COURSE TITLE

CONSTRUCTION ENGINEERING AND MANAGEMENT

Chapter 4

CONSTRUCTION PROCUREMENT

Lecture 4 (week 4)

ABC classification of construction materials, Meaning of purchasing and procurement, Procurement management, Procurement cycle, Inventory management, Procurement of consulting services

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Learning Objective

The main objective of this lecture is to understand about:

4.1 ABC classification of construction materials.

4.2 Meaning of purchasing and procurement.

4.3 Procurement management.

4.4 Procurement cycle.

4.5 Inventory management.

4.6 Procurement of consulting services

4.1 ABC CLASSIFICATION OF CONSTRUCTION MATERIALS

Construction materials cover all types of materials used in construction. It includes electrical and mechanical fittings, fixtures, devices and instruments that are incorporated during the construction of permanent works and temporary supporting works at site. Efficient materials management is an integrated approach covering numerous functions, such as materials planning, purchasing, inventory control, store-keeping and warehousing, handling and transportation, codification and standardization and the disposal of surpluses. [1] Construction materials planning involves:

- Identifying the materials,
- Estimating their quantities,
- Defining the specifications,
- Forecasting the requirements,
- Locating the sources for procurement,
- Getting the samples of materials approved,
- Designing the materials inventory,

The primary purpose of classifying materials is to control their quality, cost and timely supply. There are many factors that need consideration while classifying materials. Factors considering classification of materials are: Storage space, Useful life, and Supply reliability, and Inventory cost, ease in construction, Transportation factor, Prices, Procurement time and sources, Life of project etc.

ABC CLASSIFICATION OF MATERIALS

In general, the construction materials can be grouped into any one or a combination of the following categories:

(a) Bulky, one-time purchases, repetitive use and minor materials.

(b) Vital, Essential and Desirable materials (VED).

(c) Indigenous and imported materials.

(d) High-priced, Medium-priced and Low-priced materials (HML).

(e) High usage value, medium usage value and low usage value materials (ABC).

ABC Analysis

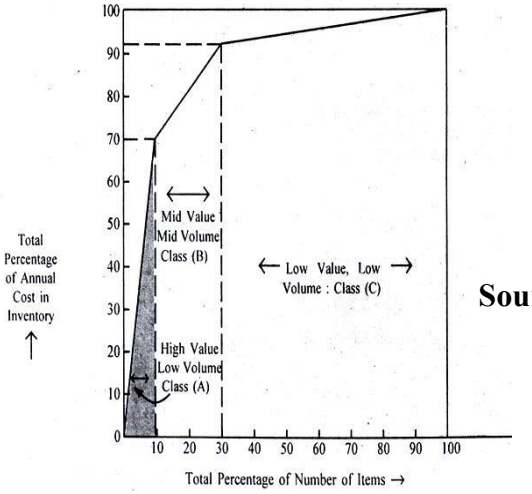
ABC analysis is the method of classifying items involved in a decision situation on the basis of their relative importance. The most commonly used method for classifying construction materials is to group them into high usage value, medium usage value and low usage value materials. ABC analysis suggests that inventories of an organization are not of equal value. Thus, the inventory is grouped into three categories (A, B, and C) in order of their estimated importance.

(a) Group A Items: These are the high usage value items, which account for 70% of the inventory cost. The number of items is about 5% to 15% of all the items.

(b) Group B Items: These are the medium usage value items, which account for 20% of the inventory costs. Their number is in the range of 15% to 25% of the total number of items.

(c) Group C Items: These are the remaining (about 65% to 75%) items, which account for hardly 10% of the inventory costs.

ABC analysis enables management to reduce the investment to the minimum possible level because a reasonable quantity of 'A' items representing a significant portion of the material cost is purchased. [2] Management time is saved by this analysis because this technique requires minimum attention to be paid to some items only.



ABC Grouping (in general)		
Group Class	**Total Items**	**Inventory Costs**
A	10%	70%
B	20%	20%
C	70%	10%

Source: [1]

4.2 MEANING OF PURCHASING NAD PROCUREMENT

Purchasing means a set of functions that are associated with buying goods and services that the company or organization requires. [3] In other words, the process of acquiring goods, works, services from external source to satisfy organizational/ personal needs. Purchasing process includes activities like ordering, expediting (timely delivery), receiving, and fulfilling payment.

Procurement is the process of sourcing and purchasing the goods and services a company needs to fulfil its business objectives, usually from an external source, like a third-party vendor or supplier.

PROCUREMENT V/S PURCHASING

Procurement is umbrella term that includes purchasing. Procurement is a broader process where few activities are performed prior to purchasing like and few activities after the purchasing. Purchasing is more reactive whereas procurement is more Proactive. Purchasing has short term goals whereas procurement has long term goals which contributes to the organizational objectives. Purchasing is typically more focused on the short-term and is more transactional whereas procurement is more long term.

Procurement is used for high-value items— contracting for construction-type works, acquiring equipment, and obtaining large quantities of goods. Purchasing is used for the ongoing supply of things such as office supplies. Procurement on the other hand, especially public

procurement, is almost always carried out in discrete packages in which bidders submit sealed bids and compete on price.

4.3 PROCUREMENT MANAGEMENT

Procurement management includes the processes required to acquire goods and services, to attain project scope, from outside the performing organization. [4]Procurement includes purchasing of equipment, materials, supplies, labor, and services required for construction and implementation of a project. [5]The term construction procurement emphasize the purchase of construction related services with the ultimate aim of: alteration, refurbishment, maintenance, extension or demolition of an existing building or structure and the creation of a new building or structure, including all associated site works.

Procurement Management focuses on planning and executing well-defined contract agreements for specific scopes of work throughout the project life cycle. Therefore, project procurement is obtaining all of the materials and services required for the project. It includes the processes required to acquire design and engineering services and construction-related materials, equipment, machinery, and services. Project procurement management includes three primary processes. These are: ***Plan procurements, Conduct procurements and Administer (or control) procurements***

Plan procurements

This includes all specifications of the materials and services, such as minimum quality requirements.

- What are the contract requirements for outside purchases?
- Required delivery dates of product or services
- Do you want a fixed price contract or cost-reimbursable?
- Are there key milestones to be included?
- What about legal terms and conditions that must be met?
- How will you search for suppliers of the materials or services you need?
- Will you release a request for proposal (RFP)?
- Do you have a preferred supplier?

Conduct procurements

- This is the execution phase of project procurement management.
- It's when the RFPs are released, bids are gathered, and selections are made.
- Any vendor negotiations will occur during this phase, and then the agreed-upon contracts are signed.
- Conducting procurements also includes the actual receipt of and payment for goods and services.

- Two key steps included in this process are: Status or progress updates from vendors and Quality checks of products or services delivered

Administer (or control) procurements

The project manager does not generally conduct the procurements. However, you are still responsible for ensuring they are conducted appropriately. This means you need to be aware of the status of procurements. If something is late, you need to know how it impacts the rest of your project schedule and mitigate it appropriately. If there is a conflict between department requirements, it will be up to you to resolve it.

Public procurement

Public procurement refers to the purchase by governments and state-owned enterprises of goods, services and works. As public procurement accounts for a substantial portion of the taxpayers' money, governments are expected to carry it out efficiently and with high standards of conduct in order to ensure high quality of service delivery and safeguard the public interest. [6] Sound public procurement policies and practices are among the essential elements of good governance. Good practices reduce costs and produce timely results; poor practices lead to waste and delays. It also involves the management of large amounts of money and is the largest single cause for allegations of corruption and government inefficiency.

Importance of Public procurement.

• It influences economic growth

• Efficiency in public procurement releases funds for development

• It is a tool to meet social and economic objectives

• It affects quality of life of the citizens

• The public servant is accountable

Public procurement is interwoven with key development issues—economic growth, poverty reduction, decentralization, and private sector development. It is also closely linked to trade and foreign investment. Weakness in the procurement system adversely affects welfare and prospects for growth.

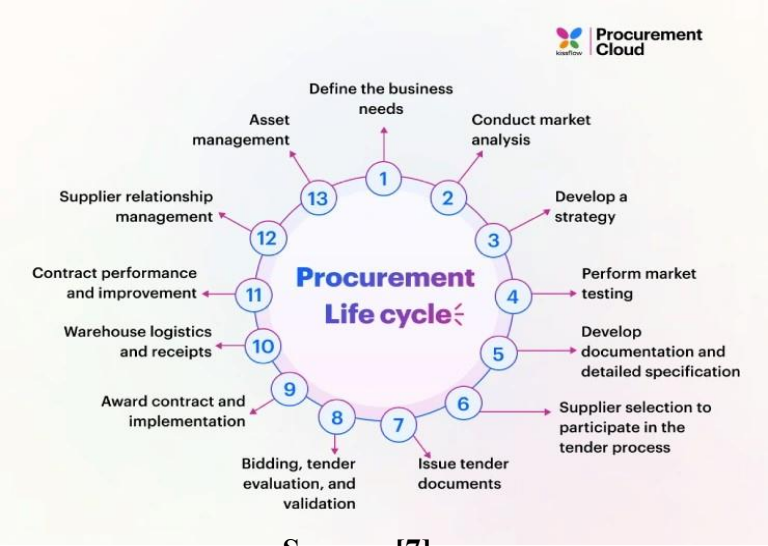
Principles of Public procurement

- Economy (Value for Money)
- Efficiency (Time)
- Fairness (No Biasness)
- Transparency (Information)
- Integrity (Reliability)
- Competition
- Accountability

4.4 PROCUREMENT CYCLE

Steps [4]:

1. Identification of the need during design or estimating.
2. Determination of the design characteristics required to perform the desired function.
3. Quantification of the element needed, and preparation of procurement specification.
4. Issuance and processing of internal requisition.
5. Solicitation of bids or price quotation,
6. Receipts and evaluation of proposals.
7. Issuance of purchase orders, subcontract or lease.
8. Vendor's preparation and submission of shop drawings or samples.
9. Review and approval of shop drawing by contractors and owner's architect or engineers.
10. Fabrication by vendor or subcontractor
11. Tracking and expediting.
12. Delivery and inspection
13. Storage and handling on site prior to use.
14. On-site fabrication operations.
15. Installation and testing in constructed facility.
16. Owner acceptance /rejection, warranties, corrections and other follow –up.



Source: [7]

Principle Documents of Procurement

1. **Prime Contract**

It is one let by the owner to a contractor who is in turn responsible for performing the work according to contract specifications.

With multiple contract and professional construction management approaches, the owner may award a number of prime contracts.

2. **Purchase order**

It is a short form of contract normally issued for procurement of materials, permanent equipment and supplies.

3. **Subcontract**

It is a form of lower-tier contract for procurement of work and services to be performed by other than a prime contractor.

4. **Agreement and Leases**

Agreement and leases are forms of contracts used in procurement of technical services or lease of automobiles, construction or office equipment or other temporary items that do not become part of the finished work.

4.5 INVENTORY MANAGEMENT

Inventory implies the cost of materials in stock at a given time. Stock of material is held to act as cushion between supply and demand. Project starts with zero material stock. Ideally construction activity should end up with zero stock when the activity is completed. Inventory management includes aspects such as controlling and overseeing purchases — from suppliers as well as customers — maintaining the storage of stock, controlling the amount of product for sale, and order fulfilment. Effective Inventory Management is

- A system to keep track of inventory.
- A reliable forecast of demand.
- Knowledge of lead times.
- Reasonable estimates of
  - Holding costs
  - Ordering Costs
  - Shortage costs
- A classification System.

INVENTORY DECISION CONTROL

Even though there are literally millions of different types of product manufactured in our society, there are only two fundamentals decisions that we have to make when controlling inventory: How much to order? And when to order?

As the inventory level goes up, the cost of storing and holding inventory also increases. Thus we must reach the fine balance in establishing the inventory levels. A major objective in inventory control is to minimize total inventory costs.

Terminologies

1. **Inventory Cost**

It is the cost of maintaining inventory. It comprises carrying cost and ordering cost.

2. **Inventory Ordering Cost**

It is the cost of placing and receiving an order. It is charged as per order. Communication cost, custom and duty charge, labor cost for loading and unloading, transportation cost etc.

*Total Ordering Cost (TOC) = Number of order (N) * Ordering cost per order (O)*

Number of Order = Total requirement (A) / Ordering quantity (N)

3. **Carrying Cost/Holding Cost**

Cost incurred in storing or holding an item till it is required. The holding cost is the cost associated with the storing of the inventory items which includes insurance, cost of handling equipment, depreciation, rent of storage space. Etc. [8]. It is charged in per unit of item

*Total Carrying Cost (TCC) = Average quantity *Carrying Cost per unit*

*TCC = Q/2 * C*

Total Inventory Cost (TIC) = Ordering cost + Carrying cost

(TIC) = TOC + TCC

4. Shortage Cost: Costs when demand exceed supply.

5. Annual Requirements is the total numbers of materials required for the given project.

6. Lead Time is the time period elapsed between placing an order and its arrival in inventory stock. The lead time is crucial in case of machinery and equipment purchased from abroad, which may take even full year or so.

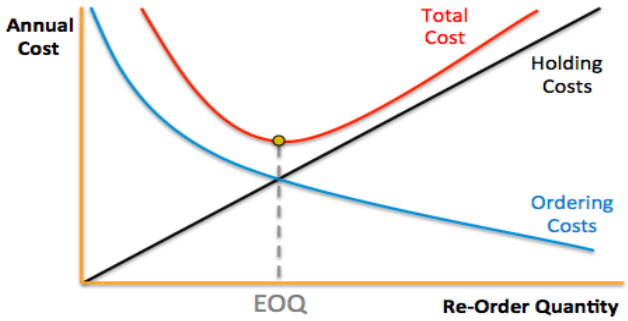
ECONOMIC ORDER QUANTITY (EOQ)

Economic Order Quantity (EOQ) also known as Wilson EOQ model or simply EOQ model is the model that defines the optimal quantity to order that minimizes the total variable costs required to order and hold the inventory. Economic order quantity refers to that number (quantity) ordered in a single purchase so that the accumulated costs of ordering and carrying costs are at the minimum level. In other words, the quantity that is ordered at one time should be so, which will minimize the total of. Cost of placing orders and receiving the goods, and Cost of storing the goods as well as interest on the capital invested.

Underlying Assumptions [2]

1. The annual demand for the item is known, deterministic and constant.
2. The lead time is zero i.e. delivery is immediate. (The time between placement of order and the receipt of the order)
3. The receipt of the order occurs in a single instant and immediately after ordering it.
4. Demand is even throughout the year.

5. There is no any quantity discount. In other words it does not make any differences how much we order, the price of the product will still be the same.



EOQ is that level where the ordering cost and holding cost lines intercepts each other.

Source: [9]

The graph shows the cost on the vertical or Y axis and the order quantity on the horizontal or X axis. The straight light which commence from the origin is the carrying cost/holding cost curve, the total costs of carrying units of inventory. As expected, as we order more on the X axis, the carrying cost line increases in the proportionate manner. The downward ward sloping curve which commence on the Y axis and decreases as it approaches to the X axis and moves to the right is the ordering cost curve. This curve represents the total ordering cost depending on the size of the order quantity.

Obliviously, the ordering cost will decrease as the order quantity is increased thereby causing there to fewer orders which need to be made in any particular period of time. The point at which these two curves intersect is the same point which is the minimum of the curve which represents the total cost for the inventory system or EOQ. Thus the sum of carrying cost curve and ordering cost curve is represented by the total cost curve and the minimum point of the total cost curve corresponds to the same point where the carrying cost curve and the ordering cost curve intersect.

Economic order quantity is that quantity at which the total inventory cost is minimum as far as possible. For this the total carrying cost must be equal to the total ordering cost.

Total carrying cost = Total ordering cost

Q/2 * Carrying Cost per unit = Number of order (N) * Ordering cost per order (O)

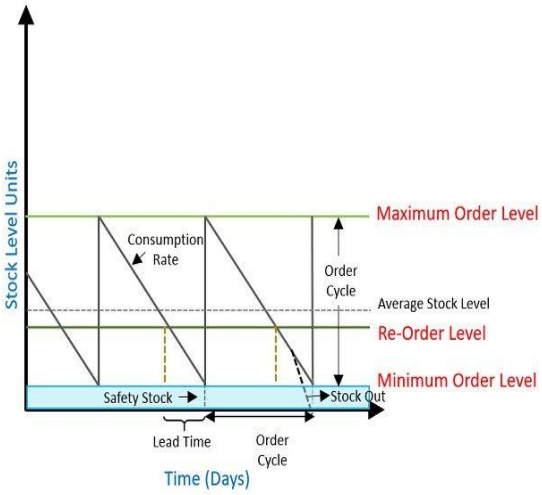
Q/2 * C = Total requirement (A) / Ordering quantity (N) * O

Using Calculus,

Economic Order Quantity (Q opt) = $[2AO/C]^{1/2}$

Reorder Point (ROP)/ Reorder Level (ROL)

We have decided how much to order, now the second inventory question is when to order? It is assumed that we have instantaneous inventory receipt i.e. firm's waits until inventory level is zero, places an order, and receives the item in stock immediately. However, the time between the placing and receipt of an order (called Lead Time) is often few days or weeks. Thus when to reorder decision is usually expressed in terms of reorder point (ROP), the inventory level at which the order should be placed.



Source: [10]

- **EOQ answers "how much" question.**
- **Re-Order Point tells "when" to Order.**
- **Re Order Point (ROP) = {Demand per day} * {lead time for new orders in days}**

= d*L

Where, d = Total annual requirement/ Number of working days in a year.

4.6 PROCUREMENT OF CONSULTING SERVICES

2. Quality & Cost Based Selection (QCBS)

This is a competitive process among shortlisted firms that take into account the quality of the proposals and the cost of the services in the selection of the successful firm.

3. Quality Based Selection (QBS)

QBS is a method based on evaluating only the quality of the technical proposals and the subsequent negotiation of the financial proposal and the contract with the Consultant who submitted the highest ranked technical proposal. [2]QBS is appropriate when assignments are complex or highly specialized making it difficult to define precise TOR.

4. Fixed Budget Selection (FBS)

FBS is a method where the RFP will indicate the available budget and request the Consultancy Organizations to provide their best technical and financial proposals in separate envelopes, within the budget.

5. Consultant's Qualification Selection (CQS)

CQS is a method where detailed technical and financial proposals are invited from only a selected Consultancy/Organization to negotiate a contract. EOI shall be invited using an amplified format and a shortlist of three to five organizations shall be prepared.

6. Least Cost Selection(LCS)

LCS is a method a "minimum" qualifying mark for the "quality" is established. Proposals, to be submitted in two envelopes, are invited from a short list. Technical envelopes are opened first and evaluated. Those securing less than the minimum marks specified shall be rejected, and the financial envelopes of the rest are opened in public. The Consultancy/Organization with the lowest price shall then be selected.

7. **Single Source Selection (SSS)**

Single-source selection of consultants does not provide the benefits of competition in regard to quality and cost. Lacks transparency in selection, and could encourage unacceptable practices. Therefore, single-source selection shall be used only in exceptional cases.

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