

## Chapter 15

### Warehousing/Distribution Management

Chapter 2 set the foundation for detailed discussion of the supply chain functions of Logistics, Warehousing, and Distribution Center Management. Each of these critical functions are important to the success of any supply chain and any operations management chain.

The 14th edition of the APICS Dictionary defines distribution as: “The activities associated with the movement of material, usually finished goods or service parts, from the manufacturer to the customer. These activities encompass the functions of transportation, warehousing, inventory control, material handling, order administration, site and location analysis, industrial packaging, data processing, and the communications network necessary for effective management.”<sup>82</sup>

According to the Warehousing Education and Research Council’s (WERC) WERCipedia (WERC’s online dictionary) a warehouse is a “Place for receiving, storing and shipping material and merchandise and making changes to their packaging or configuration.”<sup>83</sup> A Distribution Center is defined as: “a building, structure or group of units used to store goods and merchandise that are to be delivered to various places on an as-needed basis.”<sup>84</sup>

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<sup>82</sup> “Distribution,” APICS Dictionary, 14th edition, APICS, Chicago, IL, 2013, p. 40.

<sup>83</sup> “Warehouse,” WERCipedia, Warehousing Education and Research Council, [www.werc.org](http://www.werc.org), accessed, August 30, 2010.

<sup>84</sup> “Distribution Center,” <http://www.wisegeek.com/what-is-a-distribution-center.htm>, accessed April 21, 2010.

WERC also provides a definition of logistics as: “Logistics plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers" requirements.”<sup>85</sup> Logistics is the historical term for what most companies call distribution today—getting products or people from one location to another. Distribution Centers and Warehouses are part of this logistics network.

Warehouse and Distribution Center are commonly used interchangeably. This is erroneous. Although both facilities have the same basic functions as we will discuss in this chapter, a Distribution Center focuses on getting products in and out quickly, whereas a Warehouse may store products for an extended period of time. For this reason, when we discuss inventory turns later in the inventory management chapter, remember that because of the length of storage, a Distribution Center should have much higher inventory turns numbers than a Warehouse. The changing face of supply chain management and the increase in smaller/individual orders and the processing of returns have also had an impact on the size and layout of Distribution Centers.

### **Warehousing**

The introduction to the US Navy’s publication on warehousing design lays out the reason for warehousing and distribution channels. “Because of the pattern of logistics management and the technical nature of many supply functions, consolidation of operations on the basis of material handling configuration is inhibited. Although a carton of wrenches,


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<sup>85</sup> “Logistics,” WERCipedia, Warehousing Education and Research Council, [www.werc.org](http://www.werc.org), accessed August 30, 2010.

hammers, or pliers might have the same handling characteristics as a unit of avionics or a pilot's crash helmet, these items generally flow through different distribution paths in their paths in their movement between the supplier and the ultimate user.”<sup>86</sup>




Because of the differences between the various forms of materials and goods moving through the supply chain, warehouses are a necessary part of the supply chain. Warehouses exist to provide storage of the items moving through the supply chain and provide this storage at a location that is in close proximity to the customer. In general, the design of a general supply warehouse must be based on the characteristics of the material being handled and stored (shape, environment, stackability, etc.), the volume and flow pattern through the facility (transaction and cube movement rate profile), and the inventory pattern (item count, item cube, quantity mix, and inventory turnover patterns).


### **Types of warehouses**

 **Cold Storage.** Cold storage warehouses are used for the storage of food items that require temperature-controlled storage. Cold storage warehouses can be a standalone facility that is capable of storing either climate-controlled storage (i.e., fresh fruits, meats, or vegetables) or frozen storage. One of the critical considerations for operating a Cold Storage Facility is the compatibility of the material handling equipment used with the items being stored and the lower temperatures associated with cold storage facilities. A cold storage facility may be collocated with a Dry Food Storage facility.

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<sup>86</sup> Warehouse Modernization and Layout Planning Guide, Department of the Navy, Naval Supply Systems Command, NAVSUP Publication 590, March, 1985, p. 1-1.

-  **Dry Food Storage Warehouse.** A Dry Food Storage Warehouse stores staple items such as canned goods and other food items that do not require a “cold” temperature for long term storage. Just as there are considerations for the equipment to facilitate the operation of a cold storage facility, the equipment used to move dry storage food items require compatibility with the food items being stored. For example, electric or propane forklifts are better for a dry food facility than gas-powered forklifts.
  
-  **General Supplies Warehouse.** A General Supplies Warehouse is a facility that can handle almost any type of supply or material. The limit to what can be stored in a General Supply Warehouse is the square footage of the facility, the material handling equipment available, the size of the materials being stored, and the compatibility of the items being stored.
  
-  **Warehouse in a Warehouse.** A “warehouse in a warehouse” is a concept for organizing warehouses to be more efficient. This concept involves organizing the products being stored in a facility. A typical Menard’s store is a good example of a warehouse in a warehouse. A Menard’s store is organized to place like items in zones or “warehouses” within the overall warehouse. Look at the paint department or the flooring department. Each of these departments is a mini warehouse in the Menard’s Warehouse. Think about the lawn and garden section in your local Menard’s or Home Depot. The lawn and garden section is like a warehouse in a warehouse. In a repair parts warehouse, items may be stored together by vehicle type or vehicle model to enable ease of finding the right product.

 **Climate Controlled Facility.** This type of facility differs from a Cold Storage Facility in that it is not designed or certified to store food items. In the Kansas City, Missouri area, there are a number of caves used for climate-controlled storage of items as diverse as old Hollywood movie props to old vintage films and film canisters. The purpose of this type of facility is to provide protection for the items in the warehouse that may deteriorate if stored at “room temperature” or in changing climatic conditions.

- These caves are the brainchild of Kansas City Chiefs founder Lamar Hunt. The caves maintain the same temperature year-round. It is this year-round temperature that makes the underground storage a popular location for long term storage.
- One of the newer additions to public storage facilities is climate controlled storage units to provide individuals with a way of storing household goods in a controlled environment.

 **Other miscellaneous warehouses and distribution facilities:**

- **Local warehouse**—the purpose of a local warehouse is to provision the stocks and materials closer to the customer thus reducing the transit time for resupply of retailers or shorter transit time to the customer.
- **Fulfillment center**—a fulfillment center is designed to receive/pick/pack/ship smaller orders. A fulfillment center may be part of a larger Distribution Center or may be a standalone operation.
- **Value added/service center**—the purpose of a value-added services center is to provide services not normally associated with the warehouse or distribution center.

These services may be the type discussed in Chapter 5 as part of the distribution center. The value-added center may be collocated with the distribution center or warehouse in order to provide overnight shipping coordination. In this case, the shipping company such as UPS or FEDEX may collocate in the shipping area of the facility to speed the shipment of overnight deliveries or parcel shipping.

## **Warehousing History**

Warehousing is one of the oldest professions known to man. Once early man discovered fire, it became a mission to “store” the fire to keep it burning. Hunters throughout history have stored meat during the winter to ensure food throughout the winter season.

In Biblical times, Joseph, after being sold into slavery by his brothers, made history in Egypt running the grain warehouses for the Pharaoh. This led to the migration of the Israelites to Egypt during the famines and the eventual exodus of the Israelites from Egypt. The mass migration led to eventual problems that seem to be continuing today between Egypt and Israel.

Alexander the Great learned the importance of warehousing to supply his Macedonian Army as the army moved across the Asian Continent. He also learned the expense of warehousing and was one of the first operations leaders to decide that warehousing was not a core competency of his army and “outsourced” his warehousing by foraging from the local countryside to support his army.

Venice, Italy became the crossroads and warehouse location for all of the East-West trade. The growth of trade between the silk road and Europe created a need for

storage along the trade route. The warehousing industry helped to support the goods coming to and going to China and the rest of Europe.

In the United States, the military outposts west of the Mississippi served as warehouses of supplies, ammunition, and other goods to support the movement of settlers and civilization across the country. A study of the expansion of the United States is not complete without considering the purpose of these storage outposts and the contribution of these warehouse outposts to the success of the country's expansion. A quick look at Kansas shows Fort Leavenworth, Fort Riley, Fort Hays, Fort Dodge, and Fort Scott.

The forklift first appeared in the 1940s and changed the face of warehousing and distribution forever. Prior to the arrival of the forklift, all materials in warehouses were hand loaded and unloaded.

### **Warehousing/Distribution Challenges**

- **Proliferation of Stock Keeping Units (SKUs).** According to AMR Research released in early 2010, the number of SKUs in the commercial supply chains has increased by 15% over the past three years. Each of these items must pass through a warehouse or distribution center enroute to the ultimate customer. This is akin to the Apple Effect – the more new phones Apple introduces, the more new accessories there are and the distribution center has more items to stock.
- **Instant Customer Service Requirements.** As a result of the ability to order on the Internet, more direct to customer shipments are occurring each day from warehouses and distribution centers. This has several impacts on the facilities. The first is that the distribution center that used to have pallet storage, case storage, and bulk storage areas in the facility now have to also have an individual item picking and storage area in the

facility. This also impacts packing and shipping requirements and in many facility creates the need for a cross-docking area.<sup>87</sup>

- **Pressures to make inventories smaller yet more responsive.** Financial pressures to lower inventory levels puts pressure on the warehouse manager/distribution center manager. The typical act is to cut inventory levels across the board. The problem with this approach is that reducing inventory levels for nonproductive inventory or inactive inventory will not produce cost savings. The typical method for reducing the stockage levels is to reduce the level through attrition of the product and not replenishing to the previous levels. However, if the inventory is not moving, the opportunity to reduce the stocks through attrition is not available. The result from this technique is usually frustration and no visible improvements in the inventory values. The move to smaller inventories may be relooked by many companies after the panic buying of 2020 and the coronavirus pandemic. Perhaps some just in case inventory really is needed.

The more productive technique to improve the responsiveness of the inventory while reducing the inventory value is to do an analysis of the inventory activity. If an item is no longer moving, it may be time to completely eliminate the product from the stocks. Then after the nonproductive inventory is removed, the active stocks can be

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<sup>87</sup> Cross Docking according to the APICS Operations Management Body of Knowledge is “a distribution technique in which items are brought into a distribution center for immediate dispatch. Instead of being received and stored away, these items are loaded into the distribution center’s sorting system or are taken directly to shipping for sorting and dispatch.” *APICS Operations Body of Knowledge*, 2010, p. 22.



reduced to improve the inventory turns and responsiveness to the needs of the customers.<sup>88</sup>

- **Pull Philosophy.** The pull philosophy is an outgrowth of Just-in-Time. The details of Just-in-Time and the pull philosophy or pull methodology are discussed in Chapter 11. The fundamentals of pull state that an item will not be moved or shipped until someone has ordered or requested the item. The impact on the warehouse or distribution center is that the product has to be on hand in order to be available when the customer asks for it. This concept is counter to the previously discussed pressure to reduce inventory levels.
- **Smaller transactions.** This has already been discussed in other areas. The number of smaller transactions requires more space in the facility to handle the individual item picking and packing. This also requires additional personnel in the facility.
- **Value added services.** We have already discussed the use of value-added services in the distribution centers. The pressure to add these services impacts the space utilization in the facility and the number of personnel required to add these services to the offerings of the facility to improve customer satisfaction. When Polo added embroidery services, they had to carve out space from the existing distribution center rather than add on to the facility.

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<sup>88</sup> One particular distribution center called their inactive stocks as “dormant” stocks to avoid calling the stock nonproductive. This particular facility had over \$63 billion dollars in “dormant” stocks. Their definition of dormant was no orders for the item in the past two years and no replenishment actions in the past year.

- **English as a second language.** The biggest complaint in the distribution business today is that the number of workers that do not speak English or speak English as a second language. This is primarily because there are certain jobs that some Americans will not do anymore. Driving a forklift eight hours a day fits into this category.

However, this is not a new complaint. In 1945, the biggest complaint in the warehousing industry was that the workers did not speak English. This was a result of so many men deployed to Europe or the Pacific Theater to fight in World War II. This problem is not going to go away. The solution is that management has to learn another language. One facility that I worked with in Southern California had a predominant number of Spanish speaking workers and very few Spanish speaking managers. This facility complained that productivity was not good and even bragged about being “the worst distribution center in the country.” Their issue was a language problem. Only one manager spoke Spanish and only a few of the workers spoke English. The answer was to enroll managers in Spanish classes and workers in English as a Second Language classes.

- **Complicated WMS and proliferation of systems.** Every week a new advertisement hits my e-mail box about a new Warehouse Management System or new/updated Enterprise Resource Planning program. Not only do these systems continue to expand and change, but they continue to become more and more complicated. These systems require additional training and systems analysts to keep the chains strong.
- **Integration of online and bricks and mortar operations.** Traditional operations were always bricks and mortar operations. The traditional stores had a traditional way of doing business. These stores received shipments from the distribution center or warehouse and sold the products to customers in the bricks and mortar stores. With the advent of the

Internet, stores had to change their strategies and were forced to incorporate sales through the Internet to customers that may never walk through the door of the bricks and mortar store. This change in customer support strategy also impacted the way items were stored in distribution centers and warehouses.

The purchase of Whole Foods by Amazon caused a reverse of this. Amazon had to learn how to apply their years of online experience and apply it to a brick and mortar operation.

- **Smaller orders.** The trickledown effect from the change in customer support requirements was the realization that customers ordering over the Internet were ordering smaller quantities of products. These smaller quantities required new picking techniques and new picking areas to support individual item orders vice rather than the traditional case lot or pallet load shipments from the warehouse or distribution center to the stores.
- **Returns.** In Chapter 17 we will discuss the returns and reverse logistics problems and processes in great detail. The reverse logistics problem is nothing new but the increase in the number of items coming backward from the intended customer has created a whole new industry. In addition, the increase in returns and the focus on returns as a way to capture costs from the system has created a requirement for distribution centers and warehouses to have an area for returns processing and the need to store the returned products until the products are back on a store shelf or disposed of properly.
- **The appearance of 3PL providers.** A 3PL provider is a third-party logistics support provider. Once companies realized that doing logistics and distribution was not a core competency, 3PL companies started appearing around the world. These companies

provide the services, warehousing, logistics, and transportation that have been outsourced by companies. There are now over 1,400 companies in the United States alone that perform these functions as a core competency that other companies have determined are not core competencies but are still critical to the success of the company.

## **Warehousing Management**

Warehousing focuses on the storage of products whereas distribution centers focus on the short-term storage and rapid movement of products through the distribution center and out to the customer. Warehouses are concerned about storage times and holding times while distribution centers are concerned about throughput rates. The throughput is the amount of products flowing in the receiving door and out the shipping door. The use of cross-docking helps to improve throughput rates. Cross-docking is a methodology for managing the flow of products by managing the inbound products and synching these products with the outbound flow of products. This method increases the throughput through the facility because the items being cross-docked never go into a storage facility. These products come in one day and are out of the facility within 48 hours or less. Most major distribution centers have created a cross-docking area to hold products until the products are loaded on an outbound truck. This concept not only increases throughput and reduces inventory investment levels, it also increases the speed of the product to the customer.

### **Warehousing/Distribution Center Functions**

- **Receive:** This is the function of unloading the inbound freight. The accuracy of the performance of this function sets the stage for the success of the overall operations. If the receiving function is not properly performed, the product and product quantities will not

match what should be on the shelves and the ability to properly support the customer will be impacted.

- **Putaway:** Once the products have been received at the warehouse or distribution center, they have to be put on a shelf if the products are going into storage locations or moved to the cross-docking area if the products are identified for cross-docking. The importance of accurate and proper putaway is critical to the overall success of the facility. If the items coming into the facility are properly identified at the receiving docks and put in the proper location then the right item will be in the right location in the right quantity when a customer orders that item.

Putaway also involves housekeeping in the facility. When items are placed on the shelves or in a storage location, the items must be placed neatly in the location. This helps to make sure the warehouse/distribution center worker can properly identify the items when performing the picking function discussed below.

- **Store:** This function is relatively self-explanatory. This is the warehouse/distribution center function of keeping items on the shelf or in the facility. This is the focus of warehouses.
- **Pre-packaging – kitting:** This function of distribution centers is the concept of putting items of like use together to create a “kit” that can be shipped as one item. A prepackaged oil change kit is an example of this. The distribution center may kit the oil, filter, and filter wrench into one kit with a new stock number that will be sold as one item rather than three separate items. Some repair parts facilities not only kit the items together but

by storing items by vehicle type in the distribution center create a warehouse in a warehouse similar to the concept discussed earlier.

- **Order entry:** Order entry may be automated and linked to the warehouse management system or could be a manual entry “fat-fingered” in by someone in the warehouse or distribution center. This is another critical function to the success of customer service operations. If the wrong stock number or SKU is entered into the system, the wrong item will be picked by the warehouse/distribution center worker and if an audit of the shipment does not catch this error, the customer will get the wrong product or the wrong quantity of the right product.
- **Picking:** This is the physical function of getting the items off the shelf and ready for shipping. Picking may be accomplished by sending workers to various zones or sections of the warehouse/distribution center and then consolidating the items into one shipment or the picking may be accomplished as an order where one worker travels through the facility picking all the items for the order before moving to another order.

Picking may be done from a printed pick list with SKUs, storage locations, and quantities. Picking may be accomplished with a manual pick list. More modern distribution centers are using either “pick to light” where the worker stops at the next location with a light and either uses an accompanying pick list or the location will have an LED with the number to be picked; or the picking may be performed using voice picking which is relatively new compared to the other picking techniques.

With voice picking the worker has a headset linked to the warehouse management system that directs the worker to the next location and tells the worker how

many to pick from that location. Before the voice picking system will allow the worker to move to another location, the worker must confirm the location and the quantity picked. This system frees up both hands to pick the items and move the tote or cart to the next location and is a more accurate system for picking items in the facility.

The more accurate the picking process runs, the more accurate the items and quantities in the shipment to the customer will be and the more satisfied the customer will be. This has two benefits. The first benefit is that the customer will most likely buy again if satisfied and the second benefit is that the proper shipments help reduce returns thereby saving money for the company.

- **Packing—including checking for completeness; labeling; weighing; loading:** This is the function of preparing the items for safe shipping. If the items are properly packed, they should arrive undamaged when delivered to the customer. Packing the item is more than just putting it in a box or envelop. The packing department has to know what size package to use, if additional packaging is needed to protect the item. Packing also includes ensuring the address is correct, that the item is properly labeled, weighed, and prepared for loading to the outbound movement. The checks of the packing department help to ensure that the packages are delivered to the right customer.

An example of the checks at the packing department comes from a distribution center in Kentucky that was experiencing a large number of discrepant shipments. The packing department was not checking the accuracy of Zip Codes and Addresses. For example, shipments to Missouri had Zip Codes for Massachusetts. The result was delays in shipping to the customer and a decrease in customer satisfaction. A simple matching of

addresses and Zip Codes in the packing department significantly reduced the number of delayed shipments.

- **Shipping:** This is the last function under the control of the distribution center or warehouse. Accurate shipping is critical to customer satisfaction. As discussed earlier, some of the shipments via FedEx and UPS may be managed by the shipping company at the distribution center to facilitate accuracy and speed. Some shipping companies will actually plan the shipping manifest and loading to facilitate more efficient shipping from distribution centers to customers or transshipment sites.

All of these functions feed:

- **Perfect order fulfillment.** Perfect order fulfillment is a metric of distribution center effectiveness and efficiency, as part of the overall supply chain. Perfect order fulfillment is a measure of how well you are meeting the needs of the customer. This metric looks at the ability of getting the right item to the right place, at the right time, in the right quantity, in the proper condition, and with the proper billing. The calculation for perfect order fulfillment is shown in Equation 15-1.



**Right Item % x Right Quantity % x Right Place % x  
Right Condition % x On Time Delivery % x  
Correct Billing %**

**Example:**

**Right Item % = 99%**

**Right Quantity % = 99%**

**Right Place % = 99%**

**Right Condition = 100%**

**On Time Delivery % = 99%**

**Correct Billing/Invoicing % = 99%**

**Perfect Order Fulfillment = .99 x .99 x .99 x 1.00 x  
.99 x .99 = 95.09%**

**Equation 15-1: Perfect Order Fulfillment**

- **Carrying costs.** As we had seen when we discussed inventory management and the Economic Order Quantity in Chapter 11, the carrying costs for a distribution center's inventory includes the opportunity cost of the money used for the inventory, the insurance for the inventory, the overhead allocated to the inventory items, the cost of the labor to count, pick, pack and ship the items, and the costs of loss or obsolescence. A

properly managed distribution center or warehouse will have lower than the industry average for carrying costs.

- **Loss.** This could be loss of inventory as a result of mis-shipment, theft inside the supply chain, or employee theft. The distribution center management must be involved in the security of the inventory to prevent pilferage by the employees and theft from outside the distribution center. The distribution center management must also be engaged and constantly monitoring the housekeeping of the center. Proper housekeeping will prevent the internal mis-shipment and items placed in the wrong locations that give the illusion of losses.
- **Damage.** Damage in the warehouse or distribution center is inevitable. When things are moved or sit for long periods of time as they do in warehouses, things get damaged. The goal of the distribution center management or the warehouse management team is to minimize this damage. Some of the damage can be eliminated by changing the metrics for productivity in the facility. In one facility that I had the opportunity to do some work with, this was the case. The metric for productivity in most facilities is items or orders picked per hour—a measure of how many different items are taken off the shelf to prepare for shipment to the customers each hour. In this particular facility, no attention was given to the condition of the items or the techniques used to pick the items. What was happening in this facility was that the workers had “cracked the code” for productivity. They realized that the key to higher productivity was not to take the time to take the items off the top pallet in a stack of three high but to simply pull a can or two out of the middle pallet. This saved time and improved their items per hour metric. However, what it created was a lot of pallet stacks that were leaning like the Tower of Pisa by the

end of the day. The other result was that cans in the middle pallet were bent and damaged from the shift in weight placed on them. This problem was preventable with management oversight and training.

- **Mis-shipment.** This is the problem of items going to the wrong customer. This problem is fixable and preventable with proper supervision and training. I am not an advocate of 100% inspection of every shipment to prevent this, but regular spot check sampling and proper training coupled with good housekeeping in the facility helps to ensure that the right product goes to the right customer.
- **Frustrated Cargo.** This is really a misnomer. The cargo is not frustrated. The one that is frustrated is the warehouse manager. Frustrated cargo is a distribution term that describes cargo or shipments that are either not deliverable or the customer cannot be located. Frustrated cargo can be a huge problem for distribution centers and warehouses. Frustrated cargo represents materials that have been prepped for shipment, represents money tied up in products that are not available to other customers, and may end up as “lost” products. In one distribution center a couple of years ago there was a pallet of frustrated cargo that sat in the same place for so long that it became invisible to the workers and became lost even though every worker had to pass the pallet almost every day and some of them multiple times a day.

In Kuwait in 2003, we had an area we called the miscellaneous line. The miscellaneous line was two pallet positions wide and about one hundred yards long. These pallets were technically frustrated cargo, but we renamed it miscellaneous cargo. The miscellaneous cargo was cargo that the customer unit could not be identified because

of the loss of shipping labels or unknown customers such as the Defense Intelligence Agency and the Embassy.

Frustrated cargo is not necessarily an indicator of poor facility management. But the handling of the frustrated cargo may be an indicator of poor management. A good facility manager will dedicate resources to research the frustrated cargo and the causes of the frustrated cargo in order to better serve the customers.

### **Factors Influencing Distribution Operations**

Time is critical in today's distribution operations. The most successful distribution and warehousing operations are those that focus on reducing every aspect of the distribution operations. This is accomplished by walking the process and identifying areas that can be improved and getting rid of the non-value-adding, time-consuming processes that are impacting customer responsiveness of the facility.

Just as time is critical to the customers of the distribution systems, quality is also important to the customers. This is not just the quality of the product; it is also the quality of the distribution system from the suppliers' suppliers to the customers' customers. This includes error-free delivery. If you buy a new washer and dryer from a store, you expect the delivered products to match what you picked out in the store. If the delivery workers drop the dryer off the back of the truck the quality of the system is jeopardized. If a company outsources the delivery this should not change the expectations for quality in the distribution system.

The workforce mix is a challenge as distribution systems continue to try to provide quality support to their customers. This workforce mix is a combination of cultures and generations. The challenge for leaders of distribution centers is to get the most out of their employees. The challenge is to first understand what motivates each individual employee and to

understand the language and culture of the employees. The leader must motivate the workers to want to provide quality support to the customers. Without an understanding of the language and/or the background or culture of an employee, a leader cannot motivate the worker.

Safety is another aspect that impacts operations in the Warehouse or Distribution Center. The Occupational Safety and Health Administration (OSHA) provides very strict safety guidelines for facilities in the United States. These guidelines sometimes appear to be handcuffing the management of the facility to improve operations but are provided to prevent worker injuries. In the Warehouse forklifts pose a great threat to safety if these OSHA guidelines are not adhered to. Here is an example of an unsafe practice in a facility outside the United States. Figure 15.1 is an example of unsafe facility practices.



**Figure 35.1: Unsafe Pallet Storage in Panama**

### **Types of Facilities— Private versus Public**

Most facilities fall into either categorization of a Private Warehouse/Distribution Center or a Public facility.

**Private.** A Private Warehouse/Distribution Center is wholly owned or wholly leased by one company and stores only the products of that one company. This form of storage provides control to the owner or lessee of the facility. This control comes in the form of what products are stored and control of the management of the facility. If the facility is occupied by the owner, there may be tax advantages for owning the facility and the possible advantage of an increase in value for the facility and the land that it sits on. The downside of private facilities is the fixed costs and overhead for owning the facility. There is also an assumption that there will be enough sales and stocks to make the ownership of the facility profitable. At the same time, there is an intangible benefit of having your own facility.

**Public.** A Public Warehouse/Distribution Center can store products for multiple companies in the same facility. The advantage for the companies using this facility is that they do not have to own the facility to use it and only pay for the area that is used. This may be to meet peak requirements or abnormal demand requirements. Another advantage of using a public facility is the ability to store products in a facility operated by a company whose core competency is running a distribution facility. Because the company running the public facility has this as a core competency the exact costs of the storage and distribution operation will be known by the companies using the facility.

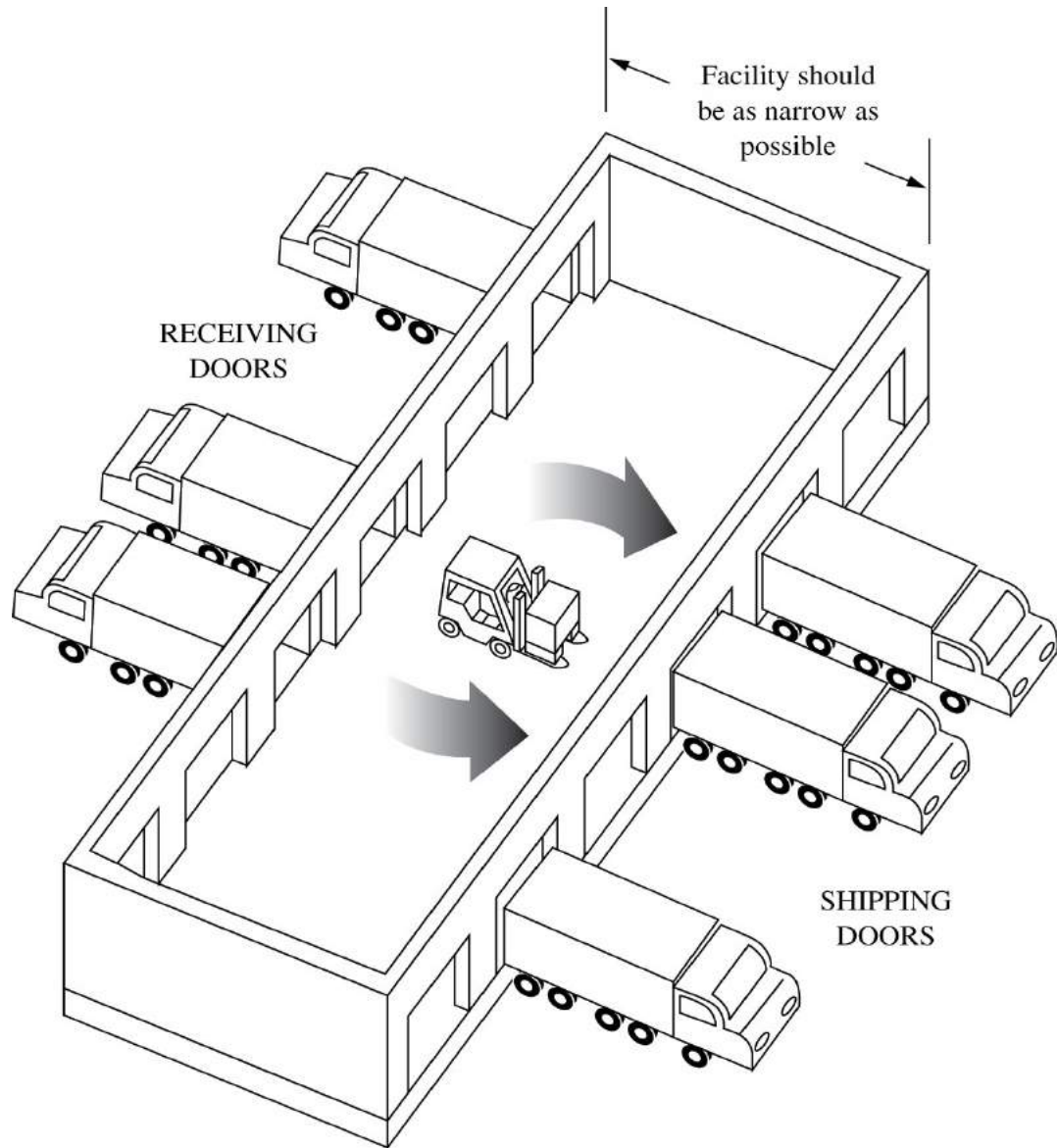
One downside of the public facility is that the needed space may not be available for peak periods when the space is needed. Another potential downside is that if a company has a

specialized storage requirement the expertise may not be available in a public facility that would be available in a privately owned facility. One more major drawback of the public facility is the compatibility of warehouse management systems. Not all warehouse management systems are the same and may require either manual intervention or middle ware to translate information from a company's system to the public facility's automated systems.

### **Warehouse/Distribution Center Layout and Design**

The design of the facility will enhance the profitability of the warehouse or distribution center. The primary goals of the distribution center or warehouse design is the maximization of space utilization (both square footage and cube footage) while minimizing the movement of products in the facility. These goals may be accomplished by using cross-docking or by analyzing the velocity of the products. The other goals discussed in the discussion of facility layout and design also are applicable for warehouse and distribution centers.

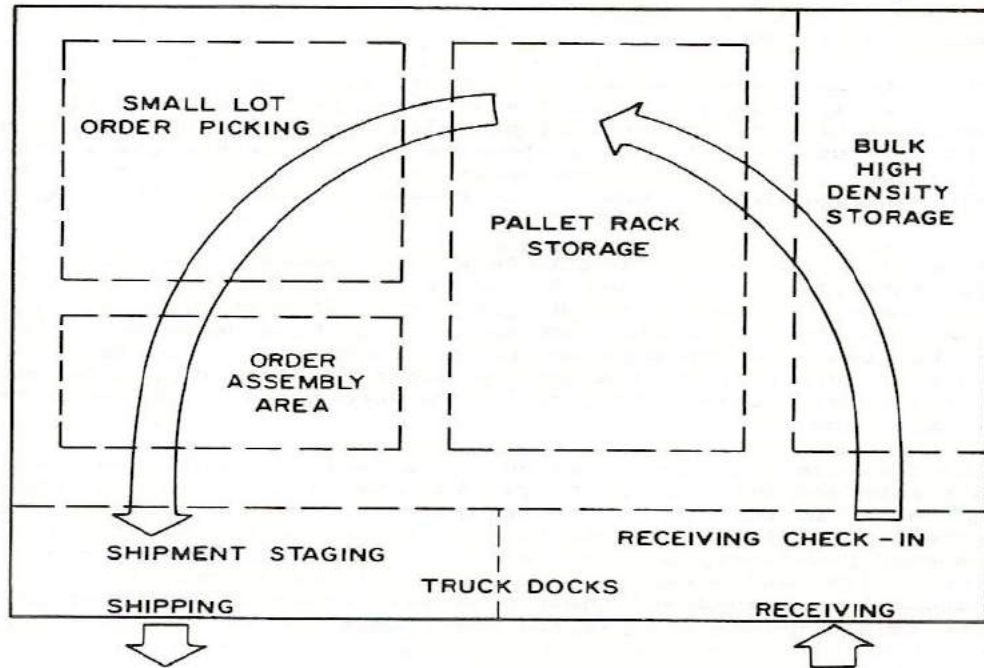
Figure 15.2 shows a layout option for consolidating shipments at a transshipment facility to produce full truckloads to customers. This diagram from the US Navy Supply Publication 590 shows the flow of products in a transshipment distribution center.



**Figure 15.2: Ideal Facility for Pure Supplier Consolidation (Full Pallet Movement)**

Figure 15.3 shows a typical flow pattern for distribution centers. This flow shows a logical flow of products through a facility to minimize movement and maximize space utilization in the facility.





## TYPICAL CYCLIC FLOW PATTERN

**Figure 15.3: Logical Flow Pattern in a Distribution Center**

### Cross-Docking

As discussed in previous chapters, cross docking is a methodology to reduce inventory value (thus increasing turns) while decreasing the time that the product is in the distribution center (also impacting turns). Cross-docking is nothing new. It is a methodology of knowing what is coming in and synchronizing the inbound shipments with the outbound shipments. For example, in Figure 15.3 the product would go from the receiving area to a holding area to the

shipping area. The goal of cross-docking is to have the product in and out of the facility in less than 48 hours. This is not that different from the operations of the Pony Express that ran from St. Joseph, Missouri to points west. The packages came in and went out in the same day. Wal-Mart executives have claimed that they invented cross-docking. They did not invent it but Wal-Mart has worked hard to perfect cross-docking. Cross-docking is not easy to accomplish but once implemented can reduce costs and improve distribution metrics to include inventory turns and customer responsiveness.

Cross-docking success depends on several key factors. The primary factor is world class communications. Communications is necessary to ensure that the facility knows what is coming in so the outbound shipments can be planned. Communications is also critical to achieve synchronization between the facility's inbound and outbound transportation partners. This synchronization is also a product of good transportation planning and reliable forecasts of product demands.

### **Attributes of World Class Warehouses and Distribution Centers**

- **100% Inventory Accuracy.** This is a must. A facility has to have 100% accuracy in their inventory counts and inventory accountability. Proper storage techniques, proper employee training, and good housekeeping will contribute to this metric. Anything less than 100% is not acceptable. This means that something is not being done right in the facility and the automated system does not match the physical count of the products. Anything less than 100% means lost profits and lost time researching why the inventory levels do not match the automated books.
- **Perfect Order Fulfillment.** Although we have already discussed this in detail, it is important to mention it again as a measure of world class warehousing/distribution.

Customers have access to inventory and shipment data online and expect delivery when promised.

- **Value added services.** Although there is no metric for this attribute, providing these value-added services or postponement services is important to attract and keep customers who have a choice of service providers.
- **Cleanliness.** There is no metric for this attribute either; however, the cleanliness and housekeeping of the facility will contribute to the perfect order fulfillment, inventory accuracy, and on-time deliveries by being able to find the right product when needed.
- **Time Definite Delivery.** This attribute is tied to transportation planning and synchronization. Time Definite Delivery tells the customer exactly when the vehicle will be at their facility. The opposite of Time Definite Delivery (TDD) is the cable companies that tell you they will be there sometime between 8:00 and 12:00 forcing the customer to sit around and wait. With TDD, the customer can plan his/her workforce around the time that the truck will arrive in order to quickly off load the vehicle.
- **On-time deliveries.** This attribute is related to TDD. This metric is measured from the perspective of the customer. How often does the shipment arrive when promised? One company was allowing their contracted trucking company to measure this for them. Amazingly, every month the company was very close to perfection. But when measured by polling customers, the on-time delivery percentage was much lower. To be world class a company has to be as close to 100% on-time delivery as possible.
- **Employee Education Programs.** The Toyota North American Parts Distribution Center has a requirement for over 80 hours a year in mandatory training programs for every

employee. Keeping employees up to date on new technologies or old methods for standardization is important to get distribution centers or warehouses to world class or to maintain world class levels of performance.

- **Safety.** This is important for any operation but for warehouses and distribution centers this must be considered and enforced. No matter how good a distribution center thinks they are, a safety problem will negate any other activity.
- **Obsolete Stocks.** A well-run facility will have the right items on the shelves in the right quantities to support their customers. The amount of stocks that are obsolete drive up costs and reduce the value of the inventory. In addition, if stocks become obsolete these stocks must be disposed of. This adds more costs to the operation.
- **Turns.** Inventory turns is a measure of how fast the inventory on the shelves is replenished. As mentioned earlier, this is a very misunderstood metric. Not because of the calculation of Cost of Goods Sold divided by the Average Value of the Inventory, but because of the interpretation that what is good for one facility is the right number for another facility. To compare turns the benchmarking must be between like facilities or industries. There is no one size turns metric.
- **Processing Times.** A world class facility is measuring their processing times in minutes. How many minutes does it take to clear the floor, pick an order or load a truck?
- **Cross-Docking.** A world class facility employs the concept of cross-docking discussed earlier. This not only improves inventory turns but reduces the average processing times by not having to place the items that are cross-docked on the shelves and later having to pick these items.

## **Summary**

Distribution Centers and Warehouses are different in nature in that warehouses focus on longer storage times. However, the metrics and tools to improve facility operations are similar. The goal of every facility manager is to ensure that his/her facility is not the weakest link in the supply chain.

### **Discussion/Review Questions**

1. Why is perfect order fulfillment so critical to successful operations?
2. What are the attributes of world class distribution systems?
3. Why is cross-docking important to reducing customer response times?
4. A company has calculated their inventory turns at 12. Is this good or bad? Explain your answer.
5. A company has calculated their Cost of Goods Sold at \$25,000,000 and their Average Inventory as \$12,500,000. What is their inventory turns rate? Is this good or bad?
6. A company has 14 inventory turns a year. The average turns calculation for their industry is 28. What should the company do to improve their turns?
7. Why is a flow important to the success of a facility?
8. What is Time Definite Delivery? Why is it important from the customer perspective?
9. From what perspective should on-time delivery be measured?
10. Think about the historical development of logistics, why is it necessary to understand the history of logistics and warehousing?
11. What is the difference between a public and a private facility?
12. How do warehouses and distribution centers differ?
13. What is the advantage of a fulfillment center?