# Warehousing

Warehousing was a customer’s function conventionally anywhere in the world. Customer to protect himself from shortages at the time of inclement weather always used to store provisions and other utilities in his house. Consumer’s own stores were underground cellars, smoke houses to store variety of items. Poor communication infrastructure was mainly the cause for this storage by customer. Producers and tradesmen conveniently shrugged off their responsibility for storage and passed it on to the customer who was left with no option.

Traditional concept of warehouse as store or godown has undergone major change now. Warehouse is considered a value adding facility now, playing a remarkable role as a function of logistical management.

As the times changed, manufacturer started applying modern scientific management techniques to improve productivity in his factories. Manufacturer visualized the need of a buffer between factory and market, now the warehouse became storehouse to stock production. This role of the warehouse supported production.

The store did not receive any engineering attention to handling and storage activities. All activities were manual as the labor was cheap. Items getting lost, damage in handling and accidents were rampant in those warehouses. Storing as much as possible was the main function of warehouses.

Post war thinking made inventory shrink and production became streamlined to demand

as the market started changing and retailers encountered a new breed of customers. Warehouse now became a support for marketing rather than for production as was the case earlier. Demand for variety in every product increased and retailers experienced the need for a facility to hold the stock and provide the product mix demanded by the market.

Production units started using the concept of warehouse as a facility to optimize production [minimize cost].

 Decades of 1960 & 70 saw engineering focus on material handling, storage & information.

 Concept of JIT production system needs dependable delivery system of which warehouses are by now an integral part.

 As we have discussed earlier, decade of 1980 was a decade of TQM which put the focus on improvement of all activities carried out in an organization. Now the attention traveled to warehouses.

**Concept of strategic storage:** We have discussed earlier that warehouse is not a store but a facility that yields economic and service benefits. But we cannot forget that storage also can be a value adding activity under special situations like stock piling and spot stocking.

**Warehouse Costs:** cost of handling and holding the materials in warehouse and costs of Order Processing, Inventory, and Lot Quantity are components of warehouse costs.

**Functions of warehouse [warehousing operations]** …[physical distribution management: logistical approach by K.K.Khanna – page # 57]

1. Receiving goods – receive and accept responsibility
2. Identifying goods – place, label, color code
3. Sorting goods- sort out the received goods for appropriate storage area
4. Dispatching goods to storage- for temporary storage with easy accessibility
5. Holding goods- security against pilferage and deterioration
6. Selecting, retrieving, packing- items are retrieved and grouped according to customer order for dispatch
7. Marshaling goods- check the items of a single order for completeness and order records are updated
8. Dispatching goods- consolidated order is packaged and directed to right transport
9. Preparing records and advices- of stocks and replenishment requirements

Economic and service benefits of Warehouses

**Economic benefits:**

Movement Consolidation: Reduction in transportation cost by consolidating movement. Several plants supply their products for the same customer to a warehouse and from this warehouse the products are sent in bulk shipment to the customer.

Plant A

 [Product A for

Customer X]

**Consolidation** warehouse

# Customer X

[Product A+

Product B+ Product C]

Plant C

[Product C for

Customer X]

Plant B

[Product B for

Customer X]

 **Fig** **[1]**

Break-bulk: goods from a plant for various customers are shipped to a warehouse obtaining the benefit of bulk shipment and then sent to the customers.

Customer X

Plant A

 [Product A for

Customers X+Y+Z]

**Break bulk** warehouse

Customer Y

 **Fig.** **[2]**

Customer Z

Cross-dock: Several plants send their goods to the warehouse and from the warehouse the goods are moved across the dock to various customers as per order. A chain of retailers would like items as per movement of their stocks.

Processing/Postponement: products uncommitted to a customer are sent to the warehouse and as per order labels are attached to the products. Process of committing the product is postponed until just in time.

Plant A

 [Product A]

Customer X

[A+B+C]

**Cross Dock** warehouse

Customer Y

[A+B]

Plant B

[Product B]

Customer Z

[B+C]

 **Fig.** **[3]**

Plant C

 [Product C]

Customer W

Products

A+B+ C

Stock piling: agricultural product which are produced during harvest are sold round the year. They need stocking. Woolen garments are sold during winter but produced earlier.

###### **Service benefits:**

Spot stocking: stocking of products in strategically located warehouses during demand sensitive period is called spot stocking. Agricultural implements are spot stocked during the growing season.

Assortment: a wholesaler would like to stock assortment of items from different manufacturers so that his customers [retailers] can choose what they want. Wholesaler can stock assortments as required by customers.

Mixing: In the warehouse, products from various plants are received and combinations are prepared as per the order and sent to customers.

Customer X

Products

A+ B+ C+D

Plant A

 [Product A]

# In transit mixing

 Warehouse

[transit mixing point, mix & make product D]

Customer Y

Products

 A+B+ C

Plant B

 [Product B]

Customer Z

Products

 A+B+ D

Plant C

 [Product C]

 **Fig** **[4]**

Production support: Components and subassemblies required by several assembly lines are stocked economically in a common warehouse and supplied to lines

Vendor A

[part A]

Assembly Line X

 Manufacturing

 Warehouse

Vendor B

[part B]

Assembly Line Y

Assembly Line Z

Vendor C

[part C]

 **Fig.** **[5]**

###### Market presence: offers quick response to customer demand.

### Principles of Warehouse design

**Design criteria**: following are the factors to be kept in mind while designing the warehouses.

**Product flow**: warehouse should be designed round material handling flow. Movement of material should be kept minimum

**No of stories:**  one is ideal as against limitations of space. Cost of land prohibits having only one story as this would need large area.

**Height utilization:** principle of cubic space, principle of ‘go vertical’, e.g.-car parking in Japan. Limitation on this concept is posed by limitation of handling equipment, fire safety rules, insurance regulations and rules and regulations imposed by the state.

**Handling Technology**

**1. Movement continuity and movement scale economics:** movement continuity is ensuring less number of long movements rather than large number of short movements.

Movement scale economies depend on movement in large bulk. Moving material in cases strapped on pallets or containers yields large benefits in handling. Handling becomes standardized and simplified. Moving material in small packages is expensive and complex. Handling technology should address these issues

2. **Storage Plan:** storage plan depends on characteristics of product. Some of the examples are

* open air storage for bulky products
* heavy items closer to floor
* light items on higher rungs of the shelf or rack
* fast moving items in large bulk closer to aisles
* hazardous items stored at safe distances to limit damage in dangerous situations.

### Warehousing alternatives

**Private Warehouses**

* Owned or leased by the product owner. Ownership is not the criterion.
* Control is fully with the product owner. Product owner exercises overall control on management.
* Changes can be made to integrate the warehouse with rest of the logistical system
* Provides market presence to the product owner
* Considered to be cheaper as there is no profit to be added to the cost.

**Public Warehouses**

* Available to companies on hire.
* Overheads get distributed over a large customer base. This makes the usage cheaper.
* As warehousing is their core business public warehouses offer expertise in management.
* Flexibility of location: if the product owner needs to change the location of warehouse, it is easier if the current warehouse is public. It is only a question of terminating the contract and starting a new one. But if the warehouse is owned, one has to dispose off the current facility and procure a new one.
* Significant scale economies, several users and resultant volume, benefits in transportation costs can be gained by utilizing these facilities.

**Contract warehouses**

* Contract warehouse operators take over logistics responsibility from manufacturing company. Warehouse owner offers long term relationship and customized service. Product owner gets the benefit of management expertise of the warehouse owner.
* As the warehouse owner centrally controls several warehouses, product owners get the benefit of shared resources with several clients. This bring down the cost.

#### General classification of Public warehouses

1.General merchandise

2. Refrigerated

3. Special commodity

4. Bonded

5. Household goods & furniture

##### **Warehousing strategy**

**What is a strategy?** Strategy in this context is finding answers some fundamental questions about warehouses keeping long term business in mind. These questions are product owner should have how many warehouses in the logistical network? Where these warehouses must be located? And what type of warehouses is suitable for the business we are in?

**How many?** Total logistical cost must be calculated keeping various number of warehouses in the logistical warehouses. If a graph is plotted with total logistical cost on Y axis and number of warehouses on X axis, shape of the curve would indicate number of warehouses required for minimum total logistical cost.

**Where?**

**Location considerations:** While deciding the location following factors are to be considered keeping potential locations in mind.

1. Cost of distribution to market area.
2. Transport requirement and facilities.
3. Cost of transportation.
4. Presence of Competition.
5. Availability and cost of utilities [power, water, gas, sewerage disposal] and cost
6. Availability and cost of labor supply.
7. I - R climate, labor productivity. Whether conditions are conducive to operations.
8. Customer’s expectation of ‘D’ for our product.
9. Any specific commitments made by the company to any ‘A’ category customer.
10. Local taxation levied by the local authority in the area.
11. Community attitude towards business from outside.
12. Restrictions associated with warehouses. In some areas some type of products are not permitted to be stored.
13. Future expansion. Whether the location is able to accommodate organizations plan to expand in future as per their strategy.
14. Cost of land.
15. Topography and soil condition: if the warehouse needs special and heavy equipment for material handling and if the incoming loads are heavy then firm soil and flat topography are ideal. If these conditions are not available, substantial amount of money is required to be invested.
16. Possibility of title change to the land: Are the title change formalities straight forward? In some situations this is complex, like title to MIDC land.

### Ideal warehouse location

1. Protects of stock against moisture, insects, dust, fumes, pests, thieves, fire etc.
2. Provides facilities for warehousing activities like plenty of water for drinking and fire fighting.
3. Facilitates economics of operation.
4. Away from sources of detrimental conditions.
5. Easy access from highway, railhead and waterfront. No geographic barriers. There are no natural barriers like river or steep hills
6. Proximity to ‘A’ category customers.

##

## **Warehousing strategy**

Of what type? Private? Contract or Public?

##

##  Private Contract Public

Presence synergy

Industry synergy

Operating flexibility

Location flexibility

Scale economies

Presence synergy: a private warehouse provides strong market presence to a company. This has a psychological impact on the customers and also provides physical presence close to the customers for prompt response to customers.

## Industry synergy: if several firms serving the same industry collocate themselves benefits in transportation cost result. These firms can share several facilities specially products handled are same.

Operating flexibility: management control is full in a private warehouse.

Location flexibility: change in location and increase or decrease in number of warehouses is very simple if public warehouses are used. This is important for seasonal demands.

Scale economies: high volume handling results into benefits due to economies of scale. This can happen when highly capital intensive handling equipment is used. Public warehouses can invest in technology as they serve a large client base.

**Inventory at various locations, the square root law**

Modern logistical management strives to reduce inventory levels in the logistical network without sacrificing customer satisfaction. As the number of locations reduces, inventory in the network also reduces, but reducing inventory beyond a certain level would certainly affect customer satisfaction. The square root law shows the amount of inventory one should hold at the new number of locations to maintain the same level of customer satisfaction. If a company decides to change the number of inventory locations as a part of their strategy, they can find out the inventory volume needed to be stored in new facilities.

The square root law states that the total safety stock inventories in a future number of facilities can be approximated by multiplying the total amount of inventory at existing facilities by the square root of the number of future facilities divided by the number of existing facilities. If a company distributes 40,000 units using 8 existing facilities and plans to reduce the number of facilities to 2, then what should be the inventory in two of their future facilities? If we use the square root formula, the answer is 20,000

X2 =[X1] [√n2/n1]

X1 = total inventory in existing facilities

X2 = total inventory in future facilities

n1 = number of existing facilities [warehouses]

n2 = number of future facilities [warehouses]

**Material handling**

Material handling covers receiving, moving, storing, dispatching activities. It has an impact on cost [capital as well as running], quality and safety. One of the principles of material handling is minimum movement. Commonly used material handling equipment are forklifts, EOT Cranes, hoists, pulley blocks, trolleys, railroad cars, conveyers, ropes and slings etc.

**Carousels:** several bins on an oval track keep rotating. The operator can choose required bin to pick from. The system saves space and reduces walking time and distances

1. Nowadays, material handling is being made automatic to combat cost and efficiency. Examples are
2. Automated guided vehicle systems, driverless vehicles that follow a magnetic path or photo path for the destination. They stop if they find any obstructions.

**Sortations**: labels are read and the packages are delivered to right docks for onward dispatch.

**Robotics:** programmed to break down a unit load for storing at different locations and also to make a unit load of items in different locations. Robots are useful in warehouses where extreme conditions of temperature and noise exist

Live racks: when a unit load is removed loads behind slide forward by gravity.

 **Packaging**

Packaging is done to make handling and transporting cost effective. It protects the product in transit and handling. Packing is expected to facilitate lifting and moving by providing easy access to forks or hooks. Packing is also expected to display universal symbols and other instructions for handling. Eg. pallets and containers, wooden boxes, wrapping etc.

### Types of packaging: consumer packaging and industrial packaging

Consumer packaging - There is no focus on logistics. Importance is given to marketing appeal and packaging the finished product.

Industrial packaging importance is given to logistics considerations handling and moving. Individual parts are packed in cartons or bags and grouped together as master cartons. Master cartons are grouped into units for handling. This concept leads to unitization and subsequently to containerization.

1. Packaging in unit loads: standardizes all equipment and operations
2. Load securing: ropes, corner posts, anti-skids, steel strapping
3. unit load platforms: pallets

## **Functions of packaging** [how packaging helps reducing overall costs and value addition]

1. Protection: Protection from environment, pilferage, shocks of handling and moving. Fried chips in tennis ball boxes
2. Cube minimization: The truck is cubed out, that means the truck is full space wise, but not fully utilized weight wise. E.g. Round containers, round bottles. Cube minimization is reducing the space occupied by the product to cut the freight charge. Square shaped bottles and oval shaped containers
3. Weight minimization: The truck is full, weight wise, but not fully utilized space wise. Liquids in glass bottles. Weight minimization is reducing the weight of the consignment to fully utilize the capacity of the truck. Liquids are packed in plastic bottles reducing the weight.
4. Facilitating handling & using: fruit juices in tetra packs, handling and consumption by users
5. Facilitating storage & reuse: ink cartridges for printers, floppies, CDs, reusable corrugated boxes, bottles and refill packs
6. Grouping goods into convenient unit for distribution: mangos in boxes, milk bags in crates, cola bottles in crates.
7. Reducing pilfering opportunities: pilfer proof caps, pilfer proof seals
8. Communication:
9. Content identification - what does this contain? Product, manufacturer, universal code etc. with high visibility
10. Tracking: bar codes and scanners
11. Handling instructions: fragile, which side up? Temperature restrictions, environment concerns, potential dangers etc

Palletization and Unitization

Importance of containerization and intermodal transportation is obvious from our class discussions.

**Unitization, unit loads:**

Unitization is a concept where size shape, weight, volume of the items is considered and a collection of such items is decided in terms of these factors. And always in this unit inventory is moved whenever required.

1. This leads to standardization of handling equipment, methods and training

2. Now, the standardization reduces the time for handling and cost of handling

3. Inbound shipment checking is simplified

4. When transport vehicles are standardized to unit loads, product protection is improved

Examples: bottles in crates, steel sheets in coils, steel ropes in coils etc. container also is an example of unit load.

**Palletization:**

Unit load platforms [ i had drawn the sketch in the class, pallets can be wooden, steel or combination in standardized shapes]- unit load is secured on a pallet to facilitate handling and protect the product which is unitized. One can say container is a self contained, ie., unitized and palletized, shipping unit.

Pallet facilitates use of standardized handling equipment like a forklift or a crane. Without the use of pallet it would almost impractical to use this equipment.

1. Palletized unit loads bring down time of handling and cost of handling

2. Safe handling

3. Product is well protected

**Types of pallets:**

1. Wooden pallets very commonly used, but break and disintegrate, wood is a rare natural resource

2. Plastic pallets, light, recyclable - being researched

3. Pressed wood fiber pallet

4. Solid molded plastic pallets

5. Corrugated fiber board pallet

6. Corrugated fiberboard slip-sheet - slip-sheet is to provide cushion effect to the unit load

7. Refrigerated pallets: self-contained shipping units for refrigerated materials

1. Pallet pools - central pools to collect pallets and issue pallets to global business