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**Course: Logistics and Supply Chain Management**

## Lecture 8: Warehousing Management

1. **Concepts related to inventory**
* **Inventory definition:**

There are several definitions of inventory which differ according to the angle from which the inventory is viewed, below we state some of these definitions:

* **Inventory**: is the amount of raw materials, components, work-in-progress, and finished goods which appear at numerous points throughout an organization's production and logistics channel
* **A** **material stock** is the quantity of that material in the store at a certain time, due to the expectation of users’ demand and expressing their need for this material
* **The storage process**: it means "keeping the stock for a certain period of time, so, the storage process is linked to the element of time, and to preserve the materials in their current condition requires the provision of certain conditions in order to preserve these materials from damage
* **Reasons for keeping inventory:**

There are three main reasons for holding stocks as the following:

* **Time**: The time delay which exists in the supply chain, from supplier to user at each stage, requires that the organization hold certain amounts of inventory for use in the "lead-in-hold" period;
* **Uncertainty**: Inventory is held to meet uncertainties in demand, supply, and movement of goods;
* **Economies of scale**: the ideal case of "one unit at one time at the place and time needed by the user" this principle tends to incur a lot of costs in terms of logistics. So bulk purchasing, movement and warehousing brings economies of scale, therefore inventory.
* **Classification of inventory**

Among inventory classifications methods, we find “**ABC inventory classification**”; it is a very popular inventory control technique which follows the Pareto Principle which states that generally 80% of effects come from 20% of causes.

In the organization, it can be said that about 20% of the finished products generate 80% of the income. In an ABC analysis, the organization reviews its inventory and classifies all items into three categories, called "A" items, "B" items, and "C" items. A typical breakdown describes "A" items as those producing 70% of the income, "B" items as those producing 25% of the income, and "C" items as those producing 5% of the income.

This classification may vary from organization to another, but managers should be able to find the method which best suits their needs.

Obviously, the "A" items require more attention and should be handled differently. Therefore higher levels of service should be assigned to these items. A higher level of service leads to higher inventory but will also reduce the possibility of out-of-stock. A 5% probability of running out of stock for an "A" item results in much higher losses than a 5% probability for a "C" item. A service level of "A" of 99% can have almost the same effect as a service level of 85% of "C" and managers should set a stand against each category accordingly.

* **Warehousing responsibilities**

By the responsibility of the storage function, we mean the tasks assigned to those in charge of this function, which are as follows.):

* **Discrimination**: The detailed determination of the specifications of production materials, devices and equipment, their quality level, and the preparation of an index of items.
* **Receiving**: This task is carried out by a special unit inside the warehouse, and the process represents all supplies necessary for industrial, operational or maintenance operations, as well as finished goods.
* **Examination**: It is the process of verifying that the materials and devices supplied to the warehouses conform to the agreed specifications, and in the event of non-conformity, those materials are rejected.
* **Issuance**: this includes the operations of packaging, shipping, unloading and handling goods until they reach their users.
* **Book entry**: It is the process of recording the details of the warehouse movement from receiving, examining and issuing day by day in the inventory records, provided that with each entry the characteristics of the received and exported items and the remaining balances are specified.
* **Stocktaking**:: that means counting, measuring, weighing, or examining the quantities of all items kept in the warehouses at the end of a certain period of time, and recording the results in the lists designated for that.
* **Inventory control**: It is that process which pertains to the permanent arrangements for receiving and issuing in a way which ensures that the level of inventory balances, whether value or quantity, or both together, is sufficient to provide the current rates of use at all times and in an economical manner.
* **Storage goals**

There are several goals with regard to the storage function in the organization making the best use of material and human resources, including the following

* Ensuring the proper functioning of the production process by providing the necessary materials and production requirements.
* Helping to benefit the advantages of buying in bulk and getting a quantity discount.
* Reducing investment in inventory to its minimum level, which provides the needs of the production process without stagnating.
* Providing data and information which enable coordination and integration between procurement, storage and production activities.
* Ensuring optimal utilization of the organization's production capacity.
* Facing the changing dynamic conditions affecting supplying, and increasing the utility and value of inventory items. It also serves the cases of regular production and irregular production.
* **Storage procedures**

There is a set of procedures that the institution follows regarding inventory as follows :

* **Goods Receipt -** Receipt and acceptance of responsibility by updating records;
* **Identification of goods** - labeling, color coding (regular stock, promotional stock, customer special stock, variable price batch, etc.);
* **Sorting of goods** - The goods received are sorted based on the identification of the appropriate storage area. For example, special customer items, revised price items, and promotional items should be sorted separately.
* **Sending the sorted goods to a suitable storage place** - for temporary storage with easy access to them;
* **Cargo reservation** - insurance against theft and deterioration;
* **Selecting, Retrieving and Packing** - Items are retrieved and collected according to customer order for dispatch;
* **Merchandise organization** - check items of a single order for completeness and order records are updated;
* **Dispatch of goods** - the consolidated order is filled out and directed to the correct transport;
* **Preparing records and notifications** of inventory and replenishment requirements.

The procedures rae explained below in detail :

* **Receipt Procedures:** include the following steps
* Receiving materials from suppliers: The warehouse department coordinates with the purchasing department, which takes the necessary procedures for supplying. When the warehouse department receives materials or goods, it checks them to ensure that the received quantity is complete with the required specifications.
* Receipt procedures when transferring materials from sub-stores to central warehouses: this case deos not need documents, it only requires a permission to transfer, but when materials are received and they are damaged or incomplete, a report is written in this regard.
* Receipt procedures in the event that the goods are returned from the production department or another department: it is possible that the goods will be returned for a defect in them, or they are not suitable for use, or in case of a change in the production program. In this case, the warehouse department prepares the numerical review and rapid examination.
* Procedures for Receiving Production Residues: The production residuals are sent to the warehouses, in this case, the warehouse management does not need to precise details and specifications, it is sufficient to allocate special places for them pending disposal for use in other fields or for sale, and they are recorded in the books and records.
* **Exit materials procedures**
* The exit authority: the goods are disbursed by writing requests, and it is signed by one or two persons to accept the exit document, and in some cases the approval of the higher management is required
* Checking the need: Checking the required needs accurately, sometimes the requesting party does not use and does not accurately specify the specifications of its need, which forces the warehouse management to refer to the requesting party for that.
* Materials exit timing: The warehouse management determines the exit periods and requests the requesting authorities to send their requests well in advance of their exit dates.
* Methods of exit: exit of materials is made according to the production plans after defining specific production schedules, and sometimes the exit is to the sales department.
* **Keeping inventory records**

Warehouse records vary according to the size of the organization and the nature of the materials stored in the warehouses. When designing the records, a thorough study of those records is necessary, in order to determine all the required information, which include all the activities that take place, whether the goods are received or exit. These activities include the following:

* Inventory movement control: The goods come to and leave the stores in a continuous movement. After examining and receiving them, the goods are sent to the warehouses until they are needed. When needed, the materials are exited according to special exit documents.
* Item Card: It is a card on which the movement of the stored material is built and kept on the material or in a place close to it. It contains data which facilitates the process of identifying the material, such as specifying the name of the material, the quantity received, the quantity withdrawn, and the balance after each operation or addition.
* Inventory card: It is usually not placed with the material, but is kept in special records, and it usually contains more extensive information than the item card information. Where we find in it the quantity of incoming and outgoing goods, storage levels for these goods( the maximum and minimum), the demand limit, the price, and the place of the material in the stores.
* **Inventory Management**:

Inventory management is a very important function that determines the health of the supply chain as well as the impacts on the financial health of the budget.

Every organization constantly strives to maintain an optimal inventory to be able to meet its requirements and to avoid excess or shortage of inventory which can affect the financial figures. Inventory is always dynamic, therefore; inventory management requires continuous and accurate evaluation of external and internal factors and control through planning and review. We find that most organizations have a separate department or function called the inventory planner who constantly monitors and reviews inventory and interacts with production, purchasing and finance departments.

Inventory management refers to all the activities involved in developing and managing stock levels of raw materials, semi-finished materials and finished goods so that adequate supplies are available and the costs of over or under stock are low.

The main objective of the inventory management is to reduce the total cost of related costs to inventory and storage for ensuring profitable operations as well as to maximize the level of customer service. To be specific, the goal of inventory control includes: Ensuring an adequate supply of products to customers, and Avoiding shortages as much as possible; To ensure that financial investment in stocks is minimal (i.e., to see that working capital is withheld as little as possible); Efficient purchasing, storing, consuming and accounting for materials is an important goal; To maintain a timely record of inventories of all items, and to maintain stock within desired limits; To ensure that actions are taken in a timely manner for renewal; To provide backup stock for changes in material delivery lead times; To provide a scientific basis for material planning in the short and long term.

The following actions take place within the organization in inventory management :

• Developing purchasing review criteria to review inventory characteristics;

• Purchasing only the amount of raw materials needed to run production or for a period of time;

• Collaborating with vendors to improve purchasing practice;

• Improving inventory control by implementing effective inventory control systems;

• Encouraging the exchange of materials within the organization;

• Just-in-time manufacturing.

1. **Store management (warehouses)**

**Definition of stores:**

There are several definitions of warehousing,):

* It is the point in the supply chain where raw materials, products in process, or finished goods are stored for varying periods of time.
* It is "the place to which the purchased or manufactured materials which are used for production and consumption operations arrive, so; it is that closed building which is equipped with all storage necessities such as: lighting, heating, cooling, catering...etc., and materials and goods are kept in it."
* A warehouse is an area which serves to store goods for production or production results -in a certain quantity and a certain period of time- which are then distributed to the intended location based on the demand on the warehouse management system;

**Types of warehouses**

There are different types of warehouses: they can be classified into production warehouses and distribution centers, and by their roles in the supply chain they can be classified as raw materials warehouses, work-in-progress warehouses, finished goods warehouses, distribution warehouses, implementation warehouses, local warehouses directly according to customer demand, and value-added service warehouses

Figure: warehouse



Basically, we can distinguish between three types of warehouses: distribution warehouses, production warehouses, and contract warehouses.

* **Distribution warehouse** is a warehouse in which products from different suppliers are collected (and sometimes aggregated) for delivery to a number of customers.
* **Production warehouse** is used to store raw materials, semi-finished products and finished products in the production facility.
* **Contract warehouse** is a facility that performs warehousing on behalf of one or more customers.

The types of warehouses can be identified from several aspects, the most important of which are as follows:

 According to the ownership: including:

• Stores owned by the same organization.

• Stores rented from either the state or the private sector and managed by them.

 According to the location:

• Stores close to the market.

• Stores close to the supplier.

• Stores in the organization.

 According to the continuity of work and the period of use, including:

• Permanent stores used throughout the year.

• Temporary stores used to fill a specific need in a particular season or circumstances.

 According to the type of materials stored, including:

• Stores number and spare parts.

• fuel stores.

• Ready goods stores (finished).

•Industrial waste stores

 According to the building quality: We find :

• Open warehouses: It may be called storage yards, and it is an area of land which is often surrounded by a wall, the purpose of which is to preserve the assets of the store and protect them from theft and loss. This type of warehouse is spread to store items which are not affected by natural factors, and some items which are stored in containers, or relatively plastic or metal containers such as oils, chemical pesticides, etc., until they are shipped to destinations. Examples of these items are: agricultural crops, herbs, scrap iron, etc.

 One of the most important advantages of open warehouses is the low cost of their establishment, and one of the most important disadvantages is that the increase in spaces and the extension of large distances requires a multiplicity of movement points, which leads to high costs, and it is also vulnerable to the arrival of birds, insects, and the like.

• Covered warehouses (one floor): It is a full-roofed building, whether the roof is metal, wooden, or concrete. It is equipped with lighting, fire-fighting means, and ground handling means such as carts, and in it different items are stored directly on the ground and on wooden shelves or box containers, depending on the nature of the materials stored. Examples of some items which can be stored in these warehouses, we state: large-sized devices, machines and boxes of spare parts, fabrics and some food items such as flour, dry grains, and other materials in bags and need storage for a relatively long period.

• Multi-storey warehouses: Sometimes the organization may be compelled to establish multi-storey warehouses in order to exploit the lands available to it to the maximum extent possible, or to benefit from the advantages of its current warehouse sites, or as a means to reduce construction costs without the need to purchase other lands. A number of special places for small and high-value items, and despite the justification for the establishment of multi-storey warehouses, it requires a good selection of land on which these warehouses are built, in addition to engineering considerations in building in terms of loads and expected weights per square meter, and care in choosing appropriate handling means for the nature of the building and its heights.

 In terms of storage conditions:

• Refrigerators or cold-freezing stores: They are places which are engineered and technically designed to maintain a low temperature, and often take the form of medium, or large refrigerators equipped with measuring devices and adjusting the temperature at the levels required for different items which contain enclosures divided into parts with different heights to match the sizes and packages items to be stored, this type of warehouse is used to store meat, fish, frozen vegetables, some types of fruits, medicines, vaccines, human blood...etc. The most important means of handling used in these warehouses are manual and electric carts and cranes.

• Air-conditioned warehouses: These are places which maintain a temperature between 15 to 25 degrees Celsius. They may be equipped with air-conditioning machines and devices for selecting and stabilizing the temperature to maintain the degree at the level required for the stored items. These stores contain enclosures and fixed plastic containers in specific places which are equipped with manual and electric carts and sometimes cranes. This type of warehouse is used to store some items which are subject to damage or explosion as a result of a temperature rise above a certain level, some examples of these materials are: tools and devices made of rubber or plastic materials, some types of food products, as well as paint materials and chemicals which used in the manufacture of explosives.

• Storage tank for petroleum materials: It is about storage places with different sizes and heights, some of which are in pits under the surface of the earth, and these tanks are made of different materials, including what is made of minerals, of stone bricks or reinforced concrete. These materials which are stored in this tank include: gasoline, kerosene, diesel and other products. The handling means take from and to the tanks in the form of pumps.

• Grain silos (grain): It is a type of warehouse equipped to preserve the grain. It is constructed of cement and limestone according to specific engineering and technical specifications, depending on the nature of the stored materials and the length of the storage period. They are equipped with conditions which help keeping the stock intact for the longest possible period. Storage capacities in these silos vary according to their size, as their storage capacities exceed 5,000 tons.

* **Warehouse Functions:**

There are several functions which take place at the warehouse level:

* **Receiving** - This includes the physical unloading of incoming transportation, inspection, recording receipts, and locating the received goods in the warehouse. It can also include activities such as unpacking and repacking, quality control checks and temporary quarantine storage of goods awaiting clearance through quality control;
* **Inspection** - checking the quality and quantity of goods received for their required characteristics;
* **Repacking** - The incoming batch may contain non-standard packaging that may not be stored as is at the respective location. In these cases, these materials must be pre-packed into unit loads appropriate for storage;
* **Consignment** - collection and storage of goods in their own locations;
* **Storage** - storing materials in their own locations;
* **Picking order** - Goods are picked from stock picking order in the required quantities and in the time required to fulfill customer orders, when goods are received from suppliers, for example, in large quantities, but are ordered by customers in smaller quantities. Picking orders is important to achieving high levels of customer service; they also take a high percentage of the total warehouse staff and are very expensive. Well-designed and well-managed picking systems and processes are therefore vital for efficient warehouse performance;
* **Sorting** - This option allows the goods incoming to the warehouse to be sorted into specific customer orders as they arrive. Then the goods will go directly to the order;
* **Packing and Shipping** - Goods picked up as per customer order are consolidated and packed according to customer order requirements, then shipped according to customer orders and respective destinations;
* **Goods distribution** - moving products directly from receipt to the shipping dock - these products are never stored in specific locations;
* **Replenishment** - is the movement of goods in bulk, from backup storage to order picking, to ensure that order picking locations do not become empty. Maintaining stock availability for order picking is important to achieving high levels of order filling.
* **Warehouse management**

There are several definitions of warehouse management as follows:

* Warehouse management is the organization of operations in a warehouse and primarily the management of inventory (quantities), and storage locations. In addition, warehouse management must ensure the smooth and cost-effective handling of all warehouse operations. It includes maintenance of various storage system components (mechanical and existing on information technology), managing reusable means of transport and packaging, such as pallets, containers, cable drums and voids, as well as receiving and examining the materials and goods incoming to the institution and storing them in appropriate places to protect them from loss, theft, damage and distortion in order to disburse them to the parties that request them inside and outside
* Warehouse management includes all planning and controlling procedures for the operation of the warehouse. Planning and controlling are concerned with managing the ongoing activities of operations in order to meet customer demand. The main purpose of planning and controlling is to ensure that operations are run effectively and products and services are produced as they should and on time. Where planning involves determining what is to be done and how, controlling is the process of ensuring that the desired (plan) output is obtained. Within planning, we distinguish between the tactical and operational level. At the tactical decision level, warehouses make plans for efficient use of resources and meeting market demand. However, due to the highly dynamic environment, the tactical planning horizon for many warehouses is only days or weeks rather than months. At the operational level, decision rules are used to sequence, schedule, and improve planned activities.

**Warehouse Management System**:

A warehouse management system (WMS) is a database-based computer application system, used to improve the efficiency of warehouses in maintaining the accuracy of inventory data by recording every transaction in the warehouse. A warehouse management system (WMS) acts as a system which organizes warehousing activities in the supply chain, such as receiving inventory, storing inventory, and managing purchase orders from inventory. The purpose of this system is to control the movement and storage of inventory in the warehouse, and transactions processing related to receiving, picking, taking and shipping inventory in the warehouse

This system has been developed to meet the needs of the users to be more efficient than the system done manually. Implementing a warehouse management system can facilitate the warehousing system by increasing efficiency in terms of data recording and processing, increasing data security and data accuracy.

This system can also be a means of exchanging information between administrators, users and warehouses, if there is a change in inventory in the warehouse it will be quickly identified

WMS often uses” Auto ID Data Capture technology (AIDC), such as barcode scanners, laptop computers, wireless local area networks (Local Area Network), and possibly Radiofrequency identification(RFID) to monitor streaming products efficiently, once the data is collected, there is either bulk synchronization with a central database, or real-time wireless transmission to a central database. The database can then provide useful reports on the condition of the goods in the warehouse.

**The concept of handling and its types in warehouses**

Materials follow a natural flow path within the organization, from its entry to its exit, and in this sense we mean what is known as handling. It is "the process of unloading, loading the conveyors, internal operations, and leaving the warehouses, in other words, it is the process of transporting materials from one place to another, from its entry into the organization until its exit or dispatch.. It is also meant : Moving and transporting various products and goods from one location to another with the aim of responding to one of the operating orders issued by the Physical Distribution Department or the Internal Inventory Department, that means the handling process inside the warehouses, whether the warehouses are for production or marketing purposes

There are several types of handling as follows:

* **Manual handling**: where automatic or semi-automatic handling means are not used. It is the moving and transporting materials or in unloading and loading depending on human effort. This type of handling is for light materials and in narrow or small warehouses close to the work or operation areas
* **Automated** **handling**: includes the use of high-speed automatic equipment in handling operations, where automated handling methods depend on the form of warehouse design . The use of this method achieves the following advantages: 1- *With regard to the time and speed component*: the automated handling devices lift the materials of heavy and large sizes at a faster rate than the manual devices. Also, the arrival of raw materials and raw materials to the production lines leads to an increase in the daily production rate and the consequent speed of capital turnover. . 2 - *In terms of operating cost:* the use of automated handling entails a reduction in the labor component, which is considered as the highest cost of operating devices, by using the most appropriate means for the technical and economic requirements of work. 3 – *With regard to reducing the warehouse space*: the use of automatic handling by speed in moving large materials repeatedly between the warehouse and the workshop, in addition to placing and arranging the materials in an upper manner at high heights helps to reduce this space in the warehouse
* **Ground means with a fixed path**: It is a group of means which move either horizontally or on the ground, and take the form of fixed lines and paths. These means vary according to the energy used, whether it is electric or fuel... and according to the container used. Examples of these means include moving tapes (conveyor belts) and trolleys which move in specific lanes and on iron rails.
* **Overhead means**: These are the means which move the inventory carrier to different heights from the surface of the floor, and they do not need ground passages which allows the exploitation of these floor spaces to store larger quantities and more materials, for example: mobile cranes on the ceiling of the inventory which have chains hanging at the bottom.
* **Vertical means:** They are means used to transport materials in a vertical direction from bottom to top or vice versa. They are suitable for multi-storey warehouses, in which mobile elevators of different sizes can be used, which can transport materials of different weights and sizes.
* **Land** **vehicles which** **are not restricted in movement**: they are means in which automatic conveyors are used and can deviate and take multiple automatic directions within the warehouse. These means are flexible and take different forms, such as regular, trailer, or towed vehicles.

**The difference between inventory management and warehouse management**

Sometimes the roles of inventory management are confused with the roles of warehouse management, but in fact there is a difference between them as it is discussed below:

* Store (warehouse) management is closely related to material management and inventory management. It is responsible for maintaining the correct amount of materials, raw materials or semi-finished products. It is responsible for providing production activities and services, proper organization of the warehouse, and taking care of the places, buildings, and warehouses designated for keeping the different items of materials which the organization deals with, planning and implementation of receiving, safekeeping and prevention operations, shipping management, recording of inspections and control operations.
* However; inventory management is responsible for collecting the appropriate stock size for the organization in the warehouse and in transportation, and is concerned with: planning, organizing, and controlling inventory aimed at minimizing investment in inventory while balancing supply and demand. Furthermore; overseeing supplying, storage and access to items in order to ensure adequate supplying without oversupplying.