

COST OF QUALITY

Cost of quality is an approach that supports a company's efforts to determine the level of resources necessary to prevent poor quality, and to evaluate the quality of the company's products and services. Any cost that would not have occurred if quality was perfect, contributes to the cost of quality. This information will help a company to determine the benefits and savings generated by potential process improvements.

Cost of quality can be divided into "the cost of good quality" involving prevention and appraisal costs, and "the cost of poor quality" involving internal and external failure costs.

Cost of Good Quality

- **Prevention Costs** are incurred to prevent or avoid quality problems. These costs are associated with the design, implementation, and maintenance of the quality management system. They are planned and experienced before actual products or materials are acquired or produced. They include:
 - Establishment of specifications for incoming materials, processes, products, and services
 - Creation of quality plans
 - Quality training (development, preparation, and maintenance of programs)
 - Creation and maintenance of the quality system
- **Appraisal Costs** are associated with the measuring and monitoring of activities related to quality. These costs are associated with the evaluation of purchased materials, processes, products, and services to ensure that they conform to specifications. They include:
 - Testing, evaluating, and inspecting the quality of incoming materials, process setups, and products, against agreed upon specifications
 - Quality assessment and approval of suppliers
 - Performing audits to confirm that the quality system is operating properly

Cost of Poor Quality

- **Internal Failure Costs** are incurred to fix defects discovered before the product or service is delivered to the customer. These costs occur when the product or service does not meet the designed quality standards, and are identified before the product or service is delivered to the customer. They include:

- Defective product or material that cannot be used, sold, or repaired
 - Correction of defective material or errors (e.g., rework and repairs)
 - Unnecessary work or inventory resulting from errors, poor organization, or poor communication
 - Analysis activities required to establish the root causes of internal product or service failures
- **External Failure Costs** are incurred to fix defects discovered by customers. These costs occur when the product or service that does not meet the designed quality standards are not detected until after the product or service is delivered to the customer. They include:
 - All work and costs associated with handling and responding to customer complaints
 - All work and costs associated with failed products that must be replaced or services that are repeated under a warranty
 - All work and costs associated with the repair and servicing of returned products and products still in the field
 - All work and costs associated with the handling and investigation of rejected or recalled products, including return transportation costs

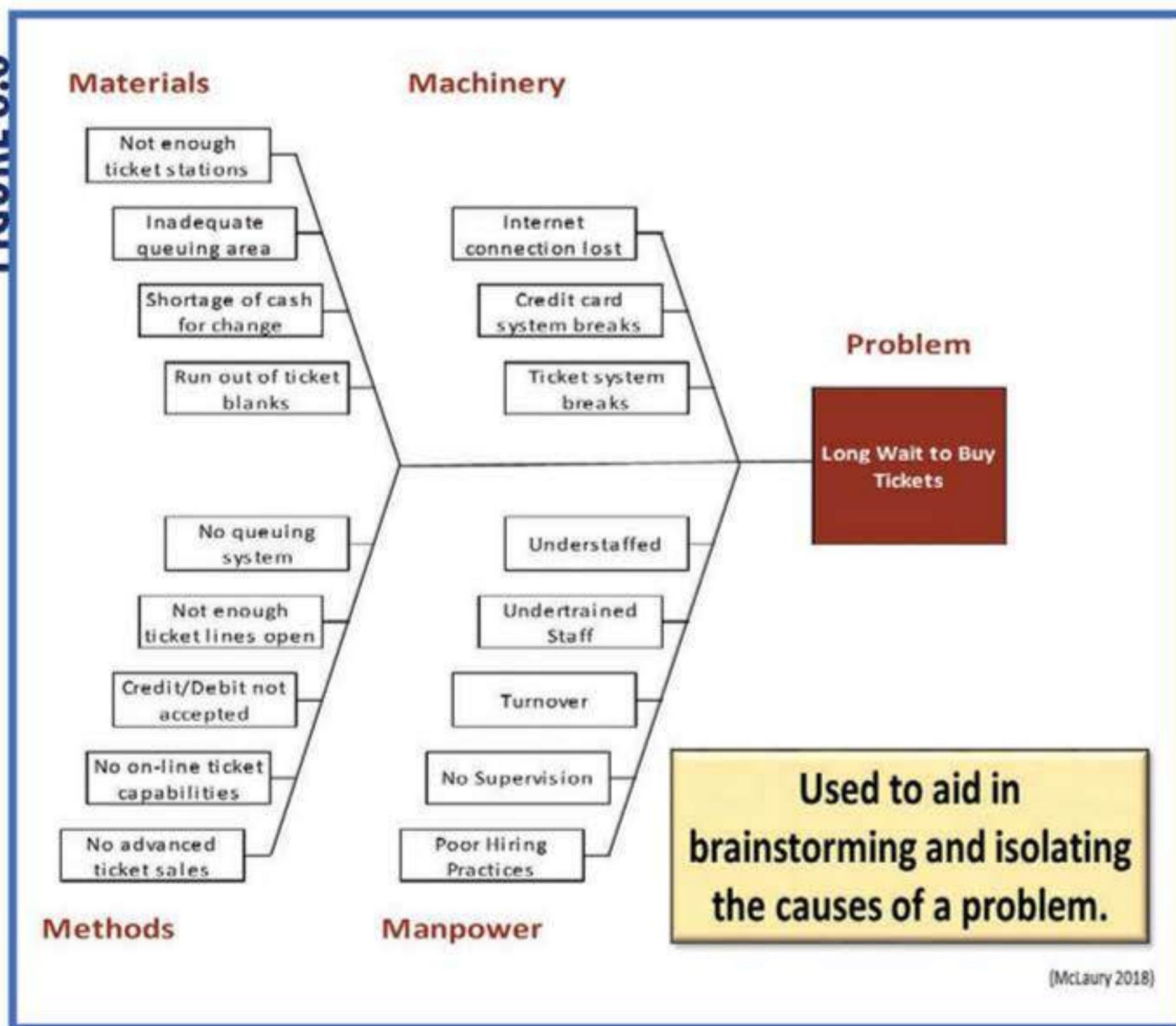
QUALITY TOOLS

Seven quality tools are commonly used in making quality management decisions based on facts. Any one or any combination of the tools may be helpful depending on the circumstances, and none of the tools are mandatory in Six Sigma. There are a number of software programs available to support these tools.

The seven tools most commonly used for quality control and improvement are:

1. **CAUSE-AND-EFFECT DIAGRAM** (Ishikawa or fishbone diagram): Tool used to aid in brainstorming and isolating the cause(s) of a problem. The function is to identify the factor(s) that are causing a defect(s) so that improvement actions can be taken. Typically, the potential factors are identified by those familiar with the process involved. Major factors could be grouped using the four Ms: materials, machinery, methods, and manpower. It is commonly used in combination with the Five Whys and Five Hows technique to help identify the root cause. See figure 8.6 for an example.

FIGURE 8.6



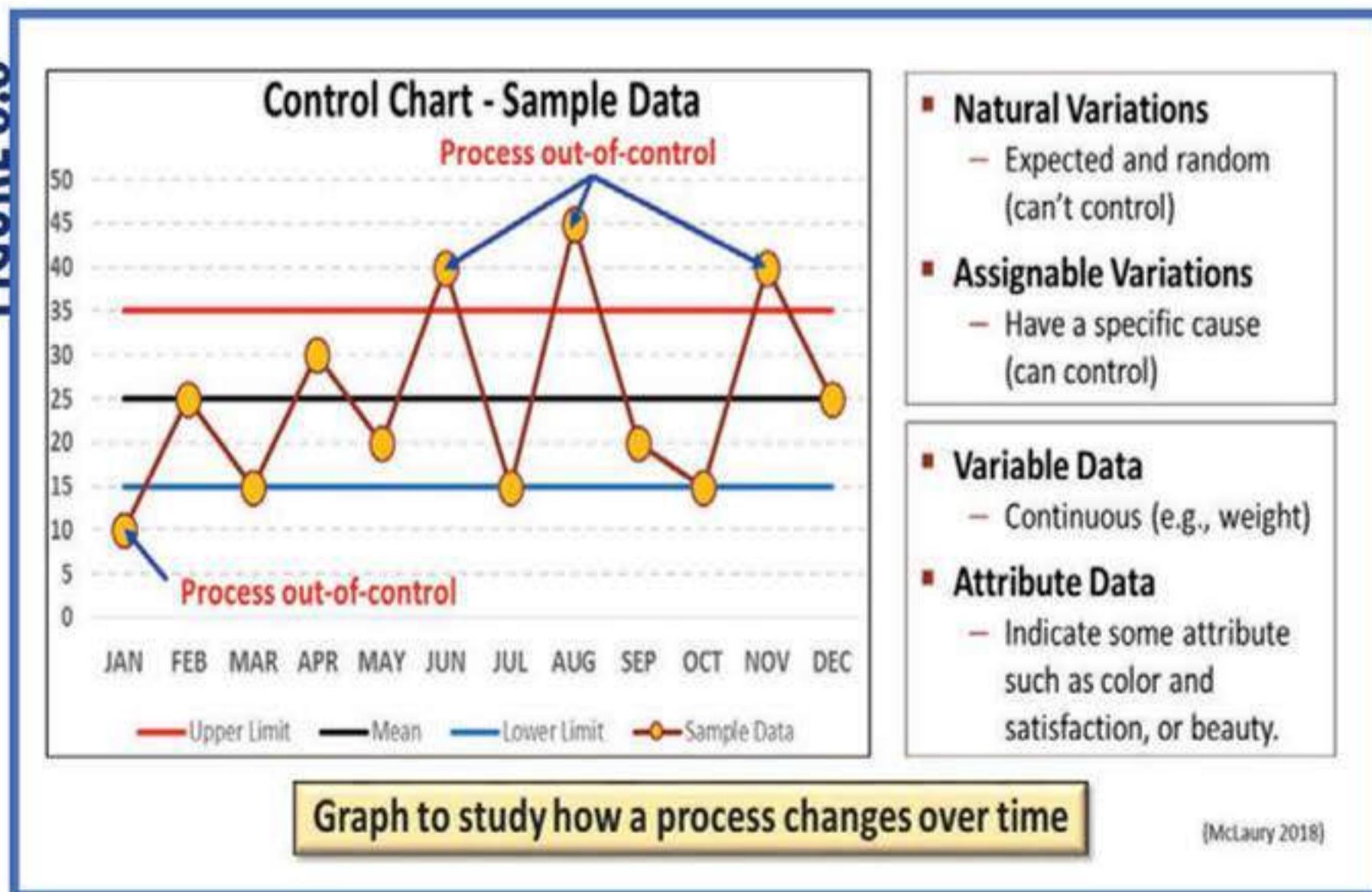
2. **CHECK SHEET:** A simple way of gathering data so that decisions can be based on facts. Check sheets are commonly used to determine the frequencies for specific problems. They could also be used to correlate the number of defects to other variables such as the day of the week or month of the year, to see if there is any significant variation or pattern. The data gathered in a check sheet can also be used as input to a Pareto chart for analysis. See figure 8.7 for an example.
3. **CONTROL CHART:** Plots representative samples of the selected values from a process, in sequence over time. Control charts are used to study how a process changes over time. A control chart always has a median line for the average, an upper line for the upper control limit, and a lower line for the lower control limit. These lines are determined from historical data. By comparing current data to these lines, conclusions can be drawn regarding whether the process variation is in control or out of control. (Refer to “Statistical Process Control” later in this chapter.) A sample measurement outside the control limits therefore indicates that the process is no longer stable, and is usually a reason for corrective action. See figure 8.8 for an example.

FIGURE 8.7

Problem	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
No Parking				5	12	15	17	49
Long Wait for Tickets	14	16	15	18	16	19	20	118
Tickets Sold Out	11	16	13	15	11	16	12	94
Long Wait for Concessions	11	15	12	11	12	15	13	89
Concessions Sold Out	5			12	13	15	15	60
Poor Seats			11	12	11	11	13	58
Poor Picture/Sound Quality			1	2	4	3	2	12
Temperature in Theater	1	2	2	3	1	2	1	12
Traffic Congestion on Exit				11	11	13	12	47
Other	2					3	5	10
TOTAL	44	49	54	89	91	112	110	549

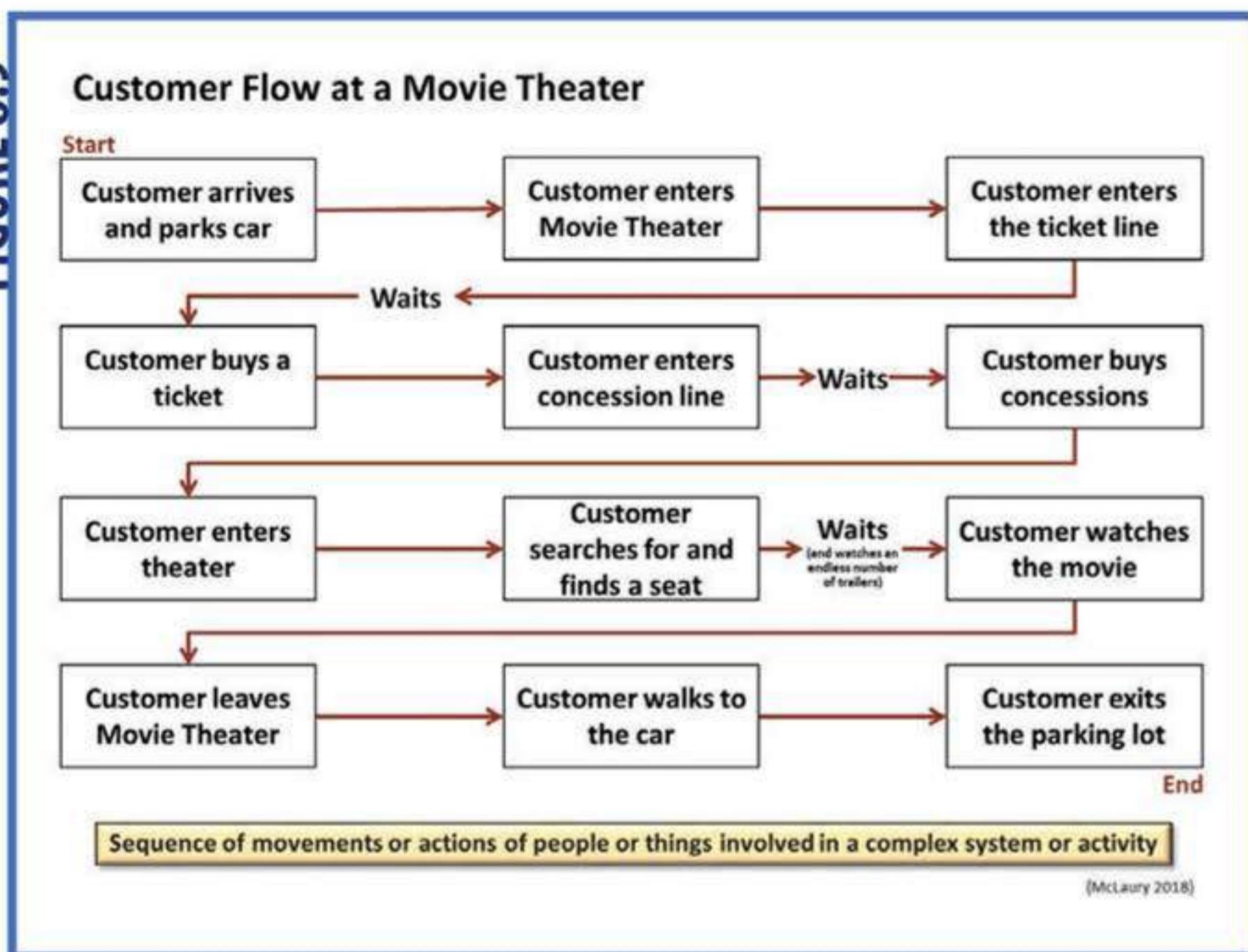
Used to determine frequencies for specific problems

(McLaury 2018)

FIGURE 8.8

4. **FLOWCHART:** A picture of process steps in sequential order. It is comprised of annotated boxes representing process steps to show the flow of products or customers. It helps users understand how a process progresses toward completion, and to identify where process improvements can be made. See figure 8.9 for an example.

FIGURE 8.9



5. **HISTOGRAM:** Another form of bar chart in which the measurements represent a range of values of some parameter. Besides the central tendency and spread of the data, the shape of the histogram can also be of interest. See figure 8.10 for an example.
6. **PARETO CHART:** A bar graph. The lengths of the bars generally represent the frequency that specific defects occur, and are arranged with the longest bars on the left and the shortest bars on the right. A Pareto chart will visually depict which defects are more significant. See figure 8.11 for an example.

FIGURE 8.10

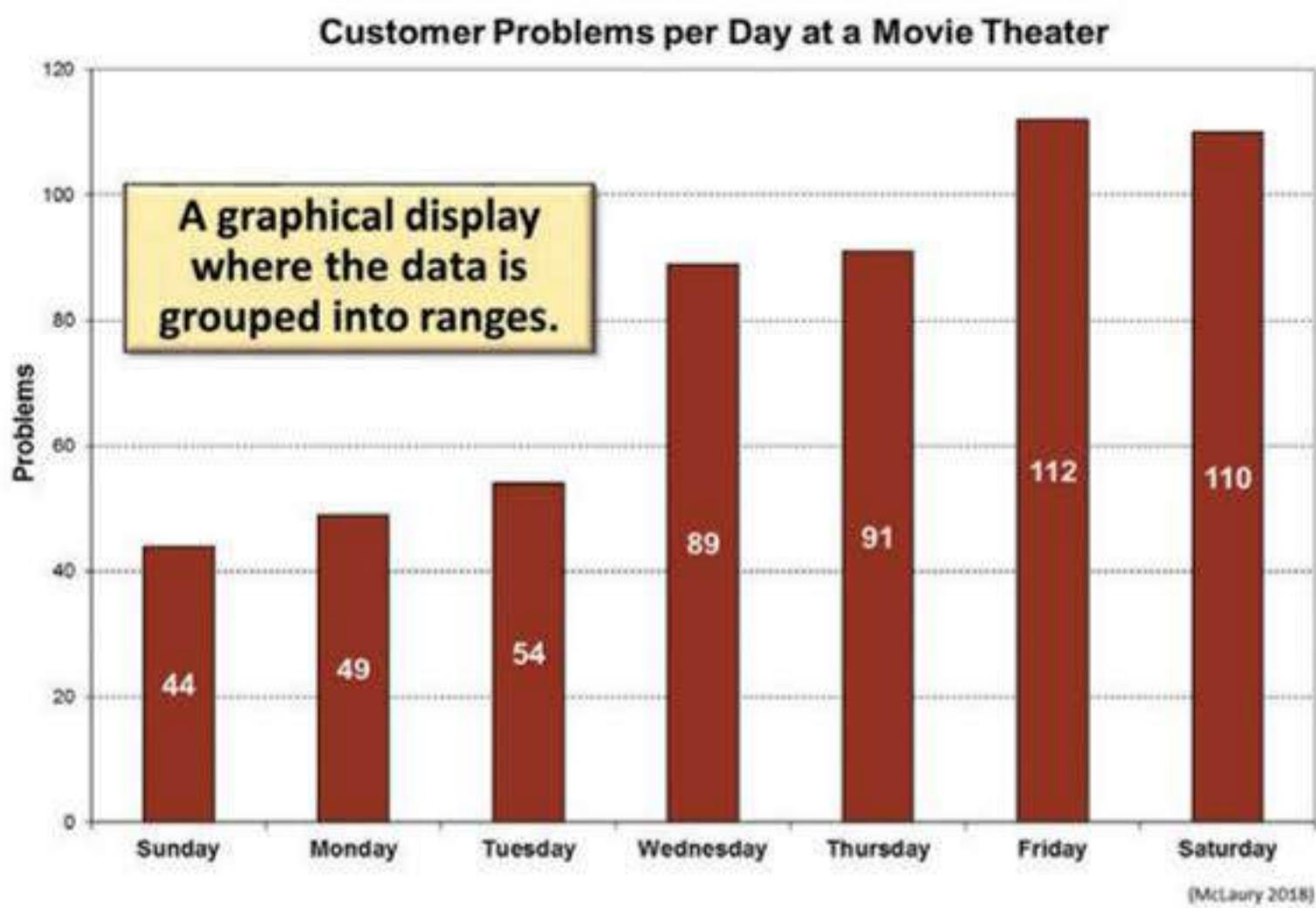
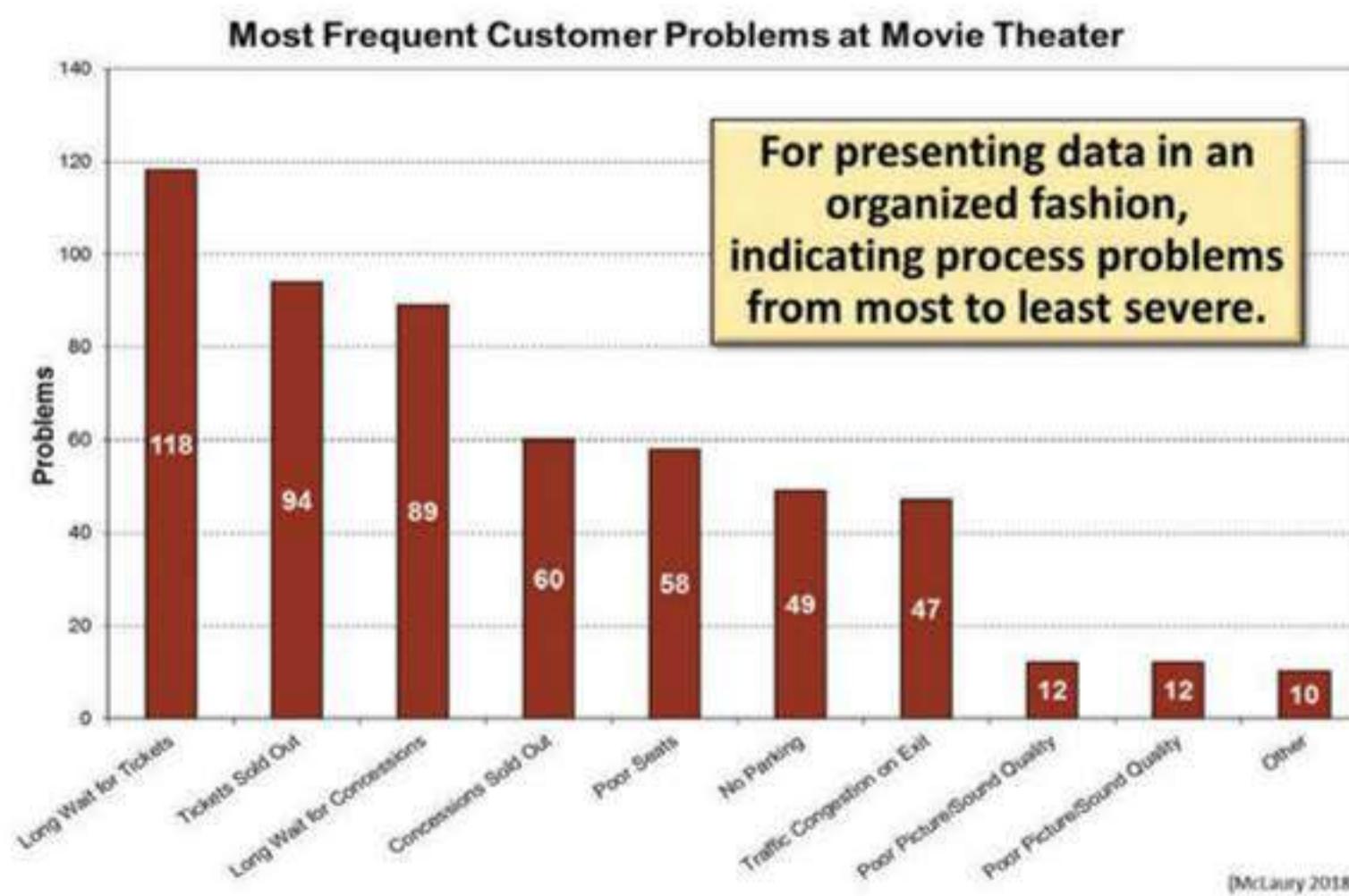
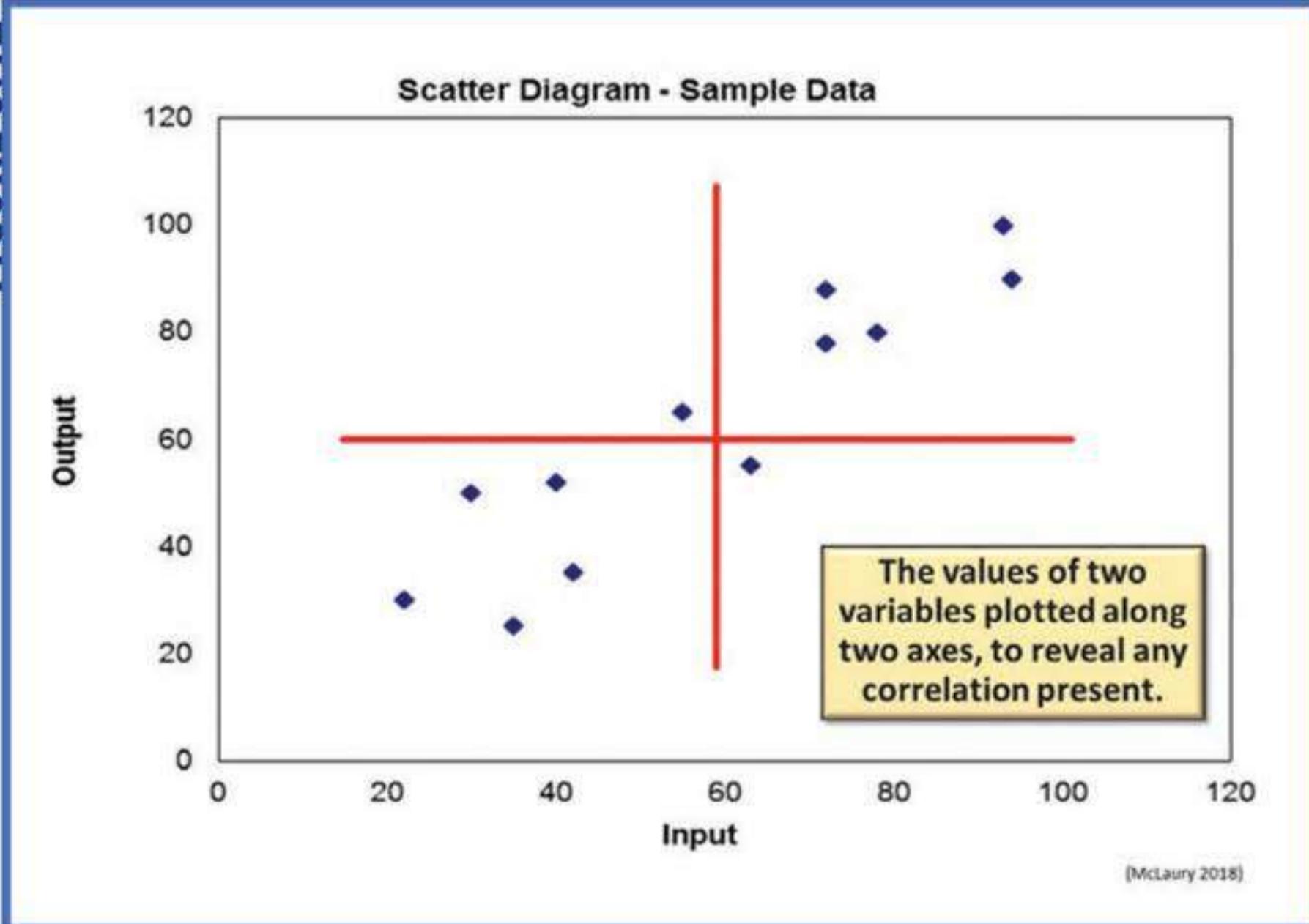


FIGURE 8.11



7. **SCATTER DIAGRAM:** Graphical method of observing whether or not two parameters are related to each other. Data are plotted with one variable on each axis. If the variables are correlated, the data points will fall along a line or curve. The tighter the points hug the line, the better the correlation of the relationship, and one can be used to predict the other. See figure 8.12 for an example.

FIGURE 8.12



The Five Whys and the Five Hows Technique

The Five Whys and Five Hows technique is a questioning process designed to drill down into the details of a problem or a solution to find the root cause and the best corrective measure. Originally developed by Sakichi Toyoda, who stated “that by repeating why five times, the nature of the problem as well as its solution becomes clear.” The Five Whys are used to reach the root cause of a problem and the Five Hows are used to develop the details of a root solution to a problem. Both are designed to bring clarity and refinement to a problem statement or a potential solution. This technique is typically used in conjunction with the cause-and-effect diagram.

5 WHYS ANALYSIS



STATISTICAL PROCESS CONTROL

Statistical process control (SPC) is a method for monitoring, controlling, and improving a process through statistical analysis. All processes exhibit intrinsic variation and SPC is the application of statistical methods and procedures, such as control charts, to analyze that inherent variability to achieve and maintain a state of statistical control. Variations can be natural (i.e., expected and random which cannot be controlled), or assignable (i.e., having a specific cause which can potentially be controlled).

Sometimes processes exhibit excessive variation that produces undesirable or unpredictable results, and SPC is used to reduce that variation to improve process capability.

- Companies:
 - Gather process performance data.
 - Create control charts to monitor process variability.
 - Then collect sample measurements of the process over time and plot on charts.
- SPC allows firms to:
 - Visually monitor process performance.
 - Compare the performance to desired levels or standards.
 - Take corrective action.



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ACCEPTANCE SAMPLING

Acceptance sampling is the selection of a set of items from a product lot to test as a representative sample of the entire lot. Sampling lets you draw conclusions or make inferences about the population from which the sample is drawn. Acceptance sampling is useful when the cost of testing is high compared to the cost of passing a defective item, or when testing is impractical or destructive. It is

a compromise between doing 100% inspection and doing no inspection at all. Sampling is also less time consuming than testing every item.

However, acceptance sampling can result in errors:

- Manufacturer's risk: A buyer rejects a shipment of good quality units because the sample quality level did not meet standards (type I error).
- Consumer's risk: A buyer accepts a shipment of poor quality units because the sample falsely provides a positive answer (type II error).

IMPLEMENTING LEAN AND SIX SIGMA

LEAN and Six Sigma are complementary principles providing the customer with the best possible quality, cost, and delivery. There is significant overlap, and the two initiatives approach their common purpose from somewhat different angles:

- LEAN focuses on waste reduction, whereas Six Sigma emphasizes variation reduction and the elimination of defects.
- LEAN achieves its goals by using less technical tools such as lean layouts, continuous improvement, and respect for people, whereas Six Sigma uses technical tools such as root cause analysis, statistical process control, and DMAIC.

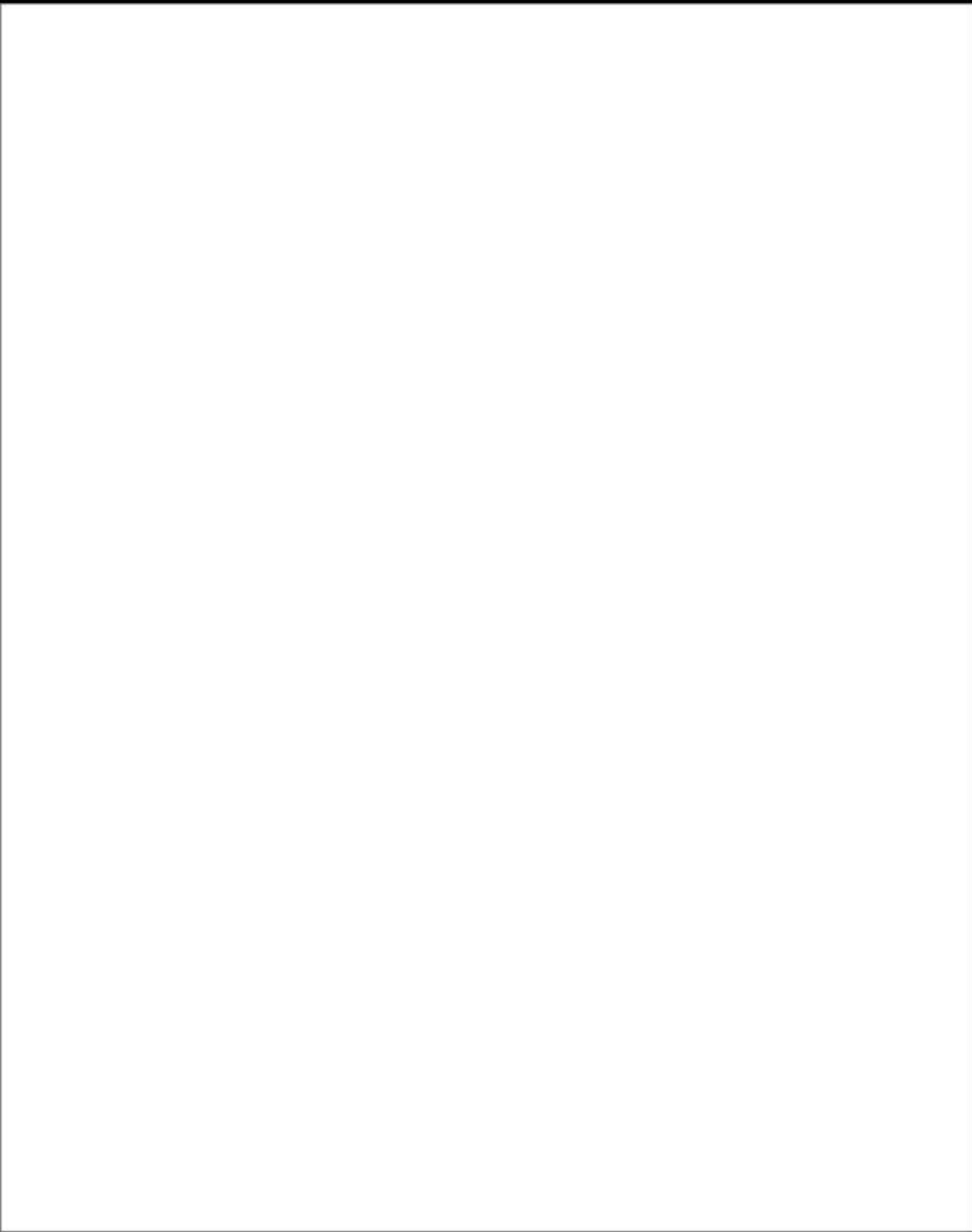
The most common and successful implementations begin with LEAN, reducing waste, and using value stream mapping to make the workplace as efficient and effective as possible. Typically this is followed by implementing the more technical Six Sigma statistical tools to resolve process problems. Both LEAN and Six Sigma require strong management support to incorporate these principles into the standard way of doing business. One way companies have found success is by forming a Lean Six Sigma team with subject matter experts to lead the company-wide implementation effort.

REFERENCE

¹ APICS Dictionary (14th ed.). (2013). Chicago, IL: APICS. www.apics.org; GoLeanSixSigma.com. (2016). What is waste? Retrieved from <https://goleansixsigma.com/8-wastes/>

DELIVER AND RETURN





Chapter 9

Logistics: Warehousing, Transportation, and Reverse Logistics

CHAPTER OUTLINE

Introduction

Logistics

Warehousing

Functions of a Warehouse

Types of Warehouses

Which Warehouse Type to Choose

Warehouse Networks

LEAN and Green Warehousing

Third-Party Logistics

Transportation

Transportation Company Classifications

Major Modes of Transportation

Transportation Pricing and Considerations

Transportation Regulation

Transportation Deregulation

Other Transportation Intermediaries

Technology and Trends in Transportation

Logistics Management Software Applications

Reverse Logistics

Summary

INTRODUCTION

Up to this chapter, discussion has centered on the supply chain elements of Plan, Source, and Make. In this chapter we begin with the Deliver and Return aspects of the SCOR model. Logistics will be discussed in general, followed by a more detailed discussion of warehousing, transportation, and reverse logistics. The next few chapters will cover the other aspects of Deliver and Return, including global logistics and international trade, customer relationship management, and supply chain in the service industry.

LOGISTICS

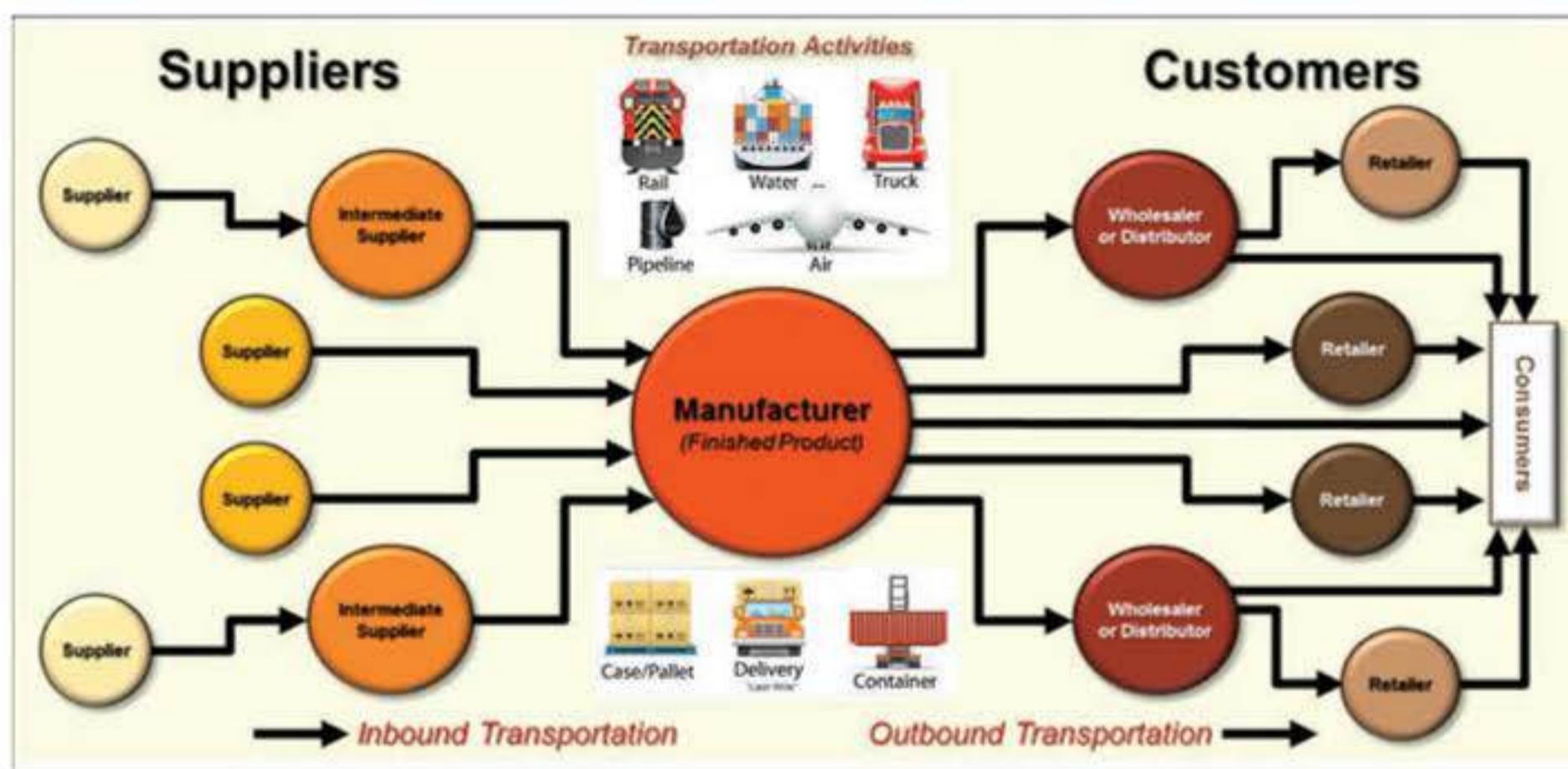
As noted earlier in this text, many people confuse supply chain management with logistics, and consider them interchangeable terms. Logistics is part of supply chain management, specifically the part involving warehousing, transportation, and reverse logistics activities.

Logistics is “that part of supply chain management that plans, implements and controls the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet customer requirements,” as per the Council of Supply Chain Management Professionals (CSCMP) official definition.

Logistics is necessary to accomplish three things:

1. To move goods and materials from suppliers to buyers
2. To move goods and materials between sites, either internally or between internal and external sites
3. To move finished goods out to customers

Referring back to figure 1.2 (excerpt shown here), you see that logistics covers the flow on the left side from supplier to buyer, the flow in the middle moving goods and materials between sites (internal and external), and the flow on the right side going out to customers, whether the customer is a wholesaler, distributor, or retailer, or even the final consumer of a product. Logistics covers all of these movement activities.



(McLaury, 2016)

Products have little value to the customer until they are moved to the customer's point of consumption. In other words, the customer cares very little about transportation and logistics activities on the front end of the supply chain. They are more interested and more directly impacted by the transportation and logistics activities on the back end when the product is actually in proximity to where they are going to use it, whether that is a wholesaler, a distributor, a retailer, or the actual end consumer. **The real value delivered by the logistics function is ensuring that the product is delivered at the right time and to the right location**—everything else up to that point is a necessary but nonvalue added activity. Although logistics on the front end of the supply chain is necessary to move materials from suppliers to manufacturers and out to wholesalers, the real value only occurs when the product is in the possession of the actual customer.

WAREHOUSING

A warehouse is a facility used to store inventory.

Warehousing is all “the activities related to receiving, storing, and shipping materials to and from production or distribution locations.”¹ Warehousing is the function that allows a company to store all of the types of inventory (i.e., raw materials, work in process, and finished goods) the company may have or need. Decisions driving warehouse management include site selection, the number of warehouse facilities in the network, the layout of the warehouse(s), and the methods of receiving, storing, and retrieving products and materials.

Most companies will have some type of warehousing operation to store inventory, whether it is an internal company owned warehouse, or an external public or contract warehouse. These warehouses function in basically the same way whether internal or external, allowing for faster and more frequent deliveries, and better customer service.



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The true value of warehousing lies in having the right product in the right place at the right time. Warehousing provides time and place utility, the availability necessary to give materials true value.

FUNCTIONS OF A WAREHOUSE

Following are the basic functions of a warehouse:

- **RECEIVING:** Function encompassing the physical receipt of material, identification, inspection for conformance with the purchase order (quantity and damage), put-away (delivery to a warehouse storage location), and preparation of receiving reports.
- **STORAGE:** The safe and secure retention of parts or products for future use or shipment. Includes placing goods into storage and retrieval of goods from storage.
- **PICKING:** Withdrawing components from stock to make assemblies or finished goods, or withdrawing finished goods from stock to ship to a customer.
- **PACKING:** Placing one or more items of an order into an appropriate container for safe shipping, and marking and labeling the container with customer shipping destination data and other information that may be required.
- **SHIPPING:** Function for the outgoing shipment of parts, components, and products. Includes packaging, marking, weighing, and loading for shipment.

Warehouse operations may also perform other activities including functioning as:

- **CONSOLIDATION POINT:** Warehouse operation that receives products from suppliers, sorts them, and then combines them with similar shipments from other suppliers for further distribution.
- **BREAK BULK:** Warehouse operation that divides full truckloads of items from a single source or manufacturer into smaller, more appropriate quantities for use or further distribution.
- **QUALITY INSPECTIONS:** Incoming and outgoing.
- **REPACKAGING:** For specific customer orders.
- **ASSEMBLY OPERATION:** Warehouse operation that puts products together with other items/components before shipping them out to the final customer. Examples include:
 - Literature
 - Spare parts
 - Advertising materials

Each of these will be described further in this chapter.

TYPES OF WAREHOUSES.....

There are different types of warehouses that companies must consider. This text will review:

- Public
- Contract
- Private
- Consolidation
- Break bulk
- Cross docking

Public Warehousing

A public warehouse is a business that provides storage and related warehouse functions to companies on a short- or long-term basis, generally from month to month. They typically own their own equipment and hire their own staff to manage the operations of the facility. A public warehouse is often divided into zones for a variety of goods, and can include temperature-controlled storage, dry storage, and general storage.

Fees are generally a combination of a monthly storage fee plus a pallet-in fee and a pallet-out fee. The storage and handling fees in a public warehouse will also vary based on exactly what is being stored and handled. So, Customer A may be charged more than Customer B per pallet within the same public warehouse. The reasons could include the size and weight of the palletized loads, how high the pallets can be stacked, how fragile they are, the risk of theft, the value of goods, any hazards associated with the goods, and so forth. Public warehouses may also have some nominal transaction or document fees, and account management fees. The fee structure can be based on each pallet moved/stored or based on each square foot used by a client.

Public warehouses also offer a variety of al la carte services including order picking and order packing, order consolidation, cross docking, packaging services, kitting, returns processing, inspection services, inventory management, physical inventory counts, assembly operations, and shipping. They charge their clients a fee for each of the services the client uses in addition to the fees for storage and handling.

Although most companies see public warehousing as a short-term solution, it can often turn into a long-term relationship as companies become accustomed to the convenience of the public warehouse services. Companies that own and operate public warehouses will invest significantly in their facilities to remain competitive. They offer clients increasing levels of flexibility in order to retain existing clients and to attract additional clients. Public warehouses offer companies a range of labor solutions up to and including a dedicated workforce. In a longer term arrangement, they may also allow clients to bring in their own ERP or warehouse software so that the public warehouse in essence becomes a satellite location of the client providing real-time data.

PUBLIC WAREHOUSING OFFERS A VARIETY OF ADVANTAGES BECAUSE OF ITS FLEXIBILITY:

- a. **NO CAPITAL INVESTMENT:** A major advantage is there is no capital investment from the user/client for warehousing. Public warehousing immediately takes away the need for a company to own and operate storage infrastructure, including the staff and security that go along with it. In this way, public warehousing is a variable cost component.
- b. **TAX AVOIDANCE:** Because the user company doesn't own the property, the user is not subject to property taxes, which can be substantial.
- c. **FLEXIBILITY:** Because a company can establish a short-term public warehouse commitment, if business conditions change, the company is not tied into a long-term commitment, and they can reduce or expand their storage needs accordingly.
- d. **ACCOMMODATES SEASONALITY:** Seasonal businesses have the option of expanding and contracting their public space on a monthly basis. You only pay for space in the month you are using it, allowing storage costs to vary directly with seasonal volume.

- e. **CAPABILITY TO EXPAND:** Public warehousing provides an economical and practical means to grow into new markets and geographies for companies that are expanding, particularly in the short term.
- f. **LOWER COSTS AND REDUCED RISK:** Compared to other types of warehousing, public warehousing is usually less costly. Because there is no long-term commitment, users can switch to another public warehouse facility in a short period of time, often within 30 days, if there is another location that may have lower rent or fees.
- g. **ACCESS TO LOWER FREIGHT RATES:** Because public warehouses handle the requirements of a number of companies, their volume allows them to negotiate consolidated freight rates rather than much higher less-than-truckload freight rates that result from shipping small quantities at a premium.
- h. **ACCESS TO SPECIAL FEATURES AND SERVICES:** Most public warehouses can offer specialized services (e.g., broken-case handling, packaging services for manufacturer products for shipping, breakbulk services, and freight consolidation services) because they can consolidate volume with noncompetitor clients who use the same public warehouse. Most public warehouses have some special features that make them unique. Examples of special features are:
 - Temperature-controlled storage (cool, cold, and frozen)
 - Crane capabilities
 - Ultraclean segregated areas
 - Guard service 24/7/365
 - Dedicated docking areas for special customers
 - Special staff functions like customer service, inventory ordering, etc.
 - Office space to rent for customer's sales, accounting, etc.
- i. **KNOWLEDGE OF EXACT STORAGE AND HANDLING COSTS:** When a company uses a public warehouse, it knows exactly how much is being spent on storage and handling costs, because the monthly bill displays all necessary information. This allows the user to forecast costs for each different level of activity. Companies that operate their own private facilities often find it difficult to determine the exact fixed and variable costs.

PUBLIC WAREHOUSING ALSO HAS SOME DISADVANTAGES:

- a. **SYSTEMS COMPATIBILITY:** There is the potential of incompatible computer systems. Public warehouses may not have a system to suit the needs of a specific customer and they are unlikely to invest in a new system for just one client.
- b. **LACK OF SPECIALIZED SERVICES:** Most public warehouse facilities provide local services which may not be what the company requires. The specialized services that a company needs may not always be available in a desired location.
- c. **SPACE AVAILABILITY:** Public warehousing space may not be available when and where a company wants it. Shortages can occur from time to time, particularly during a peak season, which may adversely affect the client company.

CRITERIA FOR CHOOSING A PUBLIC WAREHOUSE

Because of the increasing competition between the public warehouse operators, companies should review the capabilities of each potential public warehouse to identify which would be the best fit. Each company will have a number of factors that need to be considered when selecting a public warehouse. Companies have a variety of reasons why they require an outside warehouse in addition to their short-term and long-term needs, and the price they are willing to pay for the service. Companies are likely to weigh criteria such as geographical location, the type of technology needed versus what is available, whether the public warehouse has the capability to expand if more space is needed, and how flexible the public warehouse is to respond to changes in volume or other needs.

Contract Warehousing

A contract warehouse is a variation of public warehousing that handles the shipping, receiving, and storage of goods for a specific client on a contract basis. The contract can be for either an entire building or a defined portion of square-foot or cubic-foot space within a building. This type of warehouse usually requires a client to commit to services for a particular period of time. The length of time varies, often stated in years rather than months. The fee structure also varies based on transactions; it may be a fixed cost, cost-plus, or a combination of both. The company providing the space handles the employees, equipment, and maintenance expenses. They are also responsible for most incidental expenses, which further reduces costs.

Many of the advantages of public warehousing also apply to contract warehousing.

ADDITIONAL ADVANTAGES OF CONTRACT WAREHOUSING:

- **LOGISTICS EXPERTISE:** Contract warehousing companies provide a great deal of expertise for logistics demands. Contractors will be experienced in warehouse operations and supply chains. They often have knowledge that business owners don't. Because there is a long-term associated setup, it is in their interest to see that the client company's needs are met.
- **SERVICES:** The longer term nature of contract warehousing generally results in the client company obtaining specialized services that are tailor-made to suit their needs.
- **COST:** Facilities and specialized services that are provided under contract warehousing are similar to those provided by a private warehouse; however, these facilities come at a cheaper price, because significant capital costs are involved in the construction and maintenance of a private warehouse, whereas a contract warehouse is owned and operated by a third party that bears the burden of the capital costs.
- **FEES:** In the case of public warehousing, the client company is charged storage fees, and inbound and outbound transactions fees, and the user is expected to pay for any additional services that are desired. Contract warehousing also requires the client company to pay a fee for the services rendered; however, due to the longer commitment, the services provided in the contract can be bundled and negotiated, usually at a lower cost.
- **CONTROL:** A public warehouse results in the client company having to relinquish control, whereas contract warehousing offers a compromise by allowing the client company a certain degree of control at a reasonable price. In contrast, a private warehouse allows absolute control but at a higher capital cost than a contract warehouse.

DISADVANTAGES OF CONTRACT WAREHOUSING:

- **DURATION:** The client company is expected to enter into a contract for a specific period of time (generally three years). A public warehouse allows the client to store goods for both short and long periods of time, allowing flexibility when it comes to duration, which a contract warehouse limits.

Private Warehousing

A private warehouse is a storage facility that is owned by the company that owns the goods being stored in the facility. It is also known as proprietary warehousing. Private warehouses are generally established by companies that have a large volume or large value of goods being stored, or the need for some type of specialized storage or handling. They can be operated as a separate division within a company if desired, and they can be co-located onsite with manufacturing, or at an offsite location.

ADVANTAGES OF PRIVATE WAREHOUSING:

- **CONTROL:** Private warehousing offers users significant control over their storage needs and they can be constructed to meet user specifications. Companies can also control product placement within a facility providing access to products when an organization needs them. It allows the company to integrate the warehousing function more easily into its total logistics system. The company has clear visibility of inventory control, internal material flow, handling, supervision, and associated cost control.
- **FLEXIBILITY:** Offers the company greater flexibility in designing and operating the warehouse to suit the needs of its customers and the characteristics of the products. The company can install specialized handling for its products if necessary and modify the facility through expansion or renovation to facilitate product changes, which is not possible in a public warehouse.
- **COST:** Operating cost can be 15% to 25% lower if the company achieves at least 75% utilization.
- **LABOR:** There is the prevailing belief that greater care goes into handling and storage when the company's own workforce operates the warehouse. This means that the company can utilize the expertise of its technical specialists. A company may also be able to better utilize its overall workforce. During a down period in manufacturing, the company could shift manufacturing workers over to the warehouse temporarily to help. Or, vice versa, during a down period in the warehouse, or a peak in manufacturing, the company might be able to shift warehouse workers over to manufacturing temporarily.
- **TAX BENEFITS:** Depreciation allowances on buildings and equipment help to reduce taxes.
- **INTANGIBLE BENEFITS:** When a company distributes its products through a private warehouse, it gives its customers a sense of permanence and continuity of business operations. The customer perceives the company as a stable, dependable, and long-term supplier of products.

DISADVANTAGES OF PRIVATE WAREHOUSING:

- **FLEXIBILITY:** In the short term, it is very difficult for a private warehouse facility to respond to changes in the external environment, and expand or contract to meet increases or decreases in demand. Flexibility in strategic location is also an issue as private warehouses can't respond quickly to changes in market location and preferences, and this may mean that excellent business opportunities may be lost. If you own the warehouse, it is not easy to just pick up and move to another location if the market changes, which is an advantage in a public warehouse setting.
- **FIXED SIZE AND COSTS:** When demand is low, the company still assumes the fixed costs as well as the lower productivity linked to unused warehouse space. However, the disadvantages can be minimized if the company is willing and able to rent out part of its space.

- **HIGH OPPORTUNITY COST RISK:** The ROI on other investments may be greater if funds are channeled into other profit-generating opportunities rather than investing in a warehouse. Because the ROI is about the same as the company's other investments, most companies find it advantageous to use a combination of public and private warehousing. It is best to use private warehousing to handle the basic inventory levels required for the least cost logistics in markets where the volume justifies ownership. Any extra volume can be stored in the public warehouse during peak periods if the private warehouse is full. There is also the potential of not being able to sell the warehouse in the future if it is no longer needed.
- **HIGH STARTUP COST:** Companies have to generate enough capital to build or buy a warehouse. A warehouse is often a long, risky investment. In addition, there is the cost of hiring and training employees, and the purchase of material handling equipment. The high cost necessitates high and steady demand volumes for the investment to make sense. In addition, a high fixed cost alternative becomes less attractive in times of high interest rates, because it is more costly to secure the necessary financing.

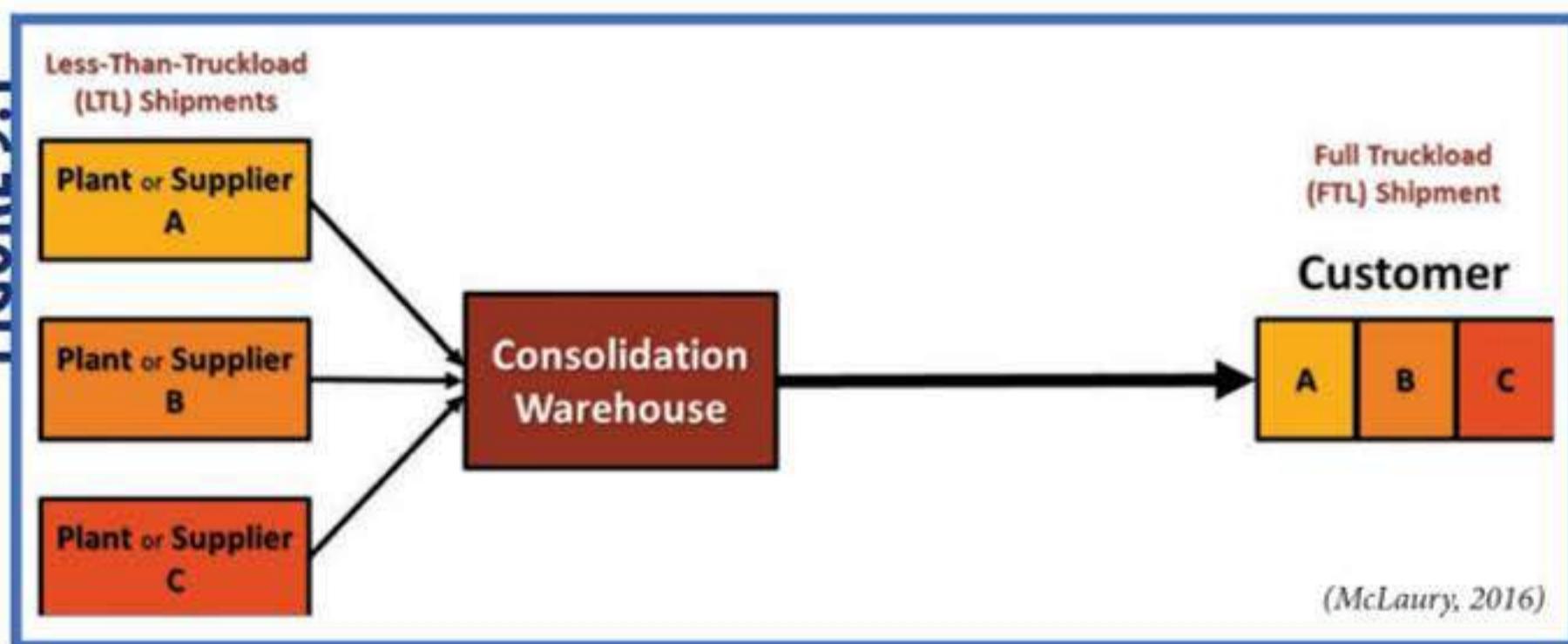
Consolidation Warehousing

A consolidation warehouse receives products from suppliers, sorts them, and then combines them with similar shipments from other suppliers into larger, more economical, shipping loads for further distribution. In other words, small flexible shipments in, and large economical shipments out. The goal is maximizing transportation utilization while minimizing costs.

The concept is similar to carpooling where several individuals in the same area come together and meet at one place, and then take one car to work instead of taking several different cars. The cost to each person is significantly less than it would have been if they went separately. Consolidation of freight shipments works in basically the same way.

Consolidation warehouses are typically established at a strategic location between suppliers and customers. Ideally, in order to minimize the total transportation costs, the consolidation warehouse should be located closer to the supply base so that the smaller LTL shipments travel the shorter distance and can be consolidated more quickly into the larger FTL shipments traveling the longer distance to the customer. Usually a third-party logistics (3PL) provider manages and maintains the warehouse and the information system needed to run it, and these operations can either be client-dedicated or multiple-user facilities.

Figure 9.1 provides an example of the flow of products through a consolidation warehouse. Products are shipped from three separate plants or suppliers into the consolidation warehouse, usually in less-than-truckload (LTL) shipments. At the warehouse, the products are received and combined together to be shipped out to a customer in a larger full truckload (FTL) shipment.

FIGURE 9.1

Break Bulk Warehousing

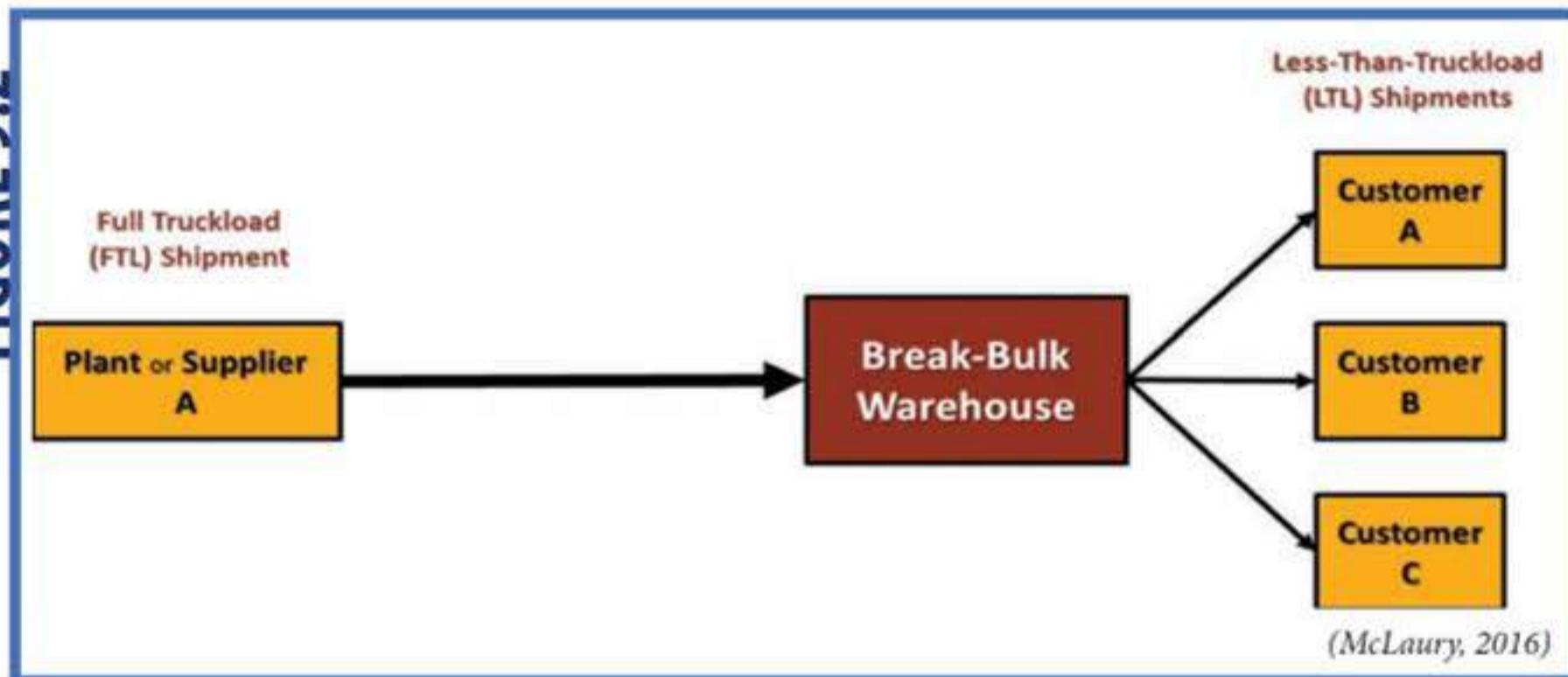
A break bulk warehouse is similar to a consolidation warehouse except that the incoming shipments are generally truckloads of homogeneous items from a single plant or supplier. The break bulk warehouse sorts or splits the items into individual orders or shipments and arranges for local delivery.

Similar to consolidation warehouses, break bulk warehouses are also typically established at a strategic location between suppliers and customers. In contrast to the consolidation warehouse location, in order to minimize total transportation costs, the break bulk warehouse should be located closer to the customer base so that the smaller LTL shipments travel the shorter distance to the customers, while the larger FTL shipments from the single supply source travel the longer distance before arriving at the break bulk warehouse.

Figure 9.2 provides an example of the flow of products through a break bulk warehouse. Products are shipped from a single plant or supplier into the break bulk warehouse, usually in FTL shipments. At the warehouse, the products are received and sorted or split into individual orders to be shipped out to customers in LTL shipments.

In both consolidation warehousing and break bulk warehousing, a 3PL provider frequently manages the warehouse and the information system(s) needed to run it. These operations can either be client-dedicated or multiple-user facilities.

FIGURE 9.2



Cross-Docking Warehouse

Cross docking is the logistics practice of unloading materials from an incoming truck or railcar and loading these materials directly onto outbound trucks or railcars, with little or no storage in between. This is a type of consolidation and/or break bulk warehouse. The advantages of cross docking are to speed throughput times, reduce inventory investment, and reduce storage space requirements.

Cross docking takes place in a distribution terminal usually consisting of dock doors on two sides (inbound and outbound) with minimal storage space on site. The name *cross docking* refers to receiving products through an inbound dock and then transferring them across to the outbound dock. Once the inbound shipment has been received, the products can be moved either directly or indirectly to the outbound destinations. Products can be unloaded, sorted and screened to identify their end destinations, and then moved to the other end of the cross-dock terminal via materials handling equipment such as a forklift, conveyor belt, or pallet truck. When the outbound transportation has been loaded, the products can then be shipped out to customers.

The main reasons that cross docking is implemented are as follows:

- To provide a central site for products to be sorted and similar products combined to be delivered to multiple destinations in the most productive and fastest method possible
- To combine numerous smaller product loads into one method of transport to save on transportation costs (i.e., consolidation)
- To break down large product loads into smaller loads for transportation to create an easier delivery process to the customer (i.e., deconsolidation or break bulk)

CROSS-DOCKING PROVIDES CERTAIN ADVANTAGES:

- **OPERATIONAL EFFICIENCY:** As the material does not have to be stored at the warehouse, and directly moves from the receiving docks to the shipping docks, the warehouse operations are more efficient.
- **INVENTORY EFFICIENCY:** As the inventory moves directly from the receiving to shipping docks, there is no storage at the warehouses, and that reduces the total system inventory in the supply chain.

Figure 9.3 illustrates a cross-docking warehouse operation. On the left side of the diagram are inbound shipments of products from four suppliers. Once these products are received and unloaded, they can be sorted, reconfigured, and moved across the dock to ship outbound to the four customers, as shown on the right side of the diagram. Notice that each customer is being shipped a different configuration of the four products.

FIGURE 9.3

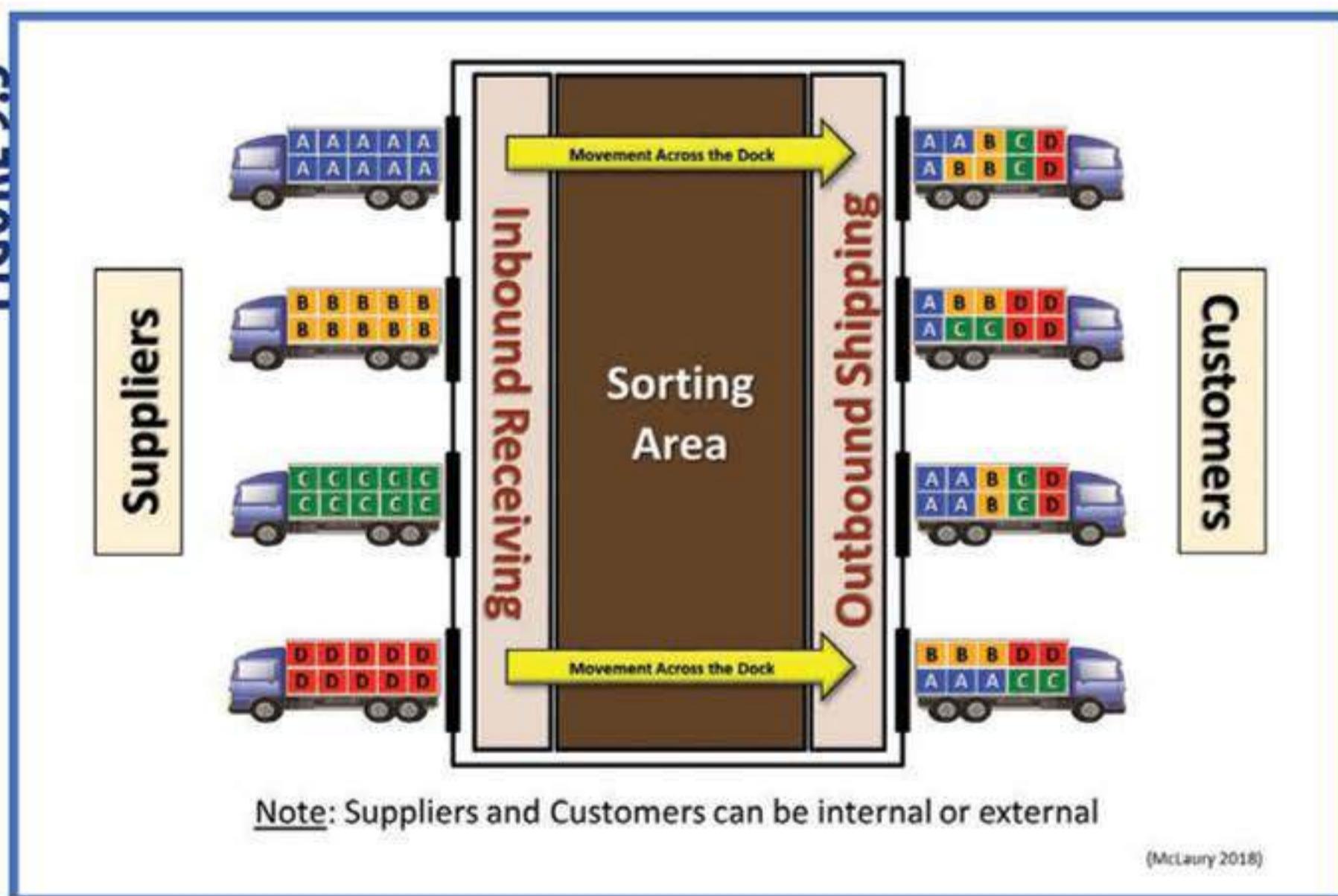
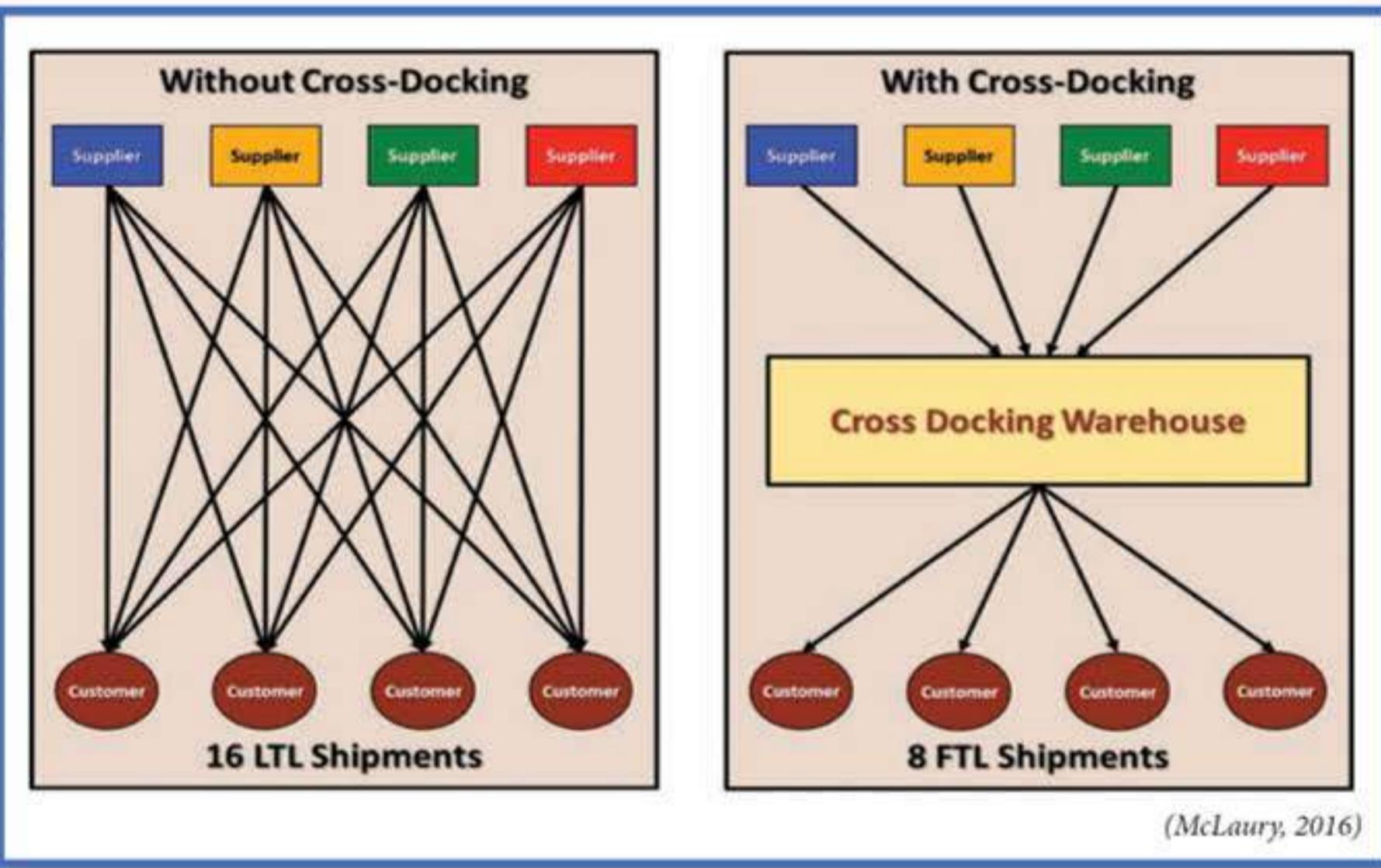


Figure 9.4 illustrates the difference with and without a cross-docking warehouse operation in this scenario. Without cross docking, each of the four suppliers must make LTL shipments to each of the four customers for a total of 16 LTL shipments. This will very likely cost significantly more than the eight FTL shipments (i.e., four inbound and four outbound), which will be completed as shown using the cross-docking operation.

FIGURE 9.4



With cross docking, larger and fewer shipments translate to lower overall transportation costs. Additionally, both suppliers and customers will experience a much more efficient use of their resources because each will only make or receive one shipment rather than four.

WHICH WAREHOUSE TYPE TO CHOOSE

To choose the most appropriate warehousing facility, the company should consider all of the services desired, the level of control that is required, and the length of time the storage facility would be required. Cost would also play a very important role when choosing between a privately owned and operated warehouse, and a warehouse owned and managed by a third party.

WAREHOUSE NETWORKS

A warehouse network is simply the number of, and the relationship between, the warehouses that a company has in its organizational structure. The fundamental questions to be answered in establishing a warehouse network are “How many warehouses should the company have?” and “Where should they be located?”

The trade-offs that will determine how many warehouses the company needs, and where they should be located, are:

1. The level of customer service the company wants to provide
2. The amount of inventory in which the company is willing to invest

Single Warehouse

If the company has only one centralized warehouse operation, then operating costs and inventory will be lower. Having fewer warehouses requires a less complicated infrastructure, and less or no duplications of equipment, warehouse staff, and managers. With fewer warehouses, the network becomes more centralized and the company will have its best people, equipment, and inventory systems concentrated in fewer places. This can be beneficial to customer service in that the warehouse can more actively focus on the needs of its customers. However, the centralized network may take longer to deliver product to some customers who are remote from the central location.

Multiple Warehouses

If the company establishes multiple warehouses that are geographically dispersed throughout the market they will likely be able to distribute product to their customers much faster than if they only have a centralized warehouse, assuming that they maintain adequate inventory in each warehouse. Every part of the market could potentially be better served through a multiple warehouse network. As responsiveness and delivery service increase, however, warehouse operating costs and inventory costs also increase as each warehouse costs money to staff and operate. Trade-offs between costs and customer service must be considered. A basic fact is that as the number of warehouses increase, the network becomes more decentralized, which may or may not be beneficial.



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Hybrid Approach (Hub-and-Spoke Network)

Companies may choose to do some type of a hybrid approach to balance costs and inventory against customer service. One such network configuration is a “hub-and-spoke,” where there is a centralized warehouse (i.e., the “hub”), which holds most of the inventory, linked to a series of smaller decentralized and geographically dispersed warehouses (i.e., the “spokes”), which hold only a small amount of inventory to support the local area in the immediate time frame. The hub warehouse feeds the spoke warehouses with inventory as necessary on a regular basis. Operating costs are lower because the spoke warehouses are smaller than in a purely decentralized model. Inventory is also lower than in a purely decentralized model as all of the safety stock is held centrally, which generally means that less total safety stock is required because all of the risk and uncertainty that the safety stock is protecting against is managed centrally. On the other side, customer service is generally better than in a purely centralized model, because some of the inventory is maintained in the spoke warehouses closer to the customers. For this model to work well, the demand in the local areas must be well understood and monitored closely.

Warehouse Network Strategies

Whether a company determines that it needs one or multiple warehouses, it will also have to determine which location strategy makes the most sense for its business. This strategy decision will be different from one business to another depending on the nature of the business and how many customers and suppliers interact with the company. The three main warehouse network location strategies are:

- **MARKET POSITIONED STRATEGY:** Warehouses are set up close to customers to maximize distribution services and improve delivery time. Companies should use this strategy if they have many more customers than suppliers, and the customers are spread out geographically around the market. If the warehouses are closer to the customers, the company can minimize transportation cost with this strategy. Similar to the break bulk warehouse setup, there will likely be FTL shipments coming in from suppliers at a greater distance, and LTL shipments going out shorter distances to customers.
- **PRODUCT POSITIONED STRATEGY:** Warehouses are set up close to supply sources to collect goods and consolidate before shipping products out to customers. This is basically the reverse of the market positioned strategy. Companies should use this strategy if they have many more suppliers than customers. If the warehouses are closer to the suppliers the company can minimize transportation cost with this strategy. Similar to the consolidation warehouse setup, there will likely be LTL shipments coming in from suppliers at a shorter distance, and consolidated FTL shipments going out longer distances to customers.

- **INTERMEDIATELY POSITIONED STRATEGY:** Warehouses are set up somewhere midway between the supply sources and the customers to try to balance costs, inventory, and customer service. Companies should use this strategy when distribution requirements are high and product comes from various supply locations.

A warehouse network optimization study may be needed to determine the optimal number and location of warehouses in this strategy. See “Warehouse Network Optimization” which follows.

Warehouse Network Optimization

Companies need to find the balance that will work for their products and markets. There are many consulting companies that offer services to help a company determine the optimal number of warehouses and geographic locations for a given company’s situation by using a number of different optimization software programs. The software analyzes the inputs including customer, manufacturer, and supplier locations, then informs the optimal number of warehouses and locations based on all the relevant factors. These programs try to minimize the amount of transportation on both ends— inbound from suppliers and outbound to customers.

LEAN AND GREEN WAREHOUSING

Warehouses and distribution centers are continuing to develop their LEAN capabilities. The following are a few ways in which warehousing is adopting and adapting LEAN principles.

Greater Emphasis on Cross Docking

Cross docking is a LEAN concept and it is on the rise in business. Cross docking eliminates the need to store inventory, which is waste, and waste reduction/elimination is the key element of LEAN. Cross docking is a form of consolidation that reduces transportation, which is also waste. The more cross docking a company can do, the “leaner” their operations will be.

Reduced Lot Sizes and Shipping Quantities

Just as small batch scheduling is a LEAN concept, because it drives down costs by reducing inventories and makes the company more flexible to meet customer demand, this same concept can be applied to warehouse operations. By reducing lot sizes and shipping quantities, a company can actually increase the velocity or throughput in the warehouse and get shipments out faster. Smaller lots or orders will take less time to pick and load for shipment, which will keep costs and inventories down. Faster throughput and lower inventories are LEAN concepts.

Increased Automation

Companies are using automated systems like pick to light, voice picking, conveyor systems, automated guided vehicles (AGVs), and robotics to improve efficiencies and throughput times in the warehouse. Automation can help to speed up the picking process and move products through a warehouse faster and more accurately than manual systems with less resources, again reducing waste.

A Tendency to Be Green

Companies are looking at what green or sustainability programs they can implement in warehousing operations. Companies want to know the size and impact of their carbon footprint. How can they reduce the amount of utilities and resources they use? Smaller, more efficient warehouses take up less physical space and use less energy to operate. One of the more sustainable goals for a green warehouse is to become a net zero energy user. In some cases, net zero buildings are able to sell excess energy back to the power grid, so much so that the cost of generating energy is neutralized by the excess energy sold. Some initiatives in this regard include lighting upgrades to use a more efficient fluorescent system, the use of daylighting, using solar-assisted heat pump or cooling systems, and the type of windows, doors, roofing materials, and insulation that are used, saving significant amounts of energy.

THIRD-PARTY LOGISTICS

Third-Party Logistics Company

A third-party logistics (3PL) company is an outsourced provider that manages all or a significant part of an organization's logistics requirements for a fee. Some of the typical services that are offered by 3PLs include but are not limited to inbound transportation, warehousing, pick and pack, outbound transportation, freight forwarding, freight bill auditing/payment, customs brokerage, customs clearance, order taking, billing/invoicing, and inventory auditing.

3PLs are used by large and small business but are particularly favored by small businesses that do not have their own logistics operations. Small business may not want to invest in activities outside their areas of expertise, and the 3PL company can bring their substantial logistics expertise into the engagement.

3PLs are also used to a significant degree for international logistics. A company is more likely to use a 3PL internationally rather than to try and establish an in-house operation in each foreign market

themselves. Also, 3PLs likely know more about the logistics in those international markets, and they will have local contacts and local contracts already established. It is potentially much more cost effective and efficient for a company to ship product internationally using the services of a 3PL than to handle this activity internally, unless this is a major part of the business, and the company decides to invest significant resources and manpower into developing this expertise.

MAJOR ADVANTAGES OF USING 3PLs:

There are a number of benefits companies gain by outsourcing logistics activities to a 3PL. Utilizing a 3PL provides businesses with a reliable logistics advantage, and maximizes profitability through a combination of knowledge and resources.

- **COST:** Eliminates the need for a company to invest in warehouse space, technology, transportation, and staff to execute the logistics process.
- **LOGISTICS EXPERTISE:** 3PLs are knowledgeable of industry best practices, and stay up to date with the latest developments in technology. This is their core competency.
- **EFFICIENCY:** Improved efficiency by exploiting a 3PL's economies of scale. 3PLs can leverage relationships and volume discounts, which results in lower overhead and the fastest possible service.
- **FLEXIBILITY:** Ability to rapidly scale space, labor, and transportation according to business needs.
- **FOCUS ON CORE COMPETENCY:** Outsourcing logistics allows your company to focus on your core competencies.

MAJOR DISADVANTAGES OF USING 3PLs:

There are also some issues and concerns that companies should consider before making a logistics outsourcing decision.

- **CONTROL:** A company will not have direct control over the logistics operation. They are relying on the 3PL to consistently deliver the promised services. This lack of direct control means that companies are at the mercy of any problems the 3PL faces.
- **DEPENDENCY:** Outsourcing logistics to a 3PL is a large commitment. When businesses contract with 3PLs it creates a dependency which can be significant. This dependency puts the company in an uncomfortable situation if pricing or service from the 3PL is not as expected. Logistical downtime can translate into large amounts of lost productivity and revenue. Although the free market dictates that a business dissatisfied with its 3PL could switch to another 3PL,

the reality is not so simple. Switching logistical support can create great problems in unforeseen costs and higher risks resulting from the transition.

- **PRICING:** Contracting with a 3PL means that the company is locked into the pricing model specified in the business agreement. By outsourcing logistics to a 3PL, companies are forgoing the possibility that an in-house logistics department could discover a less expensive or more efficient solution.
- **LOSS OF EXPERTISE:** Companies that outsource in-house logistics to a 3PL may lose their own expertise in logistics by outsourcing.
- **RISK:** Sharing confidential information with an outside partner such as a 3PL may leave some companies feeling vulnerable.

Fourth-Party Logistics Company

Fourth-party logistics (4PL) is an interface between the client company and multiple logistics service providers. A company will select a lead logistics partner (referred to as a 4PL) that is then charged with managing the activities of all the other 3PLs being used by the company. Ideally, all aspects of the client company's supply chain handled by 3PLs would be managed by the 4PL organization.

TRANSPORTATION

Transportation is “the function of planning, scheduling, and controlling activities related to mode, vendor, and movement of inventories into and out of an organization.”¹ Transportation attempts to fulfill three of the seven Rs—to get the right product, to the right place, at the right time by ensuring that the product is moved as efficiently and effectively as possible from point of origin to point of destination.

Transportation Objectives

Transportation has three objectives:

1. **TO MAXIMIZE THE VALUE TO THE COMPANY THROUGH PRICE NEGOTIATIONS.** In simple terms this means that the transportation function adds value by getting the best price to transport goods whether the goods are coming from the supplier or going out to the customer.
2. **TO MAKE SURE SERVICE IS PROVIDED EFFECTIVELY.** If you move product from a supplier, move product around internally, or move product out to a customer, you want to do it in

as few moves as possible, and making sure the product is not damaged or somehow otherwise negatively affected.

3. **TO SATISFY CUSTOMERS' NEEDS.** Ensure that the product gets to the right place at the right time. If you moved the product efficiently, effectively, and at the lowest possible cost, but it is not at the place where customers want it, when they need it to be there, the transportation function is not actually adding value.

Transportation Company Classifications

Companies transporting freight or cargo regardless of the mode of transportation are classified according to the following categories:

- **COMMON CARRIER:** A person or company that transports freight for a fee that can be hired by anyone to transport goods. Common carriers transport the majority of the freight shipments that you see on the road, rail, air, among other methods.
- **CONTRACT CARRIERS:** A person or company that transports freight under contract to one or a limited number of shippers. These carriers are not bound to serve the general public. Contract carriers establish an agreement with a shipper(s) that spells out the kinds of shipments the carrier will accept, where the carrier will take them, and the shipping fees the shipper will be obligated to pay. Shippers may in turn collect these fees from their customers.
- **EXEMPT CARRIERS:** A person or company specializing in certain services (such as taxi service) or certain commodities (such as farm products or bulk cargo) exempt from regulation by the Interstate Commerce Act. The exempt commodities usually include unprocessed or unmanufactured goods, fruits and vegetables, and other items of little or no value. The exemption under the interstate commerce act is to help the simple service groups such as taxis, farmers, and school bus drivers to operate without any interference from government regulations, as there is no threat of monopolization in these services.
- **PRIVATE CARRIERS:** A person or company that transports its own cargo, usually as part of a business that produces, uses, sells, and/or buys the cargo that is being hauled. The private carrier's primary business is not transportation, but performing a transportation function to facilitate the primary business. These carriers may refuse to sell their services at their own discretion, whereas common carriers must treat all customers equally.

Carriers, regardless of the classification type, may be prohibited by law from carrying certain types of items, including illegal and dangerous materials.

MAJOR MODES OF TRANSPORTATION

Mode refers to the way in which goods are transported; **carrier** refers to the company or service provider that actually transports the goods or materials.

There are five major modes of transportation:

- Motor carriers (trucking)
- Rail carriers
- Air carriers
- Water carriers
- Pipeline carriers

Motor Carriers

Trucking is the most prevalent mode of transportation and the one people are probably most familiar.

It is also the most flexible mode of transportation in that it carries the most varied kinds of freight to the most locations. Motor carriers (trucks) are involved in more than 80% of U.S. freight transportation annually. This doesn't mean that the rest of the carriers only transport the remaining 20%. There is actually a significant overlap with other modes of transportation, because most product that is moved by rail, air, or water is also moved by truck to and from the railyard, airport, or seaport. Motor carriers are also heavily involved with what is known as the "last mile" of transportation. The last mile is the final leg of transportation in the supply chain when the product is delivered to its final destination. In the majority of shipments, the last mile is handled by truck.



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Motor carriers transport nearly anything from packaged household goods, to building materials, to liquids. Motor carriers compete directly with rail and air for short to medium distance hauls.

There are two major categories of motor carrier: short haul and long haul.

- **SHORT HAUL** is defined as operating within 200 miles of the driver's home terminal. Drivers operate a day cab unit, and are performing short transportation legs, maybe within the state;

these are small, local type routes, and for the most part, drivers are home every night. Short-haul drivers can make four or more stops per day, loading and unloading at each location. With more stops and local work, short-haul drivers also spend more time driving on smaller streets, with difficult turns, and going to places with challenging loading docks. This requires mastering different driving skills than with long-haul trucking. Driving short haul is not as profitable as long-haul trucking; however, the quality of life is considered to be better than long haul.

- **LONG-HAUL** is defined as anything over 200 miles from the driver's home terminal. Long-haul truck drivers transport goods over hundreds and even thousands of miles. Long-haul drivers spend a lot of time traveling on large highways and they generally carry loads for two or more days before unloading. They may drive flatbed rigs, which are used for carrying things like steel, or drive tankers, or tractor trailers. They usually drive at night when traffic is light. Long-haul routes are driven by the most experienced drivers because it is challenging work and the cargo can be extremely valuable.

GENERAL FREIGHT CARRIERS AND SPECIALIZED FREIGHT CARRIERS

Motor carriers can be further categorized into general carriers and specialized carriers:

- **GENERAL FREIGHT CARRIERS** comprise the majority of the trucks you see out on the roadway, carrying most of the goods. These are trucking companies that engage in shipping packaged, boxed, and palletized goods that can be transported in standard, enclosed tractor-trailers, generally 40 to 48 feet in length. General freight carriers include common carriers as well as other kinds of carriers discussed in this chapter.
- **SPECIALIZED FREIGHT CARRIERS** transport articles that, because of size, weight, shape, or other inherent characteristics, require specialized equipment for transportation. Some important types of specialized equipment are bulk tankers, dump trucks, refrigerated trucks, and motor vehicle haulers (i.e., car carriers).

Shipments by motor carrier can be divided into either less-than-truckload (LTL) or full-truckload (FTL), generally indicating whether the volume of the shipment fills the truck trailer / container or not. Motor carriers may offer LTL or FTL, or both services.

LESS-THAN-TRUCKLOAD CARRIERS

LTL carriers are those that move small shipments—that is, when you don't have enough to fill a truck. There are many carriers that offer LTL service. Some further specialize in services such as lift gate and residential pickups and deliveries, guaranteed services, and freeze protection, just to name a few.

They stop at depots and transfer locations to match loads to the final locations. What that means for shippers is their cargo is likely going to be combined with other shippers' cargo because the carrier needs to fill up the truck as much as possible to make money. Therefore, multiple shippers' commodities will get loaded onto the same truck, going in the same direction, and there might be multiple handoffs along the way. An individual shipper's product could be picked up at the warehouse, then go to a depot or multiple depots, and be handed off from one carrier to another, making its way from point of origin to the final destination. The shipment will be subject to multiple stops and starts while other product is being picked up and dropped off, and because of that, LTL usually takes longer to get from origin to destination than FTL shipments.

LTL is also more costly in terms of price per unit, or price per weight, than FTL because carriers cannot always guarantee that they will fill the truck up and they may need to spread their fixed costs out over a smaller number of units/weight.

FULL TRUCKLOAD CARRIERS

FTL is used when a shipper has enough volume (or value) to fill the truck. These carriers generally contract an entire trailer out to a single customer. Thus, the carrier actually spreads its fixed costs out over the whole shipment and generally the individual per unit cost of shipping is lower than for LTL shipments.

A shipper may also decide to pay for a full truckload even if the volume being shipped doesn't actually fill up the whole truck. The reason may be to avoid having another shipper's cargo on the same truck for security reasons or for faster delivery. By paying for the full truck even if the shipper's cargo doesn't fill it up, the shipper can probably get a faster delivery time because the shipment won't go to a depot or make other stops along the way. Additionally, the shipper could potentially avoid any cargo mixups or cross contamination by using a dedicated truck.

Rail Carriers

A rail carrier is a company whose business is transporting persons or goods or both by railroad. Rail transportation is best used for very heavy shipments such as building materials, construction equipment, and coal, particularly when the transport distance is long.



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ADVANTAGES OF RAIL TRANSPORTATION:

- Rail is better structured than any other form of transportation. It has fixed routes and schedules making its service more certain and regular compared to other modes of transport.
- Rail is the most dependable mode of transportation as it is the least affected by weather conditions compared to other modes of transport.
- Rail transport is economical, quicker, and best suited for carrying heavy and bulky goods over long distances.
- Rail has the best speed over long distances except for air transport, but it can carry heavy bulky goods making it more versatile than air.
- Rail is a less expensive mode of transport compared to other modes. It has lower variable costs and most of the operating expenses are fixed costs. Rail is economical in terms of labor as one driver and one crewman can handle a much larger shipping load than other modes of transportation, such as motor carriers.
- The carrying capacity of rail is extremely large and can be easily expanded even further by adding more railcars.
- Rail is also the safest form of transport.

DISADVANTAGES OF RAIL TRANSPORTATION:

Although rail transport has a number of advantages, it has a number of disadvantages as well:

- Rail requires a large capital investment in infrastructure and this investment is fixed, meaning that it is not easily adaptable to changing volume requirements. Construction costs, maintenance, and overhead expenses are very high compared to other modes of transport. Railroad infrastructure and aging equipment in the United States are also problems for the railroads. The rails, bridges, and other aspects are old and deteriorating, and require a lot of upkeep and further capital expenditure. Some of the infrastructure improvements the rail carriers can make themselves; however, other improvements must be handled through local, state, or the federal government.
- Rail transport is inflexible. Trains run on a specific timetable and schedule and therefore must arrive and depart according to their set timetable. Its routes and timings cannot be adjusted to individual requirements.

- Rail transport cannot provide door-to-door service. Instead, rail provides terminal-to-terminal service, which requires loading and reloading of products at stocking points, involving greater cost, more wear and tear, and additional time. Therefore, rail carriers are generally paired with trucks for door-to-door delivery. To overcome this disadvantage, some rail carriers have begun purchasing motor carriers and now offer point-to-point pickup and delivery service.
- Rail is unsuitable and uneconomical for short distance and small volume goods. Rail transport by its nature is considered slow and inflexible and compares unfavorably with motor carriers in terms of transit times and frequency of service in short to medium distance hauls.
- Due to the high capital investment, rail cannot be operated economically in rural areas, creating an inconvenience for this mode of transportation in those areas.
- The time and labor necessary to book and take delivery of goods is unfavorable compared to motor carriers.
- Rail must fully utilize all of its available capacity to operate economically, and it has a very large carrying capacity, which can create a significant financial problem.
- Rail companies use each other's railcars to build a rail transport, so keeping track of railcars and getting them where needed can be problematic.
- The time and cost of terminal operations can also be a great disadvantage.

Some new rail technologies include articulated cars, unit trains, and double-stack cars.

- **Articulated cars** are railcars that share an axle or are suspended by other railcars. They are operated as a single unit, often called a trainset. Articulated cars reduce cost, weight, noise, vibration, and maintenance expenses. However, they reduce flexibility as additional railcars cannot easily be added to the trainset when there is additional volume.
- **Unit trains** transport a single commodity such as coal or steel. A unit train is similar to the concept of a dedicated truck.
- **Double-stack cars** are railcars specially designed to carry intermodal containers, where the intermodal containers are stacked two high on each railcar.

Air Carriers

Air carriers are organizations transporting passengers and cargo by aircraft. Air is the newest transport mode and the least utilized.



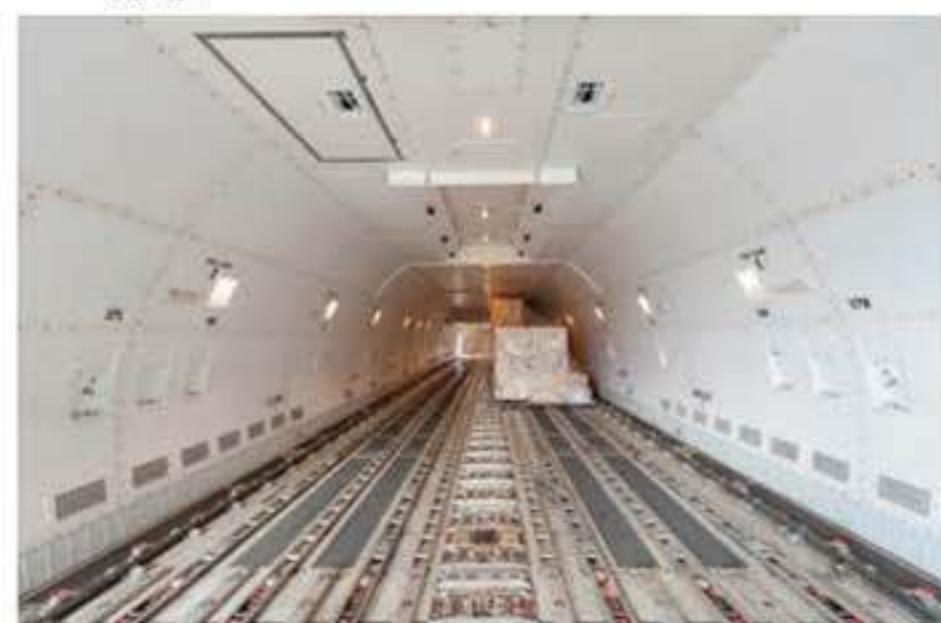
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Air shipments are relatively expensive compared to the other modes of transportation, partially because the fuel is expensive, they have a limited amount of cargo space, and they have to deal with weight and balance issues on the plane itself.

Air is the fastest mode of transportation for medium and long distances. If a company has an item that is urgently needed or being expedited by a customer, air shipment might be the way to go. Many companies use air shipments if they have had a backorder or stockout to try to get the replenishment inventory back into the marketplace or to a customer quickly. Air carriers usually transport high-value goods (i.e., items with a high cost-to-weight ratio). These are very light, high-value goods that need to travel long distances quickly, and include such products as jewelry, fine wines, pharmaceuticals, and racehorses. Air carriers can't transport extremely heavy or bulky cargo because of the weight and balance restrictions. There are also commodities that are restricted from air shipments due to the nature of the product (e.g., some materials that are hazardous, combustible, explosive, even if it is a cargo-only aircraft).

Air transport represents about 5% of the total U.S. air freight. Internationally, according to multiple sources, air cargo represents less than 0.5% of the weight of all international cargo, while at the same time this segment represents around 30% of the total worldwide shipment value. Half of the goods transported by air are carried by cargo-only airlines such as FedEx and UPS, and the other half goes by passenger planes along with passengers and their luggage.

Cargo is loaded on the main deck or in the belly of the airplane by means of nose loading, where the whole nose is opened, or side loading, through a large cargo door. When a package is shipped on a passenger plane, it is usually consolidated with other packages and freight and packed into special containers that fit in the storage area under the passenger compartment (i.e., the belly of the plane). Since there often



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isn't room to drive a forklift truck into the plane to load the pallets, the load floor is equipped with electric rollers. Once a pallet is pushed through the doorway, the electric rollers are used to move it to the front or rear of the cargo hold.

Similar to rail, air is also paired with trucks for door-to-door delivery.

Water Carriers

Water carriers are organizations transporting goods or people using waterways. Water carriers cover a broad range of water transportation routes including ocean / deep water, coastal and inter-coastal, and in-land waterways such as rivers and lakes. Transportation by water is the oldest form of transport in the United States, dating back to the birth of the nation. Water transport plays an important role in foreign trade.

Like rail, transportation by water is slow and inflexible, but is also inexpensive compared to the other modes of transportation. Water transportation is an efficient form of transportation in terms of energy costs per dollar of gross output, or compared to the market value of the goods.

Water transport is primarily used for heavy, bulky, and low-value materials (e.g., coal, grain). However, because transport by water is so comparatively inexpensive, almost any item may be shipped by water, including automobiles, petroleum, containerized cargo, and produce.

Domestic water carriers compete with railroads for the movement of bulk commodities such as grains, coal, ores, and chemicals, and with pipelines for the movement of bulk petroleum, petroleum products, and chemicals.

As with air and rail, water transportation is paired with trucks for door-to-door delivery.

Pipeline Carriers

Most people don't think of a pipeline as a mode of transportation, but any type of pipeline that moves material from one place to the other is a form of transportation. Pipeline costs are extremely low, dependability is very high, and there is limited risk of damage to the product being transported. It is actually the most efficient form of transportation. Once the pipeline is set up, there is very little



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maintenance, very little additional infrastructure that you have to build around it, and it is a continuous flow. It's also the most reliable form of transportation, not subject to the weather, traffic congestion, or breakdowns along the way.

The pipeline industry is unique in a number of important aspects, including the type of commodity hauled, the ownership, and visibility. The industry is relatively unknown to the general public, which has little appreciation for the role and importance of pipelines. Pipelines are limited in the markets they serve and very limited in the commodities they can haul. Furthermore, pipelines are the only mode with no backhaul; that is, they are unidirectional with products that only move in one direction through the line.

A major advantage offered by the pipeline industry is low rates. Pipeline transportation can be extremely efficient with large-diameter pipelines operating near capacity. Average revenues for pipeline companies are below one-half of a cent per ton-mile, which is indicative of their low-cost service. Two additional user cost advantages complement the low rates. First, pipelines have a very good loss and damage record. Second, pipelines can provide a warehousing function because their service is slow. Another positive service advantage is dependability. Although the service time is slow, scheduled deliveries can be forecasted very accurately, diminishing the need for safety stock. Additionally, the risk of terrorism is reduced when the pipelines are buried in the ground.

Although the pipeline's slow speed can be considered an advantage due to its use as a free form of warehousing, in some instances the pipeline's slow speed can be considered a disadvantage. Pipelines are also at a disadvantage when it comes to completeness of service, because they offer a fixed route of service that cannot be easily extended into a door-to-door service. That is, they have limited geographic flexibility or accessibility. The use of pipelines is limited to a rather select number of products: crude oil, oil products, natural gas, water, and a limited number of chemicals.



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Ranking of Transportation Modes

Figure 9.5 is a chart that compares and ranks the various modes of transportation against key transportation service elements on a scale of 1 (best) to 5 (worst).

- Truck ranks the best overall but only ranks number 1 in the accessibility category.
- Pipeline is the lowest cost and the most reliable.
- Air is the fastest.
- Rail has the most capability.
- Water does not come in first in any category but is widely used for international shipments.

FIGURE 9.5

1 to 5 = Best to Worst

	Accessibility	Capability (can handle the most kinds of freight, i.e., weight, size, type, etc.)	Lowest Per-unit Cost	Reliability	Speed	Total
Truck	1	2	4	2	2	11
Rail	2	1	3	3	3	12
Pipeline	5	5	1	1	4	16
Air	3	4	5	4	1	17
Water	4	3	2	5	5	19

(McLaury 2018)

Intermodal

Intermodal is sometimes referred to as the sixth mode of transportation, but it is really the use of multiple modes of transportation to execute a single transport shipment. Intermodal is growing substantially because it is fairly cost efficient and cost effective.

Some of the more common examples include:

- **RAIL AND MOTOR CARRIERS:** Offer point-to-point pickup and delivery service known as trailer-on-flatcar (TOFC).
- **RAIL AND WATER CARRIERS:** Offer point-to-point pickup and delivery service known as container-on-flatcar (COFC).
- **WATER AND MOTOR CARRIERS:** Offer point-to-point pickup and delivery service for overseas manufacturers.
- **ROLL-ON/ROLL-OFF (RO/RO) SHIP:** This is one of the most successful types of cargo ships operating today and its flexibility, ability to integrate with other transport systems, and speed of operation have made it extremely popular on many shipping routes. A RO/RO ship is specifically designed to carry wheeled and tracked vehicles as all or most of its cargo. Vehicles are driven or towed on and off the ship by means of either the ship's own ramps or shore-based ramps. Because it is designed to accommodate cargo that cannot be stacked



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but varies in height, below-deck space and volume utilization is generally less efficient than on a containership. RO/RO ships are thus commercially viable only in certain specialized trades.

TRANSPORTATION PRICING AND CONSIDERATIONS

Since deregulation in the transportation industry, the negotiating of transportation prices is common. The main transportation schemes are as follows:

- **COST OF SERVICE PRICING:** The setting of a price for a service based on the costs incurred in providing it. The carrier estimates the cost of providing the service and then adds on a percent profit margin. Commonly used for pricing transportation of low value goods or in highly competitive situations.
- **VALUE OF SERVICE PRICING:** A pricing strategy that sets prices primarily, but not exclusively, in the value, perceived or estimated, to the customer rather than on the cost of the product or historical prices (i.e., “priced at what the market will bear”). Depends on the value of the goods being shipped. Used for high value goods or when no competition exists.
- **COMBINATION PRICING:** Price setting at a value between cost-of-service minimum and value-of-service maximum. Most carriers use some form of combination pricing. Common in highly volatile markets and changing competitive situations.
- **NET-RATE PRICING:** Established discounts and accessorial charges are rolled into one all-inclusive price. Pricing is tailored to the individual customer's needs.

Terms of Sale

The delivery and payment terms agreed between a buyer and a seller. In international trade, terms of sale also set out the rights and obligations of buyers and sellers as applicable in the transportation of goods.

EXAMPLES:

- **F.O.B. Origin:**
 - Seller states price at point of origin and agrees to load a carrier.
 - Buyer selects the carrier and pays for the transportation.
 - Title passes to the buyer when the shipment originates.
 - Buyer assumes the risk for in-transit loss or damage.

- **F.O.B. Destination:**
 - Seller arranges for transportation and adds charges to the sales invoice.
 - Seller assumes the risk for in-transit loss or damage.
 - Title does not pass to the buyer until delivery is completed.

Transportation Rate Categories

Price charged by transportation carrier for moving an item or commodity from point A to point B. Actual amount charged varies based on weight of object being moved, type of commodity being moved, and distance traveled. Classified as line haul rates, class rates, exception rates, commodity rates, and miscellaneous rates.

TRANSPORTATION REGULATION

The early days of transportation in the United States was like the Wild West. Transportation carriers could charge whatever they wanted for their services and there wasn't much competition to keep the market in check. As a result, there really wasn't good service to the public, so the government began to impose a series of regulations. Some of those major regulations include:

- **THE GRANGER LAWS** (1870s), which regulated the railroads
- **INTERSTATE COMMERCE ACT** (1887), which created the Interstate Commerce Commission (ICC)
- **TRANSPORTATION ACT** (1920), which made changes to the Interstate Commerce Act
- **MOTOR CARRIER ACT** (1935), which brought motor carriers under the Interstate Commerce Commission control
- **TRANSPORTATION ACT** (1940), which established ICC control over domestic water transportation
- **FEDERAL AVIATION ACT** (1958), which created air traffic and safety regulations and the national airport system
- **DEPARTMENT OF TRANSPORTATION ACT** (1966), which established the U.S. Department of Transportation to coordinate all U.S. transportation-related matters

One of the most important was the 1887 Interstate Commerce Act, which also established the Interstate Commerce Commission (ICC). The main reason for implementing this regulation was due to the monopolies in the railroad industry. The government stepped in to break those monopolies, stop the profiteering in that industry, and improve service offerings to the public.

TRANSPORTATION DEREGULATION.....

Eventually the pendulum swung back the other way. Transportation regulation became too onerous, and the rest of the world started to catch up in terms of transportation. Foreign transportation companies started to impact the ability of U.S. transportation companies to make money. As a result, the government started to deregulate the industry allowing U.S. companies more freedom so they could become more competitive in the United States as well as in other countries. Some of those major deregulation initiatives include:

- **RAILROAD REVITALIZATION AND REGULATORY REFORM ACT** (1976), which allowed railroads to change rates without ICC approval
- **AIR FREIGHT DEREGULATION** (1977)
- **MOTOR CARRIERS DEREGULATION** (1980), which helped promote competitive, safe, and efficient motor transportation
- **SHIPPING ACT** (1984), which allowed ocean carriers to pool shipments, assign ports, publish rates, and enter into contracts with shippers
- **ICC TERMINATION ACT** (1995), which eliminated the ICC
- **OCEAN SHIPPING REFORM ACT** (1998), which ended the requirement for ocean carriers to file rates

Regulation Pros and Cons

PROS

- Regulation tends to ensure adequate transportation service throughout the country.
- Regulation protects consumers from monopoly pricing, unsafe practices, and liability.

CONS

- Regulation discourages competition.
- Regulation does not allow prices to adjust based on demand or through negotiation.

In contrast, deregulation actually encourages competition and allows prices to be set by the market. Prices are adjusted by demand and an individual's ability to negotiate rates.

Today, the U.S. transportation industry remains mostly deregulated.

OTHER TRANSPORTATION INTERMEDIARIES

- **FREIGHT FORWARDERS** are the “middle man” between the carrier and the organization shipping the product. They take small shipments (e.g., LTL) from numerous companies and consolidate them to make larger shipments (e.g., FTL). These larger consolidated shipments can take advantage of lower transportation rates associated with volume. Some of these savings can then be passed along to the individual shippers.
- **LOAD OR TRANSPORTATION BROKERS** find shipments for carriers for a fee. They bring shippers and carriers together.
- **SHIPPERS’ ASSOCIATIONS** are a group of shippers that consolidates or distributes freight on a nonprofit basis for the members of the group to obtain volume rates or service contract rates. Associations will contract for the physical movement of the cargo from members with motor carriers, railroads, ocean carriers, air carriers, and others.
- **INTERMODAL MARKETING COMPANIES (IMC)** purchase blocks of rail and truck transportation services, utilize equipment from multiple sources, and provide other value added services under a single freight bill to the ultimate shipper. They purchase rail capacity and sell it to shippers. Often, an IMC company will require a minimum number of shipments from a client, to guarantee that shipping equipment will be available.

TECHNOLOGY AND TRENDS IN TRANSPORTATION

As technology has continued to evolve in the trucking sector, it is now essential for companies to remain current with trends. According to a recent report from the *American Journal of Transporta-*

tion, technological trends have disrupted the trucking industry to the extent that early adopters are set to become the most effective and efficient operators.

Everything from driver staffing and recruiting, to driver monitoring and traffic coordination, to safety and communications are now driven exclusively through technology for many companies.

Following are some of the most prominent ways in which companies are now leveraging technologies to improve their operations and logistics.

- **DRIVER MONITORING**

With the onset of data sharing technology in the trucking sector, companies are able to keep track of driver and vehicle progress. Mileage, distance routes, and all other behaviors can be monitored remotely now, which gives companies the ability to make real-time changes and improvements.

- **TRAFFIC COORDINATION**

With the ability to communicate and access fleet information remotely, companies and drivers are now able to improve delivery times. This is achieved by coordinating driving patterns, delivering real-time traffic reports, updating information on surrounding areas, and even telling a driver about something in his or her blind spot. Traffic coordination technology has resolved many road transport issues for truckers as a result.

- **SAFETY TECHNOLOGY**

Safety technology has perhaps been the most significant disrupter in the trucking industry. This facet of the sector is constantly experiencing changes with:

- Stability control
- Antilock braking systems
- Collision avoidance systems
- Lane departure warning
- Interior cameras
- Rearview cameras
- Blind spot warning devices
- Side monitor cameras and sensors

Investments in safety technology not only reduce accidents, injuries, and fatalities, but they have been shown to cut costs as well. For instance, according to research cited by TruckingInfo.com, it costs between \$100,000 and \$200,000 in payouts for property damage, up to \$455,000 for accidents with injuries and close to \$885,000 and \$1.3 million for accidents that end in fatalities. The high costs of accidents have prompted many companies to adapt to new technologies.

The same research showed that just on the adoption of lane departure warning systems alone, there is significant return on investment. The average cost is around \$800, which means it generates an ROI of somewhere between \$1.37 and \$6.55 for each dollar spent (ProDrivers, 2016).

- **PLATOONING**

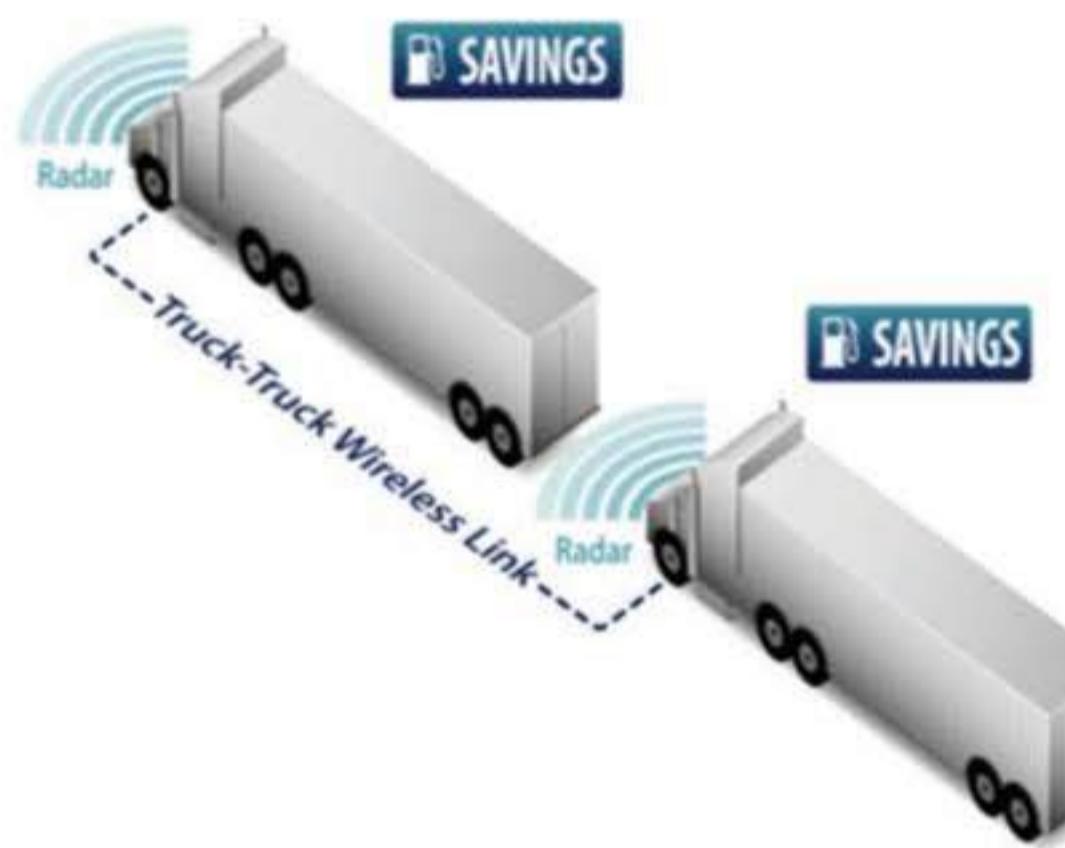
Vehicle-to-vehicle communication is tackling two of the trucking industry's largest problems—fuel and safety. By using radar sensors, intelligent braking, video screens, and a wireless link, vehicle-to-vehicle communication makes it possible for two trucks to connect in a “platoon,” or “closer together than would normally be safe.”

The two trucks are able to get as close as 20 feet from each other while platooning in order to take advantage of fuel-saving aerodynamics. The industry reports fuel savings of 10% for the second truck and 4.5% for the lead truck in a platoon. The trucks are able to get this close thanks to an active safety system that wirelessly links the trucks. The wireless link controls the truck's acceleration and braking, while radar detects potential dangers up ahead. The linked trucks react within a “fraction of a second” whereas a truck driver needs up to two seconds to react to changes in conditions. While the wireless link controls acceleration and braking, drivers still have complete control of the truck (Goldwasser, 2015).

- **ADVANCED VEHICLE EXPERIENCE—NEW CONCEPT TRUCKING**

A collaboration between Peterbilt, Capstone Turbine, and Great Dane Trailer has created a new concept truck—the Walmart Advanced Vehicle Experience, or W.A.V.E.

W.A.V.E. is a means to shake up the way things are done in the trucking industry as it combines many revolutionary ideas in tractor and trailer design.



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The advanced concept tractor has a streamlined, aerodynamic body, thanks to the driver's seat placed in the center of the cab. Furthermore, the tractor has a microturbine-powered series hybrid electric drivetrain, programmed to find the most efficient balance between its turbine and electric drivetrains.

The trailer is equally as advanced, made almost entirely of carbon fiber, and weighing 4,000 pounds less than a normal trailer. The sidewalls and roof are single, 53-feet-long pieces, held together with advanced adhesives, eliminating the need for rivets. Finally, the trailer has a convex nose that maintains cargo capacity and improves aerodynamics.

While the W.A.V.E. is still a prototype, Walmart is not only attempting to improve its own fleet efficiency, but also advance the future of the entire trucking industry with this application transportation technology (Goldwasser, 2015).

- **VERTICALLY FOLDING SHIPPING CONTAINERS**

For decades, empty cargo containers have led to inefficiencies at ports.

A new innovation hopes to bring a sustainable alternative to normal, rigid cargo containers through vertically folding, retrofitted containers.

The goal is to reduce the number of container ship movements as well as intrastate truck movements at ports related to empty containers.

These foldable containers will reduce the cost and inefficiencies involved in moving empty intermodal containers. The containers are folded vertically by collapsing the doors of the container and pushing the outer walls of the container in toward each other. With this method, five empty, collapsed containers can fit into the same space as one normal, nonfolding container. Retrofitting old containers to be collapsible rather than designing and building completely



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new containers is another hallmark of this initiative. With an idea as simple as folding containers, you don't have to build intricate software or design new trucks to have a huge impact on the logistics industry (Goldwasser, 2015).

- **DRIVERLESS TRUCKS**

According to the American Trucking Association, there are some 3.5 million truck drivers in the United States alone. That's 3.5 million people who may be impacted once driverless trucks hit the roads in full force. A convoy of these trucks recently drove across Europe and arrived without incident at their destination at the Port of Rotterdam for 75% cheaper than it would have cost had human beings been driving them.

A large part of the economic efficiency boost will include the fact that driverless trucks never get tired and can drive for 24 hours straight, non-stop, whereas humans obviously need to eat, take breaks, and sleep. Drivers are restricted by law from driving more than 11 hours a day and are required to take breaks each day. That means the technology would effectively double the output of the U.S. transportation network at 25% of the cost. In addition, truck drivers drive faster because they are paid by the mile and they're trying to get more done, a situation that throws fuel efficiency out the window in a way that won't happen with robotrucks, which will drive at a steady, set pace the entire trip (Dykes, 2016).



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LOGISTICS MANAGEMENT SOFTWARE APPLICATIONS

Companies that have a lot of inventory and make a lot of shipments may find it necessary to have some type of system(s) in place to manage logistics activities such as warehousing and transporta-

tion. The following are the basic logistics systems that companies implement beyond the standard inventory management system or enterprise resource planning (ERP) system.

- **WAREHOUSE MANAGEMENT SYSTEMS (WMS):** Software application that supports the day-to-day operations in a warehouse. WMS programs enable centralized management of tasks such as tracking inventory levels and stock locations. WMS systems may be standalone applications or part of an enterprise resource planning (ERP) system. The goal of a warehouse management system is to provide management with the information it needs to efficiently control the movement of materials within a warehouse.
- **TRANSPORTATION MANAGEMENT SYSTEMS (TMS):** Software that facilitate interactions between an organization's order management system (OMS) and its warehouse management system (WMS) or distribution center (DC); it is used to select the best mix of transportation services and pricing. TMS systems may be standalone applications or part of an ERP system. TMS products serve as the logistics management hub in a collaborative network of shippers, carriers, and customers. Common TMS software modules include route planning and optimization, load optimization, execution, freight audit and payment, yard management, advanced shipping, order visibility, and carrier management.

The business value of a fully deployed TMS should achieve:

- Reduced costs through better route planning, load optimization, carrier mix, and mode selection
- Improved accountability with more visibility into the transportation chain
- Greater flexibility to make changes in delivery plans

REVERSE LOGISTICS

What Is Reverse Logistics?

In supply chain management we are concerned with the efficient, effective, and cost conscious use of resources to move a product from concept to consumer. We must be equally concerned with the reverse flow of products back through the supply chain, known as reverse logistics. **Reverse logistics** involves the process of moving a product from the point of customer receipt back to the point of origin to recapture value or ensure proper disposal.

Keys to Reverse Logistics: Visibility, Efficiency, and Service

Companies must address a diversity of issues when trying to determine “why is there a need for reverse logistics.” They must establish return policies, processes for identifying quality issues, ways to handle defective materials, poorly packaged products, shipped errors, and the like. An additional point of importance often overlooked in reverse logistics is the possibility of remanufacturing, refurbishment, and resale of goods.

In today’s world of sustainability and green supply chains, questions arise as to the volume and level of waste involved with disposal of both products and packaging materials. There is also a question as to the possibility of the repurpose of products and the reuse of containers and package materials, which of course vary with every company and manufacture. One of an organization’s concerns should be what types of material are being used, and if they are recyclable or “green.” Additional concerns include which packaging materials can affect pollution, impact energy issues, and require hazardous materials programs?

Product Returns Are on the Rise

It is becoming painfully apparent that reverse logistics is on the rise. All manufacturers and retailers would be more comfortable if all of their products were based on a forward flow only; however, this will never be the case, as there will always be the need for a backward flow. The important questions to be asked are “What are the causes?” and “What can and must be done about it?”

The internet has become a significant contributor to the changing world of reverse logistics. With online shopping, direct sales to stores, along with other internet sale processes, direct to the consumer mistakes can be found at all levels from order taking, to fulfillment, to shipping, all of which have added complexity to the process.

An important factor when discussing reverse logistics is that a majority of errors causing returns is generally attributed to human error and not technological systems; however, the system often becomes the scapegoat for mistakes. One then has to ask the question, “What are these potential errors costing an organization, and in fact are organizations tracking the error data in such a way as to monitor costs and reasons for reverse logistics?”

One of the most important cost factors, which is extremely hard to calculate, is the loss of customer loyalty caused by poor reverse logistics processes and practices. Without a doubt, a poorly developed and managed reverse logistics program can and will have a profound effect on an organization’s ROI, bottom line, and certainly customer satisfaction level.

Reverse logistics has not always been at the forefront of enterprise planning. The negative aura that surrounds planning for product distribution failures and/or product rejection is, in itself, off-putting. It is a case where everyone loses—your customer who sends the product back dissatisfied,

your supplier who gets your parts back, and the manufacturer who wasted enterprise resources creating and distributing products that are unneeded or unwanted.

To say there is no solution to reverse logistics is no better than saying there is no reverse logistics problem. Reverse logistics is on the rise and it is not going to go away. In fact, it will only get larger as business grows and technology continues to develop.

Reverse Logistics and Returns Are Significant Parts of the Supply Chain

Reverse logistics costs money. It affects the bottom line, which has brought the issue to the forefront where it is beginning to receive significant attention. When organizations begin to truly consider reverse logistics, they will gain significant and direct understanding, control, and rewards from proactively managing the return product flow.

APICS Supply-Chain Council provided an understanding of the benefits of a good reverse/return logistics program. The APICS model suggests eight specific return points:

- Three return points at the supplier level
- Two return points at the manufacturing company level
- Three return points at the customer and the customer's customer level

There is no question the growing importance of returns reflects our changing economy. There is also no question that a strong returns policy should be considered part of an organization's business practices. Historically when times are tough and business is slow, companies tend to search for areas they may have overlooked to increase profits and decrease costs. One such area is product returns and the related manufacturing or distribution errors causing these returns.

An example is the often large return lines (sometimes longer than the checkout lines) following the Christmas season. This is also often indicative of the complexity of the reverse logistics process, including the processing of credit cards and cash returns, returning the wrong item to the wrong place, and so forth. Unfortunately, not all customers are honest, so managing this aspect of the reverse logistics is both critical and sensitive, impacting an organization's reputation. Along with all of this comes the need to be aware that there is often a defective product that requires a significant process for the physical handling to complement the normal product return policy.

Returns affect not only the retail portion of the business community, but also earlier issues with product manufacturing, raw materials use, the suppliers, and potentially how the product was handled and transported domestically and internationally. Returned goods or product can also be returned to suppliers for remanufacture and/or repackaging.

Implications in Today's Business World

In today's marketplace, many retailers treat merchandise returns as individual, singular transactions. Retailers and vendors are challenged to process returns at an effective level that allows quick, efficient, and cost-effective return of merchandise. Today customers demand a high standard of service that includes accuracy and timeliness. It's a company's responsibility to shorten the return cycle and expedite a customer's requirements. By following returns management best practices, retailers can achieve a returns process that addresses both the operational and customer retention issues associated with merchandise returns. Additionally, because of the connection between reverse logistics and customer retention, it has become a key component within service lifecycle management (SLM), a strategy to retain customers through a more efficient overall business operation.

Reverse logistics is more than just returns, it includes all related activities to avoid and those used to protect a company from all aftermarket chain issues. Reverse logistics and return management is well recognized as a significant cause that affects competitive positioning in the marketplace and is an important link between marketing and all logistical issues. Without question a company that improves its internal integration processes will influence customer external factors as applied to its returns management processes. "Studies have shown that an average of 4% to 6% of all retail purchases are returned, costing business and industry about \$40 billion per year" (Van Riper, 2005).

Return of Unsold Goods

In some industries, goods are distributed to downstream members in the supply chain with the understanding that the goods may be returned for credit if they are not sold (e.g., newspapers, magazines, even pharmaceuticals). This acts as an incentive for downstream members to carry more stock, because the risk of obsolescence is borne by the upstream supply chain members. However, there is also a distinct risk attached to this logistics concept. The downstream member in the supply chain might exploit the situation by ordering more stock than is required and returning large volumes. In this way, the downstream partner is able to offer a high level of service without carrying the risks associated with large inventories. The supplier effectively finances the inventory for the downstream member. It is therefore important to analyze customers' accounts for hidden costs.

Streamlining the Five Rs of Reverse Logistics

When considering reverse logistics, it pays to improve returns management in five key areas.

1. RETURNS

Returns are typically the first step in the reverse logistics flow. Customers return products for a number of reasons. An item may be defective, damaged, and seasonal; fail to meet expectations; or simply represents excess inventory.

Whatever the reason, the key to handling returns efficiently is having processes in place for receiving, inspecting, and testing products, along with return material authorization (RMA) verification and tracking systems. Some companies find it's more efficient to decouple the return and repair processes completely.

2. RECALLS

Another way parts and products are returned is through recalls. A critical reverse logistics category, recalls are more complex than basic returns because they typically involve a product defect or potential hazard and may be subject to government regulations, liability concerns, or reporting requirements.

High-tech devices are typically recalled because of faulty electronics, construction issues, problems with batteries, or potential hazards. The key is to have processes in place to receive, replace, resell, or reclaim failed parts/products—and whenever possible salvage revenues and turn a potentially negative customer experience into a positive one that builds brand trust.

3. REPAIR (AND REFURBISHMENT, REUSE, AND REMANUFACTURING)

Not all products that are returned go directly to landfills. If the faults are not too severe, manufacturers identify the failure and repair, refurbish, or remanufacture the product to like-new condition and return it to stock. Alternately, at end of life, manufacturers may harvest various functional components for reuse.

These practices are becoming more common as manufacturers recognize the value of reusing materials from returned goods. This may be to advance sustainability efforts, recoup costs, or both. Either way, retail shelves are increasingly stocked with both new and reused or remanufactured products.

Without a reverse logistics process in place to streamline the repair, refurbishment and/or remanufacturing of these products—and inventory management processes to go with them—you may invest too much time and money on repair parts or labor. Visibility and tracking are essential to ensuring efficiency.

4. REPACKAGING (FOR RESTOCK OR RESALE IN SECONDARY CHANNELS)

There are two scenarios where returned parts and products might be remanufactured. Most products are returned because customers are dissatisfied with them (in the neighborhood of 95%) not because there's something wrong with them. When testing reveals "no trouble found," these products are typically repackaged and returned to inventory as quickly as possible.

Alternately, parts/products with minor flaws may be repaired, reconditioned, and repackaged for resale. This is an area where co-locating forward and reverse logistics processes can deliver important returns. With multiline packaging capacity already available for packaging new products, the same facility can be used to repackage returns for resale using secondary channels such as Overstock.com.

5. RECYCLING, DISPOSAL, AND DISPOSITION

The focus on recycling returned or end-of-life parts, components, and products is driving more sustainable practices in every industry, but particularly so in high-tech industries. When products reach the ends of their useful lives and must be scrapped, electronic manufacturers are increasingly finding safe, cost-effective, and environmentally friendly ways to dispose of them. That might mean engaging third-party recycling companies to collect/reclaim waste and dispose of assets for them.

One area that's seeing a surge in recycling and reclamation efforts is in high-tech devices such as mobile phones or circuit boards, where companies recover rare earth metals of gold, silver, titanium, palladium, or copper. By salvaging, reclaiming, and reusing components, companies can reduce costs and minimize waste.

Setting up or fine-tuning reverse logistics processes can be a complex and time-consuming undertaking—especially if reverse logistics is not a core competency or you don't have the in-house resources to devote to it. As a result, many businesses outsource returns management to experienced third parties that can help them improve quality, cost savings, visibility, inventory management, and the overall customer experience.

Reverse Logistics Add-in

Six Sigma and quality are key parts of the reverse logistics process. When a product is returned to a retailer for any reason, there should be a significant process in place to track backwards what caused the reason if in fact it is a quality problem. The reverse questions of quality have to follow a specific order, starting with (1) was the product damaged when placed upon the shelf for sale by a salesperson or a stock person, (2) was it damaged when put into the stockroom by a delivery person, (3) was it damaged by a shipment from either a public or a private transporter to the retail store, or (4) was it damaged when it arrived at a distribution center?

A further examination has to go backwards again to how it arrived at a distribution center: Was it damaged in shipment? Was it damaged by the manufacturer in packaging? Was it damaged from the manufacturer when loaded onto pallets and sent to a dock for shipment? or Was it damaged when shipped from a port of exit to a port of entry and equally damaged from a port of entry to the central warehouse?

A flow diagram of this nature should be designed and followed by an organization to carefully identify where products are damaged, if it is by the manufacture, by shipping agents, or internally by the retail trade.

SUMMARY

- Logistics is “that part of supply chain management that plans, implements and controls the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet customer requirements.”
- Logistics is necessary to accomplish three things:
 - To move goods and materials from suppliers to buyers
 - To move goods and materials between sites, either internally, or between internal and external sites
 - To move finished goods out to customers
- Warehousing is all “the activities related to receiving, storing, and shipping materials to and from production or distribution locations.”¹
 - Warehousing is the function that allows a company to store all types of inventory (i.e., raw materials, WIP, and finished goods) that the company may have or need.
 - Decisions driving warehouse management include site selection, the number of warehouse facilities in the network, the layout of the warehouse(s), and the methods of receiving, storing, and retrieving products and materials.
- The basic functions of a warehouse include receiving, storage, picking, packing, and shipping. They can also perform other functions such as consolidation, break bulk, quality inspections, repackaging, and assembly operation.
- There are different types of warehouses that companies must consider: public, contract, private, consolidation, break bulk, and cross docking.
 - A public warehouse is a business that provides storage and related warehouse functions to companies on a short- or long-term basis, generally from month to month.

- A contract warehouse is a variation of public warehousing that handles the shipping, receiving, and storage of goods for a specific client on a contract basis.
 - A private warehouse is a storage facility that is owned by the company that owns the goods being stored in the facility.
 - A consolidation warehouse receives products from suppliers, sorts them, and then combines them with similar shipments from other suppliers into larger, more economical shipping loads for further distribution.
 - A break bulk warehouse is similar to a consolidation warehouse except that the incoming shipments are generally truckloads of homogeneous items from a single plant or supplier.
 - Cross docking is the logistics practice of unloading materials from an incoming truck or railcar and loading these materials directly onto outbound trucks or railcars, with little or no storage in between. This is a type of consolidation and/or break bulk warehouse.
- A warehouse network is simply the number of, and the relationship between, the warehouses that a company has in its organizational structure.
 - Whether a company determines that it needs one or multiple warehouses, it will also have to determine which location strategy makes the most sense for its business. This strategy decision will be different from one business to another depending on the nature of the business and how many customers and suppliers interact with the company. The three main warehouse network location strategies are:
 - Market Positioned Strategy: Warehouses are set up close to customers to maximize distribution services and improve delivery time.
 - Product Positioned Strategy: Warehouses are set up close to supply sources to collect goods and consolidate before shipping products out to customers.
 - Intermediately Positioned Strategy: Warehouses are set up somewhere midway between the supply sources and the customers to try to balance costs, inventory, and customer service.
 - A warehouse network optimization study may be needed to determine the optimal number and location of warehouse in this strategy.
 - Warehouses and distribution centers are continuing to develop their LEAN capabilities. The following are a few ways in which warehousing is adopting and adapting LEAN principles.

- Greater emphasis on cross docking, which eliminates the need to store inventory, which is waste, and waste reduction/elimination is the key element of LEAN.
 - Reduced lot sizes and shipping quantities. Just as small batch scheduling is a LEAN concept because it drives down costs by reducing inventories, and makes the company more flexible to meet customer demand, this same concept can be applied to warehouse operations.
 - Increased automation. Companies are using automated systems like pick to light, voice picking, conveyor systems, automatized guided vehicles (AGVs), and robotics to improve efficiencies and throughput times in the warehouse.
 - A tendency to be green. Companies are looking at what green or sustainability programs they can implement in warehousing operations.
- A third-party logistics (3PL) company is an outsourced provider that manages all or a significant part of an organization's logistics requirements for a fee. Some of the typical services that are offered by 3PLs include but are not limited to inbound transportation, warehousing, pick and pack, outbound transportation, freight forwarding, freight bill auditing/payment, customs brokerage, customs clearance, order taking, billing/invoicing, inventory auditing.
 - 3PLs are used by large and small business but are particularly favored by small businesses who do not have their own logistics operations.
 - 3PLs are also used to a significant degree for international logistics. A company is more likely to use a 3PL internationally rather than to try and establish an in-house operation in each foreign market themselves.
- Fourth-party logistics (4PL) is an interface between the client company and multiple logistics service providers. A company will select a lead logistics partner (referred to as a 4PL) that is then charged with managing the activities of all the other 3PLs being used by the company.
- Transportation is “the function of planning, scheduling, and controlling activities related to mode, vendor, and movement of inventories into and out of an organization.”¹
- Transportation has three objectives:
 - To maximize the value to the company through price negotiations
 - To make sure service is provided effectively
 - To satisfy customers' needs

- Companies transporting freight or cargo regardless of the mode of transportation are classified according to the following categories:
 - Common Carrier: A person or company that transports freight for a fee that can be hired by anyone to transport goods
 - Contract Carriers: A person or company that transports freight under contract to one or a limited number of shippers
 - Exempt Carriers: A person or company specializing in certain services (such as taxi service) or certain commodities (such as farm products or bulk cargo) exempt from regulation by the Interstate Commerce Act
 - Private Carriers: A person or company that transports its own cargo, usually as part of a business that produces, uses, sells, and/or buys the cargo that is being hauled
- There are five major modes of transportation:
 - Motor carriers (trucking)
 - Rail carriers
 - Air carriers
 - Water carriers
 - Pipeline carriers
- Motor Carriers (Trucks): The most prevalent mode of transportation and the one people are probably most familiar. It is also the most flexible mode of transportation in that it carries the most different kinds of freight to the most locations.
 - There are two major categories of motor carrier: short haul and long haul.
 - Short haul is defined as operating within 200 miles of the driver's home terminal.
 - Long haul is defined as anything over 200 miles from the driver's home terminal.
 - Motor carriers can be further categorized into general carriers and specialized carriers:
 - General Freight Carriers: Trucking companies that engage in shipping packaged, boxed, and palletized goods that can be transported in standard, enclosed tractor-trailers, generally 40 to 48 feet in length.

- Specialized Freight Carriers: Transport articles that, because of size, weight, shape, or other inherent characteristics, require specialized equipment for transportation.
- Shipments by motor carrier can be divided into either less-than-truckload (LTL) or full-truckload (FTL), generally indicating whether the volume of the shipment fills the truck trailer/container or not. Motor carriers may offer LTL or FTL, or both services.
 - LTL carriers are those that move small shipments—that is, when you don't have enough to fill a truck.
 - FTL carriers generally contract an entire trailer out to a single customer.
- Rail Carriers: A company whose business is transporting persons or goods or both by railroad. Rail transportation is best used for very heavy shipments such as building materials, construction equipment, and coal, particularly when the transport distance is long.
- Air Carriers: Organizations that transport passengers and cargo by aircraft. Air is the newest transport mode and the least utilized. Air shipments are relatively expensive compared to the other modes of transportation, partially because the fuel is expensive, they have a limited amount of cargo space, and they have to deal with weight and balance issues on the plane itself.
- Water Carriers: Organizations that transport goods or people using waterways. Water carriers cover a broad range of water transportation routes including ocean / deep water, coastal and intercoastal, and in-land waterways such as rivers and lakes
- Pipeline Carriers: Most people don't think of a pipeline as a mode of transportation, but any type of pipeline that moves material from one place to the other is a form of transportation. Pipeline costs are extremely low, dependability is very high, and there is limited risk of damage to the product being transported. It is actually the most efficient form of transportation.
- Intermodal is sometimes referred to as the sixth mode of transportation, but it is really the use of multiple modes of transportation to execute a single transport shipment. Intermodal is growing substantially because it is fairly cost efficient and cost effective.
- Transportation Pricing and Considerations: Since deregulation in the transportation industry, negotiating transportation prices is common. The main transportation schemes are as follows:
 - Cost of Service Pricing: The setting of a price for a service based on the costs incurred in providing it

- **Value of Service Pricing:** A pricing strategy that sets prices primarily, but not exclusively, in the value, perceived or estimated, to the customer rather than on the cost of the product or historical prices (i.e., “priced at what the market will bear”)
- **Combination Pricing:** Price setting at a value between cost-of-service minimum and value-of-service maximum.
- **Net-Rate Pricing:** Established discounts and accessorial charges are rolled into one all-inclusive price
- **Terms of Sale:** The delivery and payment terms agreed between a buyer and a seller. In international trade, terms of sale also set out the rights and obligations of buyers and sellers as applicable in the transportation of goods.
- **Transportation Rate Categories:** Price charged by transportation carrier for moving an item or commodity from point A to point B. Classified as line haul rates, class rates, exception rates, commodity rates, and miscellaneous rates.
- **Transportation Regulation:** The early days of transportation in the United States was like the Wild West. Transportation carriers could charge whatever they wanted for their services and there wasn't much competition to keep the market in check. As a result, there really wasn't good service to the public, so the government started to impose a series of regulations.
- **Transportation Deregulation:** Eventually the pendulum swung back the other way. Transportation regulation became too onerous, and the rest of the world started to catch up in terms of transportation. Foreign transportation companies started to impact the ability of U.S. transportation companies to make money. As a result, the government began to deregulate the industry allowing U.S. companies more freedom so they could become more competitive in the United States as well as in other countries.
- Other transportation intermediaries include:
 - **Freight Forwarders** are the “middle man” between the carrier and the organization shipping the product. They take small shipments (e.g., LTL) from numerous companies and consolidate them to make larger shipments (e.g., FTL).
 - **Load or Transportation Brokers** find shipments for carriers for a fee. They bring shippers and carriers together.
 - **Shippers' Associations** are a group of shippers that consolidates or distributes freight on a nonprofit basis for the members of the group to obtain volume rates or service contract rates.

- Intermodal Marketing Companies (IMC) purchase blocks of rail and truck transportation services, utilize equipment from multiple sources, and provide other value added services under a single freight bill to the ultimate shipper. In other words, they purchase rail capacity and sell it to shippers.
- As technology has continued to evolve in the trucking sector, it is now essential for companies to remain current with trends. Some of the most prominent ways in which companies are now leveraging technologies to improve their operations and logistics are:
 - Driver monitoring
 - Traffic coordination
 - Safety technology
 - Platooning
 - Advanced vehicle experience, or new concept trucking
 - Vertically folding shipping containers
 - Driverless trucks
- Companies that have a lot of inventory and make a lot of shipments may find it necessary to have some type of logistics management software application in place to manage logistics activities such as warehousing and transportation. The following are the basic logistics systems that companies implement beyond the standard inventory management system or ERP system:
 - Warehouse Management Systems (WMS): Software application that supports the day-to-day operations in a warehouse.
 - Transportation Management Systems (TMS): Software that facilitates interactions between an organization's order management system (OMS) and its warehouse management system (WMS) or distribution center (DC).
- Reverse Logistics: We must be concerned with the reverse flow of products back through the supply chain, known as reverse logistics. It involves the process of moving a product from the point of customer receipt back to the point of origin to recapture value or ensure proper disposal.
 - The keys to reverse logistics are visibility, efficiency, and service.

- Product returns are on the rise.
- Reverse logistics and returns are a significant part of the supply chain.
- When considering reverse logistics, it pays to improve returns management in five key areas:
 1. Returns
 2. Recalls
 3. Repair (and refurbishment, reuse, and remanufacturing)
 4. Repackaging (for restock or resale in secondary channels)
 5. Recycling, disposal, and disposition

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Chapter 10

Global Logistics and International Trade

CHAPTER OUTLINE

- Global Locations
- Global Facilities—Strategic Roles
- Global Location Factors
- Global Location Decisions
- International Trade Management
- Major U.S. International Trade Legislation
- U.S. Customs and Border Protection
- U.S. Department of Homeland Security
- Trade Compliance
- Global Logistics Intermediaries
- Import Process
- Export Process
- Penalties for Violations

GLOBAL LOCATIONS

Why would a company want to manufacture products outside of their domestic market? There are a number of significant reasons why this might be an attractive strategy, including:

- Reducing costs (direct, indirect, capital, logistics, etc.)
- Reducing taxes, and overcoming tariff barriers
- Access to more customers, and improved customer service
- Mitigating certain risks
- Establishing alternative sources of supply
- Gaining an advantage over competitors
- Obtaining knowledge from foreign suppliers, competitors, customers, and research institutions
- Securing access to global talent

In today's business environment, companies can locate anywhere in the world due to such aspects as increased globalization, advancements in technology, new transportation options, and open markets. Therefore, facility location must be part of the company's supply chain strategy.

Global location decisions involve:

1. Defining each facility's strategic role (i.e., the purpose of each facility)
2. Determining the location for each facility (i.e., where in the world to locate)
3. Identifying the market(s) that each facility will serve (i.e., local, regional, global)

GLOBAL FACILITIES—STRATEGIC ROLES

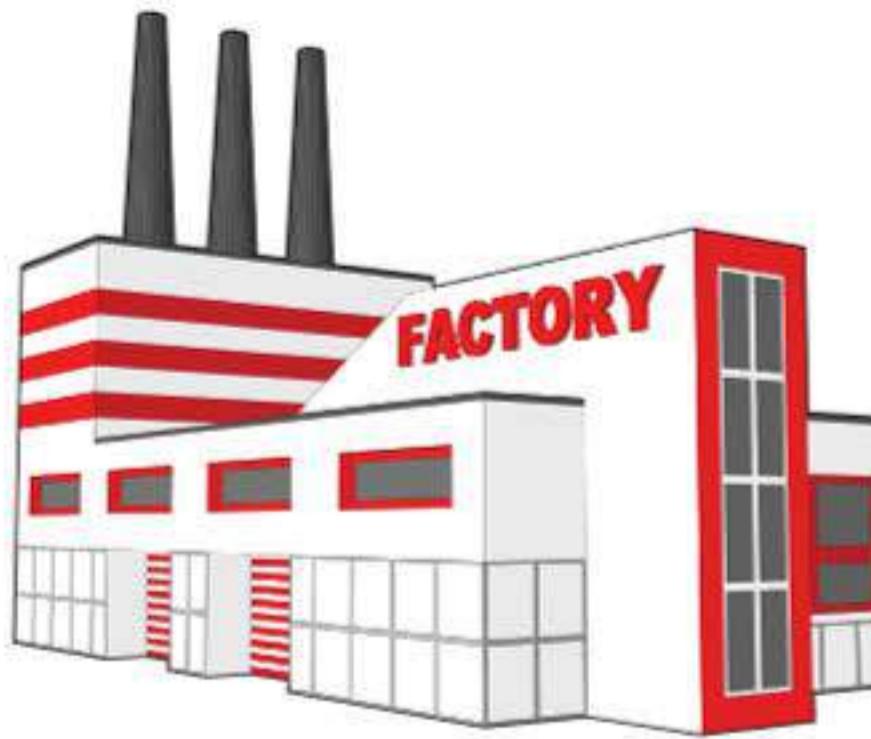
Manufacturing facilities can be categorized based on what they produce, where they are located, how much decision-making authority they have, what technical activities they perform, what markets they serve, and more. Research done by Professor Kasra Ferdows, Georgetown University, identified six specific strategic roles that a manufacturing facility can assume.⁶

1. Offshore Factory

An offshore factory is a very basic factory set up for manufacturing or assembly in a country where labor and/or raw materials are less expensive, typically for import back into the manufacturer's home country. An offshore factory can also be defined as "a plant that imports or acquires locally all components and then exports the finished product."¹

OFFSHORE FACTORY CHARACTERISTICS:

- Low cost manufacturer; set up in markets with low labor costs and lower material costs.
- Local management serves in a supervisory role, not in making management decisions.
- Little to no engineering work or technical activities.
- Imports or obtains materials locally, and then exports products to the parent company or directly to customers.



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2. Source Factory

A source factory is similar to an offshore factory in that it is generally located in a market with low labor and material costs, but it takes advantage of skilled workers and allows for more managerial input and control. Source factories have a more substantial role than offshore factories and are established to be the main source of specific products or processes.

SOURCE FACTORY CHARACTERISTICS:

- Low cost manufacturer; set up in markets with low labor costs and lower material costs.



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- Local management has an expanded role and is involved in making some management decisions regarding procurement, production planning, process changes, and distribution.
- Increased technical and managerial resources.
- Access to a skilled workforce.
- More developed local infrastructure.

3. Server Factory

A server factory is set up to serve a specific market(s). It may also be set up to take advantage of government incentives and/or reduced taxes/tariffs. A server factory can also be defined as “a facility making minor improvements to products; set up primarily to avoid the host country’s barriers to trade.”¹

SERVER FACTORY CHARACTERISTICS:

- Serves a specific market(s).
- Local management serves primarily in a supervisory role, not in making most management decisions; however, local management may be involved in managing the flow of materials from suppliers, to the factory, and out to customers.
- Takes advantage of government incentives and reduced taxes/tariffs.
- Makes minor improvements to product and processes.



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4. Contributor Factory

A contributor factory is set up to serve a specific market(s) similar to a server factory, but the role is expanded to also be the focal point for specific company activities. These factories are given the role to develop and contribute know-how for the company. They provide product development and engineering for products that they manufacturer, and they are typically involved in new product introductions.



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CONTRIBUTOR FACTORY CHARACTERISTICS:

- Serves a specific market(s).
- Increased technical and managerial resources.
- Involved in supplier, product, and process development including new product introductions.
- Local management involvement in procurement decisions and production planning.

5. Outpost Factory

An outpost factory is set up in an area with an abundance of advanced suppliers, competitors, research facilities (e.g., a business cluster) for the purpose of obtaining knowledge and information.

OUTPOST FACTORY CHARACTERISTICS:

- Established in or near a business cluster.
- Primary purpose is to obtain knowledge and information.



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6. Lead Factory

A lead factory is the source of product and process innovation and provides a competitive advantage across the entire organization. They are set up to build strategic capabilities in manufacturing, and to develop the ability and knowledge to innovate and create new processes, products, and technologies for the entire company. Lead factories are typically the major producer of the main products of a company for the global market.



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LEAD FACTORY CHARACTERISTICS:

- Major production facility for the company.
- Leader in technologies and innovation.

- Development of manufacturing capabilities.
- Competitive advantage of the organization.
- The company's "go to" factory.

GLOBAL LOCATION FACTORS

Global location factors are used to compare and contrast one potential location against another when making global location decisions. The most common location factors are:

- Access and Proximity to Markets
- Access to Suppliers and Cost
- Business Clusters
- Competitiveness
- Currency Stability
- Environmental Considerations
- Labor Availability and Cost
- Land Availability and Cost
- Quality of Life Factors
- Taxes and Incentives
- Trade Agreements
- Utility Availability and Cost



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Access and Proximity to Markets

The company's ability to deliver its products and services to customers in a timely and cost-effective manner is not only a goal or objective, but also absolutely critical to the company's long-term survival. When choosing a global location from which to establish operations, the proximity to

customers and the access to the markets being served are vitally important, and may be the deciding factors when making the final location selection.

There are some markets around the world that are restrictive, and to be granted access to sell products in those markets, companies may be required to establish local operations within those countries.

Because logistics timelines and costs are significant concerns, the trend in manufacturing is to be within delivery proximity of your customers. This also reinforces the business cluster concept discussed later in the chapter, where manufacturers, suppliers, customers, and service providers all locate near one another generally in places that offer lower cost labor, tax breaks, and lower real estate prices.

In the service industry, proximity to customers is even more critical. A company can't easily or cost effectively service a piece of equipment that they sold to a customer if the technician is thousands of miles away.

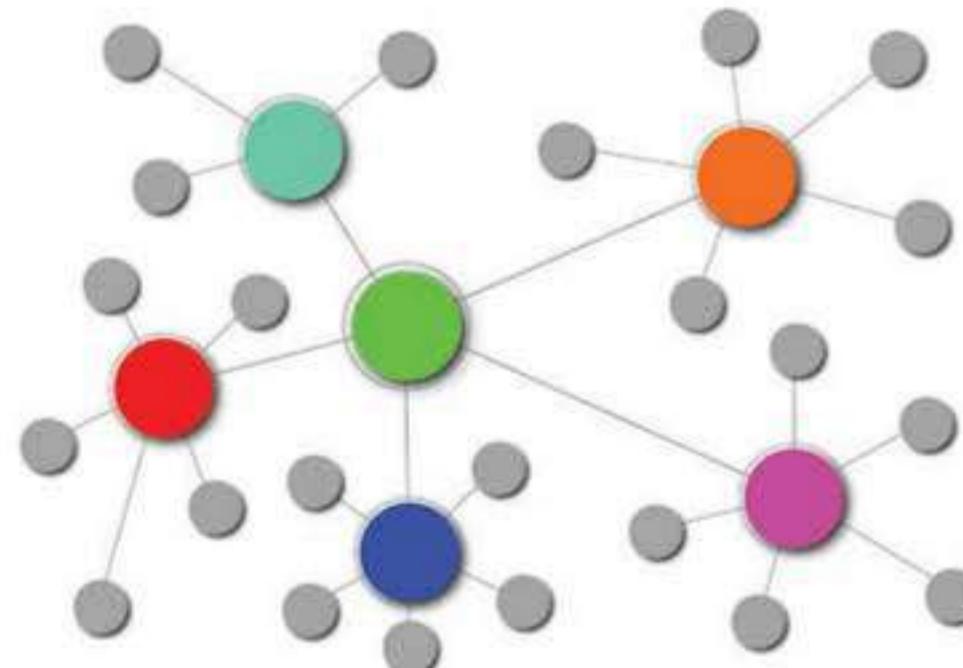
Access to Suppliers and Cost

The company's ability to receive materials and services from suppliers in a timely and cost effect manner is also critical to the company both short and long term. If the company wants to source materials and services locally, are those materials and services available, and are they priced competitively in the global locations being considered?

When choosing a global location from which to establish operations, the proximity to suppliers and the ability suppliers have to deliver materials and services to the company will be major factors in determining the effectiveness of the supply chain, and may therefore be deciding factors when making the final location selection.

Business Clusters

A business cluster is a network of manufacturers, suppliers, service organizations, and related businesses and institutions connected to one another within an industry, all located in the same geographical area. These industry concentrations are believed to provide a benefit to all of the co-located businesses and institutions whether they are partners or competitors. The proximity to



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one another provides easy access to talent, knowledge, services, supplies, technology, and even competitive information. Companies located in these business clusters are often able to increase their efficiency and productivity making them more competitive. Research parks and special economic / industrial zones can serve as magnets for business clusters. Examples of business clusters include Silicon Valley (technology), Research Triangle Park (research & development), Wall Street (financial), New Jersey (pharmaceuticals), Singapore (high-tech manufacturing), and India (software).

Reasons for the success of business clusters include:

- Innovation and competition can be geographically concentrated.
- There is close cooperation, coordination, and trust among clustered companies.
- Companies recruit from local skilled workers.

Competitiveness

The World Economic Forum defines competitiveness as the “set of institutions, policies, and factors that determine the level of productivity of a country” and identifies “12 Pillars of Competitiveness” in their Global Competitiveness Report 2014–2015.²

These pillars are used to rank and compare country locations. In general, countries that have a higher overall ranking potentially provide a more favorable business environment than lower ranked countries.

The 12 Pillars of Competitiveness are:

1. **INSTITUTIONS:** “Concepts related to property rights, efficiency and transparency of public administration, independence of the judiciary, physical security, business ethics and corporate governance”²
2. **INFRASTRUCTURE:** “Quality and availability of transport, electricity, and communication infrastructures”²



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3. **MACROECONOMIC STABILITY:** “Fiscal and monetary indicators, savings rate, and sovereign debt rating”²
4. **HEALTH AND PRIMARY EDUCATION:** “State of public health, quality and quantity of basic education”²
5. **HIGHER EDUCATION AND TRAINING:** “Quality and quantity of higher education, and quality and availability of on-the-job training”²
6. **GOODS MARKET EFFICIENCY:** “Factors that drive the intensity of domestic and foreign competition, and demand conditions”²
7. **LABOR MARKET EFFICIENCY:** “Labor market efficiency and flexibility, meritocracy and gender parity in the workplace”²
8. **FINANCIAL MARKET SOPHISTICATION:** “Efficiency, stability, and trustworthiness of the financial and banking system”²
9. **TECHNOLOGICAL READINESS:** “Adoption of the technology by individuals and businesses”²
10. **MARKET SIZE:** “Size of the domestic and export markets”²
11. **BUSINESS SOPHISTICATION:** “Efficiency and sophistication of the business processes in the country”²
12. **INNOVATION:** “Capacity for, and commitment to, technological innovation”²

Currency Stability

Any decision about locating an operation in a particular country must consider currency stability. Fluctuation in currency exchange rates is a reality of international business. An unstable currency market will have a definite impact on determining and managing business costs. A company's purchasing power could be impaired or improved, inventory could be devalued or overvalued, labor and material costs might be unpredictable, among other things.



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- A few years back, Brazil had 1,000% annual inflation rate. It is nearly impossible to determine costs and set prices in that type of currency environment.

Environmental Considerations

Another global location consideration involves understanding and evaluating the environmental situation within each potential location. Companies must consider the local environmental impact on their organization and employees, as well as the impact that their operations may have on the local environment. Countries and specific locations may have differing environmental laws, regulations, and resources which may restrict company operations and impact costs. Air and water quality, carbon emissions, and disposal of waste, among other environmental factors, could be issues a company encounters depending on the global location selected.



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Labor Availability and Cost

Availability of the type of labor, in the volumes needed, and at the desired cost are major drivers for many companies when evaluating one potential global location over another.

When a company is evaluating a global location, it should consider labor factors such as the availability of skilled or unskilled labor, labor productivity, unemployment and underemployment rates, wage rates, turnover rates, and labor force competitors. Depending on the company's needs, one or more of these factors could make or break the decision. Another factor to consider is the long-term prognosis for the labor market in a particular global location. Labor costs and availability may be favorable in the short term, but could change significantly over time.



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If the company is evaluating locations within the United States, another consideration may be the right to work laws. A **right to work law** guarantees that a person cannot be required to join or not

join (or to pay dues to) a labor union, as a condition of employment. There are currently 26 U.S. states that have right to work laws protecting the rights of employees.

Land Availability and Costs

A company considering various global locations may also be considering building a new facility or buying an existing one. In either situation, the availability and cost of land could potentially be an issue, and must be a consideration in the location decision. Many popular areas around the globe have scarce land resources available and/or the land prices are extremely high. Companies have expanded their focus beyond the major cities to include some of the more suburban and rural areas where land may be more readily available and at a lower cost, while still being close enough to the urban areas where suppliers, customers, and service providers are located.



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Quality-of-Life Factors

A higher quality of life in the workplace and also in the surrounding environment leads to higher employee morale, satisfaction, and retention. Companies that establish facilities in various global locations will need people to work at these locations. Some of the workforce will likely be local, and some personnel may transfer from other locations either from inside or from outside the company. In all cases, the quality of life in each global location will be a factor in attracting and retaining skilled and unskilled workers to that location. Companies should therefore understand and evaluate the following quality of life factors in terms of maturity, sophistication, robustness, and so forth, in each location before making a location decision:



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1. Culture
2. Economy
3. Education
4. Government / Politics
5. Healthcare
6. Mobility
7. Natural Environment
8. Public Safety
9. Recreation
10. Social Environment

Taxes and Incentives

Taxes and governmental incentives are significant considerations when comparing potential global locations. From a tax perspective, multiple levels of government must be considered as there may be federal, state/region, and/or local community taxes, any or all of which could impact the business and influence the location decision. Import tariffs, which are designed to generate revenue and/or protect local businesses, may also be imposed in various countries. Countries with high tariffs encourage multinational corporations to produce locally, and discourage importing goods into the country.



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Countries may provide tax incentives (e.g., reductions or deferments) to attract businesses to locate operations within their borders. These incentives may also be tied to the volume of business done within the country, how many local labors are employed, whether materials are purchased from local suppliers or not, among others.

Trade Agreements

Regional trade agreements impact global location decisions. A location may be more favorably viewed if there is one or more trade agreements in place providing a financial incentive and a better business environment than another country location. The following are a few examples of regional trade agreements:

- European Union (EU):
 - [1950] Following WWII, consists of 27 members countries in Europe
- North American Free Trade Agreement (NAFTA):
 - [1994] Removed most barriers to trade and investment among United States, Canada, and Mexico
- Southern Common Market (MERCOSUR):
 - [1991] Argentina, Brazil, Paraguay, and Uruguay
- Association of Southeast Asian Nations (ASEAN):
 - [1967] 10 member countries in SE Asia
- Common Market of Eastern and Southern Africa (COMESA):
 - [1993] 19 member countries in East and South Africa



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WORLD TRADE ORGANIZATION

These regional trade agreements, and many more, are monitored by the World Trade Organization (WTO).

"The World Trade Organization (WTO) deals with the global rules of trade between nations. Its main goal is to ensure that trade flows as smoothly, predictably and as freely as possible."³ The WTO was established in 1995, and is headquartered in Geneva, Switzerland. There are currently 164 member countries (as of July 2016) that use the WTO to facilitate and resolve trade issues with each other.

WTO functions³ include:

- Administering WTO trade agreements
- Forum for trade negotiations
- Handling trade disputes
- Monitoring national trade policies
- Technical assistance and training for developing countries
- Cooperation with other international organizations

Utility Availability and Cost

The cost and availability of utilities such as water, electricity, natural gas, and telecommunications could be an important consideration for companies making location decisions. The availability of all utilities on a consistent basis, as well as the cost of those utilities, are critical considerations, particularly for companies producing or supplying heavy industrial products such as iron, coal, oil, ships, and machinery. In some parts of the world, the supply of various utilities is not reliable



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in general, and also not able to meet the demand of local business growth. This has been an issue particularly in emerging markets, where some of the lower cost labor and materials are centered.

GLOBAL LOCATION DECISIONS

Generally, when a company considers various global locations for its operations there is a hierarchy or step-wise approach to narrowing down the possibilities. Companies will first start by dividing the globe into regions, and then hone in on countries that align with the company's vision, mission, and business strategy. From there, the company can begin to look at specific areas within countries, and then finally down to specific communities or sites to evaluate.

Some of the decision factors outlined in this chapter are federally controlled or related to the country as a whole, such as competitiveness, currency stability, federal taxes and incentives, and trade agreements. Some of the decision factors are locally controlled or related to the local community or specific site selected, such as land availability and costs, and local taxes and incentives. The balance of the decision factors are related to, or influenced by, all levels (i.e., federal, regional, local) within the country.

Weighted-Factor Rating Model

One method of evaluating the potential global locations is the weighted-factor rating model, which compares the attractiveness of several locations against some or all of the location factors described in this chapter. The process involves:

- Identifying the factors to be considered/evaluated
- Assigning a weight to each factor:
 - The individual factor weights must sum to 1.
 - Equal weight can be applied to all factors, or different individual weights can be applied to factors, with some factors weighing more than others in the decision-making model. This determination is made by companies based on how they value each factor, and it is company specific.



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- Determining a score for each factor at each location
- Multiplying the factor score by the weight, and then calculating the sum of the weighted scores
- The location with the highest total weighted score is the recommended location.

INTERNATIONAL TRADE MANAGEMENT

Operating a Global Supply Chain

Operating your supply chain globally can present opportunities and challenges over operating domestically.

OPPORTUNITIES

- Increased customers and revenue. Global business means the opportunity to reach many more potential customers than are available within the domestic market alone.
- Increased sourcing options. Global business means more potential sources of supply from which to choose. These additional sources of supply can bring reduced costs, more alternatives, additional knowledge, and help spread out risk. Additional sourcing options may also lead to additional customers, by opening up previously closed markets.

CHALLENGES

- International trade frequently involves having to pay tariffs or duties (i.e., import taxes) when crossing international borders, and this will obviously increase costs.
- Transporting goods across borders will potentially add distance and time to the transportation activity, and it involves additional steps to clear customs which will also add time. Carriers specializing in international transportation may be needed, which likely means building relationships with new partners.
- Customs, business practices, and regulations vary by country, and are in a constant state of change. Many companies do not have the expertise to ensure compliance with all of the international trade laws, necessitating outsourcing this activity to a specialized third party.
- Not all foreign markets are homogeneous within the country, which can create additional layers of regional and local issues to overcome.

Managing International Trade Activities

Managing international trade activities is a complex process. A typical cross-border shipment involves:

- Accurately completing and filing about 35 documents
- Compliance with over 600 laws and 500 trade agreements, which are constantly changing
- Interfacing with about 25 parties, including customs, carriers, freight forwarders, other government agencies, etc.

Trade regulations and related content are at the heart of international trade management, but staying up-to-date is a major challenge because:

- The information changes frequently.
- It's often made available only in a foreign language.
- It's not always produced in an electronic form.

MAJOR U.S. INTERNATIONAL TRADE LEGISLATION

In the 70 years from 1930 to 2000 in the United States, there were seven major laws or acts created to regulate international trade. Most of these regulations were economic based:

1. Tariff Act of 1930 & Subsequent Regulations
2. Anti-Smuggling Act of 1935
3. Public Law 95-410
4. Trade & Tariff Act of 1984
5. Title VI of the NAFTA – “Mod Act” and Subsequent Regulations
6. CAT Audits – Compliance Assessment Team Audit
7. FDA/USDA – Presidential initiatives for safety of imported goods.