimize] by coordinating performance of the various materials functions, providing a communications network, and controlling materials flow.*

The specific objectives of materials management are closely tied to the firm's main objectives of achieving an acceptable level of profitability or return

on investment (ROI), and remaining competitive in an increasingly competitive marketplace.

*The major objectives of materials management* are low costs, high levels of service, quality assurance, low level of tied-up capital, and support of other functions.

Materials management encompasses a variety of logistics activities. The primary differences between the process of materials management and that of finished goods distribution are that the items handled in materials management are incoming finished goods, raw materials, component parts, and subassemblies to be further processed or sorted before being received by the final customer. The recipient of the materials management effort is the production or manufacturing group and other internal customers, not the final customer.

*Integral aspects of materials management* include purchasing and procurement, production control, inbound traffic and transportation, warehousing and storage, management information system (MIS) control, inventory planning and control, and salvage and scrap disposal.

### **2.3. Total Quality Management and Reengineering**

*Total quality management (TQM)* and *reengineering* are concepts that gained much attention and popularity in the 1980s and 1990s.

*TQM* has been defined as:

*A philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. TQM is the application of quantitative and human resources to improve the materials services supplied to an organization, all the processes within the organization, and the degree in which the needs of the customer are met – now and in the future. TQM integrates fundamental techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continuous improvement.*

The concept of *reengineering* deals with “starting with a clean state”: that is, taking systems and processes, and rethinking and redesigning them in order to create significant improvements in quality, cost, speed, and service.



## 2.4. Kanban / Just-in-Time Systems

Kanban and just-in-time systems have become much more important in manufacturing and logistics operations in recent years. *Kanban*, also known as the *Toyota Production System (TPS)*, was developed by Toyota Motor Company during the 1950s and 1960s. The philosophy of Kanban is that parts and materials should be supplied at the very moment they are needed in the factory production process. This is the optimal strategy, from both a cost and service perspective. The Kanban system can apply to any manufacturing process involving repetitive operations.

*Just-in-time (JIT)* systems extend Kanban, linking purchasing, manufacturing, and logistics. The primary goals of JIT are to minimize inventories, improve product quality, maximize production efficiency, and provide optimal customer service levels. It is basically a philosophy of doing business.

JIT has been defined in several ways, including the following:

- ✓ As a production strategy, JIT works to reduce manufacturing costs and to improve quality markedly by waste elimination and more effective use of existing company resources.
- ✓ A philosophy based on the principle of getting the right materials to the right place at the right time.
- ✓ A program that seeks to eliminate nonvalue-added activities from any operation with the objectives of producing high-quality products (i.e. “zero defects”), high productivity levels, and lower levels of inventory, and developing long term relationships with channel members.

At the heart of the JIT system is the notion that waste should be eliminated. This is in direct contrast to the traditional "just-in-case" philosophy in which large inventories or safety stocks are held just in case they are needed. In JIT, the ideal lot size or EOQ is one unit, safety stock is considered unnecessary, and any inventory should be eliminated.

Many firms have successfully adopted the JIT approach. Companies in industries such as metal products, automobile manufacturing, electronics, and food and beverage have implemented JIT and realized a number of benefits, including:

- Productivity improvements and greater control between various production stages.

- Diminished raw materials, work in process, and finished goods inventory.
- A reduction in manufacturing cycle times.
- Dramatically improved inventory turnover rates.

In general, JIT produces benefits for firms in four major areas: improved inventory turns, better customer service, decreased warehouse space, and improved response time. In addition, reduced distribution costs, lower transportation costs, improved quality of supplier products, and a reduced number of transportation carriers and suppliers can result from the implementation of JIT.

#### *Problems Associated with Implementation JIT*

It has some inherent problems which fall into three categories: production scheduling (plant), supplier production schedules, and supplier locations.

When leveling of the production schedule is necessary due to uneven demand, firms will require higher levels of inventory. Items can be produced during slack periods even though they may not be demanded until a later time, finished goods inventory has a higher value because of its form utility; thus, there is a greater financial risk resulting from product obsolescence, damage, or loss.

However, higher levels of inventory, coupled with a uniform production schedule, can be more advantageous than a fluctuating schedule with less inventory. In addition, when stockout costs are great because of production slowdowns or shutdowns. JIT may not be the optimal system. JIT reduces inventory levels to the point where there is little if any safety stock, and parts shortages can adversely affect production operations.

Supplier production schedules are a second problem with JIT. Success of a JIT system depends on suppliers' ability to provide parts in accordance with the firm's production schedule. Smaller, more frequent orders can result in higher ordering costs and must be taken into account when calculating any cost savings due to reduced inventory levels. When a large number of small lot quantities are produced, suppliers incur higher production and setup costs. Generally, suppliers will incur higher costs, unless they are able to achieve the benefits associated with implementing similar systems with their suppliers.

Supplier locations can be a third problem. As distance between the firm and its suppliers increases, delivery times may become more erratic and less predictable. Shipping costs increase as less than truckload (LTL) movements are

made. Transit time variability can cause inventory stockouts that disrupt production scheduling; when this is combined with higher delivery costs on a per unit basis, total costs may be greater than the savings in inventory carrying costs.

JIT II applies JIT concepts to the purchasing function by having a representative of the supplier locale at the buying organization's facility. Developed by Bose Corporation, this approach improves mutual understanding between the buyer and supplier, reduces waste and redundancy of efforts, improves supplier responsiveness, and creates a positive working environment

## **2.5. MRP Systems**

MRP has been used to signify systems called materials requirements planning (MRP I) and manufacturing resource planning (MRP II). Introduced first, MRP I developed into MRP II with the addition of financial, marketing, and purchasing aspects.

MRP I became a popular concept in the 1960s and 1970s. From a managerial perspective, MRP I consists of computer system, a manufacturing information system, building on inventory, production scheduling, and administering all inputs to production, and a concept and philosophy of management.

MRP I is a computer-based production and inventory control system that attempts to minimize inventories while maintaining adequate materials for the production process. MRP I systems are usually employed when one or more of the following conditions exist:

- When usage (demand) of the material is discontinuous or highly unstable during a firm's normal operating cycle. This situation is typified by an intermittent manufacturing or job shop operation, as opposed to a continuous processing or mass-production operation.
- When demand for the material depends directly on the production of other specific inventory items or finished products. MRP I can be thought of as primarily a component fabrication planning system, in which the demand for all parts (materials) is dependent on the demand (production schedule) for the parent product.

- When the purchasing department and its suppliers, as well as the firm's own manufacturing units, possess the flexibility to handle order placements or delivery releases on a weekly basis.

MRP I systems offer many *advantages* over traditional systems, including:

- ✓ Improved business results (i.e., return on investment, profits).
- ✓ Improved manufacturing performance results.
- ✓ Better manufacturing control.
- ✓ More accurate and timely information.
- ✓ Less inventory.
- ✓ Time-phased ordering of materials.
- ✓ Less material obsolescence.
- ✓ Higher reliability.
- ✓ More responsiveness to market demand.
- ✓ Reduced production costs.

#### *Disadvantages of MRP I Systems*

MRP I does have a number of drawbacks which should be examined by any firm considering adopting the system. First, MRP I does not lend to optimize materials acquisition costs. Because inventory levels are kept to a minimum, materials must be purchased more frequently and in smaller quantities. This results in increased ordering costs.

Higher transportation bills and higher unit costs are incurred because the firm is less likely to qualify for large volume discounts. The company must weigh the anticipated savings from reduced inventory costs against the greater acquisition costs resulting from smaller and more frequent orders.

Another disadvantage of MRP I is the potential hazard of a production slowdown or shutdown that may arise because of factors such as unforeseen delivery problems and materials shortages. The availability of safety stocks gives production some protection against stockouts of essential material. As safety stocks are reduced, this level of protection is lost.

A final disadvantage of MRP I arises from the use of standardized software packages, which may be difficult to accommodate within the unique operating

situations of a given firm. Firms buying off-the-shelf software often will have to modify it, so that it meets their specific needs and requirements.

While MRP I is still being used by many firms, it has been updated and expanded to include financial, marketing, and logistics elements. This newer version is called manufacturing resource planning, or MRP II.

### *MRP II*

MRP II includes the entire set of activities involved in the planning and control of production operations. It consists of a variety of functions of modules and includes production planning, resource requirements planning, master production scheduling, materials requirements planning (MRP I), shop floor control, and purchasing.

*The advantages of MRP II include:*

- ✓ Inventory reductions of one-fourth to one-third
- ✓ Higher inventory turnover
- ✓ Improved consistency in on-time customer delivery
- ✓ Reduction in purchasing costs due to fewer expedited shipments
- ✓ Minimization of workforce overtime.

These advantages typically result in savings to a firm beyond the initial costs of implementing MRP II.

### **Chapter Checklist**

1. How does total quality management (TQM) differ from traditional management? How can TQM be applied to logistics?
2. Briefly describe the concept of just-in-time (JIT) and its relationship to logistics.
3. Discuss the role of suppliers in a JIT system. Identify areas where potential conflicts may occur.
4. MRP is computer system in materials management and manufacturing. Describe the types of situations where MRP can be effectively and/or efficiently used in a firm.

### 3. PURCHASING

#### 3.1. The Role of Purchasing in the Supply Chain

*Supply chain management* is an integration of business processes from end user through original suppliers that provide products, services, and information that add value to customers. Figure 3.1 illustrates how purchasing, (or in its expanded role, procurement) supports supply chain management.

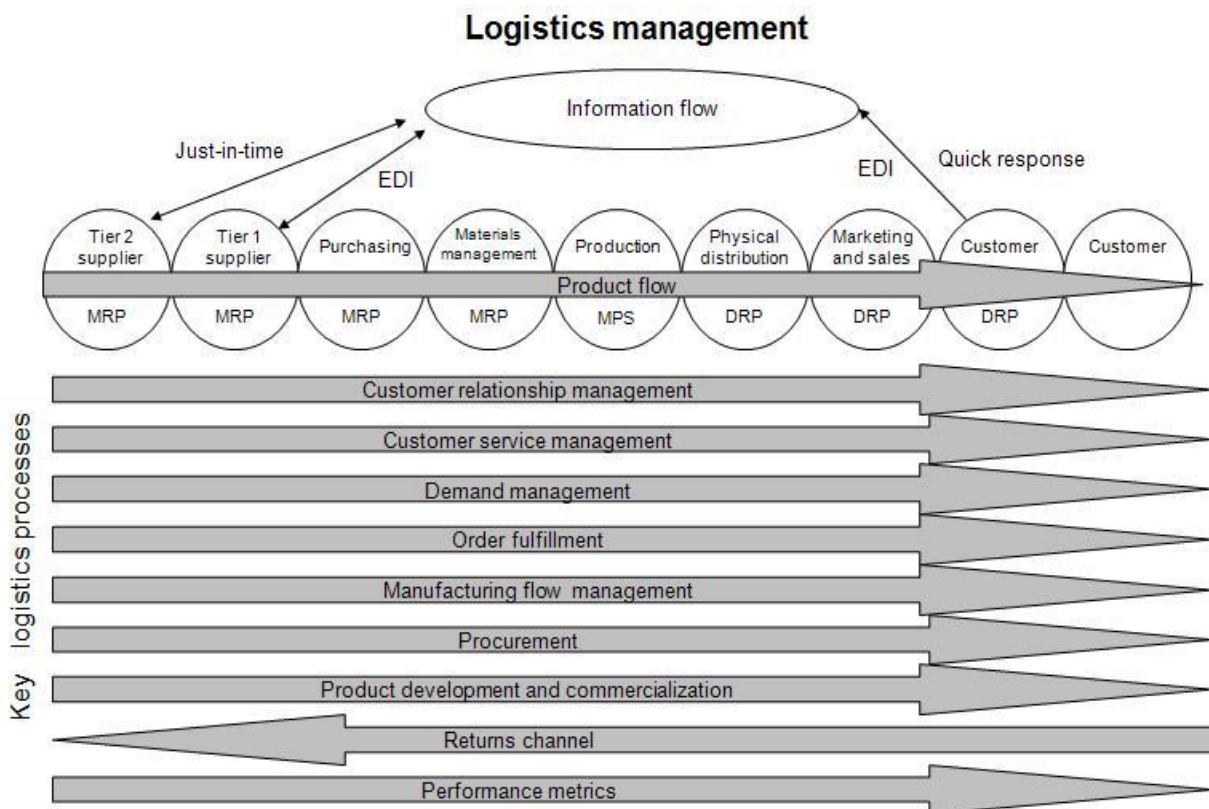


Figure 3.1 – Supply Chain Management

Purchasing is primarily responsible for inbound flows into an organization, whereas logistics spans both inbound and outbound relationships and material flows.

#### 3.2. Purchasing Activities

Purchasing was once looked upon primarily as a service function. As such, its responsibility was to meet the needs of the manufacturing function or other internal functions for which it was buying. It was not the responsibility of pur-

chasing to question those needs, forge long-term relationships with suppliers, or to understand the needs of the end customer.

This perspective severely limited the contribution that purchasing could make to the firm. In this scenario, purchasers had to focus primarily on a narrow set of activities to serve, the needs of the internal interlaces, such as production, marketing, operations, and others who needed to procure something from outside the organization. The scope of purchasing activities was defined and limited by those inside the organization.

Purchasing focused on getting the right product or service to the right place at the right time in the right quantity, in the right condition or quality, and from the right supplier at the right price.

Typically, purchasing was not seen as an activity of strategic importance. It involved following a series of prescribed steps, which included writing up a purchase order, contacting suppliers for pricing, and sometimes following up on a supplier who failed to deliver.

### **3.3. The Strategic Role of Purchasing**

The strategic role of purchasing is to perform sourcing-related activities in a way that supports the overall objectives of the organization. Purchasing can make many contributions to the strategic success of the organization through its key role as one of the organization's boundary-spanning functions.

1. *Access to external markets.* Through external contacts with the supply market, purchasing can gain important information about new technologies, potential new materials or services, new sources of supply, and changes in market conditions. By communicating this competitive intelligence, purchasing can help reshape the organization's strategy to take advantage of market opportunities.

2. *Supplier development and relationship management.* Purchasing can help support the organization's strategic success by identifying and developing new and existing suppliers. Getting suppliers involved early in the development of new products and services or modifications to existing offerings can reduce development times. The idea of time compression getting to market quickly with new ideas – can be very important to the success of those ideas and perhaps to

the organization's position as a market leader or innovator. Among the primary purchasing activities that influence the ability of the firm to achieve its objectives are supplier selection, evaluation and ongoing management (sourcing), total quality management, and purchasing planning and research.

3. *Relationship to other functions.* Virtually every department within an organization relies on the purchasing function for some type of information or support. Purchasing's role ranges from a support role to a strategic function. To the extent that purchasing provides value to other functional areas, it will be included in important decisions and become involved early in decisions that affect purchasing. Being well informed allows the purchasing function to better anticipate and support the needs of other functional areas. This support in turn leads to greater recognition and participation.

Purchasing often has the same functional reporting relationship as logistics, which is helpful for coordinating material's management. Purchasing and logistics need to work closely in coordinating inbound logistics and associated material flows.

### **3.4. Supplier Selection and Evaluation**

In the acquisition process, perhaps the most important activity is selecting the best supplier from among a number of suppliers that can provide the needed materials. The buying process is complex because of the variety of factors that must be considered when making a purchase. The process includes both decision makers and decision influencers, who combine to form the decision-making unit. Increasingly, organizations are using cross-functional teams to make important decisions.

Figure 3.2 shows a basic, *five-step purchasing process for managing supplier relationships* from the identification of a need to make a purchase through ongoing evaluation and follow-up. Purchasing managers may consider a broad range of factors when making the purchasing decision. These may include issues such as lead time, on-time delivery performance, ability to expedite, price competitiveness, and postpurchase sales support.



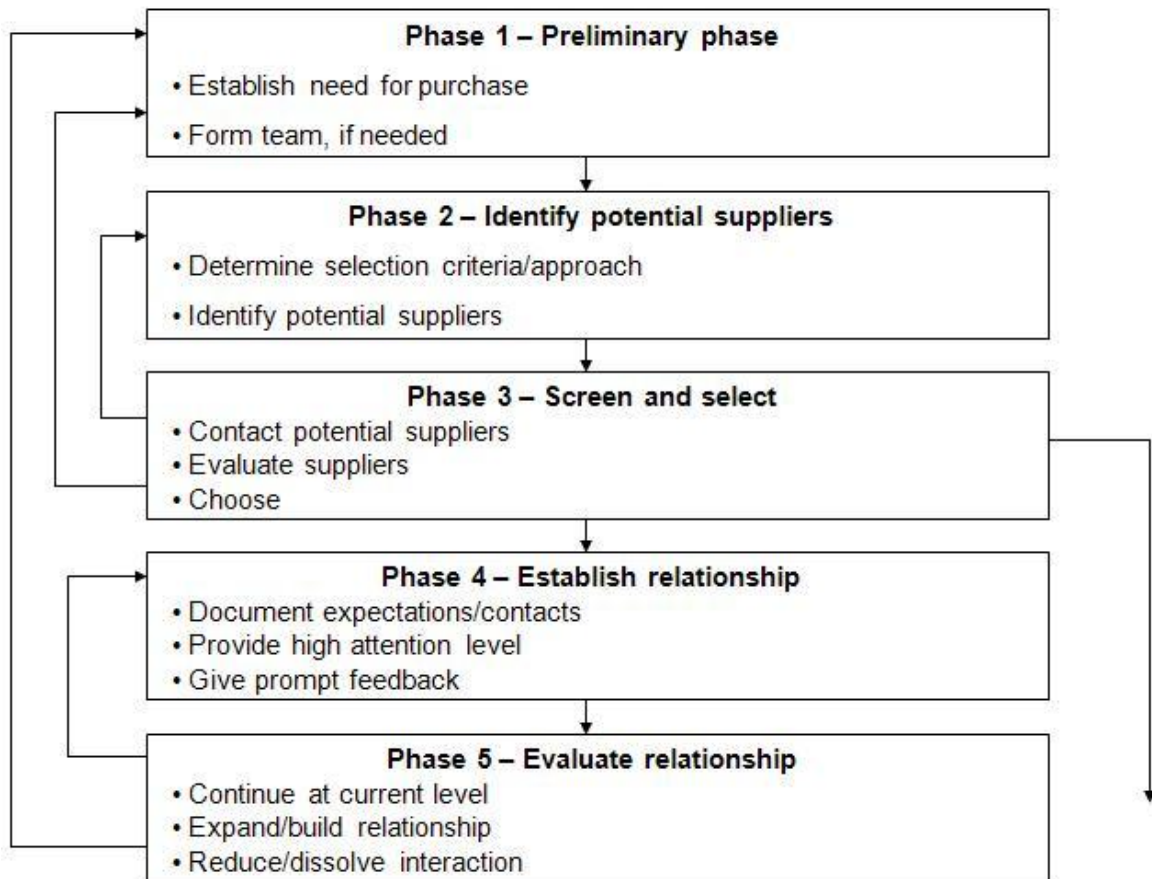


Figure 3.2 – Five-step purchasing process for managing supplier relationships

*Purchase Categories.* There are six major purchase categories in most companies: 1) component parts, 2) raw materials, 3) operating supplies, 4) support equipment, 5) process equipment, and 6) services. These may be routine, ongoing purchases or non-routine purchases that may require special attention because they represent a new buy, an infrequent purchase, a major acquisition or if there are problems or major opportunities (strategic, cost savings) associated with the buy.

To determine the impact of supplier performance on productivity, performance must be measured and evaluated (see phase 5 in Figure 3.2). Next, the data can be used to identify those suppliers with whom the firm wishes to develop long-term relationships, to identify problems so that corrective action can be taken, and to realize productivity improvements.

*Evaluating Suppliers.* Table 3.1 presents an example of an evaluation procedure.

Table 3.1 – An example of an evaluation procedure

Factor	Rating of supplier (1 = Worst rating, 5 = Highest rating) 1 2 3 4 5	Importance of factor to your firm (0 = No importance, 5 = Highest importance) 0 1 2 3 4 5	Weighted composite rating (0=Minimum, 25 = Maximum)
<u>Supplier A</u> Product reliability Price Ordering convenience ... After-sale service Total for supplier A			
<u>Supplier B</u> Product reliability Price Ordering convenience ... After-sale service Total for supplier A			
<u>Supplier C</u> Product reliability Price Ordering convenience ... After-sale service Total for supplier A			

### 3.5. Managing Supplier Relationships

#### Definition of Partnership

*A **partnership** is a tailored business relationship based on mutual trust, openness, shared risk and shared rewards that yields a competitive advantage, resulting in business performance greater than would be achieved by the firms individually.*

*Types of partnerships.* Relationships between organizations can range from arm's length relationships to vertical integration of the two organizations, as shown in Figure 3.3.

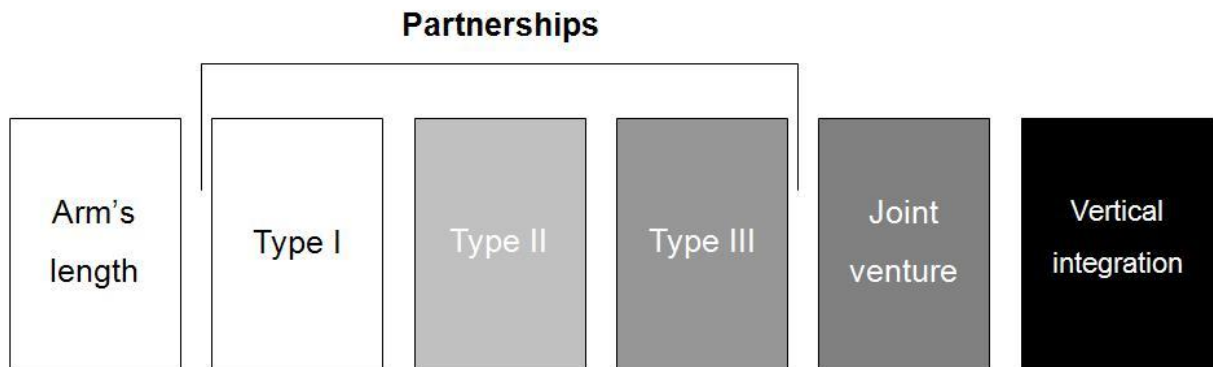


Figure 3.3 – Types of partnerships

Most relationships between organizations have been at *arm's length* where the two organizations conduct business with each other, often over a long period of time and involving multiple exchanges. However, there is no sense of joint commitment or joint operations between the two companies. In arm's length relationships, a seller typically offers standard products/services to a wide range of customers who receive standard terms and conditions. When the exchanges end, the relationship ends. Research has indicated that *three types of partnerships* exist.

*Type I.* The organizations involved recognize each other as partners and, on a limited basis, coordinate activities and planning. The partnership usually has a short-term focus and involves only one division or functional area within each organization.

*Type II.* The organizations involved progress beyond coordination of activities to integration of activities. Although not expected to last "forever," the partnership has a long-term horizon. Multiple divisions and functions within the firm are involved in the partnership.

*Type III.* The organizations share a significant level of integration. Each party views the other as an extension of their own firm. Typically no "end date" for the partnership exists.

Normally, a firm will have a wide range of relationships spanning the en-

tire spectrum, the majority of which will not be partnerships but arm's length associations. Of the relationships that are partnerships, the largest percentage will be Type I, and only a limited number will be Type III partnerships. Type III partnerships should be reserved for those suppliers or customers who are critical to an organization's long-term success.

### **The partnership model**

The partnership model shown in Figure 3.3 has *three major elements* that lead to outcomes: *drivers*, *facilitators*, and *components*. *Drivers* are compelling reasons to partner. *Facilitators* are supportive corporate environmental factors that enhance partnership growth and development. *Components* are joint activities and processes used to build and sustain the partnership. *Outcomes* reflect the performance of the partnership.

*Drivers.* Both parties must believe that they will receive significant benefits in one or more areas and that these benefits would not be possible without a partnership. The primary potential benefits that drive the desire to partner include: 1) asset / cost efficiencies, 2) customer service improvements, 3) marketing advantage, and 4) profit stability / growth. While the presence of strong drivers is necessary for successful partnerships, the drivers by themselves do not ensure success. The benefits derived from the drivers must be sustainable over the long term.

*Facilitators.* Facilitators are elements of a corporate environment that allow a partnership to grow and strengthen. They serve as a foundation for a good relationship. In the short run, facilitators cannot be developed; they either exist or they don't. And the degree to which they exist often determines whether a partnership succeeds or fails. Facilitators include: 1) corporate compatibility, 2) similar managerial philosophy and techniques, 3) mutuality and 4) symmetry.

Facilitators apply to the combined environment of the two potential partners. Therefore, unlike drivers, which are assessed in managers in each firm independently, facilitators should be assessed jointly. The discussion of corporate values, philosophies, and objectives often leads to an improved relationship even if no further steps toward building a partnership are taken. The more positive the facilitators, the better the chance of partnership success.

*Drivers and facilitators determine partnership type.*

*Components.* Components are the activities and processes that management establishes and controls throughout the life of the partnership. Components make the relationship operational and help managers create the benefits of partnering. Every partnership has the same basic components, but the way in which the components are implemented and managed varies. Components include: planning, joint operating controls, communications, risk/reward sharing, trust and commitment, contract style, scope, and financial investment.

*Outcomes and Feedback.* Whatever type of supplier partnership is implemented, the effectiveness of the relationship must be evaluated and possibly adjusted. The key to effective measurement and feedback is how well the drivers of partnership were developed at the outset. At this beginning point, the measurement and metrics of relating to each driver should have been made explicit. These explicit measures then become the standard in evaluation of the partnership outcomes. Feedback can loop back to any step in the model. Feedback can take the form of periodic updating of the status of the drivers, facilitators, and components.

### **Partnership Drivers**

- Asset/cost efficiency.
- Customer service.
- Marketing advantage.
- Profit stability/growth.

### **Partnership facilitators**

- Corporate compatibility.
- Management philosophy and techniques.
- Mutuality.
- Symmetry.

### **Partnership Components**

- Planning (style, level, and content).
- Joint operating controls (measurement and ability to make changes).

- Communications (nonroutine and day to day: organization, balanced flow, and electronic).
- Risk/reward sharing (loss tolerance, gain commitment, and commitment to fairness).
- Trust and commitment to each other's success).
- Contract style (timeframe and coverage).
- Scope (share of partner's business, value added, and critical activities).
- Investment (financial, technology, and people).

### **Partnership Outcomes**

- Global performance outcomes (enhancement of profits, leveling of profits over time).
- Process outcomes (improved service, reduced costs).
- Competitive advantage (market positioning, market share, access to knowledge).

### **Chapter Checklist**

1. Explain why supplier selection and evaluation is frequently considered the most important activity in the purchasing function.
2. What are some of the reasons that purchasing is taking on a more strategic role in organizations?
3. What are the major advantages of just-in-time purchasing? What are the possible difficulties in implementing a JIT system?
4. Why is it necessary for two firms to each have strong drivers if they are considering forming a partnership?
5. In the chapter it stated that the majority of a firm's relationships would be arm's length. Why do you think this would be the case?
6. Why are quality suppliers important to a firm? Why is this even more true in a JIT environment?

## 4. SUPPLY CHAIN MANAGEMENT

### 4.1. Definition of Supply Chain Management

*Channels* develop when many exchanges take place between producers and consumers. The alignment of firms that bring products or services to market has been called the *supply chain*, the demand chain or the value chain. The term supply chain is used to represent this alignment of firms.

*Supply Chain Management (SCM)* (figure 3.1) is a term that has grown significantly in use and popularity since the late 1980s, although considerable confusion exists about what it actually means. Many people use the term as a substitute or synonym for logistics. However, *the definition of supply chain management* is much broader than logistics.

1) *Supply Chain Management is the integration of business processes from end user through original suppliers that provides products, services, and information that add value for customer.*

2) *SCM is an integrative approach that considers both the inbound (upstream) and outbound (downstream) flow of materials, services and goods to the firm.*

### 4.2. Definition of a Channel of Distribution

**A channel of distribution** *can be defined as the collection of organizational units, institutions, or agencies within or external to the manufacturer, which perform the functions that support product marketing.* The marketing functions are pervasive: they include buying, selling, transporting, storing, grading, financing, bearing market risk, and providing marketing information. Any organizational unit, institution, or agency that performs one or more of the marketing functions is a member of a channel of distribution.

The structure of a distribution channel is determined by the marketing functions that specific organizations perform. Some channel members perform single functions—carriers transport products, and public warehousers store them. Others, such as third party logistics providers and wholesalers, perform multiple functions. Channel structure affects: 1) control over the performance of functions, 2) the speed of delivery and communication, and 3) the cost of operations.

While a *direct manufacturer-to-user channel* usually gives management

greater control over the performance of marketing functions, distribution costs normally are higher, making it necessary for the firm to have substantial sales volume or market concentration. With *indirect channels*, the external institutions or agencies (e.g. carriers, warehousers, wholesalers, retailers) assume much of the cost burden and risk, so the manufacturer receives less revenue per unit.

Most distribution channels are loosely structured networks of vertically aligned firms. The specific structure depends to a large extent on the *nature of the product* and the firm's *target market*. There is no "best" channel structure, for all firms producing similar products. Management must determine channel structure within the framework of the firm's corporate and marketing objectives, its operating philosophy, its strengths and weaknesses, and its infrastructure of manufacturing facilities and warehouses. If the firm has targeted multiple market segments, management may have to develop multiple channels to service these markets efficiently.

#### **4.3. Development of the Channels of Distribution**

The emergence of channels of distribution has been explained in terms of the following factors:

1. Intermediaries evolve in the process of exchange because they can increase the efficiency of the process by creating time, place, and possession utility.
2. Channel intermediaries enable the adjustment of the discrepancy of assortment by performing the functions of sorting and assorting. Discrepancy of assortment will be described shortly.
3. Marketing agencies form channel arrangements to make transactions routine.
4. Channels facilitate the searching process by consumers.

Marketing channels develop because intermediaries (e.g., wholesalers and retailers) make the marketing process more efficient by reducing the number of market contacts. In primitive cultures, for example, most household needs are met by family members. By many household needs can be met more efficiently by exchange. Specialization in production creates efficiency for this reason, it has become a way of life. A household must exchange goods and services to provide for all of its needs.

The advantage of an intermediary is greater as the number of specialized



producers increases.

*Intermediaries provide possession, time, and place utility.* They create possession utility through the process of exchange, the result of the buying and selling functions. They provide time utility by holding inventory available for sale. And they provide place utility by physically moving goods to the market. The assortment of goods and services held by a producer and the assortment demanded by the customer often differ. The primary function of channel intermediaries is to adjust this discrepancy by performing the following "sorting processes":

1. Sorting out.
2. Accumulating.
3. Allocation.
4. Assorting.

#### **4.4 Channel Structure**

*Channel structure* may be viewed as a function of product life cycle, logistics systems, effective communication networks, product characteristics, or firm. However, the most detailed theory of channel structure was developed by Louis P. Bucklin, who stated that the *purpose of the channel* is to provide consumers with the desired combination of its outputs (i.e., lot size, delivery time, and market decentralization) at minimal cost. Consumers determine channel structure by purchasing combinations of service outputs. The best channel forms when no other group of institutions generates more profits or more consumer satisfaction per dollar of product cost. Bucklin concluded that functions will be shifted from one channel member to another in order to achieve the most efficient and effective channel structure.

The factors that might influence channel structure include:

- ✓ Outsourcing.
- ✓ Posponement and speculation.
- ✓ Speed.
- ✓ Technological, cultural, physical, social, and political factors.
- ✓ Physical factors – geography, size of market area, location of production centers, and concentration of population.
- ✓ Local and state laws.

- ✓ Social and behavioral variables.

## 4.5 Flows in the Channel of Distribution

### Channel of Distribution

An example of the various channels of distribution that a manufacturer of grocery products might use is shown in Figure 4.1.

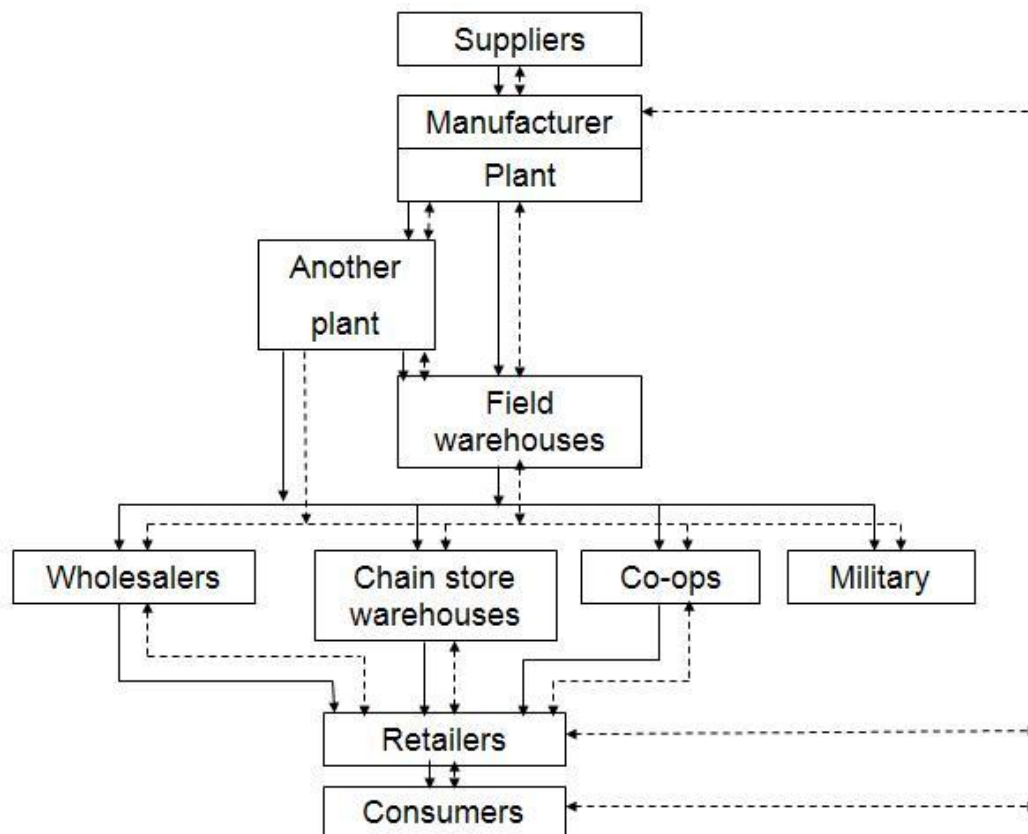


Figure 4.1 – Distribution's channels of a manufacturer of grocery products

The manufacturer sells its products to wholesalers, chain stores, cooperatives, and the military. The wholesalers and coops service retail accounts. Accounts are serviced by a national sales force.

### Product and Information Flows

Figure 4.1 illustrates the product and information flows that take place in a channel. Remember the product flows take place only after information flows are initiated. In addition to product and information flows, payments for the merchandise and promotional inventories back in the channel. The quality and speed of the information flows determine the safety stock held at each level of the

channel.

#### **4.6 Channel Design**

A firm must become involved in the channel design process when it is considering entering the market with a new product or when existing supply chains are falling short of performance objectives.

The *design process* consists of the following steps:

1. Establish objectives.
2. Formulate a strategy.
3. Determine structure alternatives.
4. Evaluate structure alternatives.
5. Select structure.
6. Determine alternatives for individual channel members.
7. Evaluate and select individual members.
8. Measure and evaluate channel performance.
9. Evaluate alternatives when performance objectives are not met, or attractive new options become available.

#### **4.7. Types of Distribution**

*Three types of distribution* can be used to make product available to consumers: 1) intensive distribution, 2) selective distribution and 3) exclusive distribution.

In *intensive distribution*, the product is sold to as many appropriate retailers or wholesalers as possible. Intensive distribution is appropriate for products such as chewing gum, candy bars, soft drinks, bread, film, and cigarettes where the primary factor influencing the purchase decision is convenience. Industrial products that may require intensive distribution include pencils, paperclips, transparent tape, file folders, typing paper, transparency masters, screws, and nails.

In *selective distribution*, the number of outlets that may carry a product is limited, but not to the extent of exclusive dealing. By carefully selecting wholesalers or retailers, the manufacturer can concentrate on potentially profitable accounts and develop solid working relationships to ensure that the product is properly merchandised. The producer also may restrict the number of retail outlets if the product requires specialized servicing or sales support. Selective distribution may be used for product categories such as clothing, appliances, televisions, ste-

reo equipment, home furnishings, and sports equipment.

When a single outlet is given an exclusive franchise to sell the product in a geographic area, the arrangement is referred to as *exclusive distribution*. Products such as specially automobiles, some major appliances, certain brands of furniture, and lines of clothing that enjoy a high degree of brand loyalty are likely to be distributed on an exclusive basis. This is particularly true if the consumer is willing to overcome the inconvenience of traveling some distance to obtain the product. Usually, exclusive distribution is undertaken when the manufacturer desires more aggressive selling on the part of the wholesaler or retailer, or when channel control is important, exclusive distribution may enhance the product's image and enable the firm to charge higher retail prices.

Sometimes manufacturers use multiple brands in order to offer exclusive distribution to more than one retailer or distributor. Exclusive distribution occurs more frequently at the wholesale level than at the retail level. In general, exclusive distribution lends itself to direct channels (manufacturer to retailer). Intensive distribution is more likely to involve indirect channels with two or more intermediaries.

#### **4.8. Product Characteristics**

Nine product characteristics should be analyzed by the channel designer:

- Product value.
- Technicality of the product.
- Degree of market acceptance.
- Degree of substitutability.
- Product bulk.
- Product perishability.
- Degree of market concentration.
- Seasonality.
- Width and depth of the product line.

#### **4.9. Processes of Integrated Supply Chain Management**

3M managers identified seven key processes requiring analysis which support the integrated SCM approach. These key processes are:

- Customer relationship management.
- Customer service management.
- Demand management.
- Order fulfillment.
- Manufacturing flow management.
- Procurement.
- Product development and commercialization.
- Returns channel process.

#### **Chapter Checklist**

1. Define supply chain management, including an identification of upstream and downstream supply chain elements.
2. Identify direct and indirect channels.
3. Why do channels of distribution develop?
4. Briefly describe utilities created by intermediaries.
5. Which steps does channel design process include?
6. What is meant by intensive, exclusive, and selective distribution? Give examples illustrating when each would be an acceptable strategy.
7. Explain how product characteristics influence channel design.
8. How can communications technology be used to improve channel efficiency and effectiveness?

## **5. TRANSPORTATION**

### **5.1. Time and Place Utility**

*Transportation* physically moves products from where they are produced to where they are needed. This movement across space or distance adds value to products. This value added is often referred to as *place utility*.

*Time utility* is created by warehousing and storing products until they are needed. Transportation is also a factor in time utility: it determines how fast and how consistently a product moves from one point to another. This is known as time-in-transit and consistency of service, respectively.

If a product is not available at the precise time it is needed there may be expensive repercussions, such as lost sales, customer dissatisfaction and production downtime, when the product is being used in the manufacturing process.

### **5.2. Transportation / Logistics / Marketing Interfaces**

Transportation moves products to markets that are geographically separated and provides added value to customers when the products arrive on time, undamaged, and in the quantities required. In this way, transportation contributes to the level of customer service, which is one of the cornerstones of customer satisfaction: an important component of the *marketing concept*.

Transportation is one of the largest logistics costs and may account for a significant portion of the selling price of some products. Low value per-pound products such as basic raw materials are examples. Transportation costs for computers, business machines, and electronic components may be only a small percentage of the selling price. Generally, the efficient management of transportation becomes more important to a firm as inbound and outbound transportation's share of product cost increases. Even with high value products, expenditures for transportation are important although the percentage of selling price must be low, primarily because the total cost of transportation in absolute terms is significant.

### 5.3. Factors Influencing Transportation Costs and Pricing

In general, factors influencing transportation cost/ pricing can be grouped into two major categories: *product-related factors* and *market-related factors*.

- *Product-Related Factors*. Many factors related to a product's characteristics influence the cost/pricing of transportation. They can be grouped into the following categories:

1. *Density*. Density refers to a product's weight-to-volume ratio.
2. *Stowability*. Stowability is the degree to which a product can fill the available space in a transport vehicle. A product's stowability depends on its size, shape, fragility, and other physical characteristics.
3. *Ease or difficulty of handling*. Related to stowability is the *ease or difficulty of handling* the product. Difficult-to-handle items are more costly to transport. Products that are uniform in their physical characteristics (e.g., raw materials and items in cartons, cans, or drums) or that can be manipulated with materials-handling equipment require less handling expense and are therefore less costly to transport.
4. *Liability*. Liability is an important concern. Products that have high value-to-weight ratios are easily damaged, and are subject to higher rates of theft or pilferage, cost more to transport. Where the transportation carrier assumes greater liability (e.g., with computer, jewelry, and home entertainment products), a higher price will be charged to transport the product.

Other factors, which vary in importance depending on the product category, are the product's hazardous characteristics and the need for strong and rigid protective packaging. These factors are particularly important in the chemical and plastics industries.

- *Market-Related Factors*. In addition to product characteristics, important market related factors affect transportation costs/pricing. The most significant are:

1. Degree of intramode and intermode competition.
2. Location of markets, which determines the distance goods must be transported.
3. Nature and extent of government regulation of transportation carriers.
4. Balance or imbalance of freight traffic into and out of a market.
5. Seasonality of product movements.

6. Whether the product is transported domestically or internationally.

#### **5.4. Carrier Characteristics and Services**

Any one or more of five transportation modes - motor, rail, air, water, and pipeline may be selected to transport products. In addition, intermodal combinations are available: rail-motor, motor-water, motor-air, and rail water.

- **Motor**

Motor carriers transport over 75 percent of the tonnage of agricultural products such as fresh and frozen meats, dairy products, bakery products, confectionery items, beverages, and consumer tobacco products. Many manufactured products are transported primarily by motor carriers, including amusement, sporting, and athletic goods; toys; watches and clocks; farm machinery; radios and television sets; carpets and rugs; clothing; drugs and office equipment and furniture. Most consumer goods are transported by motor carrier. Motor carriage offer fast, reliable service with little damage or loss in transit.

Domestically, motor carriers compete with air for small shipments and rail for large shipments. Efficient motor carriers can realize greater efficiencies in terminal, pickup to become the dominant form of transport in the Americas and in many other parts of the world. Many motor carriers, particularly those involved in just-in-time programs, operate on a scheduled timetable. This results in very short and reliable transit times.

The amount of freight transported by motor carriers has steadily increased over the years. Motor carriage has become an important part of the logistics networks of most firms because the characteristics of the motor carrier industry are more compatible than other transport mode's with the service requirements of the firms' customers. As long as it can provide fast, efficient service at rates between those offered by rail and air, the motor carrier industry will continue to prosper.

- **Rail**

In countries such as the People's Republic of China, and the former republics of the Soviet Union, rail is the dominant mode of transport.

Railroads have an average length of haul of approximately 763 miles. While rail service is available in almost every major metropolitan center in the world and in many smaller communities, the rail network is not nearly as extensive as the highway network.



Rail transport lacks the versatility and flexibility of motor carriers because it is limited to fixed track facilities. As a result, railroads--like air, water, and pipeline transport--provide terminal-to-terminal service rather than point-to-point service unless companies have a rail siding at their facility, in which case service would be point to point.

Rail transport generally costs less (on a weight basis) than air and motor carriage. For many shipments, rail does not compare favorably with other modes on loss and damage ratios. Compared to motor carriers, it has disadvantages in terms of transit time and frequency of service.

Many trains travel on timetable schedules, but depart less frequently than motor carriers. If a shipper has strict arrival and departure requirements, motor carriers usually have a competitive advantage over railroads.

- **Air**

Although increasing numbers of shippers are using air freight for regular service, most view air transport as a premium, emergency service because of its higher cost. But when an item must be delivered to a distant location quickly, air freight offers the quickest time-in-transit of any transport mode. For most shippers, however, these time sensitive shipments are relatively few in number or frequency. Modern aircraft have cruising speeds of 500 to 600 miles per hour and are able to travel internationally. The average length of haul domestically is more, than 800 miles, although international movements may be thousands of miles. To a great extent, domestic air lines compete directly with motor carriers and to a much lesser degree with rail carriers. Where countries are separated by large expanses of water, the major competitor for international air freight is water carriage.

Air carriers generally handle high-value products. Air freight usually cannot be cost-justified for low-value items, because the high price of air freight would represent too large a percentage of the product cost. Customer service considerations may influence the choice of transport, but only if service issues are more important than cost issues.

Air transport provides frequent and reliable service and rapid time-in-transit, but terminal and delivery delays and congestion may appreciably reduce some of this advantage. On a point-to-point basis over short distances, motor transport often matches or outperforms the total transit time of air freight. It is the

*total* transit time that is important to the shipper rather than the transit time from terminal to terminal.

- **Water**

Water transportation can be broken down into several distinct categories: 1) inland waterway, such as rivers and canals, 2) lakes, 3) coastal and intercoastal ocean, and 4) international deep sea. It is concentrated in low-value items where speed is not critical.

Other than in ocean transport, water carriers are limited in their movement by the availability of lakes, rivers, canals, or intercoastal waterways. Reliance on water carriage depends to a greater or lesser degree on the geography of the particular location.

Water carriage is the most inexpensive method of shipping high-bulk, low-value commodities.

- **Pipelines**

Pipelines are able to transport only a limited number of products, including natural gas, crude oil, petroleum products, water, chemicals, and slurry products. Natural gas and crude oil account for the majority of pipeline traffic. Oil pipelines transport approximately 18.4 percent of all domestic intercity freight traffic measured in ton-miles. Pipelines offer the shipper an extremely high level of service dependability at a relatively low cost. Pipelines are able to deliver their product on time because of the following factors:

- ✓ The flows of products within the pipelines are monitored and controlled by computer.
- ✓ Leaks and damages due to pipeline leaks or breaks are extremely rare.
- ✓ Climatic conditions have minimal effects on products moving in pipelines.
- ✓ Pipelines are not labor-intensive; therefore, strikes or employee absences have little effect on their operations.

The advantages in cost and dependability that pipelines have over other transport modes have stimulated shipper interest in moving other products by pipeline. Certainly, if a product is or can be liquid, gas, or slurry form, it can be transported by pipeline. As the costs of other modes increase, shipper may give additional consideration to pipelines as a mode of transport for nontraditional products.

- **Intermodal services**

In addition to the five basic modes of transport, a number of intermodal combinations are available to the shipper. The more popular combinations are *trailer-on-flatcar (TOFC)* and *container-on-flatcar (COFC)*. Intermodal movements combine the cost/ or service advantages of two or more modes in a single product movement.

### **5.5. Carrier Pricing**

Two forms or *methods of transportation pricing* can be utilized: *cost of service* and *value of service*. *Cost-of-service pricing* establishes transportation rates at levels that cover a carrier's fixed and variable costs, plus allowance for some profit. Transportation costs can vary within the cost-of-service pricing approach because of two major factors: distance and volume. Naturally, this approach is appealing because it establishes the lower limit of rates. However, it has some inherent difficulties.

First, a carrier must be able to identify its fixed and variable costs. This involves a recognition of the relevant cost components and an ability to measure these costs accurately. Many carrier firms are unable to measure costs precisely. Second, this approach requires that fixed costs be allocated to each freight movement (shipment). A second method of transportation pricing is *value-of-service pricing*. This approach is based on charging what the market will bear; and is based on the demand for transportation services and the competitive situation. This approach establishes the upper limit on rates. The rates set will maximize the difference between revenues received and the variable cost incurred for carrying a shipment. In most instances, competition will determine the price charged.

**Categories of Rates.** There are two types of charges assessed by carriers: *line-haul rates*, which are charged for the movement of goods between two points that are not in the same local pickup and delivery area, and *accessorial charges*, which cover all other payments made to carriers for transporting, handling, or servicing a shipment. *Line-haul rates* can be grouped into four types: 1) class rates, 2) exception rates, 3) commodity rates, and 4) miscellaneous rates.

1. *Class rates* reduce the number of transportation rates required by grouping products into classes for pricing purposes. A product's specific classifi-

cation is referred to as its class rating. A basic rate would be Class 100, with higher numbers representing more expensive rates and lower numbers less expensive rates. The charge to move a specific product classification between two locations is referred to as the rate. By identifying the class rating of a product, the rate per hundredweight (100 pounds) between any two points can be determined.

2. *Exception rates*, or exceptions to the classification, provide the shipper with rates lower than the published class rates. This type of rate was introduced in order to provide a special rate for a specific area, origin-destination, or commodity when competition or volume justified the lower rate. When an exception rate is published, the classification that normally applies is changed.

3. *Commodity rates* apply when a large quantity of a product is shipped between two locations on a regular basis. These rates are published on a point-to-point basis without regard to product classification.

4. *Contract rates* and *freight all kinds (FAK)* rates include other rates that apply in special circumstances. For example, contract rates are those negotiated between a shipper and carrier. They are formalized through a written contractual agreement between the two parties. These types of rates are increasing in usage because of the growth of contract carriage.

*Freight-all-kinds (FAK)* rates have developed in recent years and apply to shipments instead of products. They tend to be based on the costs of providing the transportation service: the products shipped can be of any type. The carrier provides the shipper with a rate per shipment based on the weight of the products being shipped. FAK rates have become very popular with companies such as wholesalers and manufacturers that ship a variety of products to retail customers on a regular basis.

➤ The *FOB pricing* terms that are offered by sellers to buyers have a significant impact on logistics generally and transportation specifically. For example, if a seller quotes a delivered price to the buyer's retail store location, the total price includes not only the cost of the product, but the cost of moving the product to the retail store.

➤ *In a delivered pricing system*, buyers are given a price that includes delivery of the product. As mentioned in the discussion of FOB pricing, this form of pricing is, in essence, FOB destination. The seller secures the transportation mode/carrier and delivers the product to the buyer. This option can be advanta-

geous to one or both parties of the transaction, depending on which variation of delivered pricing is used by the seller.

➤ *Zone Pricing.* Zone pricing is a method that categorizes geographic areas into zones. Each zone will have a particular delivery cost associated with it. The closer the zone to the seller, the lower the delivery cost; the farther away, the higher the delivery charge. Depending upon the buyer's location in a particular zone, some buyers will be paying more for delivery on a per mile basis than others.

➤ *Basing Point Pricing.* In a basing-point-pricing system, the seller selects one or more locations that serve as points of origin. Depending on which point of origin is selected by the seller, the buyer will pay delivery costs from that point to the buyer's location. The seller will often use a manufacturing plant, distribution center, port, live trade zone, and so forth as a basing point. This method can be good or bad for the buyer, depending on which basing point is selected.

➤ *Quantity discounts* can be cumulative or noncumulative. *Cumulative quantity discounts* provide price reductions to the buyer based on the amount of purchases over some prescribed period of time. *Noncumulative quantity discounts* are applied to each order and do not accumulate over a time period.

➤ *Allowances.* Sometimes, sellers will provide price reductions to buyers that perform some of the delivery function. For example, when using a delivered pricing system, the seller assumes all costs of delivery and adds those costs to the price of the product. If the buyer is willing to assume some of the delivery functions, the seller will often provide some allowances, or price reductions, to the buyer. The most common allowances are provided for customer pickup of the product or unloading of the carrier vehicle upon delivery at the customer's location. These services cost the seller money and if the buyer is willing to perform these functions, the seller can provide a price concession. The important element in making the right decisions about taking advantage of allowances is to know the costs associated with each delivery function. The allowance should be equal to, or greater than, the costs to the buyer for assuming these responsibilities.

➤ *Negotiated pricing.* Shippers are concentrating more business with fewer carriers and placing greater emphasis on negotiated pricing. The goal of the negotiation process is to develop an agreement that is mutually beneficial, recognizes the needs of the parties involved, and motivates them to perform. Because

most negotiations are based on cost-of service pricing, carriers should have precise measures of their costs. Only when all costs are considered can carriers and shippers work together to reduce the carriers' cost base.

### **Chapter Checklist**

1. What are time and place utility? How does the transportation function add utility to products?
2. Which factors influencing transportation costs and pricing?
3. Briefly describe the five transport modes, based on their economic and service characteristics.
4. What type of transport is the major competitor for air transport to a great extent?
5. What is the difference between cost-of-service and value-of-service pricing in transportation? How does each affect the rates charged by carriers?
6. In the evaluation of transportation modes, consistency of service is significantly more important to shippers than time-in-transit. What is the difference between the two terms? Identify some reasons why shippers consider consistency of service more important. In your answer, be sure to consider the impact on inventory levels.

## 6. LOGISTICS INFORMATION SYSTEMS

### 6.1. Introduction

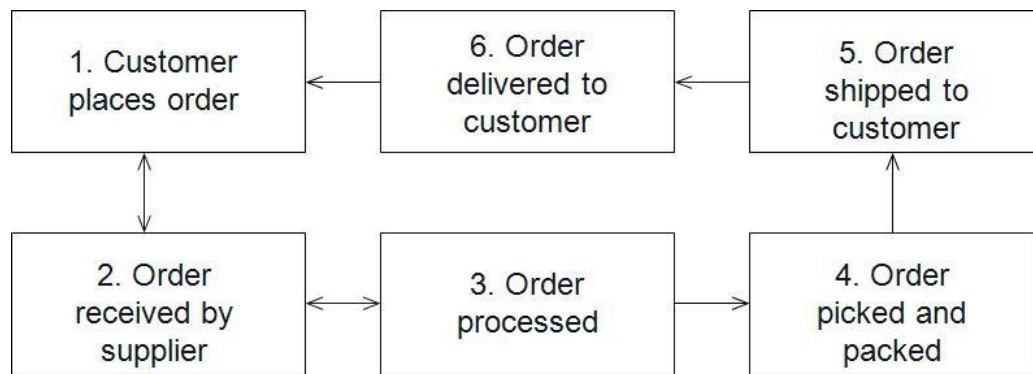
Computer and information technology has been utilized to support logistics for many years. It grew rapidly with the introduction of microcomputers in the early 1980s. Information technology is seen as the key factor that will affect the growth and development of logistics.

The *order processing system* is the nerve center of the logistics system. A customer order serves as the communications message that sets the logistics process in motion. The speed and quality of the information flows have a direct impact on the cost and efficiency of the entire operation. Slow and erratic communications can lead to lost customers or excessive<sup>1</sup> transportation, inventory, and warehousing costs, as well as possible manufacturing inefficiencies caused by frequent production line changes. The order processing, and information system forms the foundation for the logistics and corporate management information systems. It is an area that offers considerable potential for improving logistics performance.

Going beyond "transaction processing and tracking" *decision support systems (DSS)* are computer based and support the executive decision-making process. The DSS is an integrative system of subsystems that has the purpose of providing information to aid a decision maker in making better choices than would otherwise be possible.

### 6.2. Customer Order Cycle

The *customer order cycle* includes all of the elapsed time from the customer's placement of the order to the receipt of the product in an acceptable condition and its placement in the customer's inventory. The *typical order cycle* consists of the following components: 1) order preparation and transmittal, 2) order receipt and order entry, 3) order processing, 4) warehousing picking and packing, 5) order transportation, and 6) customer delivery and unloading. Figure 6.1 illustrates the flow associated with the order cycle.



Key:

1. Order preparation and transmittal – 2 days
2. Order received and entered into system – 1 day
3. Order processing – 1 day
4. Order picking/production and packing – 5 days
5. Transmit time – 3 days
6. Customer receiving and placing into storage – 1 day

Total order cycle time - 13 days

Figure 6.1 – The typical order cycle

### 6.3. The Path of a Customer Order

When studying a firm's order processing system, it is important to understand the information flow that begins when a customer places an order. Figure 6.2 represents one interpretation of the path that a customer's order might take. In the first step, shown at upper left, the customer recognizes the need for certain products and transmits an order to the supplier.

Once the order enters the order processing system, various checks are made to determine if 1) the desired product is available in inventory in the quantities ordered, 2) the customer's credit is satisfactory to accept the order, and 3) the product is scheduled for production if not currently in inventory. If these activities are performed manually, a great amount of time may be required, which can slow down (i.e., lengthen) the order cycle. The norm is that these activities are performed by computer in a minimal amount of time; often these activities can be performed simultaneously with other order cycle activities. The inventory file is then updated, product is back-ordered if necessary, and production is issued a report showing the inventory balance.



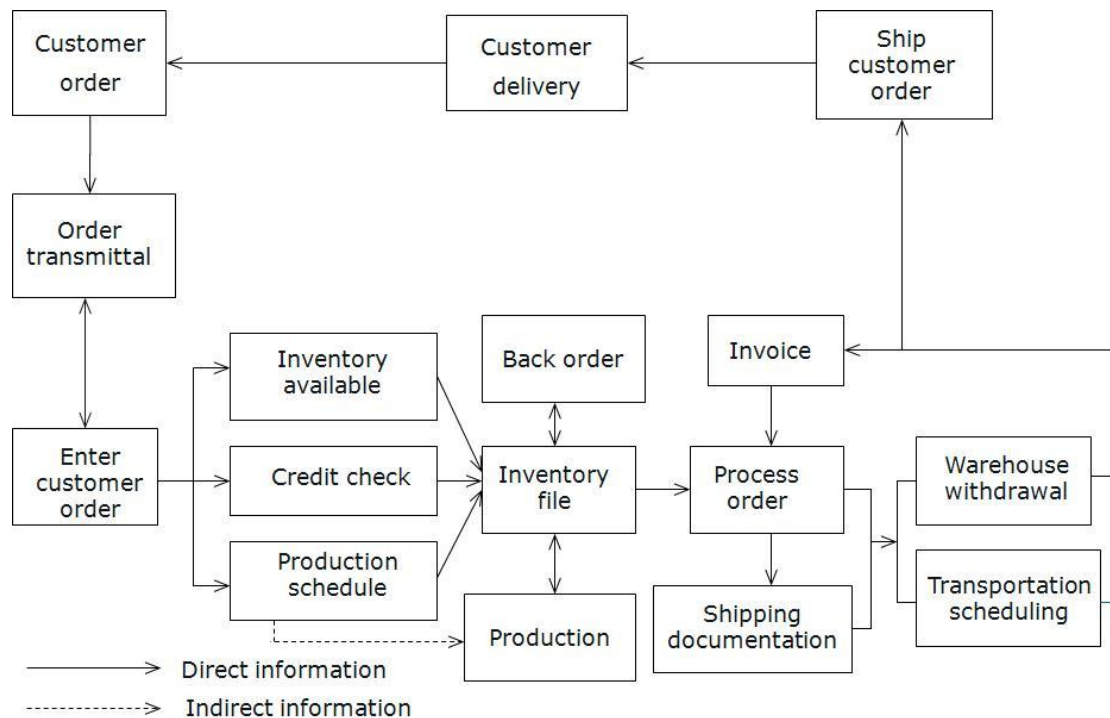


Figure 6.2 – An example of the customer's order path

#### 6.4. Definition of Electronic Data Interchange

*Electronic data interchange (EDI)* is the electronic, computer-to-computer transfer of standard business documents between organizations. EDI transmissions allow a document to be directly processed and acted upon by the receiving organization. Depending on the sophistication of the system, there may be no human intervention at the receiving end. EDI specifically replaces more traditional transmission of documents, such as mail, telephone, and even fax, and may go well beyond simple replacement, providing a great deal of additional information.

There are a couple of key points to note about the definition of EDI given above. First, the transfer is computer to computer, which means that fax transmissions do not qualify. Also, the transmission is of standard business documents/forms. Some of the purchasing-related documents that are currently being transmitted by EDI include purchase orders, material releases, invoices, electronic funds transfer (EFT) for payments, shipping notices, and status reports. Thus e-mail and sending information over the Internet, which is nonstandard, free form data, does not fit the definition of EDI.

## 6.5. EDI Standards

For EDI to function properly, computer language compatibility is required. First, the users must have common communication standards. This means that documents are transmitted at a certain speed over particular equipment, and the receiver must be able to accept that speed from that equipment. But this is not enough. In addition, the users must share a common language or message standard or have conversion capabilities. This means that EDI trading, partners must have a common definition of words, codes, and symbols; and a common formal and order of transmission.

One issue is the multitude of FDI protocols in use today. Some are unique systems created by and for a particular company. Some standards have been adopted within a certain-industry. The American National Standards Institute (ANSI) has proposed the use of the ANSI XI2 standard, which is a form of EDI that supports virtually all standard customer-order associated documents. This standard, adapted from the Transportation Data Coordinating Committee, is supported by the National Association of Purchasing Management.

## 6.6. Types of EDI Systems

Several types and variations of EDI systems are in use today. The main types of systems are *proprietary systems*, *value-added networks (VANs)*, and industry associations which were mentioned above. The difference between a proprietary system and a VAN is illustrated in Figure 6.3.

1) *Proprietary Systems*. Proprietary systems, also known as *one-to-many systems*, are aptly named, because they involve an EDI system which is owned, managed, and maintained by a single company. That company buys from, and is directly connected with, a number of suppliers. This situation works best when the company that owns the system is relatively large and powerful, and can readily persuade key suppliers to become part of the network.

The *advantage* to the system owner is control. The *disadvantages* are that it may be expensive to establish and maintain internally, and suppliers may not want to be part of the system because it is unique and may require a dedicated terminal.

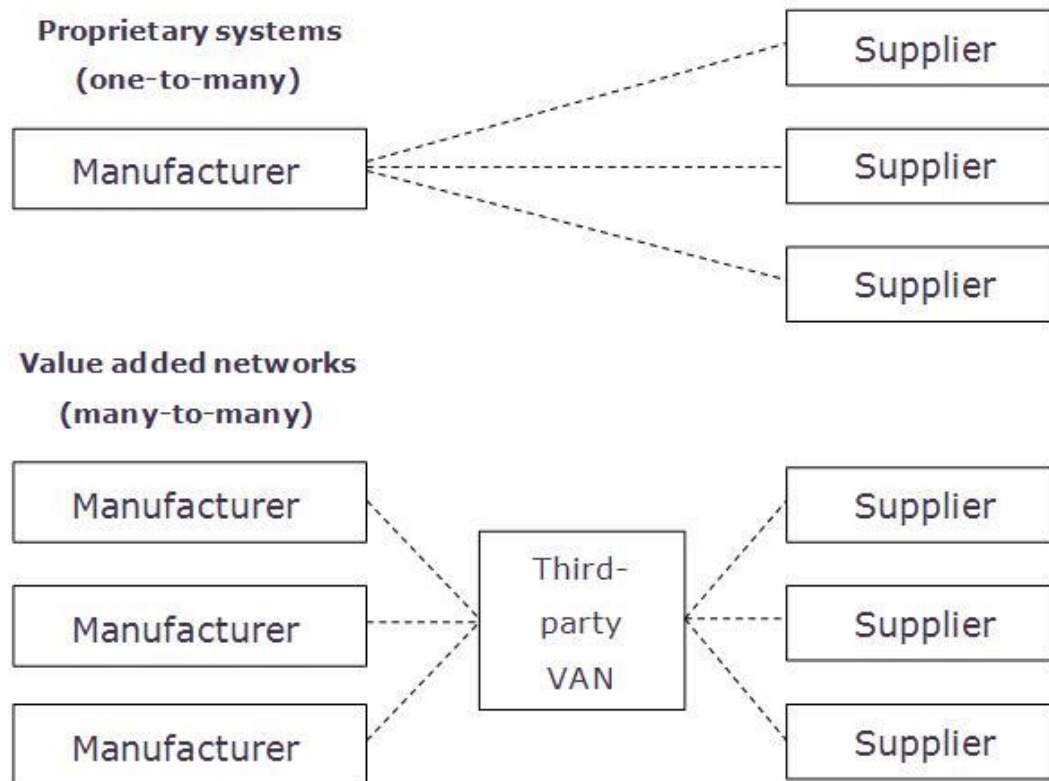


Figure 6.3 – Types of EDI systems

2) *Value-Added Networks*. Value added networks, also known as VANs, third-party networks, or *many-to-many systems*, appear to be the most popular choice for EDI systems. Under VANs, all of the EDI transmissions go through a third party firm, which acts as a central clearinghouse.

For example, a buying firm sends a number of purchase orders (POs) which go to different suppliers through the VAN. The VAN sorts the POs by supplier and transmits them to the proper supplier. The real "value added" comes in when buyers and suppliers use incompatible communication and/or message standards. The VAN then performs translation "invisibly," so that the user does not need to worry about system compatibility with its trading partners. This represents a big *advantage* over one-to-many systems.

In addition, the users do not need expertise in EDI standards and issues, as many VANs provide *turnkey*, off-the-shell systems. This can lower start up costs and reduce, start-up lead time.

Furthermore, a value-added network generally utilizes a "mailbox" feature. With the mailbox, orders and other documents are not transmitted automatically to the receiver when they arrive in the network. Instead, the receiver "picks up"

the documents whenever it chooses. This may be at a regular time several times a day, to allow those sending the documents in plan accordingly. This gives to receive flexibility, particularly if orders are placed or released to be filled at certain times. The user's system does not need to be cluttered with information that will not be acted upon immediately.

Yet another advantage of a VAN is that it can receive from and transmit to one-to-many systems. This means that the supplier who has a customer or customers that use proprietary systems does not need to have a dedicated terminal or direct linkage for each system. This capability of a VAN can increase the acceptability of networking with a customer who uses a proprietary system.

### **6.7. Benefits of EDI Implementation**

The potential benefits of EDI are many. They include:

1. Reduced paper work to be created and filed.
2. Improved accuracy due to a reduction in manual processing.
3. Increased speed of order transmission and other data.
4. Reduced clerical/administrative effort in data entry, filing, mailing and related tasks.
5. Opportunity of proactive contribution by purchasing because less time is spent on “clerical tasks”.
6. Reduced costs of order placement and related processing and handling.
7. Improved information availability due to speed of acknowledgments and shipment advices.
8. Reduced workload and improved accuracy of other departments through linking EDI with other systems, such as bar-coding inventory and electronic funds transfers (EFTs).
9. Reduced inventory due to improved accuracy and reduced order cycle time.

Most of these benefits are self-explanatory. The reduction in clerical work is a major benefit, reducing paperwork, increasing accuracy and speed, and allowing purchasing to shift its attention to more strategic issues.

The above improvements also should bring about a reduction in costs. One expert estimates that EDI can reduce the cost of processing a purchase order by 80 percent. Other firms claim that they have been able to reduce their inventory

dramatically owing to improved inventory accuracy and reduced order cycle time.

### **6.8. Integrating Order Processing and the Company's Logistics Management Information System**

The order processing system sets many logistics activities in motion, such as:

- Determining the transportation mode, carrier, and loading sequence.
- Inventory assignment and preparation of picking and packing lists.
- Warehouse picking and packing.
- Updating the inventory file: subtracting actual products picked.
- Automatically printing replenishment lists.
- Preparing shipping documents (a bill of lading if using a common carrier).
- Shipping the product to the customer.

#### *Using of a logistics information system*

A logistics management information system is necessary to provide management with the ability to perform a variety of tasks, including the following:

- ✓ Penetrate new markets.
- ✓ Make changes in packaging design.
- ✓ Choose between common, contract, or private carriage.
- ✓ Increase or decrease inventories.
- ✓ Determine the profitability of customers.
- ✓ Establish profitable customer service levels.
- ✓ Choose between public and private warehousing.
- ✓ Determine the number of field warehouses and the extent to which the order processing system should be automated.

To make these strategic decisions, management must know how costs and revenues will change given the alternatives being considered.

Once management has made a decision, it must evaluate performance on a routine basis to determine 1) if the system is operating under control and at a level consistent with original profit expectations, and 2) if current operating costs justify an examination of alternative systems. This is referred to as operational

decision making. The order processing system can be a primary source of information for both strategic and operational decision making.

#### *Sourcing of data for a logistics information system*

Data for a logistics information system can come from many sources. The most significant sources of data for the common database are 1) the order processing system, 2) company records, 3) industry/external data, 4) management data, and 5) operating data. The type of information most commonly provided by each of these sources is shown in Figure 6.4.

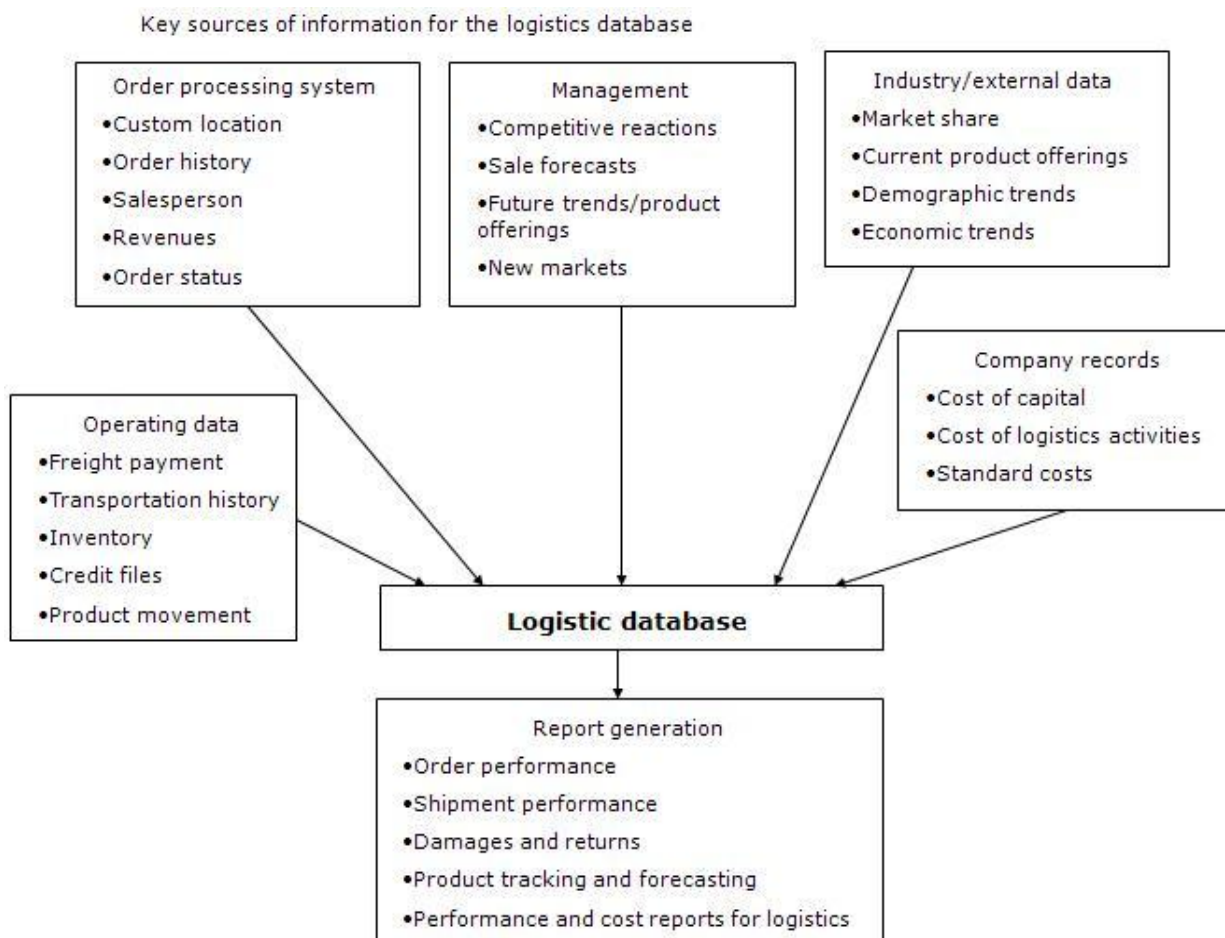


Figure 6.4 – Key sources of information for the logistics database

Usually, the database contains computerized data files, such as the freight payment system, transportation history, inventory status, open orders, deleted orders, and standard costs for various logistics, marketing, and manufacturing activities. The computerized information system must be capable 1) data retrieval, 2) data processing, 3) data analysis, and 4) report generation.

## **Chapter Checklist**

1. What is the order processing system?
2. Briefly describe the role of decision support systems in logistics decision making.
3. Which components does the typical order cycle include?
4. When does information flow begin?
5. Identify requirements for proper working of EDI.
6. What is the principal difference between a proprietary system and a VAN?
7. What are primary benefits of EDI implementation?
8. Which logistics activities does the order processing system set?
9. How does the order processing system form the foundation of the logistics management information system?
10. How is the logistics management information system used to support planning of logistics operations?

## 7. INVENTORY CONCEPTS

### 7.1. Basic Inventory Concepts

Formulation of an inventory policy requires an understanding of the role of inventory in production and marketing. Inventory serves five purposes within the firm:

1. It enables the firm to achieve economies of scale.
2. It balances supply and demand.
3. It enables specialization in manufacturing.
4. It provides protection from uncertainties in demand and order cycle.
5. It acts as a buffer between critical interfaces within the channel of distribution.

*Work-in-process inventory* is often maintained between manufacturing operations within a plant to avoid a shutdown if a critical piece of equipment were to break down, and to equalize flow, since not all manufacturing operations produce at the same rate. The stockpiling of work-in-process within the manufacturing complex permits maximum economies of production without work stoppage. Increasingly, organizations are focusing on rebalancing production processes to minimize or eliminate the need for work-in-process inventory.

*Finished goods inventory.* Finished goods inventory can be used as a means of improving customer service levels by reducing the likelihood of a stockout due to unanticipated demand or variability in lead time. If the inventory is balanced, increased inventory investment will enable the manufacturer to offer higher levels of product availability and less chance of a stockout. A balanced inventory is one that contains items in proportion to expected demand.

*Inventory as a Buffer.* Inventory is held throughout the supply chain to act as a buffer for the following critical interfaces:

- Supplier – procurement (purchasing).
- Procurement – production.
- Production – marketing.
- Marketing – distribution.
- Distribution – intermediary.
- Intermediary – consumer/user.

Because channel participants are separated geographically, it is necessary



for inventory to be held throughout the supply chain to successfully achieve time and place utility. Figure 7.1 shows the typical inventory positions in a supplier–manufacturer–intermediary–consumer supply chain.

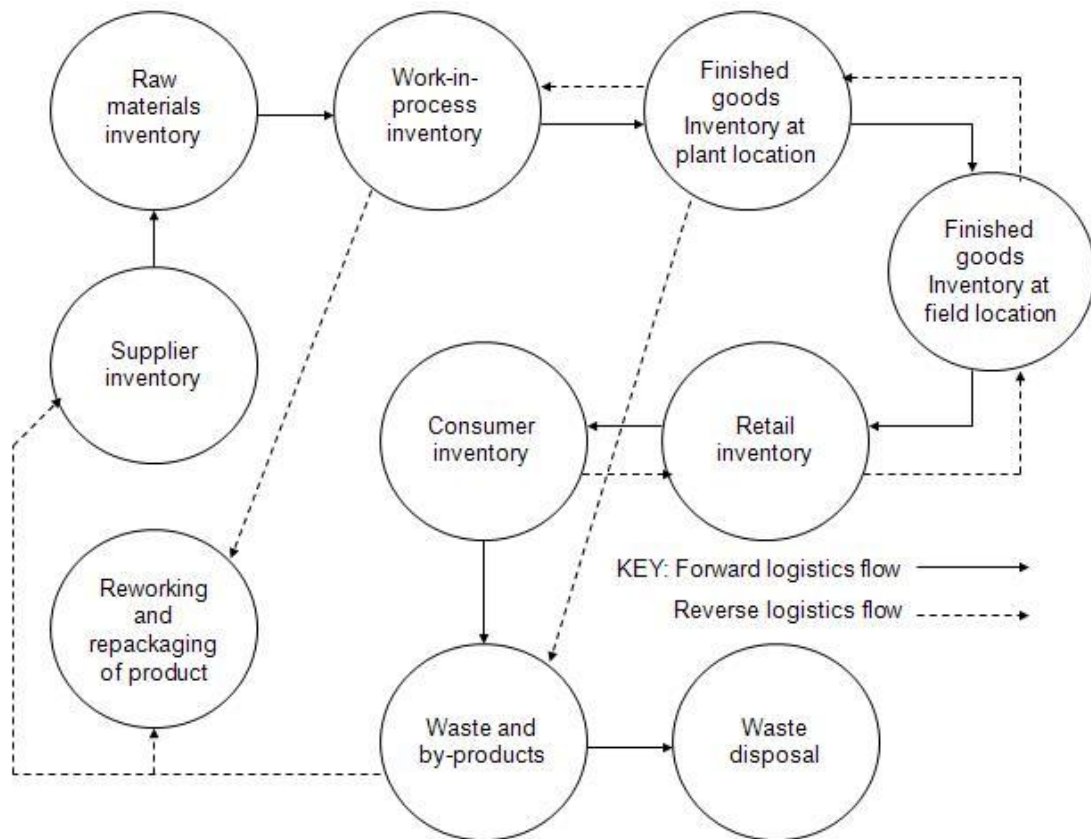


Figure 7.1 – The typical inventory positions in a supply chain

## 7.2. Types of Inventory

Inventories can be classified based on the reasons for which they are accumulated. The categories of inventories include cycle stock, in-transit inventories, safety or speculative stock, seasonal stock, and dead stock.

1. *Cycle Stock*. Cycle stock is inventory that results from replenishment of inventory sold or used in production. It is required in order to meet demand under conditions of certainty; that is, when the firm can predict demand and replenishment times (lead times). For example, if the rate of sales for a product is a constant 20 units per day and the lead time is always 10 days, no inventory beyond the cycle stock would be required.

2. *In-Transit Inventories*. In transit inventories are items that are en route from one location to another. They may be considered part of cycle stock even

through they are not available for sale or shipment until after they arrive at the destination. For the calculation of inventory carrying costs, in-transit inventories should be considered as inventory at the place of shipment origin since the items are not available for use, sale, or subsequent reshipment.

3. *Safety or Buffer Stock*. Safety or buffer stock is held in excess of cycle stock because of uncertainty in demand or lead time. Average inventory at a stockkeeping location that experiences demand or lead time variability is equal to half the order quantity plus the safety stock.

4. *Speculative stock*. Speculative stock is inventory held for reasons other than satisfying current demand. For example, materials may be purchased in volumes larger than necessary in order to receive quantity discounts, because of a forecasted price increase or materials shortage, or to protect against the possibility of a strike. Production economies also may lead to the manufacturer of products at times other than when they are in demand.

5. *Seasonal Stock*. Seasonal stock is a form of speculative stock that involves the accumulation of inventory before a seasonal period begins. This often occurs with agricultural products and seasonal items. The fashion industry also is subject to seasonality with new fashions coming out many times a year. The back-to-school season is a particularly important time.

6. *Dead Stock*. Dead stock refers to items for which no demand has been registered for some specified period of time. Dead stock might be obsolete throughout a company or only at one stockkeeping location. If it is the latter, the items may be transshipped to another location to avoid the obsolescence penalty or mark down at their current location.

### **7.3. Basic Inventory Management**

Inventory is a major use of working capital. Accordingly, the *objectives of inventory management* are to increase corporate profitability through improved inventory management, to predict the impact of corporate policies on inventory levels, and to minimize the total cost of logistics activities while meeting customer service requirements.

#### *Inventory management under conditions of certainty*

Replenishment policy under conditions of certainty requires the balancing of ordering costs against inventory carrying costs. For example, a policy of order-

ing large quantities infrequently may result in inventory carrying costs in excess of the savings in ordering costs. Ordering costs for products purchased from an outside supplier typically include 1) the cost of transmuting the order, 2) the cost of receiving the product, 3) the cost of placing it in storage, and 4) the cost of processing the invoice for payment.

In restocking its own field warehouses, a company's ordering costs typically include 1) the cost of transmitting and processing the inventory transfer, 2) the cost of handling the product if it is in stock, or the cost of setting up production to produce it, and the handling cost if the product is not in stock, 3) the cost of receiving at the held location, and 4) the cost of documentation. Remember that only direct out-of-pocket expenses should be included in ordering costs.

**7.4. Economic Order Quantity.** The best ordering policy can be determined by the total of inventory carrying costs and ordering costs using the *economic order quantity (EOQ)* model. The EOQ is a "concept which determines the optimal order quantity on the basis of ordering and carrying costs. When incremental ordering costs equal incremental carrying costs, the most economic order quantity exists. It does not optimize order quantity and thus the shipment quantity, on the basis of total logistics costs, but only ordering and carrying costs.

The EOQ in units can be calculated using the following formula:

$$EOQ = \sqrt{\frac{2PD}{CV}}, \quad (7.1)$$

where  $P$  – the ordering cost (dollars per order),  $D$  – annual demand or usage of product (number of units),  $C$  – Annual inventory carrying cost (as a percentage of product cost or value),  $V$  – Average cost or value of one unit of inventory.

The EOQ model has received significant attention and use in industry, but it is not without its limitations. The simple EOQ model is based on the following assumptions:

1. A continuous, constant, and known rate of demand.
2. Constant and known replenishment or lead time.
3. Constant purchase price independent of the order quantity or time.
4. Constant transportation cost independent of the order quantity or time.
5. The satisfaction of all demand (no stockouts are permitted).
6. No inventory in transit.

7. Only one product in inventory or at least no interaction between products (independent demand items).

8. An infinite planning horizon.

9. No limit on capital availability.

It would be very unusual to find a situation where demand and lead time are constant, both are known with certainty, and costs are known precisely. However, the simplifying assumptions are of great concern only if policy decisions will change as a result of the assumptions made. The EOQ solution is relatively insensitive to small changes in the input data.

*Adjustments to the EOQ.* Typical refinements that must be made to the EOQ model include adjustments for volume transportation rates and for quantity discounts. The simple EOQ model did not consider the impact of these two factors. The following adjustment can be made to the EOQ formula so that it will consider the impact of quantity discounts and or freight breaks:

$$Q^1 = 2 \frac{rD}{C} + (1 - R)Q^0, \quad (7.2)$$

where  $Q^1$  – the maximum quantity that can be economically ordered to qualify for a discount on unit cost,  $r$  – the percentage of price reduction if a larger quantity is ordered,  $D$  – the annual demand in units,  $C$  – the inventory carrying cost percentage,  $Q^0$  – the EOQ based on current price.

### 7.5. Fixed Order Point versus Fixed Order Interval Policy

1. *Fixed order point.* The EOQ represents a *fixed order point* policy. Once the EOQ has been determined, we order a fixed quantity each time, based on the EOQ. Actual demand may cause the time between orders to vary. An order is placed when inventory on hand reaches a predetermined minimum level necessary to satisfy demand during the order cycle. The automated inventory control system normally generates an order or at least a management report when the reorder point is reached.

2. *Fixed order interval.* Another reorder policy is the *fixed order interval* approach. Under this approach, inventory levels are reviewed at a certain, set time interval, perhaps every week. An order is placed for a variable amount of inventory, whatever is required to get the company back to its desired inventory

level. This approach is common where many items are purchased from the same supplier. A weekly order may be placed to reduce ordering costs and take advantage of purchase volume discounts and freight consolidation.

### 7.6. Inventories and Customer Service

The establishment of a service level, and thus a safety stock policy, is a matter of managerial judgment. Management should consider factors such as customer relations, customer wants and needs, competitive service levels, and the ability of the firm to support continuous production processes.

In many companies, management improves customer service levels simply by adding safety stock because the cost of carrying inventory has often not been calculated for the firm or has been set arbitrarily at an artificially low level. Figure 7.2 illustrates the relationship between customer service levels and inventory investment.

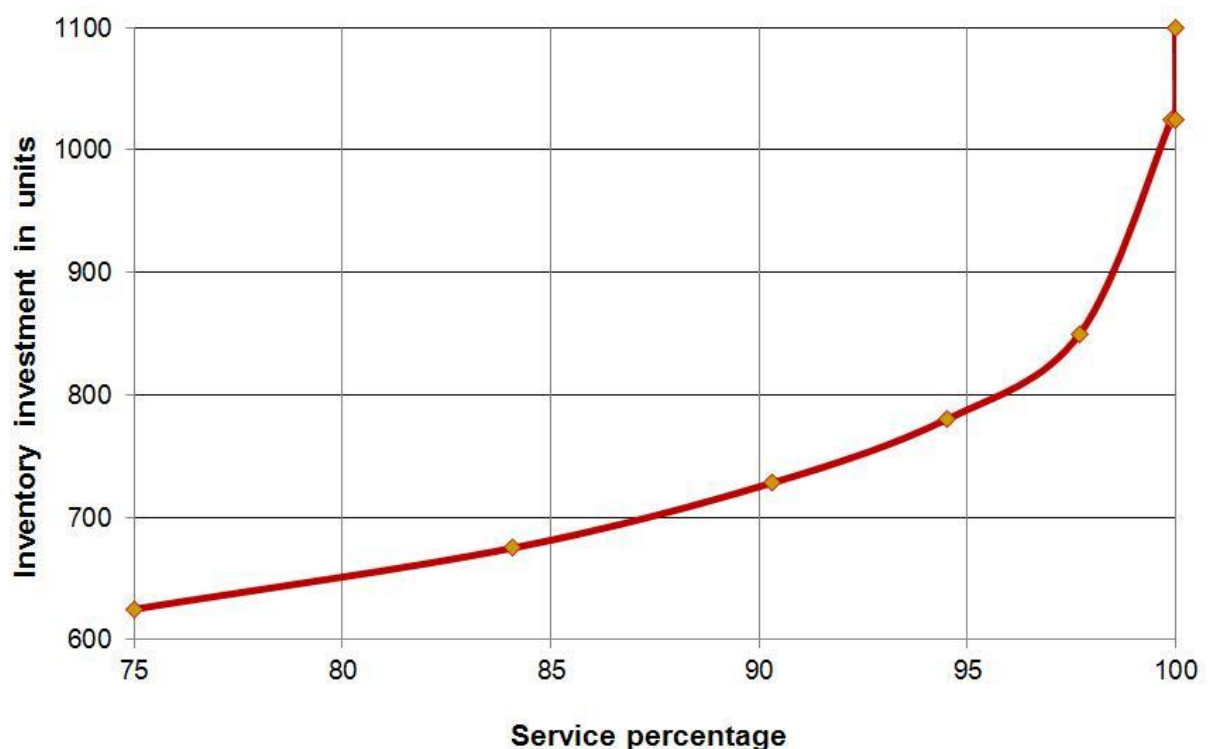


Figure 7.2 – Relationship between inventory investment and customer service levels

## **Chapter Checklist**

1. Why is inventory so important to the efficient and effective management of a firm?
2. Briefly describe the types of inventory.
3. How does uncertainty in demand and lead time affect inventory levels?
4. How does the economic order quantity model mathematically select the most economical order quantity?
5. What assumptions are used for the simple EOQ model?
6. Briefly describe the EOQ model with the adjustments.
7. Explain the basic differences between a fixed order point and a fixed order interval inventory model.

## 8. WAREHOUSING

### 8.1. Nature and Importance of Warehousing

Warehousing has traditionally provided storage of products (referred to as inventory) during all phases of the logistics process. *Two basic types of inventories* can be placed into storage: 1) raw materials, components, and parts (physical supply); and 2) finished goods (physical distribution). Also, there may be inventories of goods-in-process and materials to be disposed of or recycled, although in most firms these constitute only a small portion of total inventories.

*Why do companies hold inventories in storage?* Traditionally, the warehousing of products has occurred for one or more of the *following reasons*:

1. Achieve transportation economies.
2. Achieve production economies.
3. Take advantage of quantity purchase discounts and forward buys.
4. Maintain a source of supply.
5. Support the firm's customer service policies.
6. Meet changing market conditions (e.g. seasonably, demand fluctuations, competition).
7. Overcome the time and space differentials that exist between producers and consumers.
8. Accomplish least total cost logistics commensurate with a desired level of customer service.
9. Support the just-in-time programs of suppliers and customers.
10. Provide customers with a mix of products instead of a single product on each order.
11. Provide temporary storage of materials to be disposed of or recycled (i.e., reverse logistics).

*Several Uses of Warehousing.* Figure 8.1 identifies some of the uses of warehousing in both the physical supply and physical distribution systems. Warehouses can be used to support manufacturing, to mix products from multiple production facilities for shipment to a single customer, to breakbulk or subdivide a large shipment of product into many smaller shipments to satisfy the needs of many customers, and to combine or consolidate a number of small shipments into a single higher-volume shipment.

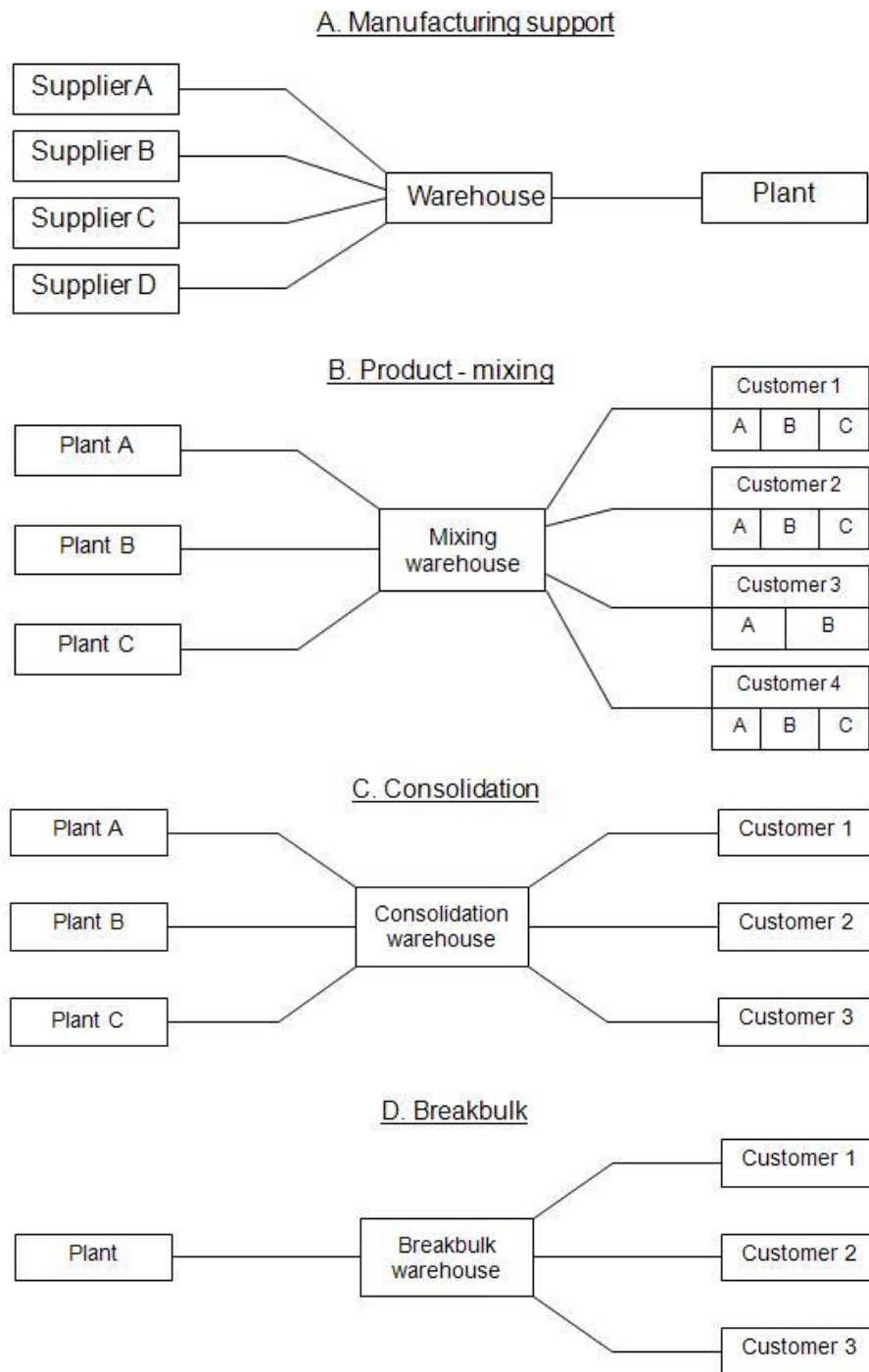


Figure 8.1 – Several uses of warehousing

**Pull versus Push systems in warehousing.** The traditional method of distribution is a *push system*. Production plans are based on capabilities and capacities of the plant, and product is produced in the expectation that it will sell. When it is produced faster than it can be sold, it is stockpiled at plant warehouses. If sales cannot be accelerated, then the plant will be slowed down until supply



moves into balance with demand. In this system, warehousing serves to absorb excess production (избыточное производство). Today's *pull system* depends on information. It is based on a constant monitoring of demand. With a pull system, there is no need for a reservoir. Instead, the warehouse serves as a flow through center, offering improved service by positioning inventory closer to the customer.

## 8.2. Types of Warehousing

In general, firms have a number of warehousing alternatives. Some companies may market products directly to retail customers (called **direct store delivery**), thereby eliminating warehousing in the field. Mail-order catalog companies, for example, utilize warehousing only at a point of origin, such as sales headquarters or plant.

**Cross-Docking.** Another alternative is to utilize cross docking concepts, whereby warehouses serve primarily as "distribution mixing centers." Product arrives in bulk and is immediately broken down and mixed in the proper range and quantity of products for customer shipment. In essence, the product never enters the warehouse.

Cross-docking is becoming popular among retailers, who can order TL, then remix and immediately ship to individual store locations. Products usually come boxed for individual stores from the supplier's location.

Most firms warehouse products at some intermediate point between plant and customers. When a firm decides to store product in the field, it faces two warehousing options: rented facilities, called *public warehousing* or owned or leased facilities, called *private warehousing*.

**Contract Warehousing.** Another option exists, termed *contract warehousing*, which is a variation of public warehousing. Contract warehousing is an arrangement between the user and provider of the warehousing service. It has been defined as:

*... a long term mutually beneficial arrangement which provides unique and specially tailored warehousing and logistics services exclusively to one client, where vendor and client share the risks associated with the operation. There is the focus on productivity, service and efficiency, not the fee and rate structure itself.*

**Public Warehouses.** There are many types of public warehouses, including: 1) *general merchandise warehouses for manufactured goods*, (2) *refrigerated or cold storage warehouses*, (3) *bonded warehouses*, (4) *household goods and furniture warehouses*, (5) *special commodity warehouses*, and (6) *bulk storage warehouses*. Each type provides users with a broad range of specialized services.

1. *General Merchandise Warehouse.* The general merchandise warehouse is probably the most common form. It is designed to be used by manufacturers, distributors, and customers for storing almost any kind of product.

2. *Refrigerated Warehouses.* Refrigerated or cold storage warehouses provide a temperature-controlled storage environment. They tend to be used for preserving perishable items such as fruits and vegetables. However, a number of other items (e.g., frozen food products, some pharmaceuticals, photographic paper and film, and furs) require this type of facility.

3. *Bonded Warehouses.* Some general merchandise or special commodity warehouses are known as bonded warehouses. These warehouses undertake surety bonds from the U.S. Treasury and place their premises under the custody of an agent of the Treasury. Goods such as imported tobacco and alcoholic beverages are stored in this type of warehouse, although the government retains control of the goods until they are distributed to the marketplace. At that time, the importer must pay customs duties to the Internal Revenue Service. The advantage of the bonded warehouse is that import duties and excise taxes need not be paid until the merchandise is sold, so that the importer has the funds on hand to pay these fees.

4. *Household goods Warehouses.* Household goods warehouses are used for storage of personal property rather than merchandise. The property is typically stored for an extended period as a temporary layover option. Within this category of warehouses, there are *several types of storage alternatives*. One is the *open storage concept*. The goods are stored on a cubic-foot basis per month on the open floor of the warehouse. Household goods are typically confined to this type of storage. A second kind of storage is *private room or vault storage*, where users are provided with a private room or vault to lock in and secure goods. A third kind, *container storage*, provides users with a container into which they can pack goods. Container storage affords better protection of the product than open

storage.

5. *Special Commodity Warehouses.* Special commodity warehouses are used for particular agricultural products, such as grains, wool, and cotton. Ordinarily each of these warehouses handles one kind of product and offers special service's specific to that product.

6. *Bulk Storage Warehouses.* Bulk storage warehouses provide tank storage of liquids and open or sheltered storage of dry products such as coal, sand, and chemicals. These warehouses may provide services such as filling drums from bulk or mixing various types of chemicals with others to produce new compounds or mixtures.

### 8.3. Operations: Three Functions

Warehousing has three basic functions: *movement*, *storage*, and *information transfer*. Recently, the movement function has been receiving the most attention as organizations focus on improving inventory turns and speeding orders from manufacturing to final delivery (see Figure 8.2).

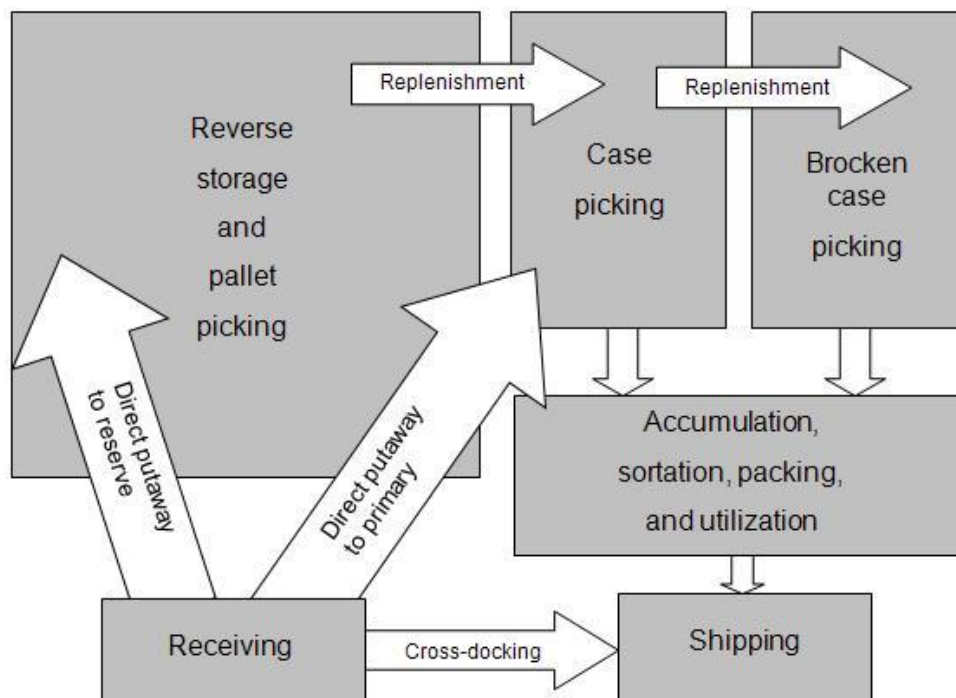


Figure 8.2 – The movement function

1. The *movement function* can be further divided into several activities, including:

- ✓ Receiving.
- ✓ Transfer or putaway.
- ✓ Order picking/selection.
- ✓ Cross-docking.
- ✓ Shipping.

2. *Storage* is the second function of warehousing, can be performed on a temporary or a semipermanent basis. *Temporary storage* emphasizes the movement function of the warehouse and includes only the storage of product necessary for basic inventory replenishment. Temporary storage is required regardless of the actual inventory turnover. The extent of temporary inventory storage depends on the design of the logistics system and the variability experienced in lead time and demand. A goal of cross docking is to utilize only the temporary storage function of the warehouse.

*Semipermanent storage* is the storage of inventory in excess of that required for normal replenishment. This inventory is referred to as buffer or safety stock. The most common conditions leading to semipermanent storage are: 1) seasonal demand, 2) erratic demand, 3) conditioning of products such as fruits and meats, 4) speculation or forward buying, and 5) special deals such as quantity discounts.

3. *Information transfer*, the third major function of warehousing, occurs simultaneously with the movement and storage functions. Management always needs timely and accurate information as it attempts to administer the warehousing activity. Information on inventory levels, throughput levels (i.e., the amount of product moving through the warehouse), stockkeeping locations, inbound and outbound shipments, customer data, facility space utilization, and personnel is vital to the successful operation of a warehouse. Organizations are relying increasingly on computerized information transfer utilizing electronic data interchange (EDI) and bar coding, to improve both the speed and accuracy of information transfer.

## **8.4. Public versus Private Warehousing**

### *8.4.1. Advantages and disadvantages of public warehousing.*

*Advantages.* The benefits that may be realized if a firm uses public warehouses rather than privately owned or leased warehouses include: 1) conservation

of capital, 2) the ability to increase warehouse space to cover peak requirements; 3) reduced risk; 4) economies of scale; 5) flexibility; 6) tax advantages; 7) specific knowledge of costs for storage and handling; and 8) potential minimization of labor disputes.

*Disadvantages.* A number of disadvantages are associated with the use of public warehousing. It includes: 1) communications problems; 2) lack of the specialized services; 3) shortage of space.

#### *8.4.2. Advantages and disadvantages of private warehousing.*

*Advantages.* The advantages associated with private warehousing include: 1) degree of control; 2) flexibility; 3) less costly over the long term; 4) better use of human resources; 5) tax benefits; 6) intangible benefits.

*Disadvantages.* A number of disadvantages are associated with the use of private warehousing. It includes: 1) lack of flexibility; 2) financial constraints; 3) rate of return.

### **8.5. Facility Development**

Two issues that must be addressed are the size and number of warehouse facilities. These are interrelated decisions because they typically have an inverse relationship; that is, as the *number* of warehouses increases, the average size of a warehouse decreases.

**Size of a Warehouse.** Many factors influence how large a warehouse should be. First, it is necessary to define how size is measured. In general, size can be defined in terms of square footage or cubic space. Most public warehouses still use square footage dimensions in their advertising and promotional efforts.

Unfortunately, square footage measures ignore the capability of modern warehouses to store merchandise vertically. Hence, the cubic space measure was developed. Cubic space refers to the total volume of space available *within* a facility. It is a much more realistic size estimate than square footage because it considers more of the available usable space in a warehouse. Some of the most important factors affecting the size of a warehouse are:

- Customer service levels.
- Size of market or markets served.
- Number of products marketed.

- Size of the product or products.
- Materials handling system used.
- Throughput rate.
- Production lead time.
- Economies of scale.
- Stock layout.
- Aisle requirements.
- Office area in warehouse.
- Types of racks and shelves used.
- Level and pattern of demand.

**Number of Warehouses.** Four factors are significant in deciding on the number of warehousing facilities: cost of lost sales, inventory costs, warehousing costs, and transportation costs.

## **8.6. Location Analysis**

### **Center-of-gravity approach**

The center-of-gravity approach, is simplistic in scope, and locates facilities based on transportation costs. This approach locates a warehouse or distribution center at a point that minimizes transportation costs for products moving between a manufacturing plant and the markets.

Envision two pieces of rope tied together with a knot and stretched across a circular piece of board, with unequal weights attached to each end of the rope. Initially, the knot would be located in the center of the circle. Upon the release of the weights, the rope would shift to the point where the weights would be in balance. Adding ropes with varying weights would result in the same shifting of the knot (assuming the knots were all in the same place). If the weights represented transportation costs, then the position where the knot would come to rest after releasing the weights would represent the center of gravity or position where transportation costs would be minimized. The approach provides general answers to the warehouse location problem, but it must be modified to take into account factors such as geography, time, and customer service levels.

## **Chapter Checklist**

1. What types of inventories are placed into storage?
2. Why do companies hold inventories in storage?
3. Explain the basic differences between a pull and push systems in warehousing.
4. Identify the major types of warehousing.
5. What are the differences between private and public warehousing? What are the advantages and disadvantages of each type?
6. What measures are used for estimation of warehouse size? Briefly describe advantages and disadvantages of these measures.
7. What are the three basic functions of warehousing? Briefly describe each.
8. Identify the most important factors affecting the size of a warehouse.
9. What factors influence on the number of warehouses?
10. Briefly describe the center-of-gravity approach. What disadvantages does it have?

## 9. MATERIALS HANDLING, COMPUTERIZATION, AND PACKAGING ISSUES

### 9.1. Materials Handling Equipment

#### ✓ *Manual or nonautomated materials handling systems*

*Manual or nonautomated materials handling equipment* has been the mainstay of the traditional warehouse and will likely continue to be important even with the move toward automated warehousing. Such equipment can be categorized according to the *functions performed*: that is, *storage and order picking, transportation and sorting, and shipping*.

*1. Storage and Order-Picking Equipment.* Storage and order-picking equipment includes racks, shelving, drawers, and operator-controlled devices (e.g., forklift trucks). Manual systems provide a great deal of flexibility in order picking, because they use the most flexible handling system (i.e. people).

The storage racks illustrated in Figures 9.1 *a* and 9.1 *b* are found in most warehouse facilities as either permanent or temporary fixtures for storage of products. They would be considered "standard" or "basic" components of a warehouse. All these storage racks are easily accessible by materials handling equipment such as forklift trucks.

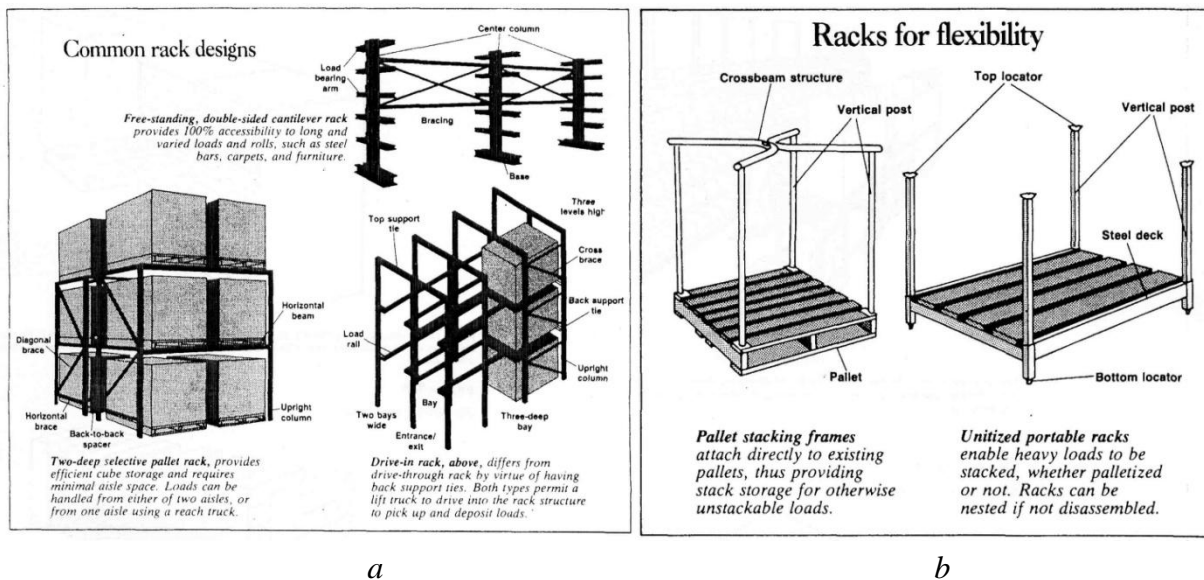


Figure 9.1 – Nonautomated storage units – storage racks

*Gravity flow storage racks* (see Figure 9.2) are often used to store high-



demand items. Products that are of uniform size and shape are well suited for this type of storage system. Items are loaded into the racks from the back, flow to the front of the racks which are sloped forward, and are then picked from the front of the system by order-picking personnel.

For small parts, *bin shelving systems* are useful. Figure 9.3 illustrates a typical bin configuration. Items are handpicked, so the height of the system must be within the physical reach of employees. Typically, the full cube of each bin cannot be used, so some wasted space exists. Bin shelving systems are relatively inexpensive compared with other storage systems, but they have limited usefulness beyond storage of small parts.

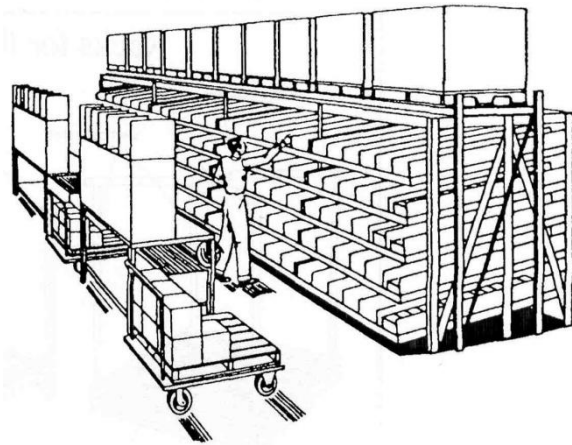


Figure 9.2 – Gravity flow storage racks

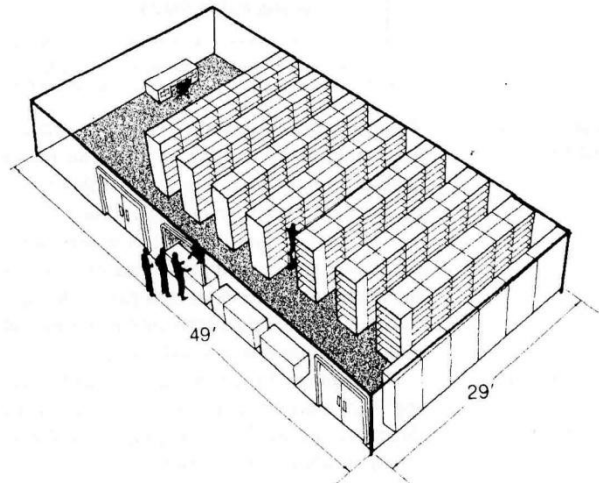


Figure 9.3 – Bin shelving systems

*The modular storage drawers and cabinets* shown in Figure 9.4 are used for small parts. Similar in function to bin shelving systems, they require less physical space and allow items to be concentrated into areas that are easily accessed by employees. The drawers are pulled out and items are selected. Fasteners, nuts and bolts, and other small parts and components are often stored in this manner. By design, modular storage drawers must be low to the floor and often less than five feet in height to allow access by employees picking items from the drawers.

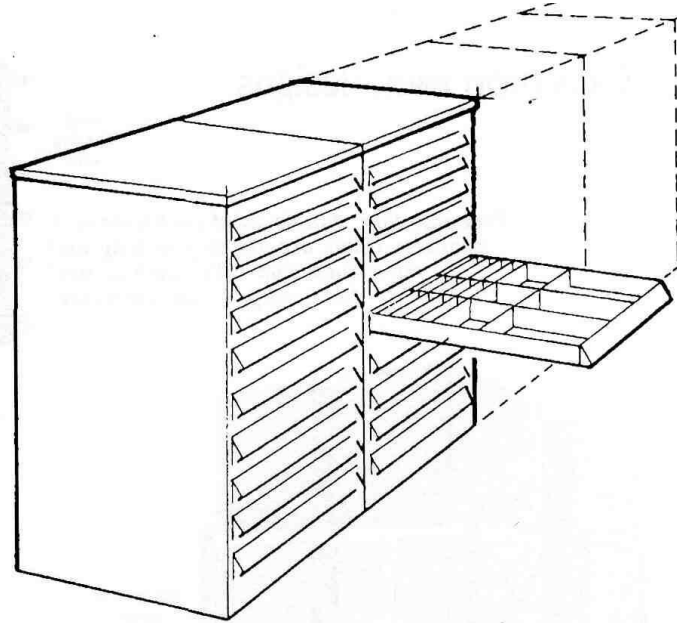


Figure 9.4 – Modular storage drawers and cabinets

*“Fixed” and “movable” storage systems.* The storage systems described previously are classified as "fixed" systems because they are stationary. Others can be classified as "movable" because they are not in fixed positions. The *bin shelving systems* shown in Figure 9.3 can be transformed from a fixed to a movable system (see Figure 9.5).

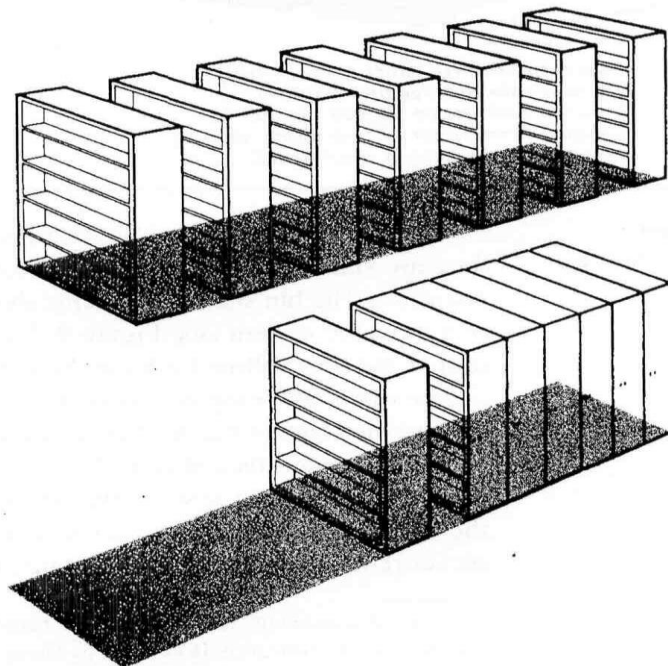


Figure 9.5 – Bin shelving mezzanine

In the bin shelving mezzanine wheels on the bottom of the bins follow tracks in the floors, allowing the bins to be moved and stacked together when not being accessed. This allows maximum utilization of space, because full-width aisles are not needed between each bin.

Products are picked from the various storage systems, using some order-picking approach. In a manual system, the personnel doing the order picking go to the location of the items, walking with a cart or riding a mechanized cart. In many cases, the order picker retrieves items from a flow-through gravity storage rack (see Figure 9.2).

*2. Transportation and Sorting.* The order picker can use a large selection of powered and nonpowered equipment for transporting and sorting items located in the racks shelves, and drawers. Examples of this type of apparatus include forklift trucks, platform trucks, hand trucks, cranes, and carts.

Manual sorting of items is a very labor-intensive part of warehousing. It involves; separating and regrouping picked items into customer orders. Personnel physically examine items and place them onto pallets or slipsheets, or into containers for shipment to customers. This is a time-consuming process subject to human error. As a result, most firm attempt to minimize manual sorting.

*3. Shipping of products* to customers involves preparing items for shipment and loading them onto the transport vehicle. The powered and nonpowered equipment previously described are used for this purpose. Pallets, palletizers, strapping machines, and stretch wrappers also are important. In addition, the shipping and receiving activity requires equipment for handling outbound and inbound transportation vehicles. Therefore, shipping and receiving docks are important elements of the material handling process. As stated previously, manual or nonautomated equipment is often used in combination with automated equipment.

### ✓ *Automated Handling Systems*

Automated storage and retrieval systems (AS/RS), carousels, case-picking and item-picking equipment, conveyors, robots, and scanning systems have become commonplace in warehouses. As a result, many firms have been able to achieve improvements in materials handling efficiency and productivity.

**Advantages of Automated Systems.** Automated systems can provide several benefits for warehouse operations. Table 9.1 lists some of the most important benefits of automated systems as identified by users. Generally, the benefits can

be categorized into operating cost savings, improved service levels, and increased control through more and better information.

Table 9.1 – Benefits of Automated Materials Handling Systems

Benefit	Percent of respondents that “agree” or “strongly agree”
Labor cost reduction	98.8%
Ability to increase output rate	95.2
Improvement in consistency of service	92.1
Reduction in materials handling	92.1
Increased accuracy level	89.5
Service availability	87.0
Improvement in speed of service	81.0

**Disadvantages of Automated Systems.** However, automated systems are not without disadvantages. Typical problems faced by firms choosing to automate materials handling operations include the following:

1. Initial capital cost.
2. Downtime or unreliability of equipment/maintenance interruptions.
3. Software-related problems (e.g., poor documentation, incompatibility, failure).
4. Capacity problems.
5. Lack of flexibility to respond to changing environment.
6. Maintenance costs.
7. User interface and training.
8. Worker acceptance.
9. Obsolescence.

### **Types of Equipment**

**Carousels.** A form of AS/RS is the carousel. Carousels are mechanical devices that house and rotate items for order picking. The most frequently utilized carousel configurations are the horizontal and vertical systems.

1. A *horizontal carousel* (see Figure 9.6) is a linked series of rotating bins of adjustable shelves driven on the top or bottom by a drive motor. Rotation takes place on an axis perpendicular to the floor at approximately 80 feet a minute.

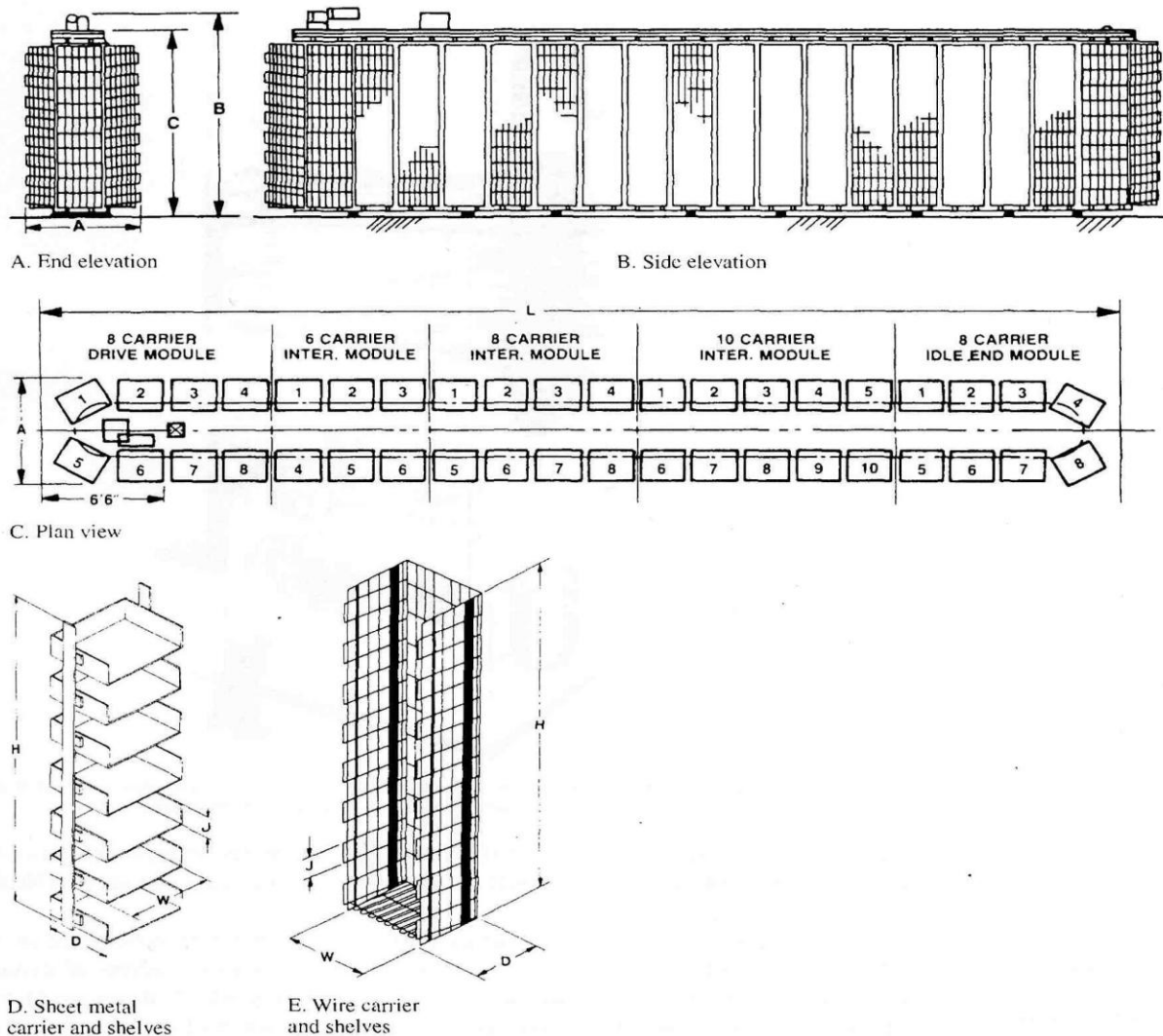


Figure 9.6 – Horizontal carousels

2. A *vertical carousel* is a horizontal carousel turned on its end and enclosed in sheet metal (see Figure 9.7). Like horizontal carousels, an order picker operates one or multiple carousels. The carousels are indexed either automatically by way of computer control or manually by the order picker operating a keypad on the carousel's work surface.

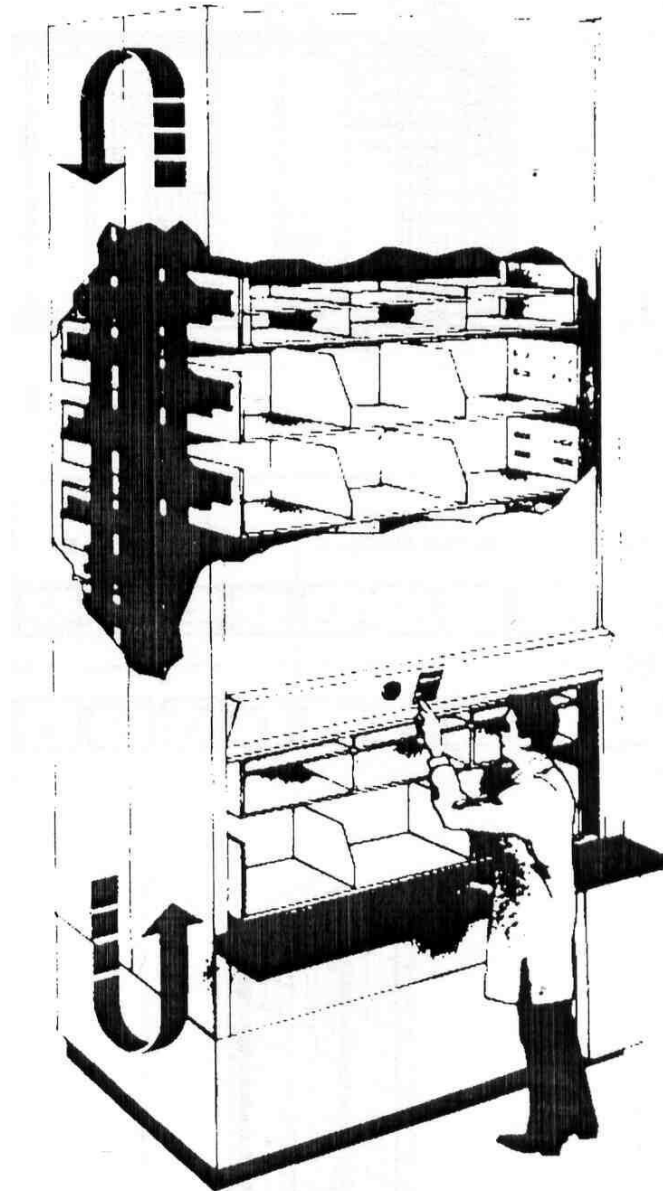


Figure 9.7 – Vertical carousels

The transportation and sorting activities are typically performed in combination with storage and order picking. The three pieces of transportation equipment most frequently used are *conveyors*, *automatic guided vehicle systems (AGVS)*, and *operator-controlled trucks or tractors*.

**Conveyors.** Sorting equipment can be specialized, such as a tilt-tray sorter with built-in diverting mechanisms, or it can be assembled from other components, such as conveyors and diverters.

**Automatic Guided Vehicle Systems (AGVSs).** Automatic guided vehicle systems (AGVSs) are "battery-powered driverless vehicles that are controlled by

computers for task assignment, path selection, and positioning." AGVSs are often used in automated warehouse operations involving AS/RSs. The benefits of AGVSs include "lower handling costs, reduced handling-related product damage, improved safety, the ability to interface with other automated systems, and reliability.

**Robots.** The robot is another type of equipment used in many phases of materials handling. Robots have been used in the manufacturing process for some time, but advances in robotics technology have expanded their use to a larger number of applications. It is likely that materials handling robots will have steady growth in many application areas.

**Automation in the shipping area** also has occurred. The two aspects of the shipping activity that have been most affected by automation are *packaging* and *optical scanning*.

**Computerized Tracking and Information Systems.** Another aspect of shipping automation is *documentation*. As other components of the warehouse become automated, firms need to computerize their tracking and information systems.

The type and scope of benefits a company receives will vary according to product characteristics, labor intensity of the operation, existing customer service levels, and present level of company expertise.

## **9.2. Warehousing in Just-in-Time Environment**

JIT places additional demands on warehousing and materials handling. Examples of these demands include the following:

1. *Total commitment to quality.* Warehouse employees must perform their tasks (inbound and outbound) at levels specified by customers.
2. *Reduced production lot sizes.* Items are packaged in smaller lots, and warehouse deliveries are smaller and in mixed.
3. *Elimination of non-value activities.* Nonessential and inefficient physical movement and handling activities are identified and eliminated, resulting in improved facilities layout and warehouse operating efficiencies.
4. *Rapid flowthrough of materials.* Because JIT stresses low or even zero inventory emphasis is placed on the mixing function of the warehouse rather than storage.

### 9.3. Packaging

Packaging is an important warehousing and materials management concern, one that closely tied to warehouse efficiency and effectiveness. The best package increases service, decreases cost and improves handling. Good packaging can have a positive impact on layout, design, and overall warehouse productivity.

#### 9.3.1. Functions of Packaging

Packaging serves **two basic functions**: *marketing* and *logistics*.

In its *marketing function* the package provides customers with information about the product and promotes the product through the use of color and shape.

From a *logistics perspective*, the function of packaging is to organize, protect, and identify products and materials. In performing this function, packaging takes up space and adds weight. Industrial users of packaging strive to gain the advantages packaging offers while minimizing the disadvantages, such as added space and weight.

More specifically, packaging performs **six functions**:

1. *Containment*. Products must be contained before they can be moved from one place to another. If the package breaks open, the item can be damaged or lost, or contribute to environmental pollution if it is a hazardous material.

2. *Protection*. To protect the contents of the package from damage or loss from outside environmental effects (e.g. moisture, dust, insects, contamination).

3. *Apportionment*. To reduce the output from industrial production to a manageable, desirable "consumer" size; that is, translating the large output of manufacturing into smaller quantities of greater use to customers.

4. *Unification*. To permit primary packages to be unitized into secondary packages (e.g., placed inside a corrugated case); the secondary packages are unitized into a stretch-wrapped pallet, and ultimately into a container that is loaded with several pallets. This reduces the number of times a product must be handled.

5. *Convenience*. To allow products to be used conveniently; that is, with little wasted effort by customers (e.g., blister packs, dispensers).

6. *Communication*. The use of unambiguous, readily understood symbols such as a UPC (Universal Product Code).

The package should be designed to provide the most efficient storage. Good packaging interfaces well with the organization's materials handling



equipment and allows efficient utilization of storage space as well as transportation cube and weight constraints.

### **9.3.2. Effects of Packaging on Costs and Customer Service**

1. *Saving Money through Efficient and Effective Packaging.* Packaging is becoming a more visible issue with the current environmental concerns about recycling and the reuse of packaging. Investing in efficient and effective packaging can save a company money in the following ways:

1. Lighter packaging may save transportation costs.
2. Careful planning of packaging size/cube may allow better space utilization of warehousing and transportation.
3. More protective packaging may reduce damage and requirements for special handling.
4. More environmentally conscious packaging may save disposal costs and improve the company's image.
5. Use of returnable containers provides cost savings as well as environmental benefits through the reduction of waste products.

2. *Ways Packaging Changes Cut Costs and Improve Customer Service.* The following are specific examples of cost savings and customer service improvements resulting from packaging modifications.

1. A frozen-foods supplier and a baked-goods company saved \$3 million and \$1 million, respectively, on annual freight costs with redesigned packaging that better fit standard pallets. Both companies could put more products on a pallet and more pallets in each truck, greatly reducing the number of truckloads.

2. A pharmaceuticals company cut freight costs by 25 percent on one product line by reducing the amount of packaging used, and it did so without compromising product protection.

3. An electronic components manufacturer changed the packaging on some products to reflect the average quantities ordered by customers. "Customers liked the larger quantities, and the reduced number of packages per order improved inventory and order accuracy, and reduced packaging and transportation costs."

*Factors Governing Good Package Design.* Good package design is influenced by: 1) standardization, 2) pricing (cost), 3) product or package adaptability, 4) protective level, 5) handling ability, 6) product packability, and 7) reusability and recyclability.

#### 9.4. Computer Technology, Information, and Warehouse Management

The fully computerized warehouse will likely have a structure similar to that shown in Figure 9.8, where all activities of the warehouse interface with the system, including receiving, quality control, storage, order picking, error control, packing, and shipping. Significant advantages will result, including improved customer service, lower costs, and more efficient and effective operations.

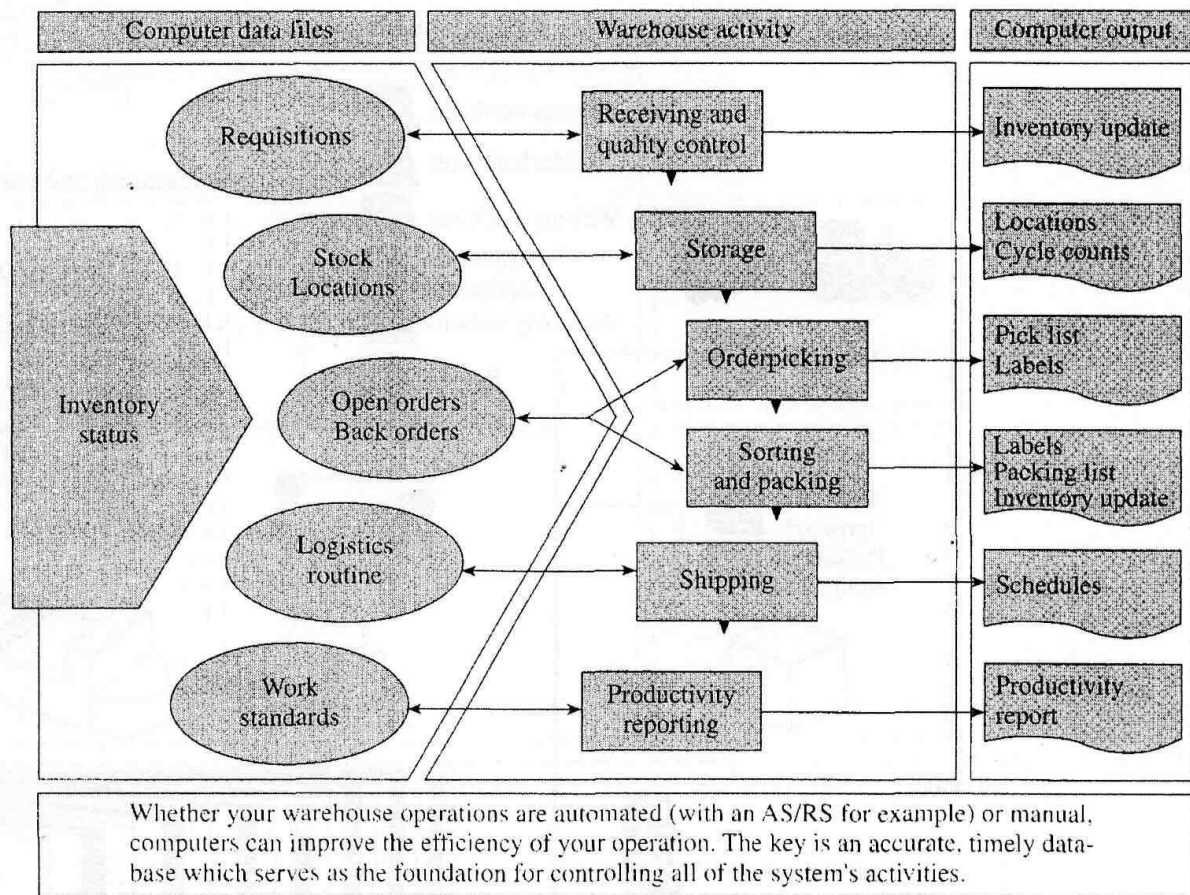


Figure 9.8 – Computers throughout the warehouse

*Information* is the key to successful warehouse management. However, many warehousing operations exhibit symptoms resulting from a lack of information. Not many warehouse managers operate in a total information vacuum, but many information gaps exist in warehousing operations.

The importance of information in warehouse management is significant. Accurate and timely information allows a firm to minimize inventories, improve routing and scheduling of transportation vehicles, and generally improve customer service levels. A typical warehouse management system achieves these improvements in three ways:

1. Reducing direct labor.
2. Increasing materials handling equipment efficiency.
3. Increasing warehouse space utilization.

#### *Local Area Networks (LANs)*

*Networks* are communications systems that allow transmission of data between a number and variety of devices such as terminals, word processors, bar-code readers, robots, conveyors, automatic guided vehicles, and AS/RSs. A local area network (LAN), whose devices are located in close proximity to one another, is typically used in warehousing. Figure 9.9 shows an example of a local area network.

Many approaches are possible to setting up a LAN system. No matter which approach a firm uses, the objectives are the same: to provide better control over information flows and to allow the warehouse facility to maximize its effectiveness and efficiency. Due to direct connection and a common database, information feeds and flows directly to the next. This reduces redundant data entry, excessive paperwork and the potential for error.

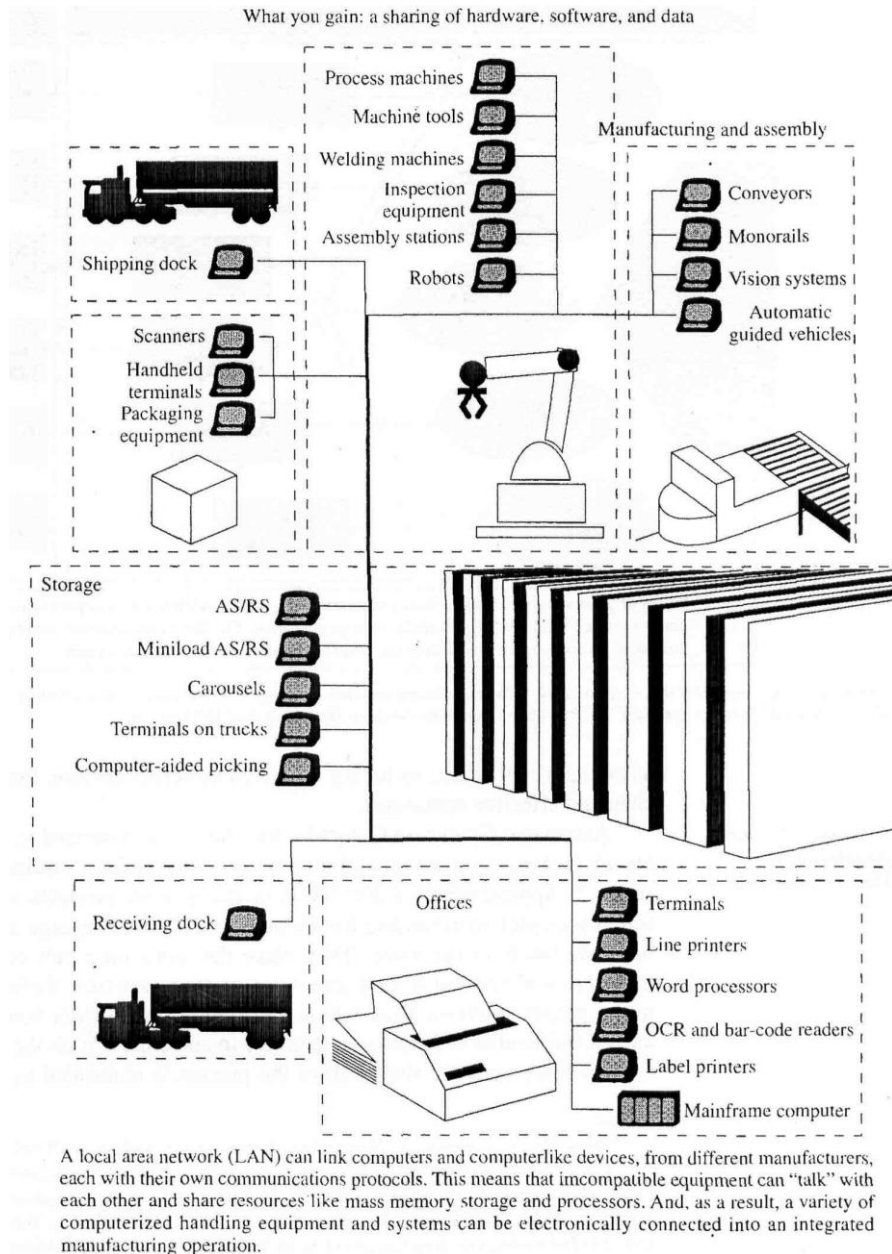


Figure 9.9 – A local area network (LAN) example

## Chapter Checklist

1. What are the kinds of manual equipment?
2. Compare the advantages and benefits of automated materials handling systems with those of manual systems.
3. Briefly describe the types of automated equipment.
4. Discuss the relationship between warehousing and JIT.
5. Briefly describe the role of information in warehousing management.
6. What is the local area network? Identify its objectives.

## 10. CUSTOMER SERVICE

### 10.1. Definition of Customer Service and Customer Satisfaction

The definition of **customer service** varies across organizations. Suppliers and their customers can view the concept of customer service quite differently. In a broad sense, *customer service* is the measure of how well the logistics system is performing in providing time and place utility for a product or service. This includes activities such as the ease of checking stock, placing an order, and postsale support of the item.

#### ✓ *Customer satisfaction*

Customer service is often confused with the concept of customer satisfaction. In contrast to customer service, customer satisfaction represents the customer's overall assessment of all elements of the marketing mix: product, price, promotion, and place. Thus, customer satisfaction is a broader concept that encompasses customer service. A thorough description of customer satisfaction can be found in many introductory marketing textbooks.

#### ✓ *Definition of customer service*

In most organizations, customer service is defined in one or more ways, including: 1) an activity or function to be managed, such as order processing or handling of customer complaints; 2) actual performance on particular parameters, such as the ability to ship complete orders for 98 percent of orders received within a 24-hour period; or (3) part of an overall corporate philosophy, rather than simply an activity or performance measures. If an organization views customer service as a philosophy, it will likely have a formal customer service function and various performance measures.<sup>8</sup>

**Customer service** can be defined as a process which takes place between the buyer, seller, and third party. The process results in a value added to the product or service exchanged. This value added in the exchange process might be short term as in a single transaction or longer term as in a contractual relationship. The value added is also shared, in that each of the parties to the transaction or contract are better off at the completion of the transaction than it was before the transaction took place. Thus, in a process view: Customer service is a process for providing significant value-added benefits to the supply chain in a cost-effective way.

## 10.2. Elements of Customer Service

The elements of customer service can be classified into three groups: *pretransaction*, *transaction*, and *posttransaction elements*. These groups are linked to the definitions of marketing which incorporate the notion of market transactions – before, during, and after the sale. This conceptualization is depicted in Figure 10.1.

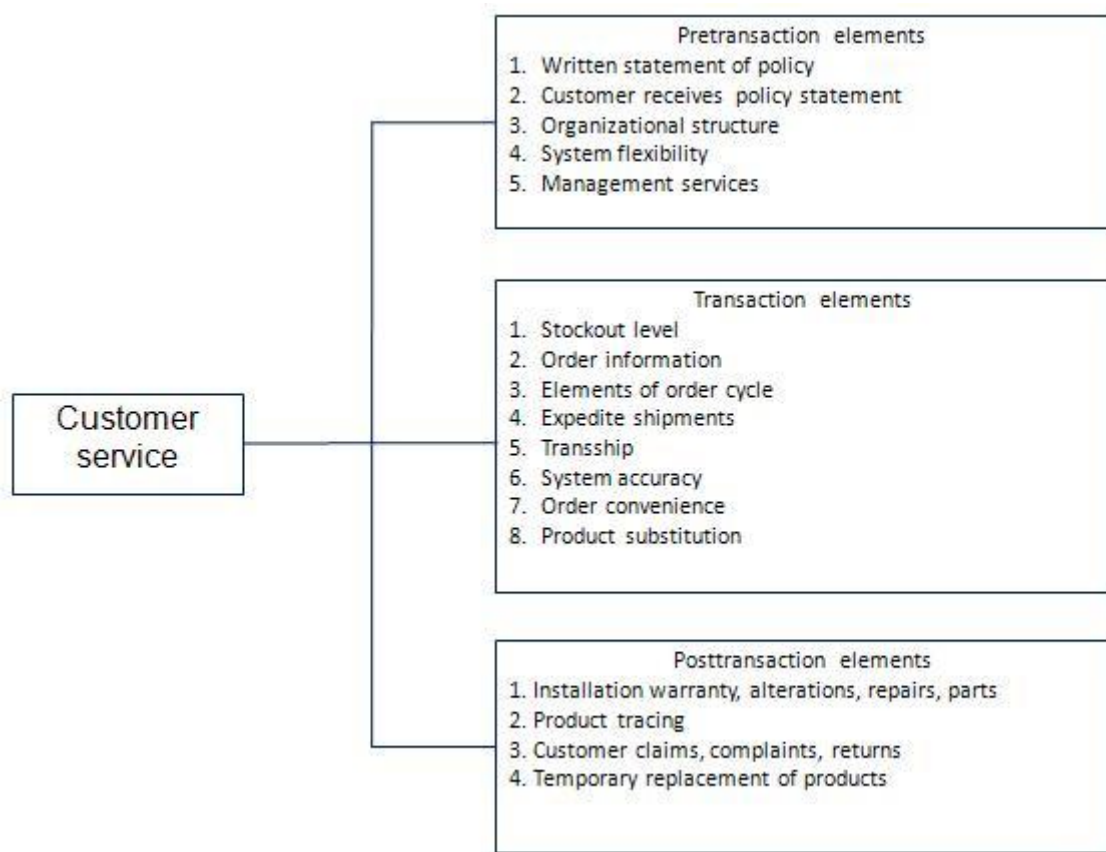


Figure 10.1 – The elements of customer service

**Pretransaction Elements.** The pretransaction elements of customer service tend to be related to the organization's policies regarding customer service, and can have a significant impact on customers' perceptions of the organization and their overall satisfaction. These elements are not all directly related to logistics. They must be formulated and in place before the organization can consistently implement and execute its customer service activities. Pretransaction elements include the following:

1. *A written statement of customer service policy.* This policy would define service standards, which should be tied to customers' needs. It should include metrics for tracking service performance and the frequency of reporting actual performance,

and be measurable and actionable.

2. *Customers provided with a written statement of policy.* A written statement lets the customer know what to expect and helps to safeguard against unreasonable expectations. It should provide the customer with information about how to respond if expected service levels are not achieved by the firm.

3. *Organization structure.* The organization structure best suited to ensure the achievement of customer service goals varies across organizations, but the senior logistics executive should be positioned at a high level and have high visibility within the firm. The structure should facilitate both internal and external communication of policies, performance, and corrective actions as needed. Customers should have easy access to individuals within the organization who can satisfy their needs and answer their questions. Imagine the frustration felt by a customer who has experienced a problem with product delivery or performance, who telephones the selling organization only to be put on hold, and transferred from one representative to another, continually reexplaining his or her entire problem! The customer may never call that organization again for anything.

4. *System flexibility.* Flexibility and contingency plans should be built into the system, which allow the organization to successfully respond to unforeseen events such as labor strikes, material shortages, and natural disasters such as hurricanes or flooding.

5. *Management services.* Providing the customers with help in merchandising, improving inventory management, and ordering are examples of some of the services an organization may provide to its customers. These may be provided in the form of policy should be in place concerning transshipments as opposed to back-ordering or drop-shipping directly to a customer from more than one location.

7. *Order convenience.* Order convenience refers to how easy it is for a customer to place an order. Customers prefer suppliers that are user-friendly. If forms are confusing, terms are not standardized, or the waiting time on hold on the telephone is long, customers may experience dissatisfaction. Order-related problems should be monitored and identified by talking directly with customers. Problems should be noted and corrected.

8. *Product substitution.* Product substitution occurs when the product that the customer ordered is not available, but is replaced by a different size of the same item or a different product that will perform just as well or better. Thus, the ability to pro-

vide a customer with acceptable substitutes can significantly improve the firm's service level.

**The transaction elements** of customer service often receive the most attention, because they are the most immediate and apparent to the customer.

**Posttransaction Elements.** The posttransaction elements of customer service support the product or service after the customer has received it. Historically, this has tended to be the most neglected of the three groups of customer service elements, in part because a relatively small proportion of customers complain about poor service. However, retaining and satisfying current customers can be much more profitable than finding new customers.

1. *Installation, warranty, repairs, and service parts.* These elements should be an important consideration in almost all purchases, especially purchases of capital equipment where such costs tend to far outweigh the cost of the purchased item itself. These elements should receive the same attention and scrutiny as transaction elements.

2. *Product tracking.* Product tracking, also referred to as product tracing, is an important customer service element. For example, in order to inform consumers of potential problems, firms must be able to recall potentially dangerous products from the market once the potential hazard has been identified.

3. *Customer complaints, claims, and returns.* To resolve customer complaints, an accurate on-line information system is needed to process the data from the customer, monitor trends, and provide the customer with the most current information available. Logistics systems are designed to move products to customers, so the cost of nonroutine handling, particularly of small shipments such as customer returns, tends to be high. Customer returns go through the logistics process in reverse; hence the term *reverse logistics*. Corporate policies should be established to handle these complaints as efficiently and effectively as possible.

4. *Product replacement.* Depending on the item, having backup product temporarily available when the item is being serviced can be critical. For example, some automobile dealerships provide leaner cars to their customers at no charge while their cars are being serviced. This minimizes the inconvenience and may create a more loyal customer.



### **10.3. Importance of Customer Service for Gaining Strategic Advantage**

Customer service is the output of the logistics system and is the key interface between the marketing and logistics functions, supporting the “place” element of the marketing mix. But even more important, customer service plays a significant role in developing and maintaining customer loyalty and ongoing satisfaction.

The product, pricing, and promotion elements of the marketing mix create value added for customers. However, when the performance of competitors is similar on these attributes, it is customer service that really brings the customer back.

Products and prices are relatively easy for competitors to duplicate. Promotional efforts also can be matched by competitors, with the possible exception of a well-trained and motivated sales force. The satisfactory service encounter, or favorable complaint resolution, is one important way that the organization can really distinguish itself in the eyes of the customer. Thus, logistics can play a key role in contributing to the organization's competitive advantage by providing excellent customer service.

### **10.4. Methods for Establishing Customer Service Strategies**

A number of methods have been suggested for establishing customer service strategies. Four have the greatest value:

1. Determining customer service levels based on customer reactions to stockouts at the retail level.
2. Cost / revenue trade-offs.
3. ABC analysis of customer service.
4. Customer service audits.

#### *1. Customer reactions to stockouts*

Most manufacturers do not sell exclusively to end users. Instead, they sell to wholesalers or other intermediaries who sell to the final customer. For this reason, it may be difficult for a manufacturer to assess the impact of stockouts on end users. For example, an out-of-stock situation at the manufacturer's warehouse does not necessarily mean an out-of-stock product at the retail level. One way to establish the desirable level of customer service at the retail level is to determine consumers' response to stockouts, which can include substituting another size of the same brand, switching

brands, or perhaps going to a different store to buy the items. For most products, consumers will switch stores only if they believe that the product they desire is superior to or considerably less expensive than the available substitutes.

To see how stockouts have a different effect at various levels of the channel of distribution, we can examine the infant formula industry. Most infant formula manufacturers do not advertise their products on national television, and generally limit the amount they spend on consumer-directed media advertising. They also limit the use of price promotion. Instead, they spend their marketing dollars on sample products to give to doctors and hospitals, who in turn give the product samples to new mothers. New mothers are often told not to switch brands because the baby develops a preference and may not adapt well to another brand. In addition, most mothers assume that their doctor would give them only the recommended products as samples. Thus, when the mother goes to the store to buy infant formula and the product is out of stock, she will go to a different store rather than risk switching products.

Understanding behavior at different levels in the channel is critical in formulating customer service strategies. The penalty for being out of stock at a particular retail store is relatively low for the manufacturer of infant formula because the vast majority of customers will switch stores.

## *2. Cost / revenue trade-offs*

The total of logistics expenditures such as carrying inventory, transportation, and information / order processing can be viewed as the company's expenditures on customer service. Figure 1.3 illustrates the cost trade-offs and considerations required to implement an integrated logistics management concept. The objective is to provide the organization with the lowest total logistics costs, given a specific customer service level. While Figure 1.3 shows logistics issues as trade-offs, in some cases simultaneous improvement may occur in multiple areas, and the organization reduces its total cost while providing improved customer service. This is only possible by taking the perspective of the total system in the long run.

### 3. *ABC analysis / Pareto's Law*

In his study of the distribution of wealth in Milan, Vilfredo Pareto (1848–1923) found that 20 percent of the people controlled 80 percent of the wealth. The concept that critical issues, wealth, importance, and so on are concentrated among a few is termed *Pareto's law*. This applies in our daily lives – most of the issues we face have little importance, but a few are critical, long-term issues – and it certainly applies to inventory systems.

This type of ABC analysis should not be confused with activity based costing, also abbreviated as ABC. The logic behind ABC analysis is that 20 percent of the firm's customers or products account for 80 percent of the sales and perhaps an even larger percentage of profits. The first step in ABC analysis is to rank products by sales or, preferably, by contribution to corporate profitability if such data are available. The next step is to check for differences between high-volume and low-volume items that may suggest how certain items should be managed. ABC analysis is used to denote a tool for classifying items or activities according to their relative importance. The logic behind ABC classification is that some customers and products are more beneficial to a firm than others: beneficial in terms of profitability, sales revenues, segment growth rates, or other factors deemed important by corporate management. Using profitability as an example, the most profitable customer-product combinations should receive the most attention and, hence, higher customer service levels. Profitability should be measured according to a product's contribution toward fixed costs and profits.

### 4. *Customer service audit*

A customer service audit is used as a means of evaluating the level of service a company is providing and as a benchmark for assessing the impact of changes in customer service policies. The objectives of the audit are to: 1) identify critical customer service elements, 2) identify how performance of those elements is controlled, and 3) assess the quality and capabilities of the internal information system. The audit typically includes four distinct stages: 1) external customer service audit, 2) internal customer service audit, 3) identifying opportunities and methods for improvement, 4) establishing customer service levels.

## 10.5. Developing and Reporting Customer Service Standards

Once management has determined which elements of customer service are most important, it must develop standards of performance. Designated employees should regularly report results to the appropriate levels of management. Customer service performance can be measured and controlled by:

- Establishing quantitative standards of performance for each service element.
- Measuring actual performance for each service element.
- Analyzing variance between actual services provided and the standard.
- Taking corrective action as needed to bring actual performance into line.

Customer cooperation is essential for the company to obtain information about speed, dependability, and condition of the delivered product. To be effective, customers must be convinced that service measurement and monitoring will help improve future service.

Figure 10.2 contains a number of possible measures of service performance.

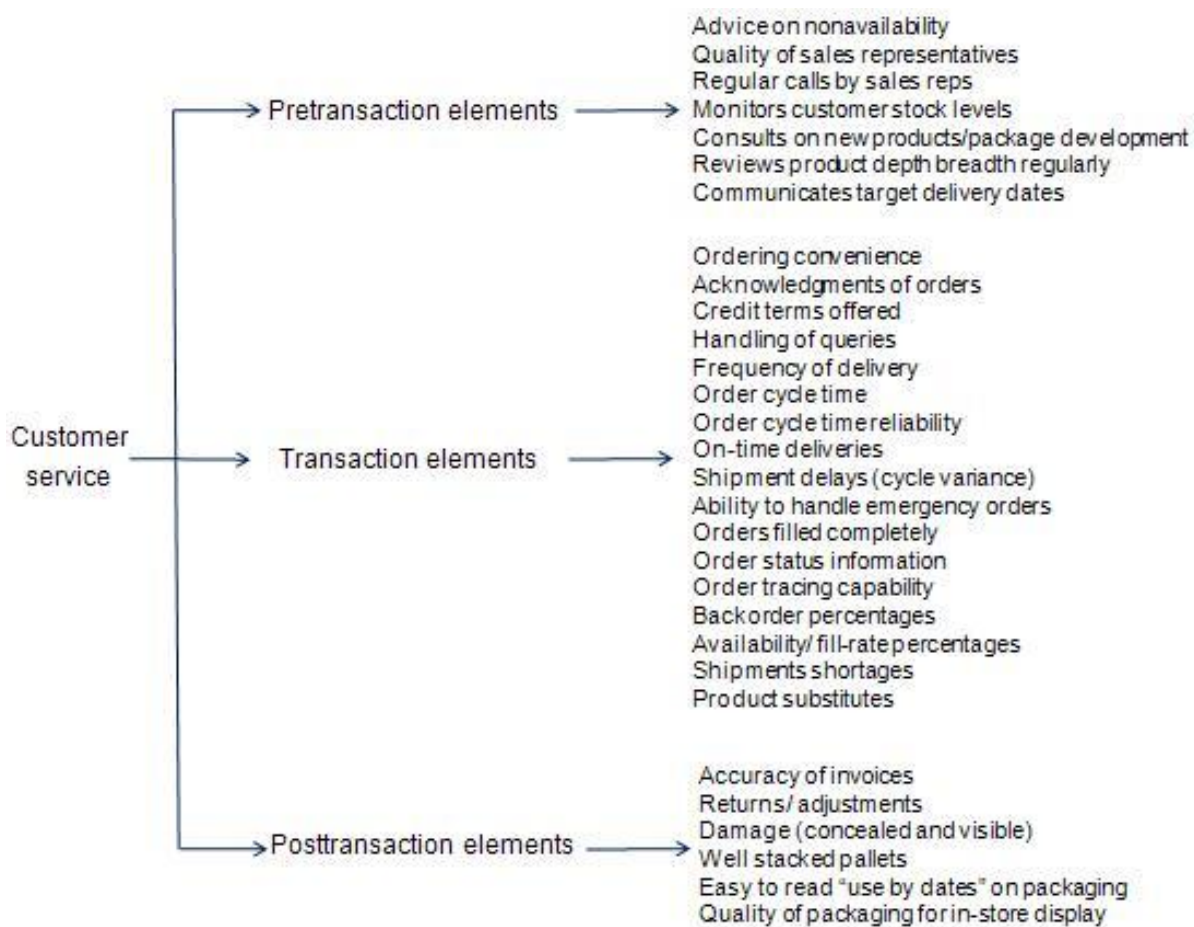


Figure 10.2 – Possible measures of customer service performance

Figure 10.3 gives examples of customer service standards.

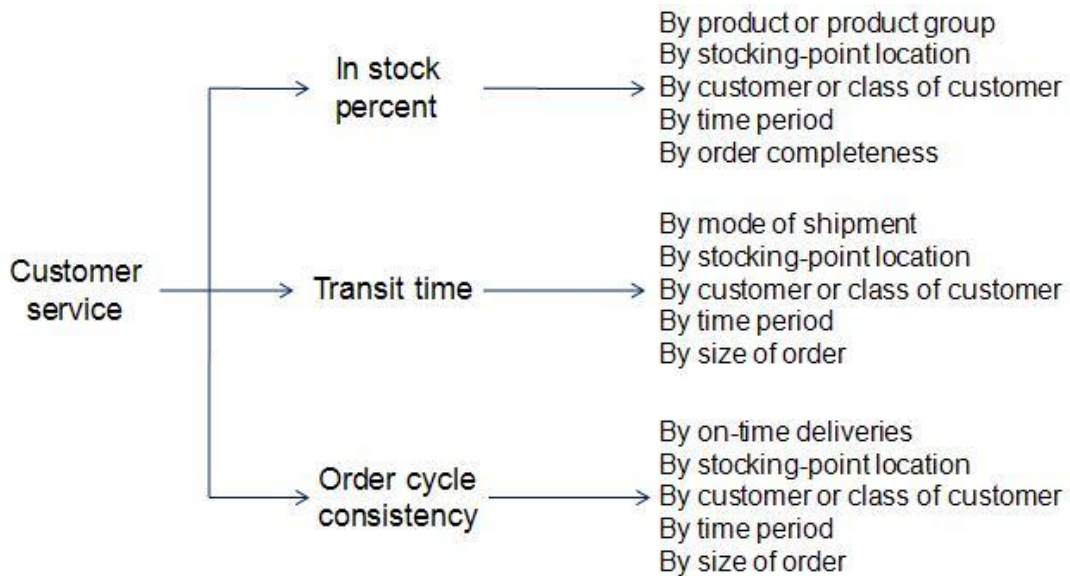


Figure 10.3 – Examples of customer service standards

### Chapter Checklist

1. Customer service can be defined as an activity, a performance measure, or a corporate philosophy. What are the advantages and disadvantages of each of these types of definitions? How would you define customer service?
2. Identify and explain the importance of the main elements of customer service.
3. Explain why customer service should be integrated with other components of the marketing mix when management develops the firm's marketing strategy.
4. Identify the methods for establishing customer service strategy.
5. Explain how ABC analysis can be used to improve the efficiency of the customer service activity.
6. Why is the customer service audit important when establishing a firm's customer service strategy?
7. What are some ways that management can improve the firm's customer service performance?
8. Why is it important to use pretransaction, transaction, and posttransaction customer service elements to identify and develop customer service measures? Discuss specific examples of measures in each category.

## **11 LOGISTICS IN DIFFERENT PARTS OF THE WORLD**

### **11.1 Introduction**

In developed nations, businesses enjoy the best logistics and transportation professionals, systems, and infrastructure in the world. Managers take for granted such standards as advanced internet-based technologies, high-capacity national highway systems, broad-band fiber-optic communications capabilities, seamless multimodal transportation, modern port facilities, high-density air traffic control, and a cadre of qualified, experienced logistics professionals and service agencies. What is experienced as the norm of logistics practice in the developed countries is often only an aspirational goal of logisticians in many other places in the world.

That said, one often perceives the world through a uniquely nationalist perspective. It's hard not to. "Self-referencing criteria" force a frame of reference that is unique to one's business and professional experience. If one is not careful, it's easy to look down upon or criticize as inferior the state of logistics and transportation development in other countries. "It's sure not like the way we do it back home!" Is a common comment from managers returning from their first overseas business experience. A more informed perspective examines the differences among countries, and evaluates each based on strengths and weaknesses, and the appropriateness of the logistical system to the business and cultural environment. Understanding different expectations for logistics performance may turn initial perceptions of inferiority to an appreciation for other ways of accomplishing logistics objectives.

This chapter discusses emergent regional trade blocs and their impact on strategic logistics practice.

### **11.2 Trade Blocs**

A major global political (and business) trend for the past 20 years has been the simplification or elimination of trade barriers and restrictions among neighboring countries. The creation of such free-trade zones or trade blocs is a recognition that barriers to trade among neighbors is not conducive for business and for national economic development. The economic logic underpinning the establishment of such new, broader trade zones recognizes the specialization of land, la-

bor, and capital resources among the members of the trade bloc. For *example*: One nation may have an abundance of raw materials, though lack the human resources or production facilities to efficiently develop these resources. A second nation may have human resources and advanced production capabilities, but lack its own raw materials. By allowing companies in each of the nations unrestricted access to needed resources, finished goods may be supplied to both countries at substantially reduced cost, benefiting consumers in both countries.

While the logic seems simple, the negotiation and implementation of free trade zones is quite difficult and fraught with nationalism and protectionist sentiments. To create a true free-trade zone, all markets of member countries must be equally accessible to companies from anywhere inside the trade zone. This creates problems when member nations desire to protect nascent industrial development or highly profitable national industries or agriculture. Levying of protectionist tariffs is contradictory within a free-trade zone, and the inevitable result of dismantling trade barriers is a shifting of industries within the trade bloc to locations that make economic sense (that is, where costs are minimized). The attendant social upheaval can be traumatic.

At the same time that trade barriers vanish within a trade bloc, protectionist barriers can be raised between trade blocs themselves. The infamous “Banana War” between the United States (and implicitly NAFTA) and the European Community (EC) during 1997–2000 is an excellent example of such bloc protectionism. U.S. firms demanded greater access to the EC for bananas grown in certain Central American countries. For largely political and protectionist reasons related to former colonies of European nations, the EC imposed high tariffs on bananas from U.S. firms. In retaliation, the U.S. government imposed outrageously high tariffs (in some cases exceeding 100 percent of the good’s value) on French cheeses and a number of luxury goods made exclusively in the EC.

Two developed-nation trade blocs bear consideration from a logistics management perspective. The economic unification of the fifteen member nations of the European Community took place in 1992 and today represents a formidable force in global trade. The North American Free Trade Agreement (NAFTA) deals with the U.S./Canadian/Mexican free-trade zone established by treaty in 1990. Also described are three regional trade blocs of emerging nations: ASEAN, MERCOSUR, and CARICOM.

### ***The European Community***

The European Community's 12 member nations decided during the 1980s to extend the notion of the original common market to a full deregulated business environment across national boundaries by the year 1992. This involved a renegotiation of all aspects of trade rules among the original 12 (now 15) countries. The impetus for such a development was clear. The EC faced substantial trade disadvantages with the United States and Japan and was battling these disadvantages from an internally divisive base. The EC member countries were individually relatively small economically and at a power disadvantage vis-a-vis American or Japanese trade. But by banding together to present a unified front to American and Japanese trade interests, the EC would wield substantial economic power and face its trade adversaries on more equal footing.

Additional advantages were seen in the synergy of a unified market representing some 300 million consumers. Manufacturers would have coordinated access to this new large market and would be able to reap economies of scale and scope that were simply not possible in a divided Europe. The prospect of a large common consumer base coupled with the possibility of raising unified trade barriers to external threats caused the common market to push forward toward an eventual economic unification of 15 countries. Negotiations aimed at implementing the first stages of this unification by January 1, 1992 were well underway during the late 1980s, and most of those provisions have now been implemented by the member nations. This represents the creation of an important new trade bloc. In effect, a new marketplace with a population greater than that of the United States came into being.

While a number of provisions have remained problematic (for example, the rollout of a common currency, the Euro, in 2002 was not accepted by Great Britain, which retained its own currency), many logistical concerns were among those to be resolved in the first stages of implementation of the 1992 accords. Prior to the unification of this market, each country had different import and export regulations, transportation laws, communications standards, inventory valuation and accounting methods, and product storage standards. Furthermore, each country had retained some protective tariffs that were governed by a crazy quilt of regulations peculiar to each trading dyad and product category.



As a result of this trade confusion, the cross-border transport of goods was cumbersome. Truck and rail freight shipments often faced days of delay at border crossings as paperwork was filed and checked and rechecked. Shipping goods across multiple borders within the community was a headache. Transportation systems, while technically highly evolved, were burdened with inefficient operations as goods massed at national boundaries. Differing communications standards inhibited the high-speed transmission of data, and multiple standards created compatibility problems. Differences in accounting standards for inventory valuation caused massive seasonal shifting of inventory across borders to avoid taxation and the de facto ineffective forward positioning of inventory relative to final consumption markets. Clearly, the economic benefits from creating a more efficient flow of goods and information was a driving force behind economic unification.

The simple act of dropping tariffs and simplifying import/export regulation was sufficient to improve the efficiency of transportation throughout the community. Border delays are now nearly nonexistent as shipments are no longer inspected and paperwork processed at national frontiers. In early 1993, a Milan-based trucker who specialized in carrying race horses said that twelve hours had been shaved off the time it took to ship a breeding mare from Italy to Ireland and back, saving \$700 on the round trip. "A dozen export-import forms were eliminated, and veterinary checks now take place only at the destination." Not all transportation barriers are being removed. Neighboring nations still enforce their own regulations regarding truck dimensions and hours of operations. Environmentalists prefer that trucking throughout Europe be discouraged so that freight traffic will be shifted to rail and water, which are less damaging to the environment. This has become a significant issue in Switzerland; while not a member of the EU, the country is an important transportation nexus for all of Europe.

Other changes mandated by economic unification are being implemented more slowly. Changing the technical standards for telecommunications must be considered carefully, and downward compatibility with existing communications infrastructure is an important problem. The gradual upgrade of the EC's telecommunications network will make this transition easier as time goes on; the adoption of a common mobile telephone standard for Europe is an example of the progress possible. Changes in accounting practices have caused some disruption

in the way business information is reported as many firms take onetime charges to earnings during the changeover. This has been especially the case with the shift to the Euro as a common currency.

The substantial reduction in regulation also has freed competitive forces within the EC. Roadway haulage has been deregulated, opening up formerly protected national markets to competition from other EC nations and potentially from companies outside the EC nations. The EC has mandated the development of high-speed rail for both passenger and freight by the year 2015, which is intended to change the balance of freight moved by air, rail, and highway. Air cargo has also been deregulated, and freight rates across modes have fallen as a result. The use of multimodal transportation is now more common. Logistics management has become increasingly important in the post-1992 EC, as managers now have the opportunity to manipulate logistics variables in ways heretofore impossible.

The strategic implications of a unified market should be apparent to the American logistics manager. The 15 member nations operate in a similar fashion to the 50 American states. Procedures, laws, and technology are largely being standardized and logistics practices have become more uniform as the integration is completed. These changes have made it possible to site manufacturing facilities, distribution networks, and transportation systems according to market needs rather than according to national boundaries. Logistics managers operating within the EC have redesigned logistics systems to conform with the needs of the larger, unified market. As businesses are now free to treat the marketplace as a whole and without international political considerations, we expect that logistics systems costs will decline and throughput efficiency will improve. For example, Mondavi Wineries used to print 13 different labels for wine that it exported to the EC area. "Under European Community rules, a winemaker can sell product throughout the continent with a single label, as long as the wine is distributed from one location within the EC. So Mondavi began acting as its own importer, using Rotterdam as a central distribution point. The only requirement is that the wine pass through Rotterdam first."

A comprehensive website dealing with the European Community can be found at <http://europa.eu.int> (European Union On-Line). Contemporary issues

regarding the admission of new nations from southern and eastern Europe are important to monitor for logistics professionals.

### *NAFTA*

The U.S./Canada Free Trade Agreement was negotiated between the United States and Canada during the 1980s, and took effect January 1, 1989. Mexico joined NAFTA as a full member in 1995. NAFTA sought to bring about many of the benefits seen in the economic unification of Europe, but without the complete economic integration of the three nations. Simply put, the United States, Canada, and Mexico desired to create a common market where tariffs and other trade barriers would be substantially reduced or eliminated to permit the free flow of goods and services across the border.

The United States and Canada have long enjoyed special trade relations. Trading across the world's longest undefended border, each nation has long been the other's largest trading partner. Many firms of Canadian and U.S. ownership operate on both sides of the border, daily shipping raw materials, work-in process, and finished goods to markets in both the U.S. and Canada. The friendly nature of the relations between the two countries and the long history of close business ties facilitated the negotiation of the treaty. Similarly, many U.S. companies developed trade relationships with Mexican firms in the 1970s and 80s, and heavily invested in U.S.-owned manufacturing plants along the Mexican-U.S. border. The implementation of NAFTA in the U.S. and Canada has been facilitated by the two nations sharing many technical standards, similar levels of logistics infrastructure development, and similarities in markets. Since joining NAFTA, Mexico's standards and infrastructure are developing to fit into established U.S.-Canadian systems.

While NAFTA has simplified the movement of goods across the border between markets, it has not achieved the type of full economic integration seen in Europe. Labor, for example, remains the province of each respective nation and does not move freely across borders. Limitations remain on cross-border capital investment as well. NAFTA focused on facilitating exchange of goods. In that sense, the changes for logistics managers have perhaps been more dramatic than for consumers. It is now possible to site distribution facilities and manufacturing plants closer to markets and without regard to national boundaries. The resulting

efficiencies improve both profits and service to different markets. As Canada continues its efforts to deregulate transportation services, competition from the freed U.S. service providers has caused additional drops in freight costs. Since 1989, cross-border sourcing and freight movements have increased substantially.

The addition of Mexico to NAFTA was not without controversy. Business practice, accounting standards, transportation system design, manufacturing standards, and communications standards differed dramatically between Mexico and the two northern nations. The level of economic development is also very different, resulting in wildly different costs of labor. Proponents argued that adding Mexico would open a very large market to U.S. and Canadian companies. Opponents focused on the loss of skilled high-paying jobs in manufacturing to lower cost Mexican labor. In the near future, it is expected that Mexican truck freight firms will have expanded access to the U.S. market as well. Allowing Mexican trucking firms equal access to the U.S. market has been opposed by organized labor in the U.S. under the guise of highway safety issues. The Teamsters union in the United States capitalized on the relatively high failure rate of Mexican short-haul trucks in U.S. safety inspections (37 percent) versus U.S. carriers combined long- and short-haul fleets (24 percent), though some highway safety experts have disputed these comparisons.

The inclusion of Mexico into NAFTA seems to have had more benefit than cost to U.S. firms. U.S. exports to Mexico in 2000 were up 170 percent from the 1993 level, while overall U.S. exports had risen 68 percent. During that same time, Mexican exports to the U.S. grew 241 percent. The U.S. has also achieved a more balanced trade with Mexico (the 2000 trade deficit was 10 percent), as compared to its trade with the European Community (14 percent), Japan (38 percent), or China (72 percent). The strategic implications of NAFTA should be apparent: open-market access, freedom to design manufacturing and logistics systems according to market demands, and decreased logistics costs with improved system productivity.

There are a number of NAFTA websites. Among the most useful starting points for NAFTA information on the Web are U.S. Department of Commerce sites (<http://www.mac.doc.gov/nafta>, <http://www.ito.doc.gov/cscanada>, <http://uscommerce.org.mx>).

### *ASEAN*

The Association of Southeast Asian Nations includes Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Unlike some regional trade blocs, ASEAN has focused in the past decade on expanding member nations' trade reach outside the bloc. This seems a logical focus for ASEAN's emerging and third-world members, given that many large global firms already operate simultaneously in several ASEAN nations and export the products of those endeavors outside the ASEAN bloc. The U.S.–ASEAN Business Council maintains a comprehensive website on ASEAN trade at <http://www.us-asean.org>.

### *MERCOSUR*

The Southern Cone Common Market was created by the Treaty of Asuncion, signed in 1991 by Argentina, Brazil, Uruguay, and Paraguay. This regional trade bloc was formed to create:

- an external common tariff and a commercial common policy regarding other states or group of states and the coordination of positions in international and regional commercial economic forums.
- the coordination of macroeconomic policies from different sectors among member States: foreign trade, agricultural, industrial, fiscal, currency, foreign exchange and capitals, services, customs, transports and communications policies and others to be agreed upon in order to assure adequate competition conditions among member states.
- the member States commitment to harmonizing their legislation in the pertinent areas so as to strengthen the integration process.

Chile and Bolivia negotiated free-trade agreements with MERCOSUR in 1996 and 1997, and are effectively members. An interregional agreement of cooperation was signed with the European Union in 1995 and with the Centro American Common Market in 1998. MERCOSUR has not fully achieved its goals of reducing internal tariffs and simultaneously raising external tariffs, though they have made substantial progress in that regard and in adopting uniform trade standards among the member nations. MERCOSUR is currently negotiating a Free Trade Area of the Americas (ALCA) with 30 nations in North and South America, which is expected to take effect in 2005.

A comprehensive website dealing with MERCOSUR, including trade statistics, can be found at <http://www.mercosur.org>, and a website devoted to building interfirm trade relationships can be found at <http://www.mercosur.com>.

### *CARICOM*

The Caribbean Community and Common Market (CARICOM) was established by the Treaty of Chaguaramas, which was signed by Barbados, Jamaica, Guyana, and Trinidad & Tobago, and went into effect in 1973. Subsequently, 11 more Caribbean nations have joined CARICOM, including Antigua, Belize, Dominica, Grenada, Saint Lucia, Montserrat, St. Kitts/Nevis/Anguilla and St. Vincent, The Bahamas, Suriname, British Virgin Islands, and the Turks and Caicos Islands. From inception, CARICOM has focused on the integration of the economies of the member states, as well as the larger political functions of a common foreign policy and social and humanitarian programs.

The national economies of CARICOM are tiny by global standards, and many are underdeveloped with existing economic institutions in many of the nations having horizons limited by the legacies of colonialism. While many of the CARICOM nations export natural resources and agricultural goods, tourism has emerged as the most important industry in the Caribbean. As this book was written, CARICOM was engaged in continued study of the effects of NAFTA on Caribbean trade and existing trade agreements (such as the Caribbean–Canada Trade Agreement), building active trade relationships with Venezuela and Colombia, and furthering economic integration within the CARICOM bloc. CARICOM maintains a comprehensive website dealing with trade and political issues, as well as useful trade statistics at <http://www.caricom.org>.

### **Chapter Checklist**

1. As a consultant to a small businessperson who is interested in beginning to export goods, what kind of advice would you give? Give three websites you might find useful as references in your advice.
2. What are the advantages and disadvantages for logistics practitioners operating within a single trade bloc?
3. What are the advantages and disadvantages for logistics practitioners operating among multiple trade blocs?

4. From a logistics perspective, what are the essential differences between NAFTA and the European Union?

5. How will the newly developing trade blocs (such as the FTAA) affect logistics practice in the future?

## 12 INTERNATIONAL LOGISTICS FUNCTIONS

### 12.1 Introduction

There are no airtight definitions of logistics or logistics systems. Experts increasingly see logistics and logistics systems as activities facilitating four different cycles in the supply chain: the customer order cycle, the replenishment cycle, the manufacturing cycle, and the procurement cycle as used in this book, logistics is the organized movement of materials, information, and sometimes, people. Logistics implies that many separate, related activities are undertaken and are coordinated.

International logistics involves movements that cross borders, and these movements are considerably more complex than domestic ones. Many international movements go aboard ship, and the entire process of moving through ports and being at sea is time consuming. Complicating matters, differences between time zones can limit the hours when verbal communications can take place. Also, the documentation required for international shipping is varied and complicated, often requiring the services of experts. And today, inventory-in-transit is managed as if it were inventory-in-place, increasing the information management complexity and demands of international logistics.

The firm's international logistics department is responsible for the management, communications, control, and planning of the logistics activities. Specific activities or functions, all of which fall under the business firm's international logistics umbrella, include the following, which may be categorized in terms of usually being associated with outbound movements, inbound movements, or overall logistics management:

Demand forecasting, order management, packaging, labeling, documentation flow, customer service and parts and service support are typically associated with outbound flows.

The various separate logistics activities listed will be discussed, but one should realize that they must be planned and executed in coordination with each other and with other functions in the firm's supply chain. Forever present is the idea of cost trade-offs: the logistics manager may pay more for one element of service in order to save an even larger amount on a different element. For *example*, if one uses air freight, an expensive form of transportation, one saves money



on packaging because airlines are more careful with cargo than are many ocean carriers. In addition, one will receive quicker payment since the goods will be delivered more quickly. Also, current logistics thought holds that improving the level of customer service has its own reward in the form of increased sales.

The second topic to be covered in this chapter is related to the first, and it deals with firms that specialize in performing the various logistics functions. These firms are referred to as facilitators or intermediaries. Intermediaries exist because they improve the efficiency of marketing channels. In addition to covering routine logistics functions, they perform literally hundreds of specialized tasks associated with import/export movements. Take translators, for example. They may be needed for verbal translations, say, in trade negotiations and in promotional videotapes, and for written translation of trade documents or users' manuals. A translator must be able to work with at least two different languages; consider the number of different language pairs for which translations might be needed!

The best-known intermediaries in international trade are the freight forwarders. Conventional wisdom continues to hold that they should be used by all first-time exporters. And many firms with long experience in exporting and importing continue to use forwarders for all but the most routine and repetitive of activities. Some companies use firms known as third-party logistics service providers, or "3PLs". These 3PL firms are capable of handling all or part of a firm's logistics service needs and are thus comprehensive in scope.

## **12.2 Outbound Logistics Functions**

In this chapter, the goal is to list and define the activities for the exporting firm. Those mostly associated with marketing include demand forecasting, order management, packaging and labeling, and documentation. Note that every firm has its own methods of selling overseas, and often uses different arrangements in different markets.

### ***1 Demand Forecasting***

Demand forecasting is carried on in conjunction with the firm's marketing staff and its principal overseas distributors and is used by the firm to project sales. This translates to production and procurement needs for the next planning period. These in turn translate into direct logistical requirements that include both

delivery to customers and receipt of raw materials or components for assembly. Since the logistics staff is also involved with order management, it also has very early information about what customers are actually ordering. This is important intelligence for others in the firm who are planning and scheduling production and may wish to make alterations because of changes in demand. Note that the free flow of accurate demand forecasts is essential among the members of a supply chain to ensure a smooth flow of goods from origin to final consumer. Thus, demand forecasting is equally important to managers of inbound movements.

## ***2 Order Management***

Order management starts with the receipt of an order from an overseas customer. It may be obtained by the firm's salesperson, be telephoned or faxed in, come by mail, or arrive electronically through EDI, email, or the World Wide Web. The first step in most international order management systems is to verify the accuracy of the order; that is, make certain that the various documents accompanying the order contain no internal errors that might mean the customer was uncertain about what he or she was ordering. The next step is to verify the customer's credit, or ability to pay. At this point, terms of sale become important, and they are covered in the next chapter. One would be concerned, for example, about insurance coverage for the shipment. A decision is made from which inventory point to ship the goods, and instructions are sent to that warehouse to fill the order. At the warehouse an order picking list is given to a warehouse worker who assembles the specific order. In the packing area, it is checked and packed for shipment, and the package is labeled. While this has been going on, the export traffic manager has been preparing the transportation documents and making arrangements for the forwarder or carrier to pick up the shipment. Various inventory and financial records are updated.

## ***3 Packaging***

Three purposes are served by packaging: identifying the product, protecting it, and aiding in handling. Identification serves a variety of purposes, from automated recognition of the product through bar coding to promotional purposes: packages make the product stand out on a store shelf and say "take me home" to the customer. The protective function is to protect the product and, in some instances, to keep the product from damaging surrounding items. Packaging also

makes handling the product in distribution a much simpler task. The choice of packaging materials is influenced by concerns for environmental protection. Containers that can be recycled, or are made of recycled materials, are enjoying increased demand. Some nations are mandating their use. Most retail products are packed in a hierarchy of packaging. The concept is of building blocks with the smallest size being the container placed on the shelf that the customer buys and takes home. These containers fit into a master carton that is typically one to two cubic feet in dimension; master cartons are unloaded, item by item, by the person stocking the shelves. Master cartons are stacked on pallets, usually wooden (though increasingly today recycled molded plastic) platforms six inches high and 40 inches by 48 inches along the top. Sometimes slipsheets are used instead of pallets. Loaded pallets are moved by fork-lift trucks into and out of warehouses, intermodal containers, railcars, and trucks. Pallet loads are also called “unit-loads,” and are the most common way of handling packaged freight.

#### ***4 Labeling***

Labeling has several functions, the principal of which is to describe the contents of a package. Labeling is usually in the language of the exporting nation, although it is often advisable to have it in the importing nation’s language as well. The buyer may intend to have the same shipping carton used for the international move serve for the domestic move as well, in which case additional labeling may be applied. Today, a common request would be to have bar code labels applied. (Providing them would be an example of value-added service.)

#### ***5 Documentation***

Documentation is the preparation and handling of all the documents accompanying a shipment. In international movements, all documents must be present at the point where the goods are passing through the importing nation’s customs and inspection posts. In recent years, computers and the electronic preparation and presentation of documents through EDI and the World Wide Web have made documentation less of a burden. International shipments require many more documents than domestic shipments. The typical number ranges from six to ten, but the number can climb far above that. An example would be that livestock must be accompanied by a veterinarian’s inspection certificate. Documentation also links the shipment to payment for the product, a form of control necessary to insure that goods are not shipped without regard to their payment status.

## ***6 Customer Service***

Customer service involves an array of activities to keep existing customers happy. “It makes sense to focus on customers you already have, encouraging repeat business. Barring that, you’ll spend a lot of time and effort refilling a leaky bucket as you chase an ever-replenishing supply of new customers.” Servicing equipment in the field and training new users are other examples of customer service. As another example of customer service, FedEx pioneered the use of Web-based tracking of customer-shipped packages in 1994, empowering the customer with real-time information on the shipping status of packages.

Customer service functions are important to a firm’s success. In a survey of logistics practice worldwide, firms listed customer service performance ahead of six other performance variables in terms of importance to the success of logistics within their firm. Customer service ranked ahead of such concerns as lowered logistics costs and delivery speed and dependability. In comparing firms globally on customer service performance, the same study found that the most successful firms differed significantly in their performance on six key customer service measures as compared to the poorest performing firms. Those performance measures were fill rate, stock outs, shipping errors, cycle time, complete orders, and overall reliability. Clearly, the customer service functions are strategically important.

Customer service levels are more challenging to maintain in international distribution systems. Repair parts, supplies, catalogs, warranties, and return policies must take into account the hurdles of crossing borders.

## ***7 Parts and Service Support***

Parts and service support are another element of customer service. Equipment that has been sold must be maintained. Buyers of capital equipment insist on knowing that their purchase will be kept in running order for many years, and thus prompt delivery of repair parts is necessary. Air freight is often used for that purpose. One large U.S. tractor manufacturer retains an outside firm to request, at random, specific repair parts from its own dealers and competitors’ dealers throughout the world to measure how long it takes to fill the part orders.

Repair parts inventories are expensive to maintain and often must be justified on different criteria than are used for the main product lines. Parts and service support is an element of customer service although, in fact, buyers of a

product may shift to another firm for long-term service support. In many trades special parts lists exist showing the interchangeability of various competitors' parts.

In an era when long-term partnerships are increasingly common, manufacturers of capital goods are recognizing that post-sales activities are important. Mercedes Benz trucks, for example, leans heavily on this approach: Before expounding on the trucks' features, the West German company uses advertisements to ask the enigmatic question: "Are you buying a vehicle or an iceberg?" In studying documents, one soon learns that the company in fact is referring to the total-cost concept to buy, operate, and replace the equipment. Mercedes Benz is happy to remind buyers that the price to buy a truck now only constitutes about fifteen percent of the total cost estimated for the average life of this kind of equipment. The company's sales directors thus advise clients to calculate the provisional costs—taking into account Mercedes Benz fuel-saving systems, rental or finance terms, and especially the large number of vehicles in stock, thanks to high quality production and efficient after-sales service—before choosing a supplier. Beyond maintenance services, which are complemented by an accelerated spare parts distribution system, the company also develops software

### **12.3 Inbound logistics functions**

Three functions associated with inbound logistics are production scheduling, procurement, and handling returned products. Either a manufacturing firm or a wholesale/retail firm must first forecast demand, and then determine what must be purchased for use in the production process or to stock inventories. Handling returned products is more of an issue for domestic transactions than for foreign ones because the difficulties in returning a product across borders may erase any advantages of doing so.

#### ***1 Production scheduling***

Scheduling of production is done with the assistance of the logistics staff. Production is scheduled in an attempt to balance demand for products with plant capacity and availability of inputs. In the international arena, one must take into account anticipated changes in relative values of currencies, longer distances and times for materials to travel, quotas on imports, etc. Some firms are truly international in stature and try to develop products that can be manufactured and sold in

many parts of the world. One example is the Ford Focus, which is a “world designed” vehicle that one can spot variants of in many countries.

Inbound materials and components must be scheduled to fit into the production process. The production process itself is scheduled to fulfill existing and planned orders, and is thus dependent on accurate sales forecasting. Manufactured products must be scheduled for shipment to wholesalers, retailers, and customers. The logistics staff advises as to costs of moving materials. They hope to develop back-and-forth hauls of materials in order to better utilize transportation equipment. Just-in-time manufacturing philosophies call for disciplined, on-time deliveries. When just-in-time systems are used in supply chains, forecasts must be shared with suppliers so that they can better make their own plans. NUMMI (a GM-Toyota joint venture) in Fremont, California sends a seven-week forecast to its North American suppliers each week. The forecasts show potential ship quantities for the week by individual part numbers. Parts from Japan are handled in two ways: for optional parts, a three-day stock is maintained at the plant store room and fed to the assembly line on a JIT basis. The other parts, such as engines that are used on all autos, move in response to seven-week plans. No safety stock of them is kept; they move in containers directly from the port to the assembly line.

## ***2 Procurement***

Closely related to production scheduling is procurement (or purchasing), since many of the inputs needed for production must be procured from outside sources, known as vendors. Boeing, for example, relies on about 10,000 vendors worldwide. The logistics staff advises as to the transportation services that must be used to insure that the purchased materials arrive in good condition and on schedule. If the vendor assumes responsibility for delivery of the inputs, the buyer's logistics staff monitors the delivery performance. The logistics staff will also attempt to consolidate the shipments of various inputs, to reduce their overall transportation costs. U. S. retail chains, buying in Asia, have consolidation points at major Asian ports, and have vendors ship goods to the consolidation points where the buyer's agent takes possession, places them into containers, and ships the full containers to the United States.

The procurement cycle has been visualized as having four major components in a process that is an input to manufacturing. First, an order is received

based on a manufacturer's production schedule or on a supplier's stocking needs. Second, the supplier schedules the necessary production. Third, components are manufactured and shipped. And fourth, the components are received at the manufacturer's location. The cycle is then repeated for a given manufacturer-vendor pair, and is similarly repeated for manufacturer-wholesaler and wholesaler-retailer pairs.

One issue in international sourcing is to learn about and rate the political stability in the nation from which one is buying. The risks are greater than for exporting to that nation since depending upon a single nation as a source may place at risk one's total production. Currency exchange rates are always an issue: in what currency does the supplier want to be paid? One must also evaluate the vendor firm and determine the quality of its product and its ability to maintain a given quality. Systems of testing and assuring quality of product should be agreed on. Often this involves use of a mutually agreed-on third party to perform such testing and assurance.

Sourcing decisions are made after determining total acquisition costs, which include the price of the product, transportation, inventory investment, packaging, and so on. From what source will the "landed" (or delivered) price be the lowest? On-time deliveries are also important. For *example*, U.S. catalog merchants are required by law to ship products to their customers within 30 days or refund their money within 90 days after the order is placed. The merchants incur extra costs as shipments to their customers are delayed beyond 30 days.

### ***3 Returned products***

In domestic markets, there are many categories of returned products. A few are subjects of product recalls, meaning that a safety defect or hazard has been discovered and the products are removed from the shelves and both retailers and consumers attempt to return them to the manufacturer or to some intermediary. Some returned goods are those that have been on the shelves too long, and are no longer fresh. In the united states many food products have a "pull date" code on the package, indicating that the product should not be sold after that date. Then there are products that the customer is returning to be repaired or replaced. Some products are returned to be recycled in some way or another. Finally, there are products that may have been placed on consignment, never sold, and are being returned.

The firm doing business internationally will have to realize that in many national markets where the product is being sold, some returns can be expected for reasons given in the previous paragraph. Reverse flow channels must be established within those nations. Strict accounting controls are necessary to protect all parties in these sorts of transactions. Some care is also needed to insure that the returned product, thought to be scrapped, does not “reappear” to compete with one’s other products in the same or perhaps in a different market.

Increasingly firms are using information technology to facilitate reverse logistics flows. One important function that requires specialized information systems is gatekeeping. Firms accepting returns must categorize, approve, and specify procedures as far forward in the distribution channel as possible. Such gatekeeping functions can now be pushed down to the point of end-customer return, typically a retail store. Returned products may be examined for completeness and condition, scanned into the reverse logistics information system, and appropriate final disposition determined before the good leaves the retail location. Firms typically outsource the design and operation of such sophisticated reverse logistics systems.<sup>7</sup>

It is possible, although unlikely, to have products returned to the nation where they were manufactured. This does not happen frequently because of logistics costs and uncertainties regarding the items’ value at its final destination point. Quite often returned products are disposed of inside of the nation in which they were sold to the end customer. This may involve repackaging and sale, salvage sale, or disposal (usually requiring some level of destruction to prevent the resale of defective goods).

### **Chapter Checklist**

1. Make a list of common international logistics channel intermediaries and their functions.
2. Explain the concept of a cost trade-off, and give an example from international logistics business practice.
3. Make lists of the common inbound and outbound international logistics functions. Which functions are common to both outbound and inbound movements?



4. Explain the relationship among demand forecasting, production scheduling, procurement, and inventory management. Give examples of cost trade-offs and information management issues that may affect the relationship among the four functions.

5. How are transportation management, warehouse location and management, and materials handling concepts related to each other? Give examples to illustrate your discussion.

## **13 THE ROLE OF LOGISTICS IN INTERNATIONAL SUPPLY CHAIN MANAGEMENT**

### **13.1 Introduction**

As the global marketplace continues to expand with advances in technology, the development of sophisticated trade blocs, and the opening of new markets in the emerging nations, international logistics has risen in the minds of leading business executives as a means for strategically integrating global supply chains. It is logistics, after all, that is concerned with the creation of time and place utility—core considerations to doing business in markets that are geographically or temporally separate. Increasingly sophisticated global market demands have forced smart companies to respond with increasingly sophisticated strategies, including the use of international logistics tactics for strategic advantage in managing supply chains with their channel partners.

The drive toward high-performance international logistics seems inevitable for companies operating in the first world of logistics. The presence in these markets of competitors who are already using sophisticated logistics practices to create strategic advantages for their supply chain is reason enough for companies to develop such expertise. Furthermore, the state of the art in advanced consumer economies dictates supply chain performance at very high levels. Consumers and companies now take for granted standards of supply chain performance that were unheard of just ten years ago.

This chapter deals with the creation and integration of international logistics systems into global supply chain strategies. The global business climate and factors that influence international logistics and supply chain management were considered.

### **13.2 The Global Business Climate and International Logistics and Supply Chain Management**

Why global logistics and supply chain management? And why now? McKinsey & Company consultant Graham Sharman cites three global trends that are affecting the way international logistics managers respond to the strategic demands of their business environments: increasing market concentration; increasing dispersion of production; and increasing product line diversity.

### ***Increasing Market Concentration***

Through increased market concentration, so-called “power retailers” have come to rule the marketplaces in first-world economies. In the United States, for example, discount retailers such as Wal-Mart, Kmart, and Target have become dominant chains in general merchandising. “Category killer” retail chains such as Toys ‘R’Us, Home Depot, and Circuit City now control substantial shares of the retail market for their specialty goods. These retailers generate tremendous sales volumes: the general merchandise discount trio mentioned above had 2000 sales of approximately \$239 billion, with a weighted annual sales growth rate of 15 percent. Home Depot alone had a 19 percent sales increase in 2000, bringing annual sales to \$45.7 billion.

Representing a substantial portion of national retail sales, these power retailers have tipped the balance of channel power. A substantial portion of toy manufacturer Mattel’s sales are to Toys ‘R’Us; a similar relationship exists between Procter & Gamble and Wal-Mart. Remember the joke “where does a nine hundred-pound gorilla sleep?” With the base of retailers shrinking to a few giant firms, manufacturers and wholesalers now respond eagerly to the demands of these power retailers. Thus the retailers, like nine-hundred-pound gorillas, are able to “sleep” wherever they wish!

According to Sharman, one profit-enhancing strategy commonly used by power retailers is the refusal to hold large inventories. The power retailers have learned the lessons of just-in-time inventory management, and firms such as Wal-Mart focus on zero inventory as a desirable goal. In essence, the power retailers want delivery of goods in precisely defined lots, to dispersed retail locations, at exactly the time they are needed on retail shelves. The retailers have strategically applied inventory technologies such as point-of-sale scanning and electronic automatic reordering to make such split-second logistics performance possible. When such retailers are paired with responsive and logistically sophisticated manufacturers, retail inventory turnover rates skyrocket. For some categories of fast-selling goods such as toiletries and cosmetics, power retailers achieve thirty-five or more inventory turns per year. This allows the retailer to sell the goods before it even pays its suppliers, lending real-world proof to the concept of zero inventory retailing. In 2000, almost two-thirds of Wal-Mart’s sales were of this

type. As this goal is reached, power retailers seek additional higher levels of logistics capabilities from their suppliers and increasingly choose to deal only with suppliers who can guarantee their logistics performance. Logistics performance guarantees are common today. Suppliers who ship with errors in quantity, SKU, packaging requirements, or delivery requirements are today often heavily penalized by their retailer customers through invoice charge-backs.

When channel power is exercised in this way, leading-edge logistics performance becomes a norm, not an aspirational goal. As such, firms that cannot provide logistics excellence are left behind their competition. The power of the logistics-linked vertical marketing system is undeniable.

### ***Increased Dispersion of Production***

Sharman also cites a trend toward the global dispersion of production. Firms have pursued two distinctly different strategies in locating production facilities. Some have chosen to go where the cost of economic inputs (land, labor, and capital) are lowest. Others, facing unwieldy transportation problems or local trade barriers, have chosen to locate their manufacturing facilities near or in the markets where their goods are sold. In a global marketplace, both of these production location approaches can greatly complicate supply chain management and bring to the forefront excellence in international logistics performance. Adding to this complexity is the continuing trend toward more sophisticated automated manufacturing to increase quality and decrease labor costs.

For global logistics managers, these trends dictate increasingly complex logistics system design. Demand and supply pipelines must now circle the globe, and factory outputs must be directed (and often redirected) with increased precision in timing. In particular, the management of transportation and inventory functions have become quite complicated. Multimodal transportation coupled with improved information management has helped logistics professionals cope with the demands of global sourcing and manufacturing. It is now possible for logistics managers to creatively manage the inbound and outbound inventories while still in transit to and from manufacturing plants. Supporting such sophisticated management practices are continuing advances in logistics infrastructure in the first-world nations.

The situation in the emerging countries and the third world is much more tentative. As logistics management consultant Stephen Gould points out:

*“[M]ost non-Chinese companies operating or sourcing in China still communicate with their Chinese partners and vendors almost entirely by telephone, fax, and e-mail. And although most shippers—both Chinese and non-Chinese—are electronically linked to their logistics services providers, they typically receive information from their providers only through one-way data transmissions. Most shippers do not have their own advanced technology-enabled tracking systems, nor are they comfortable with sharing information online with service providers.”*

Gould goes on to cite a litany of poor supply chain management practices in China, including vendors’ unreliable production schedules, delays in inland transportation, and errors in customs documentation. Cumulatively, these practices result in significantly higher logistics and inventory-carrying costs in China (24 percent to 34 percent of the U.S. landed cost of hard goods such as toys, appliances, and tools) versus 10 percent with U.S. and European vendors.

What, then, is the contribution of international logistics to this global corporate strategy of dispersion of production? Again, as the business function dealing with the creation of time, place, and form utility, leading-edge logistics allows firms to increase profitability, quality, and responsiveness to their fellow channel members and to consumers. In addition, because such complex systems with high performance standards are so difficult to duplicate, logistics can give a tremendous competitive advantage to the entire global supply chain.

### ***Increasing Product Line Diversity***

Manufacturers worldwide have responded to the increasingly sophisticated needs of consumers in first-world nations by lengthening and broadening their product lines. As marketers have gotten more in tune with the needs and wants of consumers, they have expanded the variety of products offered. A related phenomenon is the general shortening of product life cycles observed in the 1990s, most exaggeratedly in technology products. Consumers demand goods that meet their needs more precisely, and are willing and eager to change brands to achieve increased satisfaction. This fickleness and volatility in the consumer marketplace has important logistics implications.

As demands change so rapidly, logistics system throughput time becomes critical. Goods must arrive where and when they are demanded, else they risk market obsolescence. While this may seem obvious and simplistic, the challenge faced by a firm managing a global supply chain is quite complex. Trends and resulting changes in one market may not parallel those in other first-world markets. Take, for example, the case of Sony's "Minidisc" technology. This home audio-recording format was intended as a near-CD quality replacement for the audio cassette. Minidiscs are small, so are easily amenable to both home and portable use. Japanese consumers have very successfully adopted minidisc technology, and Sony has licensed it to a number of Japanese manufacturers including JVC and Sharp. However, Minidisc technology did not catch on nearly as well with North American and European consumers, with market penetrations standing at just a few percent. In contrast, American consumers rapidly adopted the MP3 standard for web-shared audio files in comparison with Japanese consumers. Thus, Sony finds itself a market leader in Minidisc products in Japan, but a market follower in MP3 products in the United States.

These market-driven trends have implications for international logistics managers. There are more products in the global supply chain, with shorter life cycles, and with more divergent sourcing requirements. These developments inherently raise the complexity of the logistics task. Dominant power retailers raise the ante for excellence in logistics by demanding leading-edge performance, and they increasingly are willing to do business only with partners who can provide such service. Moreover, as manufacturing costs have declined worldwide, increased focus is put on logistics costs. Corporate management will expect logistics costs to fall with increased logistics system efficiency in the same way they have seen manufacturing costs fall with increases in manufacturing efficiency. The old adage "do more with less" seems applicable.

Logistics has become the glue, which holds the global supply chain together, and managing the global supply chain has largely become the management of sophisticated international logistics.

### **13.3 Managing Successful Global Supply Chain Collaboration**

Creating such integrated supply chains is not the easiest of managerial tasks. In a 2001 survey of 145 U.S. high-tech firms using supply chain manage-

ment strategies, the top ten barriers to supply chain management collaboration were:

1. The cost and complexity of technology integration
2. Lack of trading partner technology sophistication
3. Lack of clear benefits and/or ROI
4. Cultural resistance to new trading partner paradigms
5. Until recently, few native Web-centric applications designed for this collaboration
6. Lack of technical standards
7. Fear of divulging proprietary information to business partners
8. Lack of awareness of solutions
9. Lack of commitment by top management
10. Lack of vendor support for collaborative processes.

Obviously, the key to successful global supply chain management is collaboration among all parties to the supply chain. Professor Karl Manrodt and logistics executive Mike Fitzgerald offer seven suggestions for successful supply chain collaboration.

***Proposition 1:*** As companies move toward collaborative strategies, logistics and supply chain executives must increasingly apply a process view of their organizations.

By *process view*, Manrodt and Fitzgerald mean that managers should view their company's activities as linked and continuous, contributing to a single outcome. When managers take such a view, they come to realize the interdependent nature of the firms in the supply chain, since many business processes both extend outside the firm and transcend any single functional area in the firm. This process view represents a conceptual leap in the experience of many managers, but is essential for understanding how collaboration in the supply chain can be achieved with both efficiency and strategic intent.

***Proposition 2:*** Not all processes are created equal. The importance of each process should be based on a company's corporate strategy.

The two generic supply chain management strategies presented earlier in this chapter provide an excellent example of this second proposition. A firm having customer responsiveness as its overall corporate strategy is likely to create a far different supply chain than a firm whose goal is efficiency. Customer service,

manufacturing, transportation, inventory management, and a whole host of business processes would rise and drop in prominence depending on the firm's overall strategy. It is important to insure that supply chain management strategy is consistent with corporate strategy.

**Proposition 3:** Before collaborative logistics can be effective, coordination must be improved.

Manrodt and Fitzgerald coin the term intragration to describe the movement of information within a single organization, and such intragration is an important first consideration that each participant in a supply chain must make for a successful collaboration. They discuss four steps toward intragration: awareness, measurement, coordination, and integration. Firms must first be aware of the potential benefits of coordination, and then must develop appropriate process-based measurements to meter improvements and problems in coordination. Coordination speaks to the implementation of process-based improvements, with integration achieved as a firm transcends functional boundaries within the organization and successfully adopts the process view in business practice.

**Proposition 4:** Collaborative logistics, currently at an immature level, is moving toward more intelligent communities.

Firms can extend their notion of a supply chain by adding entities not directly related to the market-accommodation flow, and thus leverage the assets of firms not traditionally considered to be a part of a supply chain. Such firms then become part of an intelligent community. Manrodt and Fitzgerald give several examples in transportation consolidation, where firms from different industries gain truckload (TL) rates by consolidating less-than-truckload (LTL) shipments. Similar collaborations are possible in warehousing, container consolidation, and in conducting joint negotiations or "bulk buys" across the supply chain. Such collaborative intelligent communities of firms can be facilitated by Web-based information exchanges (for example, Ship Chem in the chemicals industry, <http://www.shipchem.com>).

**Proposition 5:** New tools will enable and facilitate increased levels of "intragration," coordination, and collaboration.

In the late 1990s, the Internet demonstrated its value as an efficient communications medium that allowed real-time sharing of information in supply



chains. One study of information systems in supply chain management defines four distinct types of collaborative management tools:

- 1) enterprise resource planning (ERP), linking functions within an organization through an integrated database;
- 2) advanced planning and decision support systems, allowing dynamic and continuous planning;
- 3) logistics execution systems, including order management, manufacturing execution, warehouse management, and transportation management; and
- 4) electronic data interchange (EDI), permitting the transmission of standardized information among partners in the supply chain.

Further development and integration of Web-based technologies will enhance global supply chain collaboration.

**Proposition 6:** The key to “intragration,” coordination, and collaboration is visibility of key supply chain activities.

Visibility speaks to the transparency and availability of information throughout the supply chain. Barriers to information sharing must be broken down. The key to success is “the right information, at the right time, in the right quantity, to the right people.”

**Proposition 7:** The future lies beyond collaboration – in synchronization.

While few supply chains have achieved the level of collaboration envisioned by Manrodt and Fitzgerald, they see a higher level still: synchronization. Synchronization is collaboration among intelligent communities, linking disparate supply chains for additional efficiencies. They call for collaboration efforts to be inclusive and open to develop such cross-community synergies.

### **Chapter Checklist**

1. Discuss the ways in which increased market concentration at the retail level changes the management of the supply chain.
2. In what ways does increasing dispersion of production make supply chain management more complex?
3. What are the international supply chain management implications for suppliers, manufacturers, wholesalers, and retailers of the trend toward increasing diversity in product lines?
4. What are the unique characteristics of efficient supply chains?

5. What are the unique characteristics of responsive supply chains?
6. Explain the differences in inventory management strategies at manufacturer and retailer levels between efficient and responsive international supply chain strategies.
7. Describe the market-accommodation flow in a supply chain. Be sure to include characteristics from three different perspectives: operational, planning and control, and behavioral.
8. What advice would you give to the managers of a firm about to shift to a supply chain management philosophy?
9. What is meant by collaborative logistics?
10. What are the characteristics of an “intelligent community” in business?

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