East African Community
(EAC)

Federation of East African Freight
Forwarders Associations (FEAFFA)

THE EAST AFRICA CUSTOMS AND FREIGHT FORWARDING PRACTICING CERTIFICATE

WAREHOUSING MODULE

- WAREHOUSING OPERATIONS
- WAREHOUSING STORAGE

FEAFFA in collaboration with East Africa Revenue Authorities

BR
KENYA REVENUE AUTHORITY
RRA Rwanda Revenue Authority
TANZANIA REVENUE AUTHORITY
URA Uganda Revenue Authority

East African Community (EAC)

The East African Community (EAC) is a regional intergovernmental organization of six (6) Partner States, comprising Burundi, Kenya, Rwanda, South Sudan, Tanzania and Uganda, with its headquarters in Arusha, Tanzania.

Federation of East African Freight Forwarders Associations (FEAFFA)

The Federation of East African Freight Forwarders Associations (FEAFFA) is a regional private sector apex body of the Customs Clearing and Freight Forwarding (CFA) industry in East Africa. It aims at promoting a professional freight logistics industry for trade facilitation and regional economic growth. FEAFFA strives to address the challenges experienced by its members through training, provision of information, and other aspects of capacity building. It advocates for the full implementation of the East African Community (EAC) Customs Union. The East Africa Customs and Freight Forwarding Practicing Certificate (EACFFPC) is the Federation's and the industry's premier training program in East Africa since 2007.

C/O. Federation of East African Freight Forwarders Associations
P.O. Box 22694-00400, Tom Mboya, Nairobi.
Hillcrest Court, Waiyaki Way, Slip Road Westlands, Nairobi, Kenya

Tel: +254 202-684802 | Cell: +254 738 150 673
Email: info@feaffa.com | Website: www.feaffa.com

East African Community
(EAC)

Federation of East African Freight
Forwarders Associations (FEAFFA)

THE EAST AFRICA CUSTOMS AND FREIGHT FORWARDING PRACTICING CERTIFICATE

WAREHOUSING MODULE

- WAREHOUSING OPERATIONS
- WAREHOUSING STORAGE

FEAFFA in collaboration with East Africa Revenue Authorities

Table of Contents

FORWARD

Customs Clearing Agents, Freight forwarders, and Warehouse Operators in the East African Community (EAC) region continue to play a vital role in the facilitation of trade particularly with regards to the assessment tax, storage of goods, transportation, and last-mile delivery to clients. This, in turn, facilitates cargo movement and clearance from all ports.

The agents handle goods worth millions of dollars on behalf of the shippers. Besides, they originate documents that facilitate movement and clearance of cargo culminating in errors that slow down the flow of business. The movement of cargo depends on how fast and correctly documentation is done for verification by the respective Customs Authorities. A delay in customs clearance increases the cost of doing business.

This pointed to the need for these agents to be equipped with the requisite knowledge, skills, and attitudes to carry out their work efficiently, just as their counterparts from customs.

The EAC region, with support from TradeMark East Africa (TMEA), has made significant steps towards bridging the knowledge and skills gap in the customs clearing and freight forwarding industry. The introduction of the East Africa Customs and Freight Forwarding Practicing Certificate (EACFFPC) in 2006, a regional training programme jointly implemented by the EAC directorate of customs, the East African Revenue Authorities (EARAs), the National Association of the Freight Forwarding Industry, and FEAFFA was a big step. Since its inception, over 7000 agents have graduated from this training.

A review of the programme in 2015 and a market survey conducted in 2020 supported by TradeMark East Africa (TMEA) highlighted key areas of improvement for the EACFFPC programme to achieve the aim of producing competent customs agents, freight forwarders, and warehouse keepers. The revised curriculum has therefore been designed to address these challenges and shortcomings. The revamped EACPPFC programme is designed to enhance the ability of freight forwarders to provide competitive and high-quality end-to-end services thereby reducing inventory costs and increasing safety levels in warehousing operations in the East African region.

With the revised EACFFPC curriculum, the dream of attaining a professional and compliant freight logistics industry in the East African region has been strongly boasted.

ACKNOWLEDGMENT

The Curriculum Implementation Committee (CIC) is grateful to the EAC sectoral council on Trade Industry Finance and Investment for adopting the EACFFPC as an EAC training programme for clearing and forwarding agents in the region. This is a testimony to the effect the programmeme has had on the clearing and forwarding industry in the EAC region.

The CIC is also grateful to the EAC Directorate of Customs, the Commissioners of Customs of the East Africa Revenue Authorities, the Chairpersons of National Associations of clearing and forwarding agents, and the President of FEAFFA for their dedication and support to the EACFFPC programmeme.

Special appreciation for the National Curriculum Implementation Committees for providing their trainers to participate in the development and validation of the curriculum and training materials. CIC also acknowledges the FEAFFA secretariat for excellently coordinating the curriculum and training materials development and validation process.

The CIC in a very special way recognizes TradeMark East Africa (TMEA) who provided the financial support to update the curriculum, develop and publish the 2021 edition of the EACFFPC training materials. We remain indebted to you forever.

We also appreciate all EACFFPC trainers, students, and stakeholders for the constant feedback that has been incorporated in this edition of the training materials.

UNIT 1

WAREHOUSING OPERATIONS

Table of contents

LIST OF ABBREVIATIONS AND ACRONYMNS

ASN	Advanced shipping notice
DN	Delivery Note
DRP	Distribution Requirements Planning
EDI	Electronic Data Information
ESH	Environmental, safety and health
IMDG	International Maritime Dangerous Goods
OPA	Order picking accuracy
PO	Purchase order
RFID	Radio Frequency Identification System
RMA	Return Merchandise Authorization
ROI	Return on Investment
SKU	Stock Keeping Unit
XML	Extensible Mark-up Language

UNIT 1: WAREHOUSING OPERATIONS

1.0 UNIT OVERVIEW

1.1 Unit Description

This unit specifies the competencies required to provide warehousing services. This involves determining type of warehouse; receiving and Put-Away of goods; storing of goods; packaging and repackaging goods; dispatching goods; processing goods returned in a warehouse; and, select material handling equipment.

1.2 Unit Summary Learning Outcomes

At the end of the sub-module, the trainee should be able to:

i. Determine the most appropriate type of warehouse
ii. Receive and Put-away goods
iii. Store goods in the warehouse
iv. Package and repackage of goods in the warehouse
v. Dispatch goods from the warehouse
vi. Process goods returned in a warehouse
vii. Select material handling equipment

2.0 OVERVIEW OF WAREHOUSING

2.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Explain the meaning of Warehousing
ii. Explain the importance of Warehousing
iii. Explain the functions of Warehousing
iv. Evaluate the types of warehousing
v. Classify Warehouses
vi. Utilise the key warehousing Documents
vii. Discuss warehouse staff requirement.

2.2 Meaning of Warehousing

Warehousing refers to the activities involving storage of goods on a large-scale in a systematic and orderly manner and making them available conveniently when needed. In other words, warehousing means holding or preserving goods in huge quantities from the time of their purchase or production till their actual use or sale. According to the Chartered Institute of Purchasing and Supply Chain Management the term warehousing is used to describe the storage of goods such as raw materials, parts or finished products that will be sold or distributed through an organisation. The primary purpose of the warehousing facility is to receive, store, and process goods for the eventual shipment and distribution to manufacturing operations, other businesses, and consumers.

A Warehouse

The Chartered Institute of Logistics and Transport describes a warehouse as a temporary storage location for inventory, which ultimately acts as a buffer to smooth out differences between the supply and demand for goods and services. A warehouse is a planned space for the storage and handling of goods and material.' In general, a warehouse is a point in the logistics system where a firm stores or holds raw materials, semi-finished goods, or finished goods for varying periods of time.

2.3 Importance of Warehousing

Warehousing has become an important enabler of globalized production networks, and quite often short lead times. Volume and mix flexibility, postponed customizing in terms of assembly/ packaging, as well as corporate profitability, have been achieved through warehousing outlets serving some particular trade area (Christopher et al., 2006; Baker, 2007; Koskinen & Hilmola, 2008; Hilletofth, 2009).

More specifically, warehousing is necessary due to the following reasons:

- **Seasonal Production** —It is known that most 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.
- **Seasonal Demand** — There are certain goods, which are demanded seasonally, like woollen 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.
- **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.

- **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.
- **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.
- **Price Stabilisation** — 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. Through maintaining a balance of supply of goods, warehousing leads to price stabilisation.

2.4 Functions of Warehousing

There are many value-adding functions/roles of warehousing in a supply chain. Some of functions/ roles of a warehouse include:

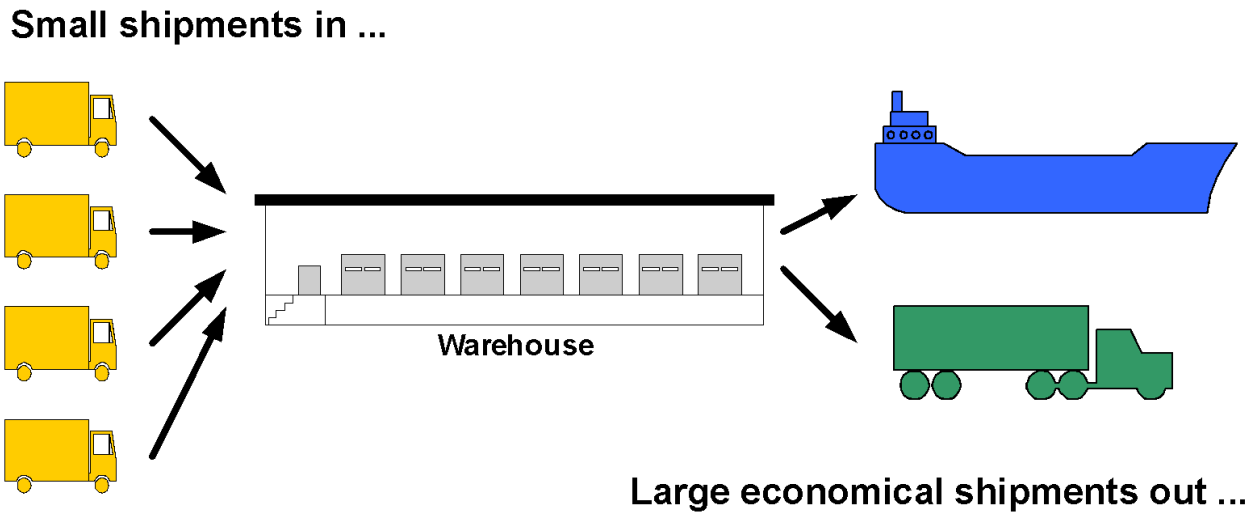
i. Transportation/shipment consolidation
ii. Break bulk
iii. Product mixing
iv. Cross-docking
v. Grading and branding
vi. Keeping Buffer stock
vii. Value-added Processing

These roles are further explained below;

i. Transportation/shipment consolidation

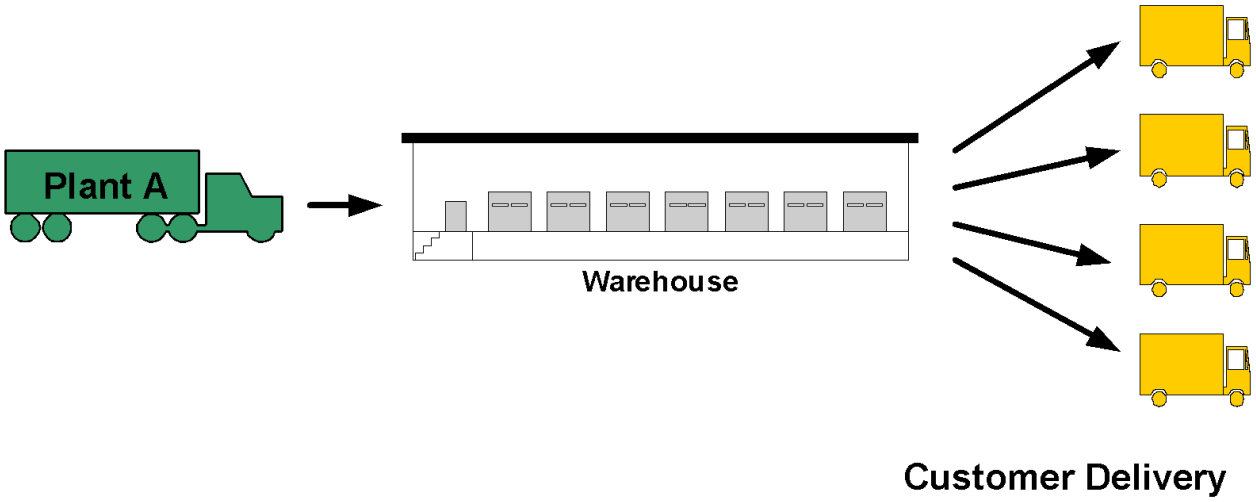
Transportation/shipment consolidation is an economic benefit of warehousing. Several sources supply their products for the same destination through a warehouse and from this warehouse the products are sent in bulk shipment to the destination. Instead of transporting the products as small shipments from different sources, it would be more economical to have a consolidation warehouse. Therefore, with this arrangement, the consolidating warehouse receives and consolidates materials from a number of manufacturing plants destined to a specific customer on a single transportation shipment. Consolidation allows the operation of the carriers to their full capacity and reduces the number of shipping and receiving operations.

In some cases, warehouses also provide transport arrangement to the bulk depositors. It collects goods from the place of production and also sends goods to the place of delivery on request of the depositors.



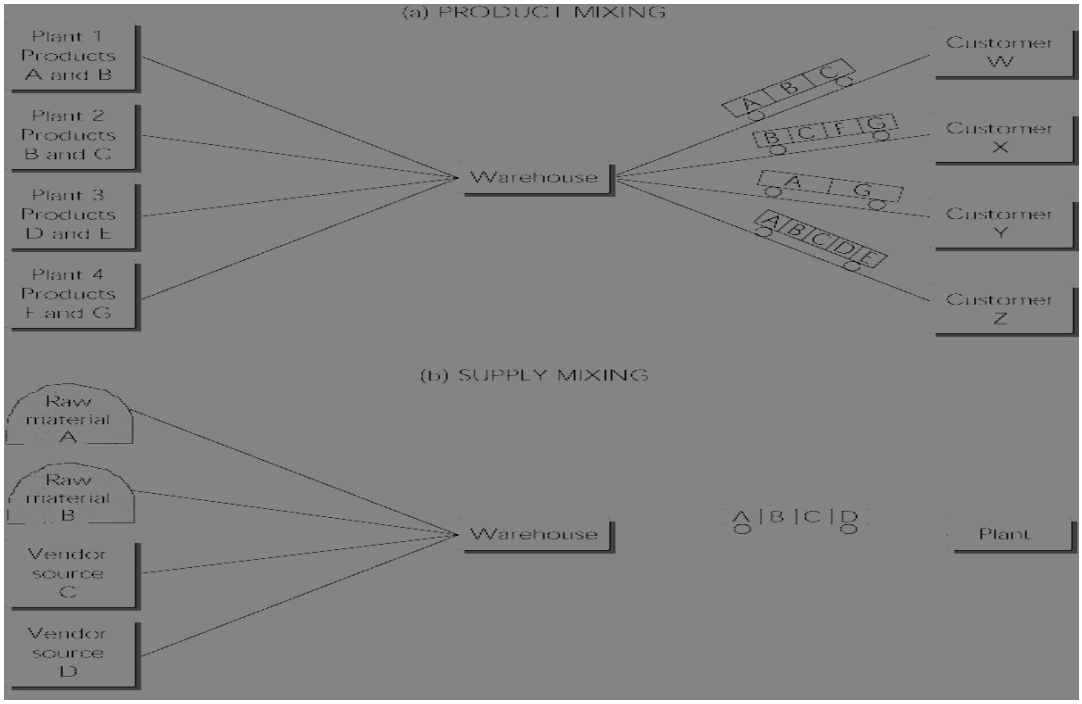
ii. Break bulk

Break bulk warehouse operations are similar to consolidation except that no storage is performed. A break bulk warehouse receives combined or bulk shipments (e.g. customer orders) from manufacturers and ships them to various individual destinations (e.g. customers). The break bulk warehouse breaks the bulk shipment, sorts or splits individual orders and arranges for local delivery. Because the long-distance transportation movement is a large shipment, transport costs are lower and there is less difficulty in tracking.



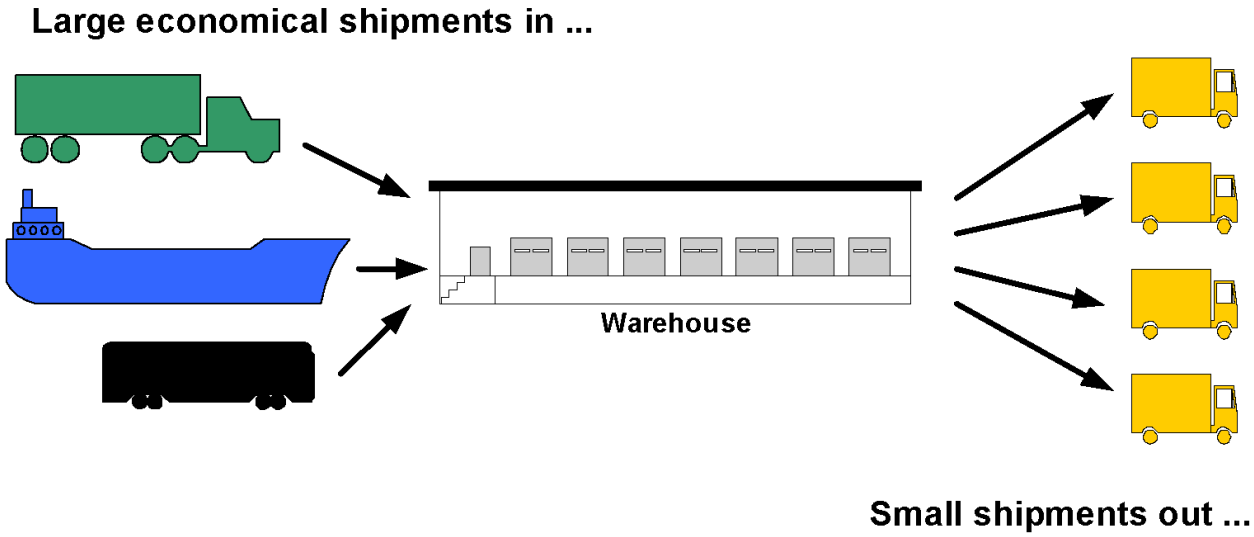
iii. Product mixing

In a typical product mixing situation, truckloads of products are shipped from material sources (e.g. manufacturing plants) to warehouses. Each large shipment enjoys the lowest possible transportation rate. Upon arrival at the mixing warehouse, shipments are unloaded and the desired combination of each product for each destination is selected. When material sources are geographically separated, overall transportation charges and warehouse requirements can be reduced by product mixing



iv. Cross-docking

Cross docking involves receipt of full shipments from a number of suppliers/plants, generally manufacturers, and direct distribution to different customers without storage. As soon as the shipments are received at the receiving dock, they are sorted and allocated to the respective customers and are moved across the warehouse to the vehicles waiting at the shipping dock for the onwards shipments to the respective customers. Cross docking is a distribution method in which the goods flow in an unbroken sequence from receiving to shipping (dispatching), with little or no material handling in between and eliminating storage. It is also called flow through distribution.



v. Grading and branding

On request warehouses also perform the functions of grading and branding of goods on behalf of the manufacturer, wholesaler or the importer of goods. It also provides facilities for mixing, blending and packaging of goods for the convenience of handling and sale.

vi. Keeping buffer stock

The economic benefit of stockpiling comes from the need of seasonal storage. For example, lawn furniture and toys are produced year-round and primarily sold during a very short marketing period. In contrast, agricultural products are harvested at specific times with subsequent consumption occurring throughout the year. Both situations require warehouse stockpiling to support marketing efforts.

Stockpiling provides an inventory buffer (holds inventory for downstream stages of the supply chain), which allows production efficiencies within the constraints imposed by material sources and the customer. The buffer inventory is held in order to allow the entire production distribution network to deal efficiently with the systematic and random variation in the network operations, or to exploit significant economies of scale.

vii. Value-added Processing

Warehouses can also be used to postpone, or delay, production by performing some value added processing tasks like:

- Packaging and labelling
- Kitting (i.e., repackaging items to form a new item; e.g., beauty products)
- Light manufacturing or light final assembly (e.g., assembly of a computer unit from its constituent components, delivered by different suppliers)
- Pricing and invoicing.

A warehouse with packaging or labelling capability allows postponement of final production until actual demand is known. For example, vegetables can be processed and canned in brights at the manufacturer. Brights are cans with no pre-attached labels. The use of brights for a private label product means that the item does not have to be committed to a specific customer or package configuration at the manufacturer's plant. Once a specific customer order is received, the warehouse can complete final processing by adding the label and finalizing the packaging.

2.5 Types of Warehouses

There are many different types of warehouses, performing many services and functions. The section below details the different types of 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.

- **Fulfilment / Consolidation Warehouses**

Warehouses where products are generally received in large quantities and shipped out in a large number of smaller mixed shipments. Such pick and pack operations require special inventory management and picking procedures. Location tracking is essential. Billing methods are generally similar to distribution warehouses.

- **Warehouses providing value added Services**

Warehouses providing a wide range of value added services. This requires the warehouse to apply labour and, in some cases, special equipment to the customer's products, such as repackaging, further processing, or labelling. This not only changes the product but requires additional billings. Such services are generally performed along with other warehouse functions.

2.6 Classification of Warehousing

Warehouses can be classified in many ways. Generally, the major classification is by **missions**. According to this classification, smaller organisations generally have just one **main** warehouse. Large organisations, particularly those involved in manufacturing, may have a number of departmental or functional warehouses or **sub-warehouses**. These warehouses may be supplied from a **main** or **central** warehouse or may accept deliveries directly. However, according to Żuchowski (2019), there is no consistency in defining warehouse classes. The classification of warehouses can be carried out according to various criteria. An example of the diversity of classifications is presented in Table below.

Divided by	Groups of division
Construction	Open half-open closed
Function	Distribution production contract
Technology applied	Manual mechanized automatized
Usable height	Low height Medium height High-bay

Other Warehouse Classifications include;

- Classification of warehouses by logistics branches
- Warehouse classification by participants in logistics system
- Warehouse classification by form of property
- ^tClassification by warehouse functions
- Classification by types of goods
- Classification by storage conditions
- Classification by degree of mechanization
- Classification by technical characteristics
- Classification by membership in material flows
- Classification by transport infrastructure
- Classification by classes

2.6.1 Classification of Warehouses by Logistics Branches

The main goal of logistics is appropriate material flows distribution. However, methods can be different depending on a company's activity. For example, manufacturers procure raw materials to produce and distribute ready-to-use products. Classification of warehouses by logistics branches are based on storage facilities functions. It includes 3 types of warehouses:

i. **Procurement logistics warehouses.** Products for manufacturing such as raw materials, components are stored here. These types of warehouses provide companies with materials to produce products.

ii. **Manufacturing logistics warehouses.** Products at the intermediate stage of production are stored here. Also, such warehouses supply necessary parts and tools.

iii. **Distribution logistics warehouses.** Here comes the production to distribute to end-users.

Thus, the classification by logistics branches clearly represents the material flows from manufacturers to the market.

2.6.2 Warehouse Classification by Participants in Logistics System

There are several parties in the long supply chains. Some of them transport goods from point A to point B, others manage demand. The classification shows who owns a warehouse in supply chains. There are 5 types of storage facilities in the warehouse classification by logistics system participants:

1. **Manufacturers' warehouses.** These facilities take part in the technological process of creating ready-to-use products from raw materials.
2. **Trading companies' warehouses.** Here goods for selling are stored. That's where products begin the way to consumers.
3. **Carriers' warehouses.** Transportation companies pick up goods from warehouses, and take them to the next point then. There may be several destinations, and freights must be stored somewhere.
4. **Forwarders' warehouses.** Forwarding companies take over the work not only for freight transportation, but also for work organization. Thus, forwarders consolidate carriers and establish communication between shippers during transportation.
5. **3PLs' warehouses.** Logistics providers completely manage supply chains. They transport commodities, handle custom clearance, store goods, deliver them to end-users, etc.

2.6.3 Warehouse classification by form of property

There are 4 types of warehouses in the classification:

1. **Internal.** Warehouses a company bought.
2. **Commercial.** It's about warehouses, where companies order storage services from 3PLs', for example. In fact, they use third party space.
3. **Leased.** Warehouses a company rents from a landlord.
4. **State and municipal.** Warehouses used for governmental purposes.

2.6.4 Classification by warehouses functions

There are 5 different types of warehouses in this classification:

1. **For long-term storage.** This is where emergency supplies are kept.
2. **For goods transhipment.** Its warehouses to store freights until loading and unloading. As a rule, they are located near highways, maritime terminals, or airports.
3. **For goods distribution.** Here commodities from manufacturers are transformed into a trade assortment. Distribution centres workers take products to store, pick orders for retail, manage stocks, etc.
4. **For seasonal storage.** Goods that are sold at the certain times of the year. For example, customers buy umbrellas more often in autumn, when it rains. It's so called buffer storage facilities. Moreover, agricultural domains use this type of warehouses often.
5. **For custom clearance.** Its warehouses where goods imported to a country of sale are stored. Commodities are there until custom clearance is completed.

2.6.5 Classification by the types of products

There are different types of goods are stored in warehouses. In which case we can divide facilities into such types:

- Warehouses of raw materials
- Warehouses of fabric.
- Warehouses of components.
- Warehouses for work-in-progress.
- Warehouses for finished/ready to use products
- Warehouses of packing materials.
- Warehouses of disposed products.
- Warehouses of equipment.

It should be noted that different types of products may be stored in warehouses at the same time. In specialized warehouses can be stored only specific goods, and in universal warehouses can be stored several types of products.

2.6.6 Classification by storage conditions

This classification is based on the opportunity to regulate the temperature in a warehouse. Here are 4 types of storage facilities:

i. **Unheated.** You can't regulate the inner temperature here. It changes with the seasons.
ii. **Heated.** These are warehouses where it is possible to maintain freezing temperatures all year round. For this, special equipment is used.
iii. **Cold.** These are warehouses for storing food at sub-zero temperatures. Cold warehouses can be refrigerated or frozen. The first type allows you to store products chilled, the second to completely freeze them.
iv. **Multi-temperature.** These are warehouses with several areas to store goods in different temperature conditions. In addition, in such premises, you can independently adjust the temperature indicators.

Storage conditions are an important aspect in the work of a warehouse. Therefore, before choosing a warehouse, you need to know what products will be stored in it.

2.6.7 Classification by degree of mechanization

The main criterion for this classification is the amount of work that can be automated. There are 4 types of warehouses in the classification by degree of mechanization:

i. **Non-mechanized.** In such warehouses, all the work is done manually. Sometimes a minimum amount of equipment may be used, such as hand trucks.
ii. **Mechanized.** These are warehouses where employees perform part of the operations manually, and for part of them special equipment is used. For example, forklifts.
iii. **Automated.** These are warehouses where most of the processes are performed by specialized equipment without human intervention. Conveyor belts, stacker cranes are installed here. Warehouse staff do the minimum part of the work. For example, they check documents or pick goods.
iv. **Self-operative.** Robots and IT systems carry all operations in these warehouses.

2.6.8 Classification by technical characteristics

According to this classification, warehouses are divided into 3 types:

i. **Open.** These are the premises where products are stored in the yard. There are no roofs here.
ii. **With a canopy.** In such warehouses, cargo is protected from the negative impact of weather conditions by special awnings.
iii. **Closed.** This is the most common type of warehouse. The premise provides complete product protection with a roof. Closed warehouses have several subtypes:
    - With one floor
    - With several floors.

In addition, ceiling heights play an important role in this classification. Low warehouses are premises with a height of up to 6 meters. High warehouses are from 10 meters. Such a warehouse can be equipped with multi-level shelving.

2.6.9 Classification by membership in material flows

This classification reflects the number of warehouse users:

i. **Closed.** These are premises where goods of only one company are stored.
ii. **Open.** There products from several companies are stored.

Classification by transport infrastructure

In this classification, there are 4 types of warehouses:

i. With maritime terminals. These are warehouses for shipping from water transport.
ii. With a railway line.
iii. Accessible via a motorway.
iv. Complex. Includes characteristics of the other three types.

A well-developed infrastructure is an important characteristic of a warehouse, since most of the costs are for transportation.

2.6.10 Classification by Classes

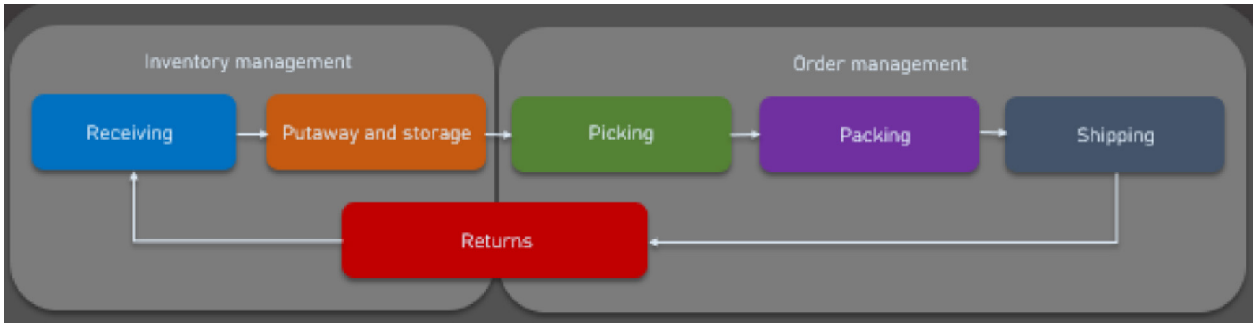
Classification of warehouses by classes is the most common. It takes into account all the features of the storage facilities. Companies operating in the logistics real estate market develop their own classifications of warehouses. Basic types of warehouses are:

- Class A+ is a modernized warehouse. It has 1 floor. To build such a warehouse, special insulating materials are used, usually sandwich panels. They are fireproof and retain heat well. Class A + warehouses have all the necessary communications: special equipment (CCTV monitoring, ventilation, fire extinguishing systems, etc.), the territory is ennobled; 24-hour security is in place. Class A + warehouses have the best characteristics: the ceiling height is not less than 13 meters, the concrete anti-dust floor can withstand a load of 5 tons per square meter.
- Class A is practically not inferior to class A + warehouses in terms of characteristics. The difference is in the technical parameters. In class A warehouses, the minimum ceiling height requirements are from 10 meters. In addition, there are fewer dock-type gates, which makes loading/unloading a little more difficult.
- Class B+ Such warehouses can only be built or reconstructed. The main difference from the previous classes is the height of the ceilings. The minimum requirements for it are 8 meters.
- Class B is a warehouse that can have 1 or more floors. In the second case, the room must be equipped with freight lifts. The minimum ceiling height is 6 meters. In addition, these buildings do not have special requirements for technical characteristics and additional communications.
- Class C are reconstructed warehouses that were previously used as a production facility or hangar. The minimum requirements for this class are ceilings from 4 meters and a concrete coating.
- Class D stands for non-core premises that were converted into a warehouse. The level of amenities is minimal. There are no specific performance requirements.

Knight Frank's classification by classes is based on the requirements for technical parameters, territory, equipment, and communications. It does not touch on the transport infrastructure. However, this is also important to consider when choosing a warehouse.

2.7 Warehousing Operations

Warehousing operations refers to the processes that take place in a warehouse revolving around the movement of goods and tracking inventory. The goal of warehouse operations is to satisfy customers' needs and requirements while utilizing space, equipment, and labor effectively. The goods must be accessible and protected. Breaking it down, warehouse operations covers a number of important areas, from the receiving, organization, fulfillment, and distribution processes. These areas include:



1. **Receiving** involves control over the delivery to your warehouse of the correct quantity of the desired

product – of the right quality at the right time. This process can in turn be broken into smaller ones:

- placing a purchase order,
- preparing space in the warehouse,
- unloading (manual or automated),
- verification,
- filling in the database, etc.

2. **Putaway** is delivering goods to the optimal place in the warehouse. Here the correct identification of each SKU (stock keeping unit) and getting it to the most relevant spot is important. Storage conditions also matter to ensure the safety of goods and employees. Slotting and space management techniques as well as overall warehouse design are critical to streamlining these operations and using space most effectively.
3. **Picking** is the process of collecting goods from the storage place according to the customer's order. It is thought of as the costliest, most time-consuming, and most error-prone. Here, mobile scanning devices and voice systems can save tons of time and reduce errors significantly. It's also worth considering adopting one of the picking methodologies, such as cluster picking, zone picking, wave picking, etc.
4. **Packing** is putting the ordered items together, checking their quality, and getting the product ready for shipment. At this point, it's important to have all the necessary data on the order and also the type/amount of packing material required for each order.
5. **Shipping** or dispatching is sending goods to the customer and making sure they are delivered safely and on time. Here, again, proper scheduling, labor management, and tracking systems are key to satisfying customer demands.
6. **Returns** is something most companies wish would never happen, but unfortunately, they are also a part of the game due to various reasons. Returned units have to be properly identified, sorted, and dealt with, whether it is by putting them back on the shelf, sent to repair, discarded, returned to the manufacturer, etc

2.8 Key Warehousing Documents

Some of the key warehouse documents include the following;

Advanced shipping notice (ASN)

Advanced shipping notice (ASN) is a document that provides detailed information about a pending delivery. The purpose of an ASN is to notify the customer when shipping occurs and provide physical characteristics about the shipment so the customer can be prepared to accept delivery. An ASN, which is usually sent over the Internet in an electronic data information (EDI) or extensible mark-up language (XML) format, provides information about when an order will be shipped, which items are being shipped, how many of each item is being shipped and physical characteristics about the shipment such as the shipment's weight, the number of boxes and a description of how the shipment units are packaged. An ASN also tells the customer which mode of transportation is being used for shipping and provides carrier information.

Waybill

A Waybill is used as the warehouse issuing document, certifying the transfer/release of goods. It is the base document for financial transactions, such as the payment of the supplier/forwarder and the recording of the accounting entries. It is the responsibility of the Warehouse Manager to ensure that the Waybill is properly filled in, signed and filed. The Waybill can be also referred to as the carrier document, listing the load, weight, size, final destination, etc. of the goods carried. As such, it is used as the delivery document to be presented to the receiving warehouse.

Goods Receiving Note (GRN)

The Goods Receiving Note (GRN) is a standard warehousing document to confirm receipt of goods. It is the base document for financial transactions, such as the payment of the supplier/forwarder and the recording of the accounting entries.

Bin/Stack Card

Bin/Stack Cards are standard warehousing documents that are fitted to an item bin/stack in the warehouse. The card displays the beginning balance, movements in and out and the current balance of an item at any given time. One bin/stack should only contain one type of item from one unique Purchase Order (PO) number. The bin/stack cards facilitate picking

and physical counts. The Bin/Stack Cards must be established or updated as a soon as an item is moved in or out for a specific bin/stack. The warehouse staff effecting the movement must note the approved Material Stock Request (MSR) number and sign after having updated the card.

Stock Card

The Stock Card is a standard warehousing document which consolidates the information of multiple bin/stack cards relating to the same item and PO in case it is stored in different bins/stacks of the warehouse. It should be continuously updated by the warehouse and maintained in the warehouse area.

Stock Card vs. Bin/Stack Card

In smaller warehouses, the Stock Cards provide the same information as the Bin/Stack Card. In larger warehouses the Stock Card information will consolidate the information of multiple Bin/Stack cards and show the total inventory holding of an item/PO which is stored in different bins/stacks.

Incoming Shipment Report

The Incoming Shipment Report is a standard warehousing document summarising all incoming shipments to a warehouse by item, Waybill/consignment and PO number. The report is used by the warehouse to control incoming inventory movements, and by the warehouse office to verify that WMS has been updated accordingly.

Outgoing Shipment Report

The Outgoing Shipment Report is a standard warehousing document summarising all outgoing shipments from a warehouse by Waybill/consignment and PO number. The report is used by the warehouse to control outgoing inventory movements, and by the warehouse office to verify that WMS has been updated accordingly.

Stock Report

The Stock Report is a non-standard warehousing document used to report the inventory position/holding for all inventory items by PO, at warehouse level. The reporting frequency will be determined based on the inventory turnover rate and/or the fluctuation in demand but is normally weekly. It is the responsibility of the local warehousing office to define the format of the report, and the reporting frequency. The report is used by the warehouse and the main office to report the inventory holdings at warehouse and/or at country level to stock owners and other stakeholders. The reports provide timely information on inventory levels by warehouse and item which is important for operational, financial and procurement planning. It is also used as a back-up source of information in case of connectivity problems with WMS.

Layout & Storage Plan

The Layout & Storage Plan is a non-standard warehousing document showing by lot ID/PO where items are currently stored and where arriving items can be stored. Thus, it facilitates the picking process and warehouse management (e.g. physical verification, consolidation, warehouse space planning, etc.). It is the responsibility of the Warehouse Office to define the format to be used and to ensure proper implementation and updates. The plan should be regularly updated so that information on free space and storage locations of items is available.

Warehouse Keeper's Receipt

It is simply an acknowledgement of goods issued by a warehouse keeper to the owner of the goods. It is not a document of title to goods and, therefore, cannot be transferred at all.

Dock Warrant or Warehouse Warrant

It is a document of title to goods issued by dock authorities certifying that the goods are held by them. To take delivery of the goods, this certificate has to be given back to the authorities.
It is a transferable instrument and if properly assigned, even a third party can take delivery of the articles from the **warehouse or dock**.

Consignment Note

It is a form issued by railway companies to be signed up by all persons who intend to **send goods by railways**. It contains terms and conditions on which the railway company undertakes the carry the goods. This form is to be filled in and handed over to the Railways along with the goods.

Bill of Lading (B/L)

Bill of lading is also a receipt of goods issued by the master of the ship or the shipping companies in sea transportation. On the one hand, it is an acknowledgement of goods and on the other, a contract of carriage.

Other Key documents may include

i. Distribution plans
ii. Dispatch authorizations
iii. Dispatch waybills (pre-printed and renumbered)
iv. Waybill tracking documentation
v. Tally sheets (loading and offloading)
vi. Casual labourer attendance sheets
vii. Separate warehouse ledgers for:
viii. Each commodity type and shipment number
ix. Damaged/unfit commodities
x. Commodity loans/transfers
xi. Commodity reconstitution records
xii. Commodity disposal/destruction records
xiii. Warehouse fumigation records/reports
xiv. Warehouse inspection reports
xv. Warehouse physical inventory count sheets/reports
xvi. Loss (damage) reports (pre-printed and pre-numbered)
xvii. Internal loss claim records and backup documents
xviii. Warehouse daily reports
xix. Warehouse monthly reports
xx. Commodity status reports
xxi. Warehouse assets/equipment list

2.9 Key Personnel of Warehouse

In order to operate effectively, there are different personnel requirements in the warehouse. These include:

Receiver

The Receiver at a warehouse receives incoming shipments, inspects, checks documents, verifies purchase order and confirms the condition and quantity of the goods delivered.

Forklift Operators

Shipments have to be moved around the warehouse using fork lift trucks, and the person who does that is the Forklift Operator. They move incoming shipments to the proper places for storage, and they move outgoing shipments to the loading dock. Forklift Operators may also assist in organizing inventory, often by moving items located on high shelves.

Material Handlers

Material Handlers help with picking, packing, and inventory in a warehouse. A Material Handler needs to have experience operating a forklift, but they're also expected to do more around the warehouse. They'll often be asked to operate other motorized machines and vehicles; including cherry pickers, pallet trucks, and industrial lift trucks. They usually assist with stacking and palletizing products, as well as loading filling machines, and using both automatic and manual packaging machines.

Delivery Drivers

Safely drive company vehicle and successfully handle and deliver packages to customers on time.

Security Guards

The key roles of the security guards include:

- Secure premises by patrolling property and monitoring surveillance equipment
- Monitor and secure gates/doors, and record incidents daily
- Conduct screening of personnel in a professional manor
- Keep safety a top priority, and report any safety hazards
- Monitor behaviour and report unusual activity
- Complete reports by recording observations, information and surveillance activities
- Monitor parking lot, warehouse, and main office
- Ensure all orders/policies are being followed in terms of security
- Respond to alarms by investigating and assessing the situation

Packaging Operators

The packaging operators ensure efficient operation of case forming, case packing, labelling and all other downstream equipment. They ensure equipment is supplied with required materials, (e.g., adhesives, shrink wrap, labels). In addition, they:

- Perform package quality checks as required and comply with all standard safety practices, safety rules, and all Company rules and policies.
- Maintain accurate records and logs as required and perform operator-related preventative maintenance duties as required.

Warehouse Clerical Support Administrator

Enters, verifies, maintains, and corrects data on a computer or handheld scanning device. Creates all work assignments for warehouse personnel. Completes reports including detention logs, product audits, receiving variance logs, and trailer shipping logs. Manages direct to client orders using multiple systems, email, and phone correspondence. In addition, verifies, maintains, and audits issues concerning vendor appointments, shipment quality, damage, and third-party logistics delivery issues. They are also responsible for all entry of third-party logistics claims and damages.

Order Picker/ Packers

Pick and confirm orders efficiently and accurately, Pack orders efficiently and correctly to prevent damage and Ticket or label orders as specified.

Warehouse Manager

Typical responsibilities of the job include:

- Ensure proper allocation and utilization of space
- Processing orders
- Operating mechanical and it systems
- Liaising with transport companies, suppliers and clients
- Training, supervising and appraising staff
- Maintaining statistical and financial records
- Devising rotas for staff
- Ensuring that quality objectives and delivery deadlines are met
- Managing budgets
- Administering stock control
- Ensuring compliance with health and safety legislation.

2.10 Learning Activities

Conduct an overall check of activities in a warehouse you are familiar with. What improvements would you suggest to the top management to improve the optimum flow of materials from receipt to dispatch?

2.11 Self-Assessment Questions and Activities

1. The role of warehousing in supply chains has evolved over time. Explain the new roles of warehousing from a global supply chain context.
2. You have been appointed as a manager of new manufacturing company, the company is considering opening a warehousing facility, briefly highlight the importance of Warehousing
3. Warehouses provide different functions to different clients, using a warehouse familiar to you, discuss the functions provided in that warehouse.
4. Using examples from your country explain the various types of warehouses.
5. Why is it important to classify warehouses? Give any five major factors that are considered when classifying warehouses.
6. Describe any five (5) key warehousing documents
7. The National Medical Stores has constructed a new modern state of the art warehouse; the human resource manager has approached you to provide a list of the key employees to be recruited to ensure the new facility runs efficiently. Provide a list of the key warehouse positions and a summary of their job descriptions to enable the Human Resources Manager recruit the appropriate employees.

2.12 References

- Hilmola, O.-P. and Lorentz, H (2010). Warehousing in Europe- Northern actor perspective. European Transport. 45, 15-33
- Żuchowski W., 2019. Attempt of warehouses classification from the future users point of view. LogForum 15 (2), 249-254, http://doi.org/10.17270/J.LOG.2019.330
- Berg, Jeroen & Zijm, W. H. M. (1999). Models for warehouse management: Classification and examples. International Journal of Production Economics. 59. 519-528. 10.1016/S0925-5273(98)00114-5.
- UNHCR (2013), Standard Operating Procedures for Warehouse and Inventory Management in UNHCR, Version 1.0
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge

3.0 RECEIVE AND PUT AWAY GOODS

3.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Explain the goods Pre – receiving operations
ii. Discuss the operations in Receiving of Goods
iii. Discuss the Put - Away of Goods operations and processes

3.2 Pre –Receiving Operations

3.2.1 Learning Outcomes

At the end of this topic you will be able to:

i. Explain the steps in preparing to receive goods in a warehouse
ii. Discuss the receiving requirements
iii. Identify the required documents in receiving goods
iv. Discuss the perceiving packaging requirements
v. Discuss the perceiving labelling requirements
vi. Discuss the required information about good to be received

3.2.2 Preparation for goods receiving

In the process of preparing for the receipt of goods, warehouse managers should develop and enforce receiving requirements for suppliers, shippers, and/or carriers in order for the warehouse receiving process to work well. The goal is for them to offer the goods in such a way that it can be processed quickly and easily. Below are some of the receiving requirements;

i. Packaging requirements should be communicated early to suppliers and where possible standardized: these include; Label position, Label information, Palletized or loose cargo, Number of packages per pallet, Items per carton, Acceptable package size and weight
ii. Shippers or customers who don't have control over packing or packaging requirements should be required to offer clear, detailed information and alert the warehouse of new incoming shipments.
iii. Transporters should load cargo according to the order of the delivery route and should have all documentation in hand when they arrive to the receiving area.
iv. In order to speed up the receiving process and reduce cargo damage, suppliers should be required to palletize cargo before it is sent to a warehouse.

3.2.3 Receiving Requirements

Labour Requirements

Labour is ranked among the highest warehouse operational costs, it therefore very important to match the work load and the work force. The volume and type of cargo to be received should be matched with available human resources and equipment in order to avoid labour shortages or idle labour in the warehouse.

- The warehouse management should determine the time and dates when cargo is delivered and received. This will help the warehouse management to ensure that the available labour resources are optimized during the receiving process. Warehouse managers can use a booking or scheduling software where the carrier can pre-book the delivery and the warehouse manager can review and process the bookings.
- For carriers who may not be able to book or for drivers that miss their appointments, "on demand" receiving teams can be set up to receive such cargo in special or specific docks.

Unloading Requirements

The main goal during the unloading process is to unload cargo safely and efficiently. This includes checking seals, capturing temperature details for perishable goods, and verifying the booking references.

The appropriate equipment should be availed and labour hours should be properly allocated to ensure that the offloading process is done in a seamless way.

When offloading palletized cargo, it is advisable to use power pallet trucks in order to optimize safety check and speed whereas for loose cargo it is recommended to use conveyors to minimise the safety and health issues related to using human hands. Regular conveyors can help reduce inefficiencies and increase personnel safety, but the use of telescopic boom conveyors will greatly decrease safety hazards and processing time. Using

conveyors will enable receiving personnel to start the sorting process early.

3.2.4 Pre-receiving documentation

Many documents are used in the receiving of goods. These include:

- Re-order notification
- Purchase order
- Delivery note
- Consignment note
- Internal packing note
- Invoice

Re-order notification

The re-order notification is usually issued by the stock controller, and a copy is sent to the purchasing department and the receiving department. The purchasing department will place an order with the supplier and the receiving department will know that a delivery of goods is on the way to be warehoused.

Purchase order (PO)

The purchasing department is responsible for issuing orders and seeing that a copy of the PO comes to the warehouse floor. The purchase order is usually a copy of the order placed by the warehouse, to replenish goods. This copy is kept on file in the warehouse and is used when deliveries arrive to be checked off.

Delivery note

The delivery note usually comes with the goods when they are delivered. It tells the warehouse what the supplier has actually delivered to the store.

Consignment Note

The consignment note is issued by the courier for the delivery of goods. The consignment note is written out when the delivery is contracted out to a third party for delivery, for example rail, post or a courier company. In some cases, the stock on a "Consignment Note" will be checked with other delivery documents (invoice, manifest etc.). A consignment note usually does not give a product description, but will give information such as how many boxes, pallets, bags, bales etc.

The consignment note includes;

- Pallet control information
- Number of items
- Description
- Sender
- Receiver or consignee
- Signature of receiver
- Delivery address
- Who is paying for freight
- Type of freight service required
- Special instructions
- Dangerous goods declaration

Internal packing note

An internal packing note is used when you carry out a more detailed check of the stock delivered. You make this check after you remove the goods from their outer containers such as cartons, drums or boxes, or you unload them from pallets. The internal packing note lists what is actually within each unit delivered. It should give specific information about:

- Quantity
- Types
- Sizes
- Specifications
- Colours
- Other identifying features.

Invoice

An invoice is a commercial document indicating the products, quantities, and agreed prices for products or services the supplier has provided. An invoice indicates the sale transaction only. Payment terms are independent of the invoice and are negotiated by the buyer and the seller. Payment terms are usually included on the invoice. Some invoices are no longer paper-based, but rather transmitted electronically over the Internet. It is still common for electronic remittance or invoicing to be printed in order to maintain paper records.

3.2.5 Pre-receiving packaging requirements

Packaging

Packaging is the act of enclosing or protecting products for distribution, storage, sale, and use.

Package labelling or **labelling** is any written, electronic, or graphic communications on the packaging. Packaging can be described as a co-ordinated system of preparing goods for transport, warehousing, logistics, sale, and end use. Packaging contains, protects, preserves, transports, informs, and sells.

Purpose of Packaging

Packaging and package labelling have several objectives including:

- **Physical protection** - The objects enclosed in the package may require protection from, among other things, shock, vibration, compression, temperature, etc.
- **Barrier protection** - A barrier from oxygen, water vapour, dust, etc., is often required.
- **Containment or agglomeration** - Small objects are typically grouped together in one package for reasons of efficiency.
- **Information transmission** - Packages and labels communicate how to use, transport, recycle, or dispose of the package or product.
- **Marketing** - The packaging and labels can be used by marketers to encourage potential buyers to purchase the product.
- **Security** - Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter tampering and also can have tamper-evident features to help indicate tampering.
- **Convenience** - Packages can have features which add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, and reuse.

Packaging Requirements

Transporting goods to the warehouse requires that goods are properly packaged. Goods may be supplied to the warehouse on a shrink-wrapped pallet, in roll cages, in tote boxes, on hangers, or simply in cases or cartons. Some packaging (such as cardboard cartons) maybe disposed of by the customer or the store at point of use or sale. In many circumstances, the major unit of packaging will be returned to the warehouse as a backload. For instance, roll cages, tote bins and pallets will normally be returned, often folded flat.

3.2.6 Labelling requirements and label positioning

Symbols used on packages and labels

Many types of symbols for package labelling are nationally and internationally standardised. For consumer packaging, symbols exist for product certifications, trademarks, proof of purchase, etc. Some requirements and symbols exist to communicate aspects of consumer use and safety. Recycling directions, Resin identification code, and package environmental claims have special codes and symbols. Bar codes, Universal Product Codes, and RFID labels are common to allow automated information management.

Labelling

Labelling of packaging for products or materials is critical for the storage and transportation of the goods. The label identifies the contents of the box/ container and would usually include a barcode used for scanning and tracking the movement of goods. Labels can be used to identify the box contents as well as the destination of the finished products. There are also specific requirements when stacking boxes onto pallets:

- All labels must face outwards so that the warehouse employees can quickly determine the storage location
- Labels should be on the pallet to make it easier to shift the stock when storing in the warehouse
- Boxes should be packaged correctly to avoid product damage during movement

Common Markings and labels and those included in the ISO standard 780[1]

Packages are often marked with handling instructions in the language of the country of origin. While this may safeguard the consignment to some extent, it is of little value for goods consigned to, or through, countries using different languages, and of no value at all if people handling the packages are illiterate.

Pictorial symbols offer the best possibility of conveying the consignor's intention and their adoption will, therefore, undoubtedly reduce loss and damage through incorrect handling. The use of pictorial symbols does not provide any guarantee of satisfactory handling; proper protective packaging is therefore of primary importance.

Symbols

Display of symbols

Symbols should preferably be stencilled directly on the package or may appear on a label. It is recommended that the symbols be painted, printed

or otherwise reproduced as specified in this ISO standard. They need not be framed by border lines. The graphical design of each symbol should have only one meaning; symbols are purposely designed so that they can also be stencilled without changing the graphics.

Colour of symbols

The colour used for symbols should be black. If the colour of the package is such that the black symbol would not show clearly, a panel of a suitable contrasting colour, preferably white, should be provided as a background. Care should be taken to avoid the use of colours which could result in confusion with the labelling of dangerous goods. The use of red, orange or yellow should be avoided unless regional or national regulations require such use.

Size of symbols

For normal purposes the overall height of the symbols should be 100 mm, 150 mm or 200 mm. The size or shape of the package may, however, necessitate use of larger or smaller sizes for the symbols.

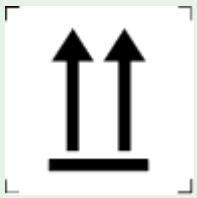
Positioning of symbols

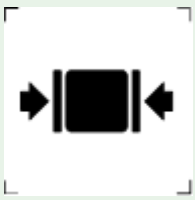
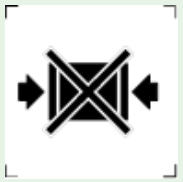
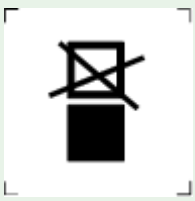
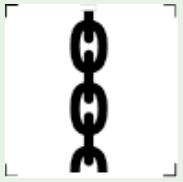
Particular attention should be paid to the correct application of the symbols, as faulty application may lead to misinterpretation. Symbols No. 7 and No. 16 should be applied in their correct respective positions and in appropriate respective places in order to convey the meaning clearly and fully.

Handling instructions

Handling instructions should be indicated on transport packages by using the corresponding symbols given in the following table.

Table1: Common Markings and labels and those included in the ISO standard 780[1]

Instruction	Symbol	Meaning	Instruction	Symbol	Meaning
Fragile		Contents of the package are fragile therefore should be handled with care.	**Use No Hand Hooks**		Hooks should not be used for handling packages
This Way Up		Indicates correct orientation of the package	**Keep Away From Sunlight**		Package should not be exposed to sunlight.
Protect From Radioactive Sources		Contents of the package may deteriorate or may be rendered totally unusable by penetrating radiation	**Keep Away From Rain**		Package should be kept away from rain and dry
Centre Of Gravity		Indicates the centre of gravity of the package	**Do Not Roll**		Package should not be rolled

Do Not Use Hand Truck Here		Hand trucks should not be placed on this side when handling	**Use No Forks**		Package should not be handled by forklift trucks
Clamp As Indicated		Clamps should be placed on the sides indicated for handling	**Do Not Clamp As Indicated**		Package should not be handled by clamps on the sides indicated
Stacking Limited By Mass		Indicates the maximum stacking load permitted.	**Stacking Limited By Number**		Maximum number of identical packages that may be stacked above, where "n" is the limiting number.
Do Not Stack		Stacking the package is not permitted and nothing should be placed on top.	**Sling Here**		Slings for lifting should be placed where indicated
Temperature Limits		Indicates the temperature limit within which the package should be stored and handled.			

Source: *ISO 780:1997(E) - UNECE*

3.2.7 Information about the goods to be received

The type of information that a warehouse keeper could expect to want to know about the goods could include:

- Whether the cargo is loose or Palletized
- The dimensions of the outer package, (height, width and length) the weight of the packaged goods
- Protective requirements, for example, against temperature, dust or moisture
- Special handling, for example, certain chemicals should not be packed together
- Outer packaging requirements, for example, if thin outer cartons are used this will limit stacking due to the danger of crushing goods within the cartons
- The shape of the stock, not all goods pack neatly into a cube dimension, for example, lengths steel may be banded and moved using a specially designed cradle
- The labelling required, for example, information about dimensions and weight, or handling instructions such as symbols or written guides that must appear on the outer pack.

3.2.8 Self-Assessment Questions and Activities on Pre-Receiving Operations

1. The pre-receiving process in a warehouse is as important as the receiving process itself. Discuss the above statement, highlighting the steps taken while preparing to receive goods in a warehouse.

2. What major requirements have to be in place before goods are received in a warehouse?
3. Describe six (6) key documents which are required at a warehouse during the process of receiving goods.
4. Why do you think it is important that goods are packaged and labelled appropriately before being shipped to a warehouse?
5. A consignment of Covid 19 Vaccines is about to be shipped to your warehouse, what kind of information would your require from the shippers about vaccines to be received.

3.3 Receiving of Goods

3.3.1 Specific Learning Outcomes

At the end of this topic you will be able to:

i. Explain the meaning of receiving of goods
ii. Describe the functions of receiving
iii. Describe the steps in receiving of goods
iv. Explain the types of handling equipment in a warehouse
v. Identify the types of docking locations
vi. Discuss the goods confirmation process
vii. Use the goods received documentation
viii. Explain how to plan and manage labour during receiving

3.3.2 Meaning of Receiving of Goods

Receiving is the collection of activities involved in (a) the orderly receipt of all materials coming into the warehouse, (b) providing the assurance that the quantity and quality of such materials are as ordered, and (c) disbursing materials to storage or to other organisational functions requiring them.

3.3.3 Functions of Receiving

The objective of the receiving function is to assure that goods and materials delivered to warehouses are verified against ordering documentation and checked for shipping damage. In the receiving area, incoming goods and materials are normally unpacked, checked for quantity accuracy and product damage, repackaged, organized into a storable format (where required), entered into the inventory system, have markings/labels applied, and staged for movement to a storage area. Cross-docking and certain value-added activities could also take place here.

Typical activities carried out in the receiving of goods include:

1. Scheduling delivery vehicles and yard control
2. Unloading product from the delivery vehicles
3. Checking product quality and quantity
4. Entering data into the warehouse management inventory system
5. Safeguarding and labelling
6. Completing JIT and cross-dock activity

As is the case with warehouse operations, the receiving function will vary greatly from industry to industry. For example, companies in the chemical and petroleum industry receive inbound supplies in bulk quantities (e.g., rail tanker cars and tanker trucks) rather than in boxes flowing over a conveyor on a receiving dock.

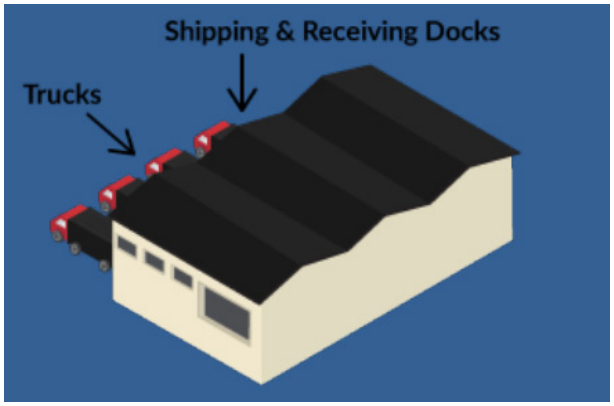
1. Scheduling Delivery Vehicles and Yard Control

Yard control activities include scheduling inbound vehicles for offloading, restraining vehicles, checking seals, opening of the truck door, and inspecting the trailer or load condition. Yard control and scheduling inbound delivery vehicles determines when delivery trucks are due to be positioned at the warehouses unloading dock. Whenever possible, this dock location minimizes the internal transportation distance between the dock door and the storage location. Other yard control activities include:

- Using chocks behind the trailer driver side rear wheels or other means of vehicle restraint
- Checking the seal and opening the truck door
- Inspecting the trailer or load condition for damage or contaminants

When trucks arrive at the dock, they generally find one of three types of warehouse dock configurations: combined, scattered, or separated.

Combined Docks



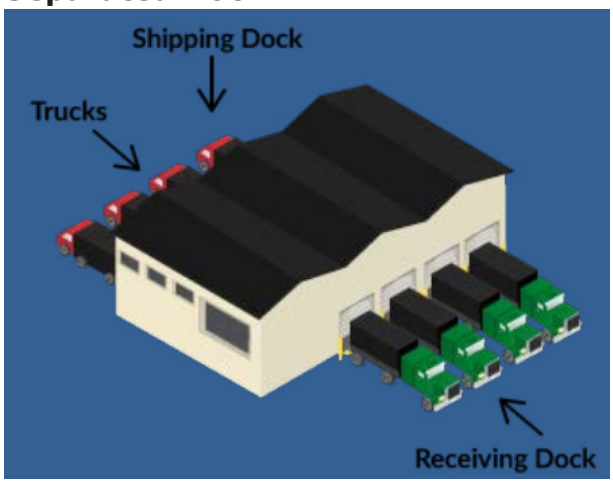
In the combination docks arrangement receiving and shipping activities are performed in one common area, so fewer dock positions are needed. These activities use the same docks, building area, equipment, and employees and lead to a more productive use of resources. For best results, this combination concept requires a truck dock schedule in which inbound and outbound products do not conflict. Receiving and shipping docks are on the same wall, so product tends to flow through the facility in a horseshoe pattern.

The disadvantage of using combination docks is that it tends to increase in-house movement of goods and requires exact scheduling of inbound and outbound trucks, and it may also lead to vehicle congestion in the yard. With this method, it becomes more difficult to compensate for product delivery problems and business fluctuations.

Scattered Dock

A scattered dock arrangement has incoming goods delivered to a number of points on the perimeter of a warehouse close to the point of use. This dock arrangement allows the product to flow directly from the delivery dock area to the assigned storage use/area. Shipping docks are located along the opposite building wall from the receiving docks, allowing product to flow from use/storage areas into the shipping dock area. This arrangement is particularly suitable for warehouses that operate a cross-docking operation. Disadvantages of the scattered dock layout include duplication of services and back-up facilities, requirements for increased labour, the need for increased management control, lack of flexibility for rearranging the layout during an expansion program, and underutilization of mechanical handling equipment (i.e., duplicate capital investments).

Separated Dock



In the separated dock arrangement incoming goods are delivered to a number of points on the perimeter along one exterior wall. This dock arrangement allows the product to flow directly in a straight line from the receiving dock area to the assigned storage area. Shipping docks are located along the opposite exterior wall from receiving, allowing product to flow from storage areas into the shipping dock area. This arrangement is particularly suitable for warehouses that operate cross-docking operations.

A disadvantage of the separated dock arrangement is that it not only requires the use of opposite ends of the building, but also utilizes separate equipment, employees, and supervision.

2. Check Product Quality and Verify Quantity

The third main receiving activity is to verify that incoming goods and materials are not damaged or contaminated and that the quantity is verified against what was ordered. This activity ensures that the product delivered to warehouses is what was ordered, the quality is acceptable, and the quantity is correct.

Once a receipt has been verified for quality and quantity, it is entered into a WMS. At this point, any discrepancies are documented using the designated process. Any missing or damaged

cartons in transit may become the responsibility of the freight carrier or transport company. Suppliers and manufacturers would be notified if the order is damaged, contaminated, has incorrect quantities, or has missing or wrong products.

Organizations can also use a total quality program with their suppliers. This type of program aims for quality at the source, or doing it right the first time at the supplier's site. This reduces or eliminates the need for performing quality checks on receipts.
In cases when the product is incorrect or damaged, it will normally be held in a separated, clearly demarcated holding area for disposition. This disposition normally takes the form of either:

- Returning the entire shipment to the supplier
- Inspecting 100% of the incoming items and separating acceptable quality items from the poor quality items. Acceptable quality items are processes for storage, and poor quality items are returned to the supplier.

3. Entering Data into the Warehouse Management System

The next receiving activity is to update the inventory system. Receiving department employees enter the SKU quantities into the system and transfer the goods from the receiving department staging area to the designated storage or staging area. In warehouses that use barcode scanners or other means of capturing receipt information, employees ensure that data is automatically entered during the scanning process. However, in warehouses that use paper-based transactions (e.g., receiving documents), employees may need a more extensive key entry to input product and quantity data.

4. Safeguarding and labelling

In certain retail warehouse operations, a sub-activity of product receiving is the SKU labelling activities, in which a unique label is placed onto each SKU. In this activity, the procedure includes a mechanical printer that prints labels, which are then glued, clipped to, stitched into, or hooked onto the SKU. Repackaging and other safeguarding operations may take place prior to further processing and storage. The purpose of this activity is to convert the product from a bulk form (e.g., products tossed into a large bin without individual packaging or wrapping) to a form that is ready to be placed into storage. These activities can involve unit load transformation. For example, parcels might be unpacked into individual cartons, pallet loads containing unstable loads might be stabilized, or it might be necessary to change the height (quantities per pallet) of a pallet to conform to storage or building constraints.

5. Value-Added Activities in Receiving

Receiving functions also include activities, such as repacking products, repackaging into customer specific cartons, and possibly in customer-specific quantities. Depending on the type of company, industry, and the nature of the operation, kitting might also take place during receiving operations.

6. Completing JIT and cross-dock activity

Another activity performed in the receiving area is the cross-dock activity. This type of operation changes the traditional sequence of activities and product flow in warehouses. Items are received and then distributed to the customers' staging-shipping area directly, without being placed into storage. This flow concept reduces the distribution facility number of product handlings and number of days of flow from suppliers to final customers but emphasizes inbound-outbound dock and sorting activities.

3.3.4 Steps in receiving of goods

The basic receiving goods process is:

Truck arrives with stock

i. Documents need to be checked for:
   - The correct address
   - The quantity of goods
   - The type of goods
   - The weight of goods

ii. Check stock for damage before unloading

iii. The security seal on the truck is checked to make sure it has not been opened

The truck is then unloaded

i. Use correct Material Handling Equipment for the weight of the goods to unload and place stock in designated receivals area.

ii. Sign consignment note as goods received in good order

iii. Use correct PPE and pallet exchange documents

The pallets then need to be unpacked

i. Unwrap pallets and dispose of wrapping material
ii. Check stock for any discrepancies

New stock then needs to be entered into the inventory system

i. Check documents for accuracy of delivered goods
ii. Access the warehouse management system and enter and update goods onto the inventory system.
iii. File documents

Then stock is put away into their locations

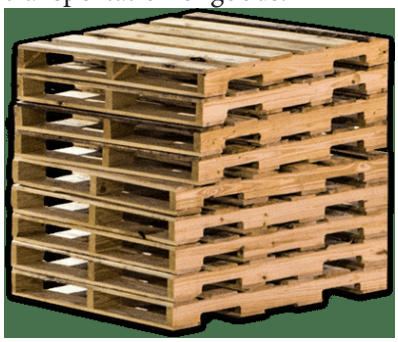
Identify stock locations and aisles numbers for the pick face locations and using rotation methods, put stock away.

3.3.5 Handling equipment in receiving goods

Some the material handling equipment include the following;

Pallets

It is a portable platform made of either wood, plastic or metal used for the storage and in the transportation of goods.



Rack

A rack consists of huge metal frames joined together both vertically and horizontally. This is where the received goods are placed for storage.

Containers

A container is a standard size metal box into which cargo is packed for shipment/storage.

Ladders

Ladders – used to facilitate climbing to pick or stack light goods.

Hand truck/hand trolley

These are used to move goods from the offloading bay and move within the warehouse.

Pallet truck
These used to move pallets from one point to another.

Forklift
Provides a motorized means of movement of goods available in a range of sizes with carrying capacity from 1 to 40 tons.

Reach Truck
They are a variant on basic forklift design, have capability of moving their forks forward, backward as well as vertically and serve the same purpose as forklifts.

Pick stackers
These are used for picking and stacking goods at high level in the truck or warehouse, can be driven to any location in warehouse.

Crane

3.3.6 Types of docking locations

Warehouse docks should be studied in-depth, since they are the access points to any storage facility. It is crucial to carefully design where they are externally located in a facility and choose the best type of dock depending on the available space. There are different warehouse docks as discussed below:

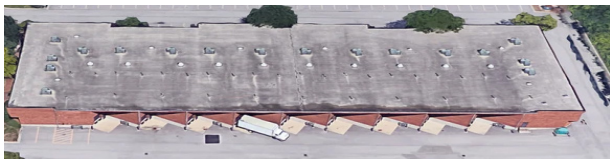
Flush Dock
The most common loading dock used in transport or heavy lifting, a flush dock allows for the back of the loading truck to be flushed against the entryway of a space. With a secure buffer to avoid damaging the wall, the dock is parallel to the building, maintaining easy and straightforward delivery of the items and materials to be loaded. Flush docks are typically used as a space saving measure, as they fit snugly inside the chosen warehouse or building, making them ideal for smaller businesses to utilize. Generally, this type of dock is used to benefit the manufacturing industries and those with commercial outputs to deliver.

Open Dock
Although rare, and unpopular with those in the trade, Open Docks are still used today. Consisting of an open platform with very little protection against natural elements – beyond a canopy – they do not

create a secure enclosure for items, making them prone to theft and damage. These docks, therefore, are rarely used for the transportation of people or easily damaged goods. The benefit, however, of open docks is the ease of access for loaders, meaning they can save time unloading and loading through the dock.

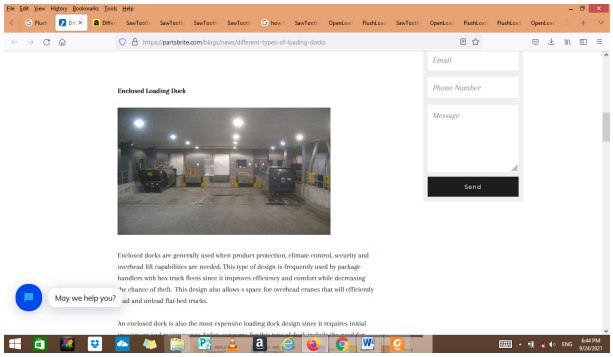
Saw Tooth Dock

A saw tooth dock is one of the most innovative when it comes to manoeuvring small outdoor spaces surrounding the designated warehouse. Uniquely shaped at an angle, they can fit easily into narrow or difficult spaces; however, they can be bulky to operate within the warehouse itself – wasting valuable storage space. The industry best adapted to the Saw Tooth Dock is usually those in large scale manufacturing, with enough warehouse room to accommodate their unusual size.



Enclosed Dock

An enclosed dock is one of the most uncommon appliances used in deliveries. Allowing trucks to park indoors, aka inside a storage space or warehouse, gives loaders quick and easy to access to the supplies, however creates many problems after the delivery has been made. Vital but costly ventilation systems must be implemented to prevent the levels of exhaust fumes and pollution from impacting both the workers and the goods. These docks also take up a significant amount of room in warehouses, reducing the already limited space down, making it harder for workers to access equipment and supplies. Yet, they do have their advantages, as their enclosed form helps to protect valuable goods from environmental or structural damage.



3.3.7 Confirmation of received goods

1. Match the delivery to a purchase order

First, ensure the delivery has come to the right place by matching the details on the Consignment Note to the Purchase Order raised by your business. The Purchase Order should also be used to check that each item matches the description and quantities ordered. Generally, the boxes or cartons will have a description of the item and quantities of its contents.

2. Ensure you record the following for each new delivery:

- The date and time goods arrived
- The name of the delivery partner and driver
- Check off quantities and description of goods against purchase order
- Note any discrepancies
- Names of the personnel who performed these checks

Maintaining accurate reports is essential for accurate bookkeeping as well as resolving any disputes that may arise in the future regarding the items or supplier. If there is no purchase order or record of the order, check with your supervisor or purchasing department before rejecting the goods.

3. Check products are not damaged

Before accepting the delivery, it's important to conduct a quality check to ensure the items are not damaged or malfunctioning. It's not always feasible to open each carton and check every single item, particularly for large shipments. So in these cases you may wish to complete a spot check rather than open each and every carton. Check for signs of breakage or faults, and ensure all items are as described on the purchase order. If any damaged items are found

in the delivery, record the extent of the damage on the consignment note and immediately notify the supplier with details of the issue to discuss the next steps.

4. Log received items into your inventory

Enter the items you have received into your warehouse management system as soon as possible, including the date and quantities received. This will allow the stock to be allocated to new orders right away.

5. Allocate storage space for goods

It's important to pack away a new delivery promptly to ensure no items become lost or damaged. Supplies should be distributed to the appropriate person in the business, or packed away in the usual space to be accessed when required. For goods received in as stock, these items will need to be allocated a space in the warehouse for storage until ready to be picked for an order.

3.3.8 Goods received documentation

Main documents to be kept by a warehouse include;

Consignment note

A consignment note is a document regarding the carriage of goods by road which declares the contract of carriage and includes the instructions given to the carrier and proves the contract of carriage. The matters which must be included in all cases are the following;

a) The date of the consignment note and the place at which it is made out;
b) The name and address of the sender;
c) The name and address of the carrier;
d) The place and the date of taking over of the goods and the place designated for delivery;
e) The name and address of the consignee;
f) The description, regarding common use, of the nature of the goods and the method of packing, and, in the case of dangerous goods, their generally recognized description;
g) The number of packages and their special marks and numbers;
h) The gross weight of the goods or their quantity otherwise expressed;
i) Charges relating to the carriage (carriage charges, supplementary charges, customs duties and other charges incurred between the making of the contract and the time of delivery);
j) The requisite instructions for customs and other formalities;
k) A statement that the carriage is subject, notwithstanding any clause to the contrary, to the provisions of this Convention.

Packing list / Slip

A packing slip is a document that includes the complete list of items included in a package. Packing slips include marks and numbers, weights, dimensions, and the number of units that are used by shipping departments to determine what inventory needs to be sent out to accurately complete an order.

Goods Received Notes

Goods received note (GRN) is a two-way document that acknowledges delivery of goods by a supplier and their receipt by the customer. When a customer issues a purchase order, the supplier is obligated to deliver them as per the terms of their contract. Upon delivery, the customer issues three delivery note copies to the department requesting the supplies, retains a copy for the finance department, and hands one over to the supplier. Details of the delivery are confirmed by the three parties before authorizing. Goods received notes confirm that an order has been delivered and received and it's satisfactory to all the parties involved.

Delivery Notes

A copy of the Delivery Note is usually sent with the transporter. The Delivery Note contains the list of Items that are sent in the shipment and updates the inventory. The DN should have the name and contact details of the sender, name and contact details of the receiver, date of issue, date of delivery of the goods, description of the goods contained in the order, and the quantity of each type of goods.

Purchase Order

A purchase order (PO) is a legally binding document created by a buyer and presented to a seller. A purchase order is essentially a list of what you want to buy. It lays out the order details, including quantity and types of products the buyer needs, as well as payment terms and delivery details.

3.3.9 Labour planning and management during receiving

Another important aspect of improving the warehouse receiving process is to allocate the proper number of man hours. Failing to properly account for the volume and type of cargo coming through the gates results in under or over-allocation of human resources. Considering that labour is among the highest of warehouse operational costs, matching workload demand with workforce supply is critical.

To avoid under or over allocation of resources (labour or equipment) and/or a collapsing receiving process, warehouse managers must define times and dates on which cargo is received. This should be a decision of the warehouse manager and not the carrier. By knowing what cargo comes in and at what time, warehouse managers are able to match workload demand with workforce supply.

3.3.10 Self-Assessment Questions and Activities on Receiving Operations

1. Explain the meaning of receiving of goods and describe the functions of receiving
2. Using examples from a warehouse familiar to you, describe, in chronological order the steps involved in the receipt of goods.
3. You are a newly recruited warehouse manager, among your duties is to recommend Material Handling equipment. Mention the types of equipment you would recommend for handling; (i) Loose Cargo (ii) Bulk Dry Cargo (iii) Palletized Cargo
4. Using simple illustrations describe the common types of docking locations
5. Explain any five ways how the goods verification process during receiving can be optimized.
6. What challenges could arise from receiving goods into a warehouse without their relevant accompanying documents.
7. Briefly explain how a warehouse known to you would plan and manage labour to receive a very large number of assorted consumer goods to be distributed in the festive season.

4.0 Put – Away of Goods

4.3.1 Specific Learning Outcomes

At the end of this topic you will be able to:

i. Explain the meaning of receiving and put – away of goods
ii. Describe the steps in put- away of goods
iii. Discuss the equipment used in put-away in a warehouse
iv. Describe how to put away goods
v. Explain the required put– away documentation
vi. Explain how to plan and manage labour during put away

4.3.2 Meaning of put - away of goods

In a warehouse, putaway refers to all the processes that happen between receiving goods from vendors and having them all placed into their assigned places. It is the act of placing merchandise in storage. It includes material handling, location verification, and product placement. Having a putaway system simplifies the process of storing items, reduces the risk of misplacing or losing items, and keeps the warehouse clean and organized. As a process, putaway involves more than just transporting inventory from Point A to Point B, though. In alignment with lean warehouse management, optimal putaway involves:

- Quick and frictionless transport of inventory
- Optimal usage of storage space
- Optimal placement of inventory for convenient retrieval
- Documentation of storage
- Safety of all inventory, resources, and warehouse team members

There are three key ways to approach the putaway process — each being more or less ideal than the other options, depending on individual circumstances.

1. Fixed-location putaway

With a fixed-location approach to putaway, you'll assign specific storage space to be used for specific types of inventory at all times Note that "specific types of inventory" provides for some flexibility, in that you don't necessarily need to designate space for a specific product, per se. Rather, the goal is to designate certain storage areas for products of certain characteristics. A few examples:

- Designating one area for lightweight inventory, another for heavier
- Placing specific inventory in climate-controlled storage as needed
- Storing quick- and slow-turnaround inventory in separate locations

Fixed-location putaway is ideal for companies that sell a wide spectrum of items, as it allows you to tailor different storage spaces as necessary for housing a specific product. Fixed-location means your team will always know where a certain product is being stored — allowing for easy retrieval and delivery whenever needed.

2. Dynamic putaway

A dynamic approach to putaway focuses on storing incoming inventory in the most convenient spot possible (for both storage and retrieval). In contrast to fixed-location, dynamic putaway is ideal when the majority of your inventory is relatively similar in terms of size, weight, and other physical characteristics. All other factors being nearly equal, you'll be able to make real-time decisions as to where inventory should be stored as it comes in.

Another key advantage of dynamic putaway is the ability to take demand into consideration above all else. With fewer physical restrictions as to where inventory can be stored, you can identify hot-ticket items as they come in and place them as close as needed for fast retrieval.

3. Direct putaway

Direct putaway is the process of immediately transporting incoming inventory directly to its final location in your warehouse. Instead of being placed in storage, you prepare for delivery as fast as products arrive. In taking this direct approach, you'll both minimize touch points and unnecessary movement of inventory, and also ensure that handoff of inventory for delivery occurs without much friction — if any. Similar to dynamic putaway, direct putaway requires real-time use of inventory management software in order to identify (a) which products should be subject to direct putaway, and (b) where that inventory should be moved to.

4.3.3 Types of putaway methods

There are 3 main types of putaway methods. Putaway can be based on the purchase order, the SKUs of the products, the type of the products, or where they need to be stored. Let's take a look at each method in detail:

1. Based on purchase order

Some warehouses choose to buy from just one vendor, while others buy from several. Regardless of the number of vendors you buy from, this method of putting away starts by analyzing your purchase order(s) and grouping all the items that are stored near each other, together. So by grouping them together at the beginning of the process, you can put them away together in one trip. Putting away based on purchase order makes it easy to weed out any mistakes or incorrect items, since you will have to look at every item in order to group the similar ones.

2. Based on SKU

Putaway based on SKU is where warehouses allocate space for their products based on their SKU (Stock Keeping Unit). The SKU of an item is determined by characteristics such as its brand, manufacturer, colour, size, and style. So this method is where you putaway items that have similar SKUs, near each other. It's typically used by warehouses that hold large quantities of products that share the same SKU, so that by storing them near each other, they're easier to find.

3. Based on product type

This method puts away items in a specific location based on criteria such as the type and size of product, how frequently it is purchased, etc. For instance, if you receive some blocks of ice, then they will need to be put away in a freezer. Or say you have products that need to be stored in locations that are difficult to reach without the help of some equipment, say the top of a large rack. To reach this, some warehouses call trained workers that know how to operate the equipment needed to reach these storage locations, to get the job done.

4.3.4 Steps in put - away of goods

Some of the common steps in the Put Away process include;

Step1: Generating the Put-Away List

The responsible personnel in the warehouse should generate a put-away list. The put-away list normally includes the following details;

i. The stock Keeping Unit Name
ii. The product's Universal product code
iii. The quantity

iv. and the location to which the put away needs be done.

Step 2: Physical Put Away

The physical stock is picked either by humans or with the help of material handling equipment like hand pallet trucks, fork lifts and stacked at the location that was indicated on the put list.

Step 3: Warehouse Stock Update

The warehouse stock is updated into the system after verifying the physical quantity of the product.

4.3.5 Optimizing the Put-Away Process

The prime objective of the putaway process is to move goods from the dock to the most optimal warehouse storage location. At the heart of the process is assuring that:

- Cargo is stored fast and efficiently
- Warehouse travel distance is reduced to a minimum
- Security of goods and the safety of warehouse employees is ensured
- Warehouse space utilization is maximized
- Cargo is easy to find and track within the warehouse
- Goods are stored in a location that is quick and easy to retrieve during the picking process

Failing to properly implement an efficient process will have a direct impact on the productivity of warehouse operations.

4.3.6 Best Practices to Optimize the Putaway Process

Collect Data & Introduce Real-Time Analytics

Data is king when it comes to improving warehouse operations and implementing an efficient putaway process. With the objective of finding the most optimal storage location, data on cargo size, weight, height, receiving and shipping frequency, cargo type (e.g. Hazmat, perishable, high value, etc.), order/sales volume, and storage availability must be consistently and accurately collected and analysed.

Therefore, the warehouse management system (WMS) must comprise two key elements: adequate/flexible data collection capabilities and on-going data analysis. Once the appropriate WMS is in place, the next step is to make sure that we are collecting data accurately and efficiently by automating collection as much as possible. This in turn will allow us to eliminate entry errors and reduce overhead. For example, if we are collecting cargo weight data, an integrated digital weighting scale does the job, while a parcel or pallet dimensioning system collects data on dimensions. Both solutions automate these tasks and eliminate data entry errors.

Monitor Storage Capacity & Space Availability

Another important element in process optimization and increased warehouse efficiency is avoiding unnecessary traveling time to locations lacking space or capacity to store the cargo by monitoring storage capacity and availability.

To monitor capacity and space availability, warehouses can use barcode scanners and bin locations to track used/unused space across warehouse zones. This solution is currently available across most warehouse management systems (WMS). However, this system is prone to human error, as it relies on the warehouse clerk to scan the bin location and cargo every time he/she performs a putaway or pick task.

Another approach is to use RFIDs to automatically record tasks without any human intervention. Although this solution is still being fine-tuned and tested, the use of RFIDs combined with more advanced solutions, such as sensors, will be part of an ecosystem of technologies to deliver real-time tracking of capacity and space within the warehouse.

Reduce Traveling Time

Reducing traveling time is another important factor when optimizing the putaway process and warehouse operations in general. The goal here is to reduce travel time of goods from the receiving area to the storage location.

To accomplish this, warehouse managers can conduct an ABC analysis to better understand high volume/frequency cargo. Then, the warehouse layout should be adjusted (if necessary) to move high volume/frequency cargo closer to shipping areas, with the goal of reducing traveling time.

Defining routes for the shortest path to the storage location is another way to reduce traveling time. When doing so, it is important that warehouse

managers consider factors such as distance, warehouse traffic congestions, and potential conflicts with other processes that involve traveling.

Use Direct Putaway When Possible

Another best practice is to use direct putaway when possible. When using this method, the cargo is directly moved from its receiving area to its final location without going through a staging phase. By eliminating the need for designated staging locations, this approach not only speeds up the process but also reduces handling and space requirements in the warehouse.

When implementing this approach, it is important to remember that the WMS must be able to assign final locations from advance shipment notice (ASN) or from the point of delivery at the receiving dock. Without this capability, it is almost impossible to run an effective direct putaway process.

Use Fixed & Dynamic Locations

It's also possible to leverage a proper mix of fixed and dynamic locations, if conditions allow.
A fixed location is a pre-determined storage space, warehouse zone, aisle or bin assigned by specific criteria. For example, a fixed location can be associated with a specific product category, customer, final destination, etc. Fixed locations help increase the efficiency of the process because warehouse clerks can memorize a cargo's specific location assignment.

On the other hand, dynamic locations provide more flexibility by allowing clerks to put anything in the first available space they find on their way. When using dynamic locations, a reliable inventory management system to track goods and locations is paramount.

Dynamic locations can also be leveraged to temporarily store high-volume seasonal items closer to picking locations, to be replaced with a different item(s) when volumes shift.

Keep the Warehouse Clean & Organized

Last but not least, a clean and organized warehouse/ distribution centre can make all the difference in running an efficient process. A cluttered and poorly organized facility will have a direct impact on the speed at which goods are put away. Clerks take more time to find available locations, move cargo around to open space, and manoeuvre around obstacles to reach the desired location. Most importantly, poor warehouse organization increases safety hazards to employees and the risk of compromising the integrity of the cargo. Without a clean and organized warehouse, streamlining your warehouse processes or using the latest warehouse technology won't matter.

4.3.7 Put – away documentation

Transfer order

A transfer order is **a document used for executing the movement of goods from one warehouse location to the other** or the goods movement between a storage unit to another within the warehouse. The transfer order occurs for the purpose of warehouse management or order processing. The transfer order occurs for the purpose of warehouse management or order processing. These may include, picking of order, putaways, order updates, repacking, or inventory management.

Stack Card

The stack card documents all quantities of commodity added to (received) or removed from (dispatched) the stack to which it is attached.

4.3.8 Labour planning and management during put-away

Upon receiving the shipment, it is crucial to unload the consignment as soon as possible. The warehouse management needs to allocate the right number of workers and staff-hours to execute the unloading without steering away from schedules. Accordingly, allocate the workers and keep a tab on staff-hours. Labour is, by far, the most significant cost centre in any warehouse.

Assign the shipments to the workers based on the cargo size and make sure that all of them are present at the time of unloading. Also, the material handling equipment is allocated concerning the dimensions and the weight of the cargo. Small yet basic operating principles like unloading entire pallets instead of unloading individual cartoons come a long way in raising efficiency. Also, they boost the speed of operations while making it easy for the workers to access the cargo. Booking and material handling equipment distribution go hands in hands to streamline unloading and further verification.

4.3.9 Learning Activities

Put away involves the physical movement of goods with the storage area, what can be done to speed up this process while minimising damages to goods. Additionally, identify the common mistakes made by putters in this process and suggest ways of overcoming the mentioned mistakes.

4.3.10 Self-Assessment Questions and Activities on Put Away Operations

1. Explain the importance of storage in supply chains.
2. Using a warehouse known to you describe the steps in put- away of goods.
3. Various equipment is used in the put away process, these can be grouped into manual equipment and automated systems. Using relevant examples, distinguish between manual equipment and automated systems.
4. What key documents are required during the put– away process?
5. What factors would a warehouse manager put into consideration while attempting to plan and manage labour during a manual put away process.

4.1 References

- Hilmola, O. P. and Lorentz, H (2010). Warehousing in Europe- Northern actor perspective. European Transport. 45, 15-33
- Żuchowski W., 2019. Attempt of warehouses classification from the future users point of view. LogForum 15 (2), 249-254, http://doi.org/10.17270/J.LOG.2019.330
- Berg, Jeroen & Zijm, W. H. M. (1999). Models for warehouse management: Classification and examples. International Journal of Production Economics. 59. 519-528. 10.1016/S0925-5273(98)00114-5.
- UNHCR (2013), Standard Operating Procedures for Warehouse and Inventory Management in UNHCR, Version 1.0
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Warehousing Operations Certification Track. LINCS in Supply Chain Management Consortium. March 2017. Version: v2.28. www.LINCSeducation.org.

5.0 STORAGE AND REPLENISHMENT OF GOODS

5.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Explain the meaning of Warehousing
ii. Explain the meaning of Storage and replenishment
iii. Use the storage location systems
iv. Utilise the storage equipment
v. Allocate the storage space in a warehouse
vi. Carry out the Stock Keeping Unit determination
vii. Preserve goods in a warehouse
viii. Carry out the replenishment processes

5.2 Meaning of Storage and replenishment

Storage

This is the physical containment of merchandise while it is awaiting a demand. The storage method depends on the size and quantity of the items in inventory and the handling characteristics of the product or its container.

Replenishment

In this process, a warehouse employee transfers product from a storage position to a given pick position. Replenishment is carried to ensure that SKUs are removed from the assigned storage area on schedule and in the proper quantity. These SKUs are then placed in the correct SKU stock position to help ensure a constant availability of stock at a given stock position. Replenishment activities include listing SKU positions in warehouses that require replenishment, withdrawing the product from the storage position, and transferring or placing the SKU in the SKU pick position.

5.3 Storage location systems

Storage location strategies organise stock in a storage system, and have a considerable impact upon storage system performance. There are two main stock location systems: dedicated location (or fixed slot) storage system and randomised location (or floating slot) storage system. It should be noted that both strategies take advantage of stock-keeping-units (SKUs), which uniquely identifies an item type. Inventory records keep a count on the quantities of each type of SKU that has a place in the storage system.

Random Location Storage System

The random location storage system is a storage technique in which parts are placed in any space that is available (empty) when they arrive in the store room. This strategy places items in the closest available slot, bin or rack. Products are then retrieved on a first-in, first-out (FIFO) basis. This approach maximises space utilisation, although it requires longer travel times between order-picking locations. Randomised systems often employ a computerised automatic storage and retrieval systems (AS/RS), which minimises labour and handling costs.
Although this random method requires the use of a locator file to identify parts location, it often requires less storage space than the fixed location method. This location method is applicable where:

i. The stores system is computerised.
ii. Fast moving items are stored.
iii. There is need to maximise space usage.

The random location storage method is typically preferred, because it provides a higher utilisation of empty locations.

Dedicated Location Storage System

The dedicated location storage system is a method of storage in which a relatively permanent location is assigned for the storage of each item in the store room or warehouse. Although more space is needed to store parts than in random storage system, dedicated location becomes familiar, and therefore a locator file might not be needed. This can simply be described as a stock location system where the same item is put in the same location every time. The system works on the principle: A Place for Everything and Everything in its Place.

Advantages

i. Stores personnel will quickly and easily become familiar with the system because a pattern has been established
ii. Items of a similar nature might be stored in close proximity. This facilitates handling, security, health and safety
iii. Items can be stores in such a way as to minimize handling & reduce pick time

Disadvantages

i. It is improper for high demand items
ii. More space is required thus long movements

The decision to use either fixed or random stock location systems depends on:

i. Type of goods stocked
ii. Type of storage facility needed.
iii. Throughput
iv. Size of orders

Other Storage Strategies include;

Popularity

The popularity criterion locates popular items near the shipping area and the unpopular items always from the shipping. By this method, the order pickers travel a shorter distance to pick the most popular items being ordered, thereby reducing the time required to pick orders.

Unit Size

The unit size criterion that small-size items be located near the shipping area and larger-size items be placed father away from the shipping area. By locating smaller-size items near the shipping area, more items can be stored near the shipping area, which reduces the order picker travel distance and order-picking time.

Cube

The cube criterion is a variation of unit size in that the items with smaller total cube space requirements are located near the shipping area.

Compatibility

Compatibility refers to how well products may be stored together. For example, pharmaceuticals cannot be stored with bagged agricultural chemicals.

Complementarity

Complementarity refers to how often products are ordered together and therefore stored together. Computer disk drives, CD-ROMs, and monitors; pens and pencils; and desks and chairs are examples of complementarity products that usually stored close to each order.

5.4 Storage Equipment

There are a number of different types of storage systems available. Systems can be combined and more than one system can be used depending on the stock. The benefits of selecting the right storage system include a better use of space, easier work processes, and better overall business efficiency. Storage systems must be accessible for safe and quick access to the stored goods.

Manual Storage Equipment

Block Stacking

Block stacking is **a form of palletised storage** that does not require any type of storage equipment, and instead loaded pallets are placed directly on the floor and built up in stacks to a maximum stable storage height. Lanes are created to ensure access to the different stock keeping units (SKUs).

The maximum storage heights or stacking levels are determined by a number of different factors such as:

- Load strength (crushability)
- Load weight
- Load stability
- Pallet conditions
- Safety limits
- Weather (humidity, water, wind can weaken pallets and soften loads)
- Warehousing clearance heights

Each of these factors needs to be considered carefully to ensure that safe stacking levels are selected. One key limitation of block stacking is that SKU's are only accessible in a Last In First Out (LIFO) method. Floor stacking is extremely space intensive and hence requires very large areas for storing large quantities of stock. When loads are removed from the storage lanes, underutilised space is created that cannot be used until the entire lane is cleared. This effect is called honeycombing. Therefore, careful attention to lane length and depth (determine storage capacity) must be taken to ensure that a high level of utilisation of each line is achieved, meaning that each line size needs to be planned based on

predicted and current stock output levels for each SKU.

Advantages of floor stacking:

i. Very low setup costs
ii. Flexible

Disadvantages of floor stacking:

i. Low density storage (Requires a large storage facility to store only a small amount of stock).
ii. Poor ventilation of products
iii. Storage height depends on a number of variable factors
iv. Only one SKU can be effectively stored in a lane, empty pallet spaces are created that cannot be utilized effectively until an entire lane is emptied.
v. You have to move the top pallet to get to the pallet underneath (LIFO).

Bin Shelving

Bin shelving is designed to handle non-palletized loads and is generally used for small parts. Because items are hand-picked, bin height usually does not exceed seven feet, which may lead to cube space underutilization.

Modular Storage Drawers

Modular storage drawers protect parts from the outside environment and allow for a higher concentration of stored items and increased picking accuracy. They also lead to underutilization of cube space. The drawers and their cabinets come in many sizes and combinations to accommodate one SKU or many SKUs. Specific SKUs are stored in each compartment, so picking accuracy should increase; however, because pickers have to reach into the drawers, the structure is usually limited to a height of about five feet, which can lead to an underutilization of cube space.

Static Shelving

As the name suggests, static shelves are storage mechanisms that are designed to stay in one place. For the most part, they are meant to hold inventory that is fairly lightweight (a few hundred pounds per shelf). It's commonly used for storing inventory that needs continuous replenishment. Because they're not compatible with forklifts, static shelving is generally used with inventory that must be manually picked, placed, and/or organized. For larger inventory, invest in a wide-span shelving system, which can hold more weight and can be used in higher-elevation configurations.

Mobile Shelves

It is similar to static shelving, but the only difference is that it can move and offers adjustable shelves. Such systems are designed to accommodate more goods in less space. Some of them can also contain locking systems and level tracks. The level tracks can either be mechanized or manual.

Wire Partitions

Wire partitions are secure wire cages, and sections are an essential accessory for improving warehouse security. They are typically made of fence-like wire mesh materials, creating a durable and robust enclosure that makes it easy to designate high-security storage areas or sections within your facility. Wire partitions are also practical additions as they

help you section off areas without investing in major renovations.

It is easy to restrict access to areas where you store sensitive or high-value materials or products with a wire partition. They are ideal for securing medical products, chemicals, and similar types of items that should not come in contact with other products, thus eliminating the risk of contamination or damage.

Mezzanine Flooring

A warehouse mezzanine floor system is an elevated floor/platform that is installed between the floor and the ceiling. Most of the time these steel structures are free-standing and can be dismantled and moved with relative ease. Industrial mezzanines are normally composed of steel (carbon or stainless). The flooring will vary based upon the specific application, but it is often made of steel (bar grate, metal decking, etc.), wood product finished floor or b-decking. Mezzanines can also be designed to accommodate a concrete flooring surface.

Mezzanine systems in a warehouse environment are an effective way to increase storage and/or work space by allowing you to utilize the unused vertical space that already exists in your facility. After the mezzanine is constructed, the space beneath it is also accessible and can be used for storage or other purposes. There are a few different types of mezzanines to choose from, but steel structural are the most common in warehouses.

Benefits of Using a Mezzanine in Your Warehouse

- It's an easy way of adding storage space in the warehouse
- This method doesn't require more land or space for expansion.

Racking

Pallet Racking

For the busiest and largest warehouses, pallet racking systems are usually treated as the centrepiece of the operation. Typically, pallet racking systems are made out of wood, metal, or plastic and hold inventory that is received in large boxes. Depending on the height, the boxes are placed on the pallet racking system with the help of a forklift or an automated mechanism.

There are a variety of sub-categories of pallet racking systems, including carton-flow racking, cantilever racking, coil racking, double-deep racking, drive-in racking, drive-through racking, high-bay racking, mobile racking, narrow aisle racking, pallet live racking, push back racking, shuttle racking, and vertical racking. Most

often, warehouses will choose systems based on weight limits, flexibility, and whether or not the system demands a change in infrastructure.

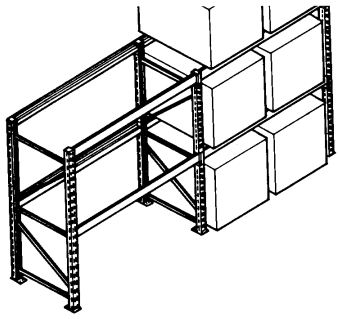
Multi-Tier Racking

A great choice for large stocks of items that have small unit sizes, multi-tier racking is a system that is designed to capitalize on vertical space. Because no warehouse is one-size-fits-all, many multi-tier racking options are flexible, with the ability to add or remove tiers depending on your current needs.

Mostly, multi-tier racking concerns relatively lightweight items that are picked and organized manually. To get the most out of this warehouse storage system, organize each tier strategically and pack items as densely as possible, while at the same time paying attention to weight limits and ceiling-to-rack height compliance guidelines.

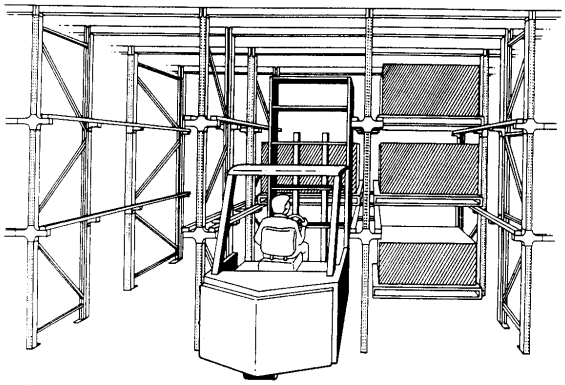
Selective Pallet Rack

- Most popular type of storage rack



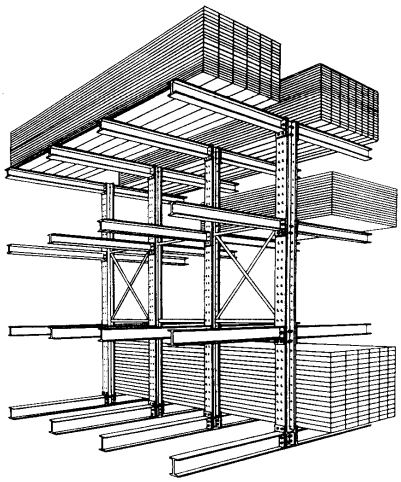
- Pallets are supported between load-supporting beams
- Special attachments and decking can be used to make the racks capable of supporting other types of unit loads besides pallets (e.g., coils, drums, skids)
- Selective racks can be used for the following types of storage:
    - *Standard*—single-deep storage using a counterbalanced lift truck
    - *Narrow-Aisle*—storage using a narrow-aisle lift truck
        - *Deep-Reach—greater than single-deep storage (typically double-deep storage)*

Drive-Through Rack



- Loads are supported by rails attached to the upright beams
- Lift trucks are driven between the uprights beams
- Open at both ends, allowing access from both ends (FIFO)
- Requires similar-width loads

Cantilever Rack



- Loads are supported by cantilever "arms"
- Used to store long loads (e.g., bar stock, pipes, lumber)
- Similar to pallet racks, except the front upright beams and the front supporting beams are eliminated

Automated Storage Devices

Automated storage systems are designed for automated storage and retrieval of parts and items in manufacturing, distribution, retail, and wholesale. Consists of an integrated computer-controlled system that combines the storage medium, transport mechanism, and controls with various levels of automation for fast and accurate random storage of products and materials.

Storage/retrieval (S/R) machine in an AS/RS operates in narrow aisle, serving rack slots on both sides of aisle; can travel in horizontal (along the aisle) and vertical (up and down a rack) directions at same time

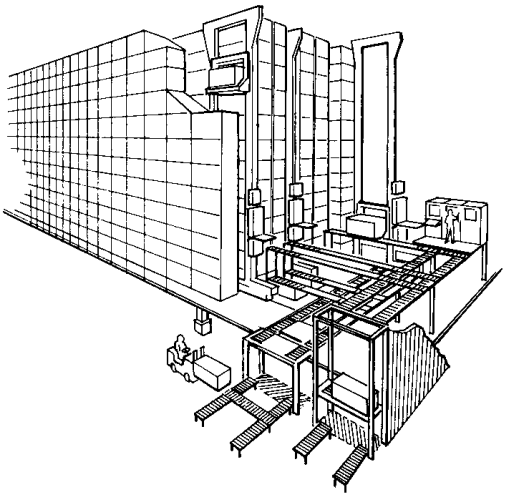
Advantages:

- fewer material handlers,
- better material control (including security),
- more efficient use of storage space

Disadvantages:

- high capital and maintenance costs,
- difficult to modify

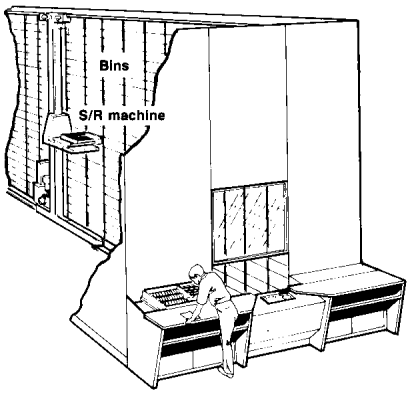
Unit Load AS/RS



- Used to store/retrieve loads that are palletized or unitized and weigh over 500 lbs.
- Stacking heights up to 130 ft. high, with most ranging from 60 to 85 ft. high; 5 to 6 ft. wide aisles; single- or double-deep storage racks

Miniload AS/RS

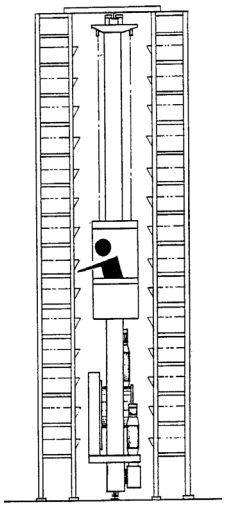
- Used to store/retrieve small parts and tools that can be stored in a storage bin or drawer



- End-of-aisle order picking and replenishment
- Stacking heights range from 12 to 20 ft.; bin capacities range from 200 to 750 lbs.
- Termed a "microload AS/RS" when used in assembly, kitting, and testing operations to deliver small containers of parts to individual workstations, where workstations are typically located on the sides of a pair of racks and the S/R machine operates between the racks to move containers to openings in the racks (storage lanes) located next to each station.

Man-On-Board AS/RS

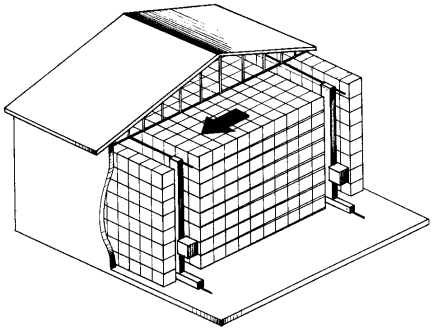
- Used for in-aisle picking; operator picks from shelves, bins, or drawers within the



storage structure
- Manual or automatic control
- S/R machine is similar to an order picker or turret truck and can sometimes operate as an industrial truck when outside an aisle, except the S/R is guided along a rail when operating in an aisle

Deep-Lane AS/RS

- Similar to unit load AS/RS, except loads can be stored to greater depths in the storage



rack
- A rack-entry vehicle is used to carry loads into the racks from the S/R machine, and is controlled by the S/R machine Termed an "automated item retrieval system" when used to automatically retrieve individual items or cases, with replenishment (storage) taking place manually from the rear of a flow-through storage lane and items are pushed forward with a rear-mounted pusher bar for automatic picking from the front of the storage lane

Carousels

Carousel consists of a set of vertically or horizontally revolving storage baskets or bins. Materials (and the storage medium) move to the operator, "part-to-man," for end-of-aisle picking. Each level of the carousel can rotate independently in a clockwise or counter-clockwise direction Control ranges from manually activated push buttons to automated computer controlled systems. Provides an alternative to typical "man-to-part" AS/RS, where the S/R machine moves to the part. Following are the two major types of carousels:

- Horizontal carousel: consists of a series of revolving bins or shelves driven by a motor
- Vertical carousel: carousel that rotates bins or shelves along a vertical enclosed loop

Horizontal Carousel

5.5 Storage Space Allocation

The following allocation strategies can be used to determine the locations of items (shelf, storage zone):

- Fast movers concentration
- Fixed storage area arrangement
- Free storage place arrangement
- Zone by zone fixed storage arrangement
- Equal distribution strategy
- Storage space adaptation
- Homogeneous item type and batch type space allocation
- Mixed item space allocation
- Minimisation of partial storage spaces

The allocation strategies mentioned above are described in more detail below:

Fast Movers Concentration

Fast movers concentration is an allocation strategy that can determine in which shelf and storage zone

units are stored and staged—utilizing allocation strategies the aim is o achieve optimal use of space, short distances and a low supply effort. If, for example, products in high demand locate close to the picking zone, an increase of handling capacity is possible. A distinction is made between the dynamic or static provision of the goods.

The less time it takes the articles to reach the picking zone, the more finely tuned the workload can be managed. Fast movers concentration is a strategy to optimise the routes of the warehouse equipment and the routes of the pickers. The travel distances of the warehouse equipment are to be reduced by storing the units of fast-moving items in a place that can be accessed quickly. Depending on whether the supply of goods is static or dynamic, a specific location is selected.

Fast movers concentration with static goods staging

Static staging refers to man-to-goods picking, which means that an order picker takes the required goods directly from the storage location. The units of fast-moving articles are therefore accessed close to the base of the staging area.

Fast movers concentration for dynamic goods supply

Dynamic staging describes goods-to-man picking. The picker carries out the respective picking order within a warehouse zone. The units transfer to the order picker via transportation devices. The access units of fast-moving articles have their place near the storage and retrieval locations of the staging area.

With fast mover concentration during order picking, path time savings of up to 30 per cent and performance improvements of up to 10 per cent are possible. The extent to which these percentages can be achieved depends on the ABC distribution, the range of the assortment, how the access points are arranged and the selected routing strategy. The danger, or rather the disadvantage of fast movers' concentration, is that staging areas in too close proximity to one another can obstruct the order pickers.

Fixed Vs Free Storage Space Allocation

With fixed storage space allocation, the maximum expected warehouse stock for an article is determined and the storage spaces required for this are firmly reserved. With free storage space allocation, storage spaces for a loading unit are used as soon as they become available. For the use of free storage spaces, it is irrelevant which article was previously stored in the particular location.

By reserving locations for certain articles, fixed storage space allocation must leave spaces free. Consequently, other articles cannot be stored there. The fixed storage area allocation makes sense, for example, in the staging area of picking zones. In the case of a fixed storage area allocation within defined zones, only as many zones as necessary should be created. Otherwise, the space required can be very high. The advantage of fixed storage areas is that the storage location can be determined quickly and without the need for warehouse management systems.

A warehouse management system is required for space management with free space allocation. The advantages of free allocation are shorter distances and the best possible use of storage capacity, as it is not necessary to reserve storage space. When goods are put away, the first free spaces can be used directly without having to drive through the entire warehouse to reach the storage area designated for this purpose.

Equal Distribution Strategy

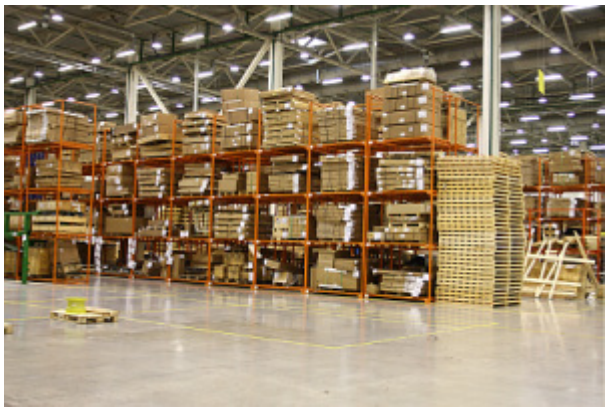
Another strategy that can be used to occupy a warehouse is the equal distribution strategy. In this strategy, identical articles are distributed to different aisles, so that each aisle can be used to access the respective goods. In which storage space and in which storage zone units are located depends on the respective target of the allocation strategy. Each strategy, therefore, pursues a different objective. The goal of the equal distribution strategy is to ensure maximum access reliability.

Storage Space Adaptation

If the warehouse is filled according to the storage space adaptation strategy, this means that the storage locations are filled with units according to their capacities. Small storage spaces are therefore occupied with small storage units and low stock of articles and large storage spaces with large storage units and a high stock of articles.

Single-Article Vs Mixed-Article Space Allocation

Homogenous article space allocation is characterized by the fact that storage areas with several bins can only be occupied with loading units of the 'same' articles. Homogenous items are, for example, T-shirts or bicycle frames in the same size. In the warehouse management system, the articles can be marked as 'same articles' employing of an identification number or a barcode. In contrast, when storage spaces are occupied with mixed articles, the storage positions are occupied with units of different articles.



Homogenous-article and mixed-article space allocation are classic allocation strategies. Mixed-article can be regarded as a stopgap solution, but it is often standard in e-commerce warehouses, where WMS systems are used that operate automatically. This storage method is implemented at Amazon, for example, and is called chaotic stock-keeping or random warehousing; it is one of the dynamic storage techniques.

Despite the term 'chaotic', this storage technique is also subject to certain rules, which are determined individually (warehouse-dependent). The benefits include increased space utilisation and more efficient and faster processes (e.g. when stocking the warehouse); in addition, financial accounting, purchasing processes and the handling of customer orders are simplified. However, this requires a high degree of discipline in booking and an absolutely reliable, automated merchandise management system; the acquisition costs are correspondingly high.

However, more stock movements take place in a mixed-article allocation, which results in higher equipment requirements than in homogenous-article space allocation. After all, in mixed-article storage, loading units of one article may first have to be moved to reach the loading units of another article. So that no problems arise in the management of the storage bins, the mixed-article space allocation has increased planning requirements.

Minimisation of partial storage spaces

Depending on whether the goal is transportation optimisation or area minimisation, the system determines in which storage space and zone units are located. It can happen that the available room in a storage space is not sufficient. In this case, the goods are then distributed to several storage spaces and so-called partial storage spaces are created. Loading units that are located in storage compartments that are not fully stocked are removed from storage first. This allocation strategy is intended to improve the fill level in multiple-article storage spaces in a warehouse and to prevent more than one storage bin per article from being opened.

Summary

An allocation strategy determines how the functional areas of a warehouse are arranged. It also affects what services can be provided in a warehouse and what costs are incurred; the allocation strategy is thus intended to reduce investment and operating costs. Correct planning and allocation of a warehouse are not only essential in terms of optimisation. If an incorrect allocation strategy is used, poor warehouse operation can be expected. For example, lack of space, low filling level, bottlenecks in storage and retrieval as well as poor space utilisation can disrupt the material flow and all processes linked to it

5.6 Stock Keeping Unit Determination

A Stock Keeping Unit or SKU is a number that is assigned to a product for the purpose of inventory management and ease of tracking. In other words, a stock keeping unit is a unique identifier assigned to each product for easier and more efficient record-keeping.

What are SKU codes used for?

SKU codes are for the identification and tracking of products. They are absolutely mission-critical in any warehouse, manufacturing or retail environment because they simplify the act of inventory management and analysis by ensuring that your people speak with a common language. There can be no confusion over what make, model, brand or specification of a product a customer ordered, because there's only one code for every permutation.

SKU examples

SKUs are alpha-numeric codes, that is, they use both numbers and letters. They are designed to be legible by humans at a glance (unlike a UPC) and offer important information. For example:

- A blue, cotton T-shirt, size medium: T-COT-MED-BL
- A 1kg jar of chocolate peanut butter: PB-1KG-CHOC
- An A/C condenser made by "Air Co.", part number 3369, designed for a Toyota car: AICO-ACCON-3369-TOY

The Importance of SKUs

Stock keeping units are highly important and commonly used by retail stores, warehouses, and product fulfilment centres. Stock keeping units have many key uses, such as the following:

i. Identifying a specific product
ii. Tracking inventory to know how many of a specific product is available
iii. Helping reconcile stock levels of products
iv. Identifying shrinkage in inventory
v. Determining which products are the most profitable (through analysis)
vi. Helping identify reorder point for products
vii. Helping customers save time by enabling them to find products quickly

Best Practices in Determining SKUs

Keep them simple, and your own

First, SKUs should be simple. Avoid making them too long or complex to read; they're meant to be digestible at a glance. This is why they utilise both numbers and letters as opposed to just numbers, so the information is clear. Second, avoid copying your supplier or manufacturer's codes where possible. It will cause confusion in future. Develop your own internal language.

Keep it consistent

When developing your language, bear in mind that you'll want to stick with it for some time. In order to be effective, SKU codes need to be consistent with each other, so you won't want to change them in future.

Be wary of certain characters

Characters like 0 and O look very similar in certain fonts, as do lower-case L and upper-case I. Try to avoid using them unless they are within a clear context. Generally, you would avoid using them on their own. Special characters such as / or , @, #, ! and so on should also all be avoided, for both clarity and because they may not format correctly in some software.

5.7 Goods Preservation

Preservation of goods in store is purely dependent on the nature of goods. The preservation of cement would be different from computer CPU because nature of product is different. For example -CPU is to be protected from dust, high temperature and moisture although there is no expiry date. Contrary, for cement which has to be used within one year and it is highly hygroscopic hence it needs to be protected from humidity and avoid lump formation.

Some common rules for preservation include;

- adherence to stacking norm to avoid the stress
- adherence to follow FMFO to avoid expiry
- Proper packing to avoid damage
- Whether protection - Temperature and moisture control
- Dust proofing
- Insect proofing
- Pest control
- Proper segregation to avoid mixing

5.8 Replenishment Processes

Another activity carried out in warehouses is replenishing stock. In this process, a warehouse employee transfers product from a storage position to a given pick position. Replenishment is carried to ensure that SKUs are removed from the assigned storage area on schedule and in the proper quantity. These SKUs are then placed in the correct SKU stock position to help ensure a constant

availability of stock at a given stock position. Replenishment activities include listing SKU positions in warehouses that require replenishment, withdrawing the product from the storage position, and transferring or placing the SKU in the SKU pick position.

5.9 Learning Activities

Visit any warehouse close to you and record the following and their functions:

1. Location storage system in use
2. Warehousing equipment in use
3. Storage space allocation techniques
4. Goods preservation system in place

5.10 Self-Assessment Questions and Activities

1. Distinguish between the following terms;
    a. Warehousing
    b. Storage
    c. Replenishment
2. Storage location systems are normally categorized in fixed and random location systems.
    a. Give the advantages and disadvantages of each location system;
    b. With justifications, recommend the best storage location system for a distribution centre with fast moving goods.
3. Mention five (5) common storage equipment and give examples of goods that could be stored with such equipment.
4. What major attributes would you consider when allocating storage space in a warehouse?
5. Stock Keeping Units are an important aspect in storage of goods, assuming you are tasked to develop and determine SKUs in your warehouse, discuss the best practices that you would base on to accomplish this task.
6. Mention any five goods that would require preservation in a warehouse. What methods would you use to preserve the mentioned goods?
7. Using relevant examples, briefly explain how technology can be used in the replenishment of goods in a warehouse.

5.11 References

- Ghalehkhondabi, Iman & Masel, Dale. (2018). Storage allocation in a warehouse based on the forklifts fleet availability. Journal of Algorithms & Computational Technology. 12. 174830181876113. 10.1177/1748301818761130.
- S.A. van Heerden & J.H. van Vuuren. (2018). Optimisation of Stock Keeping Unit Placement In A Retail Distribution Centre. South African Journal of Industrial Engineering August 2018 Vol 29(2), pp 74-91
- Hilmola, O. P. and Lorentz, H (2010). Warehousing in Europe- Northern actor perspective. European Transport. 45, 15-33
- Żuchowski W., 2019. Attempt of warehouses classification from the future users point of view. LogForum 15 (2), 249-254, http://doi.org/10.17270/J.LOG.2019.330
- Berg, Jeroen & Zijm, W. H. M. (1999). Models for warehouse management: Classification and examples. International Journal of Production Economics. 59. 519-528. 10.1016/S0925-5273(98)00114-5.
- UNHCR (2013), Standard Operating Procedures for Warehouse and Inventory Management in UNHCR, Version 1.0
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Warehousing Operations Certification Track. LINCS in Supply Chain Management Consortium. March 2017. Version: v2.28. www.LINCSeducation.org.

6.0 PACKAGING AND REPACKAGING GOODS

6.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Distinguish Packing, Packaging and Stacking
ii. Discuss the factors to consider in selecting packing and packaging materials
iii. Identify goods for packaging and repackaging
iv. Identify the types of packages
v. Utilize packaging, Stacking and loading systems and equipment
vi. Use the appropriate order management system
vii. Make an order for consolidation

6.2 Packing, Packaging and Stacking

Packing

Packing consists of combining all the items in a sales order together and getting it ready for shipment. This process involves packing the items in a suitable container, weighing the packed order, printing relevant labels, and selecting the right courier service to complete your delivery.

Packaging

The packaging is a process of designing and manufacturing container for protection and also for display. The difference between packing and packaging is that the **packing** provides the protective wrapping of goods to transport but do not display the products. **Packaging** used for the protection of goods but also display it for the retail market.

Stacking

Stacking literally means to arrange a number of things in a pile, typically a neat one. In warehousing there are different types of stacking, these include;

- Single stacking
- Block Stacking,
- Pallet-less stacking

Single stacking

Single stacking is most commonly practised method at a warehouse for the storage mechanism due to its meagre setup costs and flexibility. In this method, pallets are stored and handled directly on the floor space instead of dedicated storage equipment. Single stacking typically serves the purpose of storing goods that are high in value and require special attention throughout the storage period, to prevent any damage or contingency, resulting in significant losses. Single stacking is one of the oldest forms of storing high-value goods and only involves a 'single' row of pallets or cartons covering a flat surface.

Double Stacking or Block Stacking

Double stacking or block stacking ventures the utilization of the vertical space available after the first layer of stacking. Although, the height up to which one can stack entirely depends on the material each block is holding. Various factors come into play while planning to implement block-stacking at a warehouse facility. Factors such as crushability, load weight, load stability, pallet conditions, safety factor, weather conditions, and allowable clearance heights are keystone components that require to be studied before determining stack levels for your goods. Double stacking or block stacking is an effective method if it goes in sync with the goods that need to be stacked.

Pallet-less stacking

Pallet-less stacking is a process that aims at the complete removal of pallets for the storage of goods. The method involves utilizing the floor space and stacking cartons or crates one over the other. Stacking one box over the other enables the usage of vertical space. Pallet-less stacking also allows one to store goods based on the order.

6.3 Factors to Consider in Selecting Packing and Packaging Materials

Value of the goods

High-value consignments usually attract more expensive packaging than low-value mechanism packing but this will also depend on the nature of the commodity. High-value consignments such as valuables, paintings, etc. require adequate security and attract high freight rates.

Nature of the transit

Here we consider the type and the length of the transit. We must also take into consideration the form of transport to be used during transit (e.g. road, rail, deep sea, short sea and air). All these different modes of transport have varying characteristics which make varying demand of the packaging of the

goods. For example, train ferries and Roll On/Roll Off (RORO) consignments require modest packing but much depends on the delivery arrangements and the degree of elaborate packing needed.

Nature of the cargo

This factor, together with the nature of the goods, are two major factors which determine the type of packing of an individual's consignments. Cargo shipped in bulk requires little or no packing while general merchandise needs adequate packing. For example, apples can be consigned in cases, boxes, cartons, etc. Cement, on the other hand, may be shipped in ply paper bags or containers. Motor vehicles can be delivered unpacked. Grains, ores and coal are oil shipped in bulk. Electrical equipment can be packed in wooden cases and are usually conveyed by air. Computer equipment also fall under this category.

Customs law requirements

This is particularly relevant to dangerous cargo where strict regulations apply both by air and transport concerning the carrier's acceptance, packing, stowage, documentation, marking a carrier's liability. In most countries straw containers are unacceptable forms of packing due to the risks of poor cleaning. Raw-materials such as word products, rice husks and similar plant materials may not be used as packing material or damage materials. This ensures that all packing materials are free from soil and contamination. Also animal products which can harbour pests are not supposed to be used for packaging purposes if the exporter uses wood for packing. It is advisable to have it suitably treated before use.

Re-sale value of the packaging material in the importer country

In some developing countries large drums, wooden cases, bags have a modest resale value. This also applies to containers which can be sold after the commodity has been delivered. This helps to offset the packing costs.

General fragility of cargo

The move fragile the cargo becomes, the greater the degree of packing required. This is very much related to the mode of transport particularly air flight which has put limited packing limits.

Variation in temperature during the course of transit

Temperature variation can be quite expensive during transit and packing needs must take into account the temperature factor. Packing should be made in such a way that the cargo is given a breathing space and it should aim at avoiding extensive condensation and sweating.

Insurance-accepting condition

Cargo which is particularly fragile or which has a bad record in terms of damage and pilferage may be subject to a prescribed packaging specification by an insurance company. Otherwise, the insurer may refuse to cover the cargo at a competitive cargo insurance premium.

Ease of handling and stowage

That is to say a particular way of packing goods may not favour quick and easy handling. This goes particularly to awkwardly shaped cargo which inconveniences the packing speed, handling and storage. In addition, some cargo of awkward shape may attract additional packing and handling charges and in some circumstances shipping freight rate. Further still, such cargo is more vulnerable to damage and can attract high cargo insurance premiums.

The size and the weight of cargo

Basically there are three main considerations to be observed when determining the form a package should take and this includes size, shape and strength.

(a) The size of the package — This should be governed by the size of the marketable unit e.g. a loaf of bread and a packet of cigarettes. Some products are packed in small packets so as to allow an average consumer to have access to that product e.g. ladies' perfumes.

(b) The shape of the package — This is determined to a large extent by the goods to be enclosed within the package.

(c) The strength of certain products — Some products by their very nature need protection by the package e.g. eggs. On the other hand, some products lend support to the package materials.

Marketing Consideration

A more of a riding consideration for consumer goods and industrial products is that the package should fit into the overall market concept. On a company's strategic level, it must enhance and reinforce the company's image with the customer.

It should aim at putting across some few cardinal points e.g. the nature, the price and the advantages of the product. Packaging should also endeavour to generate further sales with the same customer by performing satisfactorily while the product is in use. Additionally, one must bear in mind any advertising motives to be accommodated in packaging.

Facilities available at the terminals

The terminals are airports, sea ports, warehouses, frontier ports, etc. Lifting equipment at some sea ports and particularly airports may be limited in capacity. Accordingly, therefore, the shipper may be compelled to dispatch his/her packages into parts instead of one integral unit. Not all ports or airports have customs clearance facilities and this could lead to an alternative terminal with differing equipment and capacity.

Type or size of the container

The container can be aircraft, train, ferry, wagon or any other transport unit. The size and the general nature of transport unit will influence the dimension of the package, and its maximum weight and shape.

Marking of Cargo

When packaging products, one should consider the type of marking he/she is to make. Some packages need to be marked on all sides and therefore packaging should provide for this. Sometimes some packaging materials may not favour a particular way of marking.

The Cost of Packaging

This is becoming increasingly important in designing the type of packaging ways. The exporter is constantly exploring means of reducing packaging costs and improving packaging techniques. Packaging therefore is not only designed as a form of protection to reduce the risk of goods being damaged in transit, but also preventing pilferage and aid marketing.

Secure and Durable

While all packaging should be reasonably strong, the amount of protection needed will of course, depend on the fragility of your product. If you're selling food items for example, freshness is a top priority. Things like bread, vegetables, sliced meats, and baked goods must be contained, so that they don't oxidise and age faster than necessary. Vacuum sealers are a good choice because they remove the air and hold the product securely in place.

Affordable and Easy to Use

The more complex the packaging, the longer it will take you to prepare products for sale. Customers aren't too fond of overly fussy packets either, so keep things simple with heat-sealed 'pull open' bags and clear, unobtrusive shrink wrap. If the packaging isn't integrated with your branding or brand design, make sure that it doesn't interfere with or disrupt it. This is particularly vital when it comes to things like book covers, which need to be protected in a way that doesn't obscure any important details.

Always Widely Available

Packaging supplies are one of those things that you'll run out of from time to time. While sales figures will give you a good idea of what to buy and how much, there's no real way to predict if or when you'll experience a spike. For this reason, we recommend working with the same packaging supplier every time. Build up a trusted relationship, so that availability is always guaranteed and you're never struggling to find a manufacturer that can meet your demands.

Eco-Friendly and Legally Compliant

There is also need to check that your packaging supplier is adhering to all of the necessary state and national environmental laws. Use quality materials, so that more strength, more security, and more protection can be enjoyed with less of an impact on the environment.

6.4 Identifying Goods for Packaging and Repackaging

Repackaging is a type of value-added service that takes place whenever a change or reconfiguration needs to be made to a product. Most 3PL warehousing and distribution providers offer some level of repackaging, though not all do so for the same reasons. One of the more common reasons for repacking a product is to move it into your company's personal branded packaging rather than use what the manufacturer sends it in. Other possible reasons can include making adjustments based on unique customer requests or to make a change to any pre-assembled kits your warehouse makes use of. Repacking procedures are not limited to just adjusting a parcel's contents, however. The process encompasses a few related tasks that can be of vital importance for maintaining accountability or the integrity of the product itself. For instance, any goods that are temperature-sensitive will

require proper and careful monitoring during the repacking steps in order to prevent spoilage or damage. Effective tracking and labelling is going to be required for repacking as well in order to make sure unit numbers, cartons per case, and other potential details are accurately reflected.

6.5 Types of Packages

Packaging Categories

Packaging may be looked at as being of several different broad categories: by transport, by type of product, and by layer/function.

Categorisation by Transport/ Distribution

A transport package or distribution package can be the shipping container used to ship, store, and handle the product or inner packages. Some identify a consumer package as one which is directed toward a consumer or household.

Categorisation by Type of Product

Packaging may be described in relation to the type of product being packaged: medical device packaging, bulk chemical packaging, over-the-counter drug packaging, retail food packaging, military material packaging, pharmaceutical packaging, etc.

Categorisation by Layer/Function

It is sometimes convenient to categorise packages by layer or function: **primary**, **secondary**, etc. **Primary packaging** is the material that first envelops the product and holds it. This usually is the smallest unit of distribution or use and is the package which is in direct contact with the contents. **Secondary packaging** is outside the primary packaging, perhaps used to group primary packages together. **Tertiary packaging** is used for **bulk handling**, **warehouse** storage and **transport** shipping. The most common form is a **palletised unit load** that packs tightly into **containers**.

Types of Packaging Materials and Techniques

Many goods have little or no form of packaging and are carried loose. These include iron and steel plates, iron rods and steel rails. Such cargoes are generally weight cargoes. We also have heavy vehicles, locomotives and buses which are also carried loose because of impracticability of packaging and high cost of packaging as well.

Packaging materials/techniques are of two categories: traditional packaging and modern packaging.

Traditional Packaging Techniques

Some of the types of traditional packaging materials include the following:

Baling

This is a form of packing consisting of a canvass cover which is often cross locked by metals or ropes. It is most suitable for paper, wool, clothes, cotton, carpets, etc. Basically, it is a cheap effective form of packing which aids handling. It also affords limited protection to cargo.

Bags

Bags made of jute, cotton mastic or paper are also a cheap form of packaging and are ideal for a wide variety of products such as cement, fertilisers, flour, animal feeds and many consumer products. Their prime disadvantage is that they are subject to sweat, leakages or breakages. The bags can be stacked on pallets to facilitate handling.

Metallic and plastic barrels

Examples of barrels are drums which are used for conveying liquids and greasy products. The main problems associated with this type of packaging are likelihood of leakage if the unit is not properly sealed and the possibility of the drum becoming misty during transit. Acids can be carried in plastic drums and bottles. Such a form of packaging can have a resale value in certain overseas countries.

Wooden boxes/cases and metal lined cases

These are used excessively in international trade. They are an expensive form of packaging but they have a resale value in certain overseas countries. This form of packaging gives complete protection, lessens the risk of pilferage and also aids handling. Basically, this form of packaging is modern in construction and varies in size and capacity. It is particularly prominent with surface transport and used for transporting machinery and other expensive equipment. However, it is becoming less popular as the cost of timber has risen sharply in recent years and containerisation has lessened the need for such packaging.

Glass containers

These are enclosed in metal baskets and have a limited use. They are primarily employed for the carriage of acids and other dangerous liquids transported in small quantities. They are a packing form primarily found in sea transport.

Cartons

These are a very common form of packaging in all modes of international distribution involving particularly consumer products e.g. salt, biscuits, soap, etc. Cartons may be constructed of card boards, straw boards or fibre boards. This form of packaging is very much on the increase as it is relatively cheap and aids marketing, handling and stowage. It is particularly ideal for containerised and palletised consignments. One disadvantage with this form of packaging is its susceptibility to pilferage. It is a very flexible form of packaging and therefore prevents breakages which may occur if rigid containers are used.

Crates

Crates or skeleton cases are a form of packaging for such goods as light weight goods of larger cubic capacity (e.g. machinery), domestic appliances (e.g. refrigerators), and sauce pans. Food stuffs such as oranges are suitable for this form of packaging.

New/Modern Packaging Techniques

New packaging techniques have emerged in recent years. Some of them are the following:

Bulk liquid bags/containers

A bulk liquid bag can be used to accommodate various types of liquid cargo. When it is not in use, it can be folded to 2% of its volume. It costs about one sixth (1/6) of the price of the steel drum and one quarter (1/4) of the price of the tank container. Each bulk liquid bag can carry a volume of liquid cargo of about 210 litres.

Shrink wrapping

This is very popular with air freight consignments whether conveyed by air or surface transport. This is a form of packing whereby goods are placed on a base usually a pallet and covered with a film of plastic. This packaging aids handling. It is a relatively cheap form of packaging particularly in relation to timber and fibre board cartons. It gives rigid protection to the cargo and it is widely used.

6.6 Packaging, Stacking and Loading Systems and Equipment

Types of packaging machines

A choice of packaging machinery includes a lot of factors. These include:

- Technical capabilities
- Labour requirements
- Worker safety
- Maintainability
- Serviceability

Packaging machines may be of the following general types:

i. Blister packs, skin packs and Vacuum Packaging Machines
ii. Bottle caps equipment, Over-Capping, Lidding, Closing, Seaming and Sealing Machines
iii. Box, Case and Tray Forming, Packing, Unpacking, Closing and Sealing Machines
iv. Cartoning Machines
v. Cleaning, Sterilizing, Cooling and Drying Machines
vi. Converting Machines
vii. Conveyor belts, Accumulating and Related Machines
viii. Feeding, Orienting, Placing and Related Machines
ix. Filling Machines: handling liquid and powdered products
x. Inspecting, Detecting and Check weigher Machines
xi. Label dispensers Help peel and apply labels more efficiently
xii. Package Filling and Closing Machines
xiii. Palletising, Depalletising, Unit load assembly
xiv. Product Identification: labelling, marking, etc.
xv. Shrink wrap Machines
xvi. Form, Fill and Seal Machines
xvii. Other speciality machinery: slitters perforating, laser cutters, parts attachment, etc.

6.7 Order Management System

A number of steps are involved in the process of order management, the knowledge of which is

essential for customer order fulfilment. The steps are as follows:

- **Product Inquiry** — In this step, the customer makes an initial inquiry about the product or visits the supplier's website or requests a catalogue.
- **Sales Quote** — In this step, a budgetary or availability quote is made.
- **Order Configuration** — In this step, ordered items need selection of options or order lines need to be compatible with each other.
- **Order Booking** — This step involves the formal order placement or closing of the deal (issuing by the customer of a **Purchase Order**).
- **Order Acknowledgment/ Confirmation** — In this step, it is confirmed that the order is booked and/or received
- **Invoicing/Billing** — In this step, the commercial invoice/bill is presented to the customer.
- **Order Sourcing/Planning** — In this step, the source/location of item(s) to be shipped is determined.
- **Order Processing** — This is the step where the distribution centre or warehouse is going to fill the order (i.e. receive and stock inventory, pick, pack and ship orders).
- **Shipment** — This step involves the shipment and transportation of the goods.
- **Delivery** — This step involves the delivery of the goods to the consignee/ customer.
- **Settlement** — In this step, the payment of the charges for goods/services/delivery is made by the customer.
- **Returns** — In this step, in case the goods are unacceptable/not required, they are returned to the supplier.

6.8 Order Consolidation

Order consolidation is the process of shipping a number of individual orders together. Shipments going to the same destination are grouped and shipped together in order to save costs and time. Instead of going through the hassle of organizing different shipping solutions for each parcel, you can put all individual parcels in the same purchase order and send them together. Then, you can send an Advanced Shipping Notice (ASN) to the buyer to inform them of their order consolidation. Your parcels will be combined with parcels from other brands and companies to be sent to their destination country; once they arrive, they will be passed onto local couriers for last-mile delivery.

Consolidation Strategies

According to existing literature (Hall (1987); Higginson and Bookbinder (1994); Ghiani et al. (2004)), consolidation strategies could be achieved in three ways. The first one is a vehicle or multi-stop consolidation (over stops), where small load shipments are picked up and dropped off along the multi-stop route by the same vehicle so that combined big loads could maximize the capacity of the container or truck. For this problem, some operational issues, such as how to route trucks and how to assign shipments into trucks or containers, need to be taken into account. The second one is inventory or temporal consolidation (over time), where the current shipments are held to wait for future shipments. By waiting for one period or multiple periods, the total combined load could be shipped using one container or one truck so as to save multiple separate LCL or LTL costs. Two fundamental operational issues in this area are (1) when to dispatch a vehicle so that service requirements are met, and (2) how large the dispatch quantity should be so that the scale of economies are realized (Cetinkaya (2005)). The third consolidation strategy is terminal or facility consolidation (over space), where the small shipments among several facilities are transported over long distances to the transshipment centre to consolidate into larger shipments. For this problem, some tactical and operational decisions on hub locations, hub service areas and vehicle routing are needed to optimize for better system performance.

6.9 Learning Activities

1. Consider an international manufacturing company supplying domestic end users in a destination country of your choice; examine the packaging requirements and issues to get goods from source to end user. Use this example to explain in no less than 600 words how the different packaging and packing materials have changed in recent years.
2. Read Case Study 1 in the Appendices and Answer the questions provided.

6.10 Self-Assessment Questions and Activities

1. Distinguish between Packing, Packaging and Stacking
2. Discuss the factors to consider while selecting packing and packaging materials
3. Using relevant examples provide the different types of packages and their inherent advantages.
4. You have been hired as a consultant to advise an inefficient warehousing company, prepare a brief report advising the company on the most appropriate packaging systems as well as stacking and loading equipment.
5. Briefly explain the major elements in a good order management system
6. What benefits and challenges are associated with order consolidation?

6.11 References

- Ghalehkhondabi, Iman & Masel, Dale. (2018). Storage allocation in a warehouse based on the forklifts fleet availability. Journal of Algorithms & Computational Technology. 12. 174830181876113. 10.1177/1748301818761130.
- S.A. van Heerden & J.H. van Vuuren. (2018). Optimisation of Stock Keeping Unit Placement In A Retail Distribution Centre. South African Journal of Industrial Engineering August 2018 Vol 29(2), pp 74-91
- Hilmola, O. P. and Lorentz, H (2010). Warehousing in Europe- Northern actor perspective. European Transport. 45, 15-33
- Żuchowski W., 2019. Attempt of warehouses classification from the future users point of view. LogForum 15 (2), 249-254, http://doi.org/10.17270/J.LOG.2019.330
- Berg, Jeroen & Zijm, W. H. M. (1999). Models for warehouse management: Classification and examples. International Journal of Production Economics. 59. 519-528. 10.1016/S0925-5273(98)00114-5.
- UNHCR (2013), Standard Operating Procedures for Warehouse and Inventory Management in UNHCR, Version 1.0
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Warehousing Operations Certification Track. LINCS in Supply Chain Management Consortium. March 2017. Version: v2.28. www.LINCSeducation.org.
- Yuankai Zhang, Lijun Sun, Xiangpei Hu, Chen Zhao,.(2018)," Order consolidation for the last-mile split delivery in online retailing, Transportation Research Part E: Logistics and Transportation Review, Volume 122,2019, Pages 309-327, ISSN 1366-5545, https://doi.org/10.1016/j.tre.2018.12.011.
- Echem, M.E. and Lulu-Pokubo, E.P. (2021), "Packaging and Repackaging of Information Products and Services for Effective Service Delivery", Chigwada, J.P. and Nwaohiri, N.M. (Ed.) Examining the impact of industry 4.0 on academic libraries, Emerald Publishing Limited, Bingley, pp. 77-89. https://doi.org/10.1108/978-1-80043-656-520201016
- Crainic, Teodor Gabriel & Marcotte, Suzanne & Rei, Walter & Pawoumodom, Matthias & Takouda, Pawoumodom. (2009). Proactive Order Consolidation in the Retail Supply Chain.

7.0 PICKING OF GOODS/MATERIALS

7.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Determine picking strategies
ii. Describe picking systems and equipment
iii. Describe warehouse picking costs
iv. Prepare picking list / documentation
v. Evaluate Picking accuracy
vi. Discuss the warehouse picking best practices

7.2 Order Picking Strategies

7.2.1 Picking

Picking consists of collecting articles according to a customer's order before shipping them. Picking uses a huge amount of resources and usually takes 60% or more of the warehouse's staff to perform the process. Order picking is an important activity in a warehouse because it has an effect on the overall level of service to the customer, irrespective of whether the customer is an internal or external customer. In order to achieve an effective order picking system Rushton et al (2006) suggested the following principles should be considered:

- Picking methods and equipment must be appropriate for the application;
- Stock availability at the picking face must be maintained with effective replenishment;
- Picking stock should be concentrated into the smallest feasible area;
- Effective information systems to order pickers;
- Addressing stock rotation and other constraints;
- A performance monitoring system to address speed, accuracy and completeness of the process.

7.2.2 Picking Strategies

An order picking strategy in a warehouse defines the manner in which pickers navigate the picking area to pick items from storage locations. There are five order picking terms commonly used: discrete, batch, zone, bucket brigade, and wave picking.

- In discrete picking a picker is responsible for picking all the items in a single order during a pick-tour.
- In batch picking several orders are batched (or grouped) together and a picker picks all the items in a given batch.
- Zone picking requires that each picker is assigned to a specific region of the storage area and is responsible for picking the items in that region only.
- Bucket brigade picking, which is actually a control policy for executing discrete order picking, requires that as soon as the most downstream picker completes an order, he/she walks back to take over the order the picker immediately upstream of him/her is currently picking. The latter, in turn, takes over the order of his/her predecessor, and so on until the most upstream picker begins a new order (Bartholdi et al., 2001).
- Wave picking

Note that, in batch or zone picking, if orders are required to be picked in a predefined time-window (known as a wave), then it is referred to as wave picking.

Discrete order picking, though simple to implement, can be labour-intensive for medium-to-high throughput DCs. Moreover, bucket brigade picking is limited to applications where handing-off the items to a downstream picker is easy. It is our observation that most DCs typically do not employ these two strategies; instead they prefer to consider batch or zone picking strategies.

7.2.3 Order Picking Methods

1. Discrete Order Picking

This is the most common type of order picking because it is basic and simple to understand. When employing a discrete order picking methodology, one order-picker picks one order, one line at a time. Additionally, there is only one order scheduling window during a shift. Therefore, orders are not scheduled and may be picked at any time on a particular day.

The advantages of using this method of order picking are: simplicity, ideal for paper based picking, provides fast response time for order fulfilment and can easily track order picker accuracy. However, this is the least efficient methodology as it requires a significant amount of travel time compared to other methods and warehouse picking rates tend to lag behind many other methods listed below.

2. Zone Picking

Order pickers are assigned a specific and physically defined zone in the pick area. The picker assigned to each zone is responsible for picking all of the SKUs located in the zone for each order. In the event that an order requires SKUs that are located in multiple zones, the order is filled after it passes through each zone. This is also referred to as the "pick and pass" methodology. In zone picking there is only one scheduling period per shift. This means there is a cut-off point for orders to be queued into the order picking process and any order received after that cut-off point will get fulfilled during the next shift.

3. Batch Picking

Batch picking is when one picker picks a group, or batch, of orders at the same time, one SKU at a time. This is advantageous when there are multiple orders with the same SKU. When that occurs, the order picker only needs to travel to the pick location for that specific SKU once, in order to fill the multiple orders. The main advantage for choosing this method is reduced travel time, which increases productivity. Batch picking is often used when the typical order profile has only a few SKUs (under four) and the SKUs physical dimensions are relatively small. Just as in zone picking, batch picking requires only one order scheduling window per picking shift.

4. Cluster Picking

Cluster picking is a methodology of picking into multiple order containers at one time. The containers could either be either totes containing order batches, discrete order shippers, or discrete order totes. There are two main piece picking systems that benefit from the use of cluster picking. Among many choices for designing your warehouse picking process, this one has options that fall under either manual or automated picking options:

- Pick to cart operations, in which, a cart would be loaded with multiple totes or shippers and the picker will make one pass through the pick zone and sort to the pick containers, thereby avoiding unproductive travel.
- Vertical lift modules (VLM) or carousel operations utilizing the independent zone picking technique, the picker would setup the pick container batch, this would initiate the mechanized pick modules, and the items would be sorted to the proper pick container. This technique is used to optimize the VLM & carousel pods by limiting the number of machine cycles.

5. Wave Picking

Wave picking is very similar to discrete picking in that one picker picks one order, one SKU at a time. The main difference is the scheduling window. In discrete picking, there is not a scheduling window whereas in wave picking there is. Orders may be scheduled to be picked at specific times of the day, which is usually done to coordinate and maximize the picking and shipping operations.

6. Zone-Batch Picking

This is a combination of methods in that pickers are assigned a zone, just like traditional zone picking, however they are also directed to batch pick within their zone. Since both zone picking and batch picking have a scheduling window, then zone-batch picking does too.

7. Zone-Wave Picking

Zone-Wave Picking is a combination of methods in that pickers are assigned a zone and each picker within their zone picks all of the SKUs for all orders that are stocked in their zone, one order at a time with one scheduling window per shift.

8. Zone-Batch-Wave Picking

This is the most complex combination of all of the order picking methodologies. Each picker is assigned a zone and picks all SKUs for orders stocked in the assigned zone. Additionally, the picker picks more than one SKU at a time and there are multiple scheduling windows per shift.

7.3 Picking Systems and Equipment

Of all warehouse processes, order picking tends to get the most attention. It's just the nature of distribution and fulfilment that you generally have more outbound transactions than inbound transactions, and the labour associated with the outbound transactions is likely a big piece of the total warehouse labour budget. Another reason for the high level of importance placed on order picking operations is its direct connection to customer satisfaction. The ability to quickly and accurately process customer orders has become an essential part of doing business.

The methods for order picking vary greatly and the level of difficulty in choosing the best method for your operation will depend on the type of operation you have. The characteristics of the product being handled, total number of transactions, total number of orders, picks per order, quantity per pick, picks per SKU, total number of SKUs, value-added processing such as private labelling, and whether you are handling piece pick, case pick, or full-pallet loads are all factors that will affect your decision on a method for order picking. Many times a combination of picking methods is needed to handle diverse product and order characteristics.

Key objectives in designing an order picking operation include increases in productivity, reduction of cycle time, and increases in accuracy. Often times these objectives may conflict with one another in that a method that focuses on productivity may not provide a short enough cycle time, or a method that focuses on accuracy may sacrifice productivity.

- **Productivity**. Productivity in order picking is measured by the pick rate. Piece pick operations usually measure the pick rate in line items picked per hour while case pick operations may measure cases per hour and line items per hour. In pallet pick operations the best measure is actual pallets picked per hour. Since the actual amount of time it takes to physically remove the product from the location tends to be fixed regardless of the picking method used, productivity gains are usually in the form of reducing the travel time.
- **Cycle Time**. Cycle time is the amount of time it takes to get an order from order entry to the shipping dock. In recent years, customer's expectations of companies to provide same day shipment has put greater emphasis on reducing cycle times from days to hours or minutes. Immediate release of orders to the warehouse for picking and methods that provide concurrent picking of items within large orders are ways to reduce cycle times.
- **Accuracy**. Regardless of the type of operation you are running, accuracy will be a key objective. Virtually every decision you make in setting up a warehouse will have some impact on accuracy, from the product numbering scheme, to the design of product labels, product packaging, the design of picking documents, location numbering scheme, storage equipment, lighting conditions, and picking method used. Technologies that aid in picking accuracy include pick-to-light systems, counting scales, and bar code scanners. Beyond the design aspects of an order picking operation, employee training, accuracy tracking, and accountability are essential to achieving high levels of accuracy.

7.3.1 Piece Picking

Piece-picking methods

Piece picking, also known as broken case picking or pick/pack operations, describes systems where individual items are picked. Piece pick operations usually have a large SKU base in the thousands or tens of thousands of items, small quantities per pick, and short cycle times. Mail order catalogue companies and repair parts distributors are good examples of piece pick operations.

- **Basic order picking**. In the most basic order-picking method, inventory is stored in fixed locations on static shelving or pallet rack. An order picker picks one order at a time following a route up and down each aisle until the entire order is picked. The order picker will usually use some type of picking cart. The design of the picking flow should be such that the order picker ends up fairly close to the original starting point. The picking document should have the picks sorted in the same sequence as the picking flow. Fast moving product should be stored close to the main cross aisle and additional cross aisles put in to allow short cuts. Larger bulkier items would be stored towards the end of the pick flow. This basic order picking method can work well in operations with a small total number of orders and a high number of picks per order. Operations with low picks per order will find the travel time excessive in this type of picking and operations with large numbers of orders will find that the congestion from many pickers working in the same areas slows down the processing.

- **Batch picking / Multi-order picking. In batch picking,** multiple orders are grouped into small batches. An order picker will pick all orders within the batch in one pass using a consolidated pick list. Usually the picker will use a multi-tiered picking cart maintaining a separate tote or carton on the cart for each order. Batch sizes usually run from 4 to 12 orders per batch depending on the average picks per order in that specific operation. Batch picking systems may use extensive logic programmed to consolidate orders with the same items. In operations with low picks per order, batch picking can greatly reduce travel time by allowing the picker to make additional picks while in the same area. Since you are picking multiple orders at the same time, systems and procedures will be required to prevent mixing of orders. In very busy operations, batch picking is often used in conjunction with zone picking and automated material handling equipment. In order to get maximum productivity in batch pick operations, orders must be accumulated in the system until there are enough similar picks to create the batches. This delay in processing may not be acceptable in same day shipping operations.
- **Zone picking**. Zone picking is the order picking version of the assembly line. In zone picking, the picking area is broken up into individual pick zones. Order pickers are assigned a specific zone, and only pick items within that zone. Orders are moved from one zone to the next as the picking from the previous zone is completed (also known as "pick-and-pass"). Usually, conveyor systems are used to move orders from zone to zone. In zone picking it's important to balance the number of picks from zone to zone to maintain a consistent flow. Zones are usually sized to accommodate enough picks for one or two order pickers. Creating fast pick areas close to the conveyor is essential in achieving high productivity in zone picking. Zone picking is most effective in large operations with high total numbers of SKUs, high total numbers of orders, and low to moderate picks per order. Separate zones also provide for specialization of picking techniques such as having automated material handling systems in one zone and manual handling in the next.
- **Wave picking**. A variation on zone picking and batch picking where rather than orders moving from one zone to the next for picking, all zones are picked at the same time and the items are later sorted and consolidated into individual orders/ shipments. Wave picking is the quickest method (shortest cycle time) for picking multi item orders however the sorting and consolidation process can be tricky. Operations with a high total number of SKUs and moderate to high picks per order may benefit from wave picking. Wave picking may be used to isolate orders by specific carriers, routes, or zones.

Part to Picker

The above are all described as "picker to part" picking methods. This means the picker travels to the location in the warehouse to pick the item. There are also "part to picker" methods which involve the picker being stationary, and something bringing the item to be picked to the picker. Part to picker requires equipment such as carousels, automated storage and retrieval systems, or robots (all covered in the next section). Part to picker methods can be used in combination with Batch Picking, Zone Picking, or Wave Picking. For example, you could have zone picking or wave picking where one zone is a set of horizontal carousels, and the other zones use more conventional multi-order picking. In fact, the carousel zone would likely also be using multi-order picking.

Piece-Picking Equipment

As with the picking methods, the picking equipment used will also depend on a variety of factors.

- **Static shelving.** The most common equipment for storage in piece pick operations, static shelving is designed with depths from 12" to 24". Product is either placed directly on the shelving or in corrugated, plastic, or steel parts bins. Static shelving is economical and is the best method where there are few picks per SKU or where parts are very small.
- **Carton flow rack**. Carton flow rack is similar to static shelving with the exception

that rather than shelves, there are small sections of gravity conveyor mounted at a slight angle. Product is stocked from the rear of the flow rack and picking is done from the face. Product can be stocked in cartons or small totes or bins. As a carton or tote is emptied, it is removed from the rack and another one will roll into place. Carton flow rack is most useful where there is a very high number of picks per SKU.

- **Carousels**. Horizontal carousels are a version of the same equipment used by dry cleaners to store and retrieve clothing. They have racks hanging from them that can be configured to accommodate various size storage bins. Generally an operator will run 2 to 4 carousels at a time avoiding the need for the operator to wait while one unit is turning. Picking is usually performed in batches with orders downloaded from the host system to the carousel software. Horizontal carousels are most common in picking operations with a very high number of orders, low to moderate picks per order, and low to moderate picks per SKU. Horizontal carousels provide very high pick rates as well as high storage density. Pick-to-light systems are often integrated into carousels. Vertical Carousels are frequently used in laboratories and specialty manufacturing operations and are rarely used in regular order picking operations.
- **Automatic storage and retrieval systems (ASRS).** An ASRS is a system of rows of rack, each row having a dedicated retrieval unit that moves vertically and horizontally along the rack, picking and putting away loads. ASRS systems are available in mini-load types that store and transfer product on some type of tray or in bins, and unit-load types that transfer and store pallet loads or other large unitized loads. In addition to the automation features, ASRS units can provide extremely high storage density with capabilities to work in racking up to 100 feet high. Unfortunately the high costs of ASRS equipment and the length of the retrieval times make it difficult to incorporate into a piece picking operation.
- **Robots.** In recent years "robots" have entered the piece-pick order-picking process. Most notably have been the Kiva robots used by Amazon. These are a part-to-picker methodology, where the robots pick up racks containing inventory, and deliver them to a station where an order picker will pick what is needed from the rack. I don't think of these as true robots, they are really just automated guided vehicles with a little more sophisticated software. You still need a human to physically pick the item from the rack. These are not the only "robots' being advertised for order picking though. There are quite a few others, some are just variations on the Kiva design, while others use completely different designs and processes. I've yet to see one that can effectively pick a diverse range of small items from bins though, so in most cases these are just assisting human beings rather than replacing them. The key to evaluating robots (or any equipment investment) is quantifying the answer to "can they perform the task more cost-effectively than other options?" These systems aren't cheap. so you have to do the math.
- **Automatic picking machines.** Fully automated picking machines (such as A-frames) are still pretty rare and are used only where very high volumes of similar products are picked such as music CDs, or, where high volume in combination with high accuracy requirements exist such as pharmaceutical fulfilment.
- **Pick-to-light.** Pick-to-light systems consist of lights and LED displays for each pick location. The system uses software to light the next pick and display the quantity to pick. Pick-to-light systems have the advantage of not only increasing accuracy, but also increasing productivity. Since hardware is required for each pick location, pick-to-light systems are easier to cost justify where very high picks per SKU occur. Carton flow rack and horizontal carousels are good applications for pick to light. In batch picking, put-to-light is also incorporated into the cart or rack that holds the cartons or totes that you are picking in to. The light will designate which order you should be placing the picked items in.
- **Bar-code scanners.** Though very useful in increasing accuracy levels, bar-code scanners in a fast-paced piece-pick operation tend to become cumbersome

and can significantly reduce your pick rates. With proper training, tracking, and accountability, you can get very high accuracy rates in order picking without scanners. I find they are better suited to case pick, pallet load, putaway, and order checking operations.

- **Voice-directed picking.** Voice technology has come of age in recent years and is now a very viable solution for piece pick, case pick, or pallet pick operations.
- **Automated conveyor and sortation Systems.** Automated conveyor systems and sortation systems will be integral to any large-scale piece-pick operation. The variety of equipment and system designs is enormous.

7.3.2 Case Picking

Case-picking methods

Case picking operations tend to have less diversity in product characteristics than piece picking operations, with fewer SKUs and higher picks per SKU.

- **Basic case-picking method.** This is the most common method for case-picking operations. Rather than product stored on static shelving, case-pick operations will have the product stored in pallet rack or in bulk in floor locations. The simplest picking method is to use a hand pallet jack (or motorized pallet truck) and pick cases out of bulk floor locations however many operations will find that going to very narrow aisle (VNA) pallet racking and using man-up order selectors or turret trucks will provide high storage density and high pick rates.
- **Batch picking.** Batch picking is rarely used in case-pick operations primarily because of the physical size of the picks. You are unlikely to have enough room on a pallet to pick multiple orders.
- **Zone picking.** Zone picking can be used in case-picking operations, however, like batch picking, the size of the picks and the size of the orders in most case-pick operations do not lend themselves well to zone picking. If you do have a case pick operation where you have a large number of SKUs, and orders with small quantities per SKU, or where you have enough cases per order per zone to fill a pallet, you may find zone picking applicable.
- **Wave picking.** Wave picking can be applied to case picking operations where you have very large orders with many picks per order and are looking for ways to reduce cycle time.

Case-picking equipment

- Pallet rack. Pallet rack is the most common storage system for case pick operations.
- Flow rack. Although carton flow rack rarely applies to case pick operations, pallet flow rack or push back rack can be useful.
- Carousels. Although you can incorporate unit-load carousels into a case pick operation, it tends to be an unlikely match-up. If doing batch picking where you have many picks per SKU and few pieces per pick you can pick from an ASRS unit onto a unit-load carousel.
- Automated storage and retrieval systems (ASRS). Unit-load ASRS systems can be useful in case-pick operations, especially if you can provide storage heights of 40 to 100 feet.
- Pick-to-light. Pick-to-light can be used in case-pick operations, however, its application is significantly less than in piece pick operations.
- Bar-code scanners. Bar-code scanners are frequently used in case-pick operations. Since the time to physically pick the product is higher in case-pick operations, the time spent scanning tends to have little impact on productivity and therefore the accuracy benefits will usually outweigh any reduction in productivity.
- Voice-directed picking. Voice technology has come of age in recent years and is now a very viable solution for piece pick, case pick, or pallet pick operations.
- Automated conveyor and sortation systems. If using zone or wave picking, automated conveyor and sortation systems will likely be a part of your system. In case picking, you may use standard conveyors to transport individual cases or unit-load conveyors to transport pallets.
- Lift trucks. As previously mentioned, motorized pallet trucks, man-up order selectors, and man-up turret trucks are the vehicles of choice for case-pick operations.

7.3.3 Pallet Picking

Full-pallet-picking methods

Full-pallet picking is also known as unit-load picking. The systematic methods for full-pallet picking are much simpler than either piece pick or case pick, however, the choices in storage equipment, storage configurations, and types of lift trucks used are many.

- **Basic pallet picking.** This is the most common method for full-pallet picking. Orders are picked one at a time. The order picker will use some type of lift truck, retrieve the pallet load and stage it in a shipping area in a staging lane designated for that order, or just pick and load directly into an outbound trailer or container.
- **Batch picking.** Since the nature of pallet picking is a single pick per trip, batch picking has no application in pallet-picking operations.
- **Zone and wave picking.** Although the normal definition of zone picking where an order is moved from zone to zone as picks are accumulated doesn't apply to pallet picking, pick zones are used in wave picking in pallet-picking operations. The storage area is broken into zones to eliminate multiple lift-truck operators from picking in the same aisle. The lift truck operator may pick the pallet and deliver it directly to the designated staging lane or place it on a unit-load conveyor that will deliver it to the sorting/staging area.
- **Task interleaving.** Task interleaving is a method of combining picking and putaway. Warehouse Management Systems (WMS) use logic to direct a lift truck operator to put away a pallet en route to the next pick.

Pallet-picking equipment

- Pallet rack. There are numerous pallet rack configurations used in full pallet operations, from standard back-to-back single pallet depth configurations to double-deep rack, push-back rack, drive-in/drive-thru rack, and flow rack. The best racking configuration for your operation will be based on the total number of pallets per SKU, pallets per pick, and the length of time the product is in the rack prior to shipment. There are a lot of trade-offs in choosing a racking configuration including storage density, picking productivity, equipment costs, and the ability to maintain first-in first-out.
- ASRS. Unit-load ASRS units when combined with unit-load conveyors and sortation systems can provide fully automatic pallet picking operations. And again, the ability to store product in racking up to 100 feet high gives excellent storage density.
- Automated conveyor and sortation systems. Automated conveyor and sortation systems can be combined with ASRS units or used in conjunction with manual picking with lift trucks in zone/wave picking systems. Either the ASRS or the lift truck operator delivers the pallet load to the conveyor. The conveyor system then delivers the pallet to the shipping area where it is either manually sorted by lift trucks into the designated staging lane, or a sortation system automatically sorts into a staging lane. Staging lanes can be equipped with automated or gravity fed unit-load conveyor.
- Bar-code scanners. Bar-code scanners are very commonly used in pallet-pick operations.
- Voice-directed picking. Voice technology has come of age in recent years and is now a very viable solution for piece pick, case pick, or pallet pick operations.
- Lift trucks. The lift trucks used for pallet picking will depend upon the storage configuration. Standard lift trucks are used in bulk floor storage and wide-aisle pallet rack storage in singe-depth, push-back, drive-in/drive-thru, and flow rack. Reach trucks are used in narrow-aisle storage in single-depth, double-deep, push-back, drive-in/drive-thru, and flow rack. Swing mast and turret trucks are used in very narrow aisle storage in single depth pallet rack.

7.4 Warehouse Picking Costs

One of the main aims of every company is to reduce costs in order to increase their profits. In a warehouse where picking operations take place, the main costs involved are the following:

i. Travelling cost: it is related to the distance that the picker has to travel in order to pick

the item. Stopping cost: it is associated with the number of different picking stops, directly related to order batching problems.

ii. Grabbing cost: it is associated with the number of cartons that picks at each stop.

iii. Closing cost: it includes all the activities related to operations at the computer station.

7.5 Preparing Picking List / Documentation

Picking Slip

The picking slip lists the contents of the shipper, providing a record for the customer to match against the invoice.

A pick list

A pick list is a document sent to your warehouse pickers to fulfil a customer order. A pick list communicates the items they will need to retrieve from inventory storage, including inventory SKU, quantities and locations. As soon as a pick list is generated, the order fulfilment process can begin. A pick list allows warehouse management to keep the picking process organized by assigning orders to each picker so they always have the next set of orders queued up as soon as one is picked.

Types of pick lists

A pick list is literally a recap of the items they ordered. Any given pick list may contain a single item, or five of a certain SKU and three of another SKU. Pick lists should be clear and easy to understand. There are a couple ways to provide picking lists.

i. Physical pick lists

The old school way of generating pick lists is printing them. Before integrated software, mobile technology, and Wi-Fi were ubiquitous, warehouses would use physical pick lists and hand each pick list on a piece of paper to a picker.

ii. Digital pick lists

Digital pick lists are used when mobile devices, tablets, or laptops are used on the warehouse floor. Order details are automatically assigned and sent to each picker, where they can follow instructions on their device for a more efficient process. A digital picking list can more easily include additional information such as product images, serving as an additional quality control check and validation that the picker is grabbing the correct item.

Elements of a picking list

A pick list is a list of products that need to be packed and shipped to customers. Your pick list will include some or all of the following information:

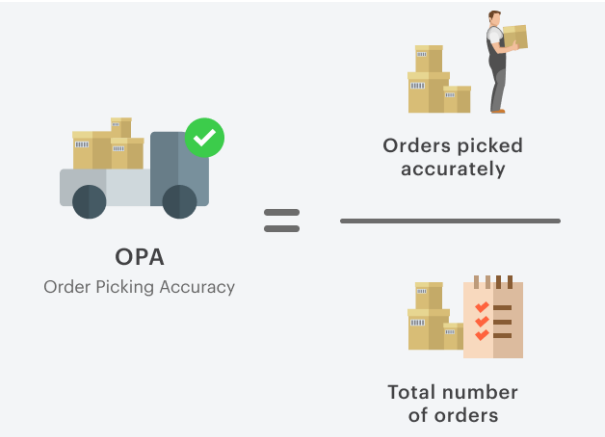
1. Product descriptions — be specific about the most important characteristics of the product (i.e., size, colour, etc.)
2. SKU number or UPC codes
3. Bar codes
4. Images of each item to be picked
5. Quantity for each item
6. Order number
7. Order date

For larger warehouses, your pick list can also include a warehouse location. Creating a system for mapping and numbering aisles and shelves within your warehouse helps workers select each product and fulfil orders more quickly.

7.6 Picking Accuracy

Order Picking Accuracy (OPA) is defined as the total number of orders picked and verified to be accurate prior to shipment divided by the total number of orders picked over the same period of time, as a percentage. Knowing the order picking accuracy (OPA) allows businesses to identify error-prone processes and take corrective actions to improve picking accuracy.

The following illustration shows the order picking accuracy (OPA) formula:



Order picking accuracy (OPA) formula

How to calculate order picking accuracy (OPA) with an example

i. You picked 1,000 orders in the month of December
ii. Out of these, 900 orders were picked accurately and 100 orders were picked incorrectly
iii. Based on this data, your order picking accuracy in the month of December = 900/1000 = 0.9
iv. Order picking accuracy (OPA) (%) for the month of December = 90%

How to increase order picking accuracy (OPA)

There are various strategies to help improve your order picking accuracy (OPA), but it is essentially done in one of the two ways:

i. Reducing number of errors through **powerful workflows**
ii. Incorporating next-gen technology for **error-free automation**

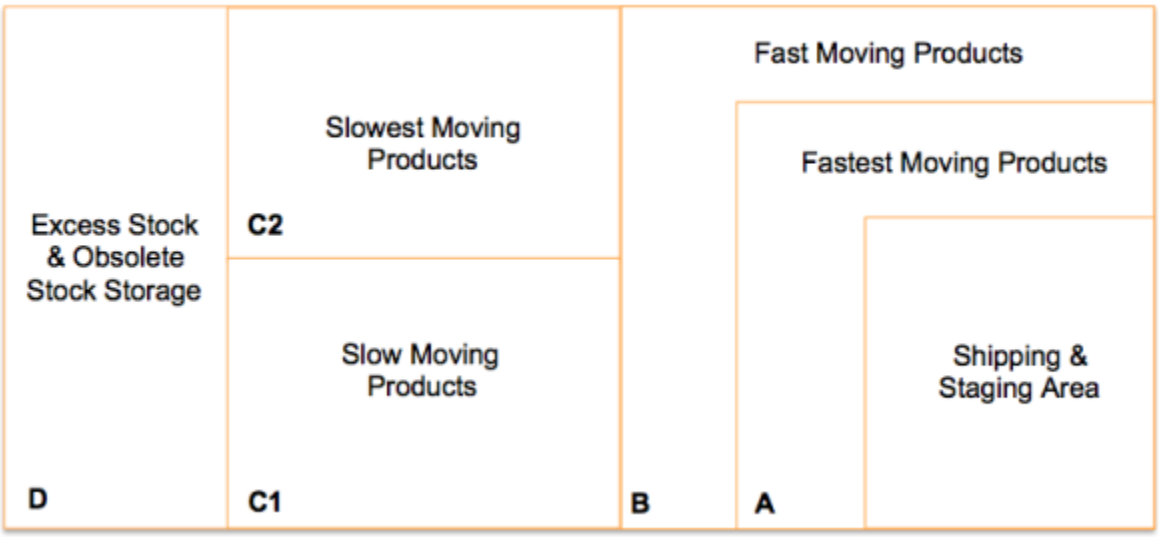
Ways to increase order picking accuracy (OPA)

Optimise your warehouse layout

The organisation of a warehouse's inventory can make or break efficiency when it comes to the picking of orders. One of the simplest ways to organise your inventory is to segment items using ABC analysis. ABC analysis basically involves grouping items based on historic purchase data and patterns.

Group A - Most frequently purchased products
Group B - Less frequently purchased products
Group C - Rarely purchased items (Dead stock and excess inventory)

This allows the picker—whether it is a human or a machine to retrieve items faster and more accurately.



Warehouse optimisation after performing ABC

Incorporate smart automation

Since humans are directly involved in the picking process, errors are likely to occur. Order pickers can spend the majority of their time moving from one point to another within the warehouse; this creates a lot of wasteful overheads. Luckily, with the advent of technology, we now have access to various tools which automate traditional warehouse operations—barcode scanners, conveyor belts, and intelligent robots are some of the tools designed to reduce workload and time spent picking orders.

Analyse errors, incentivise accuracy

You need to analyse historic operational data to identify error-prone aspects of your operation and take corrective actions with laser-like focus. Another strategy adopted by warehouse management is to use positive reinforcement to improve productivity. For example, the picker with highest accuracy is eligible for a bonus.

Benefits of Improving Order Picking Accuracy

- **Accelerate profitability**
  Order picking accuracy (OPA) is directly proportional to profitability; the more number of orders you deliver accurately, the lesser number of returns and **by extension**, lesser costs incurred.
- **Reduce errors**
  By improving order picking accuracy (OPA), businesses can avoid unnecessary errors. Mistakes while picking lead to incorrect deliveries of orders, create inefficiencies in warehouse operations and force businesses to bear additional expenses.
- **Improve customer retention**
  Modern-day customers need their orders to be delivered accurately, and they have little or no tolerance for errors. Consistently delivering orders accurately will allow customers to blindly trust your brand, this leads to higher customer retention.

7.7 Warehouse Picking Best Practices

Some of the best practices in order picking include;

Conduct ABC Analysis/Order Profiling

The first recommended step is to collect data to understand how efficiently or inefficiently we are managing inventory. One of the best ways to do this is by conducting an ABC analysis and/or order profiling. An ABC Analysis allows a warehouse manager to classify cargo into three categories (ABC) based on order volume. The idea here is to organize inventory such that the highest volume inventory (A) is stored toward the front of the warehouse, while the lowest volume inventory (C) is moved to the back. The result: less walking time and fewer man-hours required to complete picking operations. For warehouses and distribution centres that do not process customer orders, an ABC analysis can be done based on receiving and shipping volumes.

Automating Your Picking Process

A lot of innovations have taken place in the warehouse and distribution industry. Automated picking through computerized forklifts or cranes allow for increased accuracy and less travel time around warehouses to look for orders. Order pickers consume about 60 percent of their time walking product or moving product around. Installing conveyor belts can increase picking speed. You can eliminate wasted steps and reduce errors by setting up a mobile workstation with a power pack that allows the picker to create labels and to follow a guided route displayed on a computer.

Minimizing Travel Time to reduce Errors

Reducing travel time increases order picking productivity. This is the reason why batch and cluster order picking techniques are used in warehouses and why warehouses have conveyor belts installed. As previously stated, travel time can make up 60 percent or more of order picking hours. You can reduce worker movement around warehouses by grouping orders into a single travel occurrence. Other ways to reduce travel time can be letting order pickers pick from both sides of the aisle, with the use of small pick facings or by storing slow-moving items on side aisles, which are only entered when necessary. A physically tired warehouse worker is more susceptible to making a mistake. Decreasing the amount of walking needed can benefit your warehouse in the long run.

7.8 Learning Activities

1. Umoja Warehousing Services has the following items in stock.

Stock Number	Annual $ Volume	Percent of Annual $ Volume
J24	12,500	46.2
R26	9,000	33.3
L02	3,200	11.8
M12	1,550	5.8
P33	620	2.3
T72	65	0.2
S67	53	0.2
Q47	32	0.1
V20	30	0.1
Total		100.0

Required:

Determine the appropriate ABC groups of inventory items for Umoja Warehousing Services.

2. Read Case Study 2 in the Appendices and Answer the questions provided.

7.9 Self-Assessment Questions and Activities

1. Compare any two order picking strategies; be certain to include the advantages and short comings associated with each strategy.
2. In no more than 1000 words write a short paper identifying the most common picking systems and equipment.
3. You have been selected to be part of a warehouse performance evaluation team. You are required to prepare a document identifying the causes of warehouse picking costs and recommending the stop gap measures to reduce the costs.
4. Describe five (5) documents required for the picking process.
5. Which factors could affect picking accuracy in a large warehouse? How can picking accuracy be improved?
6. You have been invited to an international conference on warehouse management. Prepare a short paper on warehouse picking best practices

8.0 References

- Habazin, Josip & Glasnović, Antonia & Bajor, Ivona. (2017). Order Picking Process in Warehouse: Case Study of Dairy Industry in Croatia. PROMET – Traffic & Transportation. 29. 57. 10.7307/ptt.v29i1.2106.
- Pratik J. Parikh, Russell D. Meller, (2006) Selecting between batch and zone order picking strategies in a distribution centre, Transportation Research Part E 44 (2008) 696–719
- Che-Hung Lin, Iuan-Yuan Lu, (199) The procedure of determining the order picking strategies in distribution centre, International Journal of Production Economics, Volumes 60–61, 1999, Pages 301-307, ISSN 0925-5273, https://doi.org/10.1016/S0925-5273(98)00188-1.
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge.

9.0 DISPATCH OF GOODS

9.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Explain the meaning of key terms in dispatch of goods
ii. Use the dispatch documentation
iii. Use the order management system
iv. Utilise the picking, packaging and loading systems and equipment in a warehouse
v. Carry out the Order consolidation, packing and packaging
vi. Carry out the Good shipment / transportation in a warehouse

9.2 Meaning of Key Terms in Dispatch of Goods

Shipping

Shipping is the final warehouse process and the start of the journey of goods from the warehouse to the customer. Shipping is considered successful only if the right order is sorted and loaded, is dispatched to the right customer, travels through the right transit mode, and is delivered safely and on time.

Picking

Order picking is when the products listed in an order are retrieved from their respective storage arrears in warehouses.

Packing

Packing is generally the first step after picking and consolidation, and it defines the methods by which items are individually wrapped and protected for subsequent processing. Typically, bubble-wrap, tissue paper, and other protective materials are used to pack individual items.

Packaging

Packaging, on the other hand, is the process of placing in the individually packed items into a larger unit container, possibly supplemented with foam peanuts or other protective materials. This packaged container is designed to withstand rough handling, including accidental drops and other forms of mishandling.

Labelling and Marking

Marking and labelling are the practical ways to differentiate packed cargo in order to fulfil some regulations applied in the freight logistics chain. It aims at safe arrival to destination, speedy identification, compliance with official regulations, prevention of unnecessary damage, compliance with customs and other regulatory bodies. Marking and labelling is done by;

- Hand writing
- Printing
- Stencilling
- Bar coding

Marking Practice

The five essential aims of marking packages are;

- Safe arrival at destination
- Speed identification
- Compliance with official regulations
- Prevention of unnecessary damage
- Compliance with customers or other contractual requirements

Marks and labels should be simplistic and should appear appropriately on all packages. Enormous costs can be incurred in providing detailed shipping marks to meet requirements listed above, when in fact they are not really necessary to the safe arrival of goods. International bodies concerned with the simplification of international trade procedures and cargo handling, under the auspices of the United Nations, have drawn up a simpler shipping marks recommendation which they urge member nations, international bodies and those engaged in international trade to adopt. The "simpler mark" is a four – line mark consisting of;

- The buyer's initials or abbreviated name
- A reference number
- A destination
- A package number

Marks and labels must be such that they survive and remain legible and identifiable throughout the logistics cycle. Marks and labels should be fixed to the packages in a manner resistant to tear and wear or accidental removal. They should be easily visible and recognizable.

Essential details on labels

- Name and address of consignor
- Name and address of consignee
- Warnings/instructions, e.g. hazardous goods
- Product information/description/codes
- Protective service symbol, e.g. temperature, air, light, moisture,

exposure, etc.
- Special handling symbols
- Pictorial labels should be exhibited within a border and with contrasting colours.

Effects of poor marking and labelling

- Reduced efficiency/more time during order selection/sorting.
- Possible errors of delivery due to identifications problems.
- Customer dissatisfaction arising from above errors.
- Rejection in importing country
- Advertisement should not obscure or shadow package identification codes. Avoid complicated markings that are difficult to read or understand or recall otherwise the purpose will not be achieved.
- Product identification systems should be legible in warehouse storage environment and use within number of letter and number combinations necessary for identification otherwise the product/package may be misallocated. Where further marking is carried out of the warehouse, packages should have sufficient space for this and not in conflict with existing marks which would otherwise be confusing.

Consolidation

There are two types of transportation/shipment consolidation: inbound logistics consolidation system and outbound logistics consolidation system.

Inbound Logistics Consolidation System

With the inbound logistics consolidation system, the consolidating warehouse receives and consolidates materials from a number of suppliers to a specific plant on a single transportation shipment.

Outbound Logistics Consolidation System

With the outbound logistics consolidation system, materials from a number of manufacturing plants are received by the consolidating warehouses, sorted according to their destinations and then consolidated to a specific destination market.

10.0 Goods Dispatch Stages

i. Planning for Order Deliveries

Planning for the daily dispatches of goods involves the following actions:
- Know and confirm the daily orders to be prepared and issued
- Sort the list of orders to be prepared.
- Assign the orders to the transporters and indicate the time during which they are scheduled to pick up the goods.
- Schedule loading dock occupancy.
- Provide the necessary space for the goods in the temporary storage area next to the dispatch docks.

ii. Goods consolidation and sorting

- Goods consolidation consists of combining and grouping together items from different storage locations for their subsequent shipment.
- Ordinarily, an adjacent space within the dispatch area is reserved for this exercise.
- If the goods are picked in a disorganised way, good consolidation exercise may take a longer duration.

iii. Documentation and Goods conditioning check

- Goods dispatch represents the last contact between the goods and the warehouse. During this process the final documentation verification should be done in order to prevent errors and ensure that customers receive what they ordered for.
- It is important to check the various associated documents (goods receipt, picking order, delivery note, road map, waybill, etc.).
- Additionally, ensure that the goods ordered for are actually packed or palletized and well labelled. The weight and volume of the goods should be ascertained to be in line with transporters requirements.
- Other tasks that may be performed in this goods dispatch phase are the personalization of shipments (e.g., gift wrapping, in the case of certain e-commerce businesses) and the assembly of kits or packs (very common with promotional products).

iv. Loading of the goods

- Before loading the parcels onto the

corresponding truck, the following actions have to be taken:

- Verify that the truck waiting to be loaded is the right one.
- Place the merchandise on the truck, balancing out the loads. In addition, the trailer should be securely anchored to the loading docks. This is usually done using handling equipment, such as pallet trucks or forklifts, and should be carried out with great care.
- Hand the documentation to the transporter to be signed.

10.1 Optimizing the Good dispatch process

Strategies for optimizing the goods dispatch process

Some good practices for optimizing product dispatch processes include:

1. Schedule times in conjunction with the transportation service

Goods dispatch planning can be made more precise with the help of warehouse management software that can control and organize a vast amount of information and guide the team of workers in carrying out the related tasks.

A warehouse management system can group orders by: delivery route, vehicle type, customer, and shipping priority, among other categories. These parameters can be configured into the software according to the company's inventory characteristics.

The WMS also organizes orders by employing both static and dynamic picking. In the first case, organization takes place at the beginning of each working shift or day, using methodologies such as wave picking). When it comes to dynamic organization, picking and dispatch operations are adjusted as new orders are received.

2. Standardize and simplify document management

Document verification and management is one of the most important steps in the dispatch process. The main objective is to have zero errors, which is fostered by:

- Integration of the warehouse's labelling and documentation rules with those of the transporters: this perfectly streamlines the process and facilitates data processing.
- Use of the WMS with automatic assistive devices: voice picking, for example, would enable operators to load pallets and boxes with both hands and validate packages more quickly.

3. Assess automation options in the goods dispatch process

Shipments can be automated with the help of conveyors in the temporary storage or preload area. To streamline the loading of trucks with pallets, it is common to install live roller conveyors. These types of conveyors have brake rollers that maintain a constant sliding speed to ensure load stability.

10.2 Dispatch Documentation

Goods dispatch represents the last contact between the product and the warehouse. It is during this process that the final documentation verification takes place. This prevents errors and ensures that customers receive what they have ordered. To achieve this, you need to check the various associated documents (goods receipt, picking order, delivery note, road map, waybill, etc.), make sure the products ordered are those that are on the pallet or in the package, and verify all this information in the warehouse management system.

Accurate completion of despatch documentation will enable packed stock items to have the best chance of reaching customers as soon as possible after leaving the warehouse. You must make sure that all delivery documentation is complete and accurate. The most important piece of information in the set of documents is the customer's delivery address. You must provide all details of the address on the labels and paperwork. You also need to be sure of where the customer wants the goods to be delivered. The customer's mailing address may not be the same as the delivery address. The customer will indicate on the order where they want the goods to be delivered, when despatch documents are being filled in, all reference numbers on every document will need to be written accurately and clearly. The reference numbers should be the same on all related

documents, so that packed stock items can be traced if necessary. For example, the same consignment number will appear in each Consignment Note sticker, which is then placed on every pallet of goods delivered to a customer.

Goods Despatch Note (GDN) or Goods Dispatch Note is a document that is raised by the supplier's despatch department responsible of sending goods out to customers. A copy of the GDN is retained by the despatch department and one copy is sent to accounts department to process invoice to the customer. Without the GDN being sent to accounts department no invoice can be raised. In other words, goods despatch note acts as a source to generate invoice. These notes are usually sequentially numbered that helps identify any missing notes from the record.

A Pick List

A pick list is a document sent to warehouse pickers to fulfil a customer order. A pick list communicates the items they will need to retrieve from inventory storage, including inventory SKU, quantities and locations. As soon as a pick list is generated, the order fulfilment process can begin. A pick list allows warehouse management to keep the picking process organized by assigning orders to each picker so they always have the next set of orders queued up as soon as one is picked.

Delivery Note

A delivery note is a document that accompanies a shipment of goods. It provides a list of the products and quantity of the goods included in the delivery. A delivery note is also known as a 'dispatch note' or a 'goods received note'. Although they're normally printed, delivery notes can also be sent by email. Using delivery notes helps a business get a better overview of their input and output, whilst also giving their customers a way to check they have received all of the products they paid for. If anything is missing from the shipment, the recipient can quickly contact the sender, using the delivery note to inform both parties what's wrong with the delivery.

A Way Bill

A waybill is a document issued by a carrier giving details and instructions relating to the shipment of a consignment of goods. Typically, it will show the names of the consignor and consignee, the point of origin of the consignment, its destination, and route.

Goods Received Note (GRN)

Goods Received Note (GRN) is a record of goods received from suppliers, and the record is shown as a proof that ordered products had been received. The record is used by the buyer for comparing the number of goods ordered to the ones delivered. GRN is vital for various departments, primarily factory/store, procurement and finance/accounting departments. It is used for stock updates and the payment of goods obtained.

10.3 Order Management System

The order management system represents the principal means by which buyers and sellers communicate information relating to customer orders for goods. The order management system is also one of the most important components of firms' overall management information systems. The overall area of order placement, order processing, order preparation, and shipping has benefited from the enhanced computer information system technologies available today. Each component of the order cycle is described in the following section:

1. Order placement

Order placement time can vary from days (by mail) to minutes (by phone). Using the internet or EDI, order placement can take place instantaneously from customers directly to suppliers. Another example of using technology to expedite order placement is the use of hand held data entry units by company representatives to transmit order requirements directly to suppliers.

2. Order Processing

The order processing function involves checking customer credit, transferring information to sales records, sending the order to the inventory area, and preparing shipping documents. Improvements in computer and information system technologies have led to considerable reductions in the times necessary to accomplish these activities.

3. Order Preparation

Depending on the commodity to be handled and other factors, the order preparation process may be very simple and performed manually or may be complex and highly automated. Once the order is picked, it is packed and packaged to prepare for shipment.

4. Order Shipment

Order shipment includes the time it takes from placing the order on a truck for movement to the time it is received and unloaded at the buyer's destination. Measuring and controlling order

shipment can be accomplished through receivers of product being given advance shipping notice (ASN) from supplier firms. Shippers may also require proof of delivery documentation from carriers to pinpoint the exact time and location of delivery. Many firms have utilized information technology to provide services such as these. In addition, many carriers have made it easy for customers to track shipments when needed and provide these customers with summary reports of shipment times, service levels, etc.

10.4 Good Shipment / Transportation

Shipment Transportation Mode Selection

Defining package order shipment weights is important and generally the first step because the package weight is often used to determine which mode of transportation will be used to ship the product (e.g., parcel, LTL, or truckload). Additionally, the package shipment weight is often used as a key component to determine which specific transportation carrier will be used and an important variable in determining freight costs.

Additionally, different characteristics may be used to determine the mode of transportation and freight costs. For example, the size of the order (length, width, and height dimensions) dictates the mode selection and freight cost more than the weight alone. Other key determinants are used to decide the best transportation mode for a specific order. The expected customer required date of the order is also an important factor. For example, if a customer expects an order to reach their location in two days, but standard ground service takes five days, then using express parcel service may be required to achieve the deadline.

Furthermore, product characteristics (e.g., hazardous materials) may dictate using a specific mode or carrier. Exporting materials to another country will also lead to the use of specific modes, carriers, and documentation. In the case of export shipments, shipping personnel must be cautious to follow company-specific regulations regarding preparation of shipment paperwork, because paperwork for exports is more complex than for domestic shipments. Once the order weight and mode/carrier selection activities have been completed, documentation is prepared for the specific order and shipments at the shipping staging area.

A shipment and an order may require only one vehicle (e.g., when a single order to a single customer fills up an entire trailer); however, an outbound shipment from the warehouse dock may consist of multiple specific customer orders/shipments (e.g., when dozens of individual, consumer-specific case orders/shipments are loaded into a trailer for delivery through their network). Finally, temperature controls (i.e., perishable goods) and product security (company proprietary items) also need to be considered when selecting modes and carriers.

Outbound Vehicle Consolidation

Consolidating outbound vehicles is the process of collecting goods that are awaiting dispatch and allows for the preparation of individual vehicle loads. These loads are collected in storage lanes, or bays, that are immediately adjacent to the loading dock where delivery vehicles for those loads are waiting to be loaded or where vehicles will arrive.

Consolidating has the effect of buffering the flow rates of goods arriving from the order picking/packing stage against the uneven flows required to satisfy vehicle movement on dispatch. In addition to the goods received from the pick/pack operations, goods received for cross-docking will also be staged/consolidated in this area for shipment.

In general, the dispatch area is a single-level storage operation. Where there are space limitations or excessive space costs, available height is often utilized with the aid of pallet racks, drive-in racks, gravity live storage for pallets or cartons, and raised storage platforms

10.5 Learning Activities

A beverage manufacturer receives a supermarket order for 10,000 products to be delivered to 20 different stores. As products exit the production line, they travel along a conveyor and barcode technology directs them down the correct lane based on delivery region. Counting technology counts products as they pass through, so that each store receives its guaranteed quota. Automatic palletisers take products from the sorting bays and load them onto pallets. Each pallet receives an automatically printed label telling staff which truck the pallet needs to be loaded on to.

Required:

i. Discuss the benefits of automating the dispatch process. In your discussion include some of the challenges that could be faced while attempting to automate the dispatch process.

ii. Apart from those mentioned in the above scenario, which other technologies can be introduced in order to minimise damages and speed up the dispatch process in a warehouse.

10.6 Self-Assessment Questions and Activities

1. Explain the meaning of key terms in dispatch of goods
2. Graben Warehousing Limited has been facing some challenges in there dispatch process; many times there is a mismatch between the good in storage, the goods shipped out and the goods received by the customers. As an expert in warehousing, suggest and describe five documents that could help improve the receiving process.
3. Explain how technology can integrate and thus improve the dispatch process and order management.
4. Provide a description of ten (10) common picking, packaging and loading systems and equipment in a warehouse
5. What do you understand by the term Order consolidation?
6. What is the difference between packing and packaging?

10.7 References

- Warehousing Operations Certification Track. LINCS in Supply Chain Management Consortium. March 2017. Version: v2.28. www.LINCSeducation.org
- Dachyar, Muhammad & Zufri, Listya. (2016). Improving order management system in pump industry. 11. 4917-4923.
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge

11.0 MANAGING GOODS RETURNED

11.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Determine the return processes and procedures
ii. Develop a goods return policy
iii. Explain how to handle goods returned in the warehouse
iv. Use goods returned documentation

11.2 Goods Return Process and Procedures

"Returns management is that part of supply chain management that includes returns, reverse logistics, gatekeeping and avoidance." (Rogers, et al., 2002, p. 5). According to Rogers (2002), Returns Management is an important supply chain management process that involves planning and effective implementation through the supply chain. Furthermore, Rogers claims that the effective execution of returns management allows executives to discover improvements opportunities, but requires supply chain alignment and the inclusion of the activities avoidance and gatekeeping, pivotal concepts in return management (Rogers, et al.,

2002). Gatekeeping involves making conclusions to limit the number of items that are acceptable into the reverse flow. Successful gatekeeping enables management to organize and reduce returns without harming customer service. Gatekeeping removes the costs connected with returning items that should not be returned or the cost of items returned to the unsuitable destination. Avoidance means finding appropriate ways to reduce the number of return requests. It can consist of ensuring that the quality of items and user friendliness for the customer is at the highest level possible before the item is sold and shipped. Returns management as a supply chain management process includes several features that can make an individual company more effective and efficient (Rogers, et al., 2002).

Items that have been inspected may need to be returned either to the vendor or the dispatching warehouse because they were discovered to be:

- Duplicate or shipped in excess of PO quantity;
- The wrong items;
- Not delivered on time and no longer required.
- Defective or damaged;

Return of dispatched inventory from a warehouse should not be a common occurrence but sometimes customers will return items of stock due to the reasons mentioned above. If a dispatch, or part of it, is nevertheless returned to the issuing warehouse, the warehouse should be able to handle the returns in different situations, for example:

When receiving returns, the regular processes for receiving consignments (including the first visual inspection, the offloading & inspecting for damage or loss, etc.) must be followed. These goods must be clearly marked and stored separately as the returned goods cannot be dispatched again before the inventory adjustment process has been confirmed by the warehouse keeper.

11.3 Goods Return Policy

A Goods Return Policy refers to the rules created to manage how customers return and exchange unwanted merchandise they purchased. A return policy tells customers what items can be returned and for what reasons, and the timeframe over which returns are accepted. Return policies are a consumer risk reliever often used by retailers to increase consumer demand.

According to Narayan & Syrdal, & Freling (2015), return policies are a consumer risk reliever often used by retailers to increase consumer demand. Che (1996) further adds that, return policies allow consumers to defer their purchasing decisions until after they gain some experience with goods

If...	Then...
The same goods can or will be re-dispatched to the same location.	• Keep them overnight on the truck (if it can be secured). • Do not adjust documentation.
The goods are to be dispatched to a different location.	Adjust the appropriate documents in the warehouse.
After dispatch, some or all the goods in a shipment are returned to a warehouse and added to existing stock.	• Use a GRN, to register the shipment as an "incoming" shipment under the same PO that it was shipped out with. • Note why the goods were returned on the Waybill.
Goods returned are in 'good order'.	Return to their original storage location in the warehouse.
Goods are damaged.	Place them in the damaged goods section of the warehouse and take action to repair or dispose of them.

11.4 Requirements of a Return Policy

Every return policy needs to cover a few points to help customers understand the limits and allowances the business places on returns. This is the most important part of the return policy, as this information describes what will be accepted from customers, and how they will be refunded.

1. **Stipulate a time frame for returns**
   It's important that customers know how long they have to return a product. Generally speaking, 15-30 days is standard, although some businesses opt for 90 days. Either way, it will not helpful by accepting returns beyond that time. Failure to disclose a time frame for returns will result into customers shipping back items months, even years after they've been purchased. Needless to say, this is not a good thing for online store owners. Several large businesses have suffered losses due to open-ended return periods, to the point that most have introduced stricter rules.

2. **Define the expected condition of returns**
   It's one thing to accept a return if the customer is immediately unhappy with a product or the product is defective. It's quite different to accept a return if a product has been used, broken or devalued in any way by the buyer. When structuring your company's return policy, define the condition a product must be in before a return can be processed. If you fail to include this information, customers will attempt to return merchandise in condition too poor to be resold. In this case, you'll be forced to take a loss.
3. **Define the reason and reason codes for the returned items**
   Establish the reasons why the goods are returning to the warehouse and give reason codes. Create a table and compare after a period of time I.e weeks, months, yearly. Take measure on improvement i.e wrong picking of order, over supply of order, not ordered. Sometimes this will reduce after identifying the problem.

11.4.1 Returnable Goods and Non-Returnable Goods

For example; Eligible Products for Return:

- Received by customer as damaged
- Received by customer in error
- Goods ordered by customer in error
- Expired or In-dated product may be returned for credit

Examples of Non-Returnable Goods may include

- Product that is not in the original packaging bearing the original manufacture label.
- Product that is more than six (6) months prior to the expiration date.
- Product that is twelve (12) months or more past the expiration date.
- Product sold with specific understanding that it is non-returnable.
- Merchandise that is obtained in violation of government regulations.
- Product that has been donated.

11.4.2 Return Requirements

If you have requirements that must be met before a return can be processed, you need to let customers know ahead of time. For example, you may want to stipulate that all returns must be sent unopened and/or in its original packaging. You should also let customers know if they need an authorization number, shipping address, purchase receipt, etc. Whatever conditions you choose, state them clearly for all to see. One simple way to handle this is to use a Return Merchandise Authorization (RMA) system. This allows you to request information and images from the customer. If you decide to accept the return, you issue an authorization. If your business covers return shipping, you'll send the customer a shipping label along with the authorization.

11.5 Handling Returns in the Warehouse

Different actors in the supply chain face different return flow types (De Brito and Dekker, 2002). Independent of the return flow type, the following warehousing processes can be distinguished.

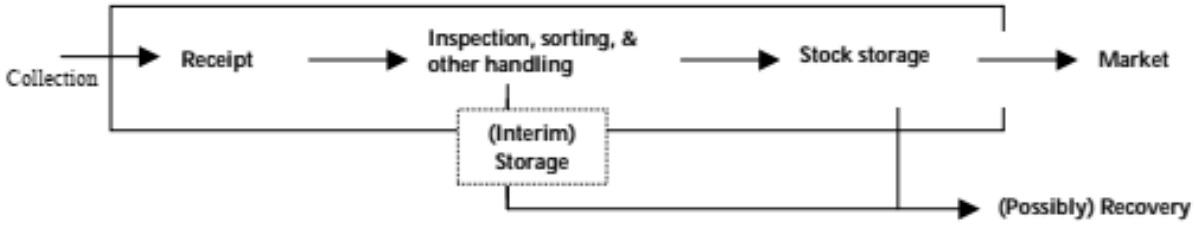
- Receiving;
- Inspection & sorting;
- (Interim/Stock) Storage;
- Internal transport.

Operations' details may differ per return type. For instance, products that come back in as good-as-new state can be restocked to be sold again, while end-of-life products may only need interim storage until they are sold to a third party recycler.

11.5.1 Return Handling Process in the Warehouse

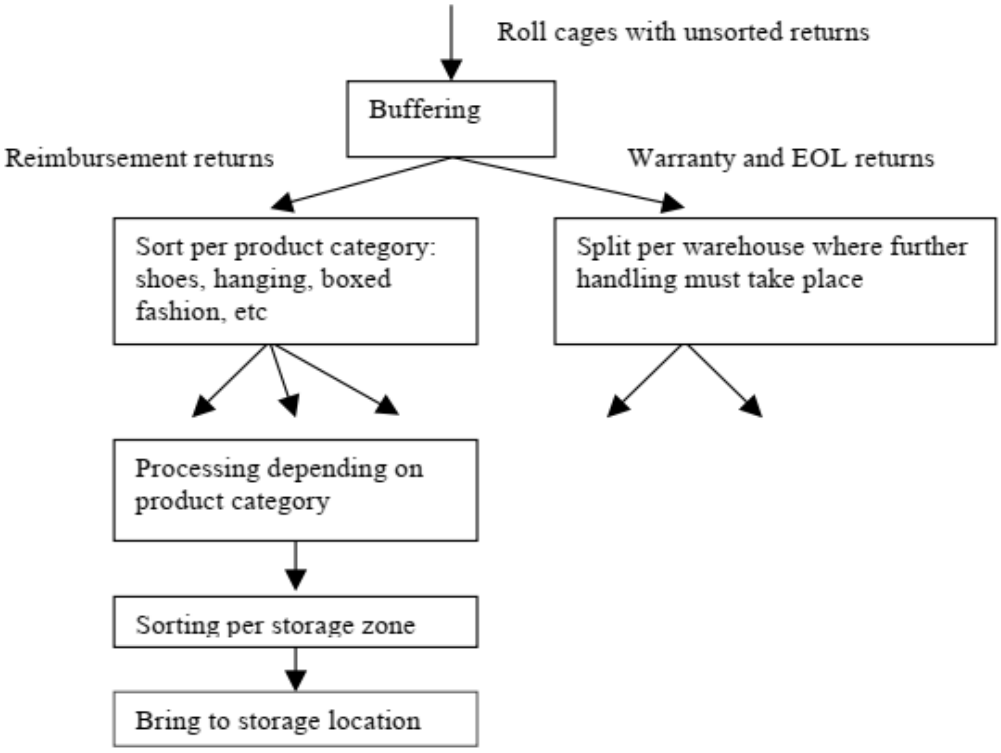
Step 1: Returned items are consolidated and collected from various sources.

Step2: The items are then received in a warehouse with accompanying documents.
Step3: The items are inspected and sorted.
Step 4: depending on the condition of the items, some are placed back into main storage for reselling while others are temporarily held in interim storage awaiting disposal or repairs.



Source: de Brito, Marisa & De Koster, René. (2003)

Flow Scheme of Receiving and Handling Returns in a Warehouse



Source: de Brito, Marisa & De Koster, René. (2003)

11.5.2 Best Practices in Handling Returns to the Warehouse

- If possible, collection of returns at customers should be integrated with the distribution of products to customers. The same third party Logistics Company carries out both processes and the route planning is based on both types of orders, although return collection has a slightly lower priority. Even the return drop-offs at the warehouse should be integrated: the truck that brings returned items also collects new orders for distribution.
- The return handling process should be completely separated from the regular receipts of suppliers, with dedicated workstations and handling equipment like conveyors.
- The inbound storage process differs from the regular receipts. For regular receipts, one product carrier (usually a pallet) consists of one product. Returns are consolidated for inbound internal transport in rolling bins.
- Returned products with a "good" status are consolidated with new products on a location in a forward pick area, whereas newly purchased items are stored in a reserve area. Other than 'good' products are either returned to vendors or to brokers.
- In the picking process, no explicit priority is given to returned items.
- Damaged/under-packing returns should be taken to blocked area awaiting repacking or scrapping.

11.6 Goods Returned Documentation

Goods Received Note (GRN)

Goods Received Note (GRN) is a document that represents the receipt of goods by customers. It also knows as a delivery note, which is used as the evidence that goods are delivered and the customers already received. Moreover, both suppliers and customers use GRN to compare between order and delivery quantity.

Return Delivery Note

When a customer buys a product and is not satisfied with the goods, the customer initiates a return. The return must be accompanied by a document called "Return Delivery Note".

Simply, the return delivery note is a form used for stating the detailed information about the goods to be returned to the seller after purchase. The form enables a clear allocation and ensures speedy processing of the returned goods.

A debit note

A debit note is a document created by a buyer when returning goods received on credit. For returned items, the note will include the total anticipated credit, an inventory of the returned items, and the reason for their return.

Credit note

A credit note is a receipt given by a warehouse to a customer who has returned goods, which can be offset against future purchases.

11.7 Learning Activities

1. Visit any warehouse close to you and record the following and their functions:
    a. Goods Return Policy
    b. Documentation used in receiving and storing goods returned.
2. Read the Case Study 3 in the appendix and answer the related questions. **Self-Assessment Questions and Activities**

1. Jumia is an online shop with millions of customers' country wide. Unfortunately, some of their customers get wrong products delivered to them, whereas others simply don't like the products delivered. Jumia has recruited you to develop for the company product return processes and procedures. What are some of the key elements that you would include in the final document?
2. From the process and procedures developed above in (1) develop a goods return policy for the company.
3. Using a warehouse known to you, briefly explain how returned goods are treated.
4. Which documents would you require before goods are returned to a warehouse? Give justifications for your answer.

11.8 References

- de Brito, Marisa & De Koster, René. (2003). Product Return Handling.
- Janakiraman, Narayan & Syrdal, Holly & Freling, Ryan. (2015). The Effect of Return Policy Leniency on Consumer Purchase and Return Decisions: A Meta-analytic Review. Journal of Retailing. 10.1016/j.jretai.2015.11.002.
- Che, Y. (1996). Customer Return Policies for Experience Goods. The Journal of Industrial Economics, 44(1), 17-24. doi:10.2307/2950557
- Rogers, D. S., Lambert, D. M., Croxton, K. L. & García-Dastugue, S. J., 2002. The Returns Management Process. The International Journal of Logistics Management, 13(2), pp. 1-18.
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge.

12.0 MATERIALS HANDLING EQUIPMENT

12.1 Specific Learning Outcomes

At the end of this topic the trainee should be able:

i. Identify the objectives of materials handling
ii. Discuss the factors to consider in selecting materials handling equipment
iii. Identify types of materials handling equipment
iv. Analyse the equipment selection strategies

12.2 Definition of Materials Handling Equipment

In a broad sense, materials handling includes all movement of materials in an organisation.
Materials handling has been defined by different professional bodies. Two such definitions are:

- Definition by the British Standards Institution (BSI) — Materials handling is the technique employed to move, transport, store or distribute materials with or without the aid of mechanical appliances.
- Definition by the Materials Handling Division of the American Society of Mechanical Engineers (ASME) — Materials handling is the art and science involving the moving, packing and storing of substances in any form.

12.3 Objectives of Materials Handling Equipment

The overall objective of materials handling is to reduce the operational cost through reduced overall costs of materials handling by reducing the number of handlings involved, that is, time in handling. The simplest solution to the materials handling problem — No movement, no cost — is hardly practicable for a complete operational process.

The general objective of reducing the overall costs of materials handling by reducing the number of handlings involved is more easily understood if it is subdivided into more specific goals which follow:

i. **Allow increased storage capacity** — Better movement and storage of materials should increase the utilisation of storage space.
ii. **Gain increased equipment and space utilisation** — Continuous flow of materials required for production can effectively utilise the equipment without any loss of time and **no delay** in movement does not require additional storage and space is thus economically utilised.
iii. **Reduce the unit materials handling costs** — It is obvious that the overall materials handling costs will be reduced if unit production costs are reduced. This concept/approach requires that the handling costs be allocated or identified to the units of product, or to its component parts that are moved. In many manufacturing situations this allocation is not too easy.
iv. **Allow reduced human fatigue and increased efficiency of the worker** — Handling equipment, mostly being power-operated, reduces fatigue and consequently increases efficiency.
v. **Increase volume of production/efficiency** — Handling equipment, being power-driven, continually feeds production machines, increasing volume of production.
vi. **Improve control of the flow of materials** — A principal way in which good materials handling practice can affect savings is by making the control of goods easier — particularly in continuous manufacturing, where all operations are **tied together** by the materials handling plan. In this situation the problem of production control is reduced to control at the starting point of the process and to the watching of the rate of flow at selected control points throughout the process.
vii. **Provide for improved working conditions and greater safety in the movement of materials** — Adherence to safe handling practices is required. These must be followed. In addition, it is evident that the safe handling of materials will be reflected in a better industrial accident record (i.e. where there is little or no accident).
viii. **Gain improved customer service** — Efficient materials handling can produce goods of the right quality, at

the right time, and in the right quantity giving improved service to customers. In essence, it speeds up delivery of products to customers.

ix. **Gain higher productivity at lower manufacturing cost** — Any materials handling system, if it is worth its investment, is designed to improve productivity. This productivity improvement can be achieved if materials are allowed to move in the fastest, most efficient, and most economical way possible.

x. **Reduce manufacturing-cycle time** — The total time required to make a product from the receipt of raw materials to the finished goods can be reduced through effective materials handling. Movement of materials can be speeded up or may be handled over short distances. Successful reduction of the manufacturing-cycle time will reduce inventory costs and other production costs incident thereto.

xi. **Provide for fewer rejects** — Care in the handling of the product will contribute to a better quality level of the goods produced. Products damaged by inefficient handling are all too often a major cost to manufacturers

12.4 Factors to Consider in Selecting Materials Handling Equipment

The handling-problem factors that enter into this consideration are the volume of production to be attained (in terms of the rate of production), the class of materials to be handled, and the layout of the facilities.

It might well be assumed that in the designing of a new plant/warehouse the layout and building facilities could be adapted to the best materials handling plan. However, in this most favourable situation some compromise may still have to be made owing to other factors, such as future plant expansion, flexibility of layout, or restrictions that may be placed on the type of building to be constructed. It is obvious that in the case of an existing plant/warehouse the layout and building facilities affect the selection of materials handling equipment.

The selection of materials handling equipment for a particular enterprise depends on the following factors:

i. **Distance**. It is important to consider the distance to be covered by the equipment.

ii. **Availability**. The load-carrying and movement characteristics of the equipment should fit the materials handling problem.

iii. **Characteristics of material**. It is important to consider type, volume, size, shape, and weigh of the material e.g. material characteristics, physical state, nature of chemical action, etc.

iv. **Flexibility**. Where possible the equipment should have flexibility to handle more than on material, referring either to class or size.

v. **Load capacity**. Equipment selected should have great enough load-carrying characteristics e.g. capacity and strength) to do the job effectively, yet should not be too large and result in excess operating costs.

vi. **Power**. Enough power should be available to do the job.

vii. **Speed**. Rapidity of movement of material, within the limits of the production/warehousing facility or safety requirements, should be considered.

viii. **Space requirements**. The space required to install or operate materials handling equipment is an important factor in selection. Thus, it is important to consider factors such as floor space available, condition of floor, clearance height, etc.

ix. **Supervision required**. As applied to equipment selection, this refers to the degree of automaticity designed into the equipment.

x. **Ease of maintenance**. Equipment selected should be easily maintained at reasonable cost. Thus, the equipment's maintenance and annual depreciation rates are very important.

xi. **Cost**. The consideration of the cost of the equipment is an obvious factor in its selection.

xii. **Production factors**. Methods of manufacture, volume of production, and the sequence of operation should be considered.

12.5 Types of Materials Handling Equipment

There are five basic types of materials handling equipment:

1. **Conveyors** — Conveyors are devices commonly used for moving uniform loads of relatively small items or units continuously from point-to-point over fixed paths. They are also when **loose** materials have to be moved in large quantities. Some conveyors are gravity-propelled with materials moving down a series of low-friction rollers. Others are powered, the most common making use of rollers on endless moving belts of rubber or some other suitable material, which convey the materials to their destinations. Conveyors are used where the primary function is conveying.
2. **Cranes and Hoists** — Cranes and hoists are overhead devices used for moving varying loads intermittently between points within an area, fixed by the supporting and guiding rails. Cranes and hoists are usually electrically-operated and are designed to transport heavy loads. They carry materials by means of hooks, buckets, or magnets. Cranes and hoists are used where the **primary function is transferring**.
3. **Industrial Trucks** — Industrial trucks are hand-propelled or powered vehicles (nonhighway) used for the movement of mixed or uniform loads intermittently over various paths having suitable running surfaces and clearances. Industrial trucks include **tow tractors** (which are commonly found in both warehouses and stockyards, and they tow trailers which contain the materials being moved), **fork-lift trucks** (which are used for heavy-duty stockyard use and both inside warehouses and outside), and **mobile cranes** (which are mainly suitable for stockyard use and requiring wide gangways if used inside warehouses). Industrial trucks are used where **the primary function is manoeuvring or transporting**.
4. **Containers -** These are either 'dead' containers (e.g. Cartons, barrels, skids, pallets) that hold the material to be transported but do not move or 'live' containers (e.g. wagons, wheelbarrows or computer self-driven containers). Handling equipment of this kind can both contain and move the material and is usually operated manually.
5. **Robots -** Many types of robots exist. They vary in size, and in function and maneuverability. While many robots are used for handling and transporting material, others are used to perform operations such as welding or spray painting. An advantage of robots is that they can perform in a hostile environment such as unhealthy conditions or carry on arduous tasks such as the repetitive movement of heavy materials.

12.6 The Cargo Handling "Human Element"

In the context of humanitarian field operations, cargo is both heavily or exclusively moved and loaded by hand. Humans are far more versatile than typical MHE, including being able to achieve specialty tasks, however there are also limitations to human labour. Logistics personnel tend to calculate needs of warehouse handling based on the maximum performance of hand loaders and ignore the fact they have limitations like anyone else. When working with or scheduling hand loaded cargo operations, a good practice is to remember:

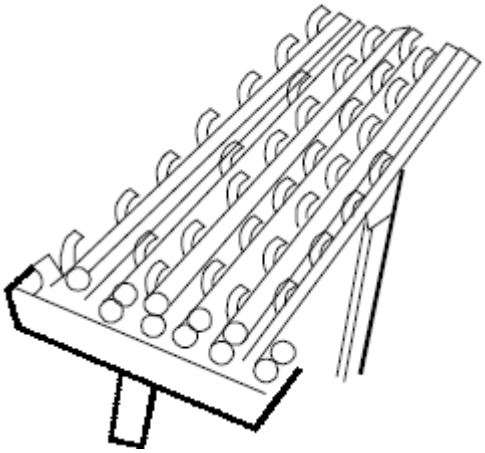
- Hand loaders require "recharging" periods such as water breaks or meals.
- Resource planners may need to factor prayer times into warehouse activities.
- People get bored with repetition which may increase mistakes.
- The overall efficiency and speed of hand driven operations will go down over the period of a day.

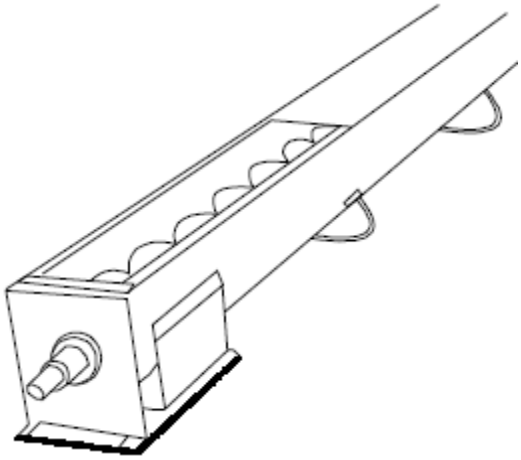
Injury and strain are common in warehouse operations, and human managed operations must acknowledge risks and needs of any tasks

12.7 Types of Common Material Handling Equipment in Warehouses

Wheel Conveyor

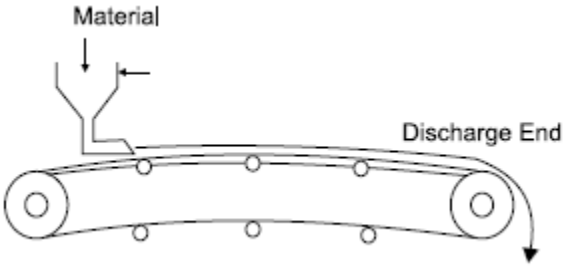
Screw Conveyor Roller



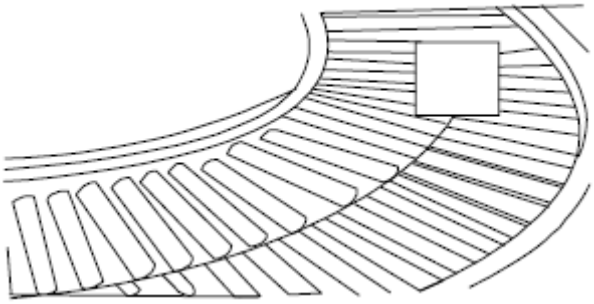


Belt Conveyor

Roller Conveyor

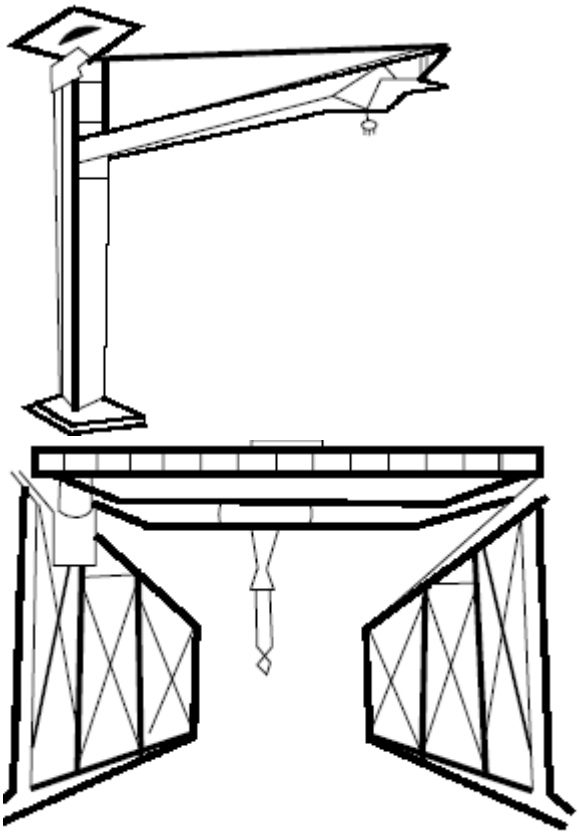


Roller



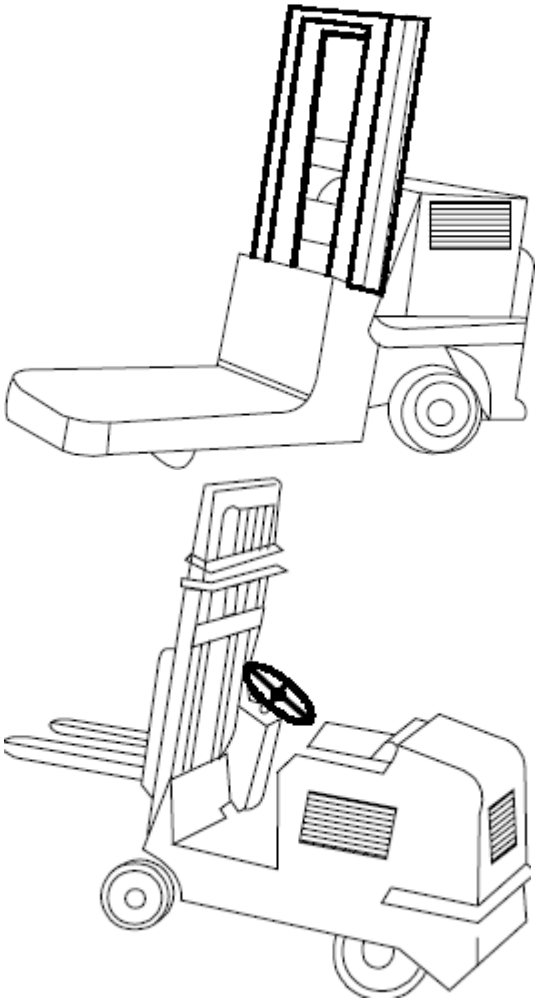
Jib Crane

Bridge Crane

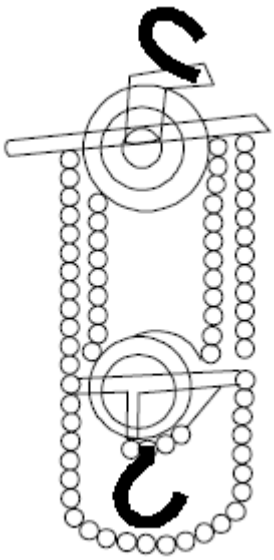


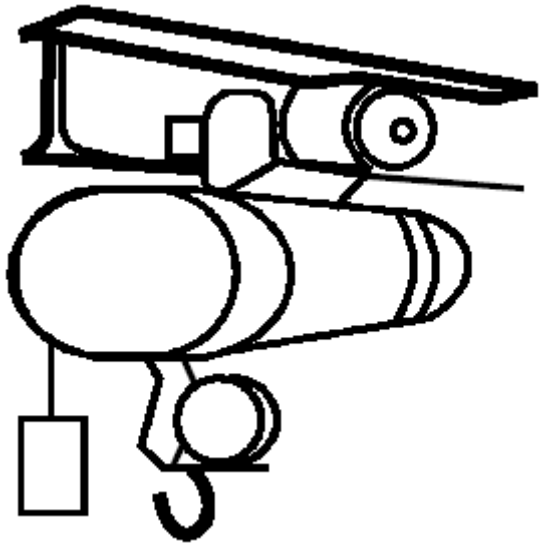
Platform Truck

Fork Truck



Chain Hoist
Electric Hoist





12.8 Equipment Selection Strategies

According to Prasad & Shankar (2012) when implementing a new MH equipment, the decision makers are faced with the following issues, that is, (a) selection of an MH equipment that would give the desired benefits to the manufacturing organization with due consideration to its objectives and operating characteristics, (b) financial justification of the investment, and (c) development of a plan to ensure that the set objectives are met when the selected MH equipment is implemented and evaluated. For these reasons, the decision makers have to consider various quantitative (load capacity, energy consumption, reliability, cost, etc.) and qualitative (flexibility, performance, environmental hazard, safety, load shape, load type, etc.) criteria. On the other hand, some of the selection criteria are beneficial (higher values are preferred) and some are non-beneficial (lower values are desired).

Other Selection strategies may include:

i. Technical Specifications like

- Load factor;
- Lift height;
- Special attachments;
- Fuel type;
- Battery;
- After sales back up.

ii. Purpose for which the equipment is being bought, e.g. indoor or outdoor loading or racking;

iii. Flexibility of use

iv. Goods to be moved (for instance electric

trucks are required in warehouses where food and paper items are stored in order not to allow exhaust gases to contaminate the goods);

v. Service and maintenance issues (some operators will sign up to a fixed term service contract with a supplier of warehousing equipment. This often aligns with the term of a specific contract with a customer.)
vi. A standardisation issue, i.e. is the equipment compatible with any existing ones so as to reduce cost of holding spares;
vii. Life cycle rating, i.e. it is essential to link the life span cost of the equipment to revenue life;
viii. Reliability and durability;
ix. Fuel type, cost and consumption rates;
x. Safety and environmental consideration, e.g. pollution, etc.;
xi. Software compatibility with warehouse management systems;
xii. Funding options.

12.9 Learning Activities

Read the case below and answer the related questions.

TORO's goods are safely moved by driverless trucks from Toyota

Since 1946, TORO has developed a broad portfolio of food products such as soups, sauces, oven dishes, baking mixes and chilled ready meals. TORO has its main factory in Arna, Bergen, where dried products are produced in a gentle way, preserving both taste and nutrients. Ever since the TORO factory was built in 1968, it has seen a continuous development. The company recently added 5 automated forklift trucks from Toyota to their existing fleet. The AGV's will handle a large number of goods transports in order to increase their competitiveness. "We are amongst the first in the Orkla group in Norway and Sweden with automated forklift trucks on such a large scale," says the TORO warehouse manager Öyvind Steinsland.

Going from Manual to Automation

"We are constantly looking into possibilities for improvement to drive the factory forward," says Steinsland, who has been working at the factory for 43 years. "How are goods packaged faster? How is food waste reduced? How can goods be moved smarter? These are just some of the topics that the factory is working on, and to the last question our long-term partner Toyota could answer us with their AGV's."

Over 30.000 transport missions that were previously carried out manually, are now carried out by automated trucks. "We can move goods in the factory much faster and cheaper than before. This strengthens our competitiveness," says Steinsland. After 10 months of testing, 5 Autopilot stackers from Toyota are now used to transport waste, deliver material and goods to the packaging and transport finished goods back to the storage area.

Safety is a Priority

The automated stacker trucks from Toyota are working side by side with manual trucks and/or operators walking around the area. Throughout the process, Steinsland and project leader Kjell-Inge Skare have cooperated closely with the Toyota team, emphasising that safety is key. "Extra safety sensors were fitted to the AGV's and special safety sensors at the mezzanines where the high-lifting manual trucks are working," Steinsland explains. The automated trucks have a maximum speed of 1,2 m/s and if the technology for any reason would not work, the forklifts can be driven manually. "Having the possibility of manual driving is also important to ensure that an error on the automated truck will not impact production," says Steinsland.

Only the beginning

"Here at the factory we have 450 different types of goods that need to be moved. Goods should be picked and returned to the warehouse, mixtures should be transported from intermediate storage to packaging and so on," says Steinsland and continues, "this results in a high number of transport missions throughout the year at the factory. The plan is to utilise more automated trucks for these tasks in the future."

Required

i. Identify the different material handling equipment used by Toro in their operations.
ii. Which other Material Handling equipment would you recommend for Toro?
iii. What measures have been put in place to ensure that safety is improved during operations?

12.10 Self-Assessment Questions and Activities

1. What benefits are associated with proper materials handling in a warehouse?
2. Discuss the factors to consider in selecting materials handling equipment
3. Your warehouse is in the process of upgrading from manual to automated material handling.
    i. Provide a list and description of some materials handling equipment that should be procured to boost the operations of the warehouse.
    ii. Which equipment selection strategies can be used for this exercise?

12.11 References

- Karande, Prasad & Chakraborty, Shankar. (2012). Material Handling Equipment Selection Using Weighted Utility Additive Theory. Journal of Industrial Engineering. 2013. 10.1155/2013/268708.
- Frazelle, E.H., (2002). *World-Class Warehousing and Material Handling.* McGraw – Hill Professional. ISBN: 9780071376006
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge

13.0 APPENDICES

13.1 Case Study 1

Merchandise Warehouses takes its operations to the next level with high-density, deep lane racking and a pallet shuttle system April 16, 2018 by Amy Wunderlin

Merchandise Warehouse, a logistics provider of multi-temperature warehouse services, hasn't stopped growing since its beginning as a 50,000-square-foot dry warehouse. An industry-wide shortage of cold storage facilities led the company to invest in cooler and freezer rooms in 1959, and now today the third-generation, family-owned warehouse has increased its facility size by eight times, with more than 400,000-square-feet of cooler and freezer space.

Consumer Demand Fuels Continued Cold Storage Growth

Yet while the company continued to excel, for years they relied on common warehouse operations. Traditional pallet racking was working, and as the old saying goes, "if it isn't broke, don't fix it." However, continued growth was already pushing Merchandise Warehouse to its limit. The facility was busting at its seams with product, and the company's customers were demanding even more room.

That growth, along with Merchandise Warehouse's more aggressive pursuit of the latest technologies, presented the perfect opportunity to act on the company's motto: "Take it to the next level."

The Warehouse As A Competitive Advantage

"We're always trying to be bigger, faster and stronger, and are looking for the latest and greatest tools that will help us achieve that," says Seth Hamman, warehouse manager at Merchandise Warehouse. "When we were facing even more rapid growth, we saw it as an opportunity to find and implement those latest solutions that were revolutionary in the industry."

Next Level, Efficient Solutions

Merchandise Warehouse knew what it needed: practical and affordable solutions that would help them be more efficient for their customers. The company started their search with who they knew and trusted: Raymond and Associated, an authorized Raymond Sales and Service Center.

"Associated and Raymond have always been leaders in the industry, so we knew we could trust them with this project," explains Scott Whiting, vice president and general manager at Merchandising Warehouse. "Plus, we have a lot of loyal Raymond fans in our warehouse, so we already had a great foundation for getting our team on board with new technologies." Merchandise Warehouse worked with Associated to assess the current operations and technologies and determine the best options for upgrading. They landed on high-density, deep lane racking and a pallet shuttle system from Raymond called Radioshuttle, which are both especially suited for cold storage.

Radioshuttle allows additional capacity and pallet positions, while also helping store and pick product faster with its pallet shuttle system. It's efficient, yet has fewer opportunities for product damage on account of fewer touches required to move product. While Radioshuttle moves pallets through racking, the operator—typically using a reach truck—is free to do other work.

The Rise of High-Tech Cold Storage

Most importantly, Radioshuttle allowed for maximum storage utilization. By using the full height of the warehouse and high-density, deep lane racking, Merchandise Warehouse could better fill the facility with product.

The reduction in product touches was furthered with the integration of three conveyor systems: one moves product from the blast freezer through a de-spacing operation on to staging for lift truck put-away in the RadioShuttle system, and two others take product from the RadioShuttle storage freezer and stage it for truck loading.

Efficient Solutions with Immediate Results

The collaboration between Merchandise Warehouse, Associated and Raymond didn't just work—it thrived.

"The companies worked together through the entire process, and in doing so, we were able to optimize our entire warehouse," says Whiting. "We started seeing results faster than we even expected. We

were seeing results in the first two months after implementing Radioshuttle and the racking."

Merchandise Warehouse added more than 14,000 more pallet positions with the new solutions, and in doing so, was able to keep staffing levels the same. "Overall, the warehouse was more efficient—44 percent more efficient," says Whiting. "What used to take seven man-hours to move product through the warehouse now takes about four. And what used to take 12 touches from receiving to shipping now only takes six. Fewer required touches means less opportunity for product damage."

The Warehouse Manager's Handbook

Outside of the storage, Merchandise Warehouse was also able to update its spacer removal process, cutting the time in half. Removing spacers from pallets used to take four hours, but now only takes two.

"Four or five years ago, I was dreaming of this kind of process improvement and upgrade. I was scribbling this stuff on napkins," says Hamman. "It's remarkable to see it come to life with the help of Radioshuttle and the new racking. We couldn't have asked for a better experience or results."

Required:

1. In your opinion why do think that customers are demanding for more cold strorage space.
2. 2.Briefly describe what the following terms mean as used in the case;
   - (i) traditional pallet racking
   - (ii) high density storage
   - (iii) deep lane racking
   - (iv) pallet shuttle system
3. Highlight the benefits achieved by the Merchandise Warehouse as a result of implementing the new solutions.
4. Using relevant examples, how do you think Warehousing can be used as a competitive advantage.

13.2 Case Study

Schumacher Triples Throughput in Existing DCs, Gains a Scalable Solution for Continued Growth: With the Numina Group's Help, Company Leverages Technology and Achieves a 12-Month ROI

Schumacher Electric, headquartered in Mt. Prospect, Ill., with plants in Mexico, China and the USA, is the world's foremost manufacturer of battery chargers. Founded in 1947, the company has built a thriving business by selling its products to large retailers such as Walmart, Napa, Advance Auto Parts and Pep Boys as well as the world's leading multinational equipment manufacturers.

Business Challenge

Manual order fulfilment processes were limiting Schumacher's potential for growth. A large percentage of Schumacher's daily orders were high case volume shipments to major retailer clients, which can range from a single carton mixed SKU parts order up to an order of 50,000 units. All mixed case order picking was done using fork trucks, staging, hand labelling and re-palletizing the orders, a process that required a dedicated staff of ten to sixteen people a day to accomplish the task.

Fulfilment was further complicated by the fact that many of Schumacher's large retail customers require vendor-compliant shipping labels on every case shipment. The risk of applying the wrong compliance labels to a customer's shipment could result in costly shipping and compliance fines imposed by the retailer.

Additionally, due to an increasing volume of Internet orders, parcel shipping was becoming a fast growing segment of the business and adding new complexity to the fulfilment workflow.
As business continued to grow, Schumacher hit a ceiling on order throughput with its existing paper-driven order fulfilment processes. "On our best day, we could only process $1.5 million in order shipments between our two DCs," said Chris Hadsall, Executive Vice President for Schumacher. "We needed more throughput and higher efficiency."

As a first step, Schumacher introduced barcode scanning to the order picking process to improve picking accuracy. However, the potential for fulfilment errors were still present due to manual batch printing and hand-applying the compliance labels to each case at the pallet build operation.

To alleviate the bottleneck in growth, Hadsall took on the initiative to improve throughput and accuracy in the company's distribution centers (DCs). Hadsall, a seasoned business professional with a background in civil engineering, computer science and business operations, knew that significant efficiency gains

could be achieved by applying the right automation expertise and technologies.

Solution

Schumacher engaged The Numina Group, a leading order fulfilment automation integrator with 30 years of experience in the design and implementation of automated warehouses and distribution centres, to perform a design study. The Numina Group studied the company's current DC operation and made recommendations on better practices and technologies to improve efficiency and order throughput.

Design Study Yields a More Efficient Picking Strategy

Numina's design study gave Schumacher a clear game plan to improve efficiency and throughput by reengineering its order fulfilment operation to eliminate labour-intensive manual processes, maximize throughput and provide the projected ROI through an investment in automation.

Numina Group analyzed SKU movement and the DCs' existing slotting to identify inefficiencies in storage and improve product movement by designing a more efficient pick path. This included locating the highest moving SKUs along the conveyor line to eliminate wasted walk time and fork truck travel. This led to improved efficiencies in picking and reduced replenishment cycles.

The new DC design slotted slow-moving SKUs in locations separately from the high-velocity SKUs. High movers were located in an accessible and ergonomically friendly pallet flow in an efficient pick path, resulting in fast picking and easy replenishment. The key to adding efficiency was the step of slotting the highest moving products in pallet flow lanes directly along the conveyor. This was an essential step to gaining productivity by locating the A and B products in the closest locations along the conveyor line to eliminate wasted walking time.
The second component of the design study assessed the potential of improving efficiency through automation technologies such as voice-directed picking, automated print-and-apply labelling and the use of a conveyor and order sorting system to reduce the use of fork trucks for the majority of case picking.

New Conveyor and Order Sorting System Streamlines Fulfilment

In addition to reconfiguring the warehouse to improve slotting, Schumacher implemented a new conveyor and order sorting system with in-line scan, weigh and print-and-apply labeling capabilities to automate the application of both the shipping and retail compliance label. Voice picking is used throughout the operation with voice managing the slow movers more efficiently by batch picking these SKUs using a fork truck. When a mixed pallet of cases for the pick wave is complete, the operator is directed to drop off the pallets for loading onto the conveyor system.

To streamline Schumacher's growing small parcel shipping volume, Numina also recommended adding voice picking technology to direct workers in the mixed SKU order picking process. Items are now picked and scan validated, using totes with a manual pack to carton process. This area is also streamlined using print-and-apply technology for automated manifesting and parcel labelling.

Warehouse Execution & Control System Manages Automated Order Flow

The entire order fulfilment operation is managed by Numina Group's Real-time Distribution System, a top-tier Warehouse Execution and Control System, (WES-WCS). RDS's order fulfilment automation software includes voice directed picking along with in-motion case barcode scanning, print and apply labelling and the pallet build sorting process control. RDS manages the batch case pick-to-conveyor process, assigns and scan-weight validates each case to the customer's order and ensures the cases are labelled with the retailer's UCC compliance label and pallet-build shipment rules, all without human intervention!

Moving to voice picking has increased accuracy to 99.99% and efficiency by over 70% at the DC. Now, order pickers are directed in the most efficient walk path to the product storage location. Using the combination of voice instructions and hands-free barcode scanning of the storage location and SKU barcode batch case, picking now occur across multiple orders at pick rates above 600 cartons per man hour.

Operators receive voice commands to pick the required quantity and scan validate each case as they are placed on the automated MDR conveyor line that transports and measures each case through the in-motion scan-weigh audit station. The case SKU barcode is captured, the case is weight audited and the print-and-apply applicator automatically applies either a compliance label or both a compliance and parcel shipping label to the case.

The scan weigh audit also performs pick count verification and the RDS labeling software module assigns the case and count matched to the customer's specific order and prints and applies the required labels. Barcode scanners after the labeling process are used to validate the entire pick and ship process. Each case is then conveyed to a pallet and shipping sorter where cases are again scanned and sorted to the order pallet build stations or directly to FedEx® or UPS® shipment lanes.

Benefits:

- Increased throughput by 70 percent
- Reduced staffing from 16 to three to five employees for LTL case picking
- Eliminated manual fulfillment practices
- Achieved 99% order picking accuracy
- Eliminated the majority of retailer charge backs and fines.

According to Hadsall, one huge benefit of speaker-independent voice technology is that it has virtually eliminated worker training. "When we need to bring temps in for the heavy season, it used to take us one to two weeks to train somebody so we were confident they weren't going to screw up a customer shipment," he said. "Now, with the speaker-independent voice picking system, there is zero voice training, so we can train workers in less than five minutes. Our CFO came in and we strapped the headgear on him. In less than five minutes he was a picking professional."

Hadsall also noted that employees are fully onboard with the new system. "At first, our DC staff was really skeptical about the new technologies we were putting in place. But once we got the system in and running they were beside themselves. They couldn't figure out why we didn't pull the trigger on this system five, six, even ten years ago," he said.

Automation is Free – With the Right Return on Investment (ROI)

Schumacher was able to implement their new fulfilment system in a six-month period. Equally important, the company's ROI has been very rapid. "When we put the first voice pick and labelling automation system in, it was just slightly under $600,000 and we certainly saw the payback within the first year," said Hadsall. Overall Schumacher has invested $1.4 million across both DCs including the conveyor system. "The investment has proven to be well worth it," Hadsall said. "We've not only improved picking and shipping accuracy, but we've also increased throughput capacity from $1.5 million to more than $5 million in order shipments per day."

By carefully investing in automation expertise and the right technology, Schumacher has eliminated operational bottlenecks and has positioned itself well for a future of continued growth.

Future Enhancements

Hadsall and his team are pleased with their new operational workflow and already exploring areas for additional improvement. Hadsall wants to add scanning to the process of trailer loading. This entails scanning and capturing pallet loading to the truck to increase accuracy and eliminate current manual data recording. "Right now, the staff loads the truck and logs load movement using paperwork to record the operation. Additional labour is required to record and enter pallet movement into our ERP system," he said. "The paperwork is not always completed correctly and becomes a source of error. We want to automate pallet-to-trailer movement with voice and scan validation for additional checks and balances and close the loop on our shipment history reporting."

Hadsall also plans to add cameras, so that as the product is being loaded in the truck, a picture is taken with a time stamp and the order number included with it. "The Numina Group has these tools," he said. "We can add them so if somebody says we shorted them 10 pieces, we can go back through the camera and verify that the pallet was complete when it went on the truck. The picture is worth a 1000 words and provides the final order shipment confirmation."

The company will probably be adding a scan tunnel to dimension lines down the road. "We already know the carton dimensions, but it would be nice to have a real time audit check that verifies the weight and dimensions in case a split case order got repacked in the pack area, especially with the higher costs of dimensional weigh parcel shipments," Hadsall said.

As Hadsell's next steps and new ideas show, Schumacher is winning through its willingness to explore new technologies. By carefully investing in automation expertise and the right technology, Schumacher has eliminated operational bottlenecks and positioned itself well for a future of continued growth

Required:

i. What warehousing challenges were faced by Schumacher Electric?
ii. Identify the practices and technologies that were recommended by The Numina Group to improve operations at Schumacher Electric?
iii. Which areas in the Schumacher Electric Company have been identified for additional improvement?

13.3 Case Study 3

MANAGING THE RISE (AND COST) OF RETURNS by Logityx technologies

Before, during, and likely following this pandemic, sellers are more aggressively working to reduce the cost and volume of returns.

E-commerce was growing rapidly before the COVID-19 pandemic; the U.S. Department of Commerce reported in early 2020 consumers spent $601.75 billion online with U.S. merchants in 2019, a 14.9% increase over the year prior. Then the pandemic hit, and shelter in place, work from home, and related initiatives accelerated this growth. In the first quarter of 2020, which only contained about two weeks of COVID-19's impact, e-commerce sales increased 14.5%-year over-year according to the U.S. Department of Commerce. Of course, e-commerce comes with a unique set of challenges, including a greater number of returns.

As e-commerce has exploded during the pandemic, returns are on the rise and growing fast. According to Statista, "In 2019, retail merchandise returned in the United States accounted for 309 billion U.S. dollars," and that number is widely expected to rise significantly in 2020. Setting aside the actual cost of the merchandise, Statista also projects return costs, including delivery and restocking, will reach $550 billion in 2020. This increased return volume will significantly impact many businesses' bottom lines.

Eliminating Returns All together

Some companies are avoiding returns altogether, including many luxury brands, who choose to skip the expense and improve customer service in one motion. E-tailers (sellers with no brick and mortar stores) are now increasingly following suit, sometimes telling customers to keep incorrect products, and avoiding the cost of returns. Among them, pet supplier Chewy.com does not have a stated policy for avoiding returns, but does have online reviews and anecdotes praising them for replacing wrong or lost orders at no charge to the consumer and encouraging the customer to keep and enjoy the incorrect items or donate them to local shelters.

There are many reasons a company might choose to completely avoid dealing with returns. The return costs might exceed that of the new delivery, the product could be perishable, the collection and restocking process could be cumbersome and time consuming, or keeping the customer happy exceeds all other priorities and eliminating the return saves them an extra hassle.

Accepting Returns

For those committed to handling returns, a two-pronged strategy can help. Reduce the cost of unavoidable returns. First, reduce the cost of unavoidable returns in the face of rising volume. Start by calculating the cost of returns. Knowing whether a $20 product costs $5 to ship each way is useful data for making an informed decision. Likewise, knowing the required shipping speeds can provide critical information; sometimes returns must be expedited as certain products may expire or have other time sensitive requirements.

Once these factors have been identified, merchants can determine, based on their business model, the best course of action, including whether to factor the cost of returns into product prices. E-commerce companies like Warby Parker and Rent the Runway expect every delivery to generate a return, and by building the cost of those returns into their products and services, they ensure returns volume does not affect profit margins.

Retailers using a traditional business model should consider whether this approach makes sense for them as well. To do so, analytics and reporting tools can help them better understand the cost of processing returns, including overall rate of returns, rate of returns by product, or another desired categorization. Armed with this data, they can then determine whether it makes sense to integrate these returns costs into the initial cost of outbound shipments as well as which carriers and service levels to use.

Multi-carrier parcel shipping should also play a critical role, especially in times of flux, like today, during a pandemic. Carriers respond to these situations with fluid rate changes, new surcharges, delayed schedules, and more. Equipping fulfilment teams with multiple carrier services from which to choose helps by ensuring they can select the best or most appropriate carrier service, rate shop to keep costs low, and identify and work around any service delays or disruptions.

Customer-driven returns: A return is initiated when the customer contacts the merchant, completes a screening with a returns representative, and the merchant selects the best carrier service based on the information provided. The merchant then sends the shipping label and any other required labels (such as hazmat) to the customer to package the item for drop off or pick up by the selected carrier.	**Proactively prepared returns:** Removes the extra steps of the customer initiating the returns process and sending the return label(s) upon request. The merchant selects the best carrier service during initial shipment for both the outbound shipment and possible return and includes the required labels in the box when shipped to the customer.

Organizations have options on how to do this:

Regardless of which approach a retailer prefers, they should not leave return carrier service selection up to the customer. Not only does it put too much burden on the customer, potentially damaging the relationship; they also likely don't have the required details to make an informed decision. The prime directive must be to make returns easy for the customer to ensure a smooth transaction, while selecting the most appropriate carrier service.

Forward-thinking organizations who put the customer experience first have employed a variety of creative methods for simplifying returns, including:

- Dual-use labels (labels that serve the purpose of both the outbound shipment and return)
- Peel-off labels (where the outbound label easily peels off to expose a return label)
- And perhaps most notably, accepting returns of online orders in store

This last approach is popular among omni channel retailers that have both online and physical stores, but it was also adopted by Amazon, who partnered with a large retail chain to accept, process, and ship returns at no cost to the customer—they simply initiate the return in the app and take the item to the store where it's scanned, processed, and held until shipment.

Of course, retailers interested in the store-drop-off model for returns must be sure to consider what happens with returns brought to stores. Determining which returns will be sent to distribution centres for restocking, put directly back on the retail shelves at physical locations, recycled if broken, or any other options, is a key component of determining whether this model is viable for any particular business.

Use Analytics to Reduce Avoidable Returns

The second money-saving strategy is reducing the number of avoidable returns. After all, zero returns cost will always be cheaper than any returns cost. Analytics and business intelligence can play a pivotal role in uncovering a variety of cost-saving opportunities beyond criteria for returns carrier service selection. Analytics can identify weak links in fulfilment by tracing wrong product shipments to certain distribution centres, pickers or procedural problems so staff can correct inventory and warehouse management processes or take other steps to resolve the issues. Identifying routinely-returned or problematic products gives the retailer a chance to take proactive steps to address the issues—whether it's something as simple as an incorrect size listing in a product description or something more serious, such as a defect in the manufacturing, prompting regular returns.

Analytics can also play a critical role in identifying the prevalence of fraudulent returns and determining their impact. Combating fraud helps many organizations reduce the cost and volume of returns, as annual losses from merchandise return fraud are estimated at $27 billion, according to Appriss Retail, who also estimates return fraud at 8.8% in 2019, a 76% increase year-over-year.

Luxury brands in particular need processes in place to ensure they never accept counterfeit products as legitimate returns; even infrequent instances of fraudulent luxury product returns can wreak havoc on organizations. Every effort should be made to determine how often this happens and deter future instances.

E-commerce merchants can learn from E-tailers by taking steps to reduce both the cost and volume of returns even as their business rapidly grows. Any of these approaches can pay dividends when proactively applied, but the first steps in determining which model is right for you are gathering and analyzing the data to see where opportunities exist for optimization of the returns process.

Required

i. Identify some of the reasons why companies are completely eliminating returns.
ii. What strategies are being used by the companies accepting returns?
iii. How are analytics being used to reduce unavoidable returns?

UNIT 2

WAREHOUSING STORAGE

Table of contents

LIST OF ABBREVIATIONS AND ACRONYMNS

ASRS	Automatic Storage and Retrieval Systems
DN	Delivery Note
EDI	Electronic Data Information
EPZ	Export Processing Zone
FIFO	First In First Out
GDN	Goods Dispatch Note
GRN	Goods Received Note
IMDG	International Maritime Dangerous Goods
LIFO	Last In Last Out
MRP	Material Requirements Planning
MSDS	Material Safety Data Sheet
MSL	Minimum Stock Level
OPA	Order picking accuracy
PO	Purchase order
RFID	Radio Frequency Identification System
RMA	Return Merchandise Authorization
RSAC	Receiving and Shipping Analysis Chart
RSL	Reorder Stock Level
SKU	Stock Keeping Unit
VLM	Vertical Lift Modules
WEC	Warehouse Execution and Control System
WMS	Warehouse Management System

UNIT 2: WAREHOUSING STORAGE

1.0 UNIT OVERVIEW

1.1 Unit Description

This unit specifies the competencies required to provide warehousing services. This involves selecting warehouse design and layout; allocating warehouse space; processing customs warehoused goods; carrying out inventory management; managing special goods in the warehouse; observing environmental, health, safety and security guidelines; and, delivering exceptional customer service.

1.2 Unit Summary Learning Outcomes

At the end of the sub-module, the trainee should be able to:

i. Select Warehouse design and layout
ii. Allocate warehouse space
iii. Process goods in a Customs Warehouse
iv. Carry out inventory management
v. Manage special goods in the warehouse
vi. Observe warehouse environment, health, safety and security requirements

2.0 WAREHOUSING DESIGN AND LAYOUT

2.1 Learning Outcomes

At the end of this topic the trainee should be able;

i. Know the role of the warehousing in the supply chain
ii. Explain the meaning warehousing design and layout
iii. Design a warehouse
iv. Explain the factors to consider when designing a warehouse layout
v. Apply space planning
vi. Identify types of warehouse Layouts
vii. Select most appropriate layout
viii. Discuss the required maintenance of the warehouse.

2.2 The Role of Warehousing in the Supply chain

Warehousing is one of the key elements in a supply chain network. While the role of a supply chain is to deliver the right products, in the correct quantity, to the right customer, at the right place, at the right time, in the right condition, at the right price, the warehouse plays a significant part in this.

Delivering the right product in the right quantity relies on the warehouse picking and dispatching products accurately. Additionally, delivering to the right customer at the right place, on time, requires the product to be labelled correctly in the warehouse and loaded onto the right vehicle with sufficient time to meet the delivery deadline.

The warehouse also has to ensure the product leaves the warehouse clean and damage free. Finally, at the right price requires a cost-efficient operation that delivers value for money. The warehouse is therefore crucial in delivering the perfect order.

2.3 The Basic Warehousing Decisions

The basic warehousing decisions are briefly described below.

Ownership

In arranging warehousing space, a company has two basic alternatives: private (or leased) ownership of facilities or use of public warehouses. The choice between the two is a major warehousing decision impacting both the company's balance sheet (facility investment) and income statement (warehousing cost). Many companies combine private and public warehousing because of varying regional market conditions and other factors, such as seasonality of demand or supply.

Number of Warehouses

Another important decision is whether to centralise or decentralise warehousing. This decision essentially concerns how many warehouses will be in the supply chain network. Small and medium size organisations with a regional market area often will need only one warehouse, whereas large companies with national or global market areas need to examine the question in great detail. The number of warehouses must be examined in light of transportation alternatives, such as the use of airfreight with one or warehouses instead of five or six warehouses. The high cost of airfreight is traded off against lower costs of inventory and warehousing.

Size
If the company is using public warehousing, the question of what size facility is less important because the public warehousing firm can make more or less space available to meet the warehousing needs at different times. For firms using private warehousing, the size decision is more important because the private facility size, once designed and built, is fixed and cannot be modified without considerable expense.

Location
As with other warehouse decisions, a firm must examine location in a trade-off perspective, such as high-service facilities near markets and raw material mixing close to suppliers. The firm must achieve a desired level of customer service at the least possible location cost.

Layout
A company using private warehousing is faced with the question of how to lay out the warehouse's interior. The company must make decisions regarding aisle space, shelving, material handling equipment, and all the physical dimensions of the warehouse interior. When using a public warehouse, the public warehousing company makes the layout decisions.

Item Stocking
Inventory decisions are required as to what products in what amounts will be stored in which warehouses. These item-stocking decisions are relevant only for firms with multiple warehouses. The firms must decide if all items will be carried at all warehouses, whether each facility will carry only specific items, or whether the warehouses will combine specialisation and general stocking.

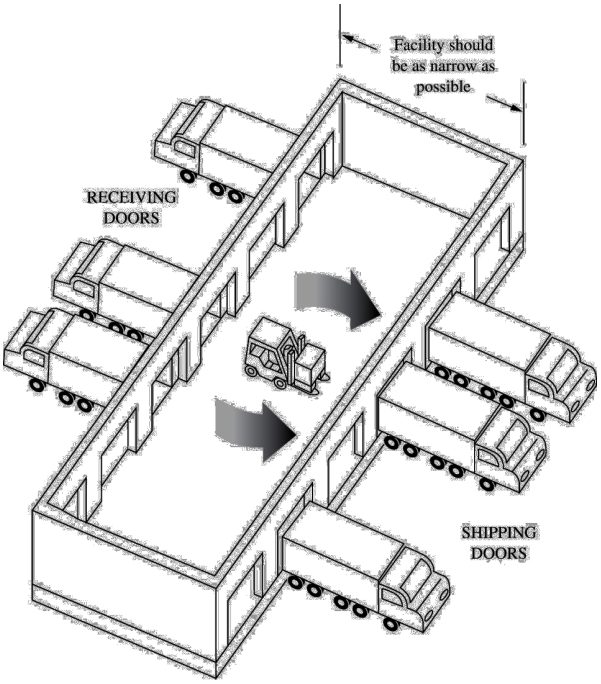
2.4 Warehouse Design and Layout

The goal of warehouse layouts and designing is to optimise a firm's warehousing functions and achieve maximum efficiency, space utilisation within the shortest period possible.

A warehouse is typically divided into areas to support a firm's every day processes. These areas include: reserve storage, forward pick, cross docking, shipping, receiving, assembly/special handling lines, and quality/inspection area.

Warehouse layout is about material flow planning. Planning the flow of materials is important in a warehouse. This is because with a plan, we would most likely be aware of the location of items in the warehouse and also the status and location of the handling equipment. With this information, better control of the warehouse can be achieved.

Designing a new facility starts with analysing your current and projected data on the activities in each of these areas, including the receiving, shipping and inventory levels. This data should be supported by other considerations such as process flows, material handling equipment, type and styles of racking equipment, special handling requirements, and personnel.



2.5 Principles of Warehouse Layout and Operation

When considering the layout and operation of any warehouse system, there are fundamental principles that embody a general philosophy of good practice. The principles are:

i. Gather as much data as possible about the warehousing aspects considered and analyse it.
ii. Forecast the functionality, demand and supply attributes of the business (in 5–10 years' time) and build flexibility in the warehouse design.

iii. Using the most suitable unit load — A unit load is an assembly of individual items or packages, usually of a same kind to enables convenient composite movement (mechanical or manual movements). Typical unit load sizes are wooden pallets, roll cage pallets, tote bins, post and cage pallets and ISO containers.
iv. Making the best use of space — it is important to make the best use of space when planning and operating a warehouse. An effective space utilisation makes good use of total volume not just the floor area.
v. Minimising movement — System planning and operation should aim to minimise movement and movement cost. When deciding a layout, there may have to be a compromise between minimising movement and minimising congestions, while avoiding consequent risk of accident or slowing down of operation.
vi. Controlling movement and location — Control is very important in warehousing. It is concerned with movement and the awareness of where the material is located within a system. The ability to control a system, to have rapid and accurate data on location and system status, enable management to run a warehouse effectively, to respond quickly to changing situations and customer request.
vii. Put the health and safety of staff at the forefront of the design, by providing safe, secure and environmentally sound conditions
    - This helps in minimising accidents and damage.
    - Provide ergonomic equipment.
    - Retain a conscientious and motivated workforce ensures that the facility has sufficient lighting and ventilation.
viii. Maintaining at minimum overall operating cost — This contributes to the objective of minimum total logistics cost.
ix. Using a one-story facility wherever possible — This usually provides more usable space per investment shilling and usually is less expensive to construct.
x. Using straight-line or direct flow of goods into and out of the warehouse — This avoids backtracking and inefficiency.
xi. Using efficient materials-handling equipment and operations — This minimum the overall materials handling expenses.
xii. Using an effective storage plan in the warehouse — In other words, the firm must place goods in the warehouse in such a way as to maximise warehouse operations and avoid inefficiencies.
xiii. Minimising aisle space within the constraints imposed by the size, type, and turning radius of materials-handling equipment — this helps in maximising effective use of space.
xiv. Making maximum use of the building's height — That is, utilising the building's cubic capacity effectively. This is usually requires integration with materials handling. Successful warehouse layouts must adhere to the principles, regardless of material being stored in order to:
    - maximise the use of space
    - maximise the use of equipment
    - maximise the use of labour
    - maximise accessibility to all items
    - maximise protection of all items
xv. Understand the local building regulations and floor loading requirements.

Although the objectives of warehouse layout and operation are easily recognised, warehouse layout problems are often complicated by large varieties of products needing storage, varying areas of required storage space and drastic fluctuations in product demand. Therefore, an effective layout design of the warehouse is required to address these problems and accomplish the objectives.

2.6 Space Requirements Planning

The first step in laying out a warehouse is to determine the overall space requirements for all warehouse processes. The space requirements for each process should be computed and summarised to estimate the overall building requirements. Effective space utilization makes good use of total building volume and not merely the floor area.

For example, when calculating the space required for the receiving and shipping staging area, the number of receiving and shipping dock doors

and the turnaround time for each dock would be considered. A congested dock area can result in arrival and departure delays, lost or misplaced product, incorrect despatches and damage to items. The common practice is to allocate enough staging space behind each dock door to accommodate a truckload's worth of material.

Some other processes that would be considered in the space requirement planning include case picking, pallet storage, broken case picking, packing and unitizing, customizing, cross docking and more.

Other factors that need to be taken into account are:

- Planned utilization within the warehouse. Once storage space utilization exceeds 85 per cent, normally productivity and safety decline. The warehouse operations will slow down significantly as product put-away is delayed whilst space is being freed up.
- The requirement for space between the backs of pallets (flue) and at the sides of pallets.
- The presence and location of sprinklers (ceiling or in rack). The overhead pipes and sprinklers will limit the height both within the warehouse and within the racking itself.
- The type of lighting utilized and any heating or cooling systems installed.
- Lift height of forklift truck. Different types of forklift truck will have different lift-height capabilities.
- Pallet orientation (short facing or long facing). How a pallet is stored within the racking has its own trade-off within the warehouse. Storing a pallet with the long face parallel to the aisle makes it easier for operators to pick, not having to stretch too far across the pallet. However, storing the pallets with the short side parallel to the aisle means greater flexibility more pallets can be stored in a length of racking. Number of pallets per beam (three pallets between the uprights will increase the number of pallets stored by removing a number of uprights).This can save up to 4 per cent of space. However, the maximum weight per beam needs to be adhered to.
- The requirement for cross aisles within the racking to reduce travel and the need for walkways between the end of the racking and the wall to provide escape routes for staff.

Warehouses should also be designed based on current and future needs to:

- Facilitate changes in business/agency growth, and size/population of office and warehouse spaces within the building. Warehouse space should be easily adapted to new functions such as office (on ground or upper levels), computer centres, or light industrial/fabrication.
- Accommodate need for future loading docks, truck space, and car parking spaces if space configuration changes through effective site design.
- Address material handling technologies and business practice, such as "just-in-time" storage, which have fundamentally changed operation of warehouses and distribution centres, and will continue to do so.
- Include roof design with built-in extra structural capacity to handle addition of future roof top equipment.
- Be designed with fire protection capacity to accommodate storage of materials with a greater fire hazard, especially needed with high plastic product content or packaging, and plastic shrink-wrapped pallets.

2.7 Factors Affecting Warehouse Layout and Planning

2.8 Outside Factors

Various external factors influence the design and layout of a warehouse operation. These factors have to be taken into considerations to achieve an optimum overall system.

- **Size and configuration of site** — must be adequate to accommodate required equipment
- **Site access** — must be adequate for the types of vehicle and volume of traffic using that particular site
- **Local authority plans** — the proposed warehouse can be greatly affected by the government development plan
- **Site details** — characteristics of the facilities found in the site such as drainage and ground.

- **Financial considerations** — consider about the rents, costs of ownership, investments grants
- **Building factors** — existing building to be use as a warehouse.

Inside Factors

These factors have a dominant influence on how effectively a warehouse can be operated.

- Flow of goods in the warehouse: 'U' flow or through flow
- Movement of people and equipment
- Access to stock and minimize congestion
- Identification of stock and codes
- Stock location, rotation (FIFO)
- Stock checking requirements
- Stock replenishment
- Handling of goods in and out of the warehouse
- Supervision, safety, stock security

2.9 Features of Good Warehouse Layout

Despite the enormous diversity of different possible layouts of warehouses, and the reasons for the diversity, certain basic features of good warehouse layout can be pinpointed. The features are:

- **Economy —** With few exceptions, storage space is limited; it is at a premium and must **not** be wasted. The most economical and efficient use must be made of the maximum area of storage space available.
- **Accessibility —** All items in the warehouse must be so positioned that they can be identified and located when needed with the minimum amount of time and effort.
- **Flexibility —** Volumes of total stock held, or quantities of different items held, can vary considerably from time to time. Also, changes in the activities of the operations of an organisation may necessitate considerable changes in the items held in the warehouse. The layout of the warehouse must be capable of being rearranged as circumstances dictate.
- **Protection —** The layout of a particular warehouse must afford the maximum protection for the items housed in it, and the warehouse personnel working in it, as well as for any visitors to it.

Advantages of Good Warehouse Layout

Advantages of good warehouse layout are:

- Increased output
- Improved material flow
- Reduced costs
- Improved customer service
- Time saving
- Increased safety of materials and people
- Increased efficiency

2.10 Considerations in Designing Warehouse Layouts

1. Flow

Ensuring the uninterrupted flow of goods, personnel, and equipment is vital to consider in the design layout for the smooth functioning of your warehouse. You can avoid inefficient routes and disruptions by strategically planning your warehouse layout design so as to facilitate each operation in a sequential manner.

2. Accessibility

While planning your warehouse layout, it is crucial to ensure easy accessibility to all the areas and products in your facility. The layout should be designed in a way that makes it easy for personnel to navigate throughout the facility while conveniently locating and picking items without having to move other products. As a result, your productivity can be enhanced and orders can be fulfilled at a faster rate.

3. Equipment

The use of different types of equipment in your warehouse, such as lifting & packing tools, pallet racks, or conveyors, can influence the layout design. By identifying the equipment needed, you can evaluate and design the most suitable layout according to your requirements and boost the productivity of your facility.

4. Throughput

Throughput in a warehouse refers to the number of products that are processed and moved through various warehouse processes such as receiving, putaway, storage, picking, packing, and shipping. By collecting and analyzing this data, you can design a layout to ensure an efficient flow of goods and accommodate the necessary equipment for your warehouse.

5. Personnel

Knowing the number of people required, their current levels of training and shift timings, and other related factors can help you design your warehouse layout in a way that doesn't limit your workforce's productivity. Also, the layout must be planned in a manner that can safely accommodate new employees and their needs in the future.

6. Authority Guidelines

While designing your warehouse layout, it is critical to comply with the guidelines provided by the local authorities. Abiding by these guidelines not only ensures the safety of your workers, equipment, or other valuable assets but also helps you avoid fines and legal problems for your business.

2.11 Types of Warehouse Layouts

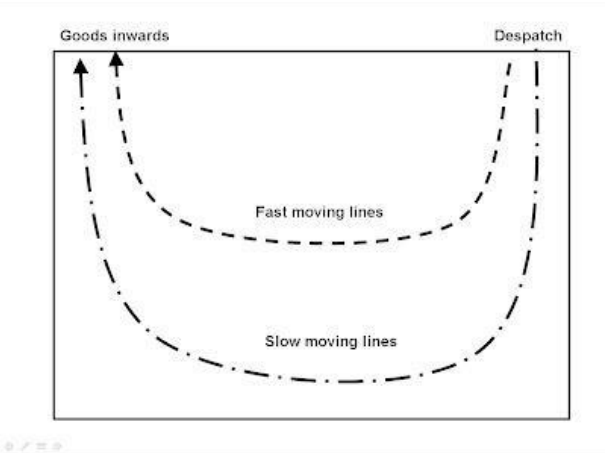
There are different types of warehouse layouts depending on the needs of the organisation and the types of materials to be housed in the warehouse — both main ones and others.

Main Types of Warehouse Layouts

Planning the flow of materials is important in a warehouse. This is because with a plan, we would most likely be aware of the location of items in the warehouse and also the status and location of the handling equipment. With these information, better control of the warehouse can be achieved. There are two main approaches of the plan of material flows. They are the **'U' flow** and **'Through' flow**.

- **U Flow (or Cross Flow) Warehouse Layout**

  A 'U' flow occurs when the goods receipt and dispatch functions are located at the same end/side of a warehouse building. Products flow in at receiving, move in to storage in the back of the warehouse, and then to shipping, which is located at the adjacent to receiving on the same side of the building. Items with higher throughput level are located closer to the located closer to the loading bays.



Advantages of 'U' Flow

- Excellent utilization of dock resources because the receiving and shipping processes can share dock doors
- Facilitating cross-docking because the receiving and shipping docks are adjacent to one another and may be co-mingled
- Excellent lift truck utilization because put away and retrieval trips are easily combined and because the storage locations closest to the receiving and shipping docks are natural locations to house fast moving items
- Yields excellent security because there is a single side of the building used for entry and exit

- **Through Flow Warehouse Layout**

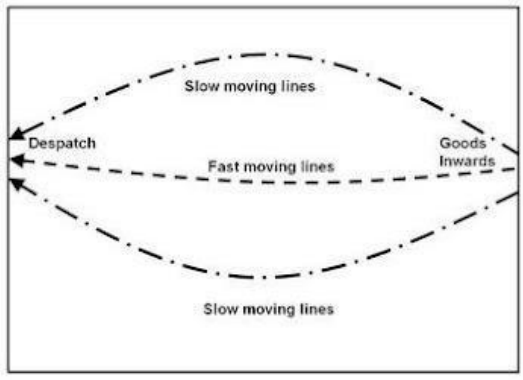
In this layout, materials inwards and materials outwards are on opposite sides of the warehouse building. Products flow in at receiving, move into storage, picking area and then the marshalling and despatch area in a straight line. All items must therefore travel full length of the warehouse. The layout also requires separate materials inwards and materials outwards management with dual yard access and this doubles the internal bay areas. Items with a higher throughput level are located at the center of the warehouse because the total distance travelled would be shorter.

'Through' flow can be used when:

- When there is a risk of interference or confusion between goods in and goods out
- When goods inwards vehicles and

dispatch vehicles are very different; for example differences in platform height or nature of unit load
- When a warehouse is connected to a production plan

An example of a 'Through' flow layout design is shown on the diagram below.



The major disadvantage of a 'Through' flow layout is goods need to travel the full length of the warehouse, even for goods that have a higher throughput level. It is also harder to control and less flexible.

2.12 Maintenance of the Warehouse

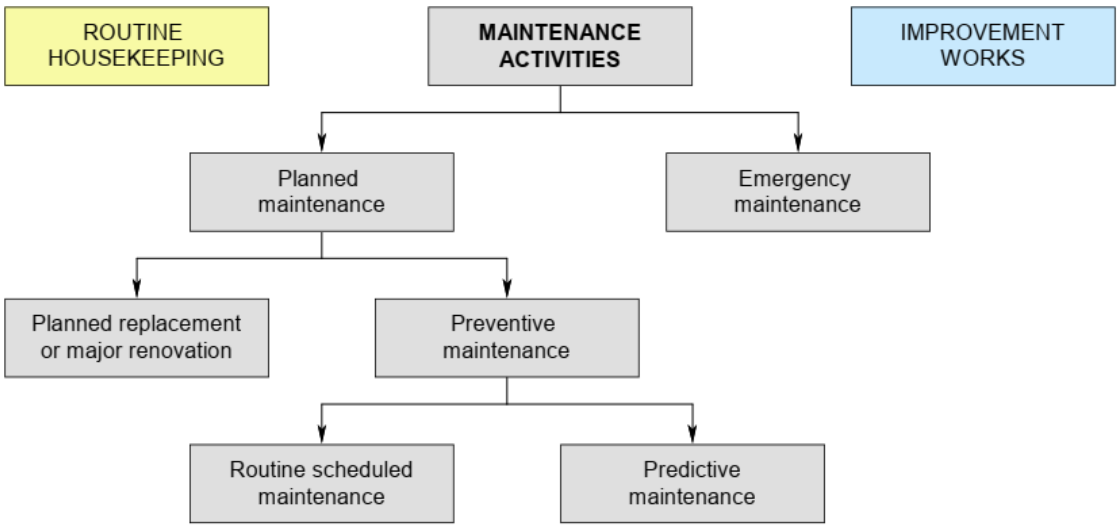
Maintenance of buildings, effectively carried out, ensures that the building and its contents are protected from damage and loss. In the case of a warehouse, the value of the inventory that is stored in the facility may well exceed the value of the building itself. Unfortunately, maintenance is often neglected and underfunded in the public sector. Defects accumulate and, if they are dealt with at all, this takes place in a piecemeal fashion.

Importance of Warehouse Maintenance

The purpose and scope of building maintenance has been defined in many ways. A good general definition is that: Building maintenance is the totality of all actions that keep a building functioning effectively. All buildings deteriorate over time. Maintenance, if well carried out, rectifies this deterioration and returns the building to its original as-built state. Maintenance helps protect the financial assets tied up in the building; it is not the same as improvement. The purpose of improvement is to alter and/or extend the building in ways which respond to changing user requirements and this may increase its value.

Types of maintenance and related activities

In order to be effective, both financially and operationally, maintenance activities should be programmed. If an effective maintenance regime is in place, emergency maintenance should only play a minor part in total maintenance activity; however, some unplanned 'emergency' maintenance will always be needed and adequate resources need to be allocated for this purpose.



Adapted from Stanford, 2010

Programmed maintenance is sub-divided into the following categories:

a. **Planned replacement** ensures that building elements such as windows and roof finishes are replaced when they reach the end of their designated service life. Planned replacement minimizes the need for emergency maintenance and prevents the consequential damage which will occur if the element is left to fail.

b. **Preventive maintenance** ensures that building elements are well maintained and that they do indeed achieve their designated service life. This can be achieved by routine scheduled maintenance – for example regular redecoration of windows or regular lubrication of mechanical components – or by predictive maintenance – dealing with a minor problem identified during a routine inspection, such as vibration in an air-conditioning unit, before it develops into a major problem and becomes an emergency.

2.13 Learning Activities

In not more than 1000 words, compare and contrast the u-shaped lay out and the through flow lay out. Be certain to include the inherent benefits and challenges of each layout in your discussion.

2.14 Self-Assessment Questions and Activities

1. The major problem addressed by the warehouse layout strategy is?
    a) Minimize the difficulties caused by material flow varying with each product
    b) Addressing trade-offs between space and material handling
    c) The movement of material to the limited storage areas around the site
    d) Requiring frequent contact close to one another

2. Which of the following is not a type of warehouse layout?
    a) U-shaped
    b) I-Shaped
    c) Corner Flow
    d) H-Shaped
3. The following are considerations in designing warehouse layouts except?
    a) Flow
    b) Accessibility
    c) Equipment
    d) Throughput
    e) None
4. Advantages of a Good Warehouse Layout a r e (i) Increased output (ii) Improved material flow (iii) Increased costs (iv) Improved customer delays
    a) and (iv)
    b) and (iii)
    c) (i) , (ii) and (iv)
    d) All

2.15 References

- Dukic, Goran & Tihomir, Opetuk. (2014). Warehouse Layouts. Warehousing in the Global Supply Chain: Advanced Models, Tools and Applications for Storage Systems. 55-69. 10.1007/978-1-4471-2274-6_3.
- Stanford, H.W. Effective building maintenance: Protection of capital assets. Fairmont Press, Lilburn GA, 2010. http://books.google.co.uk/books?id=wVV5g0UQnsC&printsec=frontcover#v=onepage&q&f=false
- Wood, B. Building maintenance. Wiley-Blackwell, 2009
- Edward H. Frazelle, World-class warehousing and material handling (2002)
- Johnny Tan, Oh Hui Ling, Cheryl Wee-Teo (2007). Distribution Centre Management, Fourth Edition
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Walters, D. (2013). Inventory Control and Management, 2nd ed. John Wiley & Sons Ltd.
- Bragg, S. M. (2011). Inventory Best Practices, 2nd Edition. John Wiley & Sons Ltd.
- Wild, T. (2018). Best Practice in Inventory Management 3rd Edition. Routledge

3.0 WAREHOUSE SPACE MANAGEMENT

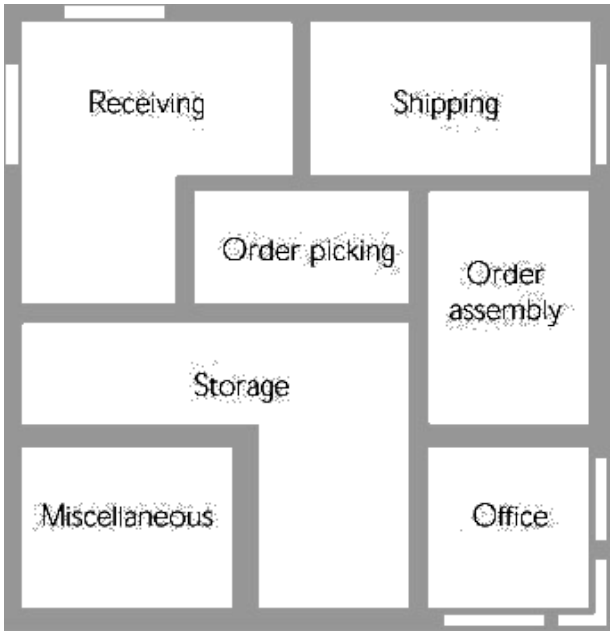
3.1 Learning Outcomes

At the end of this topic the trainee should be able;

i. Determine space requirements
ii. Determine dock area and size
iii. Determine aisle spacing and work space areas
iv. Accurately determine space for receiving and shipping
v. Allocate space based on nature of goods, flow, accessibility and throughput
vi. Manage warehouse space
vii. Discuss the issues between capacity versus speed of retrieval

3.2 Determining Space Requirements

The size of warehouse required for an operation is determined by the maximum quantity of supplies, in tonnage and volume that will be stored there at any one time. This quantity is determined by calculating the number of customers, the lead-time needed to replenish the warehouse, the type of distribution system in use, the frequency of distributions (monthly, weekly, etc.), and the nature of the goods that consumers need.



A survey by Cranfeld University (Baker and Perotti 2008) indicated that 52 per cent of the warehouse floor area is typically used for storage, 17 per cent for the pick/pack operation, 16 per cent for receiving and despatch, 7 per cent for value-adding services and a further 7 per cent for areas such as battery charging, empty pallet storage and other uses. This of course will very much depend on the type of operation envisaged.

Key Warehouse Floor Space Areas

The main floor-space areas within the warehouse that need to be calculated are as follows:

i) receiving area
ii) quarantine and inspection area
iii) reserve storage area
iv) carton-picking area
v) item-pick area
vi) value-adding services area
vii) packing area
viii) despatch area
ix) cross-dock area
x) empty pallet and packaging storage area
xi) warehouse offices and
xii) restrooms/changing rooms

3.2.1 Best Practices when Determining Space Requirements

- When calculating storage requirements, assume that only 70-80% of the warehouse's surface capacity is actually available for storage. The remaining 20-30% is required for ventilation, passageways, handling space, and repackaging areas.
- The maximum height of stacks depends on the type of goods and their packing. As a general rule, to facilitate handling by warehouse workers, avoid damage to goods, or the risk that stacks will topple over, stacks should not be higher than 2.5 m.
- Limit stack sizes to no more than 6m x 6m to prevent excessive floor load and pressure damage to packaging or goods.
- Allow at least one metre of space around and between stacks, walls, pillars, beams or other obstructions, for ventilation and manoeuvring.
- Build stacks in a square shape to maximize storage capacity.
- Different items, packages and consignments must be stored in different stacks. Each stack should contain a single item with the same Purchase Order (PO) number.
- Pallet orientation (short facing or long facing). How a pallet is stored within the racking has its own trade-off within the warehouse. Storing a pallet with the long face parallel to the aisle makes it easier for

operators to pick, not having to stretch too far across the pallet. However, storing the pallet with the short side parallel to the aisle means greater flexibility. This can save up to 4 per cent of space. None the less, the maximum weight per beam needs to be adhered to.

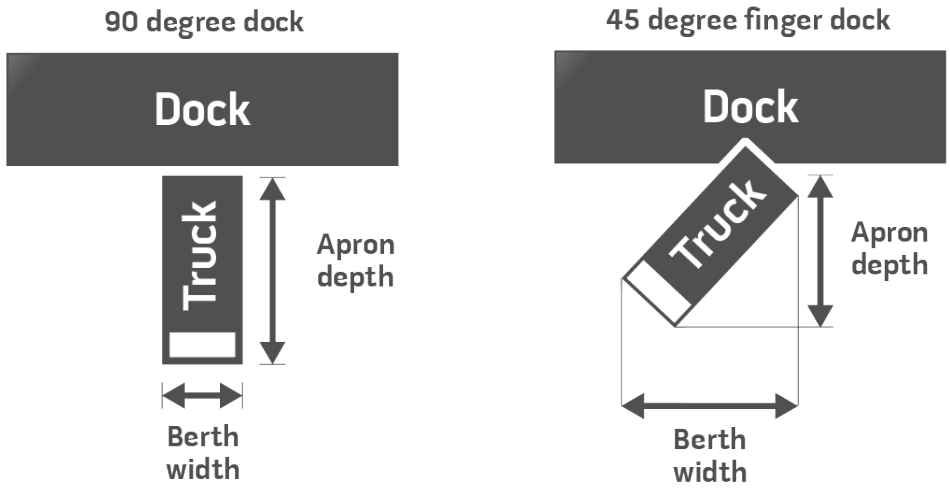
- Cross aisles within the racking to reduce travel and the need for walkways between the end of the racking and the wall and could as well provide escape routes for staff in case of an emergency.

3.2.2 Determining Dock Requirements

It is important to determine the requirements for the receiving and shipping dock bays. Important questions to keep in mind when planning this are:

- How many dock bays are required?
- Frequency of activity
- Carrier inter-arrival time and service time
- Guessing
- Waiting line analysis
- Simulation
- How should the dock bays be configured?
- Types of vehicles at the dock bay

Due to the limitation of space in the warehouse, the truck can be parked in two formats, either 90 or 45 degrees to the dock, to cope with the limitation.



A 90-degree dock requires less width and more depth. It also requires less inside warehouse space and more outside space than a finger dock.

3.2.3 Manoeuvering Allowances Inside the Warehouse

Space is needed to enter and exit the carrier and to travel between the carrier and the receiving buffer area or the shipping staging area. This area is occupied by the dock levelling devices.
An aisle must be located between the back edge of the inside dock levelling device and the receiving buffer area or the shipping staging area. The required width is six to eight feet for manual handling and non-powered material handling equipment and eight to 12 feet for powered material handling equipment.

3.2.4 Buffer and Staging Area Requirements

- The receiving buffer area serves as a depository for the materials uploaded from the carrier where a thorough check-in and inspection must be performed.
- The shipping staging area serves as an accumulation point for the merchandise that comprises a shipment. This is where packaging, unitising and verifying the customer order takes place.

Keep the following in mind when determining the amount of space needed for the buffer or staging area:

- The matter of the degree of control over the dock area which is based on how much area is required during surge periods
- Existing facilities need to be considered by analysing historical shipping pattern
- For new facilities, ask the anticipated suppliers and users how much space will be needed, based on the anticipated surges in activity
- Aisle space within the buffer or staging area

3.3 Aisle Spacing and Work Space Areas

A crucial aspect of warehouse layout is aisle width. This is the distance between pallets in adjacent racks. To ensure safety we need to calculate the distance between the pallets once they have been put onto the racks. The aisle width is determined by the turning circle of the forklift truck and the size of pallet being carried.

The maximum aisle width for a warehouse depends on what the material handling equipment requires to safely navigate the corridors and efficiently pick products. The aisle width also depends on the products placed and the type of pallets in use. There is no precise measurement. Widths are entirely relevant to how the overall warehouse functions.

There are, however, specific parameters and guidelines you need to consider when designing efficient and highly productive warehouses. It begins by appreciating how much additional space you can gain by narrowing your aisle widths. For instance, reducing your aisle width from 12 feet to eight feet gives you an extra 15 to 20 percent of storage area. That, in itself, is a significant saving and an excellent method of increasing warehouse capacity without physically expanding your building.

One foot of clearance sounds like a lot of extra room when you're striving for maximum efficiency in minimum aisle layouts. In very narrow aisle warehouses, the foot of clearance could extend a five-foot aisle to six feet. That's a 20 percent increase in space, and that sounds like a lot of expensive room to give up.

You need to start with your mobile equipment's limitations before setting your fixed material handling products in place. It's much easier to put your pallet racks or storage and shelving units in a safe position than it is to go out and purchase new material handling equipment to accommodate narrow warehouse aisles.

It makes good sense to narrow your aisles to a minimal size where your mobile equipment still functions. It is one of the best strategies to make the highest and best use of your storage space. However, calculating the minimum aisle size can be tricky. The best approach you can take is working with a provider of storage products and material handling equipment.

3.4 Determining Space for Receiving and Shipping

When calculating the space required for the receiving and shipping staging area, the number of receiving and shipping dock doors and the turnaround time for each dock would be considered. A common practice is to allocate enough staging space behind each dock door to accommodate a truckload's worth of material.

The most important functions of a warehouse take place on the receiving and shipping docks. Unfortunately, these are also the most neglected areas of the warehouse. Receiving and shipping activities as well as storage activities require careful space planning. So how then do we plan the space requirements for shipping and receiving? You would need to:

- Define the materials received and shipped
- Determine the dock bay requirements
- Determine the dock bay configuration
- Determine the manoeuvring allowances inside the warehouse
- Define the buffer and staging area requirements
- Define the dock-related space requirements

You would make use of a receiving and shipping analysis chart (RSAC) to help you with the above. Let's take a closer look at an example of a RSAC:

Description	Unit Loads				Size of shipment (Unit loads)	Frequency of shipment	Transportation		Material handling	
	Type	Capacity	Size	Weight			Mode	Specs	Method	Time/hour
1	2	3	4	5	6	7	8	9	10	11
Steel pipe plug	Wooden crate	3200 pieces	2ft x 2ft x 4ft	835lb	12 crates	Quarterly	Truck	34ft x 8ft x 7ft	Fork truck	0.75
Steel pipe plug	Bundles	25 bars	12.5in x 14in x 6ft	1625lb	bundles	Monthly	Open-bed truck	34ft x 8ft	Crane	5

- Columns 1 - 5 define what is to be received or shipped
- Column 6 displays the size of the shipment
- Column 7 shows when the receipts and shipments will occur
- Columns 8 - 9 list the types of carriers
- Columns 10 - 11 show the handling methods and time required for loading and unloading

3.5 Allocating Space Based On Nature of Goods, Flow, Accessibility and Throughput

According to Gagliardi, Ruiz and Renaud (2008), storage strategies mainly concern how SKUs are assigned to the available slots. Classic storage strategies include dedicated storage, in which products are allocated to fixed locations; random storage, in which products are allocated to various locations according to the available storage space; and class-based storage, in which products are allocated to specific zones or areas in the warehouse.

Bakkali Azmani and Fennan (2013) further clarify that for dedicated storage, if the product is not available in the warehouse, then the location will be empty and there will be loss of space. Whereas, for random storage, the same product can be found at different locations and therefore that causes a loss of time to search and retrieve products. As a conclusion, according to the chosen policy there will be a waste of space that will be offset by a gain in time or the reverse.

Four significant elements come into play when designing or laying out any storage or distribution facility, regardless of whether for example, it is a large multi-temperature composite distribution centre servicing a high market network, a spare parts store in a mobile service centre, or a raw materials store supporting a manufacturing operation. The four fundamental factors can be remembered by using the pneumonic FAST or fast standing for:

- F - Flow
- A - Accessibility
- S - Space
- T - Throughput

Flow

This is a logical sequence of operations within the warehouse where each activity is located as close as possible to that which precedes it and similarly, the function that follows it.

The concern is with the controlled and uninterrupted movement of materials, people and traffic with, if possible, no cross-flow clashes or areas of high traffic or work density.

It's also critical to know where materials are located within the system, and the status and location in the storage and handling equipment and medium. The aim here should be to situate the various warehouse activities so that each contributes to a smooth flow of operations with a minimum amount of movement and disruption.

Accessibility

By accessibility, we don't merely mean whether or not we can get to the product. For example, we need to know if we can get to the required level of packaging unit. In the case of bottled water for instance, from a regional or national FMC distribution centre, we'll be looking at being able to receive and issue product by the pallet load or possibly even by the truckload. Therefore, you only need to access full pallets, and since bottled water is very fast moving with a long shelf life, a strict policy of first-in-first-out (FIFO) by row to individual pallet level needs not be followed. At the wholesaler or distributor level, you might be accessing inventory down to case level and then in the convenience store stock room, individual bottles.

It can go further than this, of course. For pharmaceuticals, access may need to extend beyond individual item level down to specific lock and batch number. These requirements for levels of accessibility must be achieved, especially in the pick face and fast moving stock holding areas, but without unnecessarily compromising the next factor in the FAST model, which is the use of space.

Space

When considering how to use warehouse space the maximum should be allocated to operational storage and stock processing purposes, while giving up the minimum of space necessary for associated functions such as offices, working areas, empty pallets storage, battery charging, etc.

Thanks to the array of storage media available in today's market, it's possible to make optimum use of the cubic capacity of a warehouse's space—and not only within the floor area.
As most modern storage equipment is free standing and requires no structural support from the building itself, a warehouse building can be of the simplest and cheapest big box design. For the same reason, it's possible to build flexibility into the operation, by selecting the storage media that best meets the current stock profile and then changing it as the business evolves to meet future requirements. Again, this can be done without expensive and disruptive changes to the actual building—but remember, you still have to consider flow, accessibility, and now finally, throughput.

Throughput

In exploring warehouse throughput, we are not only looking at the categories of product passing through the warehouse, but also the nature of the product and its velocity through the flow. By nature, we mean the handling characteristics, dimensions and any other factors that will affect how inventory moves through the facility, such as hazard, bulk, fragility, security requirements and compatibility with other products.

The velocity of the product will consider the volume that's moving through the warehouse on each day. You will need to determine peak period activities as well as minimum activity levels. High availability of accurate throughput data will be of great aid to the outcome of the design or layout exercise.

3.6 Managing Space in a Warehouse

3.6.1 Calculating the Total Storage Capacity of the Warehouse

To figure out how well you're using your warehouse storage space, you first need to calculate the total storage capacity of the building. A common mistake is merely calculating the square footage of the entire facility and leaving it at that. This number, however, does not account for space within the building that cannot be used for product storage.

For this reason, you have to take a few additional steps to reach an accurate number for your warehouse's total storage capacity. Follow these four steps:

1. Calculate the complete square footage of your warehouse. Let's say it's 100,000 square feet.
2. Subtract the total square footage of space that is used for non-storage purposes. This should include any office space, bathrooms, loading areas and other space where you cannot store goods. Let's say that calculation comes out to 20,000 square feet. So, your warehouse has 80,000 square feet of usable space.
3. Determine your building's clear height, which is the distance from the floor to an overhead object. For most buildings, this would be the distance from the floor to the facility's steel shell, but it could also be the distance from the floor to the lowest-hanging overhead objects, such as lighting or equipment. Your building's clear height will impact your usable space because it dictates how high up you can store items.
4. Multiply your total square footage of usable space (80,000) by your facility's clear height to determine your warehouse's storage capacity in cubic feet. Going with our example, if your building's clear height is 25 feet, it has a total storage capacity of 2,000,000 cubic feet.

The reason you must convert your warehouse's total storage capacity into cubic feet is because it makes it easier to analyze how well you're using that space, as you can also calculate your warehouse storage utilization in terms of cubic feet.

3.6.2 How to Maximize Warehouse Space Utilization

Evaluate whether you can extend your racks up vertically

Extending racks up is usually the "lowest hanging fruit" to create more space. Typically, new buildings have ESFR which is a fire suppression sprinkler system, and you can store inventory within 18 inches of that area. There are some pitfalls of rack extension – the racking uprights or base plates may not be sized properly. In that case, a structural engineer and a PE can confirm that rack extension is a viable option.

Consider installing a mezzanine above a floor-level process

One of the best ways to increase space is to add a mezzanine. Installing a mezzanine above a floor-level process, like a shipping or receiving area, can nearly double floor space. Of course, there are pitfalls with a mezzanine as well. The floor loading must be able to handle it. There will be columns and base plates that now drop down to the floor that could be in the way of the process that's below it, but it is much better to add a mezzanine, if possible, than to expand the building.

Reduce aisle width in the racking area

A wide aisle can range from 10 to 12 feet, but if that can be reduced to anywhere from five to eight feet, 15 to 20 percent of the area can be saved. When considering this option, lift equipment must be evaluated. However, the material handling equipment should be capable of following or working in those narrow aisles. There is also an added expense of wire guidance in a very narrow aisle situation.

Evaluate and change your storage medium

Another option is to change the storage medium to higher density equipment, moving from a single-deep rack to a double-deep rack for example. A double-deep rack requires a reach truck to load pallets. Push-back or drive-in racks are also higher density equipment alternatives. These options are great for adding storage, but the problem becomes FIFO: first in, first out. Higher density limits accessibility to the first-in pallets.

Add half-pallet locations for product that comes in half-pallet quantities

Adding half-pallet locations can save space since some product comes in only a half-pallet quantity. We see that as fluid volume as opposed to just what's in that area. Think of it as ice cubes in a glass. If I poured water in a glass, there is a lot more liquid. If I put ice cubes in a glass, there is more space. If you condense your pallets, you can put more pallets, and therefore more product, in the same area without too much white space.

Leverage your warehouse management system for directed put-away

Directed put-away is a great way of creating or saving space in a warehouse as well. It's usually directed by your warehouse management system where instead of the put-away rules being just "put the pallet wherever you want", directed put-away knows what locations are best suited for pallets. It tells you where to put a certain pallet as opposed to letting a worker put it in the most convenient location.

Identify underutilized space

Use space you never thought you had before. There's often space above receiving or shipping doors where pallet racks full of supplies, slow-moving materials, or staging for inbound or outbound product that hasn't yet been processed can be placed. If there is a pick module in the facility and a conveyor down the center of the module, hang a shelf above the conveyor. It's an easy way to increase locations for smaller or slower-moving items that don't need replenished as frequently. Those products will need to be replenished by hand or by the conveyor system.

Store product in trailers for short-term, seasonal needs

Finally, storing products in trailers is sometimes a necessary solution to temporary storage needs. Many warehouses will bring in extra trailers and pay the demurrage charge for temporary storage without a building expansion. This is frequent for seasonal product, especially among retailers.

Storage Capacity versus Speed of Retrieval

Storage systems are used to store materials related to the product (e.g. raw materials, purchased parts, work-in-process, finished products, and scrap and rework), the process (e.g. process refuse, such as

process waste products; and tooling), and the overall support functions in the factory (e.g. maintenance spare parts, office supplies, and plant records). Storage systems can be classified into conventional storage systems and automated storage systems.

Conventional Storage Systems

Conventional storage methods and equipment refer to how storage is regularly accomplished, and the pieces of equipment that is used to achieve storage aims. Storage methods and equipment include: bulk storage for use by pallet trucks and powered forklifts; rack systems for use by pallet trucks and powered forklifts; shelving and bins for use by manual attendants or powered forklifts; and drawer storage for use by manual attendants.

Automated Storage/Retrieval Systems

An automated storage/retrieval system (AS/RS) is a storage system that performs storage and retrieval operations with speed and accuracy under a defined degree of automation. Different levels of automation may be applied. At one extreme, the AS/RS is completely automated. This can include a full complement of totally automated, computer-controlled storage functions that are integrated into overall factory or warehouse operations. At the other extreme it may use human workers to control equipment and perform storage/retrieval transactions. Using modular components, available from AS/RS vendors, the AS/RS system is custom-designed to fit the requirements of the plant in which it is installed.

3.7 Learning Activities

1. Inadequate storage space and inefficient use of available storage are common problems in warehouses. Produce a short paper of approximately 2,000 words explaining how you would address both these issues.
2. Visit any warehouse close to you and determine the following:
   a) Space management
   b) Space maximization strategies in use
   c) The use of FAST in space allocation

3.8 Self-Assessment Questions and Activities

1. This quantity of supplies to be kept in a warehouse is determined by the following except?
   a) lead-time needed
   b) the type of distribution system
   c) frequency of distributions
   d) the nature of the goods
   e) none

2. Due to space constraints at the docks, the truck can be parked in two formats, either
   a) 45 degrees and 180 degrees
   b) 60 degrees and 90 degrees
   c) 90 degrees and 180 degrees
   d) 90 degrees and 45 degrees

3. Four significant elements come into play when designing or laying out any storage facility. These are?
   a) Flow- Accessibility-Speed-Through Put
   b) Flow-Accuracy-Security-Time
   c) Fast-Adopt-Safety-Technology
   d) Flexibility-Agility-Speed-Time

4. When calculating the space required for the receiving and shipping staging area, the following are considered, except?
   a) Number of receiving dock doors
   b) Number shipping dock doors
   c) The turnaround time for each dock
   d) The Size of the delivery vehicles
   e) None

3.9 References

- Bakkali, Hajira & Azmani, Abdellah & Fennan, Abdelhadi. (2013). Dynamic Allocation of Products to Storage Areas in the Warehouse. International Journal of Computer Applications. 84. 36-43. 10.5120/14663-2974.
- *Gagliardi, J., Ruiz, A.B., & Renaud, J. (2008). Space allocation and stock replenishment synchronization in a distribution center. International Journal of Production Economics, 115, 19-27.*
- Huq, Faizul & Bhutta, M. & Cutright, Ken. (2015). Excess warehouse space allocation for cost reduction and customer service improvement. International Journal of Business Continuity and Risk Management. 6. 68. 10.1504/IJBCRM.2015.070354.
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Walters, D. (2013). Inventory Control and Management, 2nd ed. John Wiley & Sons Ltd.
- Bragg, S. M. (2011). Inventory Best Practices, 2nd Edition. John Wiley & Sons Ltd.
- Wild, T. (2018). Best Practice in Inventory Management 3rd Edition. Routledge

4.0 WAREHOUSING CUSTOMS GOODS

4.1 Specific Learning Outcomes

At the end of this topic the trainee should be able;

- Explain the types of bonded warehouses
- Discuss licencing of bonded warehouses
- Explain the procedures for depositing and removal of goods in a bonded warehouse
- Explain the exceptions of bonded warehoused goods
- Explain the documents used in bonded warehouses

4.2 Warehousing Customs Goods

Customs warehousing allows for the storage of imported goods in an authorised designated location within the customs territory of the EAC without being subject to import duties. The duty liability is discharged if the goods are re-exported outside of the EAC region. If the goods are released to free circulation, then the duty and other charges become payable at this time.

4.3 Warehousing Custom Regimes

Imports cleared for warehousing in destination Partner States

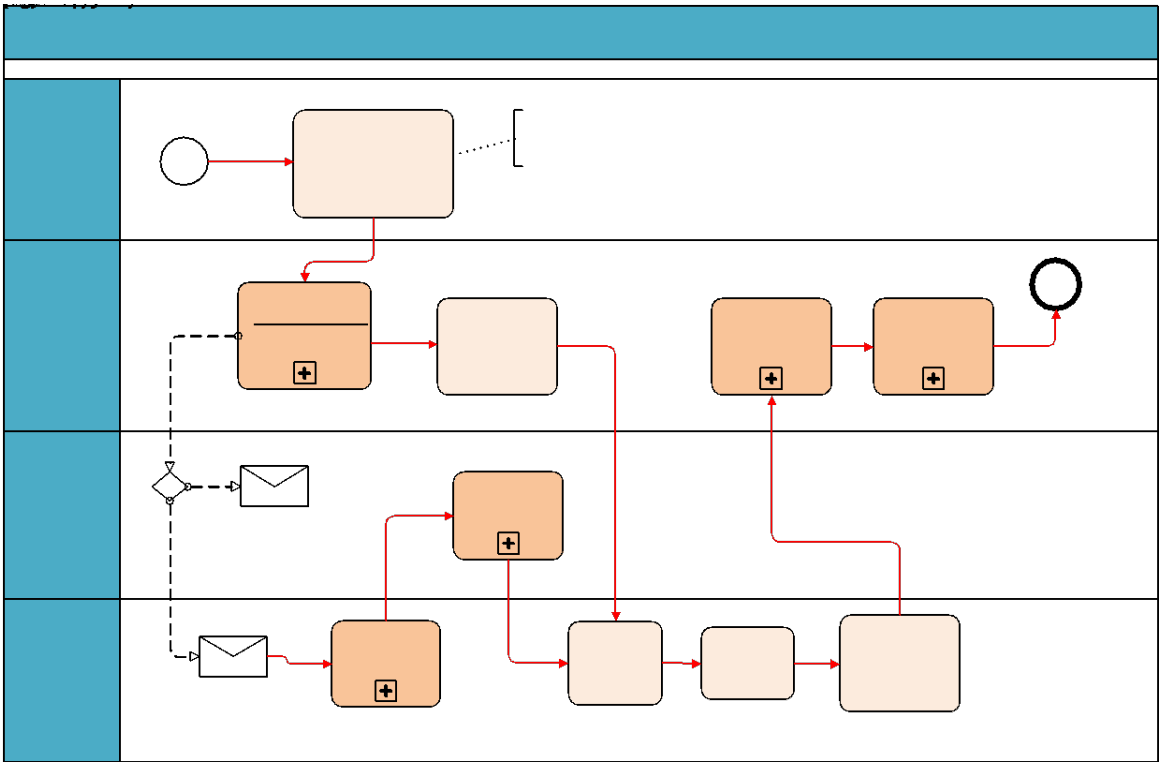
The following principles shall apply under the Single Customs Territory:

i) A single regional bond system shall apply to enable movement of goods within the territory;
ii) Goods shall be entered once for warehousing prior to or upon arrival at the first point of entry;
iii) Goods may be warehoused in a Partner State other than the Partner State of destination with approval of destination Partner State;
iv) Goods may be removed from a bonded warehouse in one Partner State to a bonded warehouse in another Partner State under bond.

The following shall be the detailed process of clearing goods under warehousing, temporary import, exemptions and EPZ in destination Partner State;

Stepwise instructions for clearing goods for warehousing:

i. The process of initiating the transaction shall be the same as defined under the clearance of goods for home consumption.
ii. Upon assessment of the Warehousing Declaration (WT8), the destination Customs Authority shall release the Declaration after all conditions have been fulfilled;
iii. Upon release, a release message or notification is sent to the Customs system of first point of entry and Port authorities who then commences the cargo removal process;
iv. The Customs officer of the destination Partner State validates departure in the system and generates the transit document T1 for the respective truck;
v. The T1 is then transmitted to the Customs system of the first Port of entry;
vi. After generation of the T1, the officer then proceeds to seal the cargo;
vii. The customs officer of the Partner State of first port of entry then generates C2, and releases the truck or wagon out of the Port or CFS or ICD;
viii. After release from the facility, cargo is monitored and tracked by enforcement and RECTS where applicable;
ix. Upon arrival at the border, the Border management procedures as stipulated under home consumption are followed;
x. Upon cargo arrival at the Bonded Warehouse, the officers at the bonded warehouse validate arrival of theT1; and a manifest is generated;
xi. The Agent uses the manifest to capture the warehousing declaration (IM7); and the RCTG Bond is retired upon assessment of the IM7.



A flow Chart of Declaration for Warehousing

4.4 Types of Bonded Warehouses

The Customs Warehouse:" means any place approved by the Commissioner for the deposit of un entered, unexamined, abandoned, detained, or seized, goods for the security thereof or of the duties due thereon.

Under Customs procedure, Warehouses are broadly categorized as **Government warehouses, Customs bonded warehouses and Customs warehouses.** The three broad categories are further sub-divided into public and private warehouses.

Government warehouses

A Government Warehouse is any building or place provided by the Government in a partner state, and approved by the Commissioner Customs for the deposit of dutiable goods on which duty has not been paid and which have been entered to be warehoused.

Customs warehouses

A Customs Warehouse is "any place approved by the Commissioner for the deposit of un-entered, unexamined, detained or seized goods for the security thereof or of the duties and taxes due thereon. "Any place or premises may be deemed to be a Customs warehouse by a proper officer where the situation so warrants.

Customs Bonded Warehouses

A bonded warehouse is any building or place licensed by the Commissioner Customs for the deposit of dutiable goods on which duty has not been paid, and which have been entered for warehousing.

Categories of Bonded Warehouses

1. **Private Bonded Warehouse** – only for the warehousing of goods which are property of the warehouse keeper. The Private Bonded Warehouse will further be subdivided and be licensed in specific categories as;
   a. Private Bonded Warehouse for general goods
   b. Private Bonded Warehouse for motor vehicle units
   c. Factory Bonded Warehouse
   d. Manufacture Under Bond Warehouse
2. **Specific Bonded Warehouse** – refers to warehouse specific goods and/or under specific conditions for which requires specific facilities of storage. These may include examples such; Specific bonded Warehouse in Silos for grain, Warehouse for bulky cargo like steel products, etc.

c. **General Bonded Warehouse**- for warehousing of all goods generally; can be used by any importer from the public for storage of such goods pending payment of duty. The General Bonded Warehouse will be applied for in specific categories as;

aGeneral Goods Bonded Warehouse
b.General Motor Vehicle Bonded Warehouse.

4. **Transit Yard**- PURSUANT to the provisions of Section 12 of the East African Community Customs Management Act, 2004, and Regulation 35 of the East African Customs Management Regulations, 2010, the Commissioner of Customs prescribes the conditions as the minimum conditions to be fulfilled by an applicant to operate a Transit Shed. Licensed Transit Yard shall be a facility to facilitate temporary storage of cargo on transit and facilitate transhipments in line with the conditions detailed in this document.

4.5 Licencing of Bonded Warehouses

According to section 62 of the East African Community Customs Management Act 2004, the Commissioner may, on application, licence any building or any other place as a warehouse for the deposit of goods liable to import duty; and the commissioner may refuse to issue any such license and may at any time suspend or revoke any license which has been issued.

Application for the approval and licensing of any premises, as a bonded warehouse must be submitted to the Commissioner Customs in the Form C22, which must be accompanied by a plan of the proposed building and its situation in relation to other buildings and thoroughfares.
A security Bond to secure the duty on the goods deposited in the bonded warehouse, when licensed, is to be given by the applicant in accordance with the Form C B.6. The applicant is to comply with the bond security amount and additional request for collateral security fixed or requested for by the Commissioner Customs.

i. The prospective licensee should prepare for an inspection to be undertaken by a Customs officer to satisfy him/herself that the premises are:
   a. safe, secure, waterproof and pest-proof
   b. suitable for use as a bonded warehouse as far as construction and situation in
ii. regard to other buildings and accommodation are concerned:
iii. fitted with adequate lights and suitable ventilators, and
iv. fitted with doors capable of being secured by Customs locks in addition to the licensee's locks.
v. prospective licensees should be instructed to arrange that only one door is locked from the outside and that all the other doors are locked from inside the premises. When the premises are fitted with sliding doors, the Inspecting Officer must see that suitable stopping arrangements are provided on the rails to prevent the doors from being slid off when locked.
vi. have suitable office for Customs which is furnished with the necessary equipment including but not limited to a connection to the Customs computerized business system.
vii. have weights, scales, measures and other facilities necessary for examining and taking account of goods and for securing them.

Marking of Warehouse

Numbering and marking must distinguish a Bonded Warehouse. When a Bonded warehouse is licensed, the words "Customs Bonded Warehouse" and the number allocated to the warehouse must be clearly marked on the principal entrance to the warehouse, or elsewhere as Customs may approve. These markings must be removed when a Warehouse ceases to be licensed under the Customs Laws, and prior to the cancellation of the security, an officer will inspect the building and ensure that the markings have been removed.

License Fees

In the event of a change of name of a licensed company, a fresh application for a license is to be made as provided for under the CMA. Such a license when granted is to be treated as a new license, for which the appropriate fee is to be charged whether or not the annual license fee has been paid by the previous company.

Under Sect. 62 of the Act it is clear that it is the building which is licensed and that any such building must be the subject of a newly granted license specific to that building. It follows therefore that when a building ceases to be licensed, the

license must be revoked and there is no provision whereby the unexpired part of any such license may be applied to any other building.

4.6 Procedures for Depositing and Removal of Goods in a Bonded Warehouse

Warehoused goods may be delivered from a warehouse for 4 main reasons:

- Home use
- Exportation
- Removal/Transfer
- Used as stores in aircraft or ship.

Home consumption

This is when goods are entered first into their respective entries by owners before delivery from a bonded warehouse. These goods are intended for a delivery into home use and duty due on them must be paid before delivery. After making the correct ex-warehouse entry and has been passed, the owner of goods goes and presents his/her goods to the proper officer for examination before delivery.

Re-exports

Means goods, which are imported and are under Customs control for re-exportation.

Removal/Transfer

The proper officer may require the warehouse keeper within such time as the proper officer may direct, to remove all or any of the goods warehoused in such private bonded warehouse to a general bonded warehouse at the expense of the warehouse keeper or to enter and deliver them for home consumption, for exportation, or for use as stores for aircraft or vessels. Cargo receipts are to be prepared for removal of warehoused goods.

Aircraft/Ship stores

"Stores" goods for use in aircraft, vessels and trains engaged in international transport for consumption by passengers and crew and goods for sale on board.

- Exceptions of Bonded Warehoused Goods

All goods may be warehoused in a Bonded Warehouse with the exception of

i. Acids for trade and business;
ii. Ammunition for trade and business;
iii. Arms for trade and business;
iv. Chalk;
v. Explosives;
vi. Fireworks;
vii. Dried fish;
viii. Perishable goods;
ix. Combustible or inflammable nature, but not including petroleum products for storage in approved places;
x. Matches other than safety matches
xi. Goods the Commissioner gazettes as not to be warehoused

4.7 Documents used in Bonded Warehouses

Goods may be entered for warehousing upon arrival at the frontier port (IM 7). The physical entry will be submitted to the Customs Business Center supported by proceeding documents such as **the Bill of lading/airway bill/railway consignment note, Customs Transit documents (T1 or RCTD).** The entry is assessed to ascertain the Bond in Force. The entry is then released for the goods to be moved to the destination Bonded warehouse. The proper officer should not pass an IM7 entry unless it is supported by a formal acceptance in accordance with Regulation 69 of the EAC-CMR 2006 (Form C) by the bonded warehouse keeper to have the goods warehoused in his bonded warehouse.

Goods not entered for direct warehousing at the entry point will be consigned to an Inland station or bonded warehouse on a C17 under IM 8 procedure. The physical entry will be submitted to the Customs Business Center supported by preceding documents such as the Bill of lading/airway bill/railway consignment note, Customs Transit documents (\ RCTD). On processing of the IM8, taxes are assessed to ascertain the Bond in force and a T1 to accompany the goods is generated. The T1 is then released for onward transit to the destination Customs station/ bonded warehouse from where a warehousing entry will be made.

4.8 Learning Activities

Evaluate the need for customs bonded warehouses in a developing economy like the EAC Countries.

4.9 Self-Assessment Questions and Activities

1. You have been invited to an international conference to present a paper on Bonded warehouses. In your presentation what types of bonded warehouses would you concentrate on?
2. From your country's perspective, what requirements are needed before a warehouse is given a license to operate as a customs bonded warehouse.
3. Assuming you are a customs broker, briefly explain to a client the procedures for depositing and removal of goods in a bonded warehouse.
4. Using relevant examples briefly explain why some goods are not allowed in bonded warehouses.
5. Describe five common documents used in bonded warehouses.

4.10 References

- East African Community. Customs Management Act, 2004
- The EAC Customs Management Regulations, 2010
- East African Community Customs Management (Amendment) Act, 2019.
- EAC (2014). Single Customs Territory Procedures Manual. Arusha: EAC.
- Uganda Revenue Authoruty (2017) Bonds licensing conditions & procedure for 2017
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Walters, D. (2013). Inventory Control and Management, 2nd ed. John Wiley & Sons Ltd.
- Bragg, S. M. (2011). Inventory Best Practices, 2nd Edition. John Wiley & Sons Ltd.
- Wild, T. (2018). Best Practice in Inventory Management 3rd Edition. Routledge

5.0 WAREHOUSING INVENTORY MANAGEMENT

5.1 Specific Learning Outcomes

At the end of this topic the trainee should be able;

i. Explain the meaning of inventory and inventory management
ii. Use the inventory control systems
iii. Carry out the inventory planning
iv. Carry out the Counting inventory
v. Determine the inventory costs
vi. Describe the use of Warehouse Management System in inventory management

5.2 Meaning of Inventory and Inventory Management

Inventory management and inventory control can be defined as follows:

- **Inventory management** is the planning, organising, monitoring and controlling of all aspects of inventory and the motivation of all people involved to achieve inventory objectives safely and within defined time, cost and performance standards.
- **Inventory control** is the actual steps taken to maintain proper stock levels in all types of materials kept (such as raw materials and finished goods).

Meaning of Inventory

Inventory has been defined as:

- those stocks of items used to support production (raw materials and work-in-process items);
- supporting activities (maintenance, repairs, and operating supplies);
- customer service (finished goods and spare parts).

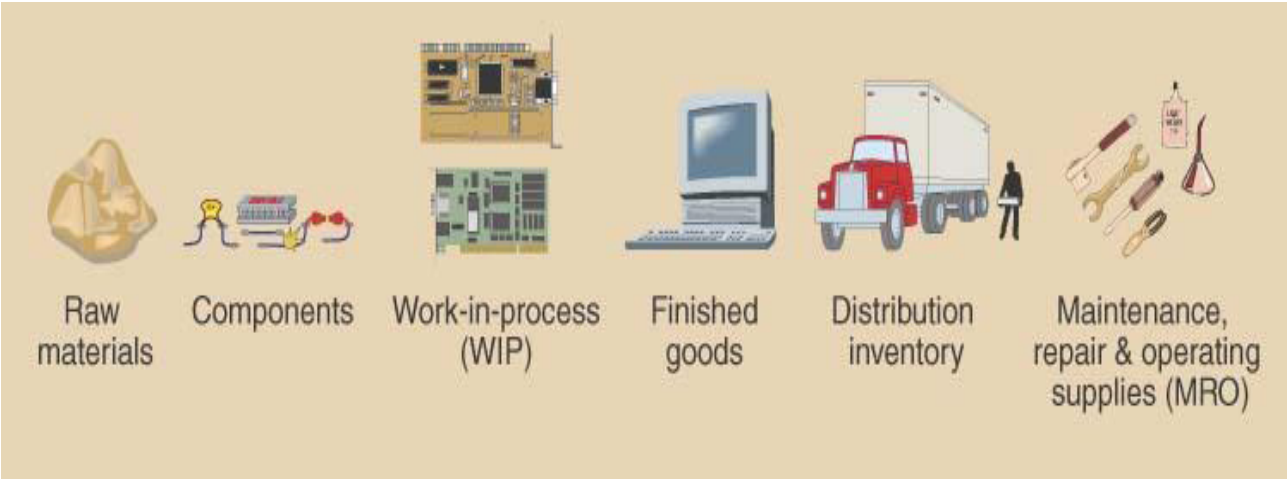
(Source: Cox and Blackstone, 2002).

The Chartered Institute of Logistics and Transport (UK) gives an alternative definition as follows: Inventory is materials in a supply chain or in a segment of a supply chain expressed in quantities, locations, and/or values (synonym stock). A simpler definition of inventory is that: Inventory means items kept by an organisation for eventual sale/use.

5.3 Inventory Classifications

Different types of inventories or stocks of material maintained in any organisation can be identified. All organisations use the same general classification of inventories. These are briefly described below:

- **Raw material** — A raw material inventory includes all items that after being received in the organisation require additional processing before becoming an identifiable part of the finished product.
- **Purchased parts** — This classification of inventory is applied to component parts of a product that need no additional processing before being assembled into the finished product. In some cases, this material may be classified as raw material inventory.
- **Work-in-process** — This classification of inventory is self-explanatory. All material that leaves either the raw material warehouse or the purchased parts warehouse enter the work-in-process inventory until the product is completed and placed in finished goods.
- **Finished goods** — This is the inventory of finished goods. Generally speaking this classification applies to the quantities of finished goods that are held at the factory awaiting shipment.
- **Supplies** — All materials needed for the operation of the plant that are not used as parts of the finished product are classified as supplies. They are also referred to as indirect materials. Lubricating oils, sweeping compound, light bulbs, and many other items fall into the supplies category.



5.4 Inventory Control Levels and Quantities

Inventory control is the process of keeping the right number of materials, parts and products in stock to avoid shortages, overstocks, and other costly problems. It is concerned with the acquisition, storage, handling and use of inventories so as to ensure the availability of inventory whenever needed, providing adequate provision for contingencies, deriving maximum economy and minimizing wastage and losses.

Control of inventory is exercised by introducing various measures of inventory control, such as ABC analysis fixation of norms of inventory holdings and reorder point and a close watch on the movements of inventories.

The most common standard stock control levels set and often stated on an item's inventory record are:

5.4.1 The Minimum Stock Level (MSL)

The minimum stock level is the level below which the inventory of an item should never be allowed to fall. It is the lower limit of inventory and it must always be on hand for continued work. If the new balance calculated after an issue is at or near the MSL figure stated on the record, urgent action must be taken to ensure that new stock is delivered. MSL is also called safety or reserve or buffer stock.

In fixing the MSL for a particular item, the effect of shortages of it on the normal operations of the enterprise may have to be considered, in addition to one or more of the other factors discussed above. For some items the MSL could be kept low or even at nil. For other items (such as essential raw materials, popular selling lines, important spare parts for machinery, etc.), the MSLs must reflect their importance by including reserves or buffers against contingencies.

Formula for Minimum Stock Level

The minimum stock level can be calculated by applying the following formula:

Minimum Stock Level= Re Order Level – (Normal Usage X Normal Lead Time)

Minimum Stock Level Worked Example

Suppose we have the following information:

- Normal consumption = 300 units per week
- Normal delivery time = 7 weeks
- Reorder level = 2,400 units

Minimum Stock Level= 2,400 – (300 x 7)
= **300 units**

5.4.2 The Reorder Stock Level (RSL)

The reorder stock level is the lowest number or quantity of the item which should be in inventory before an order for replenishment should be made. It is a level above the MSL and at which action must be taken to ensure the order and delivery of new supplies of the item before the MSL is reached. It indicates when to order or reorder. It is necessary to protect against exhaustion of stock during the time gap between an order and the date of receipt of stock.

The major factors to be considered in fixing this level for an item are:

a) the time it takes for provision-demand documents to be prepared by warehousing personnel and forwarded to supply department;
b) the time it takes for the supply department to place the replenishment order; and
c) the time taken by the supplier to deliver the new stock (referred to as exstock).

Reorder level can be calculated by applying the following formula:

Re-order Level = (Maximum Lead time x Maximum Usage)

Worked Example:

If the maximum usage is 130 units per day, minimum usage is 70 units per day and the lead time is 25 to 30 days.

Re-order Level= (130 x 30)
Re-order Level = 3900 units

5.4.3 Maximum/Higher Stock Level (HSL)

The maximum or higher stock level is the level beyond which the inventory of an item should never be allowed to rise. It is the maximum number or quantity of the item which should ever be held in inventory at any one time in the interest of economy. It is the upper limit of inventory, and is set to avoid having capital tied up unnecessarily, and the other problems connected with excess stock.

Maximum level can be calculated by applying the following formula:

Maximum stock level= Re-order + (EOQ-Minimum Usage x Minimum Lead Time)

Worked Example

If EOQ=1000 units, Re-order level 3900 units, maximum usage is 130 units per day, minimum usage is 70 units per day and the lead time is 25 to 30 days.

Maximum stock level = 3900+ (1000-(70X25))

Maximum Stock Level= 3150 units

5.4.4 The Economic Order Quantity (EOQ)/ Re-Order Quantity

By definition, EOQ is the lot size that minimises total annual inventory holding and ordering costs. Also, EOQ is the lot size that makes annual inventory holding cost equal to annual ordering cost. It is thus the optimal ordering quantity for an item of stock that minimises costs while maximising the benefits of holding inventory.

$$EOQ=\sqrt{\frac{2x(\text{annual demand x ordering costs per unit})}{\text{Carrying Cost per unit}}}$$

Worked Example

Annual demand is 60,000 units, the ordering cost per order is $25 per order, holding cost is $3 per item per year, normal usage is 100 units per day, maximum usage is 130 units per day, minimum usage is 70 units per day and the lead time is 25 to 30 days. Compute the Economic Order Quantity.

$$EOQ=\sqrt{\frac{2x(\text{annual demand x ordering costs per unit})}{\text{Carrying Cost per unit}}}$$

$$EOQ=\sqrt{\frac{2x(60{,}000 \times 25)}{3}}$$

$$EOQ=\sqrt{\frac{300{,}000}{3}}$$

$$EOQ=\sqrt{100{,}000}$$

EOQ=1000 units

5.5 Inventory Planning

Inventory planning is the process of determining the optimal quantity and timing of inventory for the purpose of aligning it with sales and production capacity. Inventory planning involves forecasting demand and deciding exactly how much inventory and when to order.

5.5.1 Demand Classification

Dependent demand: is the demand of constituent parts of a finished product. This demand stems from the fact that it was always planned to make the finished product. Dependent demand can either be 'vertical' e.g. for a chip actually required in the production of the computer, or 'horizontal', e.g. for user manuals that go with the finished product.

Independent demand: the opposite of dependent demand in that as a planner, one does not have a view of the customer requirements and as such one is forced to estimate a forecast. An example is the demand for parts of finished products which, as a supplier, you may only become aware of when the customer comes to buy or places an order.

5.5.2 Forecasting Principles

Forecasting has been defined as a technique for using past experiences to project expectations for the future (Chapman, 2006). Alternatively, a forecast is an estimate of the future level of some variable and the common variables that are forecasted are given as demand levels, supply levels and prices (Bozarth and Handfield, 2006). Every organisation engages in some form of forecasting process, especially when determining long-term needs, business plans and supply chain activities.

5.5.3 Forecasting Laws

Bozarth and Handfield, (2005) came up with the following principles that a manager should keep in mind when forecasting:

Law 1: Forecasts are almost always wrong, because even under best conditions, no exact level of prediction can be made. There are too many factors that have an effect on numbers and the idea is to get as close as one can be in their forecasts.

Law 2: Forecasts for the near term tend to be more accurate. This is because the likelihood of changes in the forecast factors is minimal.

Law 3: Forecasts of groups of products or services tend to be more accurate. This is because demand for specific items is most likely to be affected by other things than demand for particular groups.

Law 4: Forecasts are no substitutes for calculated values. There are times that calculation of demand is more appropriate than forecasts.

5.5.4 ABC Analysis of Inventories

The ABC inventory control technique is based on the principle that a small portion of the items may typically represent the bulk of money value of the total inventory used in the production process, while a relatively large number of items may from a small part of the money value of stores. The money value is ascertained by multiplying the quantity of material of each item by its unit price.

According to this approach to inventory control high value items are more closely controlled than low value items. Each item of inventory is given A, B or C denomination depending upon the amount spent for that particular item. "A" or the highest value items should be under the tight control and under responsibility of the most experienced personnel, while "C" or the lowest value may be under simple physical control.

It may also be clear with the help of the following examples:
"A" Category – 5% to 10% of the items represent 70% to 75% of the money value.
"B" Category – 15% to 20% of the items represent 15% to 20% of the money.
"C" Category – The remaining number of the items represent 5% to 10% of the money value.

The relative position of these items show that items of category A should be under the maximum control, items of category B may not be given that much attention and item C may be under a loose control.

Advantages of ABC Analysis

- It ensures a closer and a stricter control over such items, which are having a sizable investment in there.
- It releases working capital, which would otherwise have been locked up for a more profitable channel of investment.
- It reduces inventory-carrying cost.
- It enables the relaxation of control for the 'C' items and thus makes it possible for a sufficient buffer stock to be created.
    - It enables the maintenance of high inventory turnover rate.

5.5.5 Material Requirements Planning (MRP)

MRP is a product-oriented computerised technique aimed at minimising inventory and maintaining delivery schedules. It relates to the dependent requirements for the materials and components comprising an end product to time periods known as **buckets** over a planned horizon (typically one year) on the basis of forecasts provided by marketing or sales and other input information. (**Note**: a bucket is a time period to which MRP relates e.g. 1 week, etc.)

The Aims of MRP

- To synchronise ordering and delivery of materials and components with production requirements.
- To achieve planned and controlled inventories and ensure that required items are available at the time of usage or not much earlier.
- To promote planning between the purchaser and the supplier to the advantage of each. The forward projection of orders, for example, can assist suppliers to reduce lead time and production costs and minimise the inventory costs of the purchaser.
- To enable rapid action to be taken to overcome material or component shortages due to emergencies, late delivery, etc.

Applications of MRP

While having elements common to all inventory situations, MRP is most applicable where:

- the demand for items is dependent
- continuous, i.e. lumpy and non-uniform
- there is job, batch and assembly or flow production

5.5.6 Distribution Requirements Planning

Distribution Requirements Planning (DRP) is a method designed to consider requirements for multiple distribution centres. In principle DRP is an application of MRP11, by breaking down the flow of goods from source through the network of depots and transportation systems. The difference is that MRP operates in a dependent demand scenario whilst DRP is an independent demand environment. Furthermore, MRP is guided by a production schedule which is defined and controlled internally, whilst DRP is guided by customer demand which is external to the organisation. DRP allows for warehouses/ depots and sales facilities to request products from production facilities.

5.5.7 Just-in-Time (JIT) Purchasing

By definition, JIT is as an inventory control philosophy whose goal is to maintain just enough material in just the right time to make just the right amount of product. JIT is a demand pull system where the demand for a product dictates the production requirements. It looks at inventory as a waste that should be eliminated as much as possible.

For JIT to work, two things must happen:

- All parts must arrive where they are needed, when they are needed and in the exact quantity needed.
- All parts that arrive must be usable parts.

Pre-requisites for JIT Purchasing

Limited number of suppliers to encourage partnerships.

- Reliable transport and communication means for quick delivery to both production points and consumer/buyer points.
- Short lead times.
- Quality assurance and control measures to enable high quality inputs.
- Production in small lots i.e. batch production, produce when the orders come

5.6 An Inventory Control System

An inventory control system is a technology solution that manages and tracks a company's goods through the supply chain. This technology will integrate and manage purchasing, shipping, receiving, warehousing, and returns into a single system. The best inventory control system will automate a lot of manual processes. It will provide an accurate picture of what inventory you have, where it is, and when you need to reorder to keep your stock at optimal levels.

The objective of an inventory control system is to ensure the constant availability of products, by defining:

- When products should be ordered.
- What quantities of products should be ordered?
- How to maintain adequate quantities to meet demand, while avoiding overstocks and stock outs

5.6.1 Types of Inventory Control Systems

Inventory control systems have evolved. Earlier systems were little more than spreadsheets, and now machine learning is adding more automation to inventory control. There are two key types of inventory control systems: perpetual inventory systems and periodic inventory systems. Within

those systems, two main types of inventory management systems – barcode systems and radio frequency identification (RFID) systems – used to support the overall inventory control process:

- Main Inventory Control System Types:
  - Perpetual Inventory System
  - Periodic Inventory System
- Types of Inventory Management Systems within Inventory Control Systems:
  - Barcode System
  - Radio Frequency Identification (RFID) System

1. Perpetual inventory system.

A perpetual inventory control system tracks inventory in real-time. As soon as a product is sold, its barcode is scanned and it is removed from a global inventory database. When one is received, it is scanned and added to the inventory database. Each part of the system has access to the same database and information.

A perpetual inventory provides a highly detailed view of inventory changes and an accurate accounting of inventory levels without the need for manual inventory counts. It is suitable for all sizes of businesses and is necessary for stores with high sales volume or multiple locations.

2. Periodic inventory system.

A periodic inventory system is kept up to date by a physical count of goods on hand at specific intervals. With a periodic inventory system, a business will not know how many products it has until after the physical count is completed. It is easy to see how this can be a problem when it comes to filling orders. Your stock count was accurate weeks or months ago, but now when a customer wants to buy, you have to physically check your inventory to see if you have it to sell.

Counting stock manually is a process that takes a lot of time and manpower. Each and every item in stock has to be counted. This would not work well for a large warehouse. A periodic system is only acceptable for smaller warehouses with minimal amounts of inventory.

5.6.2 Barcode Inventory Systems

Inventory management systems using barcode technology are more accurate and efficient than those using manual processes. When used as part of an overall inventory control system, barcode systems update inventory levels automatically when workers scan them with a barcode scanner or mobile device.

The benefits of using barcoding in your inventory management processes are numerous and include:

- Accurate records of all inventory transactions
- Eliminating time-consuming data errors that occur frequently with manual or paper systems
- Eliminating manual data entry mistakes
- Ease and speed of scanning
- Updates on-hand inventory automatically
- Record transaction histories and easily determine minimum levels and reorder quantities
- Streamline documentation and reporting
- Rapid return on investment (ROI)
- Facilitate the movement of inventory within warehouses and between multiple locations and from receiving to picking, packing, and shipping

5.6.3 Radio Frequency Identification (RFID) Inventory Systems

Radio frequency identification (RFID) inventory systems use active and passive technology to manage inventory movements. Active RFID technology uses fixed tag readers throughout the warehouse; RFID tags pass the reader, and the movement is recorded in the inventory management software. For this reason, active systems work best for organizations that require real-time inventory tracking or where inventory security has been an issue. Passive RFID technology, on the other hand, requires the use of handheld readers to monitor inventory movement. When a tag is read, the data is recorded by the inventory management software. RFID technology has a reading range of approximately 40 feet with passive technology and 300 feet with active technology.

RFID inventory management systems have some associated challenges. First, RFID tags are far more expensive than barcode labels; thus, they typically are used for higher value goods. RFID tags also have been known to have interference issues, especially when tags are used in environments with a lot of metal or liquids. It also costs a great deal to transition to RFID equipment, and your suppliers, customers,

and transportation companies need to have the required equipment as well. Additionally, RFID tags carry more data than barcode labels, which means your system and servers can become bogged down with too much information.
When choosing an inventory control system for your organization, you first should decide whether a perpetual inventory system or periodic inventory system is best suited to your needs. Then, choose a barcode system or RFID system to use in conjunction with your inventory control system for a complete solution that will enable you to have visibility into your inventory for improved accuracy in scanning, tracking, recording, and reporting inventory movement.

Inventory control systems help you track inventory and provide you with the data you need to control and manage it. No matter which type of inventory control system you choose, make sure that it includes a system for identifying inventory items and their information including barcode labels or asset tags; hardware tools for scanning barcode labels or RFID tags; a central database for all inventory in addition to the ability to analyze data, generate reports, and forecast demand; and processes for labelling, documenting, and reporting inventory along with a proven inventory methodology like just-in-time, ABC analysis, first-in, or first out (FIFO), or last-in-first-out (LIFO).

5.7 Inventory Counting

At periodic and defined intervals, the inventory is counted to reconcile the inventory records as a way to assure that the system shows an accurate depiction of what is actually in stock. This is usually done either by counting the entire inventory at the same time (called a physical inventory) or by counting the total number of items at varying times on a prescheduled basis (called cycle counting).

Types of inventory counting

Some of the most-used types of counting are cycle counting, spot counting (sometimes also known as ad-hoc or blind counting), and tag counting.

Cycle counting

As the name implies, cycle counting is about counting in cycles. You do not count your full inventory at once but do it in parts. A different part of the store or warehouse is counted every month, week, or day. It can be based on product types, product group, warehouse/store zones. And for each differentiator, you may decide on different cycle lengths. For example, small-sized, fast-selling items should be counted more often than the big kitchen appliances.

Ad-hoc counting

Ad-hoc counting is initiated by the user and is usually not planned, meaning this counting is quite handy in extraordinary situations. Such situations include system collapse or other circumstances that may require an immediate reconfirmation of the stocks.

Tag counting

In preparation for tag counting, the store/warehouse employees should place a physical tag on each item. During counting, the worker must fill in the item ID, counted quantity, and other relevant information on the designated spaces on the tag. Some tags have two sides, so that a second worker may validate the information and, if needed, fill in the correction on the second side. After the counting is processed, these tags are collected and entered the system as journals.

5.8 Inventory Costs

The enhancement of customer service and operating efficiency is by no means free. Inventories have tangible and intangible costs. Item costs (direct material, direct labour, overhead, transportation, custom duty, and insurance), carrying costs, ordering costs, shortage costs, and capacity costs are all tangible inventory costs.

Inventory costs are important for three main reasons:

1. Inventory costs represent a significant component of total costs of goods sold in many organizations (the cost of inventory comprises up to 80% of the total costs of goods sold). Excessive and obsolete inventory build-up has a negative impact on cash flow and profitability of a company and ultimately viability and survival.
2. The inventory levels may affect the level of service the firm is capable of providing to its customers. Too much of the wrong inventory might limit a company's ability to stock the right items.

3. The cost trade-off decisions frequently depend on and ultimately affect inventory costs as discussed below.

Types of Inventory Costs

1. Ordering Cost

Ordering costs are the costs associated with placing an order with the factory or a supplier. The ordering cost does not depend on the quantity ordered. It is a composite of all costs related to placing purchase orders or preparing shop orders, including

i. Paperwork,
ii. Work station setups,
iii. Inspection, scrap, and rework associated with setups,
iv. Record keeping for work-in-process.

1. Carrying Costs

Carrying cost is the total of costs related to maintaining the inventory, including

i. Capital cost invested in inventory, or foregone earnings of alternate investment,
ii. Storage costs for space, equipment, and people,
iii. Inventory service costs such as taxes and insurance on inventory,
iv. Obsolescence costs typically based on inventory value loss or losing value altogether, and therefore having to be scrapped. This can be caused by market, design, or competitors' product changes,
v. Deterioration from long-term storage and handling,
vi. Record keeping for inventory

Determining Holding Costs Example

Category	Cost (and Range) as a Percent of Inventory Value	
Housing costs (including rent or depreciation, operating costs, taxes, insurance)	6%	(3 - 10%)
Material handling costs (equipment lease or depreciation, power, operating cost)	3%	(1 - 3.5%)
Labor cost	3%	(3 - 5%)
Investment costs (borrowing costs, taxes, and insurance on inventory)	11%	(6 - 24%)
Pilferage, space, and obsolescence	3%	(2 - 5%)
Overall carrying cost	**26%**	

2. Costs of not Holding Stock

A stockout occurs when an item that is typically stocked is not available to satisfy a demand the moment it occurs, resulting in any of the following:

- Lost sales — A lost sale occurs when a stock out results in a customer buying the wanted item elsewhere.
- Backorders — A backorder is a customer order that cannot be filled when promised or demanded but is filled later. Customers may be willing to wait for a backorder but next time may take their business elsewhere. Sometimes customers are given discounts for the inconvenience of waiting.
- Substitutions — A substitution occurs when a stockout results in a substitute product being taken by the customer instead.

5.9 Warehouse Management Systems (WMS)

It is difficult to manage a warehouse effectively without an information system. A warehouse management system is a software application designed to support and optimize warehouse functionality and distribution center management.

A WMS helps to manage a warehouse effectively, including management of inventory. The combined computer and associated software links elements in the supply chain with the ability to track inventory, locate product, measure productivity, and evaluate other performance elements. Basic warehousing functions, such as receiving, labelling, stocking, locating stock, picking, and shipping, require software that is programmed specifically for these tasks.

Whereas a warehouse primarily performs a storage function, a warehouse management system goes a long way to ensure the materials in the warehouse can also be accounted for throughout the whole supply chain process. This ensures data transparency in stock control management.

5.9.1 Functions of a WMS

Warehouse Management Systems Perform Core Functions That Include;

- Receiving goods
- Tracking stock
- Ensuring efficiency in storage
- Picking and shipping
- Providing information to managers
- Despatching goods

1. Tracking Stock

A WMS enables managers to know the amount of stock available and when restocking is required. Together with the use of minimum and maximum levels this helps the business order more stock at the right time and in the right amount, so as to avoid shortages, and also avoid overstocking the warehouse. This saves on space to allow other materials to be stored in the warehouse.

2. Layout Design

A WMS allows the placement of products within the warehouse layout to be ordered efficiently and logically, using criteria such as accessibility, weight and demand. This ensures the smooth operation of warehouse functions.

3. Picking & Shipping

An efficient WMS ensures that the correct product is picked, using the basic retrieval strategies, or business rules such as of FIFO (first- in- first out). The WMS ensures that orders are shipped to the right clients on time. Your transport system is made efficient and is less costly due to avoiding mistakes made during the picking packing and dispatch stages.

4. Reporting Information to Managers

Warehouse management systems provide a wealth of useful business information which can be gathered into reports and analysed to guide future improvements. This includes customer order data, which helps managers forecast, plan, consider alternatives and make decisions concerning the whole supply chain process. This helps the business meet its trading goals.

5.9.2 Benefits of A Warehouse Management System

It is important that warehouse owners invest in a suitable WMS with the capabilities that match their business model, culture and operational functional requirements.

A WMS enables warehouse managers to carry out their managerial functions efficiently, with greater productivity and reduced staff resources.

The following are the main benefits that come with having a good WMS:

- **Labour Control**

Most warehouse processes – to a greater or lesser degree – can be automated by the WMS. Therefore, staff resources can be rationalised and assigned to the most necessary tasks, while saving time spent on labour-intensive activities. This helps businesses to cut down on unnecessary staff expenditures and improve the productivity of the existing workforce.

- **Improved Customer Relationships**

When orders are received and deliveries made "on time in full", customers are happy and they develop trust with the business. This leads to improved customer retention.

- **Better Planning On Demand**

A good WMS gives a full record of historic orders and shipping movements. This can help managers forecast future requirements and also improve on how demands are met. Coupled with better stock control and accuracy stock write offs due to out of date stock can be minimised.

- **Improves Productivity**

A WMS provides a rational structure that is easy to follow and makes the working lives of your employees a whole lot easier! It provides your team with clear KPIs and performance parameters, and this in turn increases efficiency and accuracy.

- **Reduced Admin**

The WMS automates and centralises most of the administrative work that formerly required reams of paperwork and data entry. Reports can be collated and published in seconds, with data available at your fingertips.

- **Optimised Processes**

A good WMS offers a broad range of picking options such as batch picking, wave, and zone management. It also provides a variety of input methods such as smart scales, bar codes and equipment automation.

- **Ensures Transparency and Visibility**

WMS data is accurate, transparent and can usually be accessed remotely through any internet-enabled device. This helps suppliers to plan their production, thus reducing lead time. This transparency also lets businesses offer customers a better support service.

- **Ensures Safety of Stock**

A WMS ensures stock is stored under optimum conditions for each item. This is especially important for perishable products, such as foods, medicines and cosmetics. Advanced order planning and layout management helps reduce waste, damage and stock obsolescence, thus eliminating a significant source of lost revenue.

- **Enhanced Security**

A good WMS creates an audit trail that links transactions to the individual worker. This is because employees signed onto an individual user account, via RF controlled devices with all activity recorded. This improves accountability and provides coaching opportunities based on individual performance targets.

5.10 Learning Activities

Activity 1:

The Africa Trading Company is considering doing an ABC analysis on its entire inventory but has decided to test the technique on a small sample of 15 of its SKU's. The annual usage and unit cost of each item is shown below.

ABC Problem Data

Item	Unit $ Value	Annual Usage (in units)
101	12.00	80
102	50.00	10
103	15.00	50
104	50.00	40
105	40.00	80
106	75.00	220
107	4.00	250
108	1.50	400
109	2.00	250
110	25.00	500
111	5.00	450
112	7.50	80
113	3.50	250
114	1.00	1200
115	15.00	300

Required:

a) First calculate the annual dollar volume for each item
b) List the items in descending order based on annual dollar volume.
c) Calculate the cumulative annual dollar volume as a percentage of total dollars.
d) Classify the items into groups as per ABC Analysis.

Activity 2:

A computer company has annual demand of 10,000 units. They want to determine EOQ for circuit boards which have an annual holding cost (H) of $6/unit, and an ordering cost (S) of $75. They want to calculate total cost (TC) and the reorder point (R) if the purchasing lead time is 5 days.

Required:

a) EOQ (Q)
b) Reorder Point (R)
c) Total Inventory Cost (TC)

Activity 3:

Victoria Traders has annual cost of goods sold of $10,000,000. The average inventory value at any point in time is $384,615. Calculate:

Required:

a) Inventory turnover
b) Weeks/days of supply

5.11 Self-Assessment Questions and Activities

1. Discuss why inventory management is important in today's supply chains.
2. From a manufacturing setting, describe the different types of inventories that could be stored in a warehouse.
3. Why should organizations implement inventory control systems? Discuss the various inventory control tools and techniques.
4. Highlight the different types of inventory costs.
5. Discuss the benefits of a Warehouse Management System (WMS) in inventory management

5.12 References

- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Walters, D. (2013). Inventory Control and Management, 2nd ed. John Wiley & Sons Ltd.
- Bragg, S. M. (2011). Inventory Best Practices, 2nd Edition. John Wiley & Sons Ltd.
- Wild, T. (2018). Best Practice in Inventory Management 3rd Edition. Routledge
- Bozarth, C.C. and Handfield, R.B., (2006). Introduction to Operations and Supply Chain Management. Pearson Prentice Hall.
- Chapman, S.N., (2006). The Fundamentals of Production Planning and Control. Pearson Prentice Hall.

6.0 WAREHOUSING SPECIAL GOODS

6.1 Specific Learning Outcomes

At the end of this topic the trainee should be able;

i) Explain how to handle high value items in the warehouse
ii) Describe the process of handling food items in the warehouse
iii) Explain how to handle hazardous products in the warehouse
iv) Explain the handling of temperature sensitive products in the warehouse
v) Discuss the managing of pharmaceutical products in the warehouse
vi) Explain how to handle live animals.

6.2 Introduction

Handling specialty and high value inventory is both complex and high risk. With each unit value at over $100 per kilogram, your supply chain could be storing and protecting millions of dollars in customer assets. The most common types of high value cargo handled by supply chain operations are precious metals, semi-precious stones, electronics, documents and life science/ pharmaceutical inventory. These items are more susceptible to risk due to the increasing demand for luxury goods and increased "touch points" in longer supply chains.

6.3 Types of High Value Items in the Warehouse

Some of the known, highly desirable and frequently targeted items in warehouses include;

- **Alcohol –** due to its relatively high value, desirability and package or bottle sizes
- **Tools and instruments –** high value, low weight, compact sizes. Tools are a frequent pilferage target.
- **Electronics or electrical components –** particularly those that command value when sold or be in demand as consumer devices
- **Medication or pharmaceuticals –** these are in a different class in terms of security due to national and international regulations on some items. Specialty cages must be used to secure them.
- **Cannabis or marijuana in medical or recreational dispensaries –** since the legalization of medical and recreational marijuana in many states, security has become.
- **Jewellery –** compact, easy to conceal and typically very valuable.
- **Firearms or ammunition –** prices on guns and ammunition are always high, and many times inventories are low. Ammunition in production and distribution facilities must be secured for safety reasons as well as theft prevention.

1.1.1 Methods for Securing High-Value Inventory in a Warehouse

- **Store it in upper bay storage rack slots:** This is effective particularly for bulk storage of smaller items. Don't store pallets on the ground so that anyone walking near can cut a case open. Bulk storage should be in high bay positions where a forklift or order picker is needed to access them. This creates a barrier because it uses location to reduce access.
- **Store valuable inventory or tools in security cages:** Lockable security cages are relatively inexpensive and can be built to work in most any space. Rows of shelving or racks can be segmented away into secure areas, where only authorized personnel can travel. You can even designate card reader locks and other measures that help you identify who was in or out of the secure areas.
- **Make your rack secure:** If your storage area is such that you cannot create a freestanding cage, you can also build in security to racks by using rack cages. Almost any teardrop style pallet rack can be made secure if it contains high-value inventory.
- **Utilize modular storage:** If your inventory is typically stored in shelving or racks, you can add lockable modular storage drawers to segment particularly valuable items. Many times, these systems are used to segment smaller, more valuable components from bin storage areas.
- **Use smaller cages:** There are many types of security lockers and small cages (some on wheels) that can be locked to protect inventory.
- **Consider automation:** Some automated systems, like industrial carousels or vertical lift modules, enhance security because product is controlled through the carousel, and difficult to access without

authorization.

- **Track worker traffic:** Coded ID badges can be required to enter your secure areas, giving you intelligence on who has access to the controlled area.
- **Lay out storage zones for access control:** You can restrict zones by laying them out so they aren't in main traffic ways and have limited egress points. If you have a higher value area, don't place it in the centre of your warehouse where everyone has access.

6.4 Process of Handling Food Items in the Warehouse

Food items are normally stored in a food grade warehouse. This warehouse is a facility of any size, storing both small and large amounts of food for either short or long periods of time before leaving for normal food channel distribution. There are several different types of food grade warehouses.

The most common types include dry storage, refrigerated or chilled storage, and frozen or cold storage. The main focus of each facility is to protect the food stored within by maintaining superb sanitation and health standards, such as the use of pallets to keep food from coming into contact with the floor.

Keeping food warehousing safe is critical. Not only does it facilitate trade and economic growth, and prevent monetary losses for food channel members, but it prevents the spread of food-borne disease and illness.

1.1.2 McKenna's Four Principles for Food Grade Storage

There are four main principles that any food grade warehouse functions within as a further safeguard against food contamination or damage.

i. Sanitation Schedule

The entire facility must be tidy and cleaned properly at all times. Documentation is required for any housekeeping or cleaning performed within the warehouse, and these records need to be readily available for viewing.

ii. Personal Training and Hygiene

Every person employed in a food grade storage warehouse is required to wash their hands thoroughly with soap supplied by the company. This must be done in a sink that is hygienic dry system equipped. Records must be kept and updated on everything related to new employee training in certain areas, including crisis and incident management, quality awareness, personal hygiene, and food safety.

iii. Lot Traceability

To ensure inventory rotates on a "first in, first out" basis, there must be an in-house system to trace product date and lot codes.

iv. Pest Control

Any pest control routine changes or updates need to be reported every three months. The perimeter of the warehouse is where control substances are placed to prevent ants, birds, insects, rodents, or any other type of animal from entering the premises.

1.1.3 Basic but Essential Tips on Storing Food

- Generally, any type of frozen food product must be stored at a minimum of 0° F. Products which require dry storage need an area that can be kept between 50° and 70°F. Refrigerated or chilled products need a temperature range of 34° to 39° F.
- All areas for food storage should have thermometers present where they can be accessed easily for hourly temperature checks. After each check, the temperature must be recorded in a log book.
- Since foods require specific storage procedures, each separate area needs to have the proper humidity and temperature for correct storage, and all areas must be free from hazards of the microbiological, chemical, or physical nature.
- Humidity levels in dry storage areas should not exceed 15%.
- Do not store food in direct sunlight.
- Too much emphasis can never be placed on FIFO (first in, first out) to prevent possible illness.
- If possible cross dock food items. Cross-docking is an inventory handling process where a warehouse systematically moves a product from incoming trucks to outgoing trucks without long-term storage. Cross-docking is essential for many food products that are managed using JIT inventory management systems. Products like fruit,

which will come in on one truck and quickly move to multiple trucks going to multiple retail locations, are part of a cross-docking process.

Equipment used within the warehouse, such as shelving, humidity and temperature gauges, pallets, storage bins, forklifts, freezers and chilling units needs to be cleaned and sanitized on a regular basis following proper procedures. When purchasing equipment, look for items that are non-porous, resistant to odours and rust resistant.

6.5 How to Handle Hazardous Products in the Warehouse

When handling Hazardous products within the warehouse, operations must be closely supervised by a trained and experienced supervisor. In all cases, the area and line of responsibility must be clearly defined and understood.

Working procedures should take the first in-first out principle as the basis in order to minimize risk of deterioration of goods or packages and labels and other markings. The following written instructions must he readily available to all warehouse personnel:

- Instructions for the safe and correct operation of equipment and storage of materials.
- Material Safety Data sheet for all stored and transported products
- Hygiene and safely instructions and procedures
- Emergency instructions and procedures

6.5.1 Receipt, Despatch of Goods and Transport Procedures

On arrival, goods are identified by the bill of lading, the labelling, and the Material safety data sheets provided by the supplier. Their characteristics are checked as per information for quantity and condition. If the goals or packaging are not in a good condition, or- for any reason they seem to present a particular hazard appropriate action must be taken.

Any vehicle must be checked before loading materials for shipment from the warehouse, as well as proper packaging and appropriate accompanying documentation, e.g. A Transport Emergency Card (TREM) that will identify in the relevant language or languages;

- The shipping number including its address and contacts
- The product being carried
- The basic hazard and the precautions to be taken
- Actions to be taken in case of an accident or a spill.
- A suitable fire extinguisher and protective and clean up equipment should be available on board for use by the driver.

6.5.2 Storage Plan

A clear space should be left between all outside walls and the nearest packs within block stacks, to allow access for the inspection, free movement of air and fire fighting.

Products must be arranged so that fork lift trucks and other handling or emergency equipment is not obstructed. Narrow aisles or tight corners will increase the risk of damage to packs. All aisles as well as gangways and fork lift truck routes should be clearly defined by markings on the floors and kept free from obstructions and from pedestrians to avoid injury.

Stacking heights should not exceed three meters unless the use of racking prevents overloading the lower tiers and ensures stability. Where racking is not provided, materials should not be packed to a height which is likely to cause damage to the lower tiers.

Packages capable of being stacked higher should be specially marked to indicate maximum permissible stacking height. Special attention should be paid to 'this way up" signs on cartonned packs and, where these are not displayed, to ensure that packs are stored with the closure of the inner receptacle uppermost.

A plan should be drawn up showing the nature of hazard in each part of the warehouse;

- Sub-section number for each separated area
- Location and quantities of the stored materials or groups of materials with their hazard characteristics.
- Location of available emergency and fire-fighting equipment, access and escape routes.

The plan showing the nature of hazard in each part of the warehouse should be kept in the main office and a copy given to the local fire brigade. It should be regularly updated. A complete inventory of material stored with their location the warehouse should be kept updated as sell.

6.5.3 Product Separation and Segregation

The word separation denotes the positioning of different product groups in separate areas within a warehouse. The word "segregation' denotes the physical separation of different product groups in separate warehouses or by a firewall within a single warehouse.

The primary objective of product separation and segregation is to minimize the risks of fire or cross contamination often presented by mixed storage arrangements of incompatible materials. Correct separation will also minimize the extent of hazardous zones and the re sent to bond or to install protected electrical equipment.

The basic rule is not to mix packages of different hazard classes as defined by the symbols of the United Nations Classification of Dangerous Goods. In addition; Outside storage should be considered for highly flammable liquids and gas cylinders. Materials that are liable to explode in a fire (e.g. gas cylinder or aerosols) should be kept separate from other inflammable materials. Hazardous, flammable or explosive materials need to be stored away from inhabited areas and surrounded by metal or masonry barriers. In addition, the following applies:

i. Keep hazardous goods away from other products, especially foodstuffs;
ii. Be aware of the different hazard classes and which hazardous/dangerous goods that cannot be stored together;
iii. All hazardous/dangerous goods must be appropriately marked with markings/ stickers on the goods/packing;
iv. All staff must be informed about handling, preventive and mitigating actions, place accident cards on the stack and in the warehouse office;
v. Provide protective clothing such as goggles and gloves when necessary:
vi. Proximity to hazardous substance manufacturers should be avoided.

Note: Paint, fertilisers, pesticides, disinfectants and water treatment chemicals are examples of materials which are potentially hazardous.

6.6 Handling of Temperature Sensitive and Pharmaceutical Products in the Warehouse

Time and temperature sensitive products and pharmaceutical products should be transferred to proper safe storage with environmental controls. The location of the warehouse should be carefully selected to minimize damage from flooding and other natural disasters.

The warehouse should be purpose-built and designed for the storage of time and temperature sensitive pharmaceuticals. If not, the adaptation of existing facilities should be for this specific purpose. The design should also consider the prevailing climatic conditions of the location, to ensure energy efficiency and minimize power consumption.

The loading and delivery bays of the warehouse should be designed to avoid the temperature sensitive pharmaceutical products from exposure to direct sunlight, dirt, dust and rain.

Warehouses designed for the storage of time and temperature sensitive products and pharmaceuticals products should also contain a quarantine area. This is for the storage of rejected, faulty, recalled pharmaceutical products. For example, if a temperature excursion is found to have taken place, the compromised products can be held in this area.

6.7 Handling of Live Animals in a Warehouse

Live animals are kept in warehouses for short periods mostly as they await for transportation or clearance. Some of the common animals that may require temporary warehousing include:

- pets
- livestock
- reptiles and amphibians
- lab animals
- birds
- fish and mussels
- insects
- others

In case live animals are to be temporarily warehoused they should be placed in a separate warehouse or in a separate room in the warehouse. The place should be constantly ventilated, sound--proof, tinted, with a constant temperature 17°C, equipped with access to running water.

6.8 Learning Activities

Most warehouses keep common or general purpose goods, assuming your warehousing company wants to venture into storing high value goods. Identify and explain any five methods for securing high-value inventory in a warehouse. Highlight any five challenges that you foresee with the proposed new business venture.

6.9 Self-Assessment Questions and Activities

1. Mention any five goods considered as special goods in warehousing.
2. Using relevant examples, explain McKenna's four principles for food grade storage
3. Why is it important to separate and segregate hazardous goods in a warehouse?
4. Most African countries that have received COVID-19 Vaccines are grappling with logistics failures regarding vaccine storage. As an expert in warehousing temperature sensitive goods, suggest 5 ways how temperature sensitive goods like vaccines can be handled in warehouses.
5. Briefly explain how you would handle live animals temporarily stored in a warehouse?

6.10 References

- Kamal, Ibtisam. (2014). Proper Handling and Storage of Chemicals. 10.13140/RG.2.2.34211.45600.
- UNEP IE/PAC. (2000). Storage of hazardous materials: A Technical Guide for Safe Warehousing of Hazardous Materials. Technical Report Series No.3
- Walaszczyk, Anna & Szymonik, Andrzej. (2020). Temperature Controlled Warehouse Safety Management Model. 2020. 757-767. 10.29119/1641-3466.2020.148.56.
- Giulia Baruffaldi, Riccardo Accorsi, Daniele Santi, Riccardo Manzini, Francesco Pilati, (2019). The storage of perishable products: A decision-support tool to manage temperature-sensitive products warehouses, Sustainable Food Supply Chains, Academic Press,2019, Pages 131-143, ISBN 9780128134115, https://doi.org/10.1016/B978-0-12-813411-5.000090.
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Walters, D. (2013). Inventory Control and Management, 2nd ed. John Wiley & Sons Ltd.
- Bragg, S. M. (2011). Inventory Best Practices, 2nd Edition. John Wiley & Sons Ltd.
- Wild, T. (2018). Best Practice in Inventory Management 3rd Edition. Routledge

7.0 WAREHOUSE ENVIRONMENT, HEALTH, SAFETY AND SECURITY

7.1 Specific Learning Outcomes

At the end of this topic the trainee should be able;

i) Explain the meaning of key terms in the Warehouse Environment, Health, Safety and Security
ii) Identify the environmental safety
iii) Employ Safety Measures in the Warehouse
iv) Employ appropriate security measures
v) Identify and analyse the warehouse hazards and solutions
vi) Discuss the use of first aid protocols in the warehouse
vii) Identify and explain different types of dangerous cargo
viii) Identify the fire risk assessment and management process

7.2 Meaning of Environment, Health, Security and Safety

Environmental, safety and health (ESH) is generally defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment. EHS aims to prevent and reduce accidents, emergencies, and health issues at work, along with any environmental damage that could result from work practices.

7.2.1 Health vs Safety

Occupational safety addresses potential safety hazards that can cause injury, whereas occupational health addresses potential health concerns. Occupational safety pertains more to the physical well-being of employees, while occupational health covers the employees' overall well-being.

Occupational health programs can be quite proactive by seeking to improve an employee's health and well-being. Employers may offer smoker cessation classes, or even have on site gym. At the very least, employers are responsible for identifying potential health concerns related to the job and controlling them just as they would with safety hazards.

There are various objectives for Health and Safety in the warehouse including to:

- Identify warehouse hazards
- Prevent back injuries
- Work safely with material-handling equipment
- Protect against accidents on the loading dock
- Stack materials safely
- Prevent slips, trips, and falls.

7.2.2 Difference between Safety and Security

One of the primary differences between the two terms is their definition. Security refers to the protection of individuals, organizations, and properties against external threats that are likely to cause harm. It is clear that security is generally focused on ensuring that external factors do not cause trouble or unwelcome situation to the organization, individuals, and the properties within the premises.

7.3 Common Warehouse Hazards

Warehouse operations can present a wide variety of potential hazards for the worker both safety and health hazards.

Safety Hazards:

- Cause physical injuries and accidents
- Cause immediate harm
- Examples: broken bones, cuts, bruises, sprains or electrocutions

Health Hazards:

- Cause internal injuries like diseases or illnesses
- Cause long-term harm, may take years to develop
- Examples: Cancer, heart disease, loss of hearing or reproductive problems

For warehousing establishments, the 10 Organisational Safety and Health Association standards most frequently used are:

i. Forklifts
ii. Hazard communication
iii. Electrical, wiring methods
iv. Electrical, system design

v. Guarding floor & wall openings and holes
vi. Exits
vii. Mechanical power transmission
viii. Respiratory protection
ix. Lockout/tagout
x. Portable fire extinguishers

Docks

Hazard: Injuries happen here when forklifts run off the dock, products fall on employees or equipment strikes a person.

Solutions:

- Drive forklifts slowly on docks and dock plates;
- Secure dock plates and check to see if the plate can safely support the load;
- Keep clear of dock edges and never back up forklifts to the dock's edge;
- Provide visual warnings near dock edges;
- Prohibit "dock jumping" by employees;
- Make sure that dock ladders and stairs meet OSHA specifications.

Forklifts

Hazard: About 100 employees are killed and 95,000 injured every year while operating forklifts in all industries. Forklift turnovers account for a significant percentage of these fatalities.

Solutions to common warehouse hazards

- Train, evaluate and certify all operators to ensure that they can operate forklifts safely;
- Do not allow anyone under 18 years old to operate a forklift;
- Properly maintain haulage equipment including tires;
- Before using a forklift, examine it for hazardous conditions which would make it unsafe to operate;
- Follow safe procedures for picking up, putting down and stacking loads;
- Drive safely, never exceeding 10 kph and slowdown in congested areas or those with slippery surfaces;
- Ensure that the operator wears a seatbelt installed by the manufacturer;
- Never drive up to a person standing in front of a fixed object such as a wall or stacked materials;
- Prohibit stunt driving and horseplay;
- Do not handle loads that are heavier than the weight capacity of the forklift;
- Remove unsafe or defective trucks from service until the defect is properly repaired;
- Maintain sufficiently safe clearances for aisles and at loading docks or passages where forklifts are used;
- Ensure adequate ventilation either by opened doors/windows or using a ventilation system to provide enough fresh air to keep concentrations of noxious gases from engine exhaust below acceptable limits;
- Provide covers and/or guardrails to protect workers from the hazards of open pits, tanks, vats and ditches;
- Train employees on the hazards associated with the combustion by products of forklift operation, such as carbon monoxide.

Conveyors

Hazard: Workers can be injured when they are caught in pinch points or in the in-going nip points, are hit by falling products or develop musculoskeletal disorders associated with awkward postures or repetitive motions.

Solutions:

- Inspect conveyors regularly;
- Ensure that pinch points are adequately guarded;
- Develop ways of locking out conveyors and train employees in these procedures;
- Provide proper lighting and working surfaces in the area surrounding the conveyor

Materials Storage

Hazard: Improperly stored materials may fall and injure workers.

Solutions:

- Stack loads evenly and straight;
- Place heavier loads on lower or middle shelves;

- Remove one object at a time from shelves;
- Keep aisles and passageways clear and in good repair.

Manual Lifting/Handling

Hazard: Back injuries may occur from improper lifting or overexertion.

Solutions:

- Provide general ergonomics training and task-specific training;
- Minimize the need for lifting by using good design and engineering techniques;
- Lift properly and get a co-worker to help if a product is too heavy.

Hazard Communication

Hazard: Chemical burns are possible if spills of hazardous materials occur.

Solutions:

- Maintain a Material Safety Data Sheet (MSDS) for each chemical to which workers are exposed in the facility;
- Follow instructions on the MSDS for handling chemical products;
- Train employees on the risks of each chemical being stored;
- Provide spill clean-up kits in any area where chemicals are stored;
- Have a written spill control plan;
- Train employees to clean up spills, protect themselves and properly dispose of used materials;
- Provide proper personal protective equipment and enforce its use;
- Store all chemicals safely and securely;
- Store chemicals away from forklift traffic areas.

Other Hazards

Inadequate fire safety provisions, improper use of lockout procedures and failure to wear personal protective equipment also create hazards in the warehouse workplace. Employers should have an emergency plan that describes what is expected of employees in the event of an emergency, including:

- Provisions for emergency exit locations and evacuation procedures;
- Procedures for accounting for all employees and visitors;
- Location and use of fire extinguishers and other emergency equipment.

Warehouse operations need a lockout/tagout program to prevent equipment from being accidentally energized and injuring employees. Employees required to perform these operations should be trained and all employees should have a working knowledge of the program. Finally, management at warehouse operations needs to conduct a site hazard assessment to determine what personal protective equipment (PPE) must be worn based on the hazards present and train warehouse employees on proper PPE selection, use and maintenance.

7.4 Managing Hazards

Controlling exposures to occupational hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of controls has been used as a means of determining how to implement feasible and effective control solutions. The hierarchy can be categorized in 3 approaches.

1. Elimination and Substitution

Elimination and substitution, while most effective at reducing hazards, also tend to be the most difficult to implement in an existing process. If the process is still at the design or development stage, elimination and substitution of hazards may be inexpensive and simple to implement. For an existing process, major changes in equipment and procedures may be required to eliminate or substitute for a hazard.

2. Engineering Controls

Engineering controls are favored over administrative and personal protective equipment (PPE) for controlling existing worker exposures in the workplace because they are designed to remove the hazard at the source, before it comes in contact with the worker. Well-designed engineering controls can be highly effective in protecting workers and will

typically be independent of worker interactions to provide this high level of protection. The initial cost of engineering controls can be higher than the cost of administrative controls or PPE, but over the longer term, operating costs are frequently lower, and in some instances, can provide a cost savings in other areas of the process. Some engineering controls may include:

- Change process to minimize contact with hazardous chemicals.
- Isolate or enclose the process.
- Use of wet methods to reduce generation of dusts or other particulates.
- General dilution ventilation.
- Use fume hoods

3. Administrative Controls and PPE

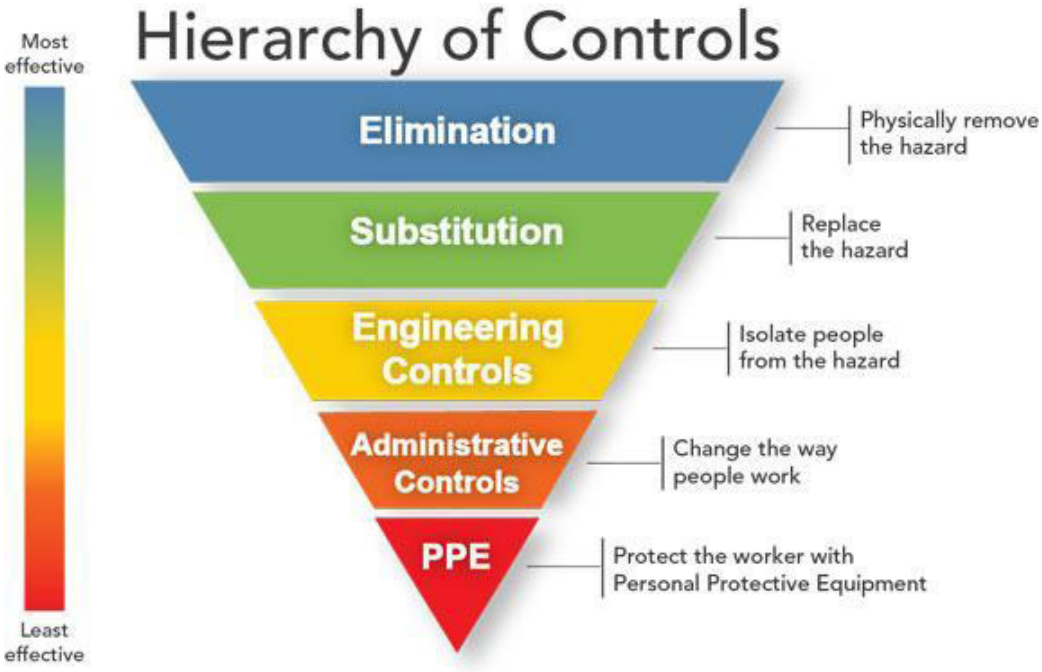
Administrative controls and PPE are frequently used with existing processes where hazards are not particularly well controlled. Administrative controls and PPE programs may be relatively inexpensive to establish but, over the long term, can be very costly to sustain. These methods for protecting workers have also proven to be less effective than other measures, requiring significant effort by the affected workers. Below are examples of Administrative controls and PPE.

Administrative controls

- Rotate job assignments.
- Adjust work schedules so that workers are not overexposed to a hazardous chemicals.

Personal protective equipment

- Use chemical protective clothing.
- Wear respiratory protection. Use gloves.
- Wear eye protection.



7.5 Emergency Equipment

Various emergency equipment should be available in the warehouse in the event of any hazard. These include:

- Sprinklers
- Fire extinguishers
- Evacuation routes
- Electrical panels
- First-aid supplies
- Alarms and phones

7.6 Warehouse Security

Warehouse security is one of the most important aspects of many commercial businesses. Companies all over the world depend on their warehouses to store valuable aspects of their business, and security problems will result in financial losses as well as lower employee morale. That's why logistics companies and storage facilities must have physical barriers and security deterrents that guard against unauthorized access.

7.6.1 Tips about the Important Features within a Warehouse Security System

Alarm systems and high definition video surveillance cameras

Alarm systems and high definition video surveillance cameras are both essential elements of warehouse security. Retrieval of recorded activities is now both readily available and easily accessible thanks to digital recording and state-of-the art DVRs that offer maximum protection and numerous benefits including:

- Superior video quality
- Real-time recording across multiple sites
- Remote monitoring
- Quick retrieval of video data
- Simultaneous recording and playback
- Unattended archiving
- Seamless integration with other security systems

One of the most valuable benefits on the list is remote alarm monitoring. With this feature, business owners and warehouse managers can utilize their IP-based video surveillance systems to monitor video data from virtually anywhere, at any time. Advanced security systems also offer a text message alert system that sends an alert every time an entrance into the building has been accessed.

Building Structure

Buildings must be constructed of materials that resist break-ins and protect from outside tampering. It is recommended that periodic inspections and repairs are done to your building's structure. This can help prevent false alarms and the fines that come along with them. If a solid structure is paired with a professional alarm system, the warehouse will be optimally protected.

Fencing

Perimeter fencing around your facility's yard should enclose every area that surrounds your storage facilities. If there is no fencing around your yard, either install some or implement procedural techniques to secure the yard from unlawful entry. Also, it is recommended that protection from outside intrusion be documented. This documentation process can be made extremely easy and effective by the implementation of an access control system. Access control systems are highly sophisticated, yet easy to use if installed professionally, and can be integrated into a number of other commercial security systems for maximum effectiveness.

Lighting

Adequate lighting must be provided inside and outside the facility, especially in the following areas: entrances and exits, cargo handling and storage areas, fence lines and parking areas.

Other ways to improve warehouse security include:

- Keep the areas designated for receiving and dispatching physically separated.
- Do a comprehensive background check when hiring new employees
- Invest in on-going employee training.
- Eliminate manual data entry, and use RFID or barcode scanning instead.
- Protect entrance and exit doors with a quality physical access control system.
- Create and adhere to a security policy to remove trash and scrap from the warehouse.
- Unload vehicles through separate channels.
- Restrict visitors from roaming the premises, unless supervised.
- Establish a proper control for the outgoing shipping consignment.
- Inspect all vehicles that enter and exit the warehouse.
- Place guards at all entrance and exit checkpoints.
- Review, test and maintain the warehouse security system on a regular basis.

7.6.2 Use of First Aid Protocols in the Warehouse

First aid is emergency care given immediately to an injured person. The purpose of first aid is to minimize injury and future disability. In serious cases, first aid may be necessary to keep the victim alive.

People working within warehouses can suffer injury or illness. Whether this is caused by work or not, it is important that arrangements are put in place to ensure employees receive immediate attention if they are injured or taken ill at work. The initial management of injuries and illness, until expert medical attention is received, could make a difference between life and death.

Employers must carry out an assessment of first aid needs and ensure that there are:

- adequate and appropriate equipment and facilities for giving first aid to employees. This includes a first-aid box and first-aid room, depending on the size of the warehouse;
- an 'appointed person' where necessary to take charge in an emergency whenever people are at work. The 'appointed person' does not need to be a qualified first aider but should take charge of the first-aid arrangements, including looking after the first-aid box and calling the emergency services when required. Short courses are available for 'appointed persons' covering emergencies, cardiopulmonary resuscitation, the unconscious casualty and the wounded or bleeding;
- Qualified first aiders. Whether these are needed and the number required will depend on the nature of the warehouse, the number of employees and location of the site. An appointed person is not necessary when there is an adequate number of first aiders.

7.7 Handling Different Types of Dangerous Cargo in the Warehouse

Dangerous goods (also referred to as Hazardous Cargo) means the substances, materials and articles that are covered by the IMDG Code and is cargo that is considered to be hazardous because of its flammable, corrosive, poisonous nature or other properties. IMDG Code (International Maritime Dangerous Goods) is a code adopted by the Maritime Safety Committee of the International Maritime Organization by resolution MSC.122 (75) for the carriage of Dangerous Goods (Hazardous Cargo).

7.7.1 Hazardous Substance Class Definitions & Labels

In the IMDG Code, substances are divided into 9 classes. A substance with multiple hazards has one 'Primary Class' and one or more 'Subsidiary Risks'. Some substances in the various classes have also been identified as substances harmful to the marine environment (MARINE POLLUTANTS).

- **Class 1** – Explosives
- **Class 2** – Gases; compressed, liquefied or dissolved under pressure
- **Class 3** – Flammable liquids
- **Class 4** – Flammable solids; Substances liable to spontaneous combustion; Substances which, in contact with water, emit flammable gases
- **Class 5** – Oxidizing substances (agents) and organic peroxides
- **Class 6** – Toxic and infectious substances
- **Class 7** – Radioactive materials
- **Class 8** – Corrosives
- **Class 9** – Miscellaneous dangerous substances and articles Non-classified materials

For the purposes of the IMDG Code, dangerous goods with a melting point or initial melting point of 20 °C or lower at a pressure of 101.3 kPa should be considered to be liquid, unless there is an explicit or implicit indication to the contrary. A viscous substance for which a specific melting point cannot be determined should be subjected to the ASTM D 4359-90 test. Goods of all classes other than 1, 2, 6.2 and 7 have also been assigned packaging groups according to the degree of danger they present; I – great danger, II – medium danger, or III – minor danger.

7.7.2 Class 1: Explosives

Class 1 comprises:

- explosive substances, except those which are too dangerous to transport or those where the predominant hazard is one appropriate to another class; [A substance which is not itself an explosive but which can form an explosive atmosphere of gas, vapour or dust is not included in class 1.]
- explosive articles, except devices containing explosive substances in such quantity or of such a character that their inadvertent

or accidental ignition or initiation during transport shall not cause any effect external to the device either by projection, fire, smoke, heat or loud noise; and
- substances and articles not mentioned above which are manufactured with a view to producing a practical, explosive or pyrotechnic effect.

Transport of explosive substances which are unduly sensitive, or so reactive as to be subject to spontaneous reaction, is prohibited. For the purposes of the IMDG Code the following definitions apply:

- An explosive substance is a solid or liquid substance (or a mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases.
- A pyrotechnic substance is a substance or a mixture of substances designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self-sustaining exothermic chemical reactions.
- An explosive article is an article containing one or more explosive substances.
- A mass explosion is one which affects almost the entire load virtually instantaneously.

Class 1 is unique in that the type of packaging frequently has a decisive effect on the hazard and therefore on the assignment to a particular division. Where multiple hazard classifications have been assigned, they are listed in the individual schedule. The correct hazard division is determined in accordance with the latest version of the United Nations Recommendations on the Transport of Dangerous Goods, Tests and Criteria (Test Manual).

The six hazard divisions of class 1 are:

Division 1.1 – Substances and articles which have a mass explosion hazard

Division 1.2 –Substances and articles which have a projection hazard but not a mass explosion hazard

Division 1.3 – Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard

This division comprises substances and articles:

- which give rise to considerable radiant heat; or
- which burn one after another, producing minor blast or projection effects or both.

Division 1.4 –Substances and articles which present no significant hazard

This division comprises substances and articles which present only a small hazard in the event of ignition or initiation during transport. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

NOTE: Substances and articles in this division so packaged or designed that any hazardous effects arising from accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity of the package, are in compatibility group S.

Division 1.5 – Very insensitive substances which have a mass explosion hazard

This division comprises substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport. NOTE: The probability of transition from burning to detonation is greater when large quantities are carried in a ship. As a consequence, the stowage requirements for explosive substances in division 1.1 and for those in division 1.5 are identical.

Division 1.6 – Extremely insensitive articles which do not have a mass explosion hazard

This division comprises articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation. NOTE: The risk from articles of division 1.6 is limited to the explosion of a single article.

7.7.3 Class 2.1 – Gases, 2.2 – Flammable Gases, 2.3 – Non-Toxic/Flammable Toxic Gases

A gas is a substance which:

- at 50 °C has a vapour pressure greater than 300 kPa; or
- is completely gaseous at 20 °C at a standard pressure of 101.3 kPa.

The transport condition of a gas is described according to its physical state as:

- Compressed gas, A gas (other than in solution) which when packaged under pressure for transport is entirely gaseous at 20 °C;
- Liquefied gas, A gas which when packaged for transport is partially liquid at 20 °C;
- Refrigerated liquefied gas, A gas which when packaged for transport is partially liquid because of its low temperature;
- Gas in solution, Compressed gas which when packaged for transport is dissolved in a solvent.

This class comprises compressed gases; liquefied gases; gases in solution; refrigerated liquefied gases; mixtures of gases; mixtures of one or more gases with one or more vapours of substances of other classes; articles charged with a gas; tellurium hexafluoride; aerosols. Class 2 is subdivided further according to the primary hazard of the gas during transport, into:

- **Class 2.1** – Flammable gases
- **Class 2.2** – Non-flammable, non-toxic gases
- **Class 2.3** – Toxic gases

7.7.4 Class 3: Flammable & Combustible Liquids

These are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (e.g. paints, varnishes, lacquers, etc., but not including substances which, on account of their other dangerous characteristics, have been included in other classes) which give off a flammable vapour at or below 61 °C closed cup test (corresponding to 65.6 °C open cup test), normally referred to as the flashpoint.

Class 3 also includes:

- Liquids offered for transport at temperatures at or above their flashpoint; and

- substances transported or offered for transport at elevated temperatures in a liquid state which give off a flammable vapour at temperatures equal to or below the maximum transport temperature.

However, the provisions of the IMDG Code need not apply to such liquids with a flashpoint of more than 35 °C which do not sustain combustion. Liquids are considered to be unable to sustain combustion for the purposes of the Code if:

- They have passed the suitable combustibility test (see the Sustained Combustibility Test prescribed in Part III, chapter 32.5.2 of the United Nations Manual of Test and Criteria); or
- Their fire point according to ISO 2592:1973 is greater than 100 °C; or
- They are water-miscible solutions with a water content of more than 90%, by mass

"Inflammable" has the same meaning as "flammable", Poisonous" has the same meaning as "toxic". Where the flashpoint is indicated for a volatile liquid it may be followed by the symbol "c.c.", representing determination by a closed cup test, or by the symbol "o.c.", representing an open cup test. Liquid desensitized explosives are explosive substances which are dissolved or suspended in water or other liquid substances, to form a homogeneous liquid mixture to suppress their explosives properties. Entries in the Dangerous Goods List for liquid desensitized explosives are: UN 1204, UN 2059, UN 3064 and UN 3343.

7.7.5 Class 4.1, 4.2, 4.3: Flammable Solids

Class 4 deals with substances, other than those classed as explosives, which, under conditions of transport, are readily combustible or may contribute to a fire or cause one.
Class 4 is subdivided further, into:

Class 4.1 – Readily combustible solids and solids which may cause fire through friction; Self-reactive (solids and liquids) and related substances; Desensitized explosives. The substances in this class are solids possessing the properties of being easily ignited by external sources, such as sparks and flames, and of being readily combustible, or of being liable to cause fire through friction. This class also covers substances which are self-reactive and related substances (i.e. liable to undergo, at normal or elevated temperatures, a strong exothermic decomposition caused by excessively high transport temperatures or by contamination); and desensitized explosives which may explode if not diluted sufficiently.

Class 4.2 – Substances liable to spontaneous combustion. The substances in this class are either liquids or solids which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire.

Class 4.3 – Substances which, in contact with water, emit flammable gases. The substances in this class are either liquids or solids which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. NOTE: Where the term "water-reactive" is used in this context, it refers to a substance which, in contact with water, emits flammable gas.

7.7.6 Class 5.1 – Oxidizing Substances, 5.2 – Organic Peroxides

Class 5 is subdivided further, into:

Class 5.1 – Oxidizing substances (agents). These are substances which, although in themselves not necessarily combustible, may, either by yielding oxygen or by similar processes, increase the risk and intensity of fire in other materials with which they come into contact.

Class 5.2 – Organic peroxides. Organic substances which contain the bivalent -O-O- structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. Organic peroxides are thermally unstable substances, which may undergo exothermic self-accelerating decomposition. In addition, they may have one or more of the following properties:

- liable to explosive decomposition;
- burn rapidly;
- sensitive to impact or friction;
- react dangerously with other substances;
- cause damage to the eyes.

7.7.7 Class 6.1 – Toxic, 6.2 – Infectious Substances

Substances that can poison and cause damage to any living body, tissue, and nervous system. "Poisonous" has the same meaning as "toxic".
Class 6 is subdivided further, into:

Class 6.1 – Toxic substances. These are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled, or by skin contact.

Class 6.2 – Infectious substances. These are substances containing viable micro-organisms, including a bacterium, virus, rickettsia, parasite, fungus or a recombinant, hybrid or mutant, that are known or reasonably believed to cause disease in animals or humans.

Note 1: Genetically modified micro-organisms and organisms which do not meet the definition of an infectious substance of class 6.2 (UN Nos. 2814 and 2900) should be considered for classification in class 9 and assigned to UN No. 3245 – GENETICALLY MODIFIED MICRO-ORGANISMS.

Note 2: Toxins from plant, animal or bacterial sources which do not contain any infectious substance or toxins that are contained in substances which are not infectious substances should be considered for classification in class 6.1 and assigned to UN No. 3172 – TOXINS EXTRACTED FROM LIVING SOURCES, N.O.S.

7.7.8 Class 7: Radioactive Materials

Radioactive material means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in IMDG code.
The following radioactive materials are not included in class 7 for the purposes of this Code:

- (a) radioactive material that is an integral part of the means of transport;
- (b) radioactive material moved within an establishment which is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
- (c) radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
- (d) radioactive material in consumer products which have received regulatory approval, following their sale to the end user;
- (e) natural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides provided the activity concentration of the material does not exceed 10 times the values specified.

7.7.9 Class 8: Corrosives

Class 8 substances (corrosive substances) means substances which, by chemical action, will cause severe damage when in contact with living tissue or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport. A substance which is designated as "stabilized" should not be transported in the unstabilized state.

7.7.10 Class 9: Miscellaneous

Class 9 substances and articles (miscellaneous dangerous substances and articles) comprise:

- Substances and articles not covered by other classes which experience has shown, or may show, to be of such a dangerous character that the provisions of part A of chapter VII of SOLAS, 1974, as amended, should apply; these include substances that are transported or offered for transport at temperatures equal to. or exceeding 100 °C, in a liquid state, and solids that are transported or offered for transport at temperatures equal to or exceeding 240 °C; and
- Substances not subject to the provisions of part A in chapter VII of the aforementioned Convention, but to which the provisions of Annex III of MARPOL 73/78, as amended, apply.

7.7.11 Non-Classified Materials

A "GENERIC" or "NOT OTHERWISE SPECIFIED (N.O.S)" entry may be used to offer for transport by sea a substance, material or article which is not listed by its name in the Dangerous Goods List. Such a substance, material or article may be transported only after:

- its dangerous, hazardous and/or harmful properties have been determined;
- it has been classified in accordance with the class definitions and criteria; and
- the entry that most accurately describes the nature of the goods has been selected.

Once the class of the goods has been established, all applicable requirements for transport laid down in the IMDG Code should be complied with. Any substance, material or article having, or suspected of having, explosive properties or characteristics should first be considered for classification in class 1.

7.8 Fire Risk Assessment and Management Process

Fire safety is just one of many safety issues management must address to minimise the risk of injury or death to staff or the public. Unlike most of the other safety concerns, fire has the potential to injure or kill large numbers of people very quickly.

7.8.1 Managing Fire Safety

Good management of fire safety is essential to ensure that fires are unlikely to occur; that if they do occur they are likely to be controlled or contained quickly, effectively and safely; or that, if a fire does occur and grow, everyone in your premises is able to escape to a place of total safety easily and quickly. The risk assessment that you must carry out will help you ensure that your fire safety procedures, fire

prevention measures, and fire precautions (plans, systems and equipment) are all in place and working properly, and the risk assessment should identify any issues that need attention.

In order to manage fire safety, it is recommended that warehouses should develop a ***fire prevention plan*** which must include:

- List of all major fire hazards,
- Proper handling and storage procedures for hazardous materials,
- Potential ignition sources and their control, and
- The type of fire protection equipment necessary to control each major hazard.

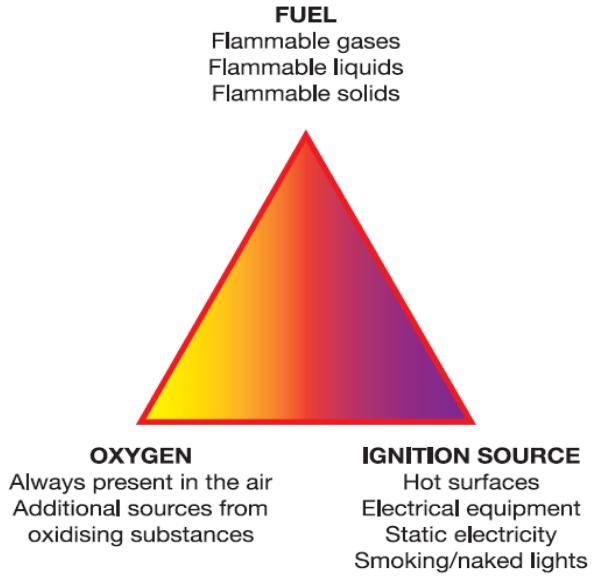
7.8.2 Conducting a Fire Risk Assessment

A fire risk assessment is an organised and methodical look at your premises, the activities carried on there and the likelihood that a fire could start and cause harm to those in and around the premises. The aims of the fire risk assessment are:

- To identify the fire hazards.
- To reduce the risk of those hazards causing harm to as low as reasonably practicable.
- To decide what physical fire precautions and management arrangements are necessary to ensure the safety of people in your premises if a fire does start.

How to conduct a fire assessment:

1. Identify fire hazards:
    - Sources of ignition
    - Sources of fuel
    - Sources of oxygen



2. Identify people at risk:
    - People in and around the premises
    - Employees especially those who work alone
    - Vulnerable people
    - Contractors
    - Young people
    - Other people in the immediate vicinity
    - Fire fighters

3. Evaluate, remove, reduce and protect from risk
    - Evaluate the risk of a fire occurring
    - Evaluate the risk to people from fire
    - Remove or reduce fire hazards
    - Remove or reduce the risks to people
        - Detection and warning
        - Fire-fighting
        - Escape routes
        - Lighting
        - Signs and notices
        - Maintenance

4. Record, plan, inform, instruct and train
    - Record significant finding and action taken
    - Prepare an emergency plan
    - Inform and instruct relevant people; co-operate and co-ordinate with others
    - Provide training

7.9 Learning Activities

You are in charge of new warehouse which is to be used to store 1000 pallets of flammable chemicals, 2000 tones of industrial paints, 600 cylinders of butane gas and 200 bags of ammonia nitrate fertilizers. Produce a list of the types of storage and MHE resources you feel you will require. You must justify each item on your list. From your list develop at least FIVE pieces of work-based safety regulations that will apply to the new facility, and explain how you intend to ensure that the new facility is safe for all workers.

7.10 Self-Assessment Questions and Activities

1. Distinguish between Health, Safety and Security
2. As a safety manager in a warehousing company, identify five common hazards in the warehouse. What safety measures can be put in place to manage the identified hazards?
3. Warehouses store valuable goods; it is therefore important that their security matches the security risks. Suggest any five modern security measures that you would deploy to enhance warehouse security.
4. Do you think it is important to train warehouse workers in First Aid measures? Provide justifications for your answer.
5. Using common examples, explain the nine classes of dangerous goods.
6. What are the three (3) aims of carrying out a fire risk assessment?

7.11 References

- Neustupa, Zdenek & Danel, Roman & Stasa, Pavel & Benes, Filip & Svub, Jiri. (2015). Ensuring the security of warehouse using automatic identification by RFID. 338-342. 10.1109/CarpathianCC.2015.7145100.
- HM Government (2006) Fire safety risk assessment for factories and warehouses
- Jones, K. (2020). Inventory Management for Competitive Advantage Including a Practical and Effective Purchasing Strategy for Managers. Routledge
- Emmett, S. (2005). Excellence in Warehouse Management: How to Minimise Costs and Maximise Value. John Wiley & Sons
- Richards, G. (2011). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page Publishers.
- Mulcahy, D. E. & Sydow, J. (2008). A Supply Chain Logistics Program for Warehouse Management. Routledge
- Walters, D. (2013). Inventory Control and Management, 2nd ed. John Wiley & Sons Ltd.
- Bragg, S. M. (2011). Inventory Best Practices, 2nd Edition. John Wiley & Sons Ltd.
- Wild, T. (2018). Best Practice in Inventory Management 3rd Edition. Routledge

NOTES

Federation of East African Freight Forwarders Associations (FEAFFA)

Hillcrest Court, Waiyaki Way, Slip Road, Westlands
P.O. Box 22694 – 00400 Tom Mboya, Nairobi Kenya
Tel: +254 (0) 738 150 673, +254 (0) 738 165 318
Email: info@feaffa.com | Website: www.feaffa.com

Federation of East African Freight Forwarders Associations (FEAFFA)
@FEAFFA
/FEAFFA