

## 6. Materials Management:

### Introduction: Materials management

#### Definition by Dr.AK Mishra

It is concerned with planning, organizing and controlling the flow of materials from their initial purchase through internal operations to the service point through distribution.

**OR**

Material management is a scientific technique, concerned with Planning, Organizing & Control of flow of materials, from their initial purchase to destination.

#### Aim of Material Management

The aim of material management is to get:

1. The Right quality
2. Right quantity of supplies
3. At the Right time
4. At the Right place
5. For the Right cost

#### Objective of Material Management

##### Primary

- Right price
- High turnover
- Low procurement & storage cost
- Continuity of supply
- Consistency in quality
- Good supplier relations
- Development of personnel
- Good information system

##### Secondary

- Forecasting
- Inter-departmental harmony
- Product improvement
- Standardization
- Make or buy decision
- New materials & products
- Favorable reciprocal relationships

## **PURPOSE OF MATERIAL MANAGEMENT**

- To gain economy in purchasing
- To satisfy the demand during period of replenishment
- To carry reserve stock to avoid stock out
- To stabilize fluctuations in consumption
- To provide reasonable level of client services

## **Four basic needs of Material management**

1. To have adequate materials on hand when needed
2. To pay the lowest possible prices, consistent with quality and value requirement for purchases materials
3. To minimize the inventory investment
4. To operate efficiently

## **Basic principles of material management**

### **1. Effective management & supervision**

It depends on managerial functions of

- Planning
- Organizing
- Staffing
- Directing
- Controlling
- Reporting
- Budgeting

### **2. Sound purchasing methods**

### **3. Skillful & hard balanced negotiations**

### **4. Effective purchase system**

### **5. Should be simple**

### **6. Must not increase other costs**

## 7. Simple inventory control program

### Elements of material management

1. Demand estimation
2. Identify the needed items
3. Calculate from the trends in Consumption during last 2 years.
4. Review with resource constraints

### Functions of material management

Some of the important functions of material management are briefly discussed below:

1. **Material Planning:** Involves setting up of consumption standards for working out the requirements of a given production program. Deciding whether to make or buy considering the financial aspects, manufacturing capacity, availability and dependability of outside sources, laying down procurement standards and specifications value analysis, standardization etc.
2. **Scheduling** Detailing the receipt of items to meet the procurement lead time availability or scarcity of materials, economic lot sizes, etc., this involves follow up of actual deliveries against the schedules and taking special action for expediting in case of any other short fall.
3. **Inventory Control:** To ensure that stock-outs don't occur for want of materials and able to minimize the inventory holding. Selective control or ABC analysis, analysis of lead times, rejection rates consumption rates, costs and other relevant factors to determine safety minimum and maximum levels re-order level etc., maintenance of central stock records to ensure better control.
4. **Purchasing and Sub-Contracting:** Locating and development of sources of supply, market research for purchasing negotiating prices,

calling for tenders, selection of suppliers, issue of purchase orders, vendor rating, preparations of material budgets etc.

5. **Warehousing and Material Budgeting:** Involves receiving of materials moving them to stores after inspection return of rejected materials of any proper and adequate storage facilities to ensure minimum re-trading, provision of suitable material handling equipment like cranes, hoists, forklifts, conveyor systems, etc., suitable warehousing arrangement to eliminate fire hazard, loss due to pilferage and determination in storage.
6. **Salvage and Disposal of Scrap and surpluses:** Investigating into cases of surpluses and obsolescence and to find out alternative uses or otherwise disposal and also to minimize recurrence of the same, aggregation if different types of scrap so that maximum prices could be obtained while disposing off.
7. **Stores Management:** Involves stores layout, improvement of storage system, stores control of terms of receipt and issues of materials, maintenance or stores records and stores accounting.

**The main functions of materials management are summarized as follows:**

- (1) Materials planning as per production requirements for quantity and time
- (2) Purchasing the required materials
- (3) Make or Buy decisions
- (4) Receipts and inspections of materials
- (5) Storage, warehousing securities and preservation
- (6) Distribution of materials
- (7) Transportation should be expedited and must be economically done
- (8) Inventory control
- (9) Disposal of over stock, surplus, scrap and salvage of materials
- (10) Developing new sources of supply at competitive way
- (11) Ancillaries industrial development

- (12) Indigenous source of supply for foreign materials
- (13) Material cost control and cost reduction
- (14) Co-ordination and co-operation with the other departments
- (15) Research and developments in materials management and their use

### **Problems in material management:**

The common issues relating to materials management are as follows:

- Receiving materials before they are required
- Causing more inventory cost and chances of deterioration in quality
- Not receiving materials at the time of requirement
- Causing loss of productivity
- Incorrect materials take-off from drawings and design documents
- Subsequent design changes
- Damage/Loss of items
- Selection of type of contract for specific materials procurement
- Vendor evaluation criteria
- Piling up of inventory and controlling of the same
- Management of surplus materials.

### **Tips for Improving Material Management**

Because of the important role that material management plays into a businesses success, we have compiled three tips that we believe will dramatically help you to improve your current material management operations.

#### **1. ESTABLISH A PROCESS**

One of the most important things you can do as a manufacturing business is to define a set process. When a company has no inventory control system or formalized materials management, one of the most frequent problems that arise is workers walking around the warehouse

aimlessly trying to locate specific items. That is an absolute waste of time and labor for everyone involved.

Thus, in order to get inventory logged into the system and under control you need to establish a process.

Ask yourself, "What is the process that my business needs to follow on a daily basis in order to successfully get orders out the door and make informed buying and selling decisions?"

Defining a set process from when a material enters your facility to when your product leaves allows you to have complete control over everything you do, as well as minimize error. You might have a top of the line ERP or WMS system, but the system by itself won't solve your problems—you still need to establish a process first.

## **2. BE DISCIPLINED**

Whichever system you put in place and whichever process you create, your team has to be disciplined to adequately execute it. If you have people on your team that aren't following the process or utilizing the system correctly, you might as well not have anyone utilizing it at all. Regardless of how good your process or system is, without a good team to execute it, you won't accomplish anything.

Keeping your team disciplined is not an easy task, especially at first. People don't respond well to a new process or system, especially when you are implementing it in place of one they have been using for years. New technology and methods of doing every day jobs can be overwhelming, and lead to user rejection. You have to do everything in your power to combat this.

There are ways around this, however. **Proper training** is the number one way to get people on board from an early standpoint. This isn't something that you can just bypass. Sitting down and taking days or weeks to get everyone on the same board is an incredibly important strategic move in system implementation.

After the system is implemented, do things to keep warehouse workers **actively engaged** in keeping the system going and keeping efficiency up. Providing incentives and prizes for when workers increase efficiency for a specific KPI is a great way to keep them happy and disciplined.

### **3. USE TECHNOLOGY WHEREVER POSSIBLE**

Paper is always a delayed process in the manufacturing industry. If you have a paper order for a worker to pull a certain product, the worker writes down what they pulled, where they pulled it, and where they put it, all on a piece of paper.

That paper is then either put into a box or keyed into a computer sometime after the fact. Nothing is live and you don't have any up to the minute information. However, if you utilize technology, that person is scanning where they're taking the product from and where they're taking it to. It's controlled.

With the implementation of certain technology, you have constantly updating information at your fingertips. Everything is continuously active and you always know what is happening with your products. It allows you to make more informed decisions on a daily basis.

When that technology gets implemented on a wider basis within the company, you are able to gather a greater amount of information about your products, which increases efficiencies and processes even further.

#### **Material Management can be improved by following:**

- Construction Materials Planning System (CMPS)- for planning of construction materials to achieved the right materials in quantities, time and meet the work programs
- Material Handling Equipment Selection Advisor (MHESA) - for material handling equipment selection

- Construction Materials Exchange (COME) – E-Commerce system for material procurement
- Bar-code system - for material storage application

Before exploring the improvement of materials management for fast-track projects, it is essential to explore current practice in materials management in fast-track construction projects. CIRIA (2001) stated that in relation to materials management, faster construction can be achieved on site through the following:

- Extra space for the site compound: to ensure sufficient materials storage space to supply the site at the speed of anticipated delivery and construction demand.
- Maintain good vertical site access: consisting of cranes, hoists, lifts, pumps, ladders and stairs to form double handling for vertical handling.
- Keep the site compound well surfaced, well organized, clean and tidy: to minimize damage and the soiling of materials for the purpose of immediate work.
- Good access for material/plant deliveries: comprehensive facilities for transport arrivals and departures.
- Delivery of bulk materials in large: transportation for large quantities by rail (eg reinforcement/steelwork) or barge (eg ballast from a dredger) and for large volume by pipeline (eg water/gas/oil/chalk/cement/concrete) or conveyor (eg excavated Material/fill).

([https://www.researchgate.net/publication/228964010\\_Improving\\_materials\\_management\\_practices\\_on\\_fast-track\\_construction\\_projects](https://www.researchgate.net/publication/228964010_Improving_materials_management_practices_on_fast-track_construction_projects) [accessed Oct 14 2018]).



### **Material management Conclusion:**

Material management is an important management tool which will be very useful in getting the right quality & right quantity of supplies at right time, having good inventory control & adopting sound methods of condemnation & disposal will improve the efficiency of the organization & also make the working atmosphere healthy any type of organization, whether it is Private, Government, Small organization, Big organization and Household.

Even a common man must know the basics of material management so that he can get the best of the available resources and make it a habit to adopt the principles of material management in all our daily activities

### **Integrated Materials Management: Introduction**

Various functions served by materials management include the materials planning, purchasing, receiving, stores, inventory control, scrap and surplus disposal. If some of these functions are separately handled, there is a chance of a conflict of interests. Purchasing department, if allowed to operate independently, may take decisions which result in sub-optimization. For example, under a separate set-up, the purchase department may treat discount as a very important factor and buy large quantities to avail of the discount without taking into account its impact on the warehousing and carrying costs. In other words, we need to achieve optimum results for the organization as a whole. An expansion, for example, will require planning for the increased requirements, developing new sources, revision in inventory levels, apart from the increased load in receipt of material, inspection and storing. In an integrated set-up, the materials manager who is responsible for all such inter-related functions, is in a position to exercise control and coordinate with an overview that ensures proper balance of the conflicting objectives of the individual functions. Integration also helps in the rapid transfer of data through effective and informal communication channels. This is

crucial as the materials management function usually involves handling a vast amount of data. Therefore, integrating the various functions ensures that message channels are shortened and the various functions identify themselves to a common materials management department, which, in turn, results in greater coordination and better control.

### **What is Integrated Materials Management:**

The concept of Integrated Materials Management evolved as a rationale for bringing all the materials related activities under one common head viz. the Materials Manager to permit uninterrupted flow of raw materials, components & parts from the suppliers to the corporation, to all consumer points in the organization & distribution of finished goods at minimum cost.

The areas which come under the framework of Integrated Materials Management are:

- Materials Planning/Materials Requirement Planning
- Purchasing
- Receiving & Inspection
- Storekeeping & Warehousing
- Inventory Control
- Materials Handling and Transportation, including Logistics & Physical Distribution Management
- Scrap & Surplus Control and Disposal
- Cost Reduction Techniques like Value Analysis, Standardisation, Variety Reduction etc.
- Forecasting & Market Analysis

Integrated MM also encompasses Production Planning on one hand & Distribution of finished goods to customers on the other. Companies which have these activities transferred under the Integrated MM set-up, have found encouraging results by the way of improved coordination & reduced inventories.

## Advantages of Integrated Materials Management

Organizations, which have gone in a big way for the integrated materials management, usually enjoy many advantages. While in the past in many organizations inventory control, purchase, stores and movement were grouped into two or three departments, it is now being realized all over the world that a combined set-up is the best from the coordination point of view, efficient working and cost reduction. The modern classification for this set-up is 'Integrated Materials Department' and the various advantages of such a unified setup are given below. These advantages, help in achieving the objectives of materials management by the company in a better way.

1. **Better accountability:** Through centralization of authority and responsibility for all aspects of materials function, a clear-cut accountability is established. Various user departments can direct their problems with regard to materials to one central point so that action can be taken immediately. This helps in evaluating the performance of materials management in an objective manner.
2. **Better coordination:** When a central materials manager is responsible for all functions, the departments under the materials manager create an identity, which is common. This results in better support and cooperation in the accomplishment of the materials function. The user departments also find that they have to approach one department for discussing and solving their materials problems. This creates an atmosphere of trust and generally better relations between the user departments and the materials management department.
3. **Better performance:** As all the interrelated functions are integrated organizationally, greater speed and accuracy results in communication. Need for materials are promptly brought to notice by materials planning. Purchase department is fed with stock levels and order status by stores or by inventory control departments. All this calls for judicious decisions leading to lower costs, better

inventory turnover, reduced stock-outs, reduced lead time and a general reduction in paper work.

4. **Adaptability to EDP:** The centralization of the materials function has made it possible to design data processing systems. All information with regard to material function is centralized under the integrated materials management function. This has facilitated the collection, collation and analysis of data, leading to better decisions. Advanced and efficient electronic data processing systems can be economically introduced under an integrated set-up.
5. **Procurement at the right time:** The principal objective of materials management is to obtain raw materials, tools, general supplies, etc, at the right time. This involves recoupmnt on time by inventory control, processing the purchase order and follow-up by purchase section; sending shortage reports by inventory control as well as by stores at different stages; clearing the goods from docks, railways or road transport offices in the case of purchases from distant sources; checking and taking materials into finished stock by stores, etc. The combined set-up brings about greater coordination and increased sense of responsibility with regard to getting materials at the right time. This avoids passing the buck between purchasing and stores.
6. **Improved Inventory control:** Variations that may occur in delivery time, its effect on inventory and production, the necessity of adjusting the minimum and maximum levels on inventory will be better understood by integrated approach which fosters better understanding between purchase and stores.
7. **Increased productivity:** Productivity is the ratio between input and output. As far as materials management is concerned, it implies reduction of costs and increase in profit. Materials management tools such as value analysis, standardization, simplification, reduction of procurement cost by bulk order, reduction of investment and carrying cost by staggered rate of delivery, avoiding obsolescence, control over consumption of materials, etc. enhance productivity. Some factors such as procurement cost and carrying cost pull in opposite directions and complicate the issues of materials management. Therefore, the solution, which will curb

the conflicting interests, can be to have a common department head. Integrated approach results in a better solution.

8. **Control of price:** The price depends upon the quantity. If the decision regarding the quantity to be bought rests with a separate department, the work of the purchase officer is handicapped. In a combined department, the department head is in a position to negotiate the price on the basis of the present and future requirements and acceptable delivery. Advantages of price break can be availed of after proper analysis through price break mathematical model under the guidance of the department head, materials.
9. **Improved Inventory control:** One of the main objectives of materials management is to keep inventory at a low level. This can be achieved by staggering delivery and control of Safety stock. There should be close coordination between inventory control and purchase. In a combined inventory control and purchase, the head of the department is in a position to see that material requisition is raised on time.
10. **Dead stock:** Dead stock will often come to the notice of a common department head during his supervision to the stores, and this facilitates quick disposal action.
11. **Effective classification and codification:** The classification and codification work requires through knowledge of the materials and their application or use. Often this calls for actual examination of the materials in the stores and consultation of the papers received in the purchase section. For large industries involving multitudes of items, codification project is very important and useful. Many times the help of an outside consultant is needed to complete the job.
12. **Heavy packages:** Handling of receipts, particularly heavy packages, is simplified when the stores and purchase sections are combined. When separate, the stores often gets advice regarding unloading too late which creates problems, pressure and irritation.
13. **Assurance of verifying right materials:** In the integrated approach the vice-president materials gets opportunity to see what is being

supplied against his orders and to assure that he receives the right material for the money paid.

14. **Better focus on urgent materials:** In an integrated set-up, a single executive is the head of both the stores and purchase. This enables him to understand the urgency of various purchases. From daily reports, he gets first hand information regarding materials which have arrived, and therefore he is in a position to expedite issue of urgent materials.
15. **Quick return of defective:** The integrated set-up monitors quicker return and replacement of rejected materials and takes action accordingly.
16. **Better utilization of stores space:** Although bulk purchases may be an advantage for better price, it may create storage difficulties. If Stores and purchase are separate, such a factor is likely to be overlooked.
17. **Reduced paperwork:** In a combined set-up, the inventory control will be adjacent to the purchase section. This enables the purchase section to utilize the information available on the Inventory for the purchase work. In a separate set-up, the inventory control goes with the stores. This means dual records and added cost.
18. **Reduced Correspondence:** Correspondence between stores, purchase and inventory control is reduced in the integrated set-up. Reduced paperwork improves office efficiency.
19. **Ease for accounting department.** The work of accounts is easier in the integrated set-up. Otherwise, accounts department has to shuttle between the stores, purchase and traffic for settling and reconciling issues.
20. **Miscellaneous advantages:** Under a central materials manager, a team spirit is inculcated. This boosts morale and enhances cooperation. The opportunities for growth and development are better in an integrated set-up. An individual under such a set-up is not confined to any one function alone, and he gets, over a period of time, exposed to broader aspects of the materials function.

## **What Is Differentiation & Integration in Organization Development?**

Businesses, much like individuals, develop in their own way and at their own pace. Several factors influence how a business develops, from the personality of its leaders to its chosen industry to the economic climate. The results can range from a structured, vertical hierarchy to a loose, horizontal free-form group. Businesses can develop from teams splitting off and pursuing their goals or from individuals coming together for a common cause.

### **Differentiation**

Differentiation occurs in large companies when different departments, sections or branch offices create their own corporate culture within the parent company's overall structure. For instance, the sales staff at a differentiated company will have a different approach to their tasks than the accounting department. Companies also can be differentiated based on product lines. A highly-differentiated brewery will have sections that brew pilsners, lagers and ales, each with its own production, accounting and marketing operations, while operating under the same corporate umbrella.

### **Product Differentiation**

Product differentiation offers customers a wide range of products within a specific industry. Many companies employ product differentiation by developing different product lines. Each of these product lines may have its own accounting, computer networking, and marketing departments, and operate like separate companies, all under the same corporate umbrella. For instance, Coca-Cola produces soft drinks under brand names such as Coke, Sprite and Diet Coke, but the company also produces Minute Maid fruit juices and PowerAde sports drinks.



## **Brand Differentiation**

Another form of differentiation comes when a company produces a single type of product, but wishes to market that product to different audiences. The audiences can consist of different genders, ethnic groups or socio-economic levels. For instance, auto manufacturers can have one brand for low- to middle-income buyers and another for high-income and luxury buyers. Examples of this include the Acura brand from Honda, the Lexus from Toyota and the Infiniti brand from Nissan.

## **Integration**

Integration relates to how the different areas of the company coordinate their operations. A highly-integrated company has strong connections between departments and product lines, with each section working under a cohesive set of rules and strategies. Integrated companies are highly vertical and hierarchical in nature. These companies operate from a "top-down" mindset, where the management dictates the structure of each department rather than allowing the individual departments to set their own agendas.

## **Vertical Integration**

Vertical integration brings together two aspects of an industry that work at different points on the production line. For instance, if a manufacturer develops or acquires a chain of retail outlets, the two companies join in a vertical integration strategy, with each portion working with the others to achieve overall company goals. Apple serves as one of the high-profile examples of vertical integration. Apple controls nearly all aspects of its hardware manufacturing, software development, marketing efforts and retail outlets.

## **Horizontal Integration**

Horizontal integration is a strategy that involves a company merging with or taking over another firm at the same stage of production. Horizontal integration gives the acquiring company more resources and a larger

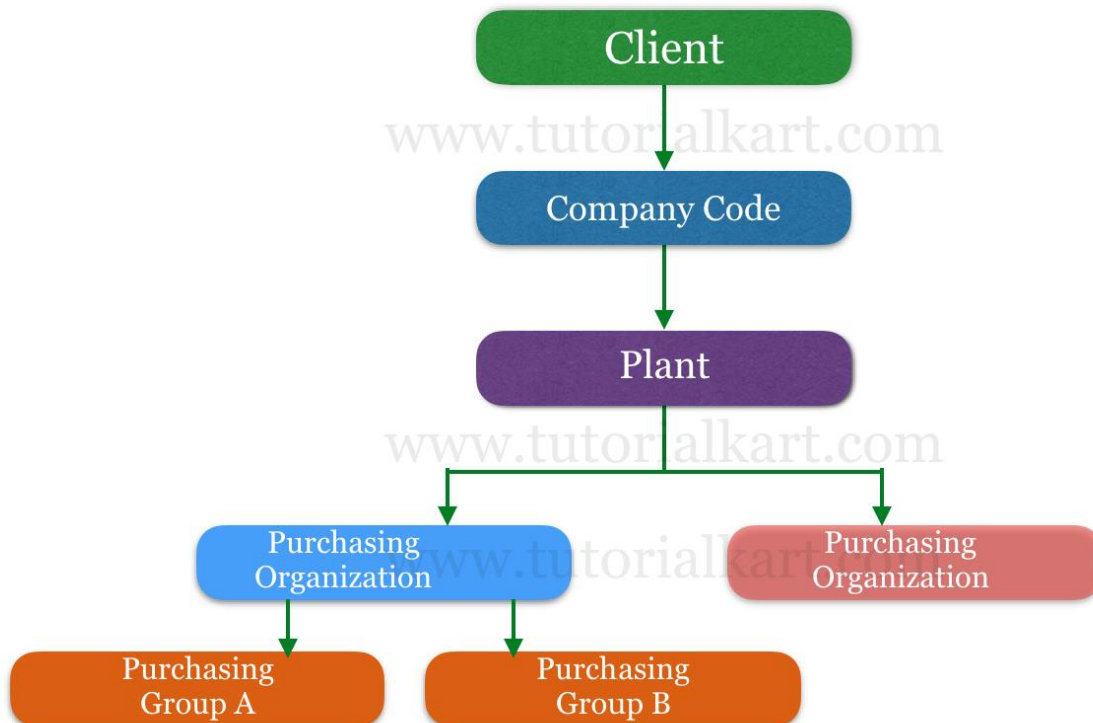


market share. In recent years, The Walt Disney Company engaged in horizontal integration by purchasing several sources of creative material, including Marvel Comics, Lucas film and Jim Henson Studios. These purchases allowed them to bring in properties such as "The Avengers," "Star Wars" and "The Muppets" into their libraries.

### **Materials management Organization:**

The organization of materials management ensures efficient integration of activities related to materials and the regulation of their use as per the production requirements to maintain stability in the department. There should be harmonious structural growth and authority within the organization's hierarchical system and integrative decision-making. This helps in achieving the goals of the organization by way of proper information supply system.

#### **Material Management Organization Structure:**



## **Duties and Responsibilities of a Materials Manager:**

A materials manager, also known as a purchasing manager, is responsible for planning, directing or coordinating the process of buying materials, products and services. In many respects he is a jack-of-all-trades. In addition to the usual supervisory skills expected of senior managers, materials managers must create the deals that keep materials flowing into the factory so that products can continue to flow out of the factory. They might procure everything from the soft drinks in the staff lounge to the multimillion-dollar machinery used to manufacture products. Following are the duties and responsibilities of material manager:

- Plan and oversee material movement through production cycle.
- Identify material requirements from production and engineering cycles.
- Handle material movement with purchasing, production and engineering.
- Manage policies, procedures and material control systems.
- Assess and plan purchasing materials requirements.
- Develop material requirements plans on automated computer system.
- Set up and manage production control system.
- Offer technical expertise to cross functional project teams.
- Develop department budget.
- Develop and review personnel to meet functional objectives.
- Create purchase orders, solicit proposal bids and review goods requisitions.
- Analyze price proposals and financial reports to identify reasonable prices.

- Negotiate and administer supplier contracts.
- Generate purchasing recommendation reports and actions.
- Support buyer to negotiations with suppliers on lead time, cost, delivery and quality.

### **Skills Required by Materials Manager:**

- Should have good negotiating skills and verbal and written communication skills
- Skillful in planning and analyzing the requirements of the production department
- Ability to design specifications for the raw materials to be ordered
- Skilled at researching the market, looking for potential suppliers and designing quotations for the purchase order
- Well-versed with the traditional as well as advanced methods used in inventory control
- Proficient in using computer, fax machines, printers, Xerox machines, etc.

### **Educational Requirements for Materials Manager:**

Most of the employers hire individuals possessing a bachelor's degree in Business Administration with specialization in Logistics, Material Management or Supply Chain Management. If you want to bag higher packages and progress in this career then you should pursue a master's degree in Business Administration, especially in fields such as retailing, inventory management or materials management. Even if you have a bachelor's degree or master's degree in any relevant field, pursuing certification courses in relevant field will give opportunity to work as materials manager.

## Sources of Construction Materials:

Construction materials are obtained from different sources. Mainly two classifications are found:

### 1. Natural

A natural material is any product or physical matter that comes from plants, animals, or the ground. Minerals and the metals that can be extracted from them (without further modification) are also considered to belong into this category. Natural materials are used as building materials and clothing. Types include:

#### a. Biotic materials:

- Wood (rattan, bamboo, bark, etc.)
- Natural fiber (silk, wool, cotton, flax, hemp, jute etc)

#### b. Inorganic material

- Stone (flint, granite, obsidian, sandstone, sand, gems, glass, etc.)
- Native metal (copper, iron, gold, silver, etc.)
- Composites (clay, plasticine, etc.)

#### c. Other natural materials: Soil

### 2. Artificial(Man made substance)

Various methods can be used to create materials from existing substances.

**Processing** a material could be as simple as hammering a piece of copper, or flaking arrowheads from a piece of flint. When sand is melted and formed into glass, the primary change occurring is in the arrangement of the silicon and oxygen atoms. There are several ways to change iron ore, a compound, into iron metal. The different processes used to produce cast and wrought iron result in different ratios of iron and carbon which create different properties in the final objects, and make them suitable for different applications.

**Synthesis** implies a major change in chemical composition; for example, polymers are synthesized by cooking mixtures of chemicals. New molecular structures result.

## Classification of Materials

Like many other things, materials are classified in groups, so that our brain can handle the complexity. One could classify them according to structure, or properties, or use. The one that we will use is according to the way the atoms are bound together:

**Metals:** valence electrons are detached from atoms, and spread in an 'electron sea' that "glues" the ions together. Metals are usually strong, conduct electricity and heat well and are opaque to light (shiny if polished). Examples: aluminum, steel, brass, gold.

**Semiconductors:** the bonding is covalent (electrons are shared between atoms). Their electrical properties depend extremely strongly on minute proportions of contaminants. They are opaque to visible light but transparent to the infrared. Examples: Si, Ge, GaAs.

**Ceramics:** atoms behave mostly like either positive or negative ions, and are bound by Coulomb forces between them. They are usually combinations of metals or semiconductors with oxygen, nitrogen or carbon (oxides, nitrides, and carbides). Examples: glass, porcelain, many minerals.

**Polymers:** are bound by covalent forces and also by weak van der Waals forces, and usually based on H, C and other non-metallic elements. They decompose at moderate temperatures (100 – 400 C), and are lightweight. Other properties vary greatly. Examples: plastics (nylon, Teflon, polyester) and rubber.

Other categories are not based on bonding. A particular microstructure identifies **composites**, made of different materials in intimate contact (example: fiberglass, concrete, wood) to achieve specific

properties. **Biomaterials** can be any type of material that is biocompatible and used, for instance, to replace human body parts.

**Advanced Materials:** Materials used in "High-Tec" applications, usually designed for maximum performance, and normally expensive. Examples are titanium alloys for supersonic airplanes, magnetic alloys for computer disks, special ceramics for the heat shield of the space shuttle, etc.

## **Types of Building Materials Used in Construction**

### **1. Natural Construction Materials**

Mud, stone, and fibrous plants are the most basic materials, aside from tents made of flexible materials such as cloth or skins. People all over the world have used these three materials together to create homes to suit their local weather conditions.

In general stone and/or brush are used as basic structural components in these buildings, while mud is used to fill in the space between, acting as a type of concrete and insulation.

### **2. Fabric**

Modern buildings can be made of flexible material such as fabric membranes, and supported by a system of steel cables or internal (air pressure.)

### **3. Mud and clay**

Peoples building with mostly dirt and clay, such as cob, sod, and adobe, resulted in homes that have been built for centuries in western and northern Europe as well as the rest of the world, and continue to be built,

though on a smaller scale. Some of these buildings have remained habitable for hundreds of years.

#### **4. Rock**

Rock structures have existed for as long as history can recall. It is the longest lasting building material available, and is usually readily available. There are many types of rock through out the world all with differing attributes that make them better or worse for particular uses.

Rock is a very dense material so it gives a lot of protection too, its main draw-back as a material is its weight and awkwardness. Its energy density is also considered a big draw-back, as stone is hard to keep warm without using large amounts of heating resources.

Mostly stone buildings can be seen in most major cities, some civilizations built entirely with stone such as the Pyramids in Egypt, the Aztec pyramids and the remains of the Inca civilization.

#### **5. Thatch**

Thatch is one of the oldest of materials known; grass is a good insulator and easily harvested. Many African tribes have lived in homes made completely of grasses year round. In Europe, thatch roofs on homes were once prevalent but the material fell out of favour as industrialization and improved transport increased the availability of other materials.

Today, though, the practice is undergoing a revival. In the Netherlands, for instance, many of new builds too have thatched roofs with special ridge tiles on top.

## **6. Brush**

Brush structures are built entirely from plant parts and are generally found in tropical and subtropical areas, such as rainforests, where very large leaves can be used in the building. Native Americans often built brush structures for resting and living in, too.

These are built mostly with branches, twigs and leaves, and bark, similar to a beaver's lodge. These were variously named wickiups, lean-tos, and so forth.

## **7. Ice**

Ice was used by the Inuit for igloos, but has also been used for ice hotels as a tourist attraction in northern areas that might not otherwise see many winter tourists.

Inuit: a member of a Native American people who live in the cold northern areas of North America and Greenland

Igloos: a dome-shaped Eskimo house, typically built from blocks of solid snow.

## **8. Wood**

Wood is a product of trees, and sometimes other fibrous plants, used for construction purposes when cut or pressed into lumber and timber, such as boards, planks and similar materials. It is a generic building material and is used in building just about any type of structure in most climates.

Wood can be very flexible under loads, keeping strength while bending, and is incredibly strong when compressed vertically.



There are many differing qualities to the different types of wood, even among same tree species. This means specific species are better for various uses than others. And growing conditions are important for deciding quality.

## **9. Brick and Block**

A brick is a block made of kiln-fired material, usually clay or shale, but also may be of lower quality mud, etc. Clay bricks are formed in a molding (the soft mud method), or in commercial manufacture more frequently by extruding clay through a die and then wire-cutting them to the proper size (the stiff mud process).

An important low-cost material in developing countries is the Sandcrete block, which is weaker but cheaper than fired clay bricks.

## **10. Concrete**

Concrete is a composite building material made from the combination of aggregate (composite) and a binder such as cement. The most common form of concrete is Portland cement concrete, which consists of mineral aggregate (generally gravel and sand), Portland cement and water.

After mixing, the cement hydrates and eventually hardens into a stone-like material. When used in the generic sense, this is the material referred to by the term **concrete**.

## **11. Metal**

Metal is used as structural framework for larger buildings such as skyscrapers, or as an external surface covering.

There are many types of metals used for building. Steel is a metal alloy whose major component is iron, and is the usual choice for metal structural construction. It is strong, flexible, and if refined well and/or treated lasts a long time. Corrosion is metal's prime enemy when it comes to longevity.

## **12.      Glass**

Clear windows have been used since the invention of glass to cover small openings in a building. They provided humans with the ability to both let light into rooms while at the same time keeping inclement weather outside. Glass is generally made from mixtures of sand and silicates, and is very brittle.

Modern glass “curtain walls” can be used to cover the entire facade of a building. Glass can also be used to span over a wide roof structure in a “space frame”.

## **13.      Ceramics**

Ceramics are such things as tiles, fixtures, etc. Ceramics are mostly used as fixtures or coverings in buildings. Ceramic floors, walls, counter-tops, even ceilings. Many countries use ceramic roofing tiles to cover many buildings.

Ceramics used to be just a specialized form of clay-pottery firing in kilns, but it has evolved into more technical areas.

## **14. Plastic**

The term plastics cover a range of synthetic or semi-synthetic organic condensation or polymerization products that can be molded or extruded into objects or films or fibers. Their name is derived from the fact that in their semi-liquid state they are malleable, or have the property of plasticity.

Plastics vary immensely in heat tolerance, hardness, and resiliency. Combined with this adaptability, the general uniformity of composition and lightness of plastics ensures their use in almost all industrial applications today

## **15. Foam**

More recently synthetic polystyrene or polyurethane foam has been used on a limited scale. It is light weight, easily shaped and an excellent insulator. It is usually used as part of a structural insulated panel where the foam is sandwiched between wood or cement.

## **16. Cement composites**

Cement bonded composites are an important class of construction material. These products are made of hydrated cement paste that binds wood or alike particles or fibers to make precast building components. Various fibrous materials including paper and fiberglass have been used as binders.

Wood and natural fibres are composed of various soluble organic compounds like carbohydrates, glycosides and phenolics. These compounds are known to retard cement setting. Therefore, before using a wood in making cement boned composites, its compatibility with cement is assessed.

## **17. Building Materials in Modern Industry**

Modern building is a multibillion dollar industry, and the production and harvesting of raw materials for building purposes is on a worldwide scale. Often being a primary governmental and trade key point between nations.

Environmental concerns are also becoming a major world topic concerning the availability and sustainability of certain materials, and the extraction of such large quantities needed for the human habitat.

## **18. Virtual Building Materials**

Certain materials like photographs, images, text may be considered virtual. While, they usually exist on a substrate of natural material themselves, they acquire a different quality of salience to natural materials through the process of representation.

## **19. Building Products**

When we talk about building products we refer to the ready-made particles that are fitted in different architectural hardware and decorative hardware parts of a building.

The list of building products exclusively exclude the materials, which are used to construct the building architecture and supporting fixtures like windows, doors, cabinets, etc. Building products do not make any part of a building rather they support and make them working.

## **Vendor Evaluation and Rating**

### **What is Vendor Evaluation?**

Vendor evaluation is a system for recording and ranking the performance of a supplier in terms of a variety of issues, which may include delivery performance and the quality of the items. A process of vendor rating is essential to effective purchasing. Vendor selection is crucial because of its strategic importance especially when it comes to Government Supplies where money & quantities involved are generally very large.

Many companies use a vendor evaluation tool that allows transaction data to be analyzed to give a comparison between vendors. The vendor evaluation uses criteria that have been determined by the purchasing department to compare vendors such as price, delivery reliability, delivery date adherence and quality of the item.

There are any numbers of criteria that can be used in a comparison and these are usually weighted so that important criteria are given more credence. For example, a company may decide that quality of the items it receives from vendors is more important than price, which in turn is more important than delivery reliability.

Vendor Evaluation supports us in procuring both materials and external services, by making use of data.

Vendor Evaluation will enable us to choose the most appropriate vendor for a specific requirement, and supports us in the continuous monitoring of existing supply relationships.

### **How it is Vendor Evaluation done?**

When a decision has to be made between vendors, purchasing department will use some vendor evaluation method to be their tool in the decision. Each vendor would then complete the RDQ with the information that was required, normally price and terms. The purchasing department would

then use these completed quotations, in conjunction with other information they have collected on the vendors, to make short list for further evaluation or make a final selection. The purchasing department would evaluate the vendors based on a number of criteria they had decided upon which may include objective criteria such as price and warranty and subjective data which would include past experience with the vendor. Based on the weighting given to these criteria the purchasing department would be able to fairly evaluate each vendor.

### **Vendor Rating:**

- A vendor is any persons or company that sells goods or services to someone else in the economic production chain.
- Vendors or suppliers are given standing, status, or title according to their attainment.
- It may take the form of a hierarchical ranking from poor to excellent and whatever ranking the firm chooses to insert in between the two.
- For some firms, it may come in the form of some sort of award system or as some verification of certification.
- It is direct result of the widespread implementation of the just-in-time concept and its focus on the critical role of the buyer-supplier relationship.

**Vendor rating is the result of a formal vendor evaluation system.**

### **Objective of Vendor Rating:**

- To help the buyer in future selection
- To provide buyer with the information helpful in subsequent negotiation
- To provide the buyer with the important information which he can act upon any corrective measure..

### **Advantage of vendor rating:**

- Helping minimize subjectivity in judgment and make it possible to consider all relevant criteria in assessing suppliers.
- Providing feedback from all areas in one package.
- Facilitating better communication with vendors.
- Providing overall control of the vendor base.
- Requiring specific action to correct identified performance weaknesses.
- Establishing continuous review standards for vendors, thus ensuring continuous improvement of vendor performance.
- Building vendor partnerships, especially with suppliers having strategic links.
- Developing a performance-based culture.

### **How vendors are rated:**

Vendors are rated on the basis of various characteristics:

- ☆ Time delivery
- ☆ Quality
- ☆ Price
- ☆ Other actors such as:
  - Supplying useful market information
  - Meet emergency order

### **Methods of vendor rating:**

#### 1. By Categorical Plan:

- This is very subjective method
- Managers from concerned department prepare lists of factors important from their views

- Each of the major suppliers is evaluated against each evaluations list of factors. Evaluation is done in the terms of:
  - a. Good
  - b. Satisfactory
  - c. Poor

2. By Weighted Point Plan: The buyer decides on:

- a. Factor important from evaluation
- b. Weightages for each factor
- c. The vendor performance in respect of each factor

3. By Cost ratio Plan:

- Under this method, the vendor rating is done on the basis of various costs incurred for procuring the materials from various suppliers.
- The cost ratio are ascertained for the different rating variables such as quality, price, timely deliver etc..
- The cost ratio is calculated in percentage on the basis of total individual cost and total value of purchase.



**Example:**

The total delivery cost is Rs 5000.00 and the total purchase are Rs 1,00,000.00 then delivery cost ratio will be:

$$5000.00 / 1,00,000.00 * 100 = 10\% \text{ (Delivery cost Ratio)}$$

**Example:**

Criteria	Weight	Performance	Rating
			Weight* Performance
Supplier 'X" Performance Evaluation			
Quality	30	98% acceptable	29.4
Price	20	Lowest/Actual price	18.6
		Rs 52/ Rs 56 = 92.9%	
Service	50	85% on Schedule	42.5
Overall Evaluation			90.5
Supplier 'Y" Performance Evaluation			
Quality	30	95% acceptable	28.5
Price	20	Lowest/Actual price	20
		Rs 52/ Rs 52 = 100%	
Service	50	82% on Schedule	41.1
Overall Evaluation			89.5

## Vendors Evaluation Process:

Here are seven tips and tools you'll need to effectively rate your suppliers and vendors, track their performance, and ultimately increase your organization's overall productivity.

- i. Evaluation of performance of Vendors/ Suppliers/ Consultants in case of PROJECTS shall be done immediately with commissioning of any Project.
- ii. On commissioning of any Project, EIC (Engineer-in-charge)/ Project-in charge shall prepare a Performance Rating Data Sheet for all Orders and Contracts.
- iii. Depending upon the Performance Rating, following action shall be initiated by Engineer-in-charge/Project-in-charge:

Sl.No.	Performance Rating	Action
1	POOR	Seek explanation for Poor performance
2	FAIR	Seek explanation for Fair performance
3	GOOD	Letter to the concerned for improving performance in future
4	VERY GOOD	No further action

- iv. Reply from concerned Vendor/ Supplier/Consultant shall be examined. In case of satisfactory reply, Performance Rating data Sheet to be closed with a letter to the concerned for improving performance in future.
- v. When no reply is received or reasons indicated are unsatisfactory, the following actions need to be taken:

#### A) Where Performance rating is “POOR”:

Recommend such defaulting Vendor/ Supplier/ Consultant for putting on Holiday for a period from one to three years as given below:

- a. Poor Performance due to reasons other than Quality : **One Year**
- b. Poor Performance on account of Quality (if any mark obtained against Quality parameter is less than 30): **Two Years**
- c. Poor Performance leading to termination of contract or Offloading of contract due to poor performance solely attributable to Vendor/ Supplier/Contractor/ Consultant or Repeated Offence: **Three Years**

Non performance of a Vendor/Supplier/Contractor/Consultant ;leading to termination of Contract/ Order, such Vendor/ Supplier/ Contractor/Consultant are also to be considered for Suspension.

#### B) Where Performance rating is “FAIR”:

Issuance warning for defaulting Vendors/Consultants to improve their performance.

## **Inventory Management & Control**

The Inventory Management & Control function is responsible for the efficient storage and monitoring of inventory in company warehouses and storage facilities. Through communications with the Forecasting and Purchasing or Procurement groups, they set levels at which to purchase additional volumes of each item (and notify the appropriate parties when those levels are reached, usually in an automated manner). They also control the quality of storage methods and ensure that incoming and outgoing items meet the necessary standards. This is especially important in industries with tight regulation, such as food production and processing, chemicals and oil and gas.

## **Quality Control**

The Quality Control (sometimes called Quality Assurance) function examines products and materials for defects or deviations from specifications. They record the results of their inspections through test reports and help to analyze and correct production problems. Quality-related information on order shipments from suppliers can also help to assess supplier performance (see Vendor Compliance & Audit).

## **Receiving**

The Receiving function is responsible for ensuring the efficient and timely delivery of goods/materials purchased from suppliers. They work with vendors to facilitate delivery, manage incoming distribution channels and assure the quality of inbound good or materials.

## **Organizational Data**

- A hierarchy in which the organizational units in an enterprise are arranged according to tasks and functions
- Are static data and are rarely changed
- The definition of organization units is a fundamental step, it is a critical actor in how the company will be structured

- The purchasing process involves the acquisition of goods and services to support the creation of goods and services in the organization
- In this unit the structure required for the purchasing process is presented

### **Functions of Store department:**

The following are the functions of a store department:

#### **1. Receipt**

- Any item of goods or material that enters the organization always enters through the stores. Similarly, every item unless specially excluded, has to leave through the store. Stores are the final account keeper of all materials.
- Material sent by any supplier after the security clearance comes to the stores. Store checks the document carried by the carrier, known as delivery challan, against the copy of the purchase order placed on the supplier by the organization.
- Once the adequacy is established and quantity is verified the material is sent for testing for quality parameters.
- Some times quality control tests are elaborate and time consuming. If the policy of receipt is to unload the material subject to quality control acceptance, it is cleared for unloading.
- Unloaded materials is kept on the hold if it not yet cleared by quality control department. if the material is rejected it is sent back to the supplier.

#### **2. Storage**

- Once the unloaded material is approved by the quality control department, as per the quality plan in the quality system, it is moved to a specific place in the store layout.

- The material is so stored that it becomes easy to get back and issue subsequently.
- Storage should also ensure protection against deterioration, damage and pilferage.( the act of stealing things of small value)
- Detailed system is adopted for location and labeling of items while in storage. Storage plan is made keeping in mind
  - i. nature of product: physical state, toxicity, inflammability and other hazards
  - ii. volume and weight: heavy or light
  - iii. movement frequency: fast moving or slow moving
  - iv. point of use

### 3. **Retrieval** (the action of obtaining stored material ) □□□□ □□□□□□ □□□□□□ □□□□□□□□

- Easy and quick retrievability of items that are demanded by the internal consumer
- Easy identification, maximum space utilization and minimum handling are key factors to retrieval function

### 4. **Issue**

- Fulfilling customer demand for the item in minimum time, keeping quality high and cost minimum is issue
- An internal customer doesn't pay the price but he has to fulfill requirement of authorization for the demand
- A duly authorized indent or requisition for the item is the key

### 5. **Records**

- Maintaining records of receipt and issue
- Updating of the stock levels as per movement of materials

- Basic records of store are bin card and stock register

## 6. Housekeeping

- Maintenance of spic and span cleanliness in the store and ensuring principle of place for every thing and everything in its place is fully implemented.
- Good housekeeping ensures satisfactory work practices

## 7. Control

- Taking measures to ensure material plan is being adhered to
- Any changes in consumption pattern or replacement pattern are closely monitored for corrective action
- Material movement is watched to identify nonmoving material for disposal. Effective control puts into effect management objective of "**no shortage and no excess**"

## 8. Surplus Management

- Effective disposal system for unneeded material to reduce inventory cost and proactive measures to eliminate deterioration and obsolescence
- Obsolete items are good in all respect but have no useful role in the project due to changes that have occurred in the course of time
- Surplus items are those that have accumulated due to faulty planning, forecasting and purchasing. hence a usage value is associated with these items
- Scrap is wasted generated due to processes like turning, boring drilling etc. and also due to bad manufacturing.

## **9. Verification**

- Stock verification to eliminate gap between information and physical stock. In store some times are maintained as stock items. The stores triggers the procurement cycle for such items when a predetermined reorder level is reached. Hence correct stock position through verification is critical to ensure " **no shortage and no excess**" for the item

## **10. Interaction and Coordination**

- Very close interaction between purchasing, production, quality control and engineering function is obviously needed. It also becomes necessary to coordinate the flow of material samples and information through a network of departments for performance of stores functions. Besides, every management function being an internal customer interaction is very important.



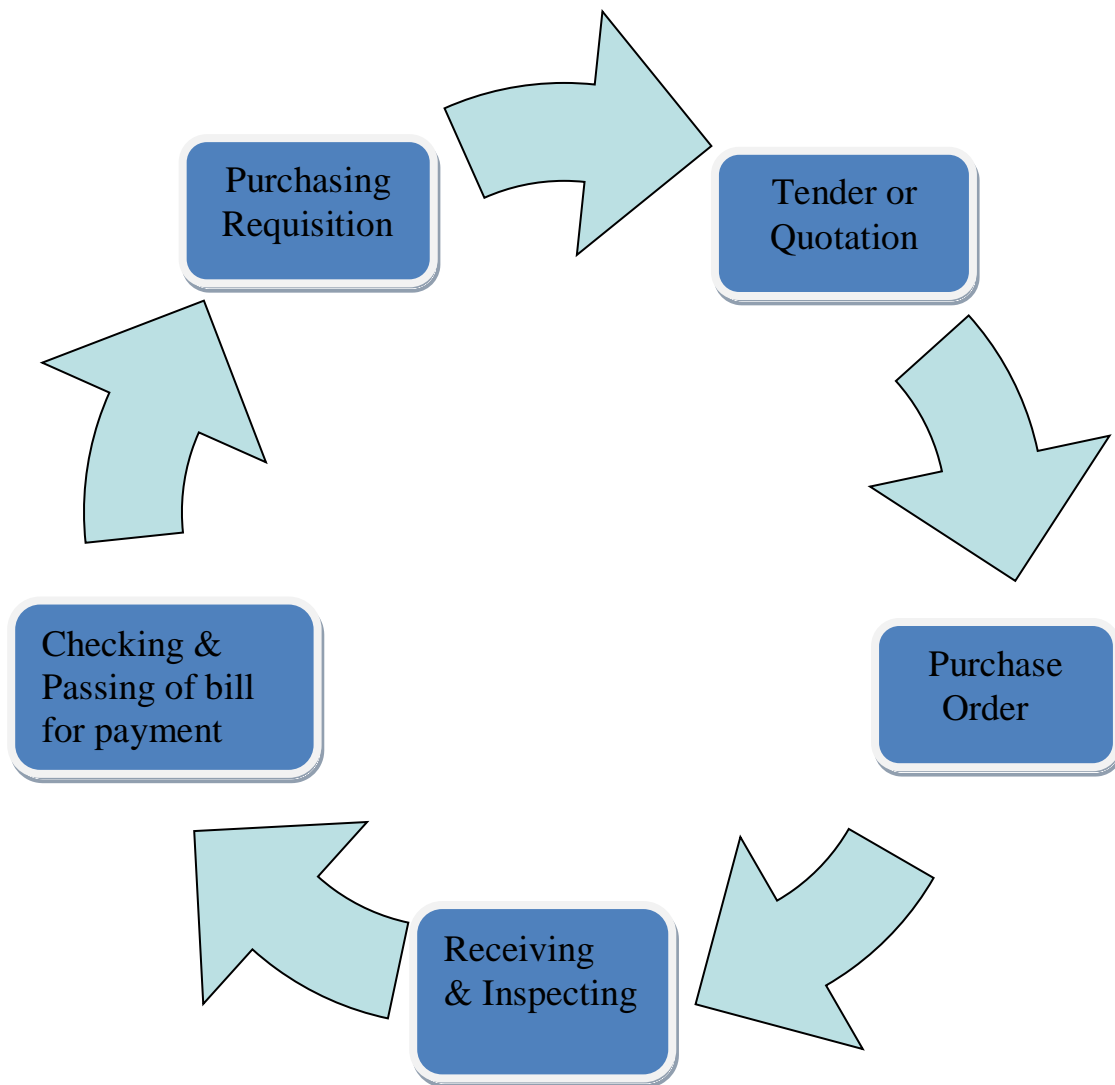
## **FUNCTIONS OF STORE DEPARTMENT**

- ❖ **THE FOLLOWING ARE THE PRINCIPAL FUNCTIONS OF A STORE;**
- 2. ENSURE THAT ALL DOCUMENTS RELATING TO RECEIPTS AND ISSUE ARE SENT TO STOCK CONTROL, ACCOUNTS AND OTHER CONCERNED DEPARTMENTS.
- 3. UNDERTAKE STOCK VERIFICATION AS PER APPROVED PROCEDURE.
- 4. TO HIGHLIGHT STOCK ACCUMULATION, DISCREPANCIES AND ABNORMAL CONSUMPTION AND INITIATE APPROPRIATE CONTROL ACTION, WHEREVER NECESSARY.
- 5. TO MINIMISE OBSOLESCENCE, SURPLUS AND SCRAP THROUGH PROPER CODIFICATION, STANDARDIZATION, PRESERVATION AND HANDLING.
- 6. TO ENSURE GOOD HOUSEKEEPING SO AS TO MINIMISE THE NEED FOR MATERIAL HANDLING.
- 7. TO MAKE AVAILABLE A BALANCED FLOW OF MATERIALS SO AS TO ECONOMISE ON CAPITAL TIED UP IN INVENTORY.
- 8. TO ACCEPT AND STORE SCRAP AND OTHER DISCARDED MATERIALS.
- ❖ **DEPENDING UPON THE NATURE OF BUSINESS (I.E. MANUFACTURING, TRADING SERVICES, ETC,) ONE OR MORE OF THESE FUNCTIONS MAY GAIN PRIMACY OVER THE REST.**

### **Materials Purchasing:**

Materials are one of the essential elements of project. The term material refers to raw materials. Purchasing involve acquiring materials of right quality in a right quantity at a reasonable price and at right time.

### **Purchasing Procedure:**



### **Purchasing Requisition: (Demand or Request)**

It is a formal request initiated by the store keeper or specific department for the purchase of specific items. It has three purpose which as follows:

- To inform the purchasing department about the need to purchase a material
- To fix the responsibility of the department making the purchase requisition
- To use for future reference

### **Tender or Quotation:**

- After receiving purchasing requisition, the purchasing department has to find the best source to purchase the material
- Selection of a particular supplier is made after inviting quotations or tenders from possible sources of supply
- Invitations for tender in a prescribed form are sent to prospective suppliers

### **Purchase Order:**

- The purchase order is a contractual agreement with the supplier for the supply of materials
- It is prepared in five copies

### **Receiving and inspecting materials:**

- The receiving department/unit should perform the function of unloading and receiving of materials dispatched by the suppliers
- It has verify the quantity and condition of materials

### **Checking and passing of bill for payment:**

- When the invoices are received from the supplier, they are sent for verification
- After the verification, the store department/unit requests the accounting department/unit to make the payment to the supplier
- Payment will be made according to the terms specified in the contract

A material purchasing process starts with the issue of material requisition and ends with the receipt of materials and payment of the cost of materials.

### **Factors affecting material waste on construction site:**

#### **Overview**

The increasing quantities of waste have created a bad image for the construction industry. In addition, an ineffective planning and control of materials on sites could lead to poor performance and undesirable project outcomes. Nevertheless, the economic impact, contributions to employment and the benefits of investment in construction industry are very enormous. Construction activity forecasts the general direction of an economy and for this reason the industry is often described as a leading economic sector.

The construction industry is one of the largest and most important industries, being at the same time the main consumer of natural resources and one of the largest polluters.

Construction material contributes significantly to the cost of construction project; therefore, material wastage has adverse impact on construction cost, contractor's profit margin, construction duration and can be a possible source of dispute among parties to a project. The cost of material

waste generated on building sites represents avoidable cost in construction which can either be eliminated or reduced.

### **Construction Waste:**

Construction waste is viewed as construction materials that are lost in transit on or off site, discarded without adding value to the project for which it was procured including overproduction or left over from newly constructed facility.

The causes of construction material waste can be measured and evaluated using a large number of construction phase related factors such as design and documentation, materials procurement and management, operations, environmental conditions, site management practices and site supervision.

### **Factors affecting material waste on construction site**

There are several factors which contribute waste generation on construction site. They are categorized as:

#### **1. Design and Documentation**

- Design changes and revisions
- Lack of attention paid to dimensions of product
- Selection of low quality product
- Ignorance about types and sizes of materials on design documents
- Specifying materials and dimensions without considering waste
- Complexity of detailing in the drawings
- Waiting for design documents
- Ambiguities, mistakes, and changes in specifications
- Errors in contract documents
- Incomplete contract documents
- Ambiguities, mistakes, and inconsistencies in drawings
- Reworks contrary to specifications

- Contractor's non-involvement
- Supplier's non-involvement
- Manufacturer's non-involvement

## 2. Materials procurement

- Poor schedule of materials procurement
- Ordering of materials that do not fulfill project requirements
- Incorrect estimated quantity
- Over ordering or under ordering
- Impossibility to order small quantities
- Purchase of materials contrary to specification
- Substitution of a material by a more expensive ones

## 3. Materials management on site

- Damage of materials on site
- Waste from uneconomical shapes
- Unnecessary inventories on site
- Overproduction
- Manufacturing defects
- Theft and vandalism
- Poor quality of materials
- Lack of on-site materials control
- Poor storage of materials
- Over-sized of building elements during execution
- Using excessive quantities of materials more than the required

## 4. Materials handling, storage and transportation

- Wrong handling of materials
- Unnecessary material handling
- Insufficient instructions about handling
- Poor and wrong storage of materials
- Inadequate stacking and insufficient storage

- Insufficient instructions about storage and stacking
- Inappropriate storage leading to damage or deterioration
- Double handling of materials
- Damage during transportation
- Bad road condition
- Accident
- Inappropriate equipment
- Breakdown of equipment
- Poor technology/malfunction of equipment

## 5. On-site operations

- Rework due to workers' mistakes
- Damage to work done caused by subsequent trades
- Use of incorrect material
- Poor workmanship
- Lack of skilled subcontractors
- Difficulty in performance and professional work
- Interaction between various specialists
- Wrong construction method
- Accidents due to negligence
- Using untrained labors
- Lack of coordination among crews

## 6. Environmental conditions

- Severe weather conditions
- Effects of subsurface conditions
- Site conditions significantly different from contract documents
- Restiveness
- Labor unrest
- Difficulties in obtaining work permits
- Government authority instruction/policy

## 7. Site Management and Practices

- Lack of waste management plan
- Lack of a quality management system aimed at waste minimization
- Lack of strategy to waste minimization
- Poor site layout
- Incompetent contractor's technical staff

## 8. Site Supervision

- Inadequate supervision
- Incompetent consultant's resident engineer
- Slow response from consultant engineer to contractor inquiries
- Change orders

## Inventory Management:

### Introduction

The term inventory refers to the goods or materials used by a firm for the purpose of construction. It also includes the items, which are used as supportive materials to facilitate production. Nearly 60% of money is allotted for the inventory in a project. Inventory constitutes one of the important items of current assets, which permits smooth operation of production and sale process of a firm. Inventory management is that aspect of current assets management, which is concerned with maintaining optimum investment in inventory and applying effective control system so as to minimize the total inventory cost. Materials Management is related to planning, procuring, storing and providing the appropriate material of right quality, right quantity at right place in right time so as to co-ordinate and schedule the production activity in an



integrative way for an industrial undertaking. Inventory Management is simply the process by which an organization is supplied with the goods and services that it needs to achieve its objectives of buying, storage and movement of materials. Inventory is seen as incurring costs, or waste, instead of adding and storing value, contrary to traditional accounting. Inventory management is the supervision of non-capitalized assets (inventory) and stock items. A component of supply chain management, inventory management supervises the flow of goods from manufacturers to warehouses and from these facilities to point of sale. A key function of inventory management is to keep a detailed record of each new or returned product as it enters or leaves a warehouse or point of sale.

**INVENTORY MANAGEMENT:** Inventory management is the practice overseeing and controlling of the ordering, storage and use of components that a company uses in the production of the items it sells. Inventory management is also the practice of overseeing and controlling of quantities of finished products for sale. Successful inventory management involves creating a purchasing plan to ensure that items are available when they are needed — but that neither too much nor too little is purchased and keeping track of existing inventory and its use. Two common inventory-management strategies are the just-in-time (JIT) method, where companies plan to receive items as they are needed rather than maintaining high inventory levels, and materials requirement planning (MRP), which schedules material deliveries based on sales forecasts.

## **Techniques of Inventory control system:**

Some of the most important techniques of inventory control system are:

1. Setting up of various stock levels.
2. Preparations of inventory budgets.
3. Maintaining perpetual inventory system.
4. Establishing proper purchase procedures.
5. Inventory turnover ratios.
6. ABC analysis.

### **1. Setting up of various stock levels.**

To avoid over-stocking and under stocking of materials, the management has to decide about the maximum level, minimum level, re-order level, danger level and average level of materials to be kept in the store. These terms are explained below:

**Re-ordering level:** It is also known as ordering level or ordering point or ordering limit. It is a point at which order for supply of material should be made. This level is fixed somewhere between the maximum level and the minimum level in such a way that the quantity of materials represented by the difference between the re-ordering level and the minimum level will be sufficient to meet the demands of production till such time as the materials are replenished. Reorder level depends mainly on the maximum rate of consumption and order lead time. When this level is reached, the store keeper will initiate the purchase requisition.

**Maximum Level:** It is the level above which stock should never reach. It is also known as maximum limit or maximum stock. The function of maximum level is essential to avoid unnecessary blocking up of capital in inventories, losses on account of deterioration and obsolescence of materials, extra overheads and temptation to thefts etc. This level can be determined with the following formula.

Maximum Stock level = Reordering level + Reordering quantity —  
(Minimum Consumption x Minimum re-ordering period)

## 2. **Maintaining Perpetual Inventory System**

This is another technique to exercise control over inventory. It is also known as automatic inventory system. The basic objective of this system is to make available details about the quantity and value of stock of each item at all times. Thus, this system provides a rigid control over stock of materials as physical stock can be regularly verified with the stock records kept in the stores and the cost office.

### **Factors Considered In Inventory Management System**

**Cost Factors:** Differentiation of currency prices is more important for contractors than client because this factor affects contractors' profit rate and cost performance.

**Time Factors:** The average delay because of closures leading to materials shortage was the most important performance factor. Local construction projects suffer from complex problems because of closures leading to materials shortage. These problems can be considered as an obstacle for time performance of projects. If resources are not available as planned through project duration, the project will suffer from the problem of time performance.

**Quality Factors:** This factor is very important because availability of personnel with high experience and qualifications assist them to implement their project with a professional and successful performance.

**Client Satisfaction Factors:** some study shows that Leadership skills for project managers have been ranked by owners', consultants', and contractors' respondents in the 1st position. This factor is the most

important one for 3 parties because leadership skills for project managers affect the degree of project performance and client satisfaction.

## **Inventory Management System in Construction Industry:**

### **1. Materials Planning and Control:**

Based on the sales forecast and production plans, the materials planning and control is done. This involves estimating the individual requirements of parts, preparing materials budget, forecasting the levels of inventories, scheduling the orders and monitoring the performance in relation to production and sales.

### **2. Purchasing:**

This includes selection of sources of supply, finalization of terms of purchase, placement of purchase orders, follow-up maintenance of smooth relations with suppliers, approval of payments to suppliers, evaluating and rating suppliers.

### **3. Stores and Inventory Control:**

This involves physical control of materials, preservation of stores, minimization of obsolescence and damage through timely disposal and efficient handling, maintenance of stores records, proper location and stocking. Stores are also responsible for the physical verification of stocks and reconciling them with book figures.

### **4. Material Management Techniques:**

Materials management is categorized to 5 processes these processes are majorly followed on construction site they are namely

1. Planning
2. Procurement
3. Logistics
4. Handling
5. Waste control processes.

Materials planning include quantifying, ordering and scheduling. Companies may have two major levels in planning- micro and macro level. Procurement is described as the purchase of materials and services from outside organizations. Purchasing procedure can be described as

Step 1: Material Indent,

Step 2: Enquiry to Vendors

Step 3: Vendor Comparison

Step 4: Vendor Selection and Negotiations

Step 5: Purchase Order

Step 6: Vendor Evaluation.

## **5. Control of Construction Waste:**

Reduction of waste can be done by practicing attitude towards Zero wastage, proper decisions at design stage, site management, proper standardization of construction materials, and Codification of the same. Construction waste can also be reduced by using waste management system on project.

## **Importance of Inventory Management:**

- i. To economies on buying/manufacturing cost
- ii. To keep pace with changing market conditions
- iii. To satisfy demand during period of replacement
- iv. To take care of contingencies
- v. To stabilize Production
- vi. To prevent loss of sale
- vii. To satisfy other business constraints

## **Inventory Control :( Definition)**

"Coordination and supervision of the supply, storage, distribution, and recording of materials to maintain quantities adequate for current needs without excessive oversupply or loss"

Following important points convey the broad meaning of inventory control

- Inventory Control mainly focuses on location, storage, recording the quantity, and accounting for the amount of inventories.
- It helps to supply inventories to different departments or units whenever demand requisition is raised. Mostly, it supplies inventories to the production department.
- It keeps a record of inventory issued to the concerned department located at a specific place.
- It provides prompt and proper service to all concerned departments or units.
- It also helps to maintain inventories at lowest costs.
- It also avoids over-stocking and under-stocking of raw-materials.

## **How to achieve Inventory Control:**

The inventory control can be achieved by:

- Purchasing items of the right-quantity, at the right-place and at right-time.
- Providing a suitable, secure, and sufficient place for storage.
- Developing a proper inventory identification system.
- Maintaining an up-to-date record keeping.
- Making proper requisition procedures.

## **Economic Order Quantity:**

The Economic Order Quantity (EOQ) is the number of units that a organization should add to inventory with each order to minimize the total costs of inventory—such as holding costs, order costs, and shortage costs. The EOQ is used as part of a continuous review inventory system in which the level of inventory is monitored at all times and a fixed quantity is ordered each time the inventory level reaches a specific reorder point. The EOQ provides a model for calculating the appropriate reorder point and the optimal reorder quantity to ensure the instantaneous replacement of inventory with no shortages. It can be a valuable tool for small business owners who need to make decisions about how much inventory to keep on hand, how many items to order each time, and how often to reorder to incur the lowest possible costs.

**EOQ** is the ideal order quantity a company should purchase for its inventory given a set cost of production, demand rate and other variables. This is done to minimize variable inventory costs, and the equation for EOQ takes into account storage, ordering costs and shortage costs. The full equation is:

$$EOQ = \sqrt{(2SD / H)}, \text{ or the square root of } (2 \times S \times D / H).$$

S = Setup costs (per order, generally includes shipping and handling)  
D = Demand rate (quantity sold per year)  
H = Holding costs (per year, per unit)

### **Cost of Inventory:**

Inventory cost includes the costs to order and hold inventory, as well as to administer the related paperwork. This cost is examined by management as part of its evaluation of how much inventory to keep on hand. This can result in changes in the order fulfillment rate for customers, as well as variations in the production process flow.

Inventory costs can be classified as follows:

1. **Ordering costs.** These costs include the wages of the procurement department and related payroll taxes and benefits, and possibly similar labor costs by the industrial engineering staff, in case they must pre-qualify new suppliers to deliver parts to the company. These costs are typically included in an overhead cost pool and allocated to the number of units produced in each period.
2. **Holding costs.** These costs are related to the space required to hold inventory, the cost of the money needed to acquire inventory, and the risk of loss through inventory obsolescence. Most of these costs are also included in an overhead cost pool and allocated to the number of units produced in each period. More specifically, holding costs include:
  - *Cost of space.* Perhaps the largest inventory cost is related to the facility within which it is housed, which includes warehouse depreciation, insurance, utilities, maintenance, warehouse staff, storage racks, and materials handling equipment. There may also be fire suppression systems and burglar alarms, as well as their servicing costs.
  - *Cost of money.* There is always an interest cost associated with the funds used to pay for inventory. If a company has no debt, this cost



represents the foregone interest income associated with the allocated funds.

- *Cost of obsolescence.* Some inventory items may never be used or will be damaged while in storage, and so must be disposed of at a reduced price or at no price at all. Depending on how perishable the inventory is, or the speed with which technology changes impact inventory values, this can be a substantial cost.

3. **Administrative costs.** The accounting department pays the wages of a cost accounting staff, which is responsible for compiling the costs of inventory and the cost of goods sold, responding to other inventory analysis requests, and defending their results to the company's internal and external auditors. The cost of cost accounting personnel is charged to expense as incurred.

As the preceding list reveals, the cost of inventory is substantial. If not properly monitored and adjusted, inventory costs can eat into profits and cash reserves.

### **Inventory Control System: ABC Analysis**

The **ABC Analysis** is one of the most established analysis methods within business administration. The basis of the ABC Analysis is the experience that very often a small number of objects cause a high portion of e.g. expenses. Thus the e.g. products are arranged into three groups A, B and C.

A typical arrangement is that the A products causes the highest portion of the expenses the B products hold a medium portion and the C products the smallest portion.

By applying the ABC Analysis the important products (A products) are tried to be separated from the less important (B, C products). The conducting of an ABC Analysis shall be shown by an example from the warehousing context. It is noteworthy that this context is not the only

context to use ABC Analysis. Other examples are: customer - sale; costs - benefit; resource - costs and many more.

### Procedural Steps:

The process is to identify the products that have the highest annual consumption value regarding their portion of their annual consumption. Thus what we have to do is to conduct an ABC - analysis in order to structure the product range in A, B and C products. For this example the procedure is the following:

1. Calculation of the annual consumption value.
2. Sorting of the products regarding their annual consumption value in decreasing order.
3. Calculation of the ratios of the annual consumption per product and accumulation of it.
4. Calculation of the ratios of the annual consumption value per product and accumulation of it.
5. Arrangement in A, B and C product groups.

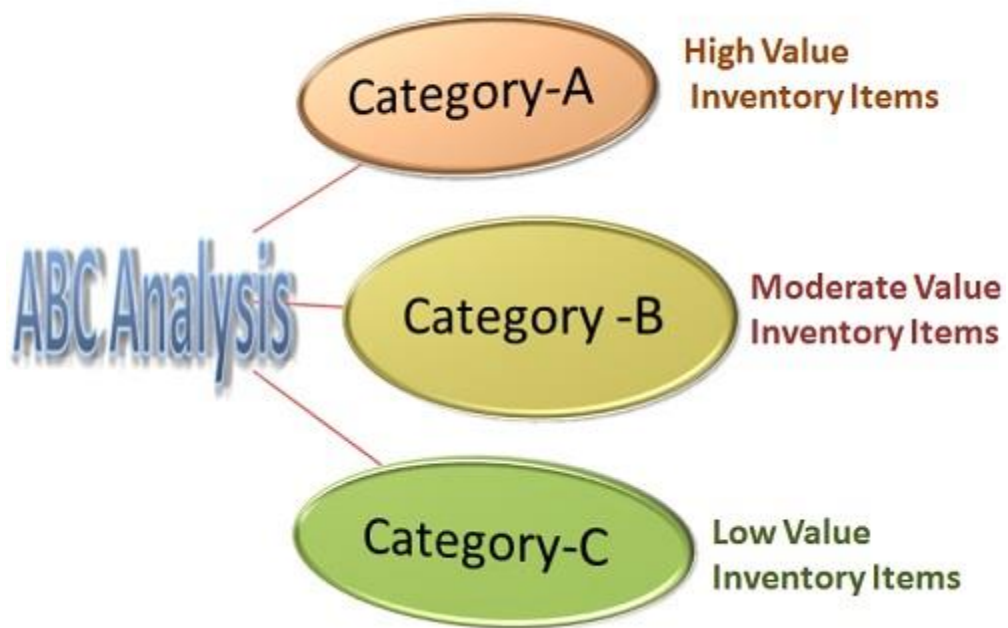
An orientation for the arrangement is given by:

Product group	Value percentage	Percentage of product range
A	60% - 80%	10% - 20%
B	10% - 20%	20% - 30%
C	5% - 10%	60% - 70%

**Example:**

Product number	Product Description	Cost per Piece (Rs)	Yearly Usage (Qty)	Yearly Turnover (Rs)	% of the Yearly Turnover
1	Spindle	0.50	1,000	500.00	8.3%
2	Clamp	1.00	24	24.00	0.4%
3	Pushing Clamp	0.25	12	3.00	0.1%
4	Ball Bearing	3.00	50	150.00	2.5%
5	Flange	10.00	300	3,000.00	50.0%
6	Sheet Metal	7.00	4	28.00	0.5%
7	Bar	0.50	10	5.00	0.1%
8	Paint	6.00	300	1,800.00	30.0%
9	Chock	20.00	7	140.00	2.3%
10	Riddle	2.00	175	350.00	5.8%
Total				Rs 6,000.00	100.0%

Sequence	Product number	Product Description	Cost per Piece (Rs)	Yearly Usage	Yearly Turnover (Rs)	% of the Yearly Turnover	Cumulative %	Category
1	5	Flange	10.00	300	3,000.00	50.0%	50.0%	A
2	8	Paint	6.00	300	1,800.00	30.0%	80.0%	A
3	1	Spindle	0.50	1,000	500.00	8.3%	88.3%	B
4	10	Riddle	2.00	175	350.00	5.8%	94.2%	B
5	4	Ball Bearing	3.00	50	150.00	2.5%	96.7%	B
6	9	Chock	20.00	7	140.00	2.3%	99.0%	C
7	6	Sheet Metal	7.00	4	28.00	0.5%	99.5%	C
8	2	Clamp	1.00	24	24.00	0.4%	99.9%	C
9	7	Bar	0.50	10	5.00	0.1%	100.0%	C
10	3	Pushing Clamp	0.25	12	3.00	0.1%	100.0%	C
Total					Rs 6,000.00	100.0%		



## **Home Assignment**

1. Write down the scope of material management in civil construction project of Nepal. Discuss with suitable examples that 'uncontrolled inventory is project cancer' in material management.
2. Write down the function of store department in Integrated Material Management (IMM). As being the material manager of a Company, how you purchase & define procedure for purchase of 2000 tons of reinforced bars in the construction site?
3. Define material productivity in material management. What are the activities to be carried out by the material manager to improve material productivity in project management? Also explain the need of material planning in construction project.
4. Write down the means from where material manager can get information about prospective suppliers of material. Explain in details about cost ratio method of vendor rating in selection of material suppliers.
5. Factors affecting standard wastage of construction material
6. State the duties and responsibilities of material manager to increase material productivity in civil engineering construction project. Write down the purchasing procedures of construction material in the construction site?
7. You are Project manager of the high rise building apartment in the city. Explain the functions of IMM in material management.
8. What is Integrated Material Management? Discuss about the advantages of Integrated Material Management?
9. What are the sources of material? How do you do vendor evaluation and vendor rating for maintaining better supply management?