Material Management

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Describe the Scope of material management.
- ✓ Explain the Issues Relating to Purchase and Storage of the material.
- ✓ Describe the Integrated materials management approach.
- ✓ Identify the role of material management in construction.

Material Management

Introduction

When a business is able to manage materials efficiently, it becomes profitable. Thus, material management is a key ingredient to maintaining a healthy and competitive edge in business endeavours. There are many other functions that can add up to a good business management concept but one of the key objectives of businesses is adopting a cost reduction strategy when undertaking material management. In order for a company to gain the full benefits of cost reduction strategy, the company has to develop a plan of how materials should be handled efficiently from purchasing to storage and finally, to the work site where they become part of the product.

Different approaches such as the centralised, decentralised, or the integrated management of materials may be adopted, but most large organisations have found the integrated approach to be superior in terms of meeting the low cost objective of material management function.

In this unit, we will delve into all aspects of material management in construction.

Definition and Scope

Material management involves coordinating, planning, sourcing and purchasing, storing, moving, and controlling of materials in such a way that the overall cost of undertaking these activities are kept as low as possible.

We may also define material management as "the process of management requiring supervision, coordination, and execution of tasks involving the flow of materials to an organisation, within the organisation or out of the organisation in an integrated manner."

It is obvious from the definitions given above that material management has a wide scope which has direct or an indirect effect on the activities of several departments within an organisation. Below, we elaborate on some of the various functions of material management.

Material Planning and Control

Material planning and control is usually done on the basis of sales forecast and production plans. It requires the estimation of the quantity of materials required, preparation of budgets for procuring the materials, determining quantities of inventories, scheduling orders, and monitoring or measuring the performance of expected outputs.

Purchasing

Purchasing is also done as part of material management. It involves identification and selection of sources of supply, agreeing terms of purchase, placing orders, payments of suppliers, evaluations, and the performance rating of suppliers.

Stores and Inventory Control

This involves physically verifying stocks and reconciling them with book records. A variety of activities are expected to be done including the physical control of materials, minimizing damages and aging, maintaining store records, accurate location and stocking of materials. It also entails setting inventory levels, fixing cost of materials to order, ABC analysis, setting limits for safety stock levels, lead time analysis, and reporting.

Importance of Material Management

According to results of the analyses of several financial statements from several public and private sector companies, materials account for close to 60% of their total expenditure.

Table 7.1 shows information on the average materials expenditure for different industry groups.

Percentage of Total Cost	Industry Groups
Above 75	Construction, Fabrication, Electrodes, Tea etc.
65-75	Wool, Sugar, Jute, Cotton, Yarn, Commercial Vehicles, Earth Moving Equipment, Scooters, Furniture etc.
55-65	Cotton Textile, Bread, Ship Building, Cables, Electricity Generator's, Refrigeration, Heavy Machinery etc.
45-55	Chemicals, Cement, Pharmaceuticals, Electronics, Paper, Engineering, Non-ferrous type Machine Tools, Explosives etc.
35-45	Fertiliser, Steel, Cigarettes, Transportation, Asbestos, News Print, News Paper, Ferrow Alloys, Aircraft Manufacturing etc.

Table 7.1: Average material cost as Percentage of total cost

Material management becomes a vital function that contributes to the profitability of an organisation provided the materials manager has the ability to reduce the cost of material. An alternative way to increase profitability apart from cutting down on cost of materials is to increase sales volume but this is much more difficult given the large number of competitors in the market. Material management therefore, presents the best opportunity to reduce cost in a competitive market. It has been established that the cost of materials forms a high percentage of overall expenditure of companies, so a small reduction in material cost leads to a high percentage increase in profitability.

Issues Confronting Material Management

There are some issues which need to be addressed when undertaking material management in any organisation. These include:

a) Material planning
b) Purchasing
c) Storage and material handling issues

We will discuss these issues in more detail below.

Material Planning

This involves a collaboration between the material management division and other relevant departments, such as design, engineering, process and production to choose the right materials, sub-assembly, spare parts, and the equipment needed to produce a product. The material management department works continuously with these departments to provide information on alternative materials that could be used to create a product. The alternatives are assessed to determine their suitability to meet both design and functional objectives under optimize production conditions. The assessment must be continuous, especially with regards to new changes introduced into the production process. Continuous assessment of the effectiveness of substitute materials, supply conditions or any changes in the method of production or product specification should also be carried out.

Standardisation

The main reason for standardisation is to make it possible to interchange parts or components in an organisation or across industries. Secondly, it is an effective means of reducing the quantities of parts or components used in production processes of companies. A typical example of standardization is when 100 different types of parts for a car can be reduced by half while maintaining the quality and functionally of the parts.

Make or Buy Decision

Many companies are usually not capable of producing all parts or components required to manufacture a product due to the following reasons:

- High cost of manufacturing
- Lack of skill or expertise
- Lack of capital to build additional facilities
- Existence of suppliers of the high quality, low-priced components in the market

Whether an item should be sourced externally or produced in-house is the prerogative of the material management and other relevant departments such as the finance, design and engineering. This decision has to be reviewed frequently. The decision to product component in-house is a major one because this means investing capital in a fixed asset (facility) and the decision cannot be reverse once it has been executed.

Coding and Classification

Provision is made by the material management to design and implement a system of classification and coding. All parts and components are classified and unique codes are assigned to each component for the

purposes of easy identification. The type of coding and classification embarked on should be understood by all relevant personnel in the organisation.

Factors to consider when designing coding and classification systems include:

i. There must be a uniform and consistent coding and classification system which should apply to all items
ii. It should also include all items currently in use and should have the ability of taking up or accommodating new items in future
iii. Unique code should be provided for each item. No two item should share the same code neither should two different codes refer to the same item
iv. Codes should be self-explanatory and understood by all.

Advantages

i. Long descriptions are avoided since each item is described by its own code
ii. It is possible to accurately identify each item
iii. No duplication of items
iv. Uniformity is achieved across all departments
v. It is useful for planning material location

Quality Specification

The desired quality and cost to produce a product is determined by the material management and other concerned departments. The quality specification forms part of the item description and is integrated into the code for the item. The quality specification may be in the form of physical or chemical properties or it may be performance related. Quality specification can also be integrated into Engineering Drawings or Blue Prints which describe the item.

Specification of quality may be done in single or in a combinational manner as follows:

i. Through provision of samples/prototype
ii. Through provision of manufacturing process specification
iii. Using brand or trade name
iv. Specification of popular market grades
v. Specification of testing procedures and standards
vi. Provision of engineering drawing or blue prints

High quality specifications are very important to purchasing department, suppliers and inspection and testing agencies.

Issues Relating to Purchasing

Centralised versus Decentralised Purchasing

The choice between centralised and decentralised purchasing is of more concern to larger companies, which run multiple plants from a single - or different – location . Considering a large organisation operating multiple plants from a single location, using the decentralised purchasing option may be possible but to a limited extent. Both types have several advantages that can be exploited. However, it is sometime more convenient to combine the two for maximum benefit. When both approaches are combined, it is best to mark the quantities of items required under each category.

Centralised purchasing involves a centralised purchasing department buying all items and later distributing it to other plants of the company at different locations. Decentralised purchasing means each plant will have to purchase its own components needed to manufacture a product.

Advantages of Centralised Purchasing

i. Easy to negotiate favourable price and terms due to larger quantities of items to purchase
ii. Promoted the establishment of specialised ancillary manufacturers to supply the right quality of components
iii. It is more easy to administer and control
iv. Less personnel required to deal with purchasing resulting in less expenditure
v. Easy to develop uniform procedures and minimize administrative tasks thereby saving time
vi. Testing and inspection can be centralised. This helps to maintain the quality of purchased components
vii. The vendor (supplier) benefits from large volume orders

Advantages of Decentralised Purchasing

i. Quicker and simpler coordination between purchase department and use department of individual plants
ii. Purchasing from local suppliers will reduce transport costs and the levels of inventories to be kept
iii. When local suppliers are available, it becomes quicker to readjust requirements
iv. Local control, rescheduling and coordination is much easier and quicker

Single Source and Multiple Source Purchasing

Organisations may opt for a single source or multiple sources to supply them with parts or components. In either case, there are advantages and disadvantages to consider before deciding

Advantages of Single Source Purchasing

i. Lower administrative and overhead cost
ii. There is a higher chance of obtaining discount on purchases or on transportation of items purchased

iii. Due to long term relationship, the supplier is motivated to corporate and improve upon his services
iv. It is possible to arrange for scheduling of deliveries an enter into long term contract
v. Single source is ideal if the supplier is the sole manufacturer or can provide items of a higher quality or offers the most competitive price compared to other supplier.

Adequate development of single source in the long term can result in substantial reduction of material cost which is desirable, especially for construction firms, since this forms a significant percentage of total expenditure.

Advantages of Multiple Source Purchasing

i. Risks associated with depending on a single supplier are reduced
ii. Problems experience by one supplier may not adversely affect the buyer
iii. It encourages competition among suppliers
iv. There is flexibility in placing orders

Vendor/Ancillary Development

In situations where a large consignment of items is required from the market, a parent company may set up ancillaries to product and supply them with the items. Any leftover from the ancillaries are shifted to the market. In some cases, more than one ancillary may be developed to produce on particular item if the volume is quite substantial.

How Parent Companies Develop Ancillary Units

i. Through provision
ii. Through provision of design drawings
iii. By financial arrangements
iv. By providing technical expertise
v. Offering credit facilities
vi. Offering testing facilities as well as quality control
vii. Assisting in procuring raw materials

The dynamic nature of the market and products where new suppliers and substitute materials become available, the changing nature of laws and regulations with regards to acceptability or non-acceptability of some materials, changes in product specifications etc, require that vendor performance be reviewed frequently since performance is not always consistent.

Size and Timing of Purchase Order

It involves determining the quantity of items, which are needed to be ordered and finding the most suitable time to place the order. This requires coordination between several functions across the

organisation including store and inventory keeping, suppliers' readiness and capability, production schedules, reliability issues, and time lag, etc.

Materials and items have different importance to the organisation. Some have critical used and are regarded as extremely important while others may not be that important. Consequently, items purchased are classified and stored based on their relative importance according to the following classification system:

ABC Class Analysis

This is based on the total value of consumption of the item. There are 3 main categories: Class A, Class B and Class C.

Class A items

These are subject to the highest level of control and management. They consist of 10-15% of total value of items which make up 60-80% of total annual consumption value of all items.

Class B items

Class B items have medium level supervision and management control. They make up 15-20% of total annual items and cost 15-20% of total annual value of all items purchased.

Class C items

These are normally not subject to tough control management because they are not of high value enough to warrant significant attention.
Economic Order Quantity (EOQ) mathematical models can be used to determine the quantity, frequency of purchase and safety stock of class A and B items.

HML

HML classification refers to High, Medium and Low classification based on the importance of price per unit for items. Management usually determines the levels of price per unit at which items should be classified as H, M or L. Items classified as 'H' have the highest control supervision followed by 'M' and finally 'L'. Guidelines for dealing with each category of items are provided by management.

VED

Items or parts may also be classified using the VED (Vital, Essential, and Desirable) system during production. The most important items are those without which production would stop and these are classified as 'V'. Categories labelled as 'D' and 'E' include items whose absence would only affect production to a limited extent but not bring it to a standstill. The expertise of personnel working in production is valuable in identifying items and classifying them with the help of formulation matrix.

FSN

The rate of item movement from the store can also be used for classification purposes. FSN denotes Fast-moving, Slow-moving and Not-moving. Measurement using this system is based on the time elapsed since an item was last retrieved from the store. Fast-moving parts need to be reviewed often so that new purchase orders can be dispatched for parts to be replenished. Slow-moving parts on the other hand should be reviewed for purposes of getting rid of some of them.

Vendor Rating

Due to poor vendor performance, there may be uncertainties with regards to scheduled deliveries and the quantity as well as the quality of items to expect from them. Any interruption in production of the buyer due to delays or low qualities of parts would cause production cost to increase as a result of resorting to emergency supplies from somewhere else.

To avoid disruptions in the production process, the purchasing organisation needs to develop a comprehensive vendor performance assessment procedure to serve as a guide to procuring reliable services.

Frequent reviews of vendor performance improve the performance of the material management and production departments. Vendor rating procedures have been developed to assess vendors based on some well-defined factors. The factors chosen depend on the parts, the production schedule, and the production process among others.

Factors may include the following:

i. Ability to follow delivery schedules, quantity schedules and specifications
ii. Flexible and cooperative
iii. Attitude when providing service
iv. Providing competitive prices and future capability of supplier
v. Technical ability
vi. Availability of testing facility and reliability of test certificates
vii. Competitive delivery cost and overall efficiency and scope of delivery

Rating Methods

Weighted Point Method

The purchasing organisation assigns weights to factors they consider to be vital to them when purchasing items from vendors. The performance of the vendors are them assessed based on these factors and weights are assigned accordingly. The overall weight after the assessment is compared to the benchmark

weight and a rating is given to each vendor. The results for all vendors are compared and the best performer is chosen.
For instance, if the company purchasing the items assigns weights of 40%, 20% and 40% to the price, quality and delivery schedules respectively, the overall rating may be calculated according to the equation:

$$rating = \frac{lowest\ market\ price}{Price\ of\ vendor} \times 0.4 + \frac{no.\ of\ lots\ accepted}{no.\ of\ lots\ supplied} \times 0.4 + \frac{expected\ delivery\ time(days)}{actual\ delivery\ time(days)} \times 0.2$$

Checklist Method

This method involves circulating a check list of questions on specific factors to the relevant departments to provide their assessment. The results are collated to arrive at a final rating for each vendor.

Critical Incident Method

Past significant events experienced when dealing with the vendors are recorded. Events may include all incidents that affected production in one way or the other. Events such as delay in delivery or defective items are noted against each vendor. Overall assessment is carried out to arrive at ratings for the vendors.

The essence of the classification and rating systems is to assist the material management department to provide adequate control supervision and management of only critical items of high value and importance since companies dealing with thousands of items may not have the means to monitor all items.

Quality Assurance of Incoming Materials

The purchasing, engineering and production departments work as a team to certify the quality of purchased material. Therefore, it is important to include exact specifications in purchase orders. The supplier is also expected to understand all technical issues pertaining to the order. Nothing should be left to change. Procedures for conducting test and inspection must be clearly laid out.
Purchasing department can achieve the required quality by:

- Providing accurate specifications
- Rating quality capability of vendors(suppliers) before placing order
- Carrying out regular testing and inspection at suppliers facilities
- Ensuring that supplier provides certification for all dispatched items (no excuse should be accepted)
- Ensuring damages are avoided by employing the right system of transportation and secure packaging and providing proper storage when delivery has been received.
- Insisting on approved certificates for the quality and quantity expected at the receiving point to facilitate release of payment
- Reviewing quality specification regularly and informing relevant parties in advance of any changes

Undertaking the procedures listed above would ensure the right quality of parts and also ensure a high end product.

Issues Relating to Storage and Material Handling

Optimum level of inventory

Inventory level should be such that the quantity of items kept is neither too high to avoid incurring extra cost nor too low to result in shortage.

Location and Layout of Store

The location of the store should facilitate easy receiving and easy accessibility by users. The nature of the store also depends on the type of items being stored. Some items require gadgets to move them. Layout of the storage place depends on factors such as:

- Safety from theft
- Damage prevention
- Easy and safe storage
- Minimising unnecessary handling within the stores
- Using space in stores efficiently
- Quick and easy physical verification of items

Storage System

Good storage facilities should make it easy to store and retrieve items. They should be easily accessible to enable counting and verification and be capable of being adjustable to accommodated new items with minimal used of additional material handling equipment.

Three most popular material location systems include:

Fixed location

Reserved space is provided for one particular item at a specific place which cannot be used by any other item. Code may be designed to include specific location for a particular item.

Random location

With this type of system, items may be stored in any vacant location. This makes it difficult to locate certain items. Also, one type of item may end up in more than one place which can create difficulty during stock checking and retrievals.

Zoned Location

Item of a particular category are grouped together and stored in an area reserved for this group of items. The individual parts or items can them be stored using the fixed or random location system. Stacking and shelves are useful in for this system.

Receiving Inspection Records Keeping

Materials arriving at the stores should be professionally inspected for quantity and quality according standard procedures. Visual inspection results should match the data specified by the purchase orders as well as the specifications on the documents that accompanied the delivery. Testing should be carried out according to pre-defined standards and the good items separated from the bad.
Accurate records of all transactions and related issues should be kept for store accounting, checking stock levels, account reconciliation, cost accounting and to assist in providing information for planners and decision-makers.

Material Handling and Equipment

The whole production process should be designed in such a manner that will reduce unnecessary handling of materials or items throughout the production plant as well as within the storage area itself. The aims of material handling and equipment include:

- Minimization of cost of handling material
- Maintaining effective flow of materials
- To ensure safety of materials during movement and to reduce damage and accidents
- To minimize the time taken to move items around
- Ensure compatibility of equipments and materials

Integrated Materials Management Approach

From previous discussions, we understand that material management consists of diverse aspects such as purchasing, planning, receiving, storing, inventory management etc. When some of these functions are operated independently, it results in conflict of interest. For instance, if purchasing department orders lots of materials because of attractive discount rates on offer without considering how effectively these items would be stored, it creates problems for the storage and inventory departments. Therefore, it is important to balance conflicting objectives to achieve the optimum results by considering the need of the whole organisation and not each individual unit in isolation.

The integrated approach of material management requires the material manager to be responsible for all interrelated aspects of the organisation by exercising control and coordinating activities of individual departments. By integrating the various functions under a central materials manager, the integrated approach makes it possible to transmit large chunks of data efficiently and more rapidly while also uniquely

identifying activities for each department. Routing all functions of each individual departmental unit to a common material management hub makes it easier to coordinate and control all functions in an optimum manner using sound principles and applications.

Advantages

I. Better Accountability

Better accountability is achieved by centralising authority and responsibility for every aspect of material management. Problems can be quickly resolved from a central point and performances objectively evaluated.

II. Better Coordination

The integrated approach encourages better relations and trust between the material management and user departments because all problems are dealt with at a central point. There is, therefore, better support and corporation.

III. Better Performance

Communication is fast between various departments resulting in speed and accuracy in administrative and production matters. Swift collection, collation and analysis of data is important for making good decision on time to reduce costs, stocks and lead times and also provide excellent inventory turnover and less paperwork.

IV. Adaptability to EDP (Electronic Data Processing

It is easy to introduce advanced EDP under the integrated approach at an affordable cost due to its centralised characteristics which facilitates collection, collation and analysis of data for timely decision-making.

V. Other Advantages

With the integrated approach, there are more opportunities for human resource growth and development due to individual getting exposed to a wider scope of all aspects of material management. Team spirit and cooperation are also nurtured under this scheme.

Material Management in Construction

Construction involves putting up a structure to serve a unique purpose. When constructing simple structures, only simple materials are required. Complex structures on the other hand require special materials or components, complex machinery and equipment as well as diverse workforce.

Materials, labour and fuel are the vital components needed for the construction of structures. It is important to ensure continuous flow of materials at an optimum rate so that the project and labour do not come to a halt.
Even though there is the need to have guaranteed levels of these three main resources available, the supply of these resources is rather done in phases during the lifespan of the project. Some money meant for securing materials later on in the course of the project would have to be locked up for a long while before being released. This present the temptation to use it for other venture but it needs to be resisted.
Materials such as bricks, steel items of various sorts, ceramics, paints, plumbing, electrical cables and glasses account for a high percentage of cost. It is common to award the construction contract to a contractor who is also expected to do the material management at the site. But recent trends shows a move to entrust material management to large companies who are engaged in a large number of construction projects to supply each project with necessary materials form centralised stores.
Construction material management is the art and science of arranging the procurement and purchase of construction materials in an organised manner such that the right quality and quantity is obtained and delivered at the right time.
When undertaking construction projects, the fundamental requirement for producing a structure is the availability of materials. There should always be adequate supply of materials at the optimum rate throughout all phases of the project. This means that sources of supply must be very reliable to ensure continuous flow and prevent stoppage which tends to delay the project as well as inflate the cost of production due to idle labour and equipments.
Construction materials components vary from one work to another. The cost of some vital components can be estimated from experience. The total material costs for normal buildings usually consist of bricks making up 14-16 of the cost, while cement and steel cost about 40-50%.
Building roads would require aggregate cost taking up 50% of the total cost whereas building a concrete bridge would mean costs of steel and cement would amount to 50-65%. Steel used for constructing steel bridges make up 75% of costs. Pipes and fittings account for 80% of costs when constructing a water supply system. Judging by the importance of materials and the costs of acquiring them, it is therefore, imperative to ensure proper planning, procurement, purchase and storage to meet the required quality specifications of the end product.
Good planning of the cost component of materials will ensure availability of the material during successive phases of the project by making adequate capital available to cover the entire project lifespan. By ensuring continuous flow of good quality materials and on time, and also having healthy competition among suppliers, material planning becomes an efficient and easy activity to do and it may even not be needed at all when everything is flawlessly synchronised.
We now examine each essential component of construction below:

Material Costs

Materials used for modern construction work may come in raw, semi-process or completely processed forms. Sand or stone comes in raw conditions, while timber sections and stone slabs are usually semi-processed. Complex factories produce completely-processed materials such as bitumen, glass, tiles etc.,

using energy and the associate costs depends on the level of sophistication of the process used to create the materials.
Materials which contribute higher costs must be handled with care and should be readily available to ensure the desired end product. The material procurement approach to use will differ from one project to another with varying costs. For instance, when constructing a road, aggregates supply account for about 70% of the cost and these are normally supplied along the length of the road. Bitumen requirement for roads may constitute about 65% of total cost and this could be supplied by an agency specializing in petroleum materials.
The type of work being undertaken usually determines the principal component and the optimum manner in which this component should be supplied. There are instances when certain materials which do not form part of the bill of quantities would be required during the course of projects. Examples of such essential components include truck tyres or explosive for steep gradient road construction.
Carefully planned procurement procedures should be used to obtain materials such as steel, cement and brick which form about 65% of overall material costs.

Labour Costs

Labour costs are associated with cost incurred by the contractor when paying workers from his own financial resources. For a road constructor, the cost of breaking stones at the quarry may not be as important as the cost associated with spreading materials on the road. The extent of mechanisation employed also affects the cost of labour. Mechanisation tends to reduce the cost of labour significantly and in recent times trends show many companies are moving towards this direction.
Labour costs tend to be high for finishing works towards the end of the project. Also, labour cost for normal work can range from 0% to 25%, but may differ significantly, depending on the qualification of workers and the nature of the work at hand. Careful planning is required for labour bearing in mind the desired output required.

Different Category	Percentage
Skilled labour on building structure	45% of total labour cost
Unskilled labour on building structure	25% of total labour cost
Plumbing labour on building structure	3% of total labour cost
Glazing labour on building structure	1.70% of total labour cost
Electrical engineering labour on building structure	7.80% of total labour cost
Mechanical engineering labour on building structure	10.30% of total labour cost
Steel work labour on building structure	7.20% of total labour cost
TOTAL	100.00%

Table 7.2 Costs components for different categories

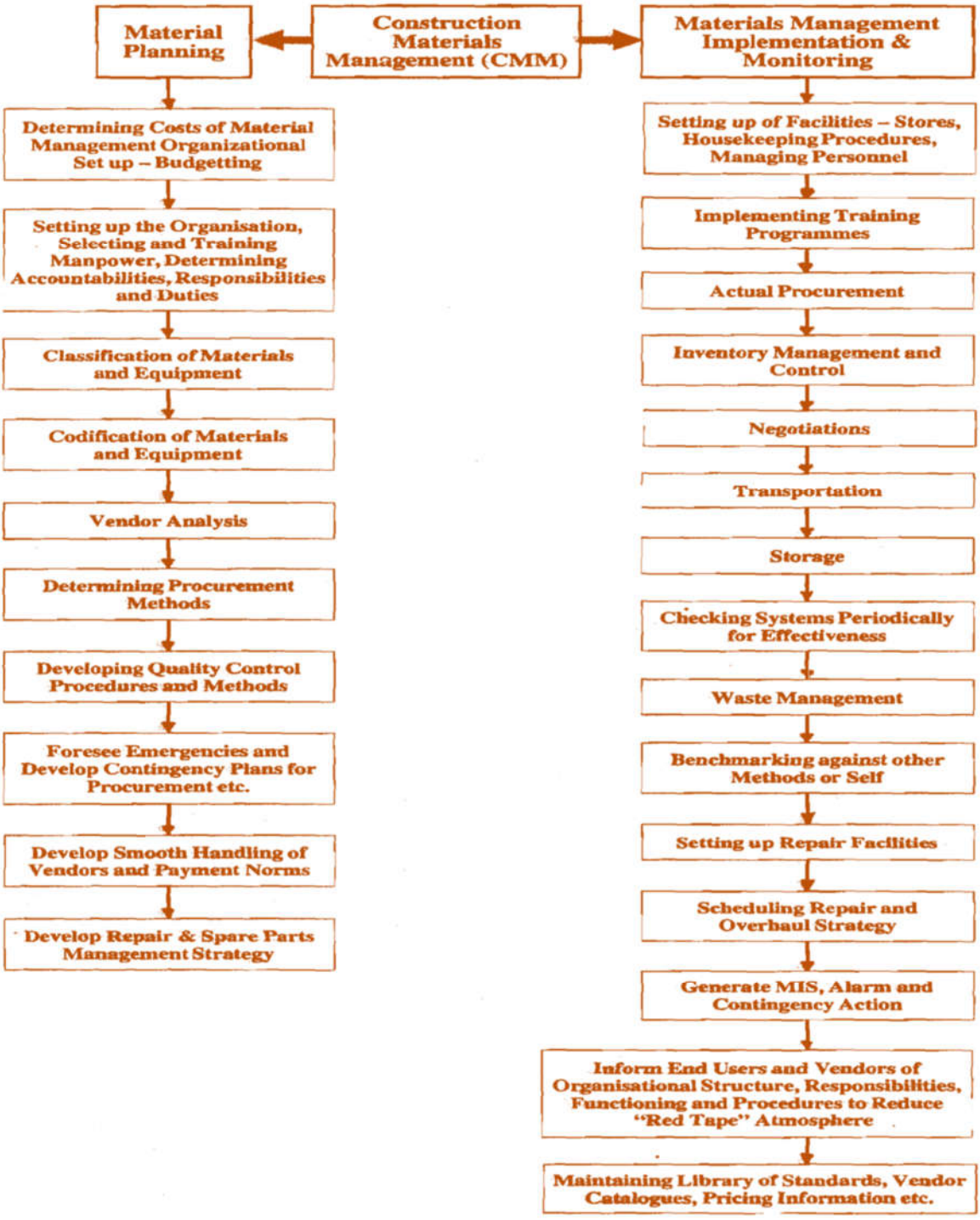
Therefore, it is necessary to plan the category of workers for each work, judging the quality of work needed, importance of work and the quality of raw materials procured for the work.

Special Material Costs

There are certain materials which do not appear in the bill of quantities but are also very important requirement during the course of executing the project. Items such as spare parts for machines are critical components of the whole process and should be readily available for hire or purchase to ensure work flows uninterruptedly.

Summary of Components of Modern Construction Material Management

There is no standard set of activities for all construction projects in terms of project management, procurement etc. However, a general outline for most activities can take the following path as shown in the flow chart:



Further Reading:

- ✓ *Peter Fewings, (2013), Construction Project Management: An Integrated Approach*
- ✓ *K. DATTA, (1995), MATERIALS MANAGEMENT: PROCEDURES, TEXT AND CASES*