UNIT Warehousing and Material Handling

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Recognise the Purpose of Warehouses
- ✓ Understand the Activities within a Warehouse
- ✓ Examine the Aims of Warehousing & Material Handling

Purpose of Warehouses

Introduction

People use different terms for warehouses, but the most general are **distribution centres** and **logistics centres.** Sometimes, distribution centres are described as places for storing finished goods on their way to end customers, while logistics centres store a broader mix of products at various points in the supply chain.

A **WAREHOUSE** is any site where material is stocked on its way through supply chains. Apart from serving as a storeroom, warehouses can be used for a lot of other activities.

If we talk about warehouses storing materials, this is actually just one part of the story. Many organisations these days are utilizing warehouses as efficient locations for doing various related jobs. Obviously, they can be used to examine, sort materials and break up bulk orders (taking large deliveries and breaking them into smaller quantities). They might also be used for finishing products, , packaging, labelling, making products 'store ready' for retailers, handling other aspects of delay and servicing seller managed inventories etc.

Fitting into the Logistics Strategy

As always, there is a chain of command for making decisions, producing policy that includes a chain of tactical and operational decisions. Apart from the clear factor of overall throughput, there are some other significant factors in choosing the very best size for a warehouse. These include:

- The number of products using the warehouse;
- The kind of demand for every product, how much it varies, standard order size and so on;
- Physical qualities of the products, specifically based on size and weight;
- Special storage situations, such as climate control and packaging, etc.;
- Target customer service level;
- Lead times from suppliers and guarantees to customers;
- Economies of scale;
- The kind of material handling equipment required;
- Plan of storage and associated facilities.

Warehouse operations have to function smoothly in a logistics strategy. We can describe one approach to this with the following steps:

1. **Examine the logistics policy** – establishing context and deciding what the warehouse has to achieve.
2. **Examine existing operations** – to observe any failings and how these can be improved or resolved.
3. **Design an outline structure** – finding the best major location and number of sub-depots etc.
4. **Make thorough plans** – finding the majority of facilities, stock holdings, material handling equipment, systems to expand, people to utilize, transport needs and so on.
5. **Get closing approval** – submitting plans to higher-level managers to agree the funding.
6. **Finalise building design** – purchasing land, choosing contractors and building.
7. **Finalise equipment design** – choosing equipment, suppliers and purchasing.
8. **Finalise systems design** – designing the ordering, inventory control, billing, goods location, monitoring and all other systems needed.
9. **Fit out –** installing all equipment, systems, staff and testing,
10. **Open and obtain stock** – test all systems, finish training and begin operations.
11. **Sort out teething problems** – to get things running smoothly.
12. **Monitor and control** – ensuring that everything works as planned, measuring performance and revising incentive schemes etc.

Activities within a Warehouse

Basic Activities

We can add a number of details and make the following list of activities that are usually included in 'warehousing'.

- Receiving goods from upstream sellers;
- Identifying the goods, matching them to orders and determining their planned use;
- Unloading materials from delivery vehicles;
- Doing any essential checks on quantity, quality and state;
- Labelling materials (usually with bar codes) so they can be recognized;
- Supporting goods as required;
- Moving goods to mass storage areas;
- Holding them in stock until required;

- When required, moving materials from mass storage to a smaller picking store;
- Picking materials from this store to meet orders;
- Moving the materials to a marshalling area;
- Assembling materials into orders;
- Packing and packaging as necessary;
- Loading delivery vehicles and dispatching the order;
- Controlling all communications and connected systems, such as inventory control and finance.

Other Activities in Warehouses

Today, organizations try to shift materials quickly through the supply chain, so their role has changed.

Warehouses are now taken more as staging points through which materials shift as fast as possible. As their role in long-term storage has decreased, they have evolved to become suitable locations for a variety of other jobs. They are, for instance, the best place for sorting materials, packing and consolidating deliveries.

A different type of consolidation happens when a manufacturer makes, or buys, parts of a finished product across diverse locations. It can arrange for all components to be sent to a warehouse, which unites the parts into the final product and organizes delivery to customers.

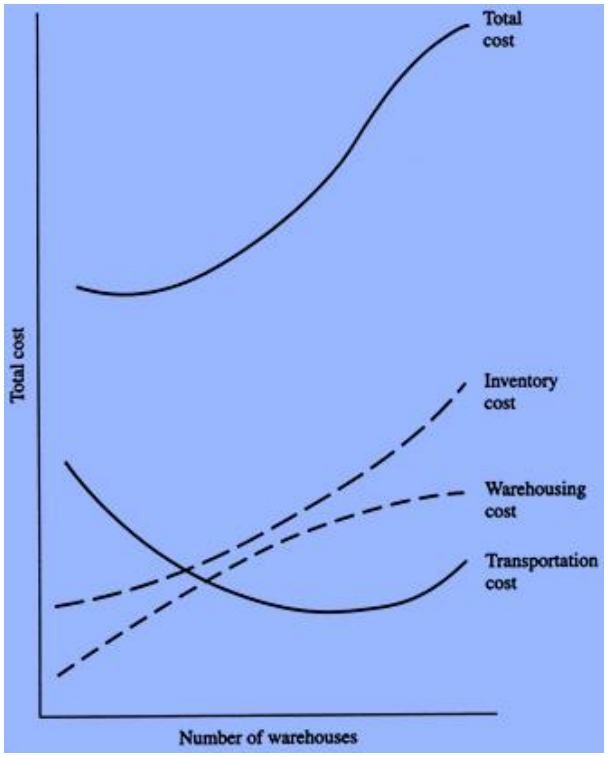

Fig 10.1 Using warehouses to reduce transport costs

This sort of consolidation can go further than just bringing together materials from diverse sources. It may add the final packing and packaging to a finished product, or even do a limited amount of final manufacturing. This is the root of **postponement**, where the final steps of production are left to the last potential moment. This has the benefit of reducing stocks and rising flexibility to meet late changes in consumer demands.

Aims of Warehousing

In general, the objectives of a warehouse are to sustain broader logistics function by providing a mixture of strong customer service and low costs.

More exact aims include:

- Providing necessary storage at key points in a supply chain;
- Offering secure storage for the type needed by materials;
- Keeping all materials in good condition and with minimal damage;
- Giving high-quality customer service;
- Doing all necessary activities efficiently and with low costs;
- Achieving high productivity and utilisation of resources;
- Controlling all movements of materials effectively and without errors;
- Sorting materials upon arrival and quickly transferring them into storage;
- Picking materials for departure, quickly transferring them out of storage and consolidating deliveries;
- Being able to store the entire range of materials needed;
- Being flexible enough to deal efficiently with variations in stock levels;
- Allowing for special conditions and rotation of stock etc.;
- Providing safe working conditions in compliance with regulations.

Ownership

A lot of organisations own and operate their own warehouses. But for small organisations, this would be both difficult and costly, so instead they use facilities provided by dedicated warehousing companies. Even large companies can benefit from this kind of agreement, so they have a vital choice between **Private and Public Warehouses.**

Private warehouses are owned or leased by a business as part of its own supply chain. The business runs its own warehouses to sustain its major operations. This gives greater control over a central part of logistics and allows the incorporation of warehousing with the broader activities of logistics.

A public warehouse is run as a self-governing business, which makes money by charging users a fee. There are a lot of types of public warehouse, including bonded warehouses, cold stores, bulk storage, tankers and various speciality stores. The facilities accessible are usually so flexible that an organisation can access, within reason, any facilities that it requires. There are also a lot of arrangements for their use. The main advantage of public warehouses is their flexibility. Some other benefits include:

- Flexibility to deal with changing demand, possibly due to seasonality;
- Ability to offer skills and knowledge that the business does not have internally;
- Access to the newest equipment and practices;
- Avoiding big capital investment, giving a higher return on investment;
- Easy access to a wider range of geographical regions;
- Allowing immediate tests of expansion into new areas;
- Use of economies of scale to lessen warehousing costs;
- Consolidating loads with other organisations to decrease transport costs;
- Guaranteed high-quality and well-organized service;
- Flexibility to deal with varying conditions, removing risks from dated practices and technology.

The move towards contracting out warehousing means that the most widespread arrangement for warehousing is perhaps a combination of private and public. The choice between private and public warehousing is frequently seen as another feature of the 'make or buy' decision, and is often presented as break-even analysis. Private warehouses have elevated fixed costs but lower unit operating costs, while public warehouses have small fixed costs but potentially high variable costs.

Layout

General Layout

One of the most significant decisions when operating a warehouse is its design. This refers to the physical plan of storage racks, loading and unloading areas, offices, rooms, equipment and all other facilities.

Layout decisions are imperative for three important reasons: (1) they require substantial investments of both money and effort, (2) they involve long-term commitment, (3) they have an important impact on the cost and competence of key operations.

This suggests that the necessary elements in a warehouse include an arrival bay or dock, where goods coming from suppliers are delivered, checked and sorted, along with:

- A storage area, where the goods are kept as stock;
- A departure bay, or dock, where customers' orders are assembled and sent out;

- A material handling scheme, for moving goods around;
- An information system, which records the position of all goods, arrivals from suppliers, departures to consumers and other applicable information.

There are a lot of variations of this fundamental outline. The most general one – which is also used in most supermarkets – has two storage areas. Goods arrive and are put into a mass store (the backroom in a supermarket) which is the major storage area.

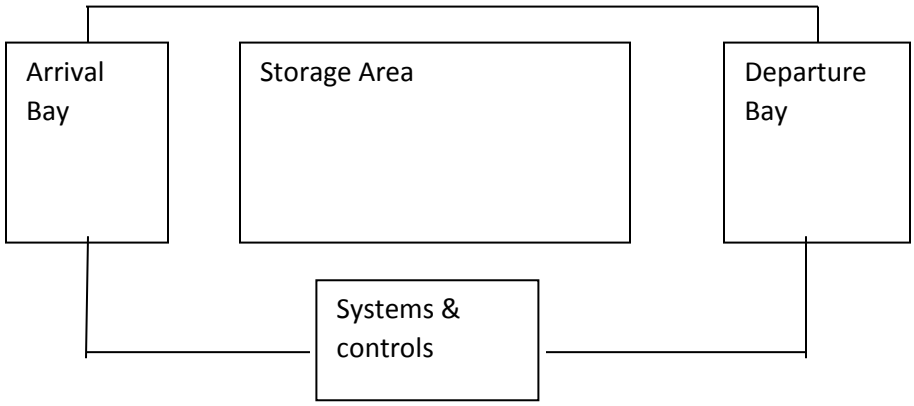

Fig: 10.2 Basic Layout of a warehouse

The packages in the mass store are split into individual units and shifted to a smaller picking store that is used to collect orders (the shelves in a supermarket). When an order is received, the items required are 'picked' from the smaller, picking store and brought jointly in a consolidation area, before moving to the departure bays. When stocks in the picking store run low, they are refilled from the bulk store. This means the run of materials flows through arrival bays, bulk store, picking store, consolidation area and finally departure bays.

Layout of Racking

In most of the warehouses, materials are stocked using some sort of shelving or racking.

This racking can take a lot of forms, leading to three fundamental questions:

- What kind of racking should be used?
- What is the very best layout for the racking?
- Where should various items be stored on the racks?

One way of planning the design is to:

- ✓ Approximate demand for materials over the subsequent five years or so;
- ✓ Translate this into estimated movements of materials into, through and out of the warehouse;

- ✓ Compare accessible equipment for making these movements and determine the most suitable;
- ✓ Allocate the room required for storing and moving every item;
- ✓ Design a broad-spectrum layout for the racking;
- ✓ See which materials should be close to each other ;
- ✓ Develop outline plans for the layouts and handling areas and choose the best;
- ✓ Add further details to produce final plans.

Experience does, however, highlight some suggestions for superior layouts.

These include:

- Plan the layout to ensure smooth flow of materials into, through and out of the warehouse;
- Simplify movements, eliminating or combining separate movements where possible;
- Use high-level storage where possible, as this reduces the overall area required;
- Have offices outside the main warehouse area, as space above them is wasted;
- Consider using spare roof space for overhead movement of materials;
- Give appropriate space for aisles – as narrow as possible to reduce non-working space, but wide enough for equipment;
- Consider mezzanine floors for picking and administration;
- Permit movements in straight lines on the floor.

Locating Materials on Shelves

A lot of the costs of running a warehouse are permanent – such as the rent, local taxes, utilities and depreciation. Some of these costs are determined by the management policy, such as the total investment in stock. The major variable cost comes from the particulars of the layout, and depends on the time required to locate items and either add them or remove them. When there are thousands of items in store, little differences in the way they are placed can result in very different service quality and costs.

Turnaround Time

Apart from the design of the storage areas, the capabilities of a warehouse also depend on how fast it can deal with delivery vehicles. There are numerous measures of **turnaround time**, however the most common is the time taken between a vehicle arriving (either delivering materials or collecting them) and departing.

Two arrangements can assist with this. First, orders can be brought together to be transferred onto a vehicle – when the vehicle arrives, it is loaded rapidly and moved on. Second, special loading and unloading apparatus can be used to speed up operations.

Materials Handling

A lot of the work in a warehouse invoves the movement of materials from one place to another. Everything has to be taken from delivery vehicles, moved around the warehouse – often quite a few times – and finally put onto departing vehicles. These activities form a division of **materials handling.**

MATERIALS HANDLING relates to the flow of materials over small distances, usually within a warehouse or between storage areas and transport methods.

Some objectives of materials handling include:

- Moving materials around a warehouse, as necessary;
- Moving materials quickly, reducing the number and length of movements;
- Increasing storeroom density, by reducing the amount of wasted space;
- Reducing costs, by using well-organized operations;
- Making very few mistakes, with competent material management systems.

Manual Warehouses

This is most likely the easiest warehouse plan to visualize, and remains one of the most common. Items are stored on shelves or in bins; people go around and choose items from the shelves, and put them into some kind of container for movement – like a supermarket trolley. Manual warehouses only work if the items are small and light enough to lift. Shelves must be low enough for the products to be reached and close together to decrease the walking distances.

Mechanised Warehouses

Mechanised warehouses substitute some of the human-power of manual warehouses with machines.

Typical examples of mechanised equipment include:

- Reach trucks;
- Order-picking machines;
- Forklift trucks;
- Cranes;
- Towlines;
- Conveyors;
- Tractors or trains;
- Carousels

These warehouses can store and work with heavier goods and can often be much bigger in size. Some equipment needs broad aisles to manoeuvre, but racking can be also higher – often up to 12 metres with a forklift truck, or even higher with cranes and other high-reach equipment.

Automated Warehouses

Traditional warehouses, including mechanised ones, tend to have elevated operating costs. These operating costs can be decreased at the same time as improving efficiency and quality of service, by using mechanization. Unfortunately, this requires a very high investment in equipment and is only actually worthwhile for extremely large facilities that move large amounts of materials.

Automated warehouses include the following components:

- Storage regions that can be accessed by mechanical equipment; these often make use of narrow aisles up to 40-meters in height to get an elevated density of materials and minimize the distances moved.
- Equipment to shift materials around the warehouse; these are typically automated guided vehicles (AGVs).
- Equipment to mechanically select materials and place them into storage, including high-speed stacker cranes that can arrive at any location in the narrow aisles very fast.
- Equipment to move materials between the various types of equipment; these mechanical loaders and unloaders may include industrial robots.
- A warehouse administration system to record material locations and manage all movements.

Choice of Equipment

In general, high volumes of throughput demand higher levels of mechanization. Warehouses with lower volumes of throughput (like a shop) are generally manual, medium volumes of throughput (like a food warehouse) are mechanised and high volumes of throughput (like Amazon) are largely automated. Although it is significant, volume is just one factor in the selection of equipment. The last decision requires a lot of examination, with key factors to consider including:

- Physical characteristics of loads – size and weight etc.;
- Number of loads to be moved – from the throughput of the warehouse, plus any internal movements for sorting to checking etc.;
- Distance to be moved – the size of the warehouse;
- Speed of movement required – how quickly the warehouse has to respond to orders etc.

Packaging

Standard Packages

We have previously mentioned pallets (the standard wooden trays about four feet square that materials are placed on for transportation) and containers (metal boxes that are used to shift a wide range of goods around the world). Collecting together materials into these standard packages is called **unitisation** to shape **unit loads**. It is much easier to move standard loads than it is to shift a diversity of different sizes and shapes. If a company always uses standard loads, it can set up all its equipment to move these well.

Purpose of Packaging

Many items require special protecting packaging during movement, typically delicate things like fragile goods and electronics. Sometimes the wrapping can effectively protect goods from harsh environments, such as rain or direct sunlight; sometimes it is essential to separate materials that would adversely affect each other, such as sugar and petrol; sometimes it packaging keeps the contents hygienically clean, such as in the instance of foodstuffs and medicines. In general, packaging serves four basic functions as it:

- Identified the product and provides fundamental information;
- Protects items while they are being shifted through the supply chain;
- Makes handling easier;
- Assists marketing - promoting the product, advertising and giving key information to customers.

The balance between these greatly depends on the product.

There are also two kinds of packaging to consider.

First, the interior, or **consumer packaging,** is made for the consumer and includes the advertising and promotional materials. This is the one that is usually brightly coloured and features both cellophane and advertisements.

Second, the exterior or **industrial packaging** is used to protect the goods and make handling easier. This is the simple box or pallet that also provides information to businesses within the supply chain.

There are five primary materials for packaging:

- Glass is simple to clean, reuse and reprocess, but is easily broken, comparatively expensive and harder to make;
- Plastic is light, strong and simple to clean, but can be costly and hard to create and reuse;
- Cardboard is light, inexpensive, and can be recycled, but has minimal strength and poor durability;
- Wood is strong, tough, easy to use and can be reused, but it is weighty, bulky and tricky to clean;
- Metal is strong and tough, but it is weighty and can be costly.

The choice of these – along with other materials – depends mainly on the kind of products, the required movement and the level of protection required.

Packaging Waste

When you purchase something, you may be surprised by the amount of packaging it comes with. Cakes and chocolates for example usually have three layers of protective packaging; sometimes you may find up to five layers. But remember that you only ever see the customer wrapping, and there have almost certainly been at two more layers of industrial wrapping which have already been removed.

This is a significant issue, as the European Union and other areas globally are introducing restrictions on the quantity of packaging waste that businesses can discard. Several countries only allow glass containers if they are reused, or at least recycled. There are similar regulations for metal containers, chiefly aluminium cans. Perhaps more obvious are the regulations on other packaging, which are increasingly forcing businesses to record the amount of packaging they use and the amount they reuse/recycle. If they fail to reach set targets for recycling, they face serious fines. The European Union has moved towards this plan, with general recycling targets for most businesses of around 50%.

Further Reading:

- ✓ Edward Frazelle, (2002), World-Class Warehousing and Material Handling
- ✓ Myer Kutz, (2009), Environmentally Conscious Materials Handling
- ✓ Riccardo Manzini, (2012), Warehousing in the Global Supply Chain
- ✓ Gwynne Richards, (2011), Warehouse Management : a complete guide to improving efficiency and minimizing costs in the modern warehouse