

**Integrity, Service, Excellence**

**CHALIMBANA UNIVERSITY**

**BSM 3101: STORES AND RECORD MANAGEMENT**

**MODULE**

Chalimbana University

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**Acknowledgements**

Appreciation is given to Mr. Christopher Phiri and Muzumara Taonga from the stores department at Chalimbana University for writing this module in stores and records management.

**Study Skills**

As learners, your approach to learning will be done on a professional and personal aspects of wanting to acquire professional knowledge.

You are further needed to read more materials concerning stores and records management in order to further broaden your understanding in an effective and efficient way.

**Module Overview**

**Introduction**

Welcome to the course of stores and record management. This course intends to equip you with knowledge and skills in stores management which are cardinal in managing the department of stores in organisations.

You will find this module to be very useful in understanding what is involved in stores management.

**Rationale**

Several things do happen in the managing of stores as well as in managing records. Therefore, there is need to have an understanding of how stores and records are managed. This looks at how stocks (inventory) is received, issued, secured and management of records.

**Aim**

The aim of this course is to equip the learners with the needed knowledge and skills in stores management.

**Outcomes**

At the end of this course the learners must be able to:

* Explain how inventory is received, stored and issued.
* Discuss how ordering of inventory is done.
* Describe the procedures of handling inventory.
* Explain how inventory is disposed of
* Discuss how to efficiently manage the stores department
* Illustrate how stores records are kept

**Method of teaching**

There will be four lecture hours per week.

**Assessment**

Continuous assessment 50%

Essays ……… 25%

One Test 25%

Final examination 50%

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**Stores and Records Management**

**UNIT 1: Stores Management**

**Introduction**

This unit will assist you to understand stores management and its aspects. The various section and sub section of this unit will also summarize the problems and developments in storing.

The store in any organisation has a vital role to play. All other activities involving materials are in day-to-day touch with the stores.

The success of the business, besides other factors, depends to a large extent on the efficient storage and material control. Material pilferage, deterioration and careless handling may lead

to reduced profits.

**Outcomes**

**Learning outcomes:**

After studying this unit, you will be able to:

* define stores management
* explain the concept of stores management
* discuss the purpose of store management
* explain the location and layout of a store

**Stores Management**

This is the aspect that is concerned with ensuring that all activities involved in store keeping and stock control are carried out efficiently and economically by stores personnel (Ramakrishnan and Arnold, 2007). It covers the actual handling of items which are in and issued out of stores.

**Purpose of Store Management**

An important role is played by stores in the operations of an organisation. Store department remains in direct touch with other departments of a company in its day-to-day activities.

The key objective of the stores is to provide non-stop service to the manufacturing divisions. Additionally, a store is time and again equated directly with money, as money is locked up on the stores.

The objectives of the stores can be classified as follows:

* Receipt: Receiving and accounting of raw-materials, bought out parts, spares, tools, equipment and other items.
* Storage: Provision of right and adequate storage and preservations to ensure that the stocks do not suffer from damage, pilferage or deterioration.
* Retrieval: Facilitating easy location and retrieval of materials keeping optimum space utilization.
* Issue: Fulfilling the demand of consumer departments by proper issue of items on the
* receipt of authorized purchase requisitions.
* Records: To maintain proper records and update receipt and issue of materials.
* Housekeeping: Keeping the stores clean and in good order so that the handling, preservation, stocking, receipt and issue can be done satisfactorily.
* Control: Keeping a vigil on the discrepancies, abnormal consumptions, accumulation of stocks, etc., and enforcing control measures.
* Surplus Management: Minimization of scrap, surplus and obsolescence through proper inventory control, and effective disposal of surplus and obsolete items.
* Verification: Verifying the bin card balances with the physical quantities in the bins and initiating the purchasing cycle at appropriate time so as to avoid the out of stock situations.
* Coordination and cooperation: To coordinate and cooperate with the interfacing departments such as purchasing, manufacturing, production planning and control, inspection, etc.

A store is an important component of material management since it is a place that keeps the materials in a way by which the materials are well accounted for, are maintained safe, and are available at the time of requirement. Storage is an essential and most vital part of the economic cycle and store management is a specialized function, which can contribute significantly to the overall efficiency and effectiveness of the materials function. Literally store refers to the place where materials are kept under custody.

A store has a few processes and a space for storage. The main processes of a store are

1. to receive the incoming materials (receiving)
2. to keep the materials as long as they are required for use (keeping in custody), and
3. to move them out of store for use (issuing).

The auxiliary process of store is the stock control also known as inventory control. In a manufacturing organization, this process of receiving, keeping in custody, and issuing forms a cyclic process which runs on a continuous basis. The organizational set up of the store depends upon the requirements of the organization and is to be tailor made to meet the specific needs of the organization.

Store is to follow certain activities which are managed through use of various resources. Store management is concerned with ensuring that all the activities involved in storekeeping and stock control are carried out efficiently and economically by the store personnel. In many cases this also encompasses the recruitment, selection, induction and the training of store personnel, and much more.

The basic responsibilities of store are to act as custodian and controlling agent for the materials to be stored, and to provide service to users of these materials. Proper management of store systems provide flexibility to absorb the shock variation in demand, and enable purchasing to plan ahead.

Since the materials have a cost, the organization is to manage the materials in store in such a way so that the total cost of maintaining materials remains optimum.

Store needs a secured space for storage. It needs a proper layout along with handling and material movement facilities such as cranes, forklifts etc., for safe and systematic handling as well as stocking of the materials in the store with an easy traceability and access. It is to maintain all documents of materials that are able to trace an item, show all its details and preserve it up to its shelf life in the manner prescribed or till it is issued for use. Store is to preserve the stored materials and carry out their conservation as needed to prevent deterioration in their qualities. Also store is to ensure the safety of all items and materials whilst in the store which means protecting them from pilferage, theft, damage, deterioration, and fire.

The task of storekeeping relates to safe custody and preservation of the materials stocked, to their receipts, issue and accounting. The objective is to efficiently and economically provide the right materials at the time when it is required and in the condition in which it is required. The basic job of the store is to receive the materials and act as a caretaker of the materials and issue them as and when they are needed for the activity of the organization.

Once the material has been received and cleared through inspection and accepted for use, it needs safe custody of the stores. The role of custody is to receive and preserve the material. A stage comes when the material is needed for use. Store at that time releases the material from its custody to the user department and the process is called ‘issue of goods. It might also happen that after partial use, some materials having useable value in future are returned to the store and thus they also become part of the custody again.

Storekeeping activity does not add any value to the materials. In fact, it adds only to the cost. The organization is to spend money on space (expenditure on land, building passage and roads), machinery (store equipment), facilities (e.g. water, electricity, communication etc.), personnel, insurance, maintenance of store equipment, stationary etc. All of these get added to the organizational overheads and finally get reflected in the costing of the finished product. However, it is an essential function in any organization.

**Store Location and Layout**

The concept of store location and layout can be explained as follows:

**Store Location**

The location of stores is a strategic decision which if once taken cannot be easily undone. It would be extremely costly to change the storage location at a later stage. It should be carefully decided and planned so as to ensure maximum efficiency. The optimal location of stores reduces the total transportation, handling and other costs related to stores operation and at the same time provided the needed protection for stores items. The models of facilities planning can be applied to determine the optimal storage location in large size organizations. Store location depends upon the nature and value of the items to be stored and the frequency with which the items are received and issued to the different departments.

Stores are generally located close to the point of use. Raw-materials stores are usually located near the first operation (in case of line layout), in process stores near to subsequent operation, and finished goods stores near the shipping area. The tools and supplies stores are located centrally to the personnel and equipment served.

**Location of a Store:**

**(a) Centralized Store:**

In small factories, it is desirable to centralize the materials so that they may be brought under the control of one store-keeper and the store-room should be as far as possible near the place, where material is to be used.

If there are several manufacturing departments, the store-room will be most conveniently situated, where it is near to all depart­ments. This will reduce handling and a lot of manual work is eliminated.

This type is called Centralized Store.

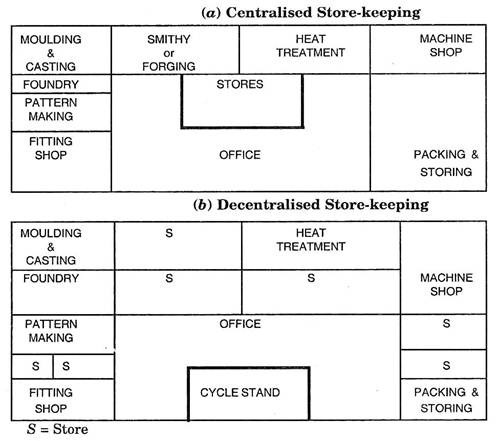
**(b) Decentralized Store:**

In large factories, where there are several departments, each using different type of materials, it becomes beneficial to separate the stores.

For example, near the welding department, store the materials required for welding; near the foundry department, store the items which are used there; near assembly department, store the parts that are required there and so on.

Some stores that are common to several or all departments, as for example, soap, station­ary, printed forms, cotton waste etc., should be kept at a central place. This type is known as Decentralized Store.

**Examples of both the types are shown with the help of sketches below:**



In big plants it may not be possible to locate the stores which are convenient to all the departments and at the same time near to the receiving section. Usually a central store is located near the receiving section and the issues are decentralized by setting up sub stores conveniently located to serve user departments.

The location and building up of stores should be done with a futuristic outlook. The provision for the new departments and the increase in the volume to be stored should be kept.

**Layout and Design of Stores**

The efficient layout and design of stores is very important from the point of view of its functioning which is linked to the overall functioning of the plant.

A good layout must bring the point of origin, store room and point of use in adjacent and proper reference of best material flow.

The planning and design of stores should be carried out with the following objectives in mind:

* To achieve maximum ease of operation with ready accessibility of major materials.
* To achieve minimum waste of space and flexibility of arrangement.
* Minimization of material handling requirements.
* Minimization of material deterioration and pilferage.

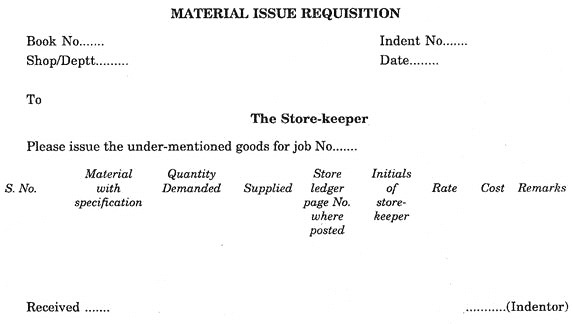
**Issuing Inventory and Documents used in stores**

There are a number of documents that are used in stores department of which the most important are:

**Materials requisition notes/ Indent**

These are documents issued to production departments. Their purpose is to authorize the storekeeper to release the goods which have been requisitioned and to update the stores records. It is also called material issue requisition. An important rule, which should be strictly followed, is not to allow any materials to pass from the stores department into the works except upon the authority of written requisition. These indents demand upon the store-keeper signed by authorized person to issue the material to bearer, to be charged to a particular job or department specified therein.

Such indents on stores are made out in triplicate from bound books supplied to each depart­ment. They contain the date, the necessary particulars of the stores requisitioned, such as quantity and description, order or job number to which the material is to be charged, depart­ment number, signature of the indentor, space for the initial of the issuing store-keeper and the signature of the person receiving the material.



**Materials returned notes**

This is a document used to record any unused materials which are returned to stores. They are also used to update the stores records. The diagram below shows a materials returned note

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Material Returned Note**  From Job No: ……………Serial No.: …………….…......  Date: …………………………  Signature: ………………….  Please receive the under mentioned materials (Foreman) | | | | | |
| Description of materials | Reasons of returning | quantity | Rate | Value | Stock ledger No. |
|  |  |  |  |  |  |
| Bin card no: …………… Received: …………….  Signature: …………….  (Storekeeper) | | | | | |

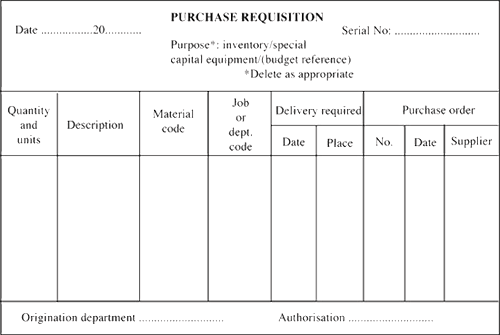
**Materials transfer notes**

This is a document used in the transferring of materials from one production department to another. They are also used to update the stores records. The diagram below shows a materials transfer note

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Materials transfer note**  **Serial No:………………..**  From: ……………………. ……………. To: ………………………...  Department: …………………………… Department: ……………...  Job No: …………………………………Date: ……………………... | | | | |
| Qty | Code No. | Description | Rate | Amount |
|  |  |  |  |  |
| Issued by: ……………… Approved by: ………………Received by: ……….. | | | | |

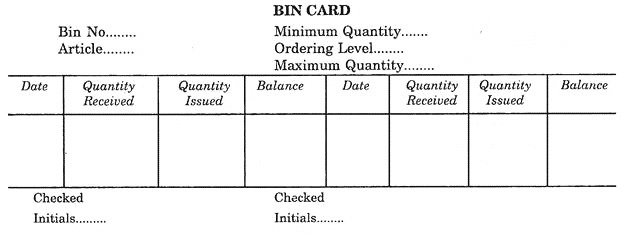
**Purchase requisition**

This is a document that shows the materials which are required to complete specific jobs. The materials should be monitored and re-ordered when levels become low. This document is sent to the purchases department and is effectively an internal purchase order. The diagram below shows a purchase requisition



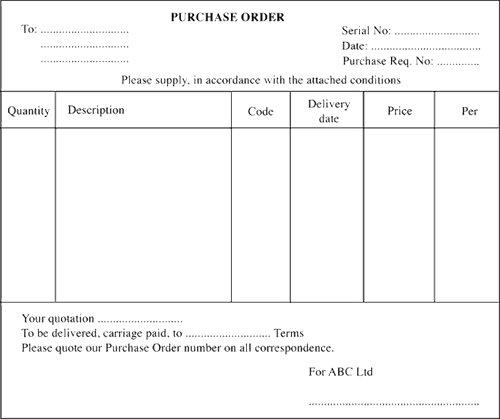
**Bin Card:**

This is a card which is attached to each bin, rack, shelf or other container for stores. A record of all materials entering or leaving the bin and balance of material in hand is kept in this card. These cards are entered by the store-keeper and only the quantities are recorded.



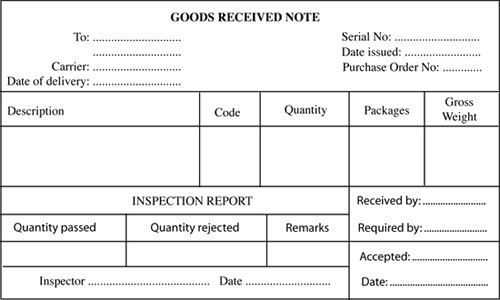
**Purchase order**

This is a document which shows the materials which the company is ordering and includes the volume of materials as well as delivery details expected and the value of materials being ordered. It is prepared by the purchase department but it has origins in stores department. The diagram below shows a purchase order.



**Goods Received note**

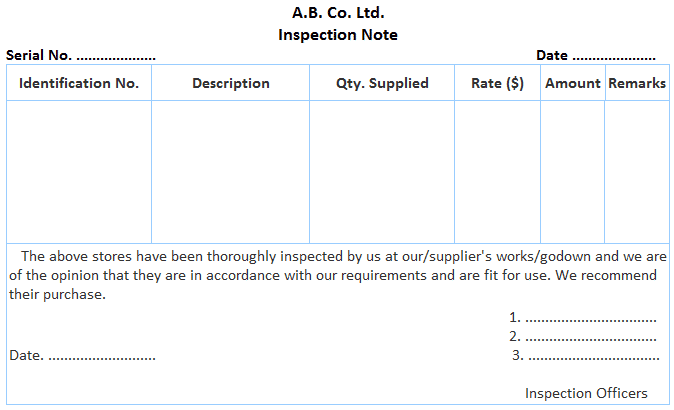
This is a document which shows the materials that have been received from the supplier. It compares the ordered stocks with the stocks received. The diagram below shows a goods received note.



**Inspection note**

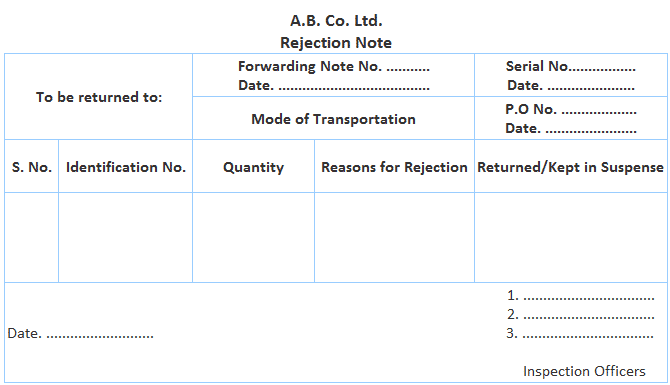
This is a document used to record goods which are not faulty or are not used. This note is then passed to the accounts department so that they can request a credit note for faulty goods.

The specimen of the inspection note is given below:



**Rejection note**

If the materials received are not found to be in accordance to the purchase order or fit for use, the inspecting staff rejects them for return to the supplier. For this purpose, a document known as Rejection Note is prepared. The specimen of the Rejection note is given below:



**Stores Ledger**

This is a document which shows the materials that have been received and it includes the outstanding items of an order, together with the costs of materials. The “stores ledger” generates the value of the closing stock at any time. Along with everything, a store ledger has information like the name of the material, different stock levels, code numbers, etc.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STORES LEDGER CARD**  **Description: ……………………Unit: ……………...Location: …………………. Code: ………………......**  **Maximum: ………………………Minimum: ………Reorder level: …………… Reorder quantity: ……** | | | | | | | | |
| Receipts | | | Issues | | | On order | | |
| Date/ref | Quantity | K | Date/ref | Quantity | K | Date/ref | Quantity | K |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

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**Activity**

1. Define stores location.
2. Discuss at least four factors that must be considered when setting up the stores.
3. Explain why it is important to consider the size when setting up the stores.

summary

**Summary**

The stores department is an important section in an organisation which has to be well and secured located. It has to be well carefully decided and planned in order to ensure maximum efficiency. The location of stores must minimize transportation; handling and other costs related to stores operation and at the same time provided the needed protection for stores items.

The stores location has to depend upon the nature and value of the items to be stored.

**Unit 2: Introduction to Inventory Management**

**Introduction**

Inventory is a modern trend. We can say that Inventories are one of the main ingredients for any physical distribution system. We cannot distribute any product without any inventory.

However, costs and investments are involved in inventories. If inventory policy of a company dictates maintenance of large stocks, then transportation characteristic will be FTL (Full truck Load) shipments.

**Outcomes**

**Learning Outcome**

By the end of this unit you should be able to;

* Explain inventory Management
* Explain the role of inventory
* Discuss the role in the competitive strategy
* Describe what inventory plays an important role in a supply chain

Time**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Inventory Management**

Inventory management can be defined as the sum total of those related activities essential for the procurement, storage, sale, disposal or use of material.

To conclude, utilities are created in goods when the right product is available at the right place, at the right time, at the right quantity and is available to the right customer. Inventory management deals itself with all these problems, placing importance on the quantities of goods needed.

Inventory is a most important source of cost in any supply chain and it has an enormous impact on responsiveness. If we think of the responsiveness range the location and quantity of inventory can move the supply chain from one end of the spectrum to the other. Levels at the retail store have a high level of responsiveness because a consumer can walk into a store and walk out with the shirt he is looking for.

Inventory also has a major impact on the material flow time in a supply chain. Material flow time is the time taken between the points at which material enters the supply chain to the point at which it exits. Another important area where inventory has a significant impact is throughput?

If inventory is represented by I, flow time by T, and throughput by D, the three can be related using Little’s law as follows:

**I = DT**

For example, if the flow time of an auto assembly process is ten hours and the

throughput is 60 units an hour, Little Law tells us that the inventory 60 x 10 =600

units. If we were able to reduce inventory to 300 units while holding throughput

constant, we would reduce out flow time to five hours (300/60). We note that in this

relationship, inventory and throughput must have consistent units.

The logical conclusion here is that inventory and flow time are synonymous in any supply chain. Managers must use measures that lower the amount of inventory needed without increasing cost or reducing responsiveness, because reduced flow time can be a significant advantage in a supply chain.

**Role in the competitive strategy**

Inventory plays an important role in a supply chain’s ability to support a company’s competitive strategy. If a company’s competitive strategy requires a very high level of responsiveness, a company can use inventory to achieve this responsiveness by locating large amounts of inventory close to the customer. Conversely, a company can also use inventory to make it more efficient by optimizing inventory through centralized stocking. The latter strategy would support a competitive strategy of being a low-cost producer. The trade-off implied in the inventory driver is between the responsiveness that results from more inventories and the efficiency that results from fewer inventories.

**Inventory control**

**PROFIT\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**ROI =**

**TOTAL ASSETS (FA+CA)**

• **Materials account for nearly 50% of total costs**

• **Inventory accounts for nearly 75% of CA**

Achieving the objectives of inventory control will result in more return on capital which is the prime objective of an organization, whether commercial or industrial. The formula given above is useful in arriving at the return of investment.

Another measure of healthiness of inventory control is Inventory Turnover Ratio (ITR). It is the ratio of total sales during specific time period (generally 1 year) to average inventory on hand during that time period.

Inventory Turnover ratio (ITR) (Finished Goods) **= Annual Sales/Average Inventory**

Inventory Turnover Ratio (ITR) (Raw Material) **= Annual Consumption/Average inventory**

**Example**

The following table shows the sales and inventory details (in millions) of 3 sub-assemblies A, B & C of a project.

Particulars A B C **Total**

Sales 320 40 2 362

Raw Material 31 5 4 **40**

Finished Goods 22 9 8 **39**

WIP 10 4 2 **16**

Others 17 2 2 **21**

ITR (A) = 320:80 = **4:1**

ITR (B)= 40:20 = **2:1**

ITR (C) = 2:16 = **1:8 (Very Poor)**

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**Activity**

1. What are the functions of inventory?
2. Discuss inventory management.
3. Explain why it is important to consider the size when setting up the stores.

summary

**Summary**

Inventory is one of the most important sources of cost in any organisations in particular in the aspect of supply chain and it has a big impact on responsiveness. If we think of the responsiveness range the location and quantity of inventory can move the supply chain from one end of the spectrum to the other. Levels of inventory at the retail store have a high level of responsiveness because the consumers can walk into a store and walk out with the shirt he is looking for.

Inventory also has an influential major impact on the material flow time in a supply chain as material flow time is the time taken between the points at which material enters the supply chain to the point at which it exits.

**UNIT 3: Functions of Inventory**

**Introduction**

The inventory does not include any material that supports production; these materials are called indirect materials. But raw material is limited to the direct material (or) component that actually becomes a part of the final product. The total inventory carrying cost is a minimum but the level of inventory is such that it does not affect the production or customer base.

**Outcomes**

**Learning out comes**

The learners should be able to:

* Explain the functions of inventories
* Describe the desired customer service level
* Discuss the types inventory

Time**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Functions**

Inventories have four functions. They are:

**Minimize costs at acceptable inventory levels:** Replacing inventories in exceptionally small quantities result in low investments but high ordering costs. Thus, a point has to be set where the total inventory carrying cost is bare minimum but the level of inventory is such that it does not affect the production or customer base.

**Provide desired customer service level:** Inventories offer service in terms of satisfying customer demand. Inventory influences the time and costs of service. The location of inventory determines the time in which the customer will be served while a company policies concerning the economic order quantity, safety stocks, placement procedures and time will determine the cost at which the customer will be served.

**Couple successive operations or functions:** The decoupling effect of inventories is apparent throughout manufacturing and distributions systems. Normally in the absence of inventories in a system, a demand by a customer triggers a chain reaction of demand at each preceding level, i.e. manufacturing and purchasing. But the customer does not have time or patience to wait for the chain reaction. A small inventory requires frequent response rather than instant response from the transport system, whereas, a large inventory reduces the need for frequent response and cost of transport system. The decoupling effect of inventories allows a physical distribution manager to choose amongst various inventory management policies.

**Stabilize production and the labor force, thereby trying to reduce capital requirements:** This function of inventories is more associated to the manufacturing process, though it influences the distribution function as well.

**Types of inventory**

* **Raw Material Inventory**
* **WIP Inventory**
* **Finished Goods Inventory**
* **MRO Inventories.**

**Raw Material Inventory**

The materials, from which the final product of the company is made, are the raw materials. The material does not include any material that supports production; these materials are called indirect materials. But raw material is limited to the direct material (or) component that actually becomes a part of the final product. The steel used for automobile production is good example of a raw material kept in mind, though that the raw material of one industry is usually the finished product of another. Some of the raw materials may be available only seasonally, like cotton, sugar cane etc. There are certain raw materials which are governed by government control and quota system, like newsprint, coke etc.

The size of the raw material inventory is dependent upon factors such as:

* internal lead time for purchase,
* supplier lead time,
* vendor relations,
* availability of raw materials
* government import policy in the case of imported material,
* the annual consumption of the materials and
* the criticality of the material.

Some of the examples of raw material inventory are steel, wood, cloth or other materials used to make components of the finished product.

The reasons for keeping this inventory are:

1. Seasonal factors of availability and price advantage.
2. As protective buffer against:
   * Delays in supply
   * Change in production rates due to market fluctuations for the finished products, etc.

**WIP Inventory (Work-In-Process Inventory)**

All materials that have been transformed from their raw materials stage by some manufacturing process but are not final products are work in-process goods.

Sometimes, what may appear to be a final product is still really an in –process good if the final production step is a packaging one. It is in-process until it is in the form that can leave the plant. WIP can be found on the conveyors, trucks, pallets, in and around the machines and in temporary areas of storage waiting to be worked upon or assembled.

In building a ship or boiler the raw material is held as in-process stock till the complete ship is made. This is true in most of the heavy Engineering industries like cement plant, chemical plant. Some time they dispatch sector by sector to the site to reduce the in-process inventory. In continuous process industries the amount of in process held is optimum, which cannot be reduced or increased like in petroleum refining, cement manufacturing and chemical industries.

The size of the inventory is dependent on the production cycle time, the percentage of machine utilization, the make/buy decision of the company, and the management policy for decoupling the various stages of manufacturing.

The reason for keeping In-Process inventory is

* As liquid stock to cater for variety and shorten the manufacturing cycle.
* As protective buffer against production breakdowns, rejections etc.
* For economic lot production.

**Finished Goods Inventory**

Finished goods inventory consists of all the stock that is ready for dispatch. In a bottling plant for example, the finished products are the bottles of beverages that are in their cartons or cases and are ready for shipment. This finished goods inventory acts as a buffer between the production department and the marketing department. Higher the stock of finished goods, then the cost of inventory is high. If the stock level is low or nil then the customer service will be affected .This will damage the good will of the customer about the company and the product. The purpose of this inventory is to reach the market by constant supply through distribution channels. This is controlled by the marketing department. The stock that is to be held at the warehouses, with the distributors and with retailers will be different depending upon the sales rate.

In pharmaceutical industries, the finished product stock will be very high at the distributors and retailers level as they have to stock all types and brand of medicine with the risk of expiry dates.

In case of daily newspapers there should be absolutely nil finished stock as its life is only one day.

The size of the finished goods inventory also depends on:

* the ability of the marketing department to push the products,
* the company’s ability to stick to the delivery schedule of the client,
* the shelf life and the warehousing capacity.

The other reasons for holding this inventory are

* To protective buffer against sales rate changes.
* To absorb economic production lots.
* To stabilize the level of production and employment when the sales is of a seasonal variety.

**MRO Inventories**

Maintenance, repairs and operating supplies which are consumed during the production process and generally do not form part of the product itself (e.g. oils and lubricants, machinery and plant spares, tools and fixtures, etc) are referred to as MRO inventories

**Inventory Cost**

**Order cost or Procurement cost**

Procurement cost is the total cost incurred during the ordering of an item (Ramakrishnan and Arnold 2007). These costs are not connected with the quantity ordered but primarily with physical activities required to process the order.

For **purchased items,** these would include the cost to enter the purchase order and/or requisition, process involved in getting the approval of the purchase order, the cost to process the receipt, raw material inspection, invoice processing for vendor payment, and in some cases a portion of the inbound freight may also be included in procurement cost. It is important to understand that these are costs associated with the frequency of the orders and not the quantities ordered. For example, in your receiving department the time spent checking in the receipt, entering the receipt, and doing any other related paperwork would be included, while the time spent repacking materials, unloading trucks, and delivery to other departments would likely not be included. If you have inbound quality inspection where you inspect a percentage of the quantity received you would include the time to get the specs and process the paperwork and not include time spent actually inspecting, however if you inspect a fixed quantity per receipt you would then include the entire time including inspecting, repacking, etc. In the purchasing department you would include all time associated with creating the purchase order, approval steps, contacting the vendor, expediting, and reviewing order reports, you would not include time spent reviewing forecasts, sourcing, getting quotes (unless you get quotes each time you order), and setting up new items. All time spent dealing with vendor invoices would be included in procurement cost.

Associating actual costs to the activities related with order cost is where many an EOQ formula runs afoul. Do not make a list of all of the activities and then ask the people performing the activities "how long does it take you to do this?" The results of this type of measurement are rarely even close to accurate. It was found it to be more effective to determine the percentage of time within the department consumed performing the specific activities and multiplying this by the total labor costs for a certain time period (usually a month) and then dividing by the line items processed during that same period.

It is extremely difficult to correlate inbound freight costs with order costs in an automated EOQ program and it only if the inbound freight cost has a noteworthy effect on unit cost and its effect on unit cost varies significantly based upon the order quantity.

In manufacturing**,** the order cost would include the time to initiate the work order, time taken for picking and issuing components excluding time associated with counting and handling specific quantities, all production scheduling time, machine set up time, and inspection time. Production scrap directly associated with the machine setup should also be included in order cost as would be any tooling that is discarded after each production run. There may be times when you want to artificially inflate or deflate setup costs. If you lack the capacity to meet the production schedule using the EOQ, you may want to artificially increase set-up costs to increase lot sizes and reduce overall set up time. If you have excess capacity you may want to artificially decrease set up costs, this will increase overall set up time and reduce inventory investment. The idea being that if you are paying for the labor and machine overhead anyway it would make sense to take advantage of the savings in reduced inventories.

**Carrying Cost**

Also called Holding cost, carrying cost is the cost associated with having inventory on hand. It is primarily made up of the costs associated with the inventory investment and storage cost. For the purpose of the EOQ calculation, if the cost does not change based upon the quantity of inventory on hand it should not be included in carrying cost. In the EOQ formula, carrying cost is represented as the annual cost per average on hand inventory unit.

Below are the primary components of carrying cost.

* **Interest**. If you had to borrow money to pay for your inventory, the interest rate would be part of the carrying cost. If you did not borrow on the inventory, but have loans on other capital items, you can use the interest rate on those loans since a reduction in inventory would free up money that could be used to pay these loans. If by some miracle you are debt free you would need to determine how much you could make if the money was invested.
* **Insurance**. Since insurance costs are directly related to the total value of the inventory, you would include this as part of carrying cost.
* **Taxes.** If you are required to pay any taxes on the value of your inventory they would also be included.

**Storage Costs**.

Mistakes in calculating storage costs are common in EOQ implementations. Generally companies take all costs associated with the warehouse and divide it by the average inventory to determine a storage cost percentage for the EOQ calculation. This tends to include costs that are not directly affected by the inventory levels and does not compensate for storage characteristics. Carrying costs for the purpose of the EOQ calculation should only include costs that are variable based upon inventory levels.

Since storage costs are generally applied as a percentage of the inventory value you may need to classify your inventory based upon a ratio of storage space requirements to value in order to assess storage costs accurately. For example, let's say you have just opened a new E-business called "BobsWeSellEverything.com". You calculated that overall your annual storage costs were 5% of your average inventory value, and applied this to your entire inventory in the EOQ calculation. Your average inventory on a particular piece of software and on 80 lb. bags of concrete mix both came to K10,000. The EOQ formula applied a $500 storage cost to the average quantity of each of these items even though the software actually took up only 1 pallet position while the concrete mix consumed 75 pallet positions. Categorizing these items would place the software in a category with minimal storage costs (1% or less) and the concrete in a category with extreme storage costs (50%) that would then allow the EOQ formula to work correctly.

Other costs that can be included in carrying cost are risk factors associated with obsolescence, damage, and theft. Do not factor in these costs unless they are a direct result of the inventory levels and are significant enough to change the results of the EOQ equation.

**Out of stock costs**

These are the third category of cost associated with inventory. These are incurred when a customer places an order and the order cannot be filled from the inventory to which it is normally assigned.

Costs are divided into main categories as:

* **Lost sales costs**
* **Back-order costs.**

**Lost Sales Costs:** These occur when the customer, faced with an out-of-stock situation, chooses to withdraw his order for the product. The cost is the profit that would have been made if the sale had occurred and the cost of negative effect that the stock out may have on future sales. The higher is the degree of substitutes available in the market, the higher is the cost. The lost costs are intangible and difficult to measure and usually estimated on the basis of personal perceptions of executives.

**Back order costs:** Back order costs assume that a customer will wait for his order to be filled so that the sales is not lost, only delayed. But these back-orders create clerical and sales costs for order-processing additional transport, which have to be

**Over stock costs:** Another category in which a company can incur is the cost concerned with the circumstances when the company is left with some stock on hand even after the demand for the product has terminated. The interpretation of this cost is proportional to whether the inventory is static or dynamic.

**Need to hold Inventory**

There are number of reasons why a company might choose or need to hold stocks of different products. In planning any distribution system, it is essential to be aware of these reasons, and to be sure that the consequences are adequate but not excessively high stock levels. The main reasons for holding stock can be summarized as follows:

* **To keep down productions costs:** Often it is costly to set up machines so production runs need to be as long as possible to achieve low unit costs. It is essential, however, to balance these costs with the costs of holding stock.
* **To accommodate variations in demand:** The demand for a product is never wholly regular so it will vary in the short term, by season, etc, to avoid stock outs, therefore, some level of safety stock must be held.
* **To take account of variable supply leads:** Additional safety stock is held to cover any delivery delays from suppliers.
* **Buying costs:** There is an administrative cost associated with raising an order, and to minimize this cost it is necessary to hold additional inventory. It is essential to balance these elements of administration and stock-holding, and for this the economic order quantity (EOQ) is used.
* **To take advantage of quantity discounts:** Some products are offered at a cheaper unit cost if they are bought in bulk.
* **To account for seasonal fluctuations:** These may be for demand reasons whereby products are popular at peak times only. To cater for this while maintaining an even level of production, stocks need to be built up through the rest of the year. Supply variations may also occur because goods are produced only at a certain time of the year.
* **To allow for price fluctuations/speculations:** The price of primary products can fluctuates for a variety of reasons, so some companies buy in large quantities to cater for this.
* **To help the production and distribution operations run more smoothly:** Here, stock is held to ‘decouple’ the two different activities.
* **To Provide Customers with immediate service:** It is essential in some highly competitive markets for companies to provide goods as soon as they are required.
* **To minimize production delays caused by lack of spare parts:** This is important not just for regular maintenance, but especially for breakdown of expensive plant and machinery. Thus spares are held to minimize plant shutdowns.
* **Work in progress:** This facility the production process by providing semi-finished stocks between different processes.

**Mechanics of Inventory Control**

Inventory control consists of finding answers to three questions

1. Should this item be stocked at all?
2. If so, when to order it?
3. How much to order?

Though these are the questions the inventory control tries to answer more stress is upon the last two questions. This is so because, what to stock is the question of sales forecasting for the target market. No item, not even the cheapest item, should be stocked without careful review. This should be a continuous process as the environmental which dictates supply of inventory and the demand environment keep changing continuously.

Suppose, a manager based on his hunch may decide to buy 5000 items of a product in stock once a month. This is so because the item costs only 10.

Error could be

* Increased order and acquisition cost
* Increased cost of transportation and packaging
* Increased receiving and inspection cost.

The cost will be twelve times higher, as compared to the situation if the stock is ordered once a year, i.e. K.6000 p. a

Let’s assume another possible situation where hunch could prove strategically wrong. If the unit cost was high, i.e. K1, 000/- and the company needed on an average 500 units p.m. what can the manager do? He has two options- first is to order in larger lot sizes for a couple of months so that transport and order processing costs are economies. Secondly, he could order on a monthly basis. But the second would increase the transport and order costs and thus he will opt for the first option (following the rule of thumb), i.e. order in lots for six months.

Error could be:

* Increased inventory carrying cost
* Increased risk of obsolescence and deterioration

These examples prove that inventory control is a very sensitive area. The decision should be taken in relation to the overall environment of inventory management rather than on the basis of hunches or rule of thumb. This is so because the environment of inventory management is very complex. For example, demand for a product can be predictable or uncertain. Customers may be small, medium or big and there may be total uncertainty about whether they will buy from you or someone else. Considering this uncertainty of the environment, quantitative tools must be used

to exercise inventory control and answer the above questions.

**When to Order?**

Under the modern concept, inventory should directly contribute to profitability of the company and should be concerned with such matters as flow, lead times, storage costs, and acquisition costs, material handling equipment, preservation and packaging.

General levels of stock should be related to sales and production policies of the firm,

in the same way specification is related to technical needs. The various levels of stocks are:

1. **Deficiency Level:**

This means stock in hand is inadequate to meet the needs. Existence of this level indicates actual or potential out-of-stock situation. Orders are placed through a faster alternative source of supply.

1. **Exhaust bin level:** This is a point popularly known as out of stock. At this point, the storage bin is empty. Emergency measures are taken to stock the bin.
2. **Buffer stock or minimum stock level:** This is the level at which any further demands upon the bin will necessitate with drawls from the reserve or buffer stock, especially when demand is immediate and fresh deliveries will take time to arrive. Usually the goods are ordered through normal channels as soon as the inventory reaches this level.
3. **Danger warning level:** It is the point of no return. After this point, a stock – out is inevitable if delay occurs. A computer program can readily include warning levels. The level should be such that if there is a possible delay, the processing should reveal this in time and the manager should take one of the following actions:

* Find an alternative source of supply
* Request sales department to warn their customers of possible delay in supplies.

**Selective Inventory Control**

The same phenomenon is noticeable in inventories as well. One would find that 20 percent of the total stock contributes to 80 percent of the value. And these 20 percent are most crucial as far as companies’ production is concerned. Realizing this phenomenon, inventory control in its attempt to reduce the cost of inventory, adopts the policy of selective control.

In selective control, inventory of high-value items is controlled because they give greatest returns. Also, not much care is assigned for the low-value items, because the returns are low. Very broadly, selective control is divided into eight categories as **ABC, HML, VED, SDE, GOLF, FSN, SOS, XYZ**.

These are summarized below:

|  |  |  |
| --- | --- | --- |
| Classification | Stands For | Criteria |
| ABC | Always Better Control | Annual value of consumption of the |
| HML | High Medium Low | Unit Price of material(Opposite of ABC |
| VED | Vital Essential Desirable | Critical nature of the component in respect to production |
| SDE | Scare, Difficult to obtain and  easy to obtain | Purchasing problem in regard to availability |
| GOLF | Government, Ordinary, Local,  Foreign | Source of material |
| FSN | Fast, moving, slow moving or  non moving | Issues from Stores |
| XYZ | ----------------------------- | Inventory Value of items stored |

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**Activities**

1. Define inventory control
2. Explain the four various levels of stocks
3. Explain the three primary components of carrying cost.
4. Discuss work in progress.

summary

**Summary**

Congratulation for reaching this far and am sure we are now confident in defining functions of inventory; we can discuss why inventory is associated with costs.

There are also a number of reasons why a company might choose or need to hold stocks of different products as to keep down productions costs, to accommodate variations in demand and to take account of variable supply leads.

To this effect all has to be planned for in any distribution system as it is cardinal to be aware of these reasons.

**Unit 4: Records Management**

**Introduction**

Congratulation for reaching this far, at this particular point we are going to turn our attention to records management. Let us sit back, relax and enjoy the end of the journey.

**Outcomes**

**Learning Outcome**

By the end of this unit you should be able to:

* Define records management
* Discuss why records are kept
* Explain the record keeping cycle
* Classify records management
* Explain records management practices and concepts
* Describe the conversion of records

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

Records management, also known as records and information management, is an organizational function devoted to the management of information in an organization throughout its life cycle, from the time of creation or inscription to its eventual disposition. This includes identifying, classifying, storing, securing, retrieving, tracking and destroying or permanently preserving records. The ISO15489-1: 2001 standard (ISO 15489-1:2001)defines records management as the field of management responsible for the efficient and systematic control of the creation, receipt, maintenance, use and disposition of records, including the processes for capturing and maintaining evidence of and information about business activities and transactions in the form of records.

An organization's records preserve aspects of institutional memory. In determining how long to retain records, their capacity for re-use is important. Many are kept as evidence of activities, transactions, and decisions. Others document what happened and why. The purpose of records management is part of an organization's broader function of governance, risk management, and compliance and is primarily concerned with managing the evidence of an organization's activities as well as the reduction or mitigation of risk associated with it.

**Inventory Records**

Inventory Records are used to keep track of the goods inside the manufacturing and service facility. Every material that is stocked at the factory must be identified and have an inventory record available for use during the material estimation process. Inventory records for each material must include: ID code, on hand, on order, lead times, and planning data Purchasing managers and head receivers are responsible for this activity. The head receivers update the stock cards upon delivery while purchasing managers update the inventory records and store them in a database for future use during the material estimation process.

**Records of Procurement**

In the Zambian public procurement organisation, records for all procurement proceedings shall be maintained. The records required shall be maintained for a period of seven (7) years from;

* Contract completion or termination
* The decision to terminate the procurement decisions
* The settlement of any disputes under the contract or
* The resolution of any complaint or appeal made.

**Concepts of record**

The concept of record is variously defined. The ISO 15489-1:2001 defines records as "information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in the transaction of business. While there are many purposes of and benefits to records management, as both these definitions highlight, a key feature of records is their ability to serve as evidence of an event. Proper records management can help preserve this feature of records.

Recent and comprehensive studies have defined records as "persistent representations of activities" as recorded or created by participants or observers. This transactional view emphasizes the importance of context and process in the determination and meaning of records. In contrast, previous definitions have emphasized the evidential and informational properties of records. In organizational contexts, records are materials created or received by an organization in the transaction of business, or in pursuit of or in compliance with legal obligations. This organizational definition of record stems from the early theorization of archives as organic aggregations of records that is "the written documents, drawings and printed matter, officially received or produced by an administrative body or one of its officials".

**Key records management terminology**

Not all documents are records. A record is a document consciously retained as evidence of an action. Records management systems generally distinguish between records and non-records (convenience copies, rough drafts, duplicates), which do not need formal management. Many systems, especially for electronic records, require documents to be formally declared as a record so they can be managed. Once declared, a record cannot be changed and can only be disposed of within the rules of the system.

Records may be covered by access controls to regulate who can access them and under what circumstances. Physical controls may be used to keep confidential records secure personnel files, for instance, which hold sensitive personal data, may be held in a locked cabinet with a control log to track access. Digital records systems may include role-based access controls, allowing permissions (to view, change and/or delete) to be allocated to staff depending on their role in the organisation. An audit trail showing all access and changes can be maintained to ensure the integrity of the records.

Just as the records of the organization come in a variety of formats, the storage of records can vary throughout the organization. File maintenance may be carried out by the owner, designee, a records repository, or clerk. Records may be managed in a centralized location, such as a records center or repository, or the control of records may be decentralized across various departments and locations within the entity. Records may be formally and discretely identified by coding and housed in folders specifically designed for optimum protection and storage capacity, or they may be casually identified and filed with no apparent indexing. Organizations that manage records casually find it difficult to access and retrieve information when needed. The inefficiency of filing maintenance and storage systems can prove to be costly in terms of wasted space and resources expended searching for records.

An inactive record is a record that is no longer needed to conduct current business but is being preserved until it meets the end of its retention period, such as when a project ends, a product line is retired, or the end of a fiscal reporting period is reached. These records may hold business, legal, fiscal, or historical value for the entity in the future and, therefore, are required to be maintained for a short or permanent duration. Records are managed according to the retention schedule. Once the life of a record has been satisfied according to its predetermined period and there are no legal holds pending, it is authorized for final disposition, which may include destruction, transfer, or permanent preservation.

A disaster recovery plan is a written and approved course of action to take after a disaster strikes that details how an organization will restore critical business functions and reclaim damaged or threatened records.

An active record is a record needed to perform current operations, subject to frequent use, and usually located near the user. In the past, 'records management' was sometimes used to refer only to the management of records which were no longer in everyday use but still needed to be kept – 'semi-current' or 'inactive' records, often stored in basements or offsite. More modern usage tends to refer to the entire ' lifecycle' of records – from the point of creation right through until their eventual disposal.

The format and media of records is generally irrelevant for the purposes of records management from the perspective that records must be identified and managed, regardless of their form. The ISO considers management of both physical and electronic records.

**Records life-cycle**

The records life-cycle consists of discrete phases covering the life span of a record from its creation to its final disposition. In the creation phase, records growth is expounded by modern electronic systems. Records will continue to be created and captured by the organization at an explosive rate as it conducts the business of the organization. Correspondence regarding a product failure is written for internal leadership, financial statements and reports are generated for public and regulatory scrutiny, the old corporate logo is retired, and a new one including color scheme and approved corporate font takes its place in the organization's history.

Examples of records phases include those for creation of a record, modification of a record, movement of a record through its different states while in existence, and destruction of a record.

Throughout the records life cycle, issues such as security, privacy, disaster recovery, emerging technologies, and mergers are addressed by the records and information management professional responsible for organizational programs. Records and information management professionals are instrumental in controlling and safeguarding the information assets of the entity. They understand how to manage the creation, access, distribution, storage, and disposition of records and information in an efficient and cost-effective manner using records and information management methodology, principles, and best practices in compliance with records and information laws and regulations.

**Records continuum theory**

The records continuum theory is an abstract conceptual model that helps to understand and explore recordkeeping activities in relation to multiple contexts over space and time.

**Records management practices and concepts**

A Records Manager is someone who is responsible for records management in an organization.

Section 4 of the ISO 15489-1:2001 states that records management includes:

* setting policies and standards
* assigning responsibilities and authorities
* establishing and promulgating procedures and
* guidelines
* providing a range of services relating to the management and use of recordsdesigning, implementing and administering specialized systems for managing recordsintegrating records management into business systems and processes.

Thus, the practice of records management may involve:

* planning the information needs of an organization
* identifying information requiring capture
* creating, approving, and enforcing policies and practices regarding records, including their organization and disposal
* developing a records storage plan, which includes the short and long-term housing of physical records and digital information
* identifying, classifying, and storing records
* Coordinating access to records internally and outside of the organization, balancing the requirements of business confidentiality, data privacy, and public access.
* Identification and maintenance of records per a specified retention period.
* executing a retention policy on the disposal of records which are no longer required for operational reasons; according to organizational policies, statutory requirements, and other regulations this may involve either their destruction or permanent preservation in an archive.

Records-management principles and automated records-management systems aid in the capture, classification, and ongoing management of records throughout their lifecycle. Such a system may be paper-based (such as index cards as used in a library), or may involve a computer system, such as an electronic records-management application.

**Defensible solutions**

A defensible solution is one that can be supported with clearly documented policies, processes and procedures that drive how and why work is performed, as well as one that has clearly documented proof of behavior patterns, proving that an organization follows such documented constraints to the best of their ability.

While defensibility applies to all aspects of records life cycle, it is considered most important in the context of records destruction, where it is known as " defensible disposition " or " defensible destruction," and helps an organization explicitly justify and prove things like who destroys records, why they destroy them, how they destroy them, when they destroy them, and where they destroy them.

**Classification of records management**

Records managers use classification or categorization of record types as a means of working with records. Such classifications assist in functions such as creation, organization, storage, retrieval, movement, and destruction of records.

At the highest level of classification are physical versus electronic records. (This is disputable; records are defined as such regardless of media. ISO 15489 and other best practices promulgate a functions based, rather than media based classification, because the law defines records as certain kinds of information regardless of media.)

* Physical records are those records, such as papers, that can be touched and which take up physical space.
* Electronic records, also often referred to as digital records, are those records that are generated with and used by information technology devices.

Classification of records is achieved through the design, maintenance, and application of taxonomies, which allow records managers to perform functions such as the categorization, tagging, segmenting, or grouping of records according to various traits.

**Managing physical records**

Managing physical records involves different disciplines or capabilities and may draw on a variety of forms of expertise.

**Identifying records**

If an item is presented as a legal record, it needs to be authenticated. Forensic experts may need to examine a document or artifact to determine that it is not a forgery, and that any damage, alteration, or missing content is documented. In extreme cases, items may be subjected to a microscope, x-ray, radiocarbon dating or chemical analysis. This level of authentication is rare, but requires that special care be taken in the creation and retention of the records of an organization.

**Storing records**

Records must be stored in such a way that they are accessible and safeguarded against environmental damage. A typical paper document may be stored in a filing cabinet in an office. However, some organisations employ file rooms with specialized environmental controls including temperature and humidity. Vital records may need to be stored in a disaster-resistant safe or vault to protect against fire and other uncertainties. In extreme cases, the item may require both disaster -proofing and public access, such as the original,

**Retrieval of records**

In addition to being able to store records, enterprises must also establish the proper capabilities for retrieval of records, in the event they are needed for a purpose such as an audit or litigation, or for the case of destruction. Record retrieval capabilities become complex when dealing with electronic records especially when they have not been adequately tagged or classified for discovery

**Circulating records**

Tracking the record while it is away from the normal storage area is referred to as circulation. Often this is handled by simple written recording procedures. However, many modern records environments use a computerized system involving bar code scanners, or radio-frequency identification technology (RFID) to track movement of the records. These can also be used for periodic auditing to identify unauthorized movement of the record.

**Disposal of records**

Disposal of records does not always mean destruction. It can also include transfer to a historical archive, museum, or private individual. Destruction of records ought to be authorized by law, statute, regulation, or operating procedure, and the records should be disposed of with care to avoid inadvertent disclosure of information. The process needs to be well-documented, starting with a records retention schedule and policies and procedures that have been approved at the highest level. An inventory of the records disposed of should be maintained, including certification that they have been destroyed. Records should never simply be discarded as refuse. Most organizations use processes including pulverization, paper shredding or incineration.

Commercially available products can manage records through all processes active, inactive, archival, retention scheduling and disposal. Some also utilize RFID technology for the tracking of the physical file.

**Managing electronic records**

The general principles of records management apply to records in any format. Digital records (almost always referred to as electronic records), however, raise specific issues. It is more difficult to ensure that the content, context and structure of records is preserved and protected when the records do not have a physical existence. This has important implications for the authenticity, reliability, and trustworthiness of records.

**Current issues**

**Security**

Privacy, data protection, and identity theft have become issues of increasing interest. The role of the records manager in the protection of an organization's records has grown as a result. The need to ensure personal information is not retained unnecessarily has brought greater focus to retention schedules and records disposal.

**Transparency**

The increased importance of transparency and accountability

**Adoption and implementation**

Implementing required changes to organizational culture is a major challenge, since records management is often seen as an unnecessary or low priority administrative task that can be performed at the lowest levels within an organization. Reputational damage caused by poor records management has demonstrated that records management is the responsibility of all individuals within an organization.

An issue that has been very controversial among records managers has been the uncritical adoption of Electronic document and records management systems.

**Impact of internet and social media**

Another issue of great interest to records managers is the impact of the internet and related social media, such as wikis, blogs, forums, and companies such as Facebook and Twitter, on traditional records management practices, principles, and concepts, since many of these tools allow rapid creation and dissemination of records and, often, even in anonymous form.

**Records life cycle management**

A difficult challenge for many enterprises is tied to the tracking of records through their entire information life cycle so that it's clear, at all times, where a record exists or if it still exists at all. The tracking of records through their life cycles allows records management staff to understand when and how to apply records related rules, such as rules for legal hold or destruction.

**Conversion of paper records to electronic form**

As the world becomes more digital in nature, an ever-growing issue for the records management community is the conversion of existing or incoming paper records to electronic form. Such conversions are most often performed with the intent of saving storage costs, storage space, and in hopes of reducing records retrieval time.

Tools such as document scanners, optical character recognition software, and electronic document management systems are used to facilitate such conversions.

**Electronic records management systems**

An Electronic Document and Records Management System is a computer program or set of programs used to track and store records. The term is distinguished from imaging and document management systems that specialize in paper capture and document management respectively. Electronic records management systems commonly provide specialized security and auditing functionality tailored to the needs of records managers.

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**Activities**

1. Define records management
2. Discuss why records are kept
3. Explain the record keeping cycle
4. Classify records management
5. Explain records management practices and concepts
6. Describe the conversion of records

summary

**Summary**

Congratulation for reaching this far and am sure we are now confident in defining records management, we can discuss why records are kept, give an explanation of record keeping cycle, records management and all the requirements of the learning outcome.

**Unit 5: Introduction to Warehouse Concepts, Decisions and Operations**

**Introduction**

We need different types of goods in our day-to-day life. We may buy some of these items in bulk and store them in our house. Similarly, businessmen also need a variety of goods for their use. Some of them may not be available all the time. But, they need those items throughout the year without any break. Take the example of sugar factory. It needs sugarcane as raw material for production of sugar. Since sugar production takes place throughout the year, there is a need to supply sugarcane continuously. Thus, the need for storage arises both for raw material as well as finished products. Storage involves proper arrangement for preserving goods from the time of their production or purchase till the actual use. The place where goods are kept is called ‘warehouse’. The person in-charge of warehouse is called ‘warehouse-keeper’.

**Outcomes**

**Learning outcomes**

After studying this lesson, you will able to:

* Explain the meaning of warehousing;
* Recognize the need for warehousing;
* Identify different types of warehouses;
* Explain the characteristics of ideal warehouses;
* Describe the functions of warehouses; and
* Enlist the advantages of warehouses.

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Need for Warehousing**

Warehousing is necessary due to the following reasons.

1. **Seasonal Production**- You know that agricultural commodities are harvested during

certain seasons, but their consumption or use takes place throughout the year. Therefore, there is a need for proper storage or warehousing for these commodities, from where they can be supplied as and when required.

1. **Seasonal Demand**- There are certain goods, which are demanded seasonally, like woolen garments in winters or umbrellas in the rainy season. The production of these goods takes place throughout the year to meet the seasonal demand. So there is a need

to store these goods in a warehouse to make them available at the time of need.

1. **Large-scale Production** - In case of manufactured goods, now-a-days production takes place to meet the existing as well as future demand of the products. Manufacturers also produce goods in huge quantity to enjoy the benefits of large-scale production, which is more economical. So the finished products, which are produced on a large scale, need to be stored properly till they are cleared by sales.
2. **Quick Supply** - Both industrial as well as agricultural goods are produced at some specific places but consumed throughout the country. Therefore, it is essential to stock these goods near the place of consumption, so that without making any delay these goods are made available to the consumers at the time of their need.
3. **Continuous Production**- Continuous production of goods in factories requires adequate supply of raw materials. So there is a need to keep sufficient quantity of stock of raw material in the warehouse to ensure continuous production.
4. **Price Stabilization**- To maintain a reasonable level of the price of the goods in the market there is a need to keep sufficient stock in the warehouses. Scarcity in supply of goods may increase their price in the market. Again, excess production and supply may also lead to fall in prices of the product by maintaining a balance of supply of goods, warehousing leads to price stabilization.

**Issues affecting Warehousing**

Since warehouses, stores and distribution centres have to operate as essential component elements within supply chains network, key decisions when setting up such facilities must be determined by the overall supply chain strategies for service and cost.

The factors that should be considered include the following:

**Market and product base stability**

Long-term market potential for growth and for how the product range may expand will influence decisions on the size and location of a warehouse facility, including space for prospective expansion. These considerations will also impact on the perceived need for potential flexibility, which in turn can influence decisions on the type of warehouse and the level of technology to be used.

**Type of materials to be handled:**

Materials handled can include raw materials, WIP, OEM Auto spare parts, packaging materials and finished goods in a span of material types, sizes, weights, products lives and other characteristics. The units to be handled can range from individual small items through carton boxes, special storage containers for liquids, drums, sacks, and palletized loads. Special requirements for temperature and humidity may also have to be met in the case of perishables and all of these will impact on the type of warehouses and technology level.

**Warehouse Facility: type, size and location**

The type of operation, the design capacity and size of a warehouse and its location will all be influenced if not directly determined by its exact role and position in the supply chain network, and the role, capacity and location of any other facilities in the supply chain. The customer base, level of inventory, the need for optimization of inventory, time compression in the supply chain and the overall customer service levels should also be considered when deciding on type, size and location. A further consideration here is whether the warehouse facility should be an own-account operation run by the company or outsourced and run by a 3PL.

**Inventory and Inventory Location:**

Within a supply chain network there is an issue not only of what materials to stock and in what quantities, but also in what locations. Options can include distribution centres devoted to specific markets or parts of the product range distribution centres dedicated to serving specific geographic areas, or regional distribution centres that hold for example the fast moving product lines, with the slower lines held only in a Regional distribution center (RDC). The option depends on such factors as customer base, product range and service levels required. The options on the level of technology have already been noted, and the range can go from very basic installations with high manual input and least mechanization to fully automated and robotic installations.

The decision can be influenced by:

1. Company-wide strategic marketing or employment policies,
2. Financial considerations,
3. Ability to achieve specified degree of throughput, and
4. Required customer service level.

Other factors can include the need for flexible operation to meet important demand fluctuations such as seasonal variations, and the perceived future stability and growth of the market and product range. The level of technology adopted in any particular application should be chosen because it almost nearly matches the given requirements and objectives. It is not true that automation or similar technologies are accurate in every case. It is true that good, probably computer-based, communication and information systems are vital in every application, irrespective of the technology level.

**Choice of Unit load:**

The option of unit load or loads – pallets, roll or cage pallets, tote bins - will be determined by the nature and characteristics of the materials passing through the supply chain, and this clearly encompasses an enormously wide range of goods, unit quantities, and pack types and sizes This may appear as a very important factor more subject to basic operation than to strategic influences. However, within the warehouse it can influence the option of handling equipment and the types of storage systems.

In the wider context it will affect transport operations in terms of vehicle loading and unloading and vehicle utilization.

**Selection of warehouse**

Warehouse Management and Physical Distribution are important flow control activities in the supply chain network. Regardless of the efficiency with which all preceding activities have been conducted, these activities have major influence in determining the degree to which total customer service level is achieved. In present global business environment, the quality of warehousing and distribution management can have major impact on corporate performance and profitability. The following flow chart clearly shows hierarchy of decisions to be made about the selection of warehouses in the strategic marketing policies with an objective of achieving max customer service level.

**Types of Warehouses**

After getting an idea about the need for warehousing, let us identify the different types of warehouses. In order to meet their requirement various types of warehouses came into existence, which may be classified as follows.

1. Private Warehouses
2. Public Warehouses
3. Government Warehouses
4. Bonded Warehouses
5. Co-operative Warehouses

**Private Warehouses** - The warehouses which are owned and managed by the manufacturers or traders to store, exclusively, their own stock of goods are known as private warehouses. Generally, these warehouses are constructed by the farmers near their fields, by wholesalers and retailers near their business centres and by manufacturers near their factories. The design and the facilities provided therein are according to the nature of products to be stored.

**Public Warehouses -** The warehouses which are run to store goods of the general public are known as public warehouses. Anyone can store his goods in these warehouses on payment of rent. An individual, a partnership firm or a company may own these warehouses. To start such warehouses a license from the government is required. The government also regulates the functions and operations of these warehouses. Mostly these warehouses are used by manufacturers, wholesalers, exporters, importers, government agencies, etc.

**Government Warehouses** -These warehouses are owned, managed and controlled by central or state governments or public corporations or local authorities. Both government and private enterprises may use these warehouses to store their goods.

**Bonded Warehouses** - These warehouses are owned, managed and controlled by government as well as private agencies. Private bonded warehouses have to obtain license from the government. Bonded warehouses are used to store imported goods for which import duty is yet to be paid. In case of imported goods, the importers are not allowed to take away the goods from the ports till such duty is paid. These warehouses are generally owned by dock authorities and found near the ports.

**Co-operative Warehouses** - These warehouses are owned, managed and controlled by co-operative societies. They provide warehousing facilities at the most economical rates to the members of their society.

**Private and public warehousing**

A warehouse may be privately owned and operated by a company making its own merchandise. This is called a **private warehouse**.

A warehouse may be owned and operated by another organization, including a government agency, and only used by a company on certain terms and conditions. This is called a public warehouse.

A public warehouse may be owned by a company in the private sector but used by the general public.

Irrespective of whether a warehouse is a private or a public warehouse, the following factors have to be taken into account to work out the cost of storage.

1. Interest on the capital used for buying the site.
2. Interest on the funds used to buy the furniture
3. Cost of repairs and maintenance
4. Depreciation on building and equipment
5. Insurance
6. If productivity (or efficient use) of the warehouse can be increased by 25 percent, there is an equivalent reduction in costs per unit handled and processed.
7. There are fixed costs in the shape of the cost of space per square meter or per cubic meter, etc.,
8. There are variable costs in the shape of cost per unit handled or processed, which must be added to the fixed costs.

**Private warehousing**

The construction and maintenance of private warehousing facilities can be extremely costly. All the expenses have to be carefully analyzed and evaluated.

These are:

1. Fixed expenses incurred on the acquisition of land and building, normally which are very high
2. Expenses, incurred on ensuring that warehouses are properly equipped with Motorized Handling Equipment (MHEs) like fork lifts, conveyors, semi-automatic trucks, storage racks and bins, and mezzanine floors, etc.
3. The cost of wages for staff required for peak activity periods like over time, which can be very high since retrenchment during slack periods may not be possible.
4. Extra payment like over time wage to be made for work on Saturdays, Sundays, and holidays.
5. Other service charges which are required in the maintenance of warehouse operations have to be taken into account.
6. Budgets have to be allocated for office and record keeping equipments for successful warehouse operations.
7. The cost of regular maintenance and repairs and the cost of such items as fire- extinguishers, fuel, air-conditioning, power and light have to be taken into account.
8. The cost of maintaining insurance records of premiums paid for fire, theft, and also for workmen’s compensation.

**Public warehousing**

All the forgoing cost factors operate in public warehousing as well. But, in public warehousing, the expenses are distributed over several consignments of their clients. In most cases, therefore, the net result is a lower cost for each consignment. Warehousing has become a extremely specialized service and a public warehousemen can provide improved service with greater flexibility for the end user. A company running a private warehouse will have to evaluate the costs incurred with the total figure for the complete service through public warehousing.

**Advantages of public warehousing**

Some of the advantages of public warehousing are:

1. It is in general less expensive and more efficient and effective to achieve more customer service level.
2. Public warehouses are usually strategically positioned and easily available.
3. Public warehousing is adequately flexible to meet most space requirements, for several plans are available to suit the requirements of different users.
4. Fixed costs of a warehouse are distributed among many users. Therefore, the overall

cost of warehousing per unit works out to a lower figure.

1. Public warehousing facilities can be given up as soon as necessary without any additional liability on the part of the user.
2. The costs of public warehousing can be easily and exactly ascertained, and the user pays only for the space and services he uses.
3. Conservation of capital is more in public warehousing
4. It has got enough space to handle peak requirements.
5. Public warehousing has reduced risk in their operations.
6. Public warehousing has got good economies of scale
7. It would give Tax advantages for end users.
8. Knowledge of exact storage and handling costs are available to end users.
9. It is insulated from labour disputes.

**Disadvantages of public warehousing**

1. problems in communication due to system incompatibility
2. Specialized services may not always be available whenever it is needed.
3. Adequate space may not always be available for end users.

**Advantages of private warehousing**

The advantages of private warehousing are:

1. Private warehousing offers better monitoring systems over the handling and storage of products as required by the management from time to time which would enhance the performance of the warehouse.
2. There is less likelihood or error in the case of private warehousing since the company’s products are handled by its own employees who are able to identify the products of their own company.
3. If there is sufficient volume of goods to be warehoused, the cost of private warehousing comparatively less than that of public warehousing. The cost of private warehousing per unit may be actually higher if the private warehouse is packed to the brim.
4. Private warehousing is the best choice for some of the locations and the products handled because of the non-availability of the public warehousing.
5. Private warehousing has the opportunity to specially design its facilities for automatic material handling equipment whereas public warehousing may have the same.
6. Enabling the end user to increase their efficiency by means of better design and structured lay-out.
7. efficient use of human resources in warehouse operation improves end users’ overall performance
8. Intangible benefits in the form of cost reduction in all the warehouse operations.

**Disadvantages of private warehousing**

1. Lack of Corporate flexibility which increases the complexity in the operation.
2. Financial issues
3. Low rate of return.
4. Tax issues are complicated.

These are summarized below.

|  |  |  |
| --- | --- | --- |
| Classification | Stands For | Criteria |
| ABC | Always Better Control | Annual value of consumption of the |
| HML | High Medium Low | Unit Price of material(Opposite of ABC |
| VED | Vital Essential Desirable | Critical nature of the component in respect to production |
| SDE | Scare, Difficult to obtain and  easy to obtain | Purchasing problem in regard to availability |
| GOLF | Government, Ordinary, Local,  Foreign | Source of material |
| FSN | Fast, moving, slow moving or  non moving | Issues from Stores |
| XYZ | ----------------------------- | Inventory Value of items stored |

**Methods of Controlling Stock Levels**

The basic approach to all inventory control methods is to establish a reorder level, which when reached means that the stock needs replenishment. The methods of controlling inventory levels are s follow:

**Re-order level system:**

Figure shows a typical stock replenishment system. It represents a smooth average

rate of consumption of 100 units per month. Supplies are obtained once in a quarter, i.e. three months’ consumption of 300 units. The minimum level (or safety or buffer stock) is fixed at 100 units or one month’s consumption. The lead time, let’s assume, in this case is 45 days. Thus, logically a company should re order the stock as soon as it reaches the level where the stock in the bin is equal to 45 days in other words, 250units and is called reorder level. The maximum stock held by the company, according to this figure will be 400 units or, reorder level quantity (300) plus buffer

Thus the rate of consumption of the inventory could be more than 100 units per month or it can be less than 100 units per month. The curve will sometimes dip into the buffer stock area and at others will be more than minimum level. However, in such cases, average inventory consumption can be taken to calculate the buffer stock levels and there is no problem once the buffer stock is achieved. The system is also known as the fixed quantity system.

**a) Optimum Order Quantity:** There are two major influences on the decision regarding quantity of product to order to accommodate the demand. First is the ordering cost and second, the inventory carrying cost. Because of the fixed nature of the ordering cost, it keeps on decreasing per unit as the order size increases. But this increases the time of storage for the quantity, i.e. It will increase the inventory conversion period (assuming constant rate of depletion).

The average annual unit inventory cost at point

**X = ICQ/2**

**Where**:

**X =** Average annual unit inventory cost.

**I =** Inventory Carrying cost as a percentage of unit cost.

**C=** Price per unit.

**Q=** Order Quantity in units.

The order cost (s) at point Q over the period of time comparable to inventory carrying cost for one year will be equal to

**D\* S/Q**

**Where:**

**D =** Annual rate of inventory depletion.

**S=** Order cost per order.

Because two levels are equal at point X, we have

**ICQ/2 = DS/Q**

Multiplying both sides by 2Q we get,

**(IC)Q2 = 2(DS)**

**Q2 = 2(DS) IC**

**Q\* = √2 (DS)/IC**

**Where**

**Q\*** = Optimum order quantity.

Let’s assume a manufactured item ZB. The manufacturing cost of this item is K600.The carrying cost in the stock is 25 percent, i.e. K150. The cost of placing an order is K100.Assume the demand to be constant at 2/3 units per day, based on a lot size day week. The order quantity will be

**Q\* =** √2(DS) IC

**=** √2 (208) (100)/.25(600)

**= 16.7 Units approx.17 Units**

**Where**

**DS =** 2/3 \* 6 \* 52

**Fixed time System:** This is also called as constant cycle system. In this case, instead of considering the stock level, we give more importance to time. Orders are placed at constant intervals to time. The quantities orders can change. Take the same example from re-order level figure. Here, the axis is showing the months in which the order was placed. Let’s say the orders were placed on the fifteenth of February or may. Then it would be a fixed time system. But in the graph, both the systems are merged. The time of placement of order is 100 percent motivated by administrative convenience or the EOQ

**Optimum Order interval:** The optimum length of the order interval, for any item in an inventory is a function of demand rate, ordering cost, and inventory holding cost for the unit.

Mathematically it can be presented as,

**Q\* =** √2DS/IC

**N\* = D/Q\***

Where N\* is optimum number of order placements in a time.

Therefore,

**Q\* = D/N\*** and **D/N\* = √2DS/IC**

**Thus**

**N\* = √DIC/2S**

**Expanding the example,**

**N\* = √ 208 (.25) (600)/2(100) = 12.5 units.**

I.e. orders should be placed every 313/12.5 =25 business days. (313 working days as six days a week)

**Reorder Level:**

The reorder point determines when the supply shipment should be initiated. If the reorder point is set too low, stock out position might occur and if it is set too high over stock costs will be high. Moreover, high reorder point will lead to increased investment in inventory and increased inventory carrying cost. A number of systems have been designed to establish the reorder point.

The basic reorder point formula is

**R = D \* T**

**Where:**

**R =** Reorder point

**D =** Average daily demand

**T=** Average performance cycle length

Take for example; ABC industry has a demand rate of approximately 100 u/ day and its performance cycle of 20 days.

Then, R = 100 \* 20= 2000 Units

In this kind of system, an order of predetermined amount is made when the stock of an item falls below the reorder point. The above approach is satisfactory as long as both D and T are certain. But when there is an element of uncertainty in any of these elements, then an inventory buffer is necessary. This is called **SS**.

Therefore,

**R = D \* T + SS**

**Maximum stock level:**

This is the level above which the stock should not be permitted to rise. If permitted, it would increase the risk of loss due to deterioration, evaporation and obsolescence. It also will increase the capital tied up in the inventories.

Thus, when to order will be dependent upon the level of stock is in the bin. But knowing the level of stock is not enough. Efficient inventory control dictates that inventory level should be controlled.

**How much to order?**

This is a concept which tries to balance inventory and ordering cost. Practically, the two costs have inverse relationship. If the order quantity is larger, the order cost will be low but the inventory carrying cost will be high. The point at which two costs are minimum is the optimum point; here in figure the total cost is minimum. Every company should try to order this much quantity.

Economic order quantity (EOQ) is the most useful techniques for determining “how much to order”? This method aims at determining the right quantity so as to ensure that the sum total of the two costs, i.e. carrying cost and procurement cost are at the minimum point possible. The result of this effort is the “purchase of right quantity “.

EOQ is that quantity at which the cost of procuring the annual requirements of an item and the inventory carrying cost are equal, i.e. the total of the two costs is minimum. Mathematically, EOQ is represented by the equation:

**EOQ = √2AP/UC**

**Where:**

**A =** Annual Consumption in units.

**P =** Procurement cost per order.

**C=** Inventory carrying cost expressed as percentage (of value)

**U =** Unit price

Here’s a table of EOQ worked out on the basis of rs.150 as purchasing cost

Per order and inventory carrying cost @ 30 per cent and unit value of one rupee

|  |  |  |  |
| --- | --- | --- | --- |
| Annual  Consumption in units | EOQ per Order | Number of orders  per year | Period |
| 1000 | 1000 | 1 | 1 year |
| 9000 | 3000 | 3 | 4 months |
| 16000 | 4000 | 4 | 3 months |
| 49000 | 7000 | 7 | 7.5 weeks |
| 80000 | 9000 | 9 | 6 weeks |
| 100000 | 10000 | 10 | 5.5 weeks |
| 400000 | 20000 | 20 | 18 weeks |
|  |  |  |  |

Q = √2 \* 80,000 \* 150/1 \*0/100 = **8944(9000 APPROX**

Therefore,

Requirement = 80,000/9000 = **9 orders per year**.

EOQ calculations are most helpful in establishing optimum inventory levels and effectively conserving the working capital invested in inventories. But in actual application EOQ faces certain objections.

**These are as follows:**

* Often the inventory holding costs and the ordering costs cannot be identified accurately and sometimes cannot be even identified properly.
* The EOQ as calculated is often an inconvenient number.
* The use of EOQ usually leads to orders at random points in time so that suppliers receive an irregular stream of orders.
* EOQ applied without due regard to the possibility of falling demand can lead to high value of obsolescent inventory.
* EOQ may not be applicable when the requirements are irregular, or where there is impending price rise.

This is where human judgment comes in. The management techniques are not 100 percent fool proof. Every decision has to be taken in consideration of variables like volume, transportation rates, quantity discount, production lot size, capital limitation and so on. For this purpose, though the extension of original EOQ formula is available yet judgment is crucial for interpretations of results.

**Imprest stock control:** This is the simplest method of inventory control and involves determination of a maximum level for the bin and a periodical inspection of stock levels in the bin. The bin is then filled up as required immediately to the maximum level. Usually this system is restricted only to classification “c” materials – materials with relatively low value- whose lead time is minimum.

**Open access bins:** Let’s assume a **XZ** motor car company. It would be a waste of time and other resources if the same accounting procedure was maintained for nuts and bolts as is for tyres or engines. In the factory, the optimum procedure would be where the employees have accounted for access to engines and tyres but a free work point access to nuts and bolts. This is called open access bin. This is used in combination with the Imprest system. The quantity replenished in this case is simply equal to quantity used

**Two Bin Systems (Clerical method of inventory control):** In this system, two bins are maintained by the companies which have different levels. When the first bin is exhausted, it indicated the time for replenishment. The second bin is like a reserve stock. The concept is similar to the petrol needle of a car. When the needle reaches the red segment of the gauge, the driver knows that the car is operating on reserve stock and it is time to replenish it.

It is fairly simple to determine various stock levels. In actual practice, however, such predictability is not always possible.

**Just in Time Systems**

JIT focuses on minimizing the holding costs of stock

* Idea is that stocks are brought into the production process at the time they are needed
* Effectively an attempt to operate production with minimal / zero buffer stocks
* With JIT systems, production and purchasing are closely linked to sales demand on a week to week basis.
* Continuous flow of raw materials into stock
* When work in progress is completed, it goes straight to the customer

**Requirements for JIT Systems**

• **Flexibility**

* Suppliers and internal workforce need to be able to expand and contract output at short notice
* Need to be able to deliver supplies quickly and reliably

• **High quality**

* Raw materials must be of guaranteed quality
* Whole production process must focus on quality
* There are no/minimal buffer stocks should a batch of raw materials from a particular supplier prove faulty, or if they are damaged during the production process.

• **Close working relationship with suppliers**

* Often geographically close
* Joint approach to ensuring quality
* Systems need to be able to share information (e.g. sales data, purchasing requirements, delivery times)

**Potential Benefits of JIT**

* Lower levels of cash tied up in stocks (i.e. – lower Working capital)
* Reduction in stock holding costs
* Reduced manufacturing lead times
* Improved labour productivity
* Reduced scrap and warranty costs
* Price reductions on purchased materials
* Reduction in the time and cost of purchasing /accounting.

**Pitfalls / Problems with JIT**

• **Not suitable for many industries / organizations**

* Higher risk of stock outs E.g. critical medical supplies

• **Lots of potential problems for suppliers**

* Break in supply causes immediate problem for supplier to solve
* May require new systems
* Potential loss of reputation if supplier responsible for stopping whole of customer’s production

• **Not something that can be done easily**

* Requires careful planning
* Cannot be done overnight – production needs to move gradually towards minimal / zero buffer stocks
* Often requires a substantial change in production culture.

****

**Activity**

1. What is difference between public and private warehousing?

2. What are the advantages and disadvantages of public warehousing?

3. What are the advantages and disadvantages of private warehousing?

4. What are the functions to be performed in a warehouse?

summary

**Summary**

Warehouses may be distributed in the field in order to shorten transportation distances to permit rapid response to customer demand. This study material shows us the process of decision making in the selection of type of warehouse between private and public warehouse and its location preferences in the whole supply chain network. It gives various functions involved in warehouse operations. It also gives the selection of storage systems required to suit various types of goods in order to increase the efficiency of warehouse operations.

**Unit 6: Location of warehouse**

**Introduction**

We need different types of goods in our day-to-day life. We may buy some of these items in bulk and store them in our warehouse. A warehouse needs to be in a well convenient located area where it is easy and possible to access.

Thus, the need for storage arises both for raw material as well as finished products. Storage takes into consideration proper arrangement for preserving goods from the time of their production or purchase till the actual use.

**Outcomes**

**Learning outcomes**

After studying this lesson, you will able to:

* Explain how well a warehouse must be located;
* discuss the need for having well located warehouse;
* Identify different types of warehouses;
* Explain the characteristics of ideal warehouses;
* Describe the functions of warehouses; and
* Enlist the advantages of warehouses.

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Location**

It is apparent that no seller can be equally near all customers or prospective customers. The space and time also impose significant limitation on the movement of goods from seller to buyer. In consequence, the location of the seller’s production and distribution facilities in relation to those of customers is an important decision making process.

In this context, the location problem can be three types:

1. Locating a warehousing system at the production facility itself;
2. Locating a single central distribution warehousing system away from the production plant;
3. Locating warehousing system at more than one place.

The optimal location is the one that is most likely to achieve the maximum rate of return on investment over the long run. For this optimal criterion, as a general rule, industrial companies tend to conform to one four locational orientations; raw materials, labour market, or power. Depending on the nature of production process, the types of materials required the characteristics of the end product and the tendency of buying companies to cluster in a given area, proximity to raw materials may be in overriding consideration. For other manufacturers, proximity to an adequate supply of labour or to customers may be the chief determinant of plants locations.

In cases of warehouses stocking finished goods, factors such as proximity of ports, railway lines, quality of roads, availability of power etc., become important considerations. Added to all the above factors the warehouses should be constructed with sufficient flexibility for expansion needs.

**The following considerations determine the location of a warehouse:**

1. Market service area and cost of distribution from the warehouse to the market service area.
2. Satisfaction of transport requirements and facilities available in the form of rail, link roads and road vehicles.
3. Transportation rates prevailing in the area and distribution costs per unit.
4. Competition by rival companies and whether they have warehouse in the same area.
5. Availability of power, water, gas sewage disposal and their cost.
6. Labour supply and labour costs in the area.
7. Industrial relations climate and labour productivity.
8. Pricing arrangements and the level of service desired to be rendered in terms of availability of the product to the customer.
9. Individual company requirements and constraints.
10. Real estate, excise and government taxes assessed in the area.
11. Attitudes of local residents and government towards establishment of the warehouse.
12. Restrictions associated with warehouses.
13. Potential for later expansion.
14. Cost of land for the warehouse and other costs.
15. Possibility of change in the use of the facility at a later date if the company so desires, and lease or sale of the land and buildings.

**Characteristics of Ideal Warehouses:**

1. Warehouse should be located at a convenient place near highways, railway stations, airports and seaports where goods can be loaded and unloaded easily.
2. Mechanical appliances should be there to loading and unloading the goods. This reduces the wastages in handling and also minimizes handling costs.
3. Adequate space should be available inside the building to keep the goods in proper order.
4. Ware houses meant for preservation of perishable items like fruits, vegetables, eggs and butter etc. should have cold storage facilities.
5. Proper arrangement should be there to protect the goods from sunlight, rain, wind, dust, moisture and pests.
6. Sufficient parking space should be there inside the premises to facilitate easy and quick loading and unloading of goods.
7. Round the clock security arrangement should be there to avoid theft of goods.
8. The building should be fitted with latest fire-fighting equipments to avoid loss of goods due to fire.

**Qualitative factor rating method of comparison**

Factor rating is a means of assigning quantitative values to all the factors related to each decision alternative and driving a composite score that can be used for comparison. It allows the decision maker to inject his own preferences into a location decision and it can accommodate both quantitative and qualitative factors.

**Procedure for qualitative factor rating**

1. Develop a list of relevant factors.
2. Assign a weight to each factor to indicate its relative importance (weights may total10)
3. Assign a common scale to each factor (ex 0-100 points) and designate any minimum.
4. Score each potential location according to the designated scale, and multiply the scores by the weights.
5. Total the points for each location, and choose the location with the maximum points.

Weighted scores are computed by multiplying the score times with the assigned weight and summing those products. Based on this data, a location among many would get

**Factors Affecting the Number of Warehouses**

* Inventory costs
* Warehousing costs
* Transportation costs
* Cost of lost sales
* Maintenance of customer service levels
* Service small quantity buyers

**Functions of the Warehouse**

1. **Receiving**-

This includes the physical unloading of incoming transport, checking, recording of receipts, and deciding where the received goods are to be put away in the warehouse. It can also include such activities as unpacking and repackaging, quality control checks and temporary quarantine storage for goods awaiting clearance by quality control

1. **Inspection-** Quality and quantity check of the incoming goods for their required characteristics selected as the preferred location for the new warehouse.
2. **Repackaging**- Incoming lot may be having non-standard packaging which may not be stored as it is in the respective location.
3. **Put away** – Binning and storing the goods in their respective locations including the temp locations from the receiving docking area.
4. **Storage** – Binning the approved material in their respective locations.
5. **Order-Order picking / selection** –Goods are selected from order picking stock in the required quantities and at the required time to meet customer orders. Picking often involves break bulk operations, when goods are received from suppliers in, say, whole pallet quantities, but ordered by customers in less than pallet quantity order picking is important for achieving high levels of customer service; it traditionally also takes a high proportion of the total warehouse staff complement and is expensive.
6. **Sortation** – This enable goods coming into a warehouse to be sorted into specific customer orders immediately on arrival. The goods then go directly to order collation.
7. **Packing and shipping** – Picked goods as per the customer order are consolidated and packed according to customer order requirement. It is shipped according to customer orders and respective destinations.
8. **Cross-docking** –Move products directly from receiving to the shipping dock – these products are not at all stored in the specific locations.
9. **Replenishing** – This is the movement of goods in larger order quantities, for example a whole pallet at a time, from reserve storage to order picking, to ensure that order picking locations do not become empty. Maintaining stock availability for order picking is important for achieving high levels of order fill.

**Activity Profiling**

Warehouse activity is primarily divided into two activities

1. Item activity profile
2. Order activity profile

**Order activity profile includes**

* Order mix distribution
* Lines per order distribution
* Cube per order distribution.
* Lines and cube per order distribution.

**Order Mix distribution**

Variety of order mix distributions that are helpful for plotting warehouse operating strategy. Three are considered the most helpful to this aspect which are the family mix distribution, the handling unit distribution and the order increment distribution.

**Family Mix Distribution**

In many cases, operating strategy of the warehouse is dictated by the order mix-the extent to which orders require items from multiple families of items. If the orders are pure, means only one of the item, then it is early indicator that zoning the warehouse will create a small warehouse within the warehouse will ensure the goods productivity and customer service.

**Example of family Mix Distribution**

Items A which carry more volume and weight has to be considered as Flat Stock, Item B Which is less volume and weight than the Item A named as cut stock, Item C which is less volume and weight than the Item B named as envelope.

**Example**

* **Rice Bags - Flat Stock**
* **Milk powder Tin - Cut Stock**
* **Tissues - Envelope.**

Assign the materials in warehouse or retail outlet; zone the warehouse by these threes item families. If the customer orders are mixed then in pallet building, we would start with flat stock, the cut stock and put the envelope stock on top of that. If that is this way, we will have to travel across those zones or pass a pallet from one zone to the next.

Zoning the warehouse by item family will yield good productivity, customer service, and increase storage density performance.

**Full/Partial pallet Mix Distribution**

With the full-partial mix distribution, try to determine if we need separate areas for pallet picking and case picking. In some warehouses, pallet and case picking are performed out of the same item location, aisle, and /or area of the warehouse. In general, it is good idea to establish separate areas for pallet and case picking-replenishing a case picking/line area from a pallet reserve/picking area. This distribution simply helps reinforce the point and helps to identify warehouse within some warehouse opportunities.

**Full/Broken Case Mix Distribution**

In some of the organization full and broken case picking are performed in the same item location, where there is lot of mixing of products in various zones. In general, it is good option to perform in a separate area for full and broken case picking.

This type of distribution helps to reinforce the point and helps to identify warehouse within some warehouse opportunities. Once the customer order reaches the warehouse management system, it should classify them immediately as pallet pick order, carton pick order or a mix order. FMCG business services most of the orders as mix order distribution, since the products are assigned as full pallet and broken cases separately, it is easy to pick the materials against the mixed customer orders.

**Order Increment Distributions**

With the order increment distribution, we determine the portion of unit load requested on a customer order. Assume there are 100 cartons in a pallet and the customer orders only 50 cartons. In that case, he ordered 50% of the pallet. In some cases, customer will order only 20% of the pallet, this is an unusual distribution.

**Decisions on the storage of ABC classified items**:

**A family item** is to be stored in automated highly storage mode, **Family B** in a semi automated moderately productive picking mode and **family C** in a manual picking mode that offers high storage density.

The basic principle is to assign the most popular items to the easy accessible area, in order to optimize the traveling time and to increase the picking efficiency.

**Popularity – Cube Movement Distribution**

Done properly, slotting takes into account both the item-popularity distribution and the Cube-movement distribution- These distributions can be combined into a joint distribution. An example popularity –cube-movement distribution for broken case picking is presented.

**Item-Order Completion Distribution**

The item-order completion distribution identifies small groups of items that can fill large groups of orders. Those small groups of items can often be assigned to small order completion zones in which the productivity, processing rate, and processing quality are two to five times better than that found in the general warehouse.

The item-order completion distribution is constructed by ranking the items from most to least popular. Beginning with the most popular item, then the two most popular items,

**Warehouse Operations –Centralized and De-Centralized**

In a multiple warehouse, the warehousing operations can either be centralized or decentralized. In decentralized warehousing operations, each warehouse is considered as a separate entity. Thus each warehouse will have a separate safety stock, there will be orders from lower warehouse to the upper warehouse and there will be in-transit stocks. Each warehouse will optimize inventory individually. This type of decentralizing will be advantageous for the following situations.

Consumption centres are located at different places and at distant places. The transaction of goods is very high.

The advantages of such system are:

1. This prevents obsolescence and also prevents accumulation of surplus materials and
2. This offers service where it is needed.

But the system has the disadvantages of having high running cost due to increased stock and personnel in each warehouse and due to handling of more information.

As against this, in a centralized system of warehousing operations, order processing, storing of safety stocks and control stock movements will be done centrally by a central warehouse. The important requirement for this centralized system is a well-established information system.

But this system has the following advantages:

1. Orders for multiple items on a single source can be bunched together.
2. There will be reduction in safety stock by a factor equal to a wherein is the number of warehouses.
3. Similarly, total inventory cost is also reduced by a factor equal to n.

Reduction in inventory costs adequately justifies, the cost of information system. In such a centralized system, the central warehouse will have to do the additional record keeping and decision making required in a branch warehouse operation. That is, it should keep track of each branch’s current stock of each item, its rate of sale at each branch, the amount currently on order and amount in transit. The central warehouse, with this above information’s will have to make decisions about when and how much to reorder from the factory. If the decisions are made on the basis of outdate, incomplete and erroneous information, many of the decisions will late turn out to be wrong, a consequence that will raise costs and reduce sales.

**Storage systems**

The type of materials passing through warehouses varies enormously, with different sizes, weights, shapes, levels of fragility and hazard characteristics. A major benefit of unit loads such as pallets is that they enable the use of standard storage systems and handling equipment, irrespective of what is handled. Nevertheless, variations in throughput and order picking patterns make it appropriate to have different types of storage system, with different operational characteristics, so that systems can be selected that most closely match the needs of the wider system within which they are to operate.

The key factors influencing the choice of a storage system are:

* The nature and characteristics of the goods and unit loads held;
* The effective utilization of building volume-horizontal and vertical:
* Good access to stock;
* Compatibility with information system requirements;
* Maintenance of stock condition and integrity;
* Personal safety;
* Overall system cost;

When comparing the costs of different storage systems, it is not only the storage equipment cost that should be taken into account. Other cost elements that could be affected by the choice of system include:

* Space-land, building and building services;
* Fire protection;
* Handling equipment including maintenance;
* Staff;
* Information management systems.

One way of classifying storage systems could be:

* Bulk storage for solids, such as silos, bunkers and stockpiles;
* Loose item storage, ex casting and fabrications held loose on the floor;
* Pallet storage systems;
* Small item storage for individual items or small unit loads;
* Non-standard unit loads such as long loads.

The location of stock within a store is an important aspect of stock management and can be considered at different levels of detail. For ex, the overall positioning of stock within particular areas of the warehouse can influence the total amount of movement required to get material into and out of stock. It can also affect the efficiency with which order picking operations can be carried out by affecting the distance order pickers have to travel to get to required stock.

**Fixed and random stock location**

The effective storage capacity of a given installation is influenced by whether individual product lines are held in fixed and dedicated locations, or whether any product line can be located randomly in any available storage location.

If a fixed location system is used, any specific location can be used for its designed product line, and never for any other product. Consequently, the installation must be designed with enough capacity to hold the maximum stock of every product line.

Random location is often used for reserve storage, which tends to take up the largest

area in a warehouse, and fixed location for order picking stock, which enables the use of

concepts such as popularity storage- fast–moving product lines located to minimize

picker movement.

**Palletized storage systems**

**Block staking**

Block storage does not use any storage equipment. Loaded pallets are placed directly on the floor and built up in stacks, one pallet on top of another to a maximum stable height. The pallet loads must be capable of carrying the superimposed pallets, and the top of each load should be flat enough to provide a stable base for the next pallet.

Block stacking is suitable for that part of the product range where there are few product lines, each with high stock level, and where very strict FIFO movement of stock is not required. The advantages are good use of area, flexibility to change the layout of the blocks and quick to stock for rapid throughput.

**Drive-in and drive-through racking**

Although this is a racked storage system, it is operationally similar to block storage. There should only be one product line in each row, and the effective utilization of the pallet positions is about 70%. The racking structure supports the weight of the pallets so this system is suitable for high stock product lines, where strict FIFO movement is not required, but where the pallet loads are not strong enough or of regular enough shape to carry superimposed loads. This system consists of vertical support frames, tied at the top, with cantilever pallet support beams at different heights.

**Push back Racking**

This type of racking is a comparatively recent development. Like-drive-in racking it gives high-density storage and can be built to any height up to the maximum lift height of the lift trucks accessing it. Pallets can be stored up to about four deep in the racking, on either side of the access aisle. The basic operational difference between this system and block stacking or drive-in racking is the increased selectivity achieved. There should be no mix of product lines in any one lane, but there can be between the lanes in any row.

**Adjustable Pallet Raking-(APR)**

Adjustable pallet racking is probably the most widely used type of pallet racking, and offers free access to every pallet held. It can be built to match the lift height of any forklift truck. Unit loads other than pallets can be stored using APR, and there is a range of accessories such as drum supports and channel supports for post pallets to facilitate this.

The conventional way of laying out APR is to have one row single deep at each end of the installation, with back-to-back rows in between. This gives every truck aisle access to two rows of racking, and minimizes the number of aisles required.

APR is a flexible, versatile storage system, which gives excellent stock access. It is simple in concept, easily laid out, and damaged parts are easily replaced. It can be suitable for fast-moving and slow –moving stock, and for product lines with high or low levels of palletized stock-holding. However, APR does not make good use of volume of building volume.

**Double deep Racking**

If some loss of totally free access to stock can be accepted, although not nearly as severe as in block, drive-in or push back storage, space utilization can be improved using double deep racking. This supports pallets on pairs of beams as in APR, but improves space utilization by eliminating alternate access aisles, and using a double reach fork-lift truck, which can access not just one but two pallets deep into the racking.

**Powered Mobile racking**

Powered mobile racking is effectively single deep APR, with the racking, except the end or outer rows, mounted on electrically powered base frames. Operationally it has similar characteristics to APR, but it is slower in use, and the pallet position utilization is likely to be similar to APR at 90 to 95%. This type of storage is expensive in equipment and floor costs, and it tends to be slow in operation. However, it gives very dense storage, and is suitable for the typically large number of product lines forming the ‘Pareto tail’ of a product range, where individual product lines have low stock and low throughput. It also finds use in cold-storage applications where space costs are especially high, and however temperature variations are reduced by cutting the air space in the storage area.

**Pallet live storage**

Live storage systems are made up of inclined gravity roll conveyors, laid out side by side and at a number of vertical levels. Pallets are fed in at the higher end and removed as required at the lower. Such a system imposes FIFO. The only accessible pallets are at the out feed end, so any one lane should only hold pallets of the same product line.

Pallet live storage systems are suitable for very fast-moving product lines. They can provide effective order picking regimes, which automatically refill empty locations, and also provide physical separation between picking and replenishment operations.

**Small item storage systems**

As with palletized storage systems, there is a range of different types system for holding small items. With small item storage it often happens that different systems are incorporated into one installation. For ex, drawer units and cabinets may be built into a shelving installation. Consequently, the concept of standard equipment sizes and modularity is important for small item storage systems.

The following lists are some of the storage systems used for small items:

* Shelving
* Tote bins
* Drawer units
* Dynamic systems –mobile and live storage
* Mechanized systems- carousels and mini loads



**Activity**

1. Briefly describe about “cross-docking”?
2. What is meant by activity profiling in a warehouse?
3. Describe various storage systems used in a warehouse for different applications?
4. What are the factors to be considered in the selection of location of the warehouse?
5. Describe briefly about the qualitative factor rating method for the selection of location of a warehouse?

summary

**Summary**

Warehouses to properly located so as to make convenient to reach to permit rapid response to customer demand. This study material shows us the process of decision making in the selection of warehouse location. Warehouse and its locational preferences in the whole supply chain network. Qualitative factor rating method is helpful in the selection of the location of a warehouse and activity profiling is useful for the design of storage systems and material handling equipments.

**Unit 7: Warehouse Management System (WMSIntroduction**

**Introduction**

The evolution of warehouse management systems (WMS) is very similar to that of many other software solutions. Initially a system to control movement and storage of materials within a warehouse, the role of WMS is expanding to including light manufacturing, transportation management, order management, and complete accounting systems. To use the grandfather of operations-related software, MRP, as a comparison, material requirements planning (MRP) started as a system for planning raw material requirements in a manufacturing environment.

**Outcomes**

**Learning outcomes**

After studying this lesson, you will able to:

* Explain what warehouse management system is;
* Explain the system to control movement and storage of
* Describe materials within a warehouse;
* Discuss Material Requirement Planning (MRP;
* Explain the Automated Data Collection (ADC);
* Describe the functions of warehouses;
* Enlist the advantages of warehouses.

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Warehouse Management System (WMS)**

The evolution of warehouse management systems (WMS) is very similar to that of many other software solutions. Initially a system to control movement and storage of materials within a warehouse, the role of WMS is expanding to including light manufacturing, transportation management, order management, and complete accounting systems. To use the grandfather of operations-related software, MRP, as a comparison, material requirements planning (MRP) started as a system for planning raw material requirements in a manufacturing environment. Soon MRP evolved into manufacturing resource planning (MRPII), which took the basic MRP system and added scheduling and capacity planning logic. Eventually MRPII evolved into enterprise resource planning (ERP), incorporating all the MRPII functionality with full financials and customer and vendor management functionality.

Even though WMS continues to gain added functionality, the initial core functionality of a WMS has not really changed. The primary purpose of a WMS is to control the movement and storage of materials within an operation and process the associated transactions. Directed picking, directed replenishment, and directed put away are the key to WMS. The detailed setup and processing within a WMS can vary significantly from one software vendor to another; however, the basic logic will use a combination of item, location, quantity, unit of measure, and order information to determine where to stock, where to pick, and in what sequence to perform these operations.

One proven method for increasing customer service without incurring additional long-term expenses is the implementation of a warehouse management system (WMS).

The WMS concept and technology are not new. These systems have matured into time tested methods for reducing inventory costs while increasing overall efficiencies.

Implementing WMS technology within an organization already using an ERP system allows that company to achieve a higher return on their software dollars and provide the best possible service to their customers WMS can provide an organization with tangible benefits quickly, improving warehouse operations and increasing efficiencies without adding headcount. By implementing a WMS, a company achieves a number of dramatic benefits.

They include:

* Directed put-away and directed order picking
* Warehouse capacity management
* Radio Frequency (RF) capability for data capture
* Load planning
* Cross docking
* Picking optimization
* ABC stratification
* Interleaving of work
* Eliminate preparation work for shipping documents and ERP ship confirmations.
* Eliminate physical inventory Cycle counting will replace physical inventory requirement.

At a bare minimum, a WMS should:

* Have a flexible location system.
* Utilize user-defined parameters to direct warehouse tasks and use live documents to execute these tasks.
* Have some built-in level of integration with data collection devices.

Warehouse Management Systems are big, complex, data intensive, and applications. They tend to require a lot of initial setup, a lot of system resources to run, and a lot of ongoing data management to continue to run. That’s right, you need to "manage" your warehouse "management" system. An often time, large operations will end up creating a new IS department with the sole responsibility of managing the WMS.

The Claims:

* WMS will reduce inventory!
* WMS will reduce labor costs!
* WMS will increase storage capacity!
* WMS will increase customer service!
* WMS will increase inventory accuracy!

**The Reality:**

The implementation of a WMS along with automated data collection will likely give you increases in accuracy, reduction in labor costs (provided the labor required to maintain the system is less than the labor saved on the warehouse floor), and a greater ability to service the customer by reducing cycle times..

**Setup**

A system to control movement and storage of materials within a warehouse can be extensive. The characteristics of each item and location must be maintained either at the detail level or by grouping similar items and locations into categories. An example of item characteristics at the detail level would include exact dimensions and weight of each item in each unit of measure the item is stocked (cases, pallets, etc) as well as information such as whether it can be mixed with other items in a location, whether it is rack able, max stack height, max quantity per location, hazard classifications, finished goods or raw material, fast versus slow mover, etc. Although some operations will need to set up each item this way, most operations will benefit by creating groups of similar products.

Since computers cannot be truly random (nor would you want them to be) the term random location is a little misleading. Random locations generally refer to areas where products are not stored in designated fixed locations.

Like zone logic, you will need some additional logic to determine exact locations. First-in-first-out (FIFO). Directs picking from the oldest inventory first, Last-in-first-out (LIFO). Opposite of FIFO, I didn't think there were any real applications for this logic until a visitor to my site sent an email describing their operation that distributes perishable goods domestically and overseas. They use LIFO for their overseas customers (because of longer in-transit times) and FIFO for their domestic customers. Quantity or Unit-of-measure. Allows you to direct picking from different locations of the same item based upon the quantity or unit-of-measured ordered. For example, pick quantities less than 25 units would pick directly from the primary picking location while quantities greater than 25 would pick from reserve storage locations.

Fewest Locations-This logic is used primarily for productivity. Pick-from-fewest logic will use quantity information to determine least number of locations needed to pick the entire pick quantity.

The pick-from-fewest logic will leave small quantities of an item scattered all over your warehouse, and the put-to-fewest logic will ignore small and partially used locations.

Pick-to-clear -Logic directs picking to the locations with the smallest quantities on hand. This logic is great for space utilization.

**Reserved Locations** -This is used when you want to predetermine specific locations to put away to or pick from. An application for reserved locations would be cross-docking, where you may specify certain quantities of an inbound shipment be moved to specific outbound staging locations or directly to an awaiting outbound trailer. Nearest location also called proximity picking/put away, this logic looks to the closest available location to that of the previous put away or pick. You need to look at the setup and test this type of logic to verify that it is picking the shortest route and not the actual nearest location.

**Consolidate.**

Considers if there is already a location with the same product stored in it, with available capacity, this may also create additional moves to consolidate like product stored in multiple locations.

**Lot Sequence -** Used for picking or replenishment, this will use the lot number or lot date to determine locations to pick from or replenish from.

It’s very common to combine multiple logic methods to determine the best location.

**Other Functionality/Considerations**

Wave Picking/ Batch Picking/ Zone Picking- Support for various picking methods varies from one system to another. In high-volume fulfillment operations, picking logic can be a critical factor in WMS selection.

**Task Interleaving-** Task interleaving describes functionality that mixes dissimilar tasks such as picking and put away to obtain maximum productivity. Used primarily in full-pallet-load operations, task interleaving will direct a lift truck operator to put away a pallet on his/her way to the next pick. In large warehouses this can greatly reduce travel time, not only increasing productivity, but also reducing wear on the lift trucks and saving on energy costs by reducing lift truck fuel consumption. Task interleaving is also used with cycle counting programs to coordinate a cycle count with a picking or put away task.

**Automated Data Collection (ADC) -** It is generally assumed when you implement WMS that you will also be implementing automatic data collection, usually in the form of radio-frequency (RF) portable terminals with bar code scanners. It is recommended to incorporate your ADC hardware selection and your software selection into a single process. This is especially true if you are planning on incorporating alternate technologies such as voice systems, RFID, or light-directed systems. You may find that a higher priced WMS package will actually be less expensive in the end since it has a greater level of support for the types of ADC hardware you will be using.

**Integration with Automated Material Handling Equipment-** If you are planning on using automated material handling equipment such as carousels, ASRS units, AGVs, pick-to-light systems, or sortation systems, you’ll want to consider this during the software selection process. Since these types of automation are very expensive and are usually a core component of your warehouse, you may find that the equipment will drive the selection of the WMS. As with automated data collection, you should be working closely with the equipment manufacturers during the software selection process.

**Cross Docking -** In its purest form cross-docking is the action of unloading materials from an incoming trailer or rail car and immediately loading these materials in outbound trailers or rail cars thus eliminating the need for warehousing (storage). In reality pure cross-docking is less common; most "cross-docking" operations require large staging areas where inbound materials are sorted, consolidated, and stored until the outbound shipment is complete and ready to ship. If cross docking is part of your operation you will need to verify the logic the WMS uses to facilitate this.

**Pick-to-Carton** - For parcel shippers pick-to-carton logic uses item dimensions/weights to select the shipping carton prior to the order picking process. Items are then picked directly into the shipping carton. When picking is complete, Dunn age is added and the carton sealed eliminating a formal packing operation. This logic works best when picking/packing products with similar size/weight characteristics. In operations with a very diverse product mix it's much more difficult to get this type of logic to work effectively.

**Slotting -** Slotting describes the activities associated with optimizing product placement in pick locations in a warehouse. There are software packages designed just for slotting, and many WMS packages will also have slotting functionality. Slotting software will generally use item velocity (times picked), cube usage, and minimum pick face dimensions to determine best location.

**Yard Management-**Yard management describes the function of managing the contents (inventory) of trailers parked outside the warehouse, or the empty trailers themselves. Yard management is generally associated with cross docking operations and may include the management of both inbound and outbound trailers.

**Labour Tracking/Capacity Planning -** Some WMS systems provide functionality related to labor reporting and capacity planning. Anyone that has worked in manufacturing should be familiar with this type of logic. Basically, you set up standard labor hours and machine (usually lift trucks) hours per task and set the available labour and machine hours per shift. The WMS system will use this info to determine capacity and load. Manufacturing has been using capacity planning for decades with mixed results. The need to factor in efficiency and utilization to determine rated capacity is an example of the shortcomings of this process. Not that I’m necessarily against capacity planning in warehousing, I just think most operations don’t really need it and can avoid the disappointment of trying to make it work.



**Activity**

1. Explain the following terms
2. Yard Management
3. Cross Docking
4. Pick-to-Carton
5. Discuss Warehouse Management System
6. List any five dramatic benefitsWarehouse Management System.

summary

**Summary**

Warehouse management systems need a proper functional system to ensure control movement and storage of materials within a warehouse.

Therefore, there is need to implement a sound warehouse management systems technology which can use systems like an ERP allows the company to achieve a higher return on their software investments and provide the best possible service to their customers.

WMS can enable an organization to have tangible benefits fast, improving warehouse operations and increasing efficiencies without adding headcount.

**Unit 8: Material Requirement Planning (MRP) Department**

**Introduction**

Material Requirement Planning (MRP) Department is the section responsible for selecting the different suppliers with whom the factory is going to work with, keep track of the goods inside the factory, and order the different materials to support the production schedule.

Material Requirement Planning department must be strong enough in order to to come up with an efficient material delivery and control system. It has to colloborate with suppliers in the inventory control system, and share the responsibility for keeping track of the material levels at the factories.

**Outcomes**

**Learning outcomes**

After studying this lesson, you will able to:

* Define Material Requirement Planning
* Explain the role materials planning play within a warehouse;
* Explain how Suppliers play a role in the inventory control system by keeping track of the material levels at the factories
* Discuss the system of material inspection and storage

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Material Requirement Planning (MRP) Department**

The responsibilities of this department can be fulfilled by the purchasing department. It is responsible for selecting the different suppliers with whom the factory is going to work, keep track of the goods inside the factory, and order the different materials to support the production schedule. It uses the master production schedule by transforming it into a material need schedule.

Then this schedule and the inventory records are used to develop the material purchasing schedule. The purchasing schedule defines different material quantities and times when materials need to be ordered. Finally, the material orders are sent to the proper supplier. The MRP department is formed by material handlers, head receivers, and the purchasing manager.

**Suppliers**

The suppliers are the ones who produce or supply the different materials used by the manufacturing factories, and send them to the facility. The relationship between suppliers and the MRP department must be strong in order to develop an efficient material delivery and control system. Suppliers must be involved in the inventory control system, and share the responsibility for keeping track of the material levels at the factories.

**Activities of the Dependent Demand System**

The activities of the new system have been developed from a material point of view; therefore, some activities are explained considering only their influence in the material flow and management system.

The material supply chain management system is broken down into two main activities:

The material flow and the information flow system. Each of these activities is divided into different processes that define the complete material cycle for any Manufacturing factory.

This module focuses on the information flow system. The material flow inside the factory will be explained briefly while the information flow will be explained in detail, since the MRP activity is the most important activity of the system.

The other activities feed the MRP department with the required information to estimate the material requirements at the factory.

**Material Flow System**

The material flow system considers all physical material movement. This system compiles not only the movement of material inside the manufacturing facility, but also the movement outside from suppliers to the factory. This system is divided into three sub-activities: material delivery, material inspection and storage, and material utilization. The people involved in these processes include suppliers, head receivers, and material handlers.

**Material Delivery**

This activity was not considered as part of the system by the Manufacturing industry, but it is part of the depended demand system. Suppliers are responsible for this activity. It begins when suppliers receive the purchasing order from the MRP department. They process the order and produce or obtain the different items. The required material is transported to the manufacturing facility, where it awaits inspection.

**Material Inspection and Storage**

The depended demand system joins together the material inspection and material storage used in the current system and gives more responsibility to the head receiver who is in charge of the activity. The material inspection must be done by the head receiver and the suppliers. Inspection affect both, therefore it is in the supplier’s benefit to help with this process. The material must be inspected considering three criteria: material type, quantity and quality. This process consumes time that must be considered inside the lead time, but it is essential to verify these criteria and compare them with the original order.

Once the material is accepted, the head receiver has to evaluate if the material is needed at the station or if it is going to be stocked. The material is normally moved to the main storage where the material is held until it is needed at the different stations.

Finally, the head receiver updates the stock card and provides this information to the purchasing manager.

Material handlers use forklifts to supply material to different stations located in the assembly line. The material is supplied to each station when it is needed. The different materials are placed as near as possible to the working station in order to minimize the number of times the material is moved and also avoid wasting time required by the labour to look for the material.

**Material Utilization**

Once the material is placed at the proper station, it enters the manufacturing process. The material is used by the labour and it passes through all production steps in the assembly line. Finally, the house is finished and it is transported to the dealer.

**Information Flow System**

The information flow system includes all material related activities without the physical movement. These activities must be integrated in order to have an efficient information flow system. The information shared by each part of the system is compiled by the MRP system which uses it to estimate the material required at the factory to support the production process.

**Inventory Records**

Inventory Records are used to keep track of the goods inside the Manufacturing facility (Ramakrishnan and Arnold, 2007). Every material that is stocked at the factory must be identified and have an inventory record available for use during the material estimation process. Inventory records for each material must include:

ID code, on hand, on order, lead times, and planning data Purchasing managers and head receivers are responsible for this activity. The head receivers update the stock cards upon delivery while purchasing managers update the inventory records and store them in a database for future use during the material estimation process.

**Distribution Resource Planning (DRP)**

The DRP process handles the logistics at any manufacturing facility, developing strategies to plan and set goals. An efficient DRP system in the Manufacturing industry must be able to answer three logistic questions that become the basis of any planning strategy that it needs to take.

From the material point of view, the DRP process becomes the first information chain inside a Manufacturing facility. The DRP receives the order from dealers and the information of any specific item the customer wants. Then, the DRP processes the order and sends it to the MPS, giving the required information to do the master production schedule. It can be concluded that the DRP is the customer of manufacturing.

**Master Production Scheduling (MPS)**

The job of the master production scheduling system is to plan the production so that the demand set by logistic can be satisfied. The MPS process is divided into two steps: the development of the master plan schedule and the estimation of the production rates required to satisfy the manufacturing demand.

A master plan schedule is a statement of what can and will be created by the Manufacturing facility. It becomes a realistic consensus between production and sales.

This schedule indicates the date that different house models are entering the assembly line. Once the master plan schedule is updated, it is sent to the MRP department to be utilized for the material requirement estimation.

**Material Requirement Planning (MRP)**

The MRP process plans all items that need to be purchased and completed to support the master production schedule. In this manner, the replenishments can be planned and managed. Its principal goal is to reduce stock levels with consequent saving in capital, resources, and space.

This MRP system uses the information available at any factory and proposes the use of a computer database as a tool to optimize their utilization. It uses the information provided by the MPS department and the information compiled in the inventory records system. The MRP system is designed to use backward scheduling as the primary tool.

The master schedule date becomes the end point and then all elements are offset backward in time. MRP completes the supply chain and uses the resources and information provided by the other parties to optimize the material order, delivery and therefore the production process. This process has been divided into three different steps described below:

**Step 1: Material Need schedule.**

This step uses the master plan schedule to develop a material need schedule for the Manufacturing facility. The bill of materials and quantities that are used in each product is known, therefore the information needed to develop the material need schedule is available. This information is used to transform the master production schedule into the material need schedule.

**Step 2: Purchasing Schedule.**

The second step in the MRP process is to use the lead time for each material to determine the material purchasing schedule. The lead time must consider also a material inventory holding time that needs to be defined by each factory. This additional time becomes a safety factor for the purchasing manager and it is used to assure that the material will be available for use when it is needed. The purchasing schedule will help the MRP department determine when the material needs to be ordered.

**Step 3: Purchasing Orders.**

Finally, this purchasing schedule is converted into different purchasing orders with respect to the suppliers. These purchasing orders are completed with the supplier’s contact information. Once these orders are ready, they are sent to the different suppliers. This step uses the existing database to relate the different materials with the different suppliers. The purchasing orders will answer the question where it is going to be bought.

MRP is a more efficient planning tool that can be used to propose back-up strategies when demand changes appear. Any changes to the master schedule automatically update the outputs of the system.

**Material Process Flow**

The entire material supply management system process is summarized. All activities are linked to each other forming the entire material cycle at any Manufactured Facility.

Each individual step inside the process must be done efficiently to support the success of the entire supply chain. The process flow indicates the customers as the starting point and ending point of the material cycle.

**Comparison between independent demand system & dependent demand system**

The depended demand system has been compared with the standard system used in the Manufacturing industries. The depended demand system presents many advantages over current practices used by the Manufacturing industry. Some of them are described below:

* The depended demand system can be qualified as a pull system that uses backward scheduling as the primary tool by relating material requirement to the master production schedule.
* This system eliminates the need of historical data for material requirement estimation. Instead the material requirement is estimated directly from the products that the facility is producing. This system provides more accurate values and therefore it reduces wastage of material.
* It replaces a weekly order process with a daily ordering process, leading to lower levels of inventory at the facility, therefore improving the use of space at the Manufacturing factory.
* It eliminates unnecessary processes and redundant information making the system leaner.
* It introduces inventory control and supply chain management concepts to the Manufacturing industry opening a new frontier for further application.
* This new system solves the drawbacks detected in current practices by optimizing the use of information and available resources, and by radically reducing the process time of material requirement estimation.

This dependent demand system integrates the different parties related with material management and proposes the use of modern practices for material quantities estimation.

In order to have an efficient material supply chain management system, the system must be supported by facilitators of quick information and material flow. Today, there are technologies available that can be used to accomplish this task. Internet, local networks and electronic data interchange (EDI) are being successfully used by many manufacturing industries, and they show potential benefits for the Manufacturing industry.

The depended demand system presents potential benefits to the Manufacturing industry by solving the problems detected in the current system. Experience shows that application of this type of system has brought several benefits in other manufacturing industries. The main advantage of the proposed new MRP system is its ability to relate demand for material directly to the master production schedule. This process reduces the amount of items on stock thus reducing holding cost and provides better planning.

**Problems of the Generic Material Flow and Management System**

1. No standard material management system exists

2. Redundancy of information.

3. Poor use of advanced technology.

4. High inventory levels resulting in waste of space, money and resources.

5. Difficulty to estimate amount of material needed due to various types of house.

6. Irregular lead times due to dealing with great number of suppliers

7. Dependence on historical data in estimating the material requirement

8. Employee’s poor knowledge about inventory control

**ABC Inventory Control**

ABC analysis or Pareto's law is a well-known principle that is widely used for decision making and management control in many areas of management. Most researchers and practitioners are well aware of ABC analysis. However, textbooks and research articles are very brief and cryptic on how to use ABC analysis in practice.

**“A”** - items are the highest priority, the tightest control, frequent deliveries, close follow-up, and accurate records. Planning and Scheduling these parts utilize MRP (Material Requirements Planning), DRP (Distribution Requirements Planning, or EOQ (Economic Order Quantity) or other lot sizing techniques such as Lot for Lot. 10 % of the “A” items volume accounts for 70% of the total inventory value

**“B”** - items are the priority when low or out of stock. Normal control is used and good records are maintained.

**“C”** - items are the lowest priority, simplest method of control. Min/Max used for ordering. These parts are usually expensed, as there are no records for them. These parts represent 10% of the total value, and 70% of the volume.

***Managing Inventories by ABC:***

ABC analysis is the method of classifying items involved in a decision situation on the basis of their relative importance. Its classification may be on the basis of monetary value, availability of resources, variations in lead-time, part criticality to the running of a facility, new customer parts unique to that product, and others.

***Cycle inventory can be managed through ABC analysis***:

**“A”** value items have to be counted more frequently i.e., once in a week to do accurate monitoring of these items which has more impact on the inventory value.

**“B”** value items can be counted once in a month because they are moderate value items which have less impact on the inventory value.

**“C”** items have to be counted once in three months or six months because they are least consumed value items and has very less impact on the inventory value.

**Obsolescence budgeting also takes the management of ABC analysis into consideration**.

“**A”** items have the most impact on the budget, if it is determined to be obsolete and scrapped from inventory. These parts may fool the reviewer because the “A” parts may not have a use for several years, but due to its critical importance may be needed at a later date. The slow moving activity report would not detect this need. Management and storeroom management need to consider all aspects of the parts before it is scrapped to obsolescence. ABC analysis puts a perspective that enhances this decision-making.

**Other use of ABC analysis is in the reorganization of the storeroom.**

In this analysis, ABC coding should be considered so that the “A” parts are continually being moved to the lower or easier access areas. ‘B” items are to be moved to middle areas, and “C” items placed in all other areas of the stores.

**ABC analysis even affects lot-sizing considerations**.

A plant using EOQ (Economic Order Quantity where a fixed order quantity is established that minimizes the total of carrying and preparation costs under conditions of certainty and independent demand.) uses ABC as well, so that inventory levels are minimized with the higher cost part. A review of the ABC Codes for the parts in stores should occur quarterly. Improper coding of parts may result in incomplete investigations of more expensive parts, improper storage, poor decisions on obsolescence and scrap, and less than adequate lot sizing.

ABC Code Management is an important tool for parts in storage. It puts a perspective on parts and emphasizes its value in relation to the quantity on-hand. Without this type of inventory management program in use, inventory decision-making would be based on just quantity alone. ABC management techniques methods involve both quantity and inventory valuation to make a more complete evaluation of parts in storage.



**Activity**

1. Discuss material Requirement Planning
2. Explain the following terms:
   1. ABC Inventory Control
   2. Distribution Resource Planning (DRP)
3. Explain how cycle inventory can be managed through ABC analysis

summary

**Summary**

Material Requirement Planning (MRP) is the process which plans all items that need to be purchased and completed to support the master production schedule. In this manner, the replenishments can be well planned and effectively managed. It has a principal goal is to reduce stock levels with consequent saving in capital, resources, and space.

Also Inventories can be managed by ABC analysis which is a method for classifying items that are involved in a decision situation on the basis of their relative importance. Its classification can be on the basis of monetary value, availability of resources, variations in lead-time, part criticality to the running of a facility, new customer parts unique to that product, and others.

**Unit 9: The Principles and performance measures of Material Handling Systems**

**Introduction**

This unit will assist you to understand handling materials in the warehouse. The warehouse in any organisation has a vital role to play. All other activities involving materials day-to-day handling are discussed. Material handling involves unloading, stacking, loading and transportation of the material. Materials handling is a system that takes place one way or another along all the links of the supply chain including production, distribution, and storage and retail functions.

Materials handling in a warehouse or distribution centre will have a major impact on how effectively materials flow through the system, and on the cost, resource and time taken to get orders out to the customer.

**Outcomes**

**Learning outcomes**

After studying this lesson, you will able to:

* Explain the material handling in stores
* Discuss the way of material handling in stores
* Explain various types of material handling equipment
* Demonstrate vehicle travel proportions
* Explain AS/RS (Automated Storage & Retrieval Systems)

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

A number of different performance measures have been used in the design and analysis of material handling systems. These performance measures have measured either:

(1) the entire manufacturing system (e.g. job throughput), or

(2) the material handling system independently (e.g. vehicle travel distance).

The following is a review of performance, reliability, and performability measures used in the analysis and design of material handling systems in a manufacturing environment.

The material handling system in any manufacturing setting plays an important part in the performance of the entire manufacturing system. Research in the design of material handling systems within a manufacturing environment has primarily studied system performance as a function of:

* guide path design or layout
* type of flow path
* number of lanes in each aisle,
* location of pick-up/delivery points,
* fleet size,
* unit load size,
* vehicle speed and
* queue capacity at each workstation.

Research in the operation of these systems has primarily studied performance as a function of:

* vehicle dispatching rules and scheduling,
* idle vehicle positioning,
* vehicle routeing, and
* zone definitions.

A number of different performance measures have been used in analysing material handling system design and operation. However, the appropriateness and/or the adequacy of the performance measures used in material handling system analysis is rarely addressed.

A ***performance measure*** may be defined as a metric for quantifying efficiency and/or effectiveness. As applied to material handling systems, the ***effectiveness*** of a material handling system describes to what extent the system per- forms the required handling tasks, whereas ***efficiency*** describes how economically (in terms of resource utilization)these tasks are performed. Thus, it is possible for an effective system to be inefficient; it is also possible for an efficient system to be ineffective.

**Vehicle travel: Distance (or travel time)**

Vehicle travel is generally measured as actual path distances, and not rectilinear or Euclidean distances. The total vehicle travel distance consists of loaded and empty vehicle travel. Material flow can then be characterized as either:

* departmental (within departments) or
* Intra-departmental (between departments).

Material flow within departments is usually not modelled in material handling system analysis.

The measurement of vehicle travel may include loaded vehicle travel, empty vehicle travel, or both. Vehicle travel distance is easily calculated when the flow volumes (trips required per unit time) and distances between stations are known.

Vehicle travel time directly corresponds to vehicle distance when:

* the vehicle speed is constant or may be assumed to be constant,
* the acceleration and deceleration effects are negligible, and
* there are no delays due to blocking, queues or other congestion effects.

Another vehicle travel distance measure is the average loaded or empty vehicle travel. This measure is defined as the average time to complete a transportation task. A measure is also taken vehicle travel using the ratio (*RLE*) of empty versus loaded vehicle travel.

**RLE = TL/ TE**

Where **TL** total loaded travel time,

**TE** total empty travel time.

**Vehicle travel proportions**

A vehicle may be in one of three states at any given time:

* travelling loaded,
* Travelling empty or
* idle. Idle time spent in the parking area is used as a performance measure. Then, travel time percentages may be calculated as the fraction of time that a device is travelling loaded, travelling empty, and waiting in an idle state. That is,

**T = TL + TE + TI,**

**Where:**

**TI** total idle time,

**T** total time,

**TL** as above (total loaded travel time),

**TE** as above (total empty travel time)

**Vehicle travel: response time**

Response time for a pick-up call is also considered as a performance measure. The authors define response time for a pick-up call as the time from when the pick-up request is made until the vehicle (starting from an idle and empty condition) arrives at the pick-up location. This measure differs from the total empty vehicle transportation time in that it consists of only empty vehicle travel when the vehicle starts from an idle position and does not include empty vehicle travel from a drop-off station to a pick-up station.

**Handling time per job**

The handling time per job is comprised of the time directly associated with material handling.

This time includes:

* the time the job spends in queues waiting for the material handling vehicle,
* he total travel time, and
* the total loading and unloading times, and
* total vehicle blocking times. The total handling time per job includes the time from when a job enters the system until it leaves the system.

**Vehicle utilization**

Vehicle utilization may be used to determine the vehicle fleet size requirements for a system. Vehicle utilization may be based on:

* the total vehicle mission time (including loaded and/or empty vehicle travel),
* the loaded vehicle time and
* the average of the time-averaged loads carried by all vehicles in the system. (Note: when the vehicles are able to carry multiple loads, the utilization value may be larger than one.)

**Number of loads completed**

The number of loads completed is defined as the number of loads (or deliveries) completed over a period of time by all of the material handling vehicles. The number of loads completed is considered as a performance measure. Some industry measure the time required for the material handling system to deliver a specified set of loads.

**Station queues: Mean load waiting times**

The mean load waiting time is defined as the mean time loads wait in queues for material handling transportation. These queues are located either at processing stations or at separate load transfer stations.

**Station queues: Mean queue lengths**

The mean queue length is the mean number of loads waiting for a material handling vehicle over a specific length of time. The variance of queue lengths may also be of interest, as a means of examining the adequacy of the physical space provided for the queue. Blocking occurs when a workstation’s output queue (or buffer) is full and the Workstation can no longer place completed parts into this queue. Starvation occurs when a workstation’s input queue is empty.

**Material handling system cost**

Material handling system costs may be comprised of variable and fixed costs. Variable costs are generally the operating costs of the material handling system. These costs can include the cost of power, lubricants, and maintenance. The variable costs may also include the routeing or travel expenses, which are proportional to the distance travelled.

Costs associated with idle or waiting vehicles may also be included in the variable costs. Fixed costs include such costs as the construction and purchase of equipment and hardware.

The authors given below in Table 5, use material handling system costs as a performance measure

In addition to the use of *total* cost as a performance measure, cost ratio (C) is also used as a performance measure.

This cost ratio is defined as:

**C**= C in/ c out

Where:

**C** in moving cost of one-unit load and one-unit distance within a department, **C** out moving cost of one-unit load and one-unit distance between departments.

**Material handling system flexibility**

Industry has identified range and response as dimensions of flexibility. Range refers to how much the system can change. Response refers to how rapidly and cheaply the system can change. Ii has been defining material handling system flexibility as the material handling system’s ability to reconfigure (to handle new material flows) and the material flow capacity. They define material handling system flexibility for a vehicle based system as:

**Fmhs = sum xi¹it i²ib i,**

**ni=1**

**where:**

**xi** number of equipment of type i,

**¹i**max unit load quantity factor, based on capacity of the equipment,

**Ti** equipment speed, based on the normal operating speed of the equipment,

**Ei** equipment loaded travel factor, b i relative rerouting cost, indicates ability of equipment to reconfigure.

**Congestion**

Congestion prevents vehicles from travelling freely on a guide path. As a result of congestion, vehicles may travel at reduced speeds or may be required to stop. Vehicles may be delayed by other vehicles blocking the path or at intersections. Congestion levels may be measured by the following quantities:

* Vehicle Blocking Time: the total blocking time of the vehicles is defined as the time where vehicles are unable to move due to other vehicles
* Track Blocking Percentage: track blocking is defined as the blocking time (as percentage) for track segments due to vehicle interference
* Track utilization by averaging the utilization of all track segments and then dividing by the number of AGVs.
* Vehicle Waiting Time at Intersection: average vehicle waiting time at intersections

**12. Congestion index**

The congestion index (*Ic*) is defined as:

**Ic**=TA/TS

**Where:**

**TA** the actual travel time,

**TS** shortest travel time if there were no congestion.

**Characteristics of effective performance systems**

For most systems, the selection of performance measures is not simply a question of determining which measures are `good’ and which measures are `bad’, and selecting the `best’ one or the `good’ one. On the contrary, performance measure selection is the process of defining a set of measures that possess the following characteristics, all of which are found in any effective performance measurement system.

* **Inclusiveness**: The performance measure (or performance measurement system) should measure all pertinent aspects of the material handling system. In this way, good performance of one particular component of the system would not be possible without similar performance of other system components.
* **Universality**: The performance measurement system should allow for comparison under a wide range of operating conditions. That is, if two competing material handling system designs must be compared, then the measurement system should allow for this comparison, even if the system characteristics differ significantly.
* **Measurability**: All data required by the measurement system should be readily measurable. Furthermore, the process of measuring the performance of the material handling system should occur with a minimum of measurement errors and at a reasonable expense.
* **Consistency**: The performance measures used should be consistent with the overall goals of the organization. The value of the performance measure should therefore provide meaningful insights into overall material handling system performance with respect to organizational objectives.

Numerous performance measures have been used to analyse material handling systems. Although traditional manufacturing system measures, such as job throughput, have commonly been applied to material handling systems, they do not measure the material handling system independently. In these instances, the performance of the material handling system is confounded with the performance of the manufacturing system. Thus, these traditional measures are not necessarily effective or appropriate in the analysis and design of material handling systems. Multiple performance measures provide more comprehensive information about system behaviour. In fact, the use of multiple performance measures results in more efficient and effective system designs and operation. Although multiple criteria decision making

has largely been ignored as a decision tool, it has been established as the most appropriate method for the simultaneous consideration of multiple performance measures in material handling system design and analysis.

The reliability of material handling system components has largely been ignored in the literature, even though material handling system components are not completely reliable. Material handling systems are unique in the sense that they are degradable systems.

That is, a failure of one or more material handling components does not necessarily indicate failure of the entire system. Indeed, system component failures may only indicate that the system will continue to perform its tasks, but at some reduced level of performance. Therefore, neither traditional notions of performance nor reliability alone are appropriate in this context. Performability measures, then, which simultaneously measure performance and reliability, emerge as appropriate measures for use in the design and analysis of material handling systems.

**The fundamentals of various types of material handling equipment**

“Every time you pick up an article without changing its form, you add to its cost but not to its value” – Mr. Henry Ford.

Materials Handling Systems (MHS) can be defined as “the set of all pieces of equipment that make possible the physical movement within the distribution chain –including the production chain and the warehouse – of raw material, work in progress and finished goods”. Therefore, materials handling systems perform a wide range of activities. In general, Materials Handling refers to the necessary tasks to be performed in order to move a load around the factory floor as well as to store and freight it.

Materials handling takes place one way or another along all the links of the supply chain including production, distribution, and storage and retail functions.

Handling in a warehouse or distribution centre will have a major impact on how effectively materials flow through the system, and on the cost, resource and time taken to get orders out to the customer. In addition, handling equipment can be capital – intensive, and the act of movement can be labour – intensive. Material handling equipment eases manual handling chores and enhances operational efficiency.

Various methods of handling goods are used in warehousing, from manual through to automated or robotic systems, and a broad categorization could be:

* Manual handling;
* Manually operated trucks and trolleys;
* Powered trucks and tractors, operator controlled and driven;
* Powered trucks and trolleys, driverless, computer-controlled;
* Crane systems;
* Conveyors;
* Robotics.

CH - 11

Although this chapter will concentrate on powered trucks, cranes, and conveyors, it must not be forgotten that there is a wide range of non-powered industrial trucks for pedestrian use. These include hand pallet trucks, order picking trolleys, stair climbing trolleys and wide range of platforms, shelf and cage trolleys.

Industrial lift trucks are used in warehousing for moving material over relatively short distances, for lifting into and out of storage, and for vehicle loading and unloading.

Trucks facilitate load utilization, speed up movement, can handle large loads and consequently reduce the frequency of movements. Their lift ability enables the use of building height-the cost building volume reduces as building height increases.

The main types of powered trucks used in warehousing and stock yard operations are:

* Powered pallet trucks;
* Counterbalanced fork-lift trucks;
* Reach trucks including double reach and four –directional reach variants;
* Stacker trucks;
* High rack stacker trucks-very narrow aisle;
* Side loaders;
* Order picking trucks;
* Tugs and tractors;
* Straddle carriers-container handling

**Non-powered hand trucks**

Non-powered hand trucks are used in many situations. They are inexpensively manufactured for diverse and specific applications. Common construction materials include aluminium/magnesium, steel, and wood.

Because these trucks are so inexpensive, it makes sense to design them for specific material handling functions. In this way, it is possible to increase the cube utilization within the truck for material handling optimization. Aluminium or magnesium trucks generally carry 300-500 pounds of material, while steel or wooden trucks can be used to carry approximately 1000 to 2000 pounds, respectively. The trucks range in weight from as little as 20 pounds for aluminium trucks to as much as 125 pounds for wooden trucks.

**Non-powered hand pallet trucks**

These trucks are designed to carry unit loads on pallets from one location to another, generally in indoor settings. Because unit loads can be quite heavy, the distances transported using this type of equipment is generally short. In many settings, hand pallet trucks are used to supplement motorized truck fleets. They are extremely efficient for transporting unit loads short distances when high lifting is not required.

**Pallet Trucks**

The full featured ergonomic pallet truck is an economical way for one person to move heavy pallet loads without the use of a fork truck. Proven ergonomic design has been tested for providing years of reliable usage.

This pallet truck includes two articulating steering wheels and two front load rollers.

Ergonomic design requires only 75 lbs. of pulling force when fully loaded. Steering wheels include bearing dust covers for added life. Nose wheels are located on the front edge of each fork to assist in clean pallet entrance and exit. Reinforced triple formedsteel forks provide twice the strength of standard single-formed forks.

Equipped with internally mounted solid steel adjustable push rods. Spring loaded loop handle automatically returns to vertical position when not in use. Chrome-plated hydraulic pump piston for long seal life.

Hand pallet trucks, with capacities up to a max of 2 tonnes, are probably the most commonly used trucks for the horizontal movement of pallets. It is not uncommon to see these trucks lifted on to the back of the vehicle for positioning pallets during loading and unloading. However, for frequent movements, and where there are inclines to be negotiated, battery –powered trucks are preferable in terms of operator effort and safety, and these can be pedestrian – or rider- controlled.

**Pallet**



**Counter balanced fork-lift trucks**

Counterbalanced fork-lift trucks carry the payload forward of the front wheels, so there is always a turning moment lending to tip forward. To balance this, a counter balance weight is built into the rear of the machine-hence the name. These machines capacity varies from 1000kgs to 45,000kgs with a lift height of up to 6/7 metres.



**Reach trucks**

Reach trucks are designed to be smaller and lighter than counter-balanced trucks and to operate in a smaller area. Its capacity varies from 1000kgs to 3,500 kgs with a max fork-lift up to about 11 metres. This is achieved by having a mast that can move forward or back in channels in the outrigger truck legs. Then picking up or setting down a load, the truck is turned through 90 degrees to face the load location; the mast reaches forward, places or retrieves the load, and is retracted back into the area enclosed by the wheels.



Reach truck - (www.forklifttruck.com)

**Double reach trucks**

A conventional reach truck can only reach one pallet deep into racking. For accessing

double deep racking a double reach truck has to be used, which uses a pantograpgh mechanism to achieve the additional reach. Double reach can also be achieved on some lighter trucks by the use of telescopic forks. Double reach machines are also used for side-loading pallets on to road vehicles, working only from one side of the vehicle.



Double reach truck - (www.forklifttruck.com)

**Four-directional reach trucks**

On a conventional reach truck, the front wheels always face forward, and steering is from the rear wheels. The 4D truck has an additional option of being able to turn the front wheels through 90 degrees and lock them in this mode. This effectively converts the truck into a side loader and is especially useful in stores and warehouses where oart of the stock range consists of long loads. For access to say cantilever storage, very wide aisles would be necessary if this option were not available



Four–directional reach trucks - (www.forklifttruck.com)

**Stacker trucks**

These are fairly light weighted trucks with max capacities up to 2000 kgs. There are pedestrian, stand-on and ride-on versions. Pallets are put into or taken out of storage racking by the truck legs being driven into the space either under the bottom pallet beam supported). When picking up pallets at floor level, the forks have to be lowered right down on to the outrigger legs, so perimeter-based pallets cannot be used, since they would be sprung apart as soon as the forks were raised. This problem is overcome if the lowest pallets are located on low beams with sufficient space underneath to accommodate the outrigger. These trucks are usually limited to about a 6 metre lift, but they can operate in 90- degree turning aisles of only 2 metres or less.

**High rack stacker trucks-very narrow aisle**

These trucks typically with lift capacities up to 2 tonnes and lifting to 12/13 metres, are equipped with mechanisms on the mast that can set down or pick up pallets from the racking without the truck having to turn in the aisle. Consequently, they can operate in aisles of 1.8 metres or less. The very narrow aisles and high lifts give good space utilization, but also necessitate very flat floors, which are expensive, to minimize the risk of collision between load and racking when manoeuvring loads. It is also necessary to have a guidance system to keep the trucks centrally positioned in the aisles.



High rack stacker trucks - (www.forklifttruck.com)

**Order picking trucks**

There is a range of manual and powered trucks designed specifically for order picking operations. These range from trolleys, such as roll cage pallets, to ground-level pedestrian trucks such as long fork powered pallet trucks, up to multi-level trucks in which the operator is raised for high-level picking.



Order picking truck -(www.forklifttruck.com)

**Conveyors for unit load handling**

Conveyor systems are used for moving material between fixed points, for holding material as short-term buffer, for sortation and for process industry applications such as separation, grading and cooling.

The general characteristics of the conveyor systems are:

* High through-put with few operators and low power requirement;
* Suitable for fixed routes, and floor surfaces are not critical as they are for fork trucks;
* Fast response and suitable for continuous or intermittent movements;
* Can utilize very sophisticated movement control.

Conveyor systems now find very wide application in both conventional and automated warehousing.

The less positive aspects of conveyor systems include:

* High capital cost;
* Can obstruct working areas and access;
* Inflexibility for future change;
* Hence very careful system design required including safety features.

The handling of products is a key to warehouse productivity for several important

reasons.

1. The relative number of labour hours required to perform material handling creates a vulnerability to any reduction in the output rate per labour hour.
2. Warehousing is typically more sensitive to labour productivity than manufacturing since material handling is highly labour-intensive.

The nature of warehouse material handling is limited in terms of direct benefits gained by improved information technology. While computerization has introduced new technologies and capabilities, the preponderance of material handling requires significant manual input.

Material handling in the logistics system is concentrated in and around the warehouse

facility. A basic difference exists in the handling of bulk materials and master cartons. Bulk handling is a situation where protective packaging at the master carton level is unnecessary. Specialized handling equipment is required for bulk loading, such as for solids, fluids, or gaseous materials.

Over the years a variety of guidelines have been suggested to assist management in the design of material handling systems. These are representative:

* Equipment for handling and storage should be as standardized as possible.
* When in motion, the system should be designed to provide maximum continuous product flow.
* Investment should be in handling rather than stationary equipment.
* Handling equipment should be utilized to the maximum extent possible.
* In handling equipment selection, the ratio of deadweight to payload should be minimized.
* Wherever practical, gravity flow should be incorporated in system design.

The factors to be considered when deciding on the appropriate type of handling system

for a particular application include:

* Types of load being handled including the unit load characteristics;
* Quantity of material being handled;
* Frequency of movement;
* Distances to be travelled, horizontal and vertical;
* Numbers and locations of pick-up and drop points;
* Adjacent activities;
* Nature of terrain;
* Flexibility required.

The principles governing the design and use of handling systems include:

* + Control of position and movement;
  + Elimination of unnecessary movement and minimization of the necessary movement;
  + Selection of the most appropriate handling method to meet the system requirements;
  + Provision of adequate handling capacity;
  + Integration of handling with the storage and other adjacent operations;
  + Thorough and effective operator training;
  + Effective equipment maintenance for operational availability and safety;
  + Safe methods of handling and working practices.

Handling system are classified as

* mechanized,
* semi-automated,
* automated, and
* Information- driven.

A combination of labour and handling equipment is utilized in mechanized systems to facilitate receiving, processing, and/or shipping. Generally, labour constitutes a high percentage of overall cost in mechanized handling. Automated systems, in contrast, attempt to minimize labour as much as practical by substituting capital investment in equipment. An automated handling system may be applied to any of the basic handling requirements depending on the situation. When selected handling requirements are performed using automated equipment and the reminder of the handling is completed on a mechanized basis, the system is referred to as semi-automated. An Information – directed system uses computers to maximize control over mechanized handling equipment. Mechanized handling systems are the most common. However, the use of semi-automated and automated systems is rapidly increasing. As noted earlier, one factor contributing to low logistical productivity is that information-directed handling has.

**AS/RS (Automated Storage & Retrieval Systems)**

This looks atan overview of some of the more sophisticated handling and storage systems to be found in warehousing applications. They include highly mechanized systems, automated systems with computers controlling the physical movement and storage of materials, and robotic applications. Such applications may be said to be at the technologically advanced end of the equipment and system spectrum in the context of warehousing, although some of the technology is well established and has been with us for many years.

An example is the use of automated storage and retrieval systems (AS/RS) using computer-controlled driverless high lift stacker cranes in high bay warehouses, a concept that has been with us since the early 1960s.In this sort of application the computer is used to manage and control the physical movement of equipment, and hence of the materials being handled and stored. Many of the earlier stacker cranes were operator-controlled, but the facility for on-board operation is now more usually for maintenance purposes only.

During the last 10 to 15 years the pace of technological development and application has increased considerably.

Systems should be designed that best meet the overall system requirements, and in some cases that will be a ‘low-tech’ solution. One example of this was the building of a new clothing warehouse that had to be able to meet peak seasonal sales of up to three times the volumes experienced at other times of year. In this case the flexibility of a labour-intensive solution, in which the company could ‘throw people at the problem ‘was seen as a major requirement for meeting seasonality and peak sales volumes. An automated solution would have been underutilized for much of the time.

**AS/RS Systems for Unit Loads**

The basic components of an AS/RS system are:

* Storage medium, e.g. pallet racking, or shelving for small-item tote bins;
* Storage and retrieval machines that operate in the storage medium;
* In-feed and out-feed systems, e.g. Forklift trucks, conveyors, AGVs
* Controlling computer.

The controlling computer monitors the status of all the components of the system and, based on the warehouse stock and movement requirements, plans the work to be carried out within the system and instructs the equipment accordingly.

The computer would control the incoming and outgoing material flows, monitor the status of the pallet racking (what stock is located in each location and which locations are empty), and control the crane movements. Because of the generally tight clearances in such installations and to prevent possible jams in the racking, a strict profile check for incoming pallets is adopted to ensure that loads have not slipped on the pallets during transit, and that packaging material has not come loose. Pallets outside the dimensional specification are rejected, and have to be rectified before being accepted into the system.

A stacker crane consists of a vertical mast or pair of masts supporting a unit load handling mechanism, which can be raised or lowered. The crane travels on floor mounted rails running the length of each aisle, and is guided by an overhead rail. The unit load mechanism can pick up and put away pallets from and to either side of the racking aisle. Cranes can be designed for accessing pallets in single deep and double deep racking.

The number of cranes required is determined by the total amount of a pallet movement that has to be carried out in a given period of time. If the number of cranes is significantly less than the number of aisles in the racking, a transfer facility can be incorporated into the design to enable the computer to move cranes between aisles as required. This usually consists of a transverse aisle at one end of the tracking, equipped with one or more transfers cars on to which the cranes can be driven and moved between aisles. If the number of cranes required is close to the number of aisles in the racking, it is probably better to have one dedicated crane in each aisle.

**Design of AS/RS Systems:**

The highly automated AS/RS has a simple design. A pallet conveyor system transports the heavy unit loads that interface with the AS/RS. Dual induction assures that pallets of product are inducted quickly and easily. A scan clearance tunnel checks for overhanging loads. Product is tracked from receiving to shipping by a “small system” that tracks it from manufacturing and other sites. Software and controls provide information on inventory status, which assist in production planning and customer shipping schedules.

The pallets of product are stored by one of the six AS/RS, without operator intervention. Reduced handling translates into increased productivity and efficiency.

A unique feature of the AS/RS is its ability to interface with three different pallet types on rack load beams in both single and double deep configurations. As product is needed the pallets are retrieved. The AS/RS eliminates fork lift traffic in picking and transportation.

Pallet loads are transported by the heavy unit load conveyor system to order picking stations. An ergonomic conveyor lift is used to transfer the load. These lifts make picking easy by positioning the pallet loads at optimal working height.

Once the order is complete, it is dispatched to shipping by an automated rail guided transfer car. Pallets with remaining products are returned to the AS/RS automatically by the pallet transport system. Empty pallets are stacked and returned to production.

**There are various applications of this principle of automated storage. These include:**

* Small –item storage using ‘mini’ crane installations
* Long load storage of metal bar and tubing using cantilever racking-often in support of manufacturing operations.
* Paper reel handling using overhead travelling cranes fitted with vacuum lifting heads, moving the reels into and out of vertical stack storage.

It should be noted that the term ‘automated warehouse’ is frequently used to describe installations that in reality are only partially automated. The handling of whole pallets into and out of racking may indeed be automated, but the order picking of cases from those pallets is in many applications still carried out manually.

**The major benefits of AS/RS Systems:**

Cut order fulfilment time in half while servicing manufacturing operations

* Reduce operations costs
* Maximize utilization of floor space
* Increase inventory accuracy
* No restocking errors
* Fast and accurate service

**Types of conveyors**

**1. Fixed Path Conveying**

Fixed path conveyances are advantages for periodic and continuous transport of material between locations in warehouses and factories. They are also used to accumulate goods, store packages, change elevations, and provide a continuous work surface on which progressive assembly or processing can be performed.

**Conveying systems Planning Criteria**

* + Product size and weight (or container characteristics if used).
  + Distance
  + Control requirements.
  + Flow Rates.
  + Obstructions and facility limitations.
  + Human factors, including noise
  + Environment.

**2. Gravity Conveyors**

These conveyors are the simplest and usually least expensive. They are useful where material is moved for short distances and movement requirements are simple.

Three common types are chutes, skate wheels, and rollers. They are often used in conjunction with powered systems. Pros and Cons are listed below

**Advantages of Gravity Conveyors**

* + Excellent for elevation drops.
  + Low initial and operating cost.
  + Quieter operation than powered conveyors.
  + Low maintenance
  + Low profile.
  + Easier to manually move products.
  + Unlimited configurations allow use for wide range of product weight.

**Disadvantages of Gravity Conveyors**

* + Less control of products on long runs, including failure to move once stopped.
  + Impractical for fragile products that are damaged by bumping or crashing.
  + Singulation and non-contact difficult.
  + Tend to increase the work in progress.
  + High pitch requirements.
  + May require manual assistance.

**3. Horizontal powered conveyors.**

These are used to move material over moderate to long distances.

**Live Roller**

This type of conveyor is used for a variety of applications, loads, and environments, but they are typically used for 30-50 lb.ft loads in warehouses. They can provide brief periods of product accumulation or dwell points. Live rollers can handle up to10,000 lbs and can carry irregular shaped containers. Live rollers are classified by their drive method, listed below. Some disadvantages are containers:

Liver rollers are classified by their drive method, listed below some disadvantages are:

* + Higher cost due to construction materials.
  + Product slippage on rollers requires frequent tracking update and diverter timing.
  + Products cannot negotiate inclines over 7 degrees without manual assistance.
  + Power surges when accumulating on driving rollers; disrupting product spacing.

**4. Liver Roller Accumulation Conveyors.**

These conveyors are used to regulate the flow of products into downstream operations by providing a temporary buffer for excess products. Selection criteria depend on specific applications. Proper product alignment is required when using accumulation conveyors. Various releases are available, depending on conveyor speed. Three types of powered accumulation conveyors

* Zero-pressure. The line pressure (horizontal pressure between products) is eliminated.
* Non-Contact. Products are always separated from each other.

**5. Slider Bed/Roller Bed Conveyors**

The slider bed consists of a moving belt operated across a steel support bed. The roller bed is a belt supported by rollers. The slider bed is the least expensive powered conveyor, but handles less loading than the roller bed. Roller beds require more power than live rollers. Belt conveyors offer stable support, are used for heavy loads, and can be operated at high speeds. The belt conveyors maintain product spacing to allow excellent material racking. These conveyors are also used for inclines and declines of up to 30 degrees.

Belt conveyors are not used to accumulate products, but they can start and stop and they can be used to meter products at the exist of an accumulator conveyor.

**6. Roller Curves and belt Turn Conveyors**

Curves and turns are used to change the direction of material flow. Roller curves are less expensive than belt curves and they are the most common. They can be self-powered or slave driven. Belt curves are used to maintain product orientation and spacing. The flat surface also allows handling of smaller, irregular sized products.

**7. Sortation Conveyors**

Sortation conveyors are used to identify packages, present packages to sortation equipment, or sort packages to multiple locations.

**8. Powered Overhead Conveyors**

Powered overhead conveyors are used when system flexibility is desired or floor space is congested because material flow paths are easily established and altered and obstructions are minimized, enhancing freedom of movement. Additionally, drivers and other equipment are offered some protection from the environment on the floor.

**9. Vertical Conveyors**

Vertical conveyors are used to lift or lower heavy loads between various levels in intermittent-flow operations and where horizontal space is limited. Of the two vertical types, the reciprocating is simpler, but the continuous supports a higher flow rate.



**Activity**

1. Explain the three characteristics of an effective performance system in materials handling.
2. Define conveyors for unit load handlinglist three characteristics.
3. List and explain the main types of powered trucks used in warehousing and stock yard operations.
4. what are the basic components of an AS/RS system?

summary

**Summary**

There are fundamentals of various types of material handling equipment. Warehousing uses various methods of handling goods which ranges from manual through to automated or robotic systems, and a broad categorization.

The performance measurement in materials handling uses the measures as, reliability, and performability in analyzing and designing of material handling systems in a manufacturing environment.

The AS/RS (Automated Storage & Retrieval Systems) looks at an overview of some of the more sophisticated handling and storage systems that are to be found in warehousing applications. They include highly mechanized systems, automated systems with computers controlling the physical movement and storage of materials, and robotic applications.

**Unit 10: computerisation in material management**

**Introduction**

Efficiently run businesses require many operations to flow seamlessly and without hindrance. Automatic Identification or "bar codes", as the industry is more often referred to, makes these steps more efficient and accurate. A bar code does not change how a business operates, but it makes procedures faster and more accurate, providing useful management information in a timely manner. Bar codes can be employed in virtually all organizations and all professions to increase the productivity, efficiency and accuracy of specific business processes.

**Outcomes**

**Learning outcomes**

After studying this unit, you will be able to:

* Explain the role of computers in stock management
* Discuss electronic computers
* Explain the Integrated computer system for stock management
* Discuss the stock planning
* Explain Barcoding and its components
* Discuss the aspect of Radio Frequency Identification (RFID)

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Bar Coding Technology & Applications in Logistics Industry**

**What is a Bar Code?**

A bar code is simply a set of symbols used to represent alpha-numeric information. Basically, instead of seeing the number "1", or the letter "A", you would see a series of bars, both fat and thin, used to represent that number.

Even though Optical Character Recognition has come a long way in recent years, it's much quicker and much more accurate for a mechanical device to decode and series of black and white lines than it is to read human text.

A number of bar code standards have been developed and refined over the years into accepted languages called symbologies. We would use different symbologies for different application in the same way that we would use a bold or itallic font to emphasize a particular line of text in a report. Different symbologies or "bar code fonts" are used for different applications. By having standardized symbologies, we ensure that when you print a bar code, I will be able to scan and decode it with my equipment and you will be able to scan and decode my bar codes—as long as we both use the same code and are within the specifications dictated by the barcode standards.

Bar code symbologies come in two basic varieties. They can be either linear or two dimensional in their configuration. A linear bar code symbology consists of a single row of dark lines and white spaces of varying but specified width and height, as indicated by the example below.





Similarly, a 2-Dimensional symbology can be configured into a stacked or matrixformat. Two dimensional bar codes are special rectangular codes which ‘stack’.

The amount of data that can be encoded in a linear barcode symbology is more limited than that of a 2-D bar code symbology. A one inch 2-D matrix symbology, for example, can encode thousands of characters of data, whereas a comparable linear bar code would have to be several feet long to hold the same amount of information.

**Components of Bar coding**

Bar code systems come in many different sizes and shapes. The complexity of system required is determined by the application. A basic scanning system is fundamentally broken down into the following four components:



**Component1-TheBarCodePrinter**

The bar code printer provides the first component part in a bar code system. A variety of technologies and methods exist to print a bar code label. You can use laser printers and pre-set templates (often included in label design software such as Wasp Labeller or Zebra Bar One software) to print your bar code labels. They are usually printed onto Avery stock. More commonly, labels are printed using bar code label printers such as those made by Intermec, Datamax, or Zebra. These printers print labels much faster

and are of higher quality than those printed using a conventional laser printer.

**Component2-TheBarCodeLabel**

As mentioned above, you need the bar code printer to print the bar code labels. In addition, you need some software application that can design your labels. These are the same labels that you will then attach to a box or an asset for tracking. An item label can contain any combination of text, graphic or bar code information. Many label packages such as Wasp Labeller or Zebra Bar One, have pre-made templates that can easily start you on your way to designing your label. In addition, they have compliance label templates for specific industry labels such as the automobile industry.

**Component3-ScanningEquipmentforDataCollection**

The data collection phase occurs through the use of scanners that instantly and accurately read, capture and decipher the information contained in the bar code label.

Scanners read information much faster and more reliably than humans can write or type, thus, significantly reducing the rate or likelihood of error. There are two different types of scanners: contact and non-contact. Contact scanners required physical contact to scan as opposed to non-contact scanners which can be several inches to several feet away. Of these two types of scanners, there is also one other major attribute; they are either decoded or non-decoded. Decoded scanners have built in hardware decoders that interpret the meaning of a bar code before sending the data to the computer. Undecoded scanners simply have light sources that capture the encrypted data, and send them to a decoder of some sort. Decoders are either in-line hardware units or software decoders that run on your computer. As you may have guessed, decoded units are usually more expensive than their undecoded counterparts. They do have the distinct advantage of only having one component to worry about if something breaks down instead of trouble shooting many components to find out why your bar codes aren't reading properly.

**Why Should You Consider Bar Coding?**

Implementing a proper bar code system offers tremendous advantages to a company. The most compelling advantages of bar coding and automatic data collection are:

**Accuracy**

Bar coding increases accuracy by reducing the likelihood of human errors from manual entry or miscommunication from misread or mislabelled items.

**Ease-of-Use**

Bar codes are easy-to-use provided the appropriate hardware and software aspects are in place to maximize the process of automatic data collection. Obviously, pulling a trigger to enter in inventory is going to take much less effort and brain drain than it would to accurately account for all the inventory by hand.

**Uniform Data Collection**

Diverse compliance standards and standardized bar code symbologies ensure that bar code information is captured and relayed in a fashion that is universally understood and accepted.

**Timely Feedback**

Bar coding promotes timely feedback in that data is captured in real-time as it occur, enabling decisions to be made from current information.

**Improved Productivity**

Bar codes improve many activities that streamline workflows throughout a business. Remember when cashiers used to enter the price of your groceries by hand?

**Increased Profitability**

The increased efficiencies that bar coding promotes enables companies to save costs and substantially improve their bottom line.

**Benefits of Bar-coding**

Many people think of bar coding strictly as a technology. A broader way of looking at bar coding is viewing it as a tool for managing information. Bar codes enable quick, accurate data entry. Having accurate data available enables managers to make decisions based on valid information. For example, with a manual system you often must make an educated guess on inventory levels and when to reorder products. On the other hand, the accuracy of bar code scanning provides up to- the-minute information about inventory levels, including the value of inventory investment. This information can help you maintain lower inventory levels and improve cash flow, which is invaluable to your hospital. The most compelling advantages of bar coding and automatic data collection are:

* **Accuracy:** Bar coding increases accuracy by reducing the likelihood of human errors from manual entry.
* **Ease of use:** Bar codes are easy to use as long as the appropriate hardware and software components are in place to maximize the process of automatic data collection.
* **Timely feedback:** Bar coding promotes timely feedback of data captured in real time, enabling decisions to be made from current information.
* **Improved productivity:** Bar codes improve productivity in that many manual activities and tasks become automated, enabling resources to be utilized in other ways to increase efficiencies.
* Bar code technology can be translated into three primary functions: **tracking, inventory management, and validation. Whether** you use one function or a combination of functions, the benefits in cost savings, improved productivity, and quality can be substantial.

**Tracking**

Anything that can be identified with numbers (or numbers and letters) can be tracked using bar code technology. Materials management, central services, medical records, radiology, pharmacy, and laboratory are areas where bar codes are commonly found in hospitals. However, applications continue to expand to nearly every area to help track cost per procedure, products used by clinicians, and total patient costs. In addition to assuring greater accuracy, bar codes help speed the process of recording where and what an item is, or what service is provided. Bar codes can be used to track a product throughout the supply chain and clinical workflow. They may be used to track a supply to a particular patient and also can identify the clinician who used it with the patient. Bar coded numbers also can be used to track a particular item back to the manufacturer. For example, if a nurse discovers a defective supply item, bar coding can help track the item back through materials management and purchasing to the distributor and/or original manufacturer so the hospital can obtain a refund. Although it is possible to do the same thing manually, the amount of time involved would make the process too cumbersome. Often, the hospital will bear the cost of an unusable item rather than trying to investigate and complete all the paperwork.

**Inventory management**

Maintaining accurate inventory is a very complex process of knowing what you have, how much of it you have, who has it, where it is, how much it is worth, and when to reorder it. Every hospital maintains centralized and decentralized inventories that could include medical/surgical products, office supplies, linens, pharmaceutical products, X-ray film, cleaning supplies, laboratory products, and more. Bar coding helps you manage these inventories wherever they are located, so that the right materials are available when and where you need them. Using a bar code also can help you monitor usage patterns throughout your hospital. In one hospital, the materials management department began collaborating with nurses to reduce inventory at nursing stations.

Because the materials management department had accurate, documented information, they could create more realistic inventory levels (Ramakrishnan. R V, Tony Arnold. J R 2007). For example, if a particular unit used only eight of a certain item a day, but was keeping 17 of those items on the unit, the two groups worked together to find a satisfactory lower inventory level. In addition to the savings in inventory costs, this process strengthened communication and trust between materials management and nursing. Scanning the bar code on a product can speed the reorder process. Some hospitals use systems designed to automatically reorder products when they reach a specified inventory level.

**Stock control systems - keeping track using computer software**

Computerised stock control systems run on similar principles to manual ones, but are more flexible and information is easier to retrieve. You can quickly get a stock valuation or find out how well a particular item of stock is moving.

A computerised system is a good option for businesses dealing with many different types of stock.

Other useful features include:

* Stock and pricing data integrating with accounting and invoicing systems. All the systems draw on the same set of data, so you only have to input the data once.

**Sales Order Processing** and**Purchase Order Processing** can be integrated in the system so that stock balances and statistics are automatically updated as orders are processed.

* Automatic stock monitoring, triggering orders when the re-order level is reached.
* Automatic batch control if you produce goods in batches.
* Identifying the cheapest and fastest suppliers.
* Bar coding systems which speed up processing and recording. The software will print and read bar codes from your computer.

**Stock control systems- keeping track manually**

Stocktaking involves making an **inventory**, or list, of stock, and noting its location and value. It's often an annual exercise - a kind of audit to work out the value of the stock as part of the accounting process.

**Codes**, including barcodes, can make the whole process much easier but it can still be quite time-consuming. Checking stock more frequently - a rolling inventory - avoids a massive annual exercise, but demands constant attention throughout the year.

Any stock control system must enable you to:

* Track stock levels
* Make orders
* Issue stock

The simplest manual system is the **stock book**, which suits small businesses with few stock items. It enables you to keep a log of stock received and stock issued.

It can be used alongside a simple **re-order system**. For example, the two-bin system works by having two containers of stock items. When one is empty, it's time to start using the second bin and order more stock to fill up the empty one.

**Stock cards** are used for more complex systems. Each type of stock has an associated card, with information such as:

* Description
* Value
* Location
* Re-order levels, quantities and lead times (if this method is used)
* Supplier details
* Information about past stock history

More sophisticated manual systems incorporate **coding** to classify items. Codes might indicate the value of the stock, its location and which batch it is from, which is useful for quality control.

**Validation**

The validating function of bar coding can be an especially effective method of ensuring quality in a Health care setting. Validation assures that an action has taken place or that the item you want is on hand. The ability to validate an action by a bar code scan helps reduce errors and waste, provides a management check on productivity, and helps construct the necessary documentation to meet requirements of the Joint

Commission on Accreditation of Healthcare Organizations (JCAHO) and insurance companies, the most important validating function is to verify that the patient being

**Common Bar Code Applications**

In retail applications, labels adhered or attached to a product or item of clothing contain barcodes which are read by a scanner during checkout and interpreted by a computer. The computer recognizes the barcode’s data bit reference and is able to link the item to its sales price and description contained in the store’s mainframe database.

This product information is reflected, not only, on your sales receipt, but is automatically linked to the store’s inventory tracking system which knows to deduct the quantity of the item purchased from the stores current level of inventory. This entire process occurs in a matter of seconds with only minimal data entry required by the checkout person in the form of quantity purchased – e.g. one or more.

Generally, any industry or company can utilize bar coding to track and improve their current processes and operations. Some of the most common bar code applications referenced in the industry are:

**Shipping & Receiving Compliance Labelling**

Compliance labels utilize bar codes to facilitate and expedite shipping and receiving process functions between one’s suppliers and/or vendors. As a purchase order is received, the operator scans the bar code label and keys in the quantity that has been received into a hand-held portable data terminal which uploads this information to the computer mainframe. The mainframe can then point out product shortages that are double-checked on the spot rather than after an item has been moved or partially

used. Similarly, as items are loaded in preparation for shipping, they are scanned enabling shortages or misloads to be detected immediately. As items are stored into inventory, the computer, thus, immediately registers the stock quantities as being available for picking to satisfy an upcoming order.

***Note:*** Compliance label specifications vary depending on the customer. Any shipment not in accordance with a client’s specified compliance labelling requirement may be rejected and can result in a monetary fine, depending on the frequency and extent of the occurrence.

**Inventory Control**

Bar codes are frequently used for inventory control to track an item’s location and turnaround. When an item is either removed or entered into inventory its Product Description, Lot #, and Location are scanned from the shelf label by a portable data entry terminal which communicates this information back to the company’s computer mainframe via radio frequency. The quantity of product removed from inventory is entered separately (by the user) into the portable data terminal for relay to the mainframe so that the current inventory level is also registered within the mainframe.

**Work-in-Process**

Work-in-process labelling is frequently used in manufacturing facilities to monitor each phase in a manufacturing process to ensure consistent quality and output. With on-line or portable readers, scanning of a routing sheet with bar codes on them as parts or sub-assemblies are completed enables work-in-process costs and manufacturing progress to be tracked.

**Labour or Assembly Tracking**

Similar to work-in-process, bar codes for labour tracking of a manufacturing process ensure the consistent quality and output of a job. Consider the following example: In a custom assembly, a terminal leads the operator in what to assemble. As the operator scans each part or sub-assembly added, the computer can monitor it for correct specifications. Should a manufactured part be found faulty, it can then be tracked back to the exact point and/or person responsible for the error.

**Time and Attendance**

Time and attendance is yet another popular application for bar codes. An employee badge with a bar code can be read into a computer terminal at clock-in and clock-out stations to provide attendance data to a computerized payroll program.

**Asset-Tracking**

Bar codes can help companies to track their assets by way of equipment or hardware that they may temporarily loan out to someone. A bar code placed on a rental video, for example, is scanned at checkout along with the borrower’s ID card enabling the item to be tracked while it is on loan.

**Warehouse Picking**

Involves a computer that downloads a list of items to a portable data terminal, that instructs a warehouse worker to pick those items associated with a specific order. As locations are reached or items are picked, the bar codes are scanned and the terminal compares what was scanned to ensure that the right location or item is being picked.

**Radio Frequency Identification (RFID)**

**RFID Technology & Applications**

Radio Frequency Identification (RFID) is a fast and reliable means of automatically identifying and logging just about anything, including retail items, vehicles, documents, people, components and works of art. Because it makes use of radio waves, there is no need for “line of sight” reading of information, which is one of the limitations associated with barcode systems. It means RFID tags can be embedded in packaging or, in some cases, in the goods themselves.

**The principle of RFID**

RFID architecture that leverages the auto ID centre’s current set of production ready standards consists of the following building blocks:

* A passive RFID tag, which, when exposed to the electromagnetic waves of the
* RFID reader broadcasts its electronic product code (EPC) information.
* An RFID Reader, which activates the tag and reads its response.
* The Air Interface, which can be specified using the Auto ID centre standard or ISO 18006.
* The savant server, which has a real-time in memory database (REID), an event management services (EMS) and a task-management system (TMS) used to filter the stream of information from the reader to the next higher level.

The Application server communicates with the savant server via a simple object Access Protocol (SOAP) interface that leverages secure socket layer (SSL) encryption to transport information over the Internet. The application server middle ware bridges the gap between the savant-based protocols (SOAP) and the (proprietary) protocols used by the business systems. RFID information can also be routed directly to the supply-chain execution systems, such as a TMS, WMS, and point of sale or Supply Chain Event Management Environment. However, this puts additional load onto these systems and exposes them directly to the savant deployment strategy in the enterprise.

The RFID tag responds to the reader by broadcasting its EPC, which is a 96-bit code consisting of

* 8 bits of header information.
* 28bits identifying the organization that assigned the code
* 24 bits identifying the type of product.
* 36 bits representing serialization information for the product

**RFID Challenges**

**RFID Better than Barcode?**

As RFID technology reaches greater deployment levels, the cost of tags and readers will drop even further and RFID will become price competitive with conventional barcodes. However, RFID brings several key advantages to the table that will make it a relevant competitor to barcodes, even while the cost of a tag is higher than the cost of a printed barcode label.

* Barcode can be read only the line of sight; labels must be positioned to be directly visible to the barcode reader. RFID tags need to be within the RFID reader’s radio reach (about ten feet).
* Barcodes cannot be read inside other containers; RFID tags can be read through most materials. Thus, the concept of a shipping container can be verified easily without the costly overhead of an “Open Box Inspection” and manual counts and comparisons with shipments manifests.
* Barcodes provide only limited amounts of information –even two-dimensional barcodes are limited in the amount of data they can carry. The Auto ID centre’s definition of a product information server (consisting of a distributed repository Infrastructure and naming services) allows us to tie unlimited amounts of dynamic information to each tag.
* Barcodes identify classes of products –RFID tags identify individual products. The Auto ID centre concept aims at identifying and tracking individual product instances as they move through the supply chain, thus achieving greater granularity and better accuracy.
* The migration of supply chains from barcodes to RFID will require significant investments and will not happen overnight, RFID and barcodes will co-exist –in fact, they will co-exist with human readable labels-for the foreseeable future.

**Benefits of RFID**

**Labour Productivity**

Worker productivity levels will increase in the receiving area of the warehouse. Instead of manually scanning each inbound shipment and verifying it with the purchase order, the increased automation from the RFID technology permits employees to eliminate manual operations in the receiving function which will allow products to move to storage or the outbound dock faster. Other tasks that receiving can complete more efficiently with RFID are:

* + facilitating the return process of damaged or unsaleable goods;
  + improving quality control (on order integrity);
  + increasing put away rate; and,
  + minimizing errors in placement of shipments (cross dock or storage). Fork lift drivers will also have an easier time putting away items in assigned and unassigned slot locations. There would be no need to scan an additional barcode on a pallet at the slot location.

**Inventory Reduction**

By installing RFID technology into a warehouse, organizations reduce many of the challenges associated with inventories. RFID tags provide more visibility to the products so their location is more easily determined in the warehouse. This increased visibility reduces the likelihood of a stock-out occurring because of misplaced inventory or inaccurate inventory levels. Cycle service levels will also improve due to lower safety stock levels and the overall faster throughput of product at a warehouse.

According to an inventory management report, RFID technology will reduce total system inventory by approximately 5%.

**Facility/Equipment productivity**

RFID technology allows more data to be processed faster through a WMS. The WMS uses the acquired information to improve the operations of the warehouse. If vehicles are scanned as they enter the inbound gates of the warehouse, dock utilization improves because the WMS can more effectively assign vehicles to unloading doors based on order priority. If the product is not needed right away, the WMS would assign the vehicle a position in the yard. RFID technology also removes the need to manually

place bar coded items on conveyors in a specific orientation so that barcode readers can read them.

**Other Benefits**

There are several other benefits to the warehouse using RFID technology. Shrinkage, which is product stolen by employees along with misplaced items, will be reduced because the warehouse will have a better understanding of where the products are located and it will be more difficult to move products out of the warehouse without being detected. Forecast accuracy will also increase due to higher levels of visibility of product throughout the supply chain. This improvement will positively affect the overall efficiency and effectiveness of the warehouse in areas such as:

* + order cycle times;
  + safety stock levels;
  + fulfilment accuracy; and,
  + cycle service levels.

One of the most serious examples of misinformation about RFID in recent years has been the claim that it is generally more expensive than barcode systems. It’s true that an individual tag is more expensive than an individual barcode.

It’s also true that RFID

– currently, at least

– is inappropriate for the tagging of low-cost items.

An RFID system can track and trace the containers, dollies and other reusable equipment used in the transportation of the goods, as well as the goods themselves.

This is highly significant for distribution / logistics companies with container inventories of several million pounds, who need to ensure that their assets are returned regularly. If 10 per cent of assets are lost in a year due to poor or non-existent trace ability by a distributor with £10 million worth of reusable containers, an RFID system could pay for itself in months on this basis alone.

RFID has been proven to be more efficient than barcode systems in terms of read failure rates, even though the speed of read is many times faster. RFID is also less prone to human errors.

**In summary, RFID provides:**

* Substantial productivity gains
* Elimination of re-labelling costs and effort.
* Greater accuracy
* Flexibility of data on the tag – e.g., goods and containers can be identified and tracked using the same tag
* Ability to write additional or replacement information to a tag at any stage in the supply chain.

All of this means that goods can be checked in and out much faster and **AT A LOWER OVERALL COST THAN THAT ACHIEVED BY EXISTING SYSTEMS**. For a comparison of costs associated with bar-coding and RFID systems in a typical supply chain situation, see RFID vs. Bar-coding on our Asset Tracking page.

RFID’s biggest advantage is being a non-line-of-sight communication technology. Eliminating the need for line-of-sight communication allows products, cases and pallets to be automatically scanned in larger volumes and at higher speeds, allowing for greater improvements in efficiency. RFID solutions consist of four basic components:

* + Tags;
  + readers;
  + antenna; and
  + software. Each will be discussed briefly below.

**Tags**

RFID tag is a device that is placed onto, or in some cases into, the pallet or SKU. Basically, a tag is an electrical device that uses radio frequency antenna to communicate with the RFID reader. Information is stored in the tags that describe the object Tags can be differentiated as being active or passive (Ramakrishnan and Arnold, 2007). These can be seen in the pictures below. The active tags are self-powered whereas the passive tags use the signal from the RFID reader as the source of power. While the distinction between tags might seem minimal, the impact on their capability is significant in both read range and data storage. Active tags use a battery-powered transponder that emits a constant signal containing identification information. Active tags have the greatest range of all RFID tags, including search and read/write capability. Today, they have up to 128 Kbytes of storage space, but could hold more in the future. Passive tags have no battery, but instead rely on an antenna as the power source, drawing power from the reader’s electromagnetic signal. Passive tags have a much more limited range (less than 2-3 yards), have limited storage space (as of now, 128 bytes, but could hold more in the future), and lack data manipulation capabilities.





**Readers**

RFID tag readers are simply devices that scan the RFID tags. RFID tags have an antenna that transmits and receives information. The reader decodes and reads the information. The RFID reader converts the radio waves from the RFID tag into a form that can be passed along to an information system. The cost of the readers corresponds directly to the level of functionality needed. Readers that must scan multiple items, moving quickly on a high-speed conveyor or through a dock door are significantly more expensive than the basic hand held readers.

**Fixed Reader Mobile Reader**

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**Antenna**

RFID tag readers use an antenna to communicate to the RFID tag through the tag’s antenna. Some readers have integral antenna while other can have various types and sizes of antenna fitted to them. The antenna is a critical component in the RFID system, as it has to be built for the coverage area. The antennas vary depending upon the facility location, size, area, and volume. Usually, an antenna operates in the 3-15 MHz range.

**Software**

Software and middleware are the most important pieces of an RFID solution. These packages are needed to make use of the information read by the reader to integrate the RFID technology with all the other systems operating in the warehouse: warehouse management systems (WMS), transportation management systems (TMS), event management systems (EMS), order management systems (OMS), and enterprise resource planning (ERP) systems. The ability to capture, store, rationalize, and integrate information captured by RFID technology, including product information, location, volume, and transactional data, allows organizations to more efficiently pick/pack, ship, route, track and distribute materials. This operational improvement can result in lower inventory levels and improved labour and equipment productivity.

Integrating the information from RFID tags into an EMS or ERP system allows alerts and alarms to be sent when a certain set of conditions has occurred, e.g., inventory is running low or products have been idle too long. The information from RFID will also be useful when integrated with reporting software. Companies will be able to quickly target problem areas in their warehouse and identify areas of improved efficiency.

**RFID IN Retailing Sector**

Operating at razor thin margins in a highly competitive and largely undifferentiated market, top retailers are always on the lookout for opportunities that have a positive impact on the bottom line. Retailers have engaged in several initiatives to operate at higher levels of efficiency. Extensive use of information technology for process automation, supply chain collaboration techniques like CPFR, VMI and efficient data exchange mechanisms like EDI and XML have all enabled leading retailer’s Wal-Mart to run a tight-ship and gain competitive advantage. Within RFID inching up to the peak of inflated expectations in the hype cycle, this paper explores whether the added benefits from RFID provide reasonable justification for accelerated adoption by these enterprises.

RFID is an automatic identification and data capture (AIDC) technology which allows for non-contact reading to track and monitor physical objects.

A key benefit of RFID technologies is automatic identification of individual objects coupled with automatic data capture. Automatic electronic identity contributes significantly to enhance supply chain visibility, and the automation brings in data capture and has a direct bearing on operational efficiency in labour intensive Retail Logistics.

**Supply Chain Visibility**

Physical tracking of merchandise today is a challenge with significant implications across the supply chain for Retailers.

**Operational Efficiency**

A key element of cost in a retail enterprise is the area of Logistics Management – encompassing all activities that enable the movement of merchandise from vendor/manufacturer premises to the intended point of sale. About 25-30% of the supply chain costs can be attributed to labour costs in the process of distributing merchandise. Retailers extensively use software tools for warehouse management, yard management and transportation management. Industrial automation systems like conveyors, carousels, unit sorters enable enhanced operational efficiency within the distribution centre. Business process innovations like multi-order picking, pick-to-light, use of voice and wireless technologies have all contributed significantly to higher productivity in warehouse operations.

**Potential Benefits of RFID to Retail Enterprises**

Falling prices of tags and readers and the rapid strides in the standards development process is making RFID technology an increasingly viable option for pallet and case level tagging. However, Retailers stand to gain most when individual items are tagged, with significant opportunities in enterprise inventory management and retail store operations. While the current tag costs rule out the economic viability of item/unit level tagging in most cases, there still could be a good business case in certain specific.

An RFID system also offers greater efficiencies in warehouse systems that rely on conveyors.

RFID eliminates the need to ensure that cases/items are placed properly on the conveyor so that the bar code can be read accurately with the bar code reader.

Normally, this means that the bar code is “face-up” or on top of the box since many bar code readers scan from above the conveyor. RFID allows for accurate reads regardless of product position, resulting in fewer reading errors. Elimination of product positioning requirements on the conveyors will also improve the speed of overall product flow through the warehouse. This will also reduce labour costs since additional workers will not be needed on the conveyor to reposition products so the bar code is facing the proper direction.

**Storage**

RFID technology also provides benefits in put-away accuracy and efficiency. Forklift drivers could still rely on the current WMS system to identify the locations for pallets and products. However, an RFID system can eliminate the need to scan the bar code on the pallet and at the slot location in the racks. For example, if the pallet and slot location read by the RFID scanner do not match the WMS specification, the system notifies the driver that the product has been placed in the wrong location. Moreover, the need for additional bar codes on each pallet is eliminated. This pallet identifier bar code is also called a “license plate.”

**Pick / Pack**

RFID readers can integrate with the WMS and OMS systems to ensure that the correct items and amounts are picked. Another benefit of RFID is to help measure productivity in the warehouse. Through a type of RFID-enabled time-motion measurement, management could analyse the process to set benchmarks, evaluate employees and plan labour requirements. This is also enabled by bar code systems. The difference is that with RFID systems, manual scans of products are eliminated.

**Shipping**

An RFID reader can confirm that each item is placed onto the correct outbound vehicle, which can improve the accuracy of the shipping process. This verification can be made as the product moves through the portal of the outbound dock door. These processes allow for an automatic double check of the items loaded into the trailer against the bill of lading (a bill of lading must accompany each shipment tendered to a carrier; it is, among other things, a description of the shipment) or manifest (a manifest identifies the products and their locations in the outbound vehicle). It should also be noted that the use of RFID could greatly reduce the amount of employee theft in a warehouse. Placing RFID readers at exits of the facility and employee areas ensures that all items leaving the building are accounted for, regardless of the removal method.



**Activity**

1. Discuss any four advantages and disadvantages of computer inventory management system
2. Discuss Radio Frequency Identification
3. What are the four benefits of Radio Frequency Identification over Barcode?
4. Discuss the potential benefits of RFID to Retail Enterprises

summary

**Summary**

This unit has looked at important computers are in the management of inventories. As a learner you should know and understand why it is good to have computerized system in the inventory management by using bar code system.

Radio Frequency Identification (RFID) is enabling companies to see further into the supply chain than ever before, providing more accurate real-time information and improvements in process efficiency. The increased visibility can result in faster inventory turns, less shrinkage, reduced labour and higher material flow through your warehouse or distribution centre. Greater efficiency means RFID enabled processes take less time and effort; entire pallets of product can be recognized in seconds without the need to break them down, and cycle counting inventory can be accomplished in hours or even minutes instead of days.

**Unit 11: Materials Management Vocabulary**

**Introduction**

Efficiently run businesses require many operations to flow seamlessly and without hindrance. In keeping the materials in stores there are certain terms that are used which needs to be understood very well as materials management has its language.

**Outcomes**

**Learning outcomes**

After studying this unit, you will be able to:

* Explain material management languages
* Explain what some terms mean
* Explain where some terms are used
* Explain well the terms used

Time

**Time Frame:**

You will cover the following time;

* 2 hour 30 minutes’ study time
* 2 hours in class

**Languageinmaterials management**

Materials management has a language of its own. It has numerous terms knowing which communicating among the interested parties becomes easier. Practitioners of this profession, in any capacity, will find the terms and their explanation useful. Below are given the alphabetical series and each series contains many professional terms. Click the series letter to get the terms starting with that letter. You are welcome to suggest more terms so that the same can be put here for the benefit of others too.

**Get terms alphabetically: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z**

**ABC Analysis**

Applied in the context of inventory, it's a determination of the relative ratios between the number of items and the currency value of the items purchased on a repetitive basis.

10-20% of the items ('A' class) account for 70-80% of the consumption, the next 15-25% ('B' class) account for 10-20% of the consumption and the balance 65-75% ('C' class) account for 5-10% of the consumption. 'A' class items are closely monitored

**ABC Inventory Control**

An inventory control approach based on the ABC volume or sales revenue classification of products (A items are highest volume or revenue, C—or perhaps D—are lowest-volume SKUs).

**Absolute Advantage**

A competitive strength enjoyed by a party as a result of a natural endowment or other natural gifts that other parties do not have.

**Acceptance**

The intentional indication of an offeree to be bound by the terms of an offer.

**Acceptable Sampling Plan**

In quality management, a specific plan indicates the sampling sizes and the associated acceptance or non-acceptance criteria to be used.

**Acceptance Testing**

A statistical quality control technique used to evaluate the overall condition of a given lot by inspecting only a sample, drawn randomly from the lot.

**Accessorial Charges**

Costs that carriers usually charge in addition to the transportation cost, these include single shipment, inside delivery, loading, unloading, notification and storage and redelivery charges.

**Accessibility**

The ability of a carrier to provide service between an origin and a destination

**Administered Price**

A price determined by certain policies rather than by the competitive forces of the marketplace. For example, prices of sugarcane etc. in India are determined by the government rather than the market forces of demand and supply.

**AD Valorem Rate**

Customs duty charged in terms of percentage on the value of goods that are dutiable, irrespective of quality, weight, or any other considerations. The ad valorem rates of duty are ascertained from the invoice.

**Activity Based Costing**

A method for calculating indirect costs, based on the activities that drive cost. This is in contrast to the classical accounting methods which pool and arbitrarily allocates indirect cost.

**Accounting System**

The grouping of records and procedures that find out, record, classify and report information about the financial position and operations of an organisation

**Acculturation**

The process of becoming familiar with another culture, helps in conducting transnational businesses.

**Acknowledgement**

A written communication used to inform the buyer by the supplier that the supplier has accepted the purchase order placed on him. An acknowledgement thus creates a bilateral contract as long as the terms of the acknowledgement are not significantly different from those of the purchase order.

**Acquisition Cost**

Acquisition costs are the total costs associated with the acquisition of a material. Such costs include costs towards ordering, transportation, handling, inventory holding etc. It is noted in the context of the Economic Order Quantity (EOQ).

**Acquisition Process**

The sequential activities involved in obtaining necessary inputs for an organization is the Acquisition process. It includes determination of need, communication of need, identification of potential sources, invitation and consideration of bids, placement of the Purchase Order, receipt and inspection and making payment.

**Advance Payment**

Payments in advance of delivery for a mutually agreed amounts or for specified percentage of the purchase price that buyer shall pay to the seller.

**Advance Shipping Notice**

A standardized Electronic Data Interchange form detailing an inbound shipment to a receiving location (consignee)

**Advanced charges**

The amount of freight or other charges on a shipment advanced by one carrier to another, or to the shipper, to be collected from the consignee

**Agency**

It's a legal entity denoting the legal relationship that exists between two parties by which one is authorised to perform or transact specified business activities for the other.

**Agent**

A person or an organisation authorised to act for another person or organisation in dealings with a third party.

**Air Waybill**

A document used for shipment of air freight by national and international air carriers and declares therein the commodities shipped, shipping instructions and shipping costs.

**Anticipated Inventories**

Those stocks that are accumulated for a well-defined future need. they differ from buffer (safety) stocks in that they are committed to specific future plans

**ASP**

Application Service Provider is an organisation that provides software applications over the internet.

**Application Package**

A system of programs designed to assist in specific applications.

**Approved list**

It is a list of vendors maintained by an organisation for those vendors which meet the set criteria of the organisation for supply of materials and/ or services. It's also known as list of registered vendors.

**Arbitrage**

It implies purchasing a security, commodity or currency in one market with the intention of financial gain. In international currency transactions, profits can be made by simultaneous buying and selling one or more than one currency. In arbitrage it's the aberrations in the market that is taken advantage of.

**Arbitration**

A means of settling disputes between parties in which an outsider acts as an arbitrator who acts as a fact finder and decision maker. The parties agree to abide by the decision of the arbitrator.

**Assignment**

A transfer of a right or title to another party, it is commonly used with a bill of lading that involves transfer of rights, title and interest by means of endorsement. Such endorsement gives, to the party named, the title to the property covered by the bill of lading.



**Activity**

1. Define the term material management language
2. Explain the terms:
3. activity based costing
4. advance payment arbitrage
5. Define the following terms
   1. Advance Shipping Notice
   2. Arbitration

summary

**Summary**

This unit has looked and explained some of the most used terminologies in the management of inventories.

As a learner you are encouraged to know and understand all these terminologies in order to manage the store department well.

**Prescribed readings**

* Baily P. H. and Farmer D. H. (1995). Purchasing Principles and Management. London: pitman.
* Morrison, A. and Jessop, D. A. (1994). Storage and Supply of Materials. London: CIPS.
* Ramakrishnan. R V, Tony Arnold. J R (2007). “Introduction to Materials Management”. Pearson
* K. Shridhar Bhat, “Production and Materials Management”. Himalaya Publishing House
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* Lysons, C. K. (1998). Purchasing Hand Book. London: CIPS.
* Morrison, A. (1995). Storage and Control of Stock. London: Pitman
* Carter, R. and Price (1993). Stores Management. London: Pitman.
* Zambia National Tender Board Procurement Guidelines. Lusaka: ZNTB