



APPENDIX – I



Material Handling – Storage and Packing Challenges

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APPENDIX – II

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APPENDIX - III

Declaration by the Guide

This is to certify that the **Ms. Anitha Sangeeth**, a student of **MBA in Logistics & Supply Chain Management**, SAP ID **500070041** of UPES has successfully completed this dissertation report on "**Mr. Nagarajan R**" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA.

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APPENDIX – IV**TABLE OF CONTENTS**

CHAPTERS		PAGE NO.
1.	Introduction	5 - 34
2	Objectives	35
3	Statement of the Problem	36
4	Need for Research	37
5	Literature Review	38 - 45
6	Research Methodology	46 - 49
7	Analysis Framework	50 - 81
8	Observations	82 - 85
9	Conclusion	86
10	References	87 - 92
11	Appendix	93 - 100

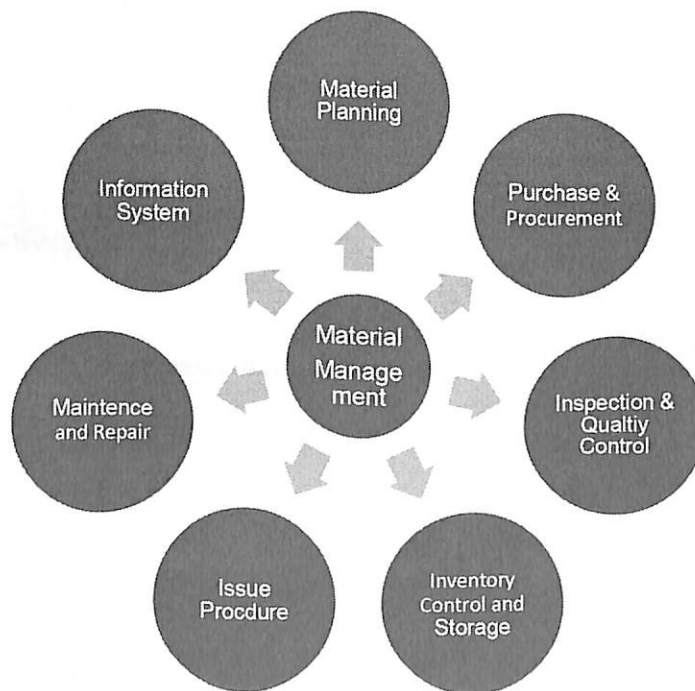
INTRODUCTION

Material handling is the term used for number of operations that can be executed either manually or by mechanical devices to transport material and to reduce human labour. For ease in carrying out the operation and getting desired capacity for the product it is very important to select proper transport system. In other words, it is an art of moving, packing and storing of products in any form. The main objective of the material handling is to reduce the production costs, increase equipment and space utilization, increase capacity, improving working conditions and improve customer service. In addition to handling of materials in an industry it is also significant in terms of saving of costs in overall operations as it is something that is quite common to all the manufacturers. It is difficult to overlook it as a major potential of effecting cost reduction, once its nature is exposed. The problems of material handling assume importance due to following factors:

1. Various studies made in different industries indicate that the cost of handling alone accounts for about 25-28% of total manufacturing costs. The cost in any particular industry is largely affected by the result of the methods and equipment used.
2. It is usually found that on an average 60 tons of material are handled for every ton of finished products and each part is handled 50-55 times while it passes through the chain of manufacture.

3. It ensures increase in safety, as material handling accounts for 20% of the permanent disabilities and 24% of temporary disabilities.
4. It also helps in reducing damage claims of parts and materials.
5. Most of the jobs done by man handling are mere drudgery for men in the first place and some of the automatic handling jobs being done today would be impossibility for manual labour within the present economic framework.
6. Competition is beginning to force the new technology upon industry and the area of material handling is still to be fully explored. It is not only the biggest opportunity but has also become the necessity.

Organization of Material Management



Objectives of Material Management

There are primary and secondary objectives of material management, which are listed below:

Primary Objectives

- Right Price & High Turnover
- Low procurement and storage costs
- Continuity and consistency in supply
- Good supplier relationship
- Development of personnel
- Good Information System

Secondary Objectives

- Forecasting & product improvement
- Inter-departmental harmony
- Standardization
- Make or buy decision

- New materials and products
- Favourable reciprocal relationships

Basic needs of material management - There are four basic needs of material management which are listed below:

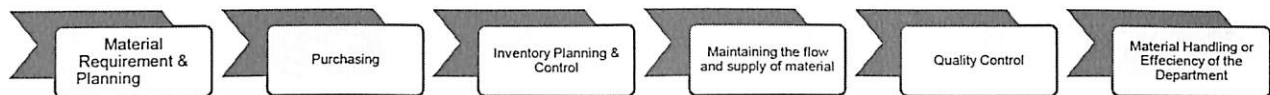
- To minimize the inventory investment
- To have adequate material in hand when required.
- To operate efficiently and effectively
- To pay the lowest possible prices in consistent with the quality and value requirement for purchase material.

- **Functional areas of Material Management**

- Purchasing
- The pharmacy
- Central service supply
- The Print shops
- Dietary
- Linen Services

- Central stores

Activities involved in Material Management



1. Materials Requirements Planning (MRP)

The important function of any organization is the planning of materials requirements and it involves an inventory of materials of about 60% of the overall investment of the organization. The profit earned depends on the utilization of these materials and thereby reducing the inventory of the materials. The latest technique that has been used is known as Just in Time (JIT) However, in the current scenario in any of the organization especially the manufacturing organization, it is not possible to keep and hold inventory of materials required for production. The MRP (Material Requirement Planning) is a technique that is used to plan the materials from the beginning i.e. from the raw materials - finished parts – components - sub-assemblies and assemblies as per Bill of Materials (BOM) in order to procure or produce them to support a Master Production Schedule (MPS). This technique is used by any company that uses MPS to manufacture products which require assemblies, components and materials to produce the final products.

2. Purchasing

All the organizations needs an efficient and economic purchasing and procurement departments to manage the supplies of materials from the suppliers. To perform such activity very efficiently and effectively the materials management department has to play an important role diligently. Since 55% - 60% of sales turnover is spent on the purchase of various materials, the amount of profit earned on the sale depends how economically the materials are purchased and utilized in the organization. The profitability of any department depends on the efficiency by which this particular function of purchasing and procuring the materials at the right time will be done and its availability is assured. The various function of purchasing department can be stated as follows:

- a. The requisition of material is mandatory from the authority to initiate its purchase.
- b. To select proper supplier for the materials requisitioned, before placing an order.
- c. To negotiate about the price of the material from the supplier and it will be purchased at the cost effective price.
- d. The quality of material must be assured and should not be compromised with the cost of the material.
- e. The material should be purchased of right quantity and right quality at proper time at the cheapest cost.
- f. To set the proper purchase policy and procedure.

3. Inventory Planning and Control

The modern idea of inventory planning is that the materials should be purchased and brought in the stores just before it enters the production or sold out so that inventory cost is zero or negligible. The zero inventories is also labelled as the ideal planning. There are three kinds of inventories - raw materials, purchased goods and finished parts. The inventory control of these various materials lies with the materials management department, production department and sales department. Procurement of Inventory at different levels is necessary to make sure about the availability of all these types of materials and goods and their proper flow from one facility to another at different levels of production centres in a manufacturing concern. This involves inventory planning and control of materials in the stores department. Many a time, the supplier may not be in a position to supply the materials of the ordered quantity at the proper time. To maintain the continuity in production and line balance in assembly work, the various types of inventories are necessary to be maintained and kept in the stores. The raw materials before being supplied to a production process, some of it is sent to store as inventory and rest is sent to production facility as per its requirements and in the same way, various parts manufactured and assembled as components and assemblies are also stored as finished parts inventories at the different places in the stores. The final products before being supplied to the customers are also stocked as inventory of the final products of the organization to meet the fluctuating demand and to regularize the supplies in the market. Thus, the inventory control is a very important function of the materials management department. The various types of inventory models are developed for the different materials to economise the purchase, supply, inventory control and production control to

analyse and optimize the costs involved in ordering, set-up and inventory carrying of materials required in the production.

4. Maintaining the Flow and Supply of Materials

Distribution of materials is requisitioned through the various production centres and other departments. Insufficient or zero inventories many times create the situations of stock-outs and thus leading to stoppage of production. Failure of materials handling devices is also responsible for the disruption in the supplies of material. Various alternatives or emergency supply systems can be used for assuring production lines to continue the production. The major factor is the uncertainty in demand and production quantity due to changes in the needs and liking of the customers. The management has to maintain continuity in production to meet the uncertainty in demand and control the situation by proper flow of materials supply and distribution at various production facilities and other departments as per changes in production quantity.

5. Quality Control of Materials

It depends upon the quality of the materials used to manufacture a particular product. It is a very important and to purchase the right quality of materials. The inspection, quality control, simplification, specification, and standardization are the activities which are involved in the measurement of quality of the materials. The quality assurance is done by inspection and checking departments. It involves the checking of the various properties of materials as per their specifications and standard, size and dimensional measurements within tolerance limits assures the interchangeability and reliability of components and

parts. Currently, the market is controlled by the buyer and innovation of the product is determined by consumer taste and liking. Material quality control aims at delivering product at higher quality at lower cost. The product will be specified not only by its dimensional accuracy but its quality standards, durability and dependability, high performance, reliability and aesthetic value. Each of this factor helps in controlling the cost to the product. In order to achieve high quality, the materials input to the product should be of high quality, which will have higher cost. The performance of the same is also decided by the reliability, which is obtained through high quality production and it is checked by quality inspection and accuracy. The quality of the materials also decides the selection of vendors and the relationship between buyers and suppliers. The specifications, size and quality of materials must be mentioned and if possible the standard should be followed for specifications and sizes. The types of tests required for assuring the quality should be specified and conducted to establish the standards.

6. Material Management or Departmental Efficiency

The objective of this function is to ensure the efficiency of the system adopted. If the system and procedure adopted for materials management are inefficient or faulty, none of the objectives mentioned above can be fulfilled, therefore, it is very important that the procedure may be good. In order to maintain the things in proper way as per planning an efficient control is necessary in the department over each and every process. MIS (Management Information System) and feedback control at every stage of working must be adopted to control and make the management and employee work as efficiently as possible to achieve the best results.

Scope of Material Handling

Material handling is spread over many different industries along with the field of engineering.

Manufacturing

It is the largest single field for applications of material handling process where a wide range of material handling equipment is used. The problem of material handling involves surveys, routing, plant & equipment layouts and storage of material.

Construction

It needs proper receiving, sorting, storing and movement of materials. In construction projects, the choice of special methods and equipment of material handling and influences project planning as well.

Processing

It requires handling of bulk materials like liquids, gases, bulk solids, semi-liquids. The problems of special handling affect the plant design.

Power

For handling fuel and ashes, material handling equipment are required.

Machine Tools

The design of many processing machines is affected by the need for integrating number of material handling features and attachments to modern machine mechanisms.

Mining

There is now a variety of equipment involved for the operations to be performed at the underground mines and open pit for extraction, handling and transportation of coal and ore and the cost of the same has been reduced to the minimum.

Rail road car builders

The material handling equipment is also involved in the improved rail-road cars, development of terminal equipment and improvement in handling the procedure for loading and securing the freight, transferring or unloading it at the terminals.

Truck Building

The automotive engineer develops it as an efficient material handling vehicle that are designed for the speedy loading and unloading of material, ensuring the security of cargo and safe transportation of variety of materials.

Aircraft

Material handling also helps in the better cargo and storage methods for air transport, where it is concerned.

Barge and Ship building

In this industry new handling devices and improved kinds of marine carriers are manufactured.

Sales forecast and production plan

Sales forecast and production plan an important role in the planning and controlling of the material, which involves estimation of the individual requirements of parts, preparing material budget along with estimation of the requirements of machine parts, scheduling of orders and monitoring its performance in relation to the sale and production.

Purchasing of Material

There are various steps that need to be considered while purchasing of material like the selection of sources of supply finalization, placement of purchase order along with follow ups, building and maintaining smooth relations with suppliers and finally evaluating, rating and approval of payments to suppliers.

Store Management

A store management is responsible for the physical verification of stocks and reconciling of the book figures. A store plays a very important role in the operations of a company, this also involves physical and automated control of the material, minimization of damage, maintenance of records, proper location and stocking.

Inventory Management

Inventories are referred as those items that are either in stock for sale or they are in the form of finished goods which are yet to be utilized. Depending upon the cycle time of manufacture the gap between the receiving of the purchased parts and transforming it into the final products varies from industry to industry. It is essential to hold the inventories of

various kinds which acts like buffer stock between demand and supply for the operation of the system.

Importance of Material Handling

The success of the many large companies depends on the safe and efficient transport of the product from one warehouse to another in a very cost-effective way. Following are the importance of material handling techniques:

- The use of proper methods and equipment pertaining to different industries can lead to the cost optimization i.e. observations from different studies have shown that the handling cost alone accounts for 18-25% of the entire manufacturing cost.
- The right methodology reduces claims for the damaged parts and material.
- It ensures safety from temporary and permanent disabilities.
- It promotes productivity by using gravity, movement of more material at one time, automation of the material handling techniques, material flow in a straight line.
- It promotes the increase use of facilities by promoting the use of building cube, purchasing of multi-purpose equipment, maximizing the equipment utilization and developing a preventive maintenance program.

Functions of Material Handling

One of the basic functions of material handling is to choose and apply the most appropriate and efficient materials handling equipment which can fulfil the material handling conditions at the bare minimum cost along with the safety of using it. Below are the functions of the good material handling system:

- a) Using the principles of centralization with an aim of moving maximum number of pieces at one go i.e. in one unit.
- b) In order to speed up the material movement, the mechanical assistance needs to be taken into consideration in place of manual labour.
- c) The selection of material handling equipment should be based on safety, standard, efficient, effective, flexible and appropriation.
- d) To minimize the movement engaged in material movement.
- e) Unloading the incoming material from the transport vehicle.
- f) In order to economize handling and reduction in damage to materials in transit, designing of containers and packages need to be selected optimally.
- g) Regular or periodical check-ups, repairs and maintenance of material handling equipment to be initiated.
- h) Lifting the material from its storage place during the order picking.

Principles of Material Handling

The key principle of Material Handling is as follows:

- **Planning Principle** – It ascertains a plan which includes basic requirements, alternatives and planning for emergency. The main points of planning principle are mentioned below:
 - The plan should be established in consultation with the planner and all the people who will use the equipment employed.

- The success in planning the material handling project requires a strong team which includes suppliers, consultants, engineers, computer and information system specialists, finance and operations specialist.
- It should reflect the strategic objectives and the needs of the organization.
- It should also take into the consideration the existing methods, problems, physical and economic hindrances and goals.
- The plan should help in promoting co-existing engineering of the product, process design, layout and the methods of material handling.

- **Standardization Principle:**

It encourages standardization of handling methods, equipment, software and control within the limits of achieving overall objectives. In other words, standardization means less variety and customization in the methods and equipment employed. Following are the important points related to this principle:

- The planner selects standardized methods and equipment that can perform a variety of tasks under a variety of operating conditions and the same can be applied to sizes of containers and other load forming components, operating procedures and equipment.
- Standardization, flexibility and modularity must not be mismatched.

- **Ergonomic Principle –**

Ergonomics is defined as a science that seeks to adapt work or working conditions to suit the abilities of workers and also ensure safe and effective operations, the human capabilities and limitations must be recognized and respected in the design of material handling tasks and equipment. The key points pertaining to this principle is as follows:

- Efficient equipment to be selected that removes repetitive and exhausting manual labour and which effectively interacts with human operators and users.
- It holds both the tasks: physical and mental. The material handling workplace and the equipment employed must be designed in such a way so that they are safe for people.

- **Unit Load Principle**

A unit load is defined as the one that can be stored or moved as a single entity at one time like pallet, container. It should be appropriately sized and configured in such a way which helps in achieving the material flow and inventory objectives at each stage in the supply chain. The key points pertaining to this principle are as follows:

- The main advantage is that the less effort and work is required to collect and move single load than to move many items at a single point of time.
- The composition and size of load changes as the material and product moves through different stages of manufacturing and distribution channels.
- Large unit loads in the form of raw materials and finished goods are common for both the pre and post manufacturing of a product.

- Unit loads are a mixture of different items that are consistent with just in time or customized supply strategies.

- **Space Utilization Principle**

Space is counted as a cubic space as in material handling it is three dimensional. The principle of space utilization is the effective and efficient usage of the available space.

The key points pertaining to this principle are as follows:

- In storage space the purpose of maximizing storage density should be balanced against accessibility and selectivity.
- The use of overhead space should be considered when transporting the loads within the facility.
- In work areas, unorganized spaces and blocked aisles should be removed.

- **System Principle**

A system is defined as collection of interdependent entities that forms a unified whole. Material movement and storage activities should be combined to form a coordinated and operational system which covers inspection, storage, production, packaging, unitizing, shipping and transportation of material. The key points pertaining to this principle are as follows:

- The integration of system includes the entire supply chain process including reverse logistics and includes suppliers, manufacturers, distributors and customers.

- The minimization of the Inventory levels at all stages of production and distribution.
- Information and physical material flow should be treated as synchronised activities and should be integrated.
- Customers requirement with respect to quantity, quality, consistency, on time delivery should be met without exception.
- For the effective integration of material flow and information management, computerized material handling systems should be considered where appropriate.

- **Environmental Principle**

This principle stems from a desire of not wasting the natural resources and to forecast and remove the possible negative effects of our daily actions on the environment. It should be considered as vital criteria while designing or selecting the alternative equipment and material handling systems. The key points pertaining to this element are as follows:

The containers or the pallets or the other products should be designed for reusability or biodegradable, whenever it is appropriate. The design should accommodate the handling of the empty containers and other by-products of the material handling. Materials mentioned as hazardous have special needs with regard to the spill protection and other involved risks.

- **Automation Principle**

In order to improve the operational efficiency, increase responsiveness, improve consistency and predictability, the material handling operations should be automated.

- **Life Cycle Cost Principle**

The life cycle includes all the cash flows that occurs between the first amount spent in order to plan or procure a new equipment, in order to place a new method or an equipment is to be replaced. The key points pertaining to this principle is as follows:

- Capital investment, setup and equipment programming, training, system testing and acceptance, maintenance and repair, reuse value and disposal is included in it.
- A plan for preventive and predictive maintenance should be prepared for the equipment and the estimated cost of maintenance spare parts should be included while calculating the economic analysis.
- A long range plan for replacement of the obsolete equipment should be prepared. Measurable cost is one of the primary factor but it cannot be considered as an alone factor in selecting among alternatives.
- Other factors of a strategic nature to the organization and which form the basis for competition in the market place should also be considered.

Design of Material Handling Systems

The vital part in material handling is to design the most effective and efficient production systems in order to have the efficient flow of the material between the activities of the production system, as it is majorly dependent on the layout of the activities. The conveyor can move the material at a low cost, if the activities are in order. Industrial trucks or overhead conveyors are required if the activities are separated which incurs huge cost, as the main reason for the high cost of using an industrial truck for material transport is due to the

labour costs of the operator and the negative impact on the performance of a production system

A Unit Load Concept

This is either a single unit of item or multiple units so that they can be handled as a single unit and maintains their reliability. The granular, gaseous materials and liquid can be transported in bulk quantities as they can also be contained into unit loads using same time, thereby, reducing the number of trips and reducing the handling cost, product damage and loading and unloading cost, thereby enabling the use of standardized material handling equipment. The disadvantage of unit loads is the negative impact on the production system performance and the high cost that is been involved in returning empty containers to their point of origin.

Distribution

Selection of a unit load size for distribution is difficult as the containers are usually available only in the standard sizes and configurations. The practical size of a unit load is limited by the equipment and the aisle space that is available and the need for safe handling of the material.

In-Process Handling

Unit Loads can be used for distribution and in-process handling including receiving, storing and shipping. The design of unit load involves determining the type, size, weight of the load, the equipment and method used to handle the load and methods of forming and breaking down the load. For the in-process handling, unit loads should not be larger than the production batch size of the parts and the large production batches can be split into smaller

transfer batches for the purpose of handling and the small unit loads can be combined with the larger batch in order allow more efficient transport.

Types of Material Handling Equipment

Below mentioned categories are the main categories of material handling equipment:

- Storage and Handling Equipment
- Engineered Systems
- Industrial Trucks
- Bulk Material Handling

Storage and Handling Equipment

The storage equipment refers to pallets, racks and shelves on which the material can be stacked in an orderly manner to wait for the consumption or the transportation, whichever is applicable. It is usually limited to non-automated examples which are grouped with the engineered systems. It is used to hold material during the times when they are not being transported. Long term storage is designed to allow the build-up of stock and many companies have investigated the possibility of increased efficiency in the storage equipment by designing exclusive packaging that allows materials of certain type to reserve the space while lying in the inventory. Below are the few examples of storage and handling equipment:

- **Stacking Frames**

These are stackable like blocks and allow crushable pallets of inventory to be stacked to save the space without any damage such as containers of liquid.

- **Racks**

This is one of the important basic methods of storage, helps in saving the floor space while keeping their material accessible such as pallet racks, push back racks, sliding racks, drive through or drive in racks.

- **Mezzanines**

This type of storage help to create more floor space in a warehouse or other storage building for offices and it is a type of indoor platform. It includes modular, building and rack supported and frees standing versions.

- **Shelves, bins and drawers**

This is another basic storage method and is less open than racks. They are more able to keep smaller and used with bins and drawers. Shelving types includes cantilever, revolving and tie down.

Engineered Systems

It covers a variety of units which works unified to enable the storage and transportation. They are automated systems. An Automated Storage and Retrieval System which is often known as AS/RS is the good example of an engineered system involving racks, aisles and shelves which are accessible by a shuttle system of retrieval. The shuttle system is a system that is used by a worker to quickly locate the location of the storage items and retrieve it for other uses. It can also perform fully automated functions. Below are the types of the engineered systems:

- **Conveyor System** – It comes in variety of types which is depending on the method of transporting the material including overhead, chain, vertical and apron conveyors.
- **AGV (Automatic Guided Vehicles)** – These are the independent computer operator trucks that transport loads on a predetermined path with sensors and detectors in order to avoid bumping of the material.

Industrial Material Handling Trucks

It refers to the different kinds of transportation items and the vehicles that are used to move the materials and products in the material handling process. These include small hand operated trucks, various kinds of forklifts and pallet jacks. These trucks have diversified features which make them suitable for performing different operations. Some trucks have forts or a flat surface which helps it to lift the items while some trucks require a separate piece of equipment for loading. It can also be operated manually or automatically i.e. powered lifted and operation can be a walk or ride which requires a user to manually push them or to ride along on the truck. A stack truck can be used to stack items while a non-stack truck is not for loading and is only used for transportation. Below are the types of the industrial trucks:

- **Hand Trucks**

This is one of the basic type of material handling equipment which features a small platform to set the edge of heavy object and a long handle to use. Whatever object is being moved should be tipped so that it rests on the handle and is carried at a tilt to its final destination.

- **Walkie Stackers**

It lifts pallets like a forklift though a place for the operator to ride in is not included in. They come in both forms – manual or the powered versions.

- **Pallet Trucks**

This is specifically designed for pallets and is also called as pallet jacks. They slide into a pallet and lift it up to move it. It comes in both types: manual and electrical.

- **Side loaders**

It is also known as Very Narrow Aisle (VNA) trucks are meant to fit in narrow warehouse aisles, as they can load objects from different directions as well.

- **Platform Trucks**

These are the hand trucks low to the ground with a wide platform for transporting goods.

- **Order Pickers**

It lifts the operator several feet above the ground with a wide platform for transporting of goods.

Bulk Material Handling Equipment

It refers to the storing, transportation and control of materials in loose bulk form and can include food, liquid, minerals among others. This equipment deal with the items in the loose form like conveyor belts or elevators designed to move large quantities of material or in

packaged form through the use of drums and hoppers. Below the are the types of bulk material handling equipment:

- **Conveyors** – It comes in wide variety of types for different types of the bulk material.
- **Bucket elevators** – It is also known as grain legs and uses buckets attached to a rotating chain or belt to carry material vertically.
- **Reclaimers** – These are the opposite of stackers used for retrieving material from stockpiles using bucket wheels to carry the material.
- **Stackers** – These are automated, pile bulk material onto stockpiles moving it between two points along rails in a yard.
- **Silos** – These are generally large storage structures used for the bulk materials though they don't necessarily include equipment to convey the material to the top of the structures. There are different types of silos like tower, bunker and bag silos.
- **Hoppers** – These are funnel shaped containers that allow material to be poured from one container to another and it can hold material until its needed and then release it.
- **Grain Elevators** – These are the tall buildings specifically for storing grain and include equipment to convey the grain to the top of the elevator from where it is sent out for processing.

→ **Integrated Materials Management Concept**

The concept of Materials management is to manage resources in an integrative way for national economic development and this is possible with the development various factors like Management Information System (MIS), technological innovations and selection of economic and newly-developed materials for manufacture. It is the management's responsibility to develop the materials management system, which will find its own ways and means for efficiently and effectively use of its resources using new technological processes, methods and ideas. The various resources to be fully utilized are men, money and materials and therefore there is importance of materials management.

Average Expenditure on the Materials by Various Industries

The various industries, which are spending their money on the materials to produce the products, are mentioned below:

S. No	Industries	Average expenditure on material (%)
1	Electrodes, cotton and silk yarns, sugar	65%-68%
2	Engineering Goods	62%-65%
3	Cotton, Textiles, Wires	65%-70%
4	Ship building, cement, chemicals	50%-55%
5	Pharmaceuticals	40%-43%
6	Other Industries	40%

The integration of materials management functions is necessary in the following ways:

- Materials management will take decisions for purchase of materials.

- The centralization of authority is necessary, which will co-ordinate all the functions.
- Speedy and accurate decisions are needed.
- Data analysis through Electronic Data Processing (EDP) and use of computers is necessary.
- Opportunity for growth must be emphasized.

Types of Materials - The various types of materials to be managed are listed below:

- **Purchased materials :**

It includes raw materials, components, spare parts, oils, grease, cotton waste, consumables and tools.

- **Work in process (WIP) materials :**

It includes semi-finished and finished parts and components lying on the shop floor.

- **Finished goods :**

These are the final products either waiting to be assembled in the assembly lines or in stores which are stocked for final delivery waiting to sell. The various costs involved in these materials are basic price, purchasing costs, inventory carrying cost, transportation cost, materials handling cost, office cost, packing cost, marketing cost, obsolescence and wastages.

➤ **Material Management Organization**

The major resources in any organization is to manage the materials via management, materials, money, man power, machines, methods and matrix or facilities which include systems, plants, location and buildings etc. The main aim of materials management organization in any industry is to plan the materials requirements for the production of goods and services. The structure of the organization should be such so that the efficient management of materials can control its flow, conservation and utilization. The product must be produced from the available materials purchased at the economic price and bring together under one organizational component sharing responsibilities of all the aspects affecting flow, conservation, utilization, quality and cost of materials. Materials management include inventory management, purchase management, value analysis, store keeping, maintenance and upkeep of the inventories in hand and in process. The organization of materials management must be such as to efficiently integrate the activities concerned with materials and regulate its use as per requirements in the production so as to have stability. The structural development and authority within the hierarchy of the system must be harmonious and integrative for proper decision making and achieving goals of the organization through proper information supply system

Advantages of Material Handling Equipment

It refers to an assortment of products that helps in streamlining the transportation and storage of material. It boosts the efficiency of the workflow in manufacturing, manages the warehouse for its optimum utilization and updates the supply chain distribution channels. It promotes efficiency, accuracy and cost-effective way to ensure the swift movement of goods across an organization and these equipment are designed to be either mechanical, automated or hydraulic. Below are the advantages of the same:

- The material handling equipment can help in reducing the manual labour and the number of workers needs to perform a task.
- Flexible and efficient material handling equipment can address the issues of congestions, re-routing and many more.
- It also helps in devising the job right fit for the worker. Apart from the efficiency, they created a safe and comfortable place to work which further results in improving the productivity.
- It also helps in accuracy and control of the things and there is no chance for misplaced items, hassles or any kind of damages.
- It helps in reducing the shipping and handling costs and thus reducing the time that is taken to ship a package.
- It also helps in protecting the welfare of the workers and thereby enhancing a better working environment.

- It adds in gaining more customers into the business and customers become happy when their shipments get delivered at the right time and right place without any kind of damage.
- It also helps in increasing the confidence of workers in performing tasks and promote the positive workplace.
- It helps in reducing the back and hand injuries that the workers may experience on a daily basis.
- It ensures an increase in the safety of the workers.
- It can protect goods also from damage. Material handling solutions can easily protect goods from damage during lifting and transporting of goods.

OBJECTIVES

The main objectives of this study are mentioned below:

- Describe the changes in the material handling processes at the company
- Evaluation of internal material handling flow in manufacturing and verifying the improvements
- Analysing the internal customer's satisfaction levels in relation to the new system.
- To provide future research room to improve on the present research.

STATEMENT OF THE PROBLEM

- Improper and inadequate usage of material handling in the manufacturing process.
- Poor maintenance and careless handling of material handling equipment.
- Lack of training and development of staffs/employees regarding best usage of any machine and minimizes the damage.

NEED FOR RESEARCH

Material handling plays an important role in any industry, which starts from the time the raw material enters the factory, formed in different shapes and moves out of the factory in the form of the finished products. To yield the required output the material is to be turned, moved and positioned on the respective machines. In the same way there are other inter-department transfers of material for the final conversion operation executed to the final inspection.

Despite the important impact of material handling on the industrial competitiveness, it has not yet attracted the attention of many of the researchers. The connections between material handling education and research have been explored and the traditional sources of support are examined. This research focuses on the future needs and opportunities along with the future support of material handling research.

LITERATURE REVIEW

Lambert and Chopra, 2002 put it forth that materials handling makes production flow possible, as it gives vitality to constant elements like materials, products, equipment, layout and human resources. Groover (2007) further highlighted that despite the importance of material handling, this topic is treated casually by the companies. However, other authors have observed its importance and relevance. During the period in which Shingo (1998) developed the Production Function Mechanism that explains how the production phenomenon happens.

According to Asef-Vaziri & Laporte (2006) an important proportion of manufacturing expenses can be attributed to material handling and the most important decision with respect to material handling is the arrangement and design of material flow patterns. This idea is shared and argued by Loannou (2004), stating that an important aspect of any production system is the design of a material handling system which integrates the production operations

For Bowersox (1997), the main responsibility of logistics in manufacturing is to make a master-program for the timely provision of materials, components and work-in-process. Stevenson (2001) pointed out that materials handling and flowing of goods in and out of a production facility and internal handling has also become very important to an organization to gain competitive advantages, as the companies struggle to deliver the right product at the correct place and time. One of the main challenge is to promote it with low cost and maintain a good speed flow which allows the implementation of manufacturing process with the expected satisfaction level.

According to Kulak, 2009 some of the factors which influences selection of material handling equipment are effective use of labour, providing system flexibility, increasing productivity, decreasing in the lead times and costs. These factors are directly related to some attributes found in the present study. As per Sujono and Lashkari, 2006, the determination of a material handling system includes both the selection and the assignment of suitable material handling equipment and operations.

As per stock & Lambert, 2002 the material handling makes production flow possible, as it gives vitality to the static elements like material, product, equipment, layout and human resources. Groover, 2002 further highlights that despite its importance, this is a topic that is frequently treated as superficially by many of the companies. However, other authors have observed its importance and relevant.

Shingo, 1997 has contributed towards the development of the production function mechanism that helps in explaining how the production phenomenon happens. He further indicated that in the West, the production has been treated as the process of sequence of multiple operations. In the Production Function Mechanism, the concepts are directly related to the production analysis focus and a process analysis which consists of a finding of the product flows that changes the raw material to the finished goods. The author further highlighted that the main analysis is the one which is associated with the process because it follows the production object. As per the analysis of the operations it focuses on the production subjects and it is possible to observe the relevance of the material handling. Beyond the basic function of the movement, it is important to cite the various functions of the storage and information which occurs simultaneously and has both dimensions related to strategic and operational.

As per Lambert & stock, 2002, Milan & Basso, 2008, organizations are relying on the information systems using tools such as EDI i.e. Electronic Data Interchange and similar other information technology resources in order to gain reliability and accuracy.

Asef and Laporte, 2007 further pointed out the important proportion of the manufacturing expenses that can be attributed to the material handling and the most critical decisions pertaining to material handling are arrangement and design of material. This was further shared by Loannou, 2003 who argues that an important aspect related to any production system is the design of material handling system (MHS) which integrates the various operations pertaining to production process. The relevance of the same also occurred in the same context which has been put forth by Ballou, 1994. As per him the storage and handling of goods are the most essential elements among the set of logistics activities and their costs can absorb 15%-45% of its costs. Additionally, the MHIA projected that 25% of manufacturing costs are associated to the handling charges.

As per Sule, 1995 and Lakshari, 2008, material handling accounts for 35%-65% of the total cost of a product along the production chain and efficient material handling can be responsible for reduction the manufacturing operation system cost by 16%-27%. Bowersox & Closs, 1997 further pointed out that the main responsibility of logistics in manufacturing is to devise a master program for the timely provision of material and its components.

Stevenson, 2002 understands that logistics of materials and goods flowing in and out of a production facility as well as its internal handling has become very important to an organization in order to acquire the competitive advantages as the companies are struggling to deliver the right product at the right place and time. One of the main challenges involved

is to promote the same with low cost. Dias, 1994 adopted the term moving to describe which is called management or handling of the material. When dealing with the equipment he presents a classification which covers five categories i.e. transporters, cranes, industrial vehicles, positioning equipment and stents and support structures.

According to Chan & Lau, 2000, one of the key factor in material handling system design process is the selection and configuration of the equipment for material transportation and this is directly related to this study. According to Gurgel, 1998, the equipment should be selected on the basis of some preliminary considerations like taken into account the utilization of the factory floor, load capacity, dimensions of doors and corridors, ceiling high, avoid the use of combustion engines, traction equipment in storage of food products identifications of environmental conditions and its nature and meet all the safety standards to protect humans and to eliminate the possibility of incurring the various liabilities arising from accidents and examine all kinds of available energy options. For the optimization of company's manufacturing capacity, the right choice of equipment and location of work is the fundamental.

As per Bowersox and Closs, 1998, an important factor in the process of positioning stocks is a balance between the convenience and consolidation to created efficiencies. The systems and information technology constitute the important factors for material handling management. Stair, Reynolds, Laudon and O'Brien, 2006 have supported the study of general principles & fundamentals of information systems towards material handling.

Chakravorty, 2009 has put it forth that in order to improve the performance of the distribution operations in the internal material handling process, it is important to consider both the human and technical factors and this study assesses the internal customers perception of a

material handling process improvement. With respect to the attributes to be considered in a material handling system, effective use of labour, flexibility, increasing productivity, decreasing lead times and costs are some of the most important factors which influences the selection criteria of material handling equipment.

The study done by Edwanjala, 2010 indicates a disagreement between the need for efficient and effective services and the need to economize in stockholdings. On one hand, the larger the stock held, the easier it is to have the goods available on demand, on the other hand, the larger the stock held, the greater is the cost. It is, therefore, necessary to seek, find and operate a satisfactory compromise between the various opposing costs, i.e. optimizing stock holding in such a way that both operating and financial objectives are attained. At no point of the time, work should suffer for want of critically required materials and at the same time unnecessary funds are not blocked in stocks, especially inactive/slow moving items. In addition, the stores department itself should be economically operated with other functions to achieve saving in material and other costs wherever practical. Cost of transportation shall be lowest possible by selecting right mode of transportation and an effective carrier for the given materials. Many items like Insurance spares are required to be kept in stores for years together. It is, therefore, important that in order to avoid unusable of the product due to atmospheric conditions, proper methods of storage and preservation be applied so that items do not worsen and loose some of their properties.

Further, Namukasa 2007 observed that as companies continue to strive at achieving their objectives, management is required to focus more on the area of operations management. One main reason for failure in achieving and realizing company objectives is unfavourable cost structures, which compromise on the profitability levels. In today's business operating

environments, major developments have been done in stores and inventory management aspect. With the increasing need for effective operations management, business organizations now require that costs and cost centres be well managed and controlled. In the same way stores who acts as cost centres must be well managed. In practice, firms spend an excessive amount of resources i.e. time and money managing and directing their suppliers to ensure that critical inventory or stock control levels are maintained, and the important flow of products needs for operation continue. Therefore, companies must find ways for safeguarding the effectiveness and efficiency. Namukasa, 2007 has further emphasized the importance of stores function in view of the financial performance of the organization and there is a lot of scope for business organizations in India to utilize the modern techniques in managing store functions.

In the study done by Salawati Sahari, Michael Tinggi, 2012, the relationship between the inventory management, firm performance and capital intensity has been observed on a sample of financial data for 84 construction firms in Malaysia for the period 2006–2011. The study of inventory management certainly implies the operational issues involved in store management. The nature of products may differ from organization to organization, but the function of store remains same.

A research paper titled ‘inventory management in a high technology organization: the impact on consumers from perspective of third-party logistics provider’ by Shahadat Khan and Robert Mark Bosgraaf, 1998 addresses two inventory management systems that are evident in the high technology industry being inventory postponement and inventory speculation. Moreover, the paper further investigates a high technology organization with respect to

inventory management decisions and identifies factors that lead the high technology organization to adopt inventory postponement over inventory speculation.

A study done by Hong-ying Shan, 2018 in his paper 'simulation research of warehousing logistics layout based on Tabu algorithm' discussed about re-planning or reorganizing of the layout of the warehouse logistics by rezoning goods according to their weight based on the priority principle. It shall establish cost constraint model based on Tabu algorithm and make the simulation research and the research suggests that the improved layout plan of warehouse logistics saves the total cost and improves the storage efficiency. The paper indicates that appropriate store layout can save the total cost and can help in improving the efficiency of the stores. Of course, layout decision is a job of the top management mostly at the time of raising the infrastructure for the organization but the layout can have direct impact on the working of the stores.

A research paper published by L Birkhola Adam, 1998 captioned as optimization of material handling in a manufacturing warehouse facility suggested that the customer satisfaction and organization competitiveness are depending upon implementing and improving existing logistics strategies. Thus, warehousing has become an important part of a comprehensive logistics strategy for organizations. In order to reduce the customer shipment lead time and minimizing of inventory storage requirements, organizations are continuing to streamline material movement. Technological advances in enterprise resource planning and warehouse management systems have made these efforts easier to achieve. However, the implementation of technology into warehousing represents a beginning from which current performance and improvement opportunities must be constantly evaluated.

According to the research done by Eric Johnson and Margaret Brandeau, 2014 material handling systems are always interconnected with the production system they serve but problems at this interface are rarely considered together. Their study develops a model that considers the costs of material handling and inventory to simultaneously design a material handling system and set up shop floor inventory policy.

RESEARCH METHODOLOGY

Research in general terms refers to a search for knowledge and one can also describe it as a scientific and systematic search for appropriate information on a specific subject/topic. In short, research or the analysis is an art of scientific investigation. The meaning of the term research has been defined by the Advanced Learner's Dictionary of Current English as a careful study through search for new facts." Redman and Mory define research as a "structured effort to gain new knowledge." Methodology is a set of practices not a formula. There are four methods used to collect data i.e. observation, questionnaire, group discussion and analysis of documentary. The method which we have used is the questionnaire and interview method survey.

Objectives

The main objectives of this study are mentioned below:

- Describe the changes in the material handling processes at the company
- Evaluation of internal material handling flow in manufacturing and verifying the improvements
- Analysing the internal customers satisfaction levels in relation to the new system.
- To provide future research room to improve on the present research.

Types of Research

The basic types of research are as follows:

- **Descriptive vs. Analytical:** Descriptive analysis includes surveys and enquiries of different kinds. The aim of descriptive analysis is to describe the state of affairs as it is, whereas, In analytical research, the researcher has to use available facts or information and analyze these to make a critical evaluation of the material.
- **Applied vs. Fundamental:** Researcher can either use applied analysis (i.e. action) or fundamental analysis (i.e. basic) for doing analysis or research of any topic. The aim of Applied analysis is to find a solution for an immediate problem that is being faced by the society or an industrial/business organization, whereas fundamental analysis is mainly concerned with the generalizations and formulation of a theory.
- **Quantitative vs. Qualitative:** Quantitative analysis or research is a phenomena that can be expressed in terms of quantity and it is based on the measurement of quantity or amount, whereas, Qualitative analysis is concerned with the qualitative phenomenon, i.e. phenomena relating to or involving quality or kind.
- **Conceptual vs. Empirical:** Conceptual analysis is related to some theoretical idea or abstract, which is generally utilized by the philosophers and thinkers to develop new ideas and concepts or to reinterpret existing ones. On the other hand, empirical analysis relies on experience or observation alone, often without due regard for system and theory.

Limitations

The researcher tried to predict the research limitations in advance and planned to minimize the effect of these limitations.

- Time management is the foremost limitation as the researcher could conduct the research in a short span of time.
- The lack of availability of monetary outside support of the research, the study also has little monetary controls for the collection of data.
- The reliability of the information or data is another potential limitation of the research.
- The researcher's lack of experience working with the business analysts or involved in analytics provides a challenge as to whether they are on the right path or not. The researcher ensured confidence in all participants' which made them trust and respect the researcher.

Sources of Data

- **Primary Data** - The researcher undertakes the primary data collection as an essential part of the proposal. A descriptive research design was adopted to do the survey along with the questionnaire. The study used non - probability convenience sampling and the methodology used is the interview method survey. The sample was collected from 250 people directly involved with the daily flow of materials of different departments. The respondents held positions as leaders, supervisors, forklift drivers, warehouse operators & others. Data collection for the satisfaction survey was divided into: Open ended questionnaire survey and performance improvement survey based on the scale of 1:5.

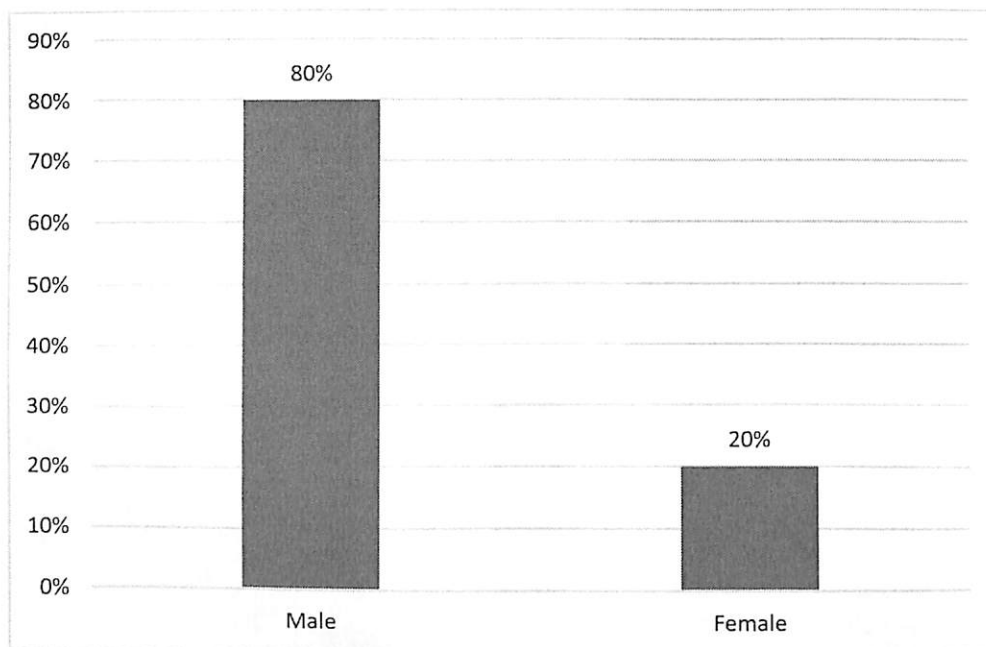
- **Secondary Data** - Where appropriate the researcher makes use of existing sources of data that are publicly available, also known as secondary sources of data. Secondary data is related to the data that has been originally collected for some other purpose or research. This secondary data includes company and industry specific organizational websites (internal secondary data), as well as any previous and relevant research papers or journal articles or websites (external secondary data).

ANALYSIS FRAMEWORK

1. Gender of the Respondents

1. Male
2. Female

Male	80%
Female	20%



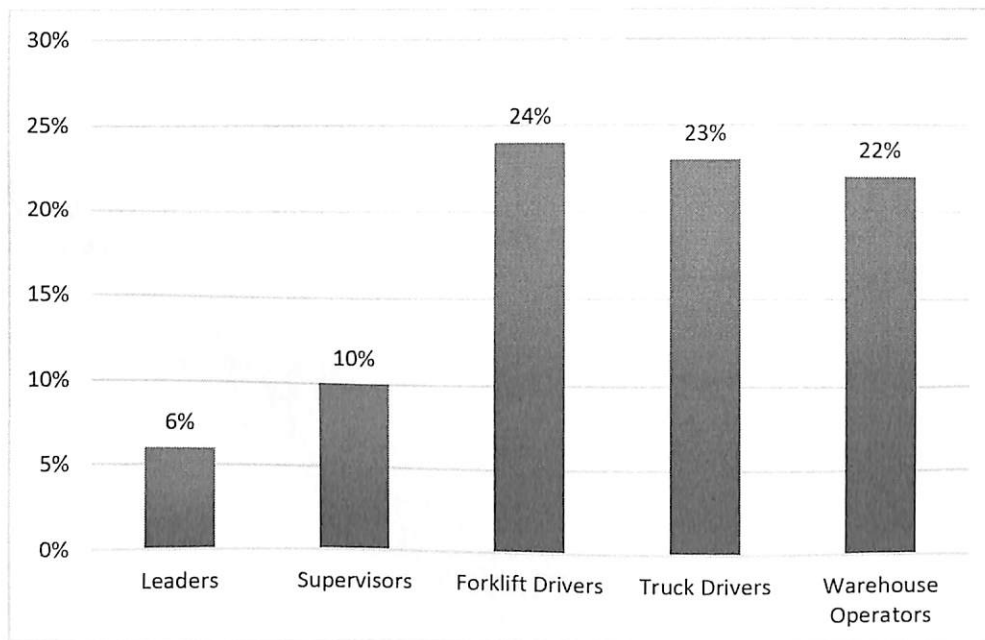
Interpretation

Based on the above analysis, it is clear that 80% respondents are male and 20% respondents are female.

2. Designation of the Respondents

- Leaders
- Supervisors
- Forklift Drivers
- Warehouse Drivers
- Others

Leaders	6%
Supervisors	10%
Forklift Drivers	24%
Truck Drivers	23%
Warehouse Operators	22%
Others	15%



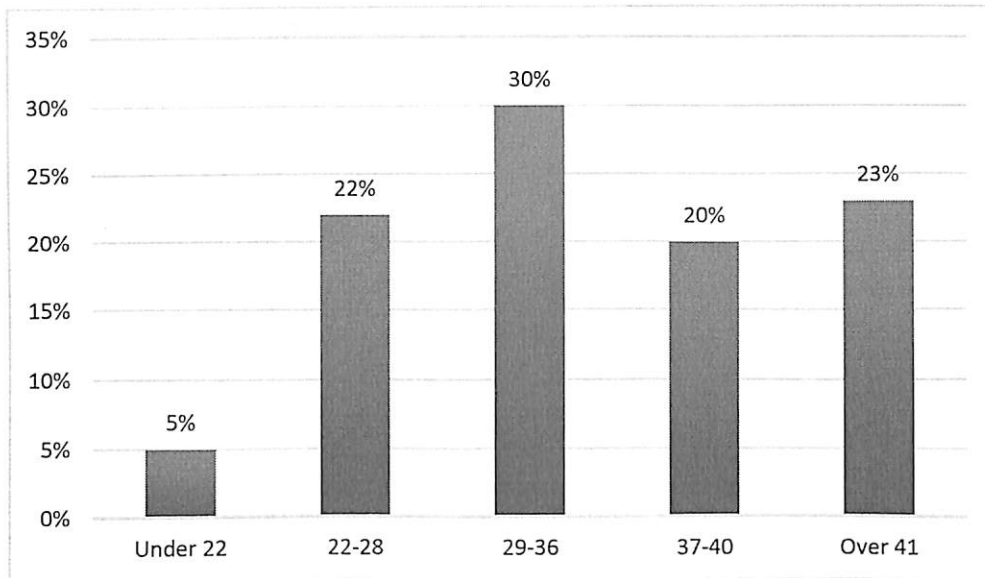
Interpretation

Based on the above analysis it is clear that 6% respondents are leaders, 10% are supervisors, 24% are the forklift drivers, 23% are the truck drivers, 22% are the warehouse drivers and 15% belong to others category.

3. Age of the Respondents

- Under 22
- 22-28
- 29-36
- 37-40
- Over 41

Under 22	5%
22-28	22%
29-36	30%
37-40	20%
Over 41	23%



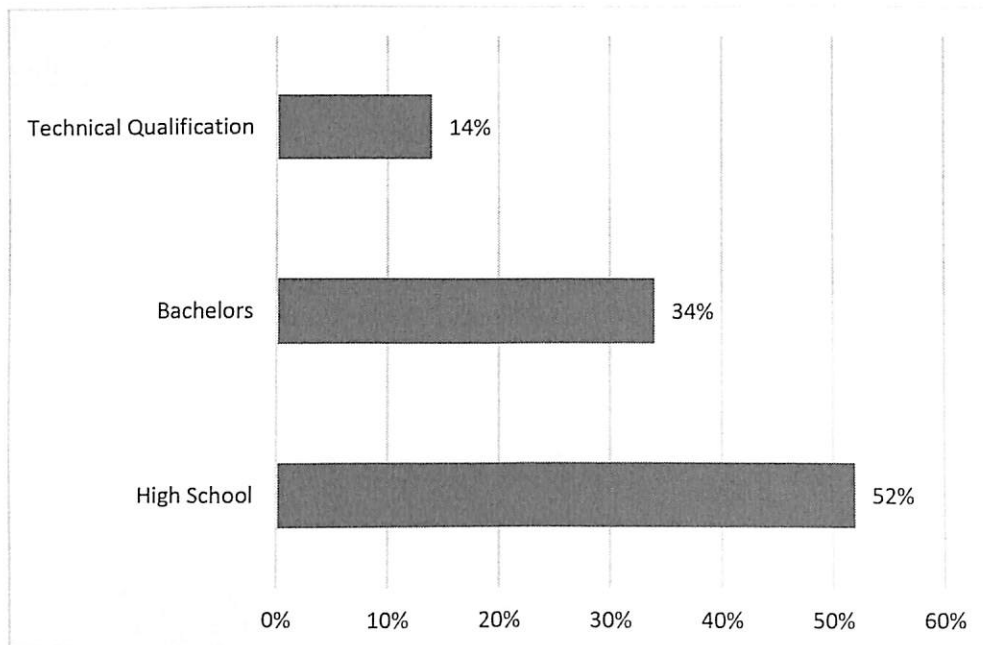
Interpretation

Based on the above analysis, it is clear that 5% respondents are under 22 years, 22% are between 22-28, 30% are between 29-36, 20% are between 37-40 and 23% are over 41 years.

Education of the Respondents

- High School
- Bachelor's Degree
- Technical Qualification

High School	52%
Bachelors	34%
Technical Qualification	14%



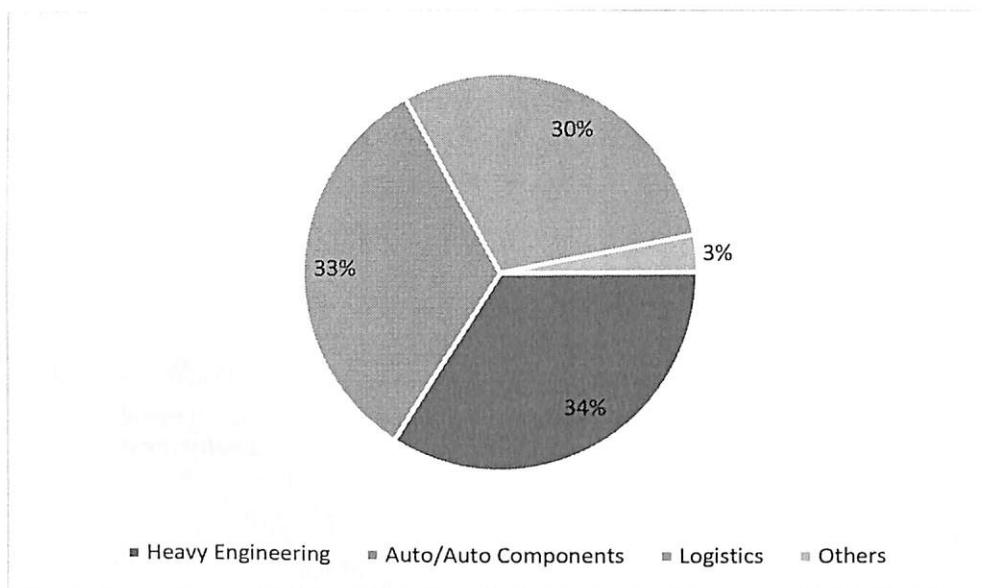
Interpretation

Based on the above analysis it is clear that 52% respondents are high school pass outs, 34% hold bachelor's degree and 14% holds technical qualification.

4. What type of organization you are working in?

- Heavy Engineering
- Auto/Auto components
- Logistics
- Others

Heavy Engineering	34%
Auto/Auto Components	33%
Logistics	30%
Others	3%



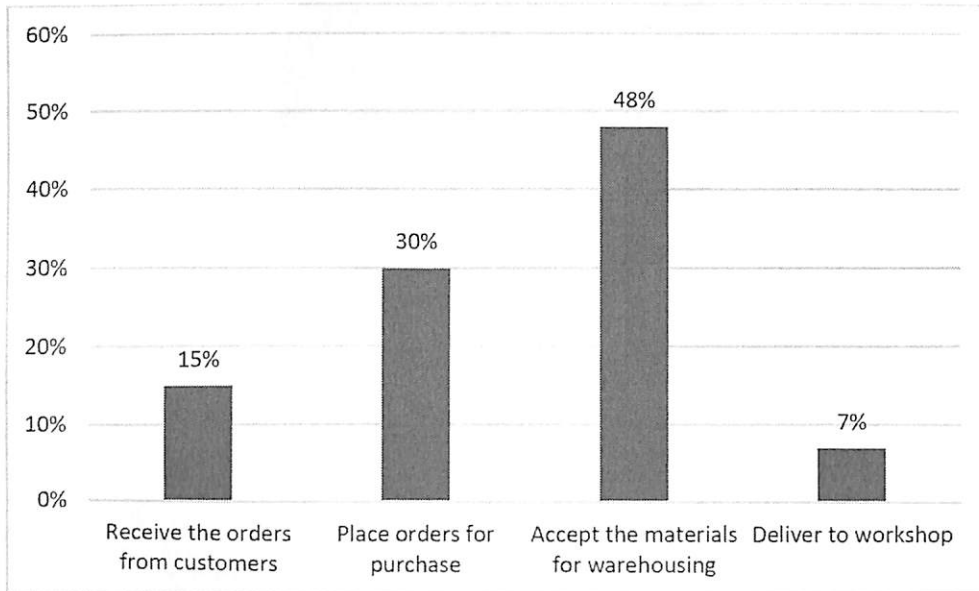
Interpretation

Based on the above analysis it is clear that 34% respondents are employed in heavy engineering firms, 33% are employed in Auto/Auto components firms, 30% are employed in logistics firm and 3% belongs to other category.

5. Encoding the material while warehousing

- Receive the orders from customers
- Place orders for purchase
- Accept the material for warehousing
- Deliver to workshop

Receive the orders from customers	15%
Place orders for purchase	30%
Accept the materials for warehousing	48%
Deliver to workshop	7%



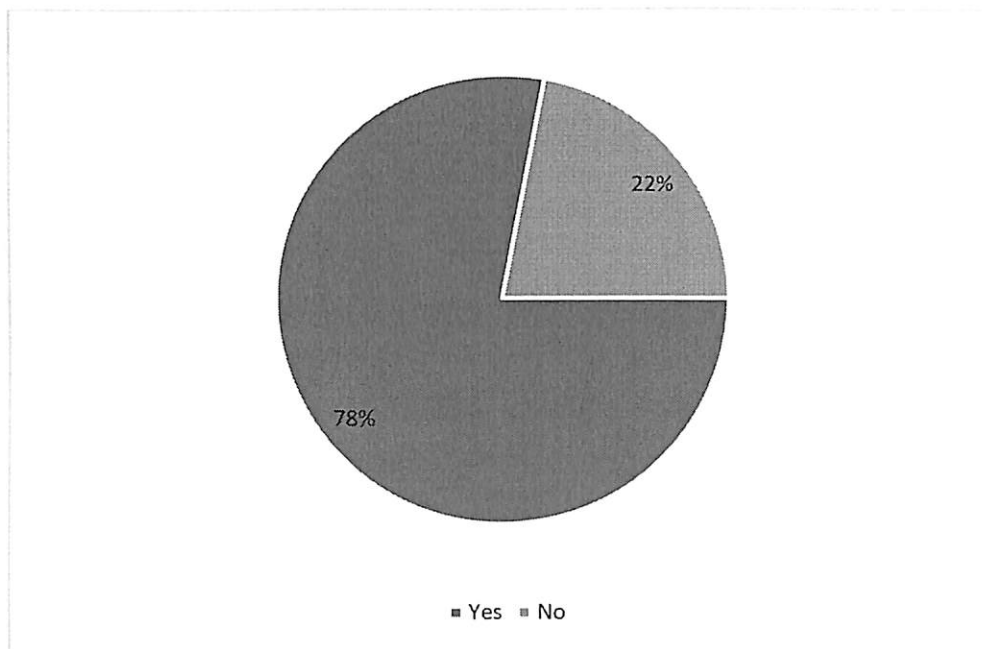
Interpretation

Based on the above analysis, it is clear that 15% respondents say that their companies receive orders from customers, 30% respondents say that the customers place orders for purchase, 48% respondents say that their organizations accept the material for warehousing and 7% says that their organization delivers the finished goods directly to the workshop.

6. Awareness about ERP system

- Yes
- No

Yes	78%
No	22%



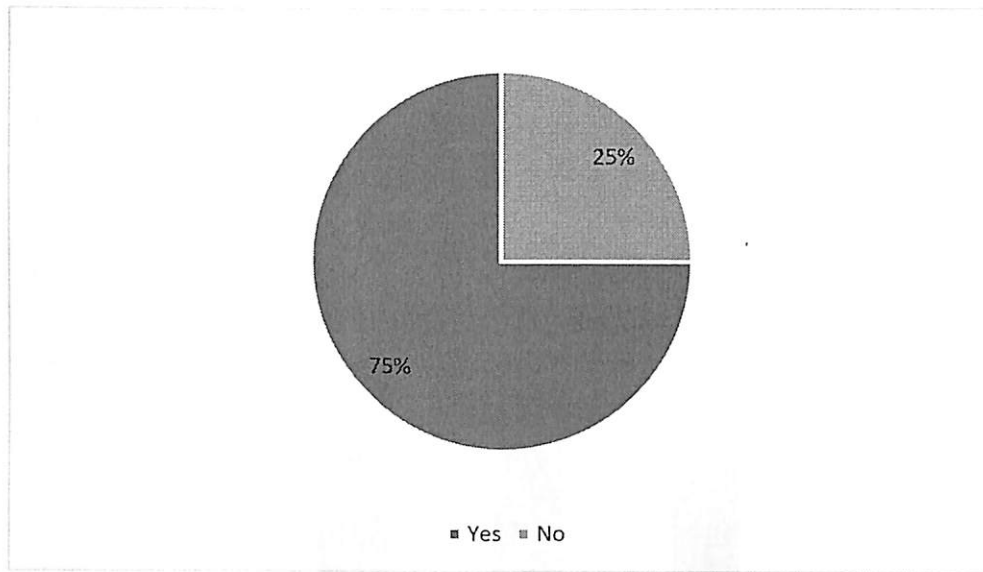
Interpretation

Based on the above analysis, 78% respondents are aware of the ERP system that's being used in their organization and 22% respondents are still not aware of the same.

7. Training regarding ERP System

- Yes
- No

Yes	75%
No	25%



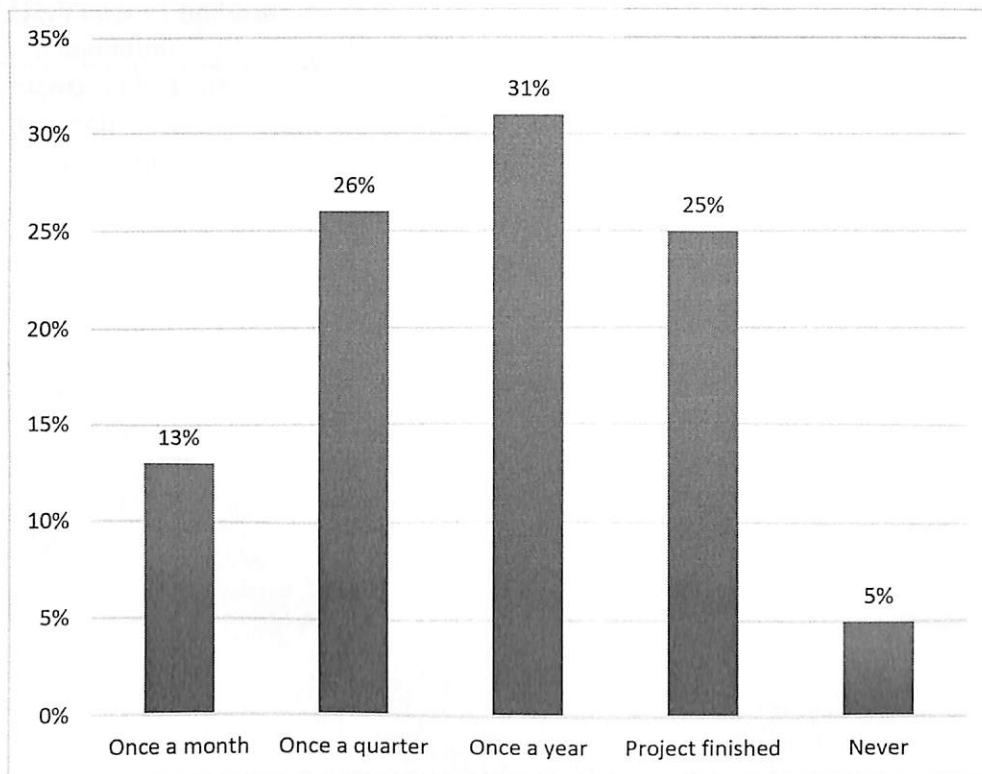
Interpretation

It is clear from the above analysis that 75% respondents have undergone the training regarding ERP system, which is being used in their organizations and 25% respondents have still not undergone the same.

8. Feedback on the cycle of Stocktaking

- Once a month
- Once a quarter
- Once a year
- Project finished
- Never

Once a month	13%
Once a quarter	26%
Once a year	31%
Project finished	25%
Never	5%



Interpretation

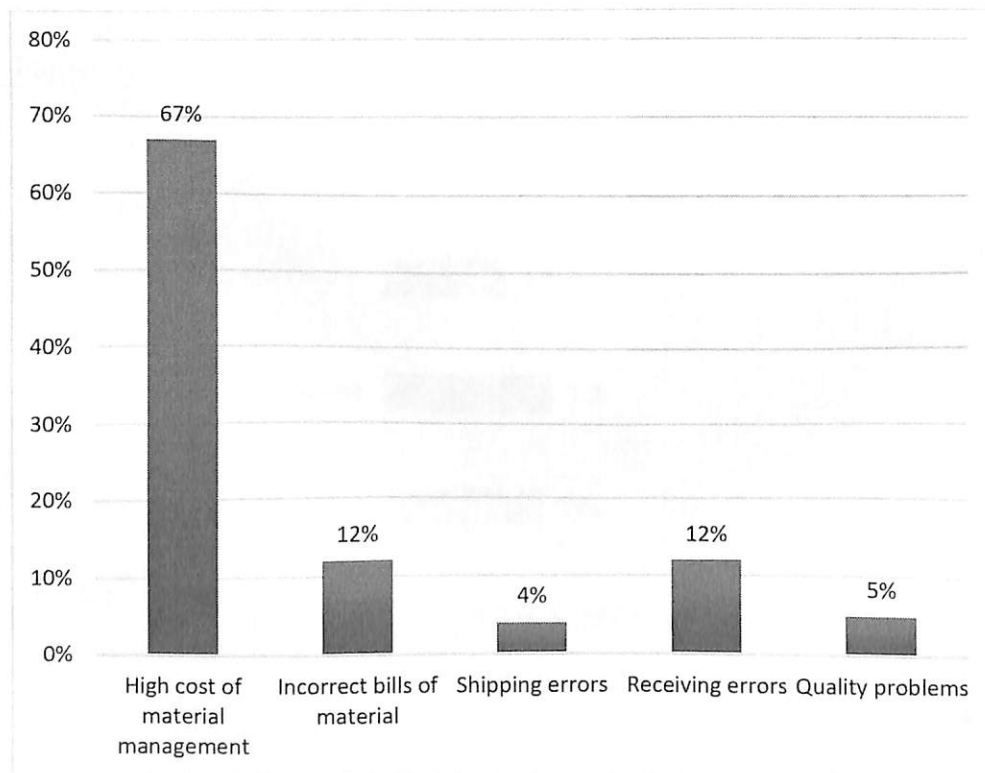
Based on the above analysis it is clear that 13% respondents say that their organization take feedback on the cycle of stocktaking once a month, 26% says that it happens once a quarter,

31% says that it happens once a year, 25% says that organization takes the feedback once the project is finished and 5% says that it never happens.

10. Problems of material management

- High cost of material management
- Incorrect bill of material
- Shipping errors
- Receiving errors
- Quality problems

High cost of material management	67%
Incorrect bills of material	12%
Shipping errors	4%
Receiving errors	12%
Quality problems	5%



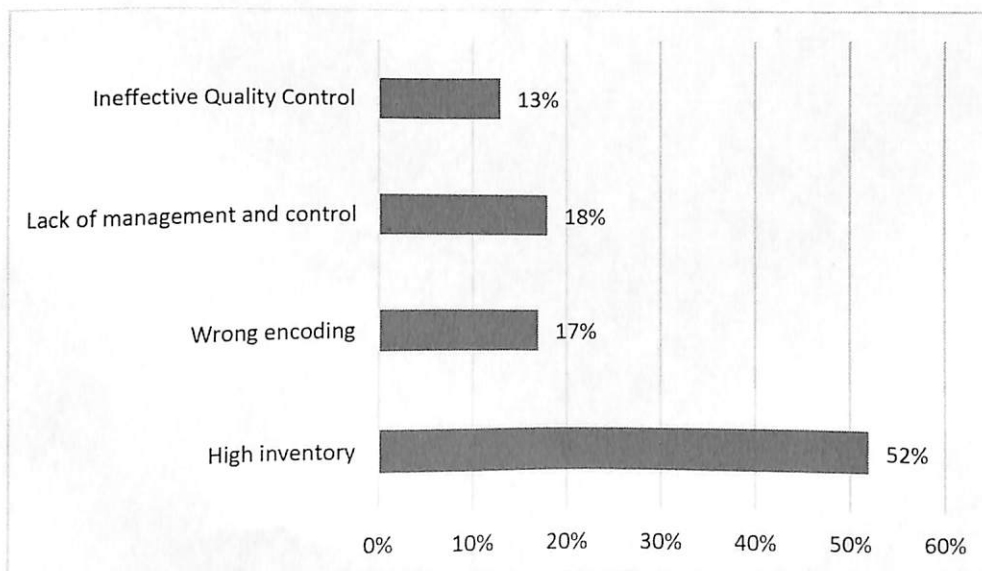
Interpretation

Based on the above analysis it is clear that 67% respondents feel that the problem related to material management is the high cost that is involved in the same, 12% says it is due to incorrect bill of material, 4% says that it is due to shipping errors, 12% are of the opinion that it is due to receiving errors and 5% are of the opinion that it is due to quality problems.

11. Reasons for the problems related to material management

- High inventory cost
- Wrong encoding
- Lack of Management and Control
- Ineffective Quality Control

High inventory	52%
Wrong encoding	17%
Lack of management and control	18%
Ineffective Quality Control	13%



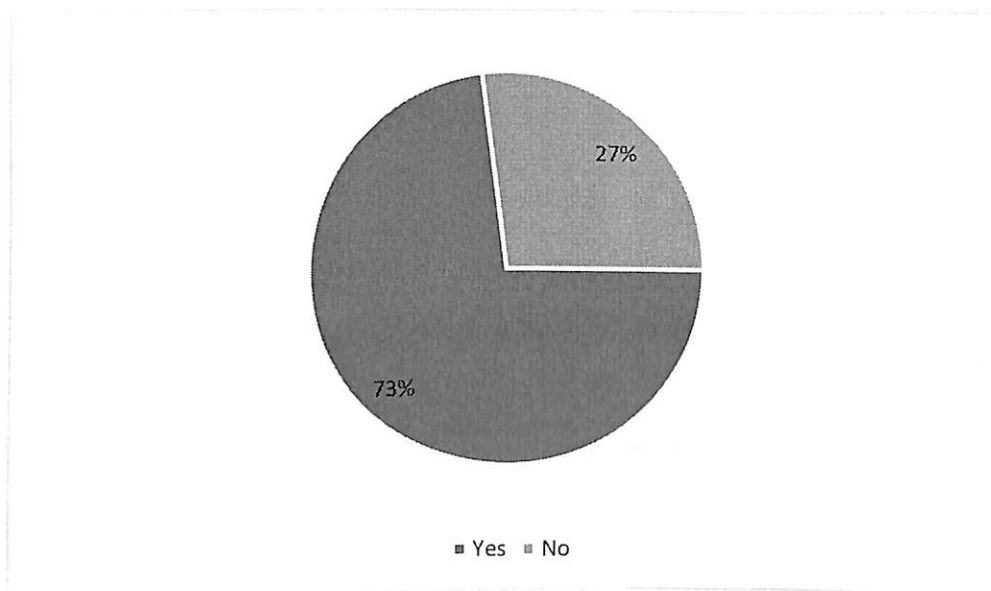
Interpretation

Based on the above analysis it is clear that the 52% respondents are of the opinion regarding reason for the problems relating to material management is high inventory cost that is being involved in the same, 17% are of the opinion that wrong encoding is the reason for the problems pertaining to material management, 18% are of the opinion that it is due to lack of management and control & 13% says it is due to the ineffective quality control.

12. Has management taken the appropriate steps to safeguard the employees

- Yes
- No

Yes	73%
No	27%



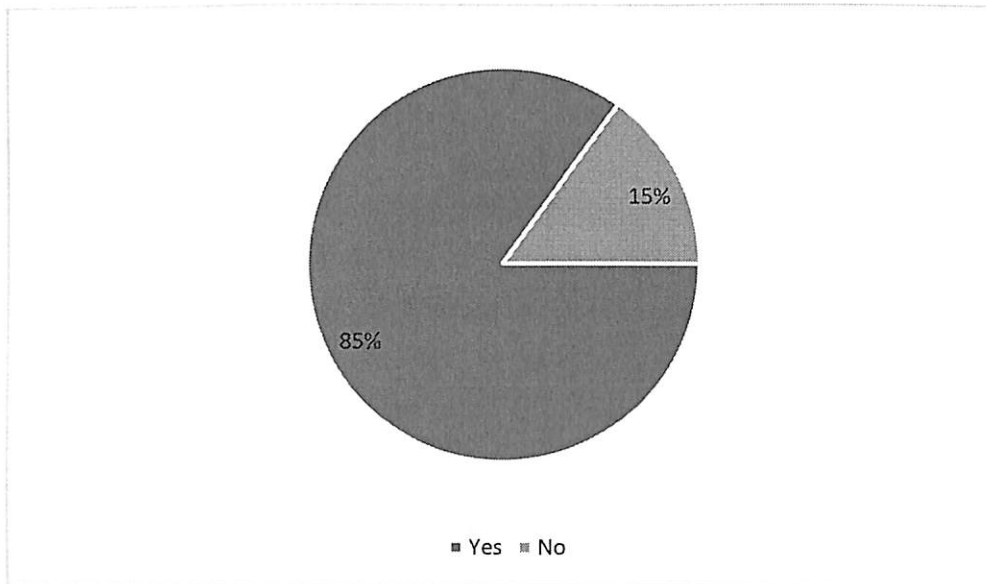
Interpretation

Based on the above analysis 73% respondents feel that management has taken the appropriate steps in order to safeguard the employees and 27% respondents denies the same.

13. Do relevant departments compare the quantities received against receiving reports

- Yes
- No

Yes	85%
No	15%



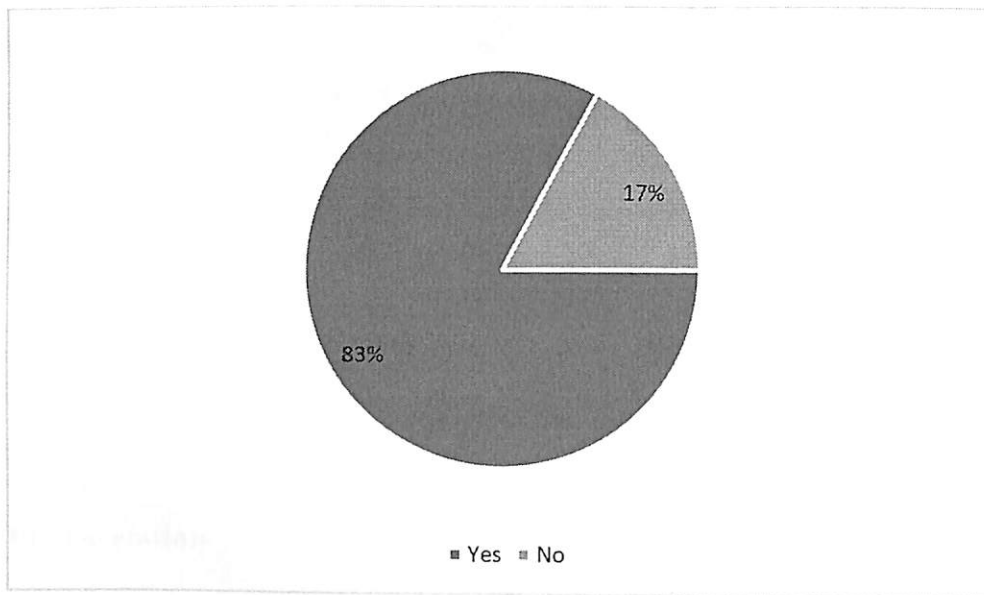
Interpretation

Based on the above analysis it is clear that 85% respondents are of the opinion that the relevant departments compare the quantities received against receiving reports in order to check the inventory of the organization and 15% denies the same.

14. Is adequate provisions has been made for the obsolete and inactive items in inventories.

- Yes
- No

Yes	83%
No	17%



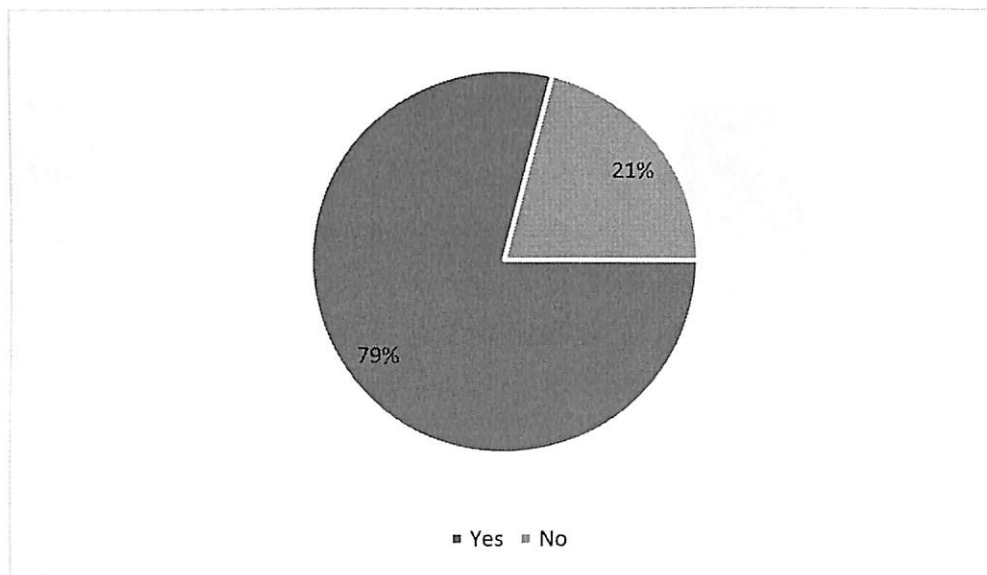
Interpretation

Based on the above analysis it is clear that 83% respondents say that their organizations have made adequate provisions for the obsolete and inactive items in the inventories and 17% denies the same and says that it is one of the biggest challenges that their organization is dealing with.

15. Does management monitor and approve the write offs of the obsolete and inactive inventories

- Yes
- No

Yes	79%
No	21%



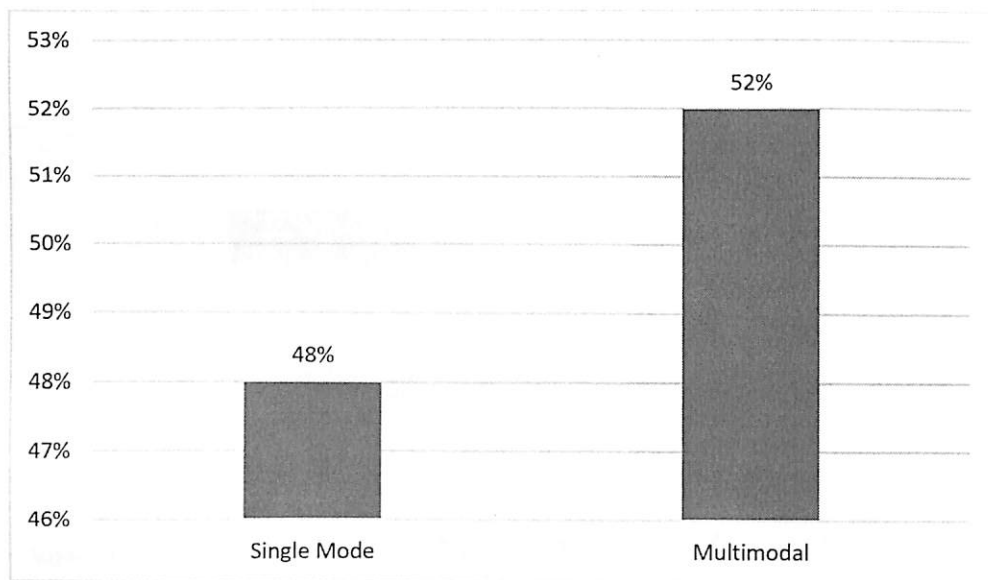
Interpretation

Based on the above analysis, it is clear that 79% respondents says that their management do monitor and approve the write offs of the obsolete and inactive inventories and 21% denies the same.

16. What is the mode of transport of the finished goods in your organization?

- Single mode
- Multimodal

Single Mode	48%
Multimodal	52%



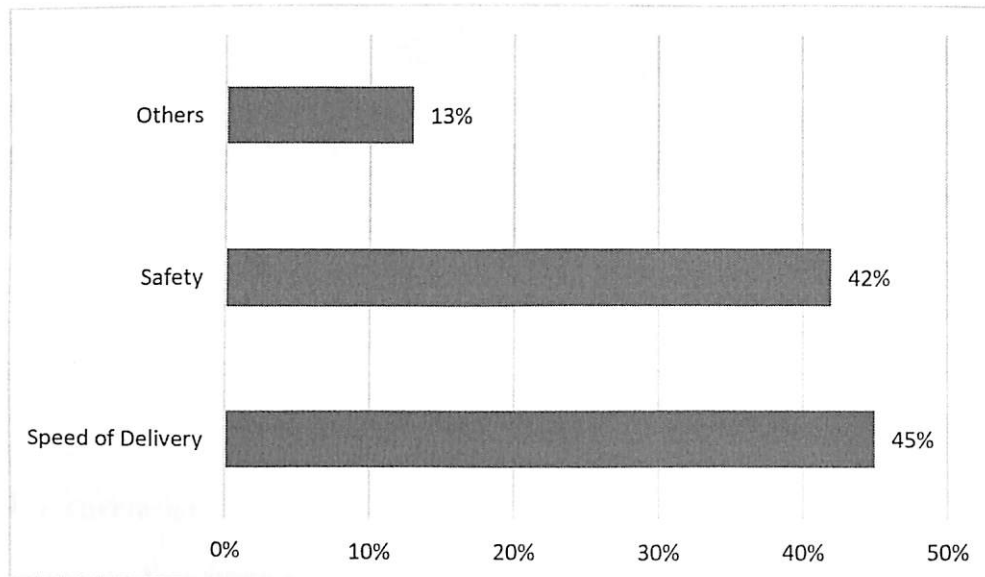
Interpretation

Based on the above analysis it is clear that 48% respondents says that their organization uses single mode of transport for transporting the finished goods and 52% says that their organization uses multimodal way of transport for the same.

17. What do you think is the parameter of the management regarding selection of mode of transportation of goods?

- Speed of Delivery
- Safety
- Others

Speed of Delivery	45%
Safety	42%
Others	13%



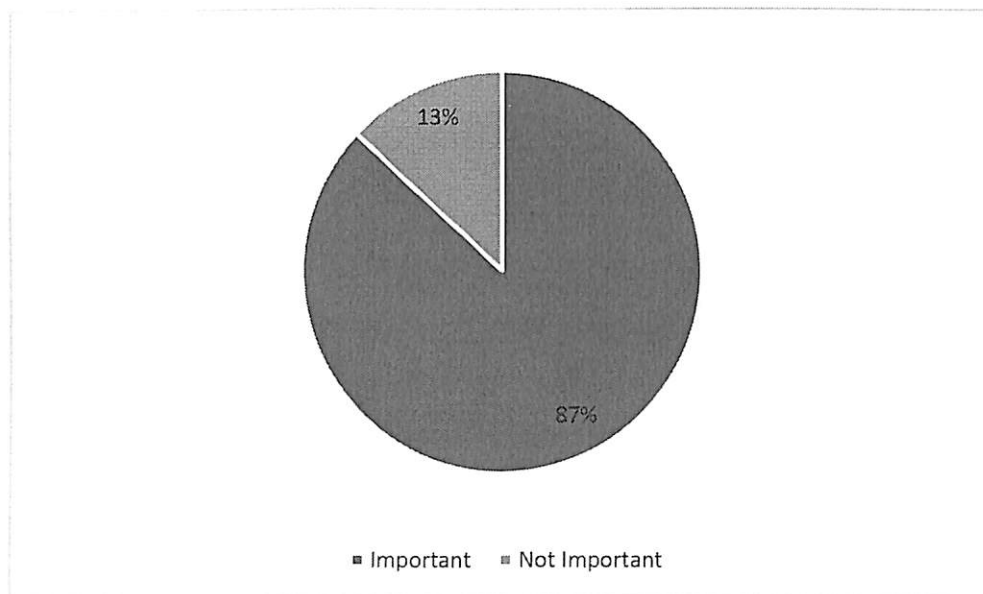
Interpretation

Based on the above analysis it is clear that 45% respondents feel that speed of delivery is an important parameter of the management regarding selection of mode of transportation of goods, 42% respondents feel that safety plays an important role while selecting the mode of transport and 13% respondents feels that other factors plays an important role in the same.

18. What is the priority of your organization to work with the ethical service providers

- Important
- Not Important

Important	87%
Not Important	13%



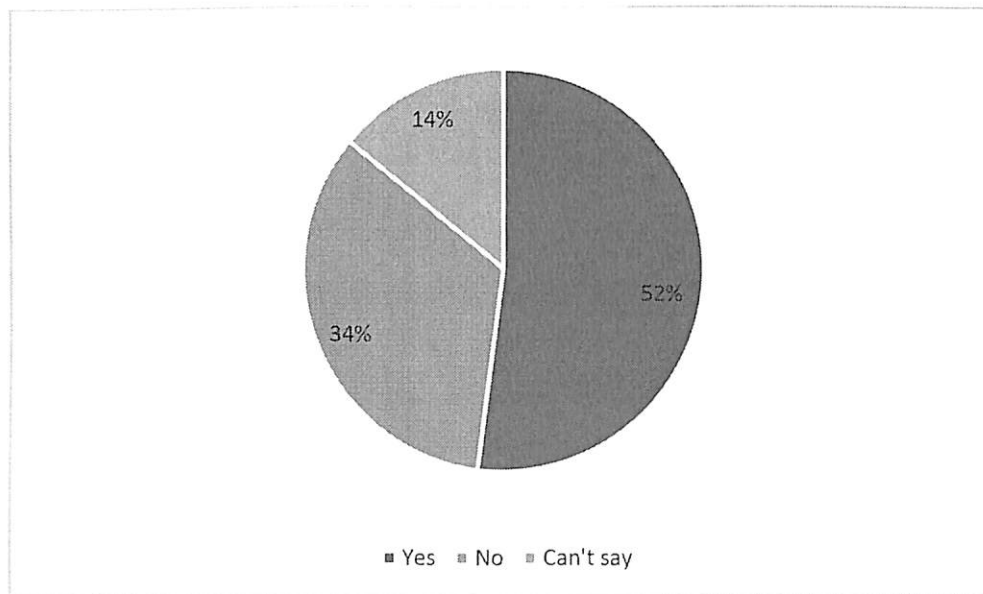
Interpretation

Based on the above analysis it is clear that 87% respondents feel that it is important for an organization to work with the ethical service providers and 13% respondents denies the same.

19. Is your organization an ISO compliant

- Yes
- No
- Can't say

Yes	52%
No	34%
Can't say	14%



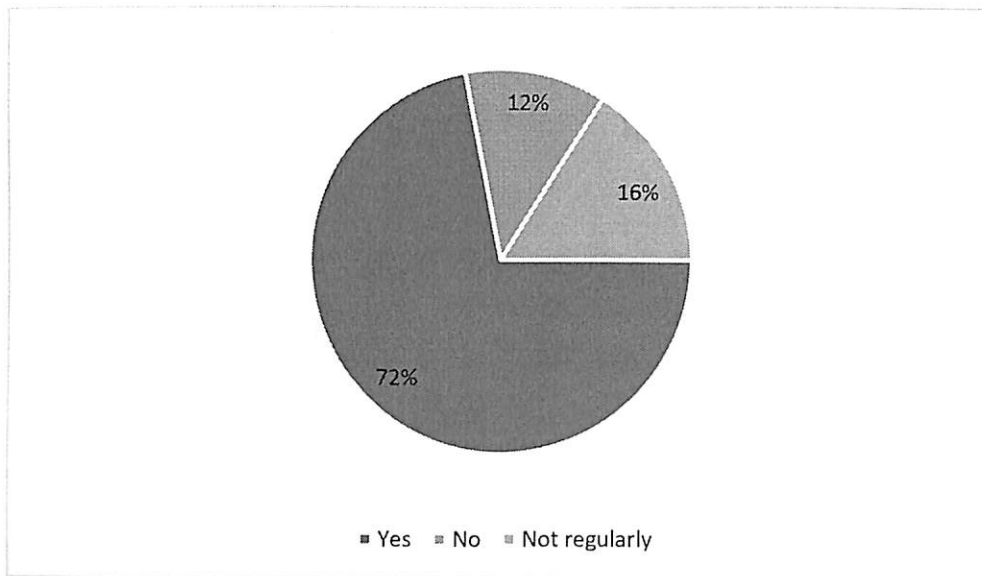
Interpretation

It is clear from the above analysis that 52% respondents know that their organization is an ISO compliant, 34% respondents denies the same and 14% respondents are not aware of the same.

20. Does the company arranges a training sessions for the employees

- Yes
- No
- Not regularly

Yes	72%
No	12%
Not regularly	16%



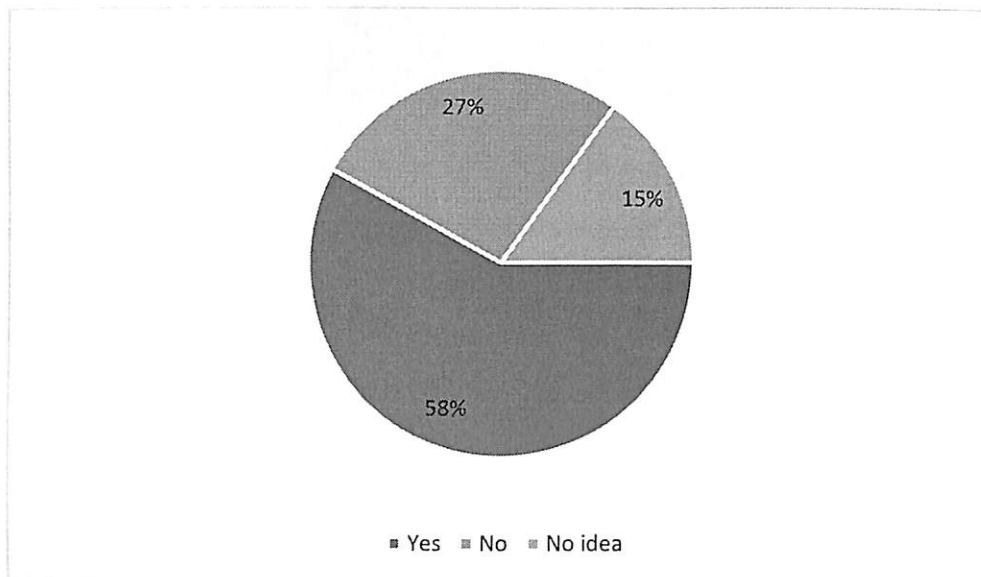
Interpretation

It is clear from the above analysis that 72% respondents say that their company regularly arranges a training session for their employees, 12% respondents say that their organization doesn't arrange the same and 16% respondents say that the organization does not regularly do so.

21. Are you aware whether the regular audits being taken place in your organization

- Yes
- No
- No Idea

Yes	58%
No	27%
No idea	15%



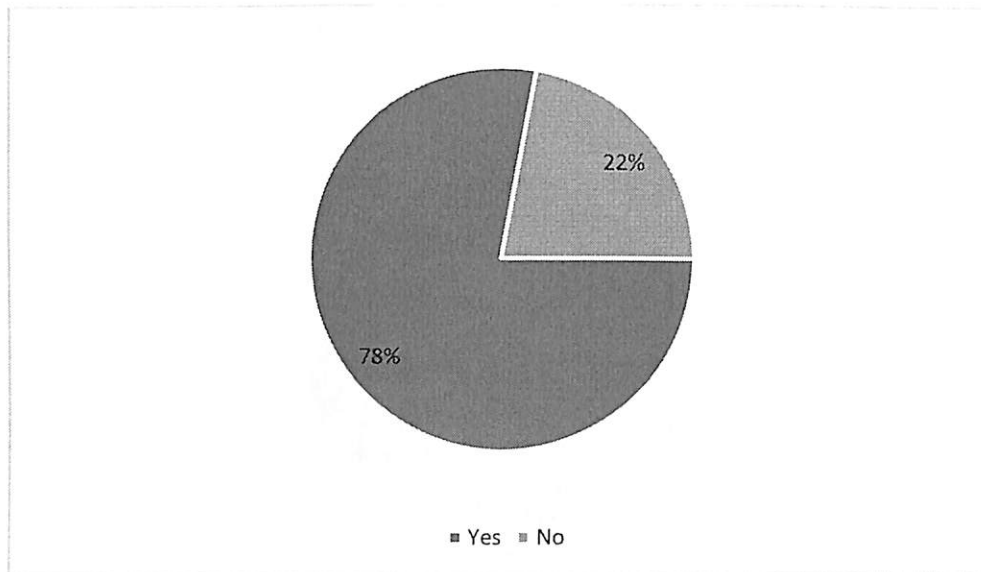
Interpretation

It is clear from the above analysis that 58% respondents are aware regarding the regular audits that's being taken place in the organization, 27% denies the same and 15% does not have any idea regarding the same.

22. Are the pallets or the boxes managed in the system with a unique number

- Yes
- No

Yes	78%
No	22%



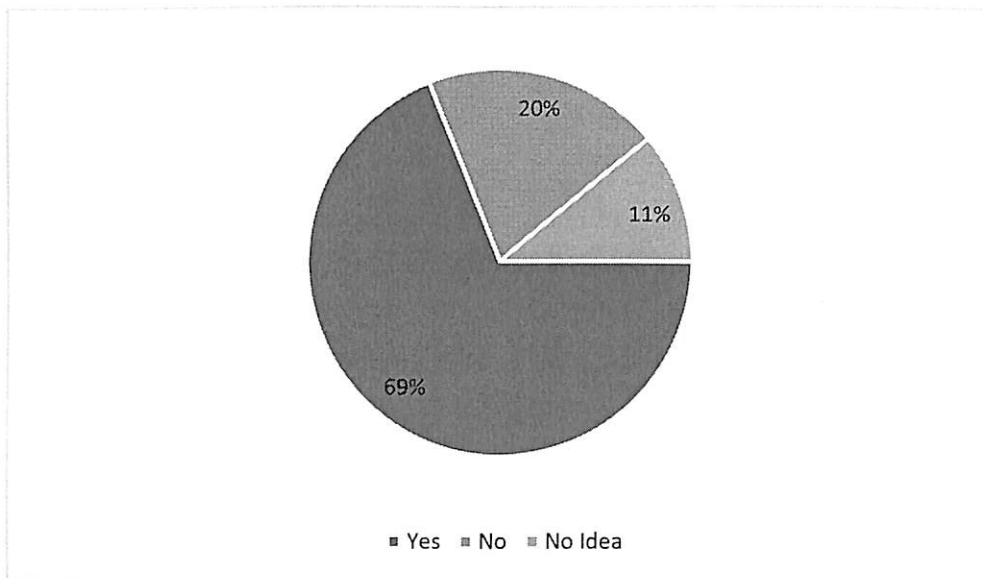
Interpretation

Based on the above analysis it is clear that 78% respondents says that the pallets or the boxes used in their organization are managed with a unique number and its being generated by the system, however, 22% respondents denies the same.

23. Are you aware about ergonomic program

- Yes
- No
- No idea

Yes	69%
No	20%
No Idea	11%



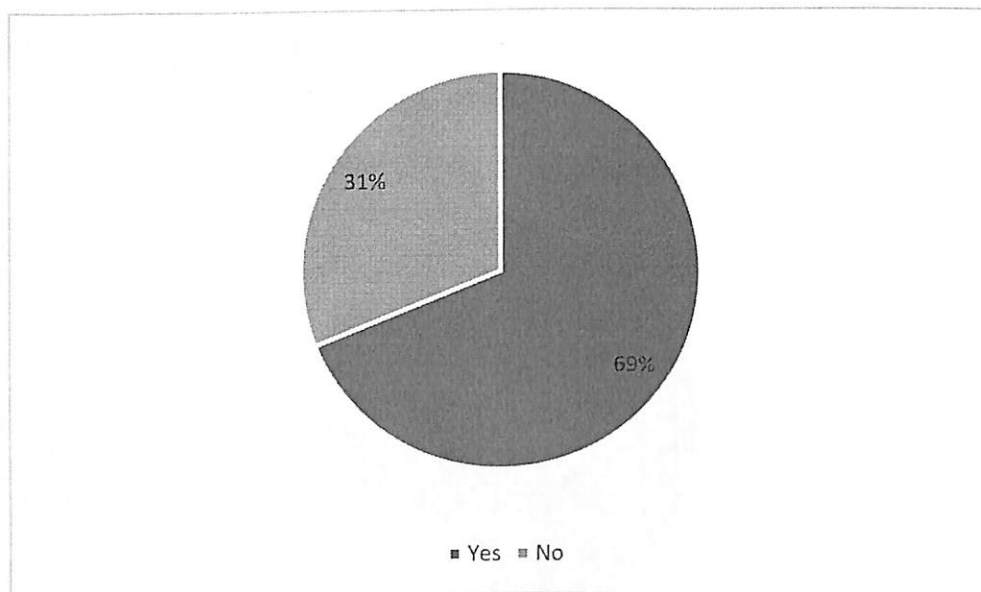
Interpretation

It is clear from the above analysis that 69% of the respondents are aware of the ergonomic program that's been led by their organization for the safety of its employees, 20% respondents denies the same and 11% respondents has no idea about the same.

24. Are AGVs (Automated Guided Vehicles) the right solution for material handling problem

- Yes
- No

Yes	69%
No	31%



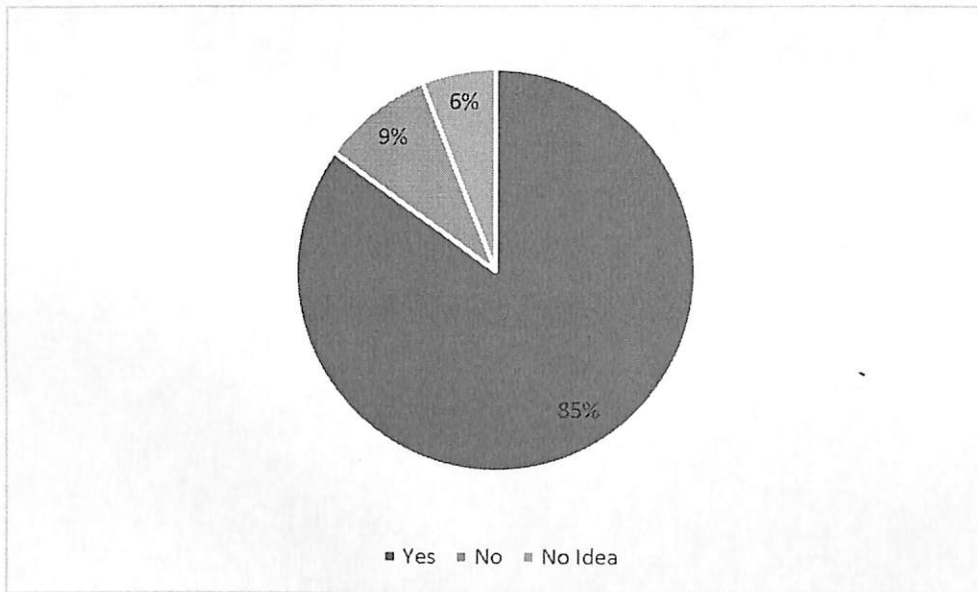
Interpretation

Based on the above analysis it is clear that 69% respondents are of the opinion that AGV's is the right solution in solving material management problems, however, 31% denies the same.

25. Do you use technologies like bar codes, EDI and RFID for inventory control of managing material

- Yes
- No
- No Idea

Yes	85%
No	9%
No Idea	6%



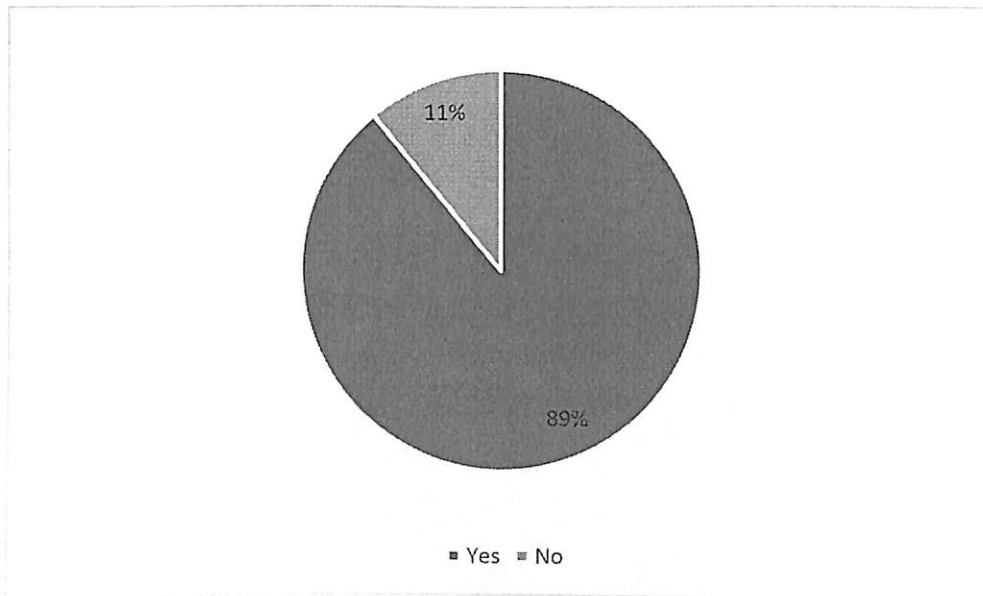
Interpretation

Based on the above analysis, it is clear for controlling the inventory management, 85% respondents say that their organization uses bar codes, EDI and RFID, however, 9% says that the organization doesn't use the same and 6% respondents does not have an idea about it.

26. Does your organization do JIT (Just In Time) delivery

- Yes
- No

Yes	89%
No	11%



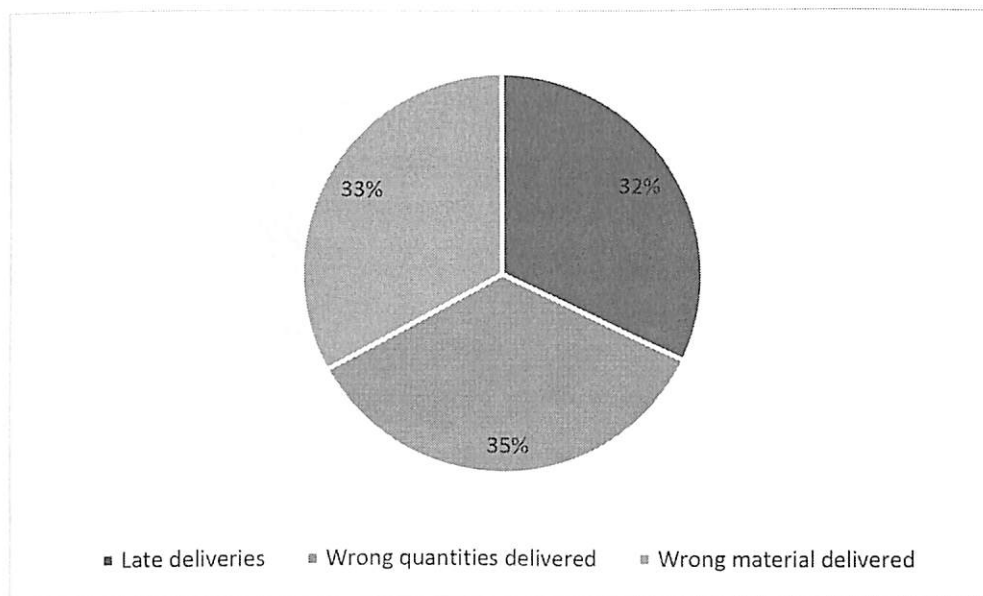
Interpretation

Based on the above analysis it is clear that 89% respondents say that their organization follows JIT i.e. Just In Time process for delivery of goods, whereas, 11% respondents denies the same.

27. What are typical issues that are associated with JIT

- Late deliveries
- Wrong quantities delivered
- Wrong materials delivered

Late deliveries	32%
Wrong quantities delivered	35%
Wrong material delivered	33%



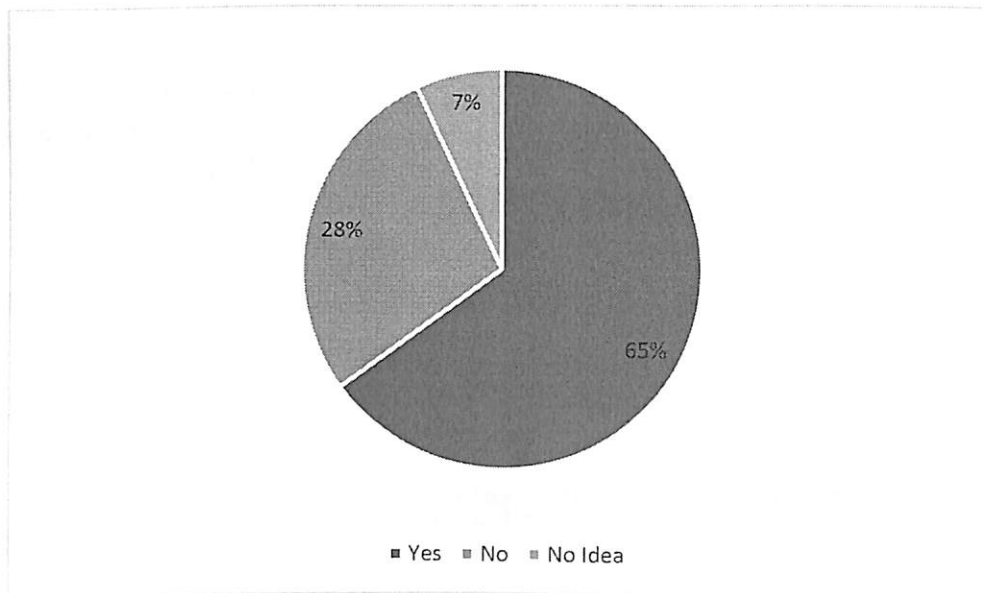
Interpretation

As per the above analysis, it is clear that the respondents feel that Late deliveries, wrong quantities delivered and wrong material delivered plays an equal role pertaining to issues associated with JIT. 32% respondents feel that late deliveries is an issue that is associated with JIT, 35% respondents feel that wrong quantities delivered is an issue and 33% feel that wrong material delivered is an issue associated with JIT.

28. Do you have any idea about the procedures used to evaluate the potential suppliers?

- Yes
- No
- No Idea

Yes	65%
No	28%
No Idea	7%



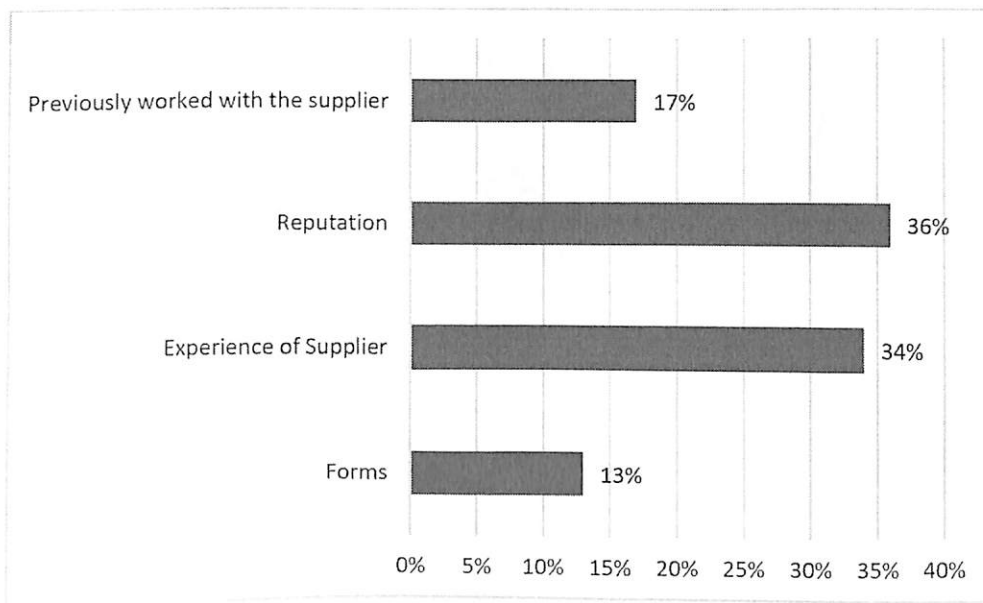
Interpretation

It is clear from the above analysis, that 65% respondents have an idea about the procedures that are used to evaluate the potential suppliers, 28% respondents deny the same and 7% does not have any idea about it.

29. What are the procedures used to evaluate potential suppliers

- Forms
- Experience of supplier
- Reputation
- Previously worked with the supplier

Forms	13%
Experience of Supplier	34%
Reputation	36%
Previously worked with the supplier	17%



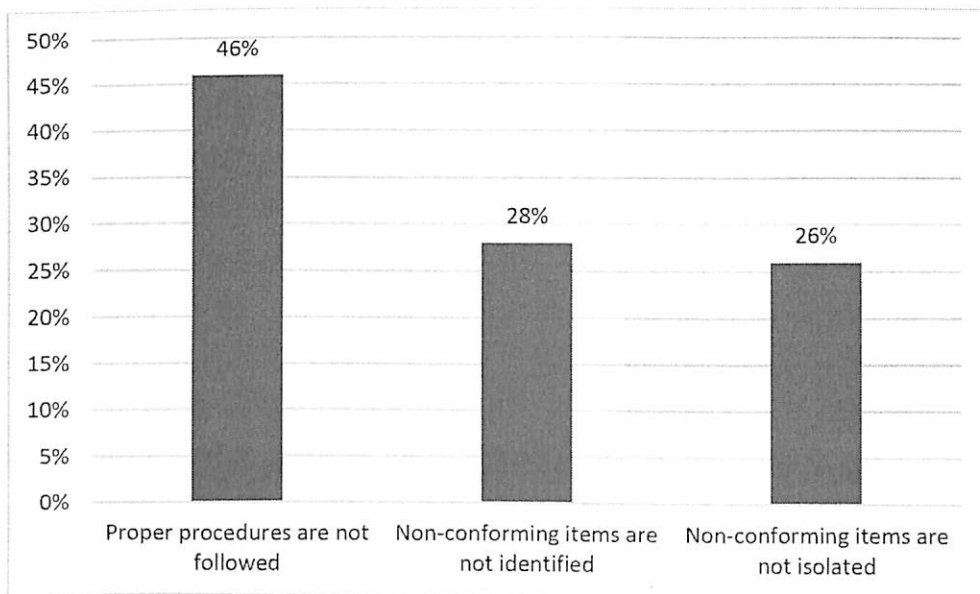
Interpretation

As per the feedback received from the respondents, 13% organizations uses forms to evaluate the potential suppliers, 34% goes with the experience of supplier, 36% goes with the reputation of supplier and 17% have worked previously with the supplier.

30. What are the problems being faced with the inspection procedures of the material

- Proper procedures are not followed
- Non-conforming items are not identified
- Non-conforming items are not isolated

Proper procedures are not followed	46%
Non-conforming items are not identified	28%
Non-conforming items are not isolated	26%



Interpretation

As per the above analysis, it is clear that 46% respondents are of the opinion regarding the problems being faced with the inspection procedures of the material that proper procedures are not followed, 28% respondent feel that it happens due to the non-conforming items that are not being identified and 26% respondents feel that it is due to non-conforming items that are not isolated.

Satisfaction Survey Based on Likert's scale

1=strongly disagree/strongly dissatisfied, 2=disagree/dissatisfied, 3=Neither agree or disagree/ moderately satisfied, 4 = agree/satisfied, 5 = strongly agree/strongly satisfied

1	How do you evaluate material handling system at the company after the established changes	1	2	3	4	5
2	How do you evaluate the cost of operations	1	2	3	4	5
3	How do you assess the occurrence of mechanical shutdown	1	2	3	4	5
4	How do you assess the occurrence of electrical shutdown	1	2	3	4	5
5	How do you evaluate the need for corrective painting	1	2	3	4	5
6	How do you rate safety in service	1	2	3	4	5
7	How do you access safety in handling	1	2	3	4	5
8	How would you rate tooling storage	1	2	3	4	5
9	How do you access the operator's autonomy	1	2	3	4	5
10	How do you access route efficiency	1	2	3	4	5
11	How do you access the agility of operations	1	2	3	4	5
12	How do you evaluate the set-up time	1	2	3	4	5
13	How would you rate the tooling handling quickness	1	2	3	4	5
14	What is the overall assessment of the situation after the changes	1	2	3	4	5

OBSERVATIONS

- 80% respondents are male and 20% respondents are female.
- 6% respondents are leaders, 10% are supervisors, 24% are the forklift drivers, 23% are the truck drivers, 22% are the warehouse drivers and 15% belong to others category.
- 5% respondents are under 22 years, 22% are between 22-28, 30% are between 29-36, 20% are between 37-40 and 23% are over 41 years.
- 52% respondents are high school pass outs, 34% hold bachelor's degree and 14% holds technical qualification.
- 34% respondents are employed in heavy engineering firms, 33% are employed in Auto/Auto components firms, 30% are employed in logistics firm and 3% belongs to other category.
- 15% respondents say that their companies receive orders from customers, 30% respondents say that the customers place orders for purchase, 48% respondents say that their organizations accept the material for warehousing and 7% says that their organization delivers the finished goods directly to the workshop.
- 78% respondents are aware of the ERP system that's being used in their organization and 22% respondents are still not aware of the same.
- 75% respondents have undergone the training regarding ERP system, which is being used in their organizations and 25% respondents have still not undergone the same.

- 13% respondents say that their organization take feedback on the cycle of stocktaking once a month, 26% says that it happens once a quarter, 31% says that it happens once a year, 25% says that organization takes the feedback once the project is finished and 5% says that it never happens.
- 67% respondents feel that the problem related to material management is the high cost that is involved in the same, 12% says it is due to incorrect bill of material, 4% says that it is due to shipping errors, 12% are of the opinion that it is due to receiving errors and 5% are of the opinion that it is due to quality problems.
- 52% respondents are of the opinion regarding reason for the problems relating to material management is high inventory cost that is being involved in the same, 17% are of the opinion that wrong encoding is the reason for the problems pertaining to material management, 18% are of the opinion that it is due to lack of management and control & 13% says it is due to the ineffective quality control.
- 73% respondents feel that management has taken the appropriate steps in order to safeguard the employees and 27% respondents denies the same.
- 85% respondents are of the opinion that the relevant departments compare the quantities received against receiving reports in order to check the inventory of the organization and 15% denies the same.
- 83% respondents say that their organizations have made adequate provisions for the obsolete and inactive items in the inventories and 17% denies the same and says that it is one of the biggest challenges that their organization is dealing with.
- 79% respondents says that their management do monitor and approve the write offs of the obsolete and inactive inventories and 21% denies the same.

- 48% respondents say that their organization uses single mode of transport for transporting the finished goods and 52% says that their organization uses multimodal way of transport for the same.
- 45% respondents feel that speed of delivery is an important parameter of the management regarding selection of mode of transportation of goods, 42% respondents feel that safety plays an important role while selecting the mode of transport and 13% respondents feels that other factors plays an important role in the same.
- 87% respondents feel that it is important for an organization to work with the ethical service providers and 13% respondents deny the same.
- 52% respondents know that their organization is an ISO compliant, 34% respondents denies the same and 14% respondents are not aware of the same.
- 72% respondents say that their company regularly arranges a training session for their employees, 12% respondents say that their organization doesn't arrange the same and 16% respondents say that the organization does not regularly do so.
- 58% respondents are aware regarding the regular audit that's being taken place in the organization, 27% denies the same and 15% does not have any idea regarding the same.
- 78% respondents says that the pallets or the boxes used in their organization are managed with a unique number and its being generated by the system, however, 22% respondents denies the same.
- 69% of the respondents are aware of the ergonomic program that's been led by their organization for the safety of its employees, 20% respondents denies the same and 11% respondents has no idea about the same.

- 69% respondents are of the opinion that AGV's is the right solution in solving material management problems; however, 31% denies the same.
- for controlling the inventory management, 85% respondents say that their organization uses bar codes, EDI and RFID, however, 9% says that the organization doesn't use the same and 6% respondents does not have an idea about it.
- 89% respondents say that their organization follows JIT i.e. Just In Time process for delivery of goods, whereas, 11% respondents denies the same.
- The respondents feel that Late delivers, wrong quantities delivered and wrong material delivered plays an equal role pertaining to issues associated with JIT. 32% respondents feel that late deliveries is an issue that is associated with JIT, 35% respondents feel that wrong quantities delivered is an issue and 33% feel that wrong material delivered is an issue associated with JIT.
- 65% respondents have an idea about the procedures that are used to evaluate the potential suppliers, 28% respondents deny the same and 7% does not have any idea about it.
- 13% organizations use forms to evaluate the potential suppliers, 34% goes with the experience of supplier, 36% goes with the reputation of supplier and 17% have worked previously with the supplier.
- 46% respondents are of the opinion regarding the problems being faced with the inspection procedures of the material that proper procedures are not followed, 28% respondent feel that it happens due to the non-conforming items that are not being identified and 26% respondents feel that it is due to non-conforming items that are not isolated.

CONCLUSION

Efficient material management is crucial for the success of any organization and can act like a deciding factor between a successful project and project which has been delayed. Improved material management methods and decision models are required to improve the current practices and thus increasing the efficiency and minimizing costs. An important factor which is required for managing efficient material management is an effective supply management system which helps in avoiding the material shortages, loss and theft. The primary goal is to have the right material at the right place and at the right time. Standardization of the material management system could be a step forward in improving the system and removing the bottlenecks. The process capability is the unique combination of people, machine, methods and measurements in order to produce a product that will help in meeting the customers expectations. There are three types of material handling : Manual Handling, Semi-automatic handling and automatic handling. Material handling is also related with the movement of raw material/semi-finished or finished goods in the plants. Other activities that are involved in it are storing, controlling and protecting the material. The material handling is very helpful to lower the unit material handling costs and provides better control of the flow of materials in the organization. It also helps in reducing the manufacturing cycle time, thus reducing any further delays or damages of raw material, semi-finished or finished goods.

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APPENDIX

PART A

1. Gender of the Respondents

- Male
- Female

2. Designation of the Respondents

- Leaders
- Supervisors
- Forklift Drivers
- Warehouse Drivers
- Others

3. Age of the Respondents

- Under 22
- 22-28
- 29-36
- 37-40
- Over 40

4. Education of the Respondents

- High School
- Bachelor's Degree
- Technical Qualification

5. What type of organization are you working in

- Heavy Engineering
- Auto/Auto Components
- Logistics
- Others

6. Encoding the material while warehousing

- Receive the orders from customers
- Place orders for purchase
- Accept the material for warehousing
- Deliver to workshop

7. Awareness about ERP system

- Yes
- No

8. Training regarding ERP system

- Yes
- No

9. Feedback on the cycle of stocktaking

- Once a month
- Once a quarter
- Once a year
- Project finished
- Never

10. Problems of Material Management

- High cost of material management
- Incorrect bill of material
- Shipping errors
- Receiving errors
- Quality problems

11. Reasons for the problems related to material management

- High inventory cost

- Wrong encoding
- Lack of Management and Control
- Ineffective Quality Control

12. Has management taken the appropriate steps to safeguard the employees

- Yes
- No

13. Do relevant departments compare the quantities received against receiving reports

- Yes
- No

14. Is adequate a provision has been made for the obsolete and inactive items in inventories.

- Yes
- No

14. Does management monitor and approve the write offs of the obsolete and inactive inventories

- Yes
- No

15. What is the mode of transport of the finished goods in your organization

- Single mode
- Multimodal

16. What do you think is the parameter of the management regarding selection of mode of transportation of goods

- Speed of Delivery
- Safety
- Others

17. What is the priority of your organization to work with the ethical service providers

- Important
- Not Important

18. Is your organization an ISO compliant

- Yes
- No
- Can't say

19. Does the company arranges training sessions for the employees

- Yes
- No
- Not regularly

20. Are you aware whether the regular audits being taken place in your organization

- Yes
- No

- No Idea

21. Are the pallets or the boxes management in the system with a unique number

- Yes
- No

22. Are you aware about ergonomic programme

- Yes
- No
- No idea

23. Are AGVs (Automated Guided Vehicles) the right solution for material handling problem

- Yes
- No

24. Do you use technologies like bar codes, EDI and RFID for inventory control of managing material

- Yes
- No
- No Idea

25. Does your organization do JIT (Just In Time) delivery

- Yes
- No

26. What are typical issues that are associated with JIT

- Late deliveries
- Wrong quantities delivered
- Wrong materials delivered

27. Do you have any idea about the procedures used to evaluate the potential suppliers.

- Yes
- No
- No Idea

28. What are the procedures used to evaluate potential suppliers

- Forms
- Experience of supplier
- Reputation
- Previously worked with the supplier

29. What are the problems being faced with the inspection procedures of the material

- Proper procedures are not followed
- Non-conforming items are not identified
- Non-conforming items are not isolated

PART B

1	How do you evaluate material handling system at the company after the established changes	1	2	3	4	5
2	How do you evaluate the cost of operations	1	2	3	4	5
3	How do you assess the occurrence of mechanical shutdown	1	2	3	4	5
4	How do you assess the occurrence of electrical shutdown	1	2	3	4	5
5	How do you evaluate the need for corrective painting	1	2	3	4	5
6	How do you rate safety in service	1	2	3	4	5
7	How do you access safety in handling	1	2	3	4	5
8	How would you rate tooling storage	1	2	3	4	5
9	How do you access the operator's autonomy	1	2	3	4	5
10	How do you access route efficiency	1	2	3	4	5
11	How do you access the agility of operations	1	2	3	4	5
12	How do you evaluate the set-up time	1	2	3	4	5
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14	What is the overall assessment of the situation after the changes	1	2	3	4	5