1.0 CHAPTER 1: SUPERVISE CONSTRUCTION PROJECTS

Unit of learning code CON/OS/BUT/CR/11/6

Related Unit of Competency in Occupational Standard **Supervise Construction Project**

1.1. Introduction to the unit of learning

This unit specifies the competencies required to supervise a construction project. It entails organizing construction sites; interpreting building contract documents; preparing; project work plan, ledgers, journals, and final accounts; manage human resource, site records & activities as well as coordinating quality standards and costing construction projects.

1.2 Summary of Learning Outcomes

1. Organise construction site
2. Interpret building contract documents
3. Prepare construction work plan
4. Prepare accounts
5. Manage project human resource
6. Keep site records
7. Monitor site activities
8. Participate in quality standards
9. Cost construction cost

1.2.1 Learning Outcome 1: Organise construction site

1.2.1.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to organize a construction site. It involves drawing construction site maps, allocating construction site zones, identifying site infrastructure, and positioning site plant and equipment.

1.2.1.2 Performance Standard

1.1 Construction site map is drawn

1.2 Construction site spaces are allocated as per construction site zoning.

1.3 Site infrastructure and traffic routes are identified as per the site map.

1.4 Site plant and equipment are positioned according to the site map.

1.5 Site installations are placed according to the site map.

1.6 Site arrangement is checked and re-planned

Definition of terms

Site – the position where something is fixed or located

Site layout

Construction site layout involves identifying, sizing, and placing temporary facilities within the boundaries of construction site. These temporary facilities range from simple lay-down areas to warehouses, fabrication shops, maintenance shops, batch plant, and residence facilities.

To enable construction work to take place the builder requires men, materials and plant, all of which have to be carefully controlled so that the men have the right machines in the most advantageous position, the materials stored so that they are readily available and not interfering with the general site circulation, and adequate storage space and site accommodation.

To ensure that a site is laid out in the most effective and efficient manner, much thought and consideration must be given to the task before the work actually starts. The period after tender acceptance and actual starting date, called the 'pre-construction period', is the time to carry out this exercise.

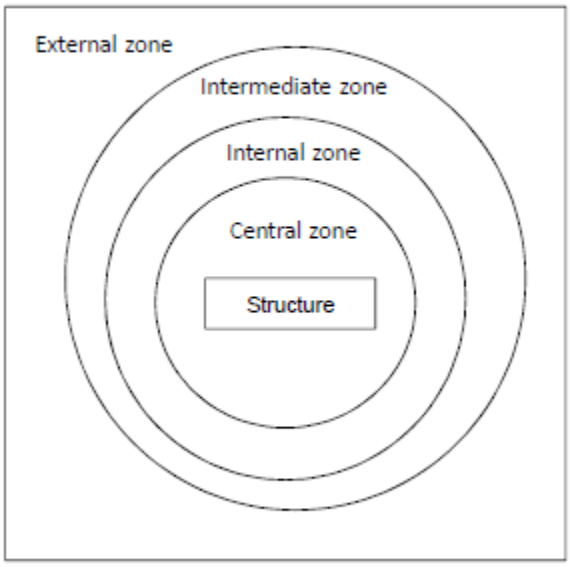
Any planned layout should be reviewed periodically and adjusted to suit the changing needs of the site activities. If this aspect of building construction is carefully considered and planned it will be reflected in the progress and profitability of the contract.

A study of the drawings, together with the bill of quantities and the specification preferably at the pre-tender stage will enable the builder to make a preliminary assessment of the size and complexity of the contract, the plant required and the amount of money which can reasonably be expended on labour-saving items such as concrete mixing and placing alternatives, handling and transporting equipment and off-site fabrication of such items as formwork and reinforcement.

Failure to plan the site layout in advance is a prime cause of operational inefficiency, and can increase the overall cost of a project substantially. In the absence of a precise site layout plan, the following problems may occur:

a) .Material stacks wrongly located. Materials arriving on site are off-loaded into what someone guesses to be the correct location. This problem may involve double or triple handling of materials to another location. For example:
   -They may be stocked over a drainage line or near the edge of excavation;
   -They are too far from the work area;
   -They are too remote from the hoist or not within the radius of the crane;
   -They impede the smooth flow of work traffic across the site;
   -Their delivery was wrongly phased and they are not needed until much later in the project; -They are fragile.
b) Plant and equipment wrongly located. For example:
   -The mixer is inaccessible for the delivery of materials; not enough room for the storage of aggregates;
   -Fixed cranes are unable to reach all parts of the works;
   -Hoists have insufficient capacity or height to handle the loads or badly located in relation to the floor layout;
c) Inadequate space allowed. Where inadequate space is allowed for the stacking of materials or activities:
   -Materials may be stacked to high or stacked on roadways causing hazards.
   -Working areas may become too cramped or additional areas may have o be allocated with the consequent waste of time caused by having to travel between them.
d) Site huts wrongly located in relation to their effective use, such as:
   -Site office located too near noisy activities such as mixer, or located too near to site roads in dusty conditions, or too remote with insufficient overview of the site.
   -Warehouses having inadequate access for loading and unloading or located in insecure area.

Construction site zones



Central zone:

The structure and the closest place around. (Usually place for tower crane, lifting equipment, scaffolding)

Internal zone:

Uploading places, active depots (e.g. formwork, prefabricated elements, etc.)

Intermediate zone:

The tower crane still reaches this zone. Facilities of prefabrication, inactive depots.

External zone:

The tower crane does not reaches this zone. Ideal for temporary facilities, staging buildings, parking places, small machine and power tool container, etc.

Figure 1 Construction site zones

A site investigation should be carried out; preferably by the site agent who will supervise the contract should the tender be successful. His report should include (access to site, security and) the following information:

1. **Available services** – available power and water supplies together with rates of payment, nuisance or value of services already on site, diversions required and the time element involved in carrying out any necessary diversions together with cost implications.
2. **Layout** – general site conditions such as nature of soil, height of water table, flooding risks, tidal waters, neighbouring properties and any demolition problems
3. **Labour** – travel distances, local or own labour resources to be used, availability of local labour and prevailing rates of pay, lodging and local catering facilities.

Objectives of a good Construction Site Layout

Site layout comprises the arrangement of site huts, storage sheds and compounds and the placing of loose material, mixing bays and so on.

1. Orderly layout shows new operatives that they are employed by an organisation with planning care and consideration in mind.
2. To the general public the impression created is one of efficiency, which is a good advertisement.
3. Through the period of the project, a good tidy site will often reflect the efficiency of the site supervisor; reduce waste and purposeless movement of plant and materials.
4. Well-laid out sites enhance security of materials, tools and equipment as the security personnel, night watchmen, flood lighting, storage areas will be in place.

Site Layout Planning Elements

When planning site layouts the following must be taken into account:

1. Site activities
2. Efficiency
3. Movement
4. Control
5. Accommodation for staff and storage of materials

1. Site activities

The time needed for carrying out the principal activities can be estimated from the data obtained previously for preparing the material and labour requirements. With repetitive (or over-lapping) activities estimates will be required to determine the most economical balance of units which will allow simultaneous construction processes; this in turn will help to establish staff numbers, work areas and material storage requirements, access facilities and possibly plant types and numbers. If a particular process presents a choice in the way the result can be achieved the alternatives must be considered; for example, the rate of placing concrete will be determined by the output of the mixer and the speed of transporting the mix to the appropriate position. Alternatives, which can be considered are:

i. More than one mixer
ii. Regulated supply of ready mixed concrete
iii. On large contracts, pumping the concrete to the placing position.

2. Efficiency

To achieve maximum efficiency the site layout must aim at maintaining the desired output of the planned activities throughout the working day and this will depend largely upon the following factors:

i. Avoidance, as far as practicable, of double handling of materials

ii. Proper store-keeping arrangements to ensure that the materials are of the correct type, in the correct quantity and are available when required

iii. Walking distances are kept to a minimum to reduce the non-productive time spent in covering the distances between working, rest and storage areas without interrupting the general circulation pattern.

iv. Avoidance of loss by the elements by providing adequate protection for unfixed materials on site, thereby preventing time loss and cost of replacing damaged materials

v. Avoidance of loss by theft and vandalism by providing security arrangements in keeping with the value of the materials being protected and by making the task difficult for the would-be thief or vandal by having adequate hoardings and fences. Also to be avoided is the loss of materials due to pilfering by site staff who may consider this to be a perquisite of the industry. Such losses can be reduced by having an adequate system of stores' requisition and material checking procedures.

vi. Minimizing on-site traffic congestion by planning delivery arrivals, having adequate parking facilities for site staff cars and mobile machinery when not in use, and by having sufficient turning circle room for the types of delivery vehicles likely to enter the site.

3. Movement

Apart from the circulation problems mentioned above the biggest problem is one of access. Vehicles delivering materials to the site should be able to do so without difficulty or delay. If it is anticipated that heavy vehicles will be operating on site it will be

advantageous to lay the roads and paved areas, if these are part of the contract and will have adequate strength for the weight of the anticipated vehicles, at a very early stage in the contract. Otherwise lay only the hard-core layer at the initial stages or temporary roadways composed of railway sleepers, metal tracks or mats until a later stage in the contract, especially if such roads will only be required for a short period**.**

4. Control

This is mainly concerned with the overall supervision of the contract, including men, materials and the movement of both around the site. This control should form the hub of the activities, which logically develops into areas, or zones of control radiating from this hub or centre. Which zone is selected for storage, accommodation or specific activities is a matter of conjecture and the conditions prevailing on a particular site but as a rule the final layout will be one of compromise with storage and accommodation areas generally receiving priority.

5. Accommodation

Accommodation for staff is covered by the Construction (Health and Welfare) Regulations 1966, which sets out the minimum amount and type of accommodation which must legally be provided for the number of persons employed on the site and the anticipated duration of the contract. Apart from these minimum requirements the main areas of concern will be sizing, equipping and siting the various units of accommodation.

Methods of Site Layout

There are two methods used to ensure satisfactory site layout. Both entail the use of a site plan showing outline of building with drain and service runs (possibly to scale). The site planner may:

i) Cover site with sheet of plastic and draw on arrangement, simply rubbing out wrongly placed huts, and so on until the best solution is achieved.

ii) Prepare simple plywood or hardboard cut outs to scale, and place them around the plan until satisfied of the layout

By using these methods, the wrong positioning of necessary allocated area is reduced to a minimum and the moving of plant, materials and huts because of unforeseen service trenches is eliminated.

SITE PLANNING STEP BY STEP

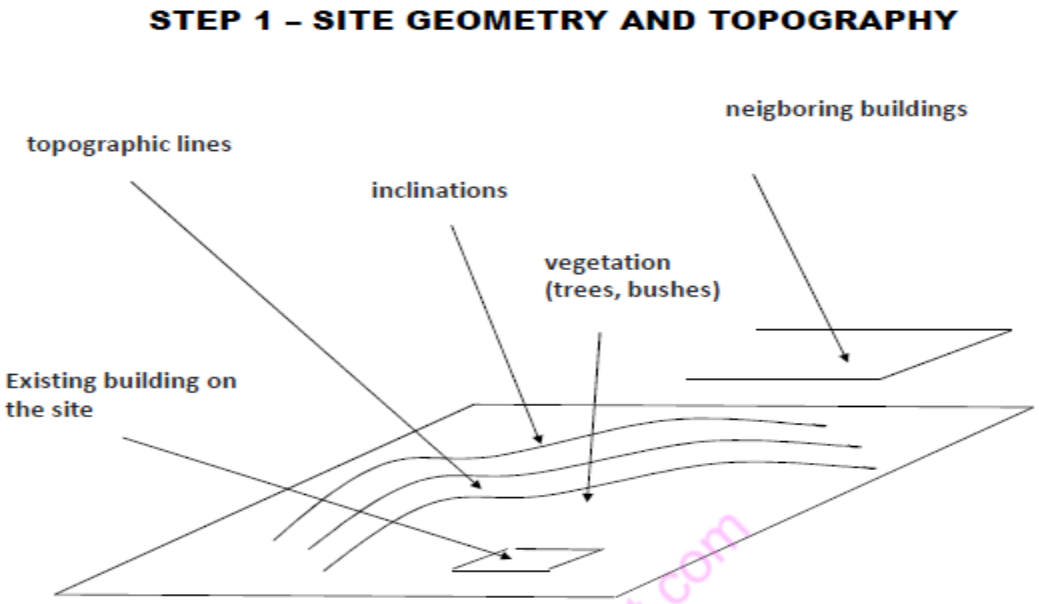


Figure 2 Site geometry and topography

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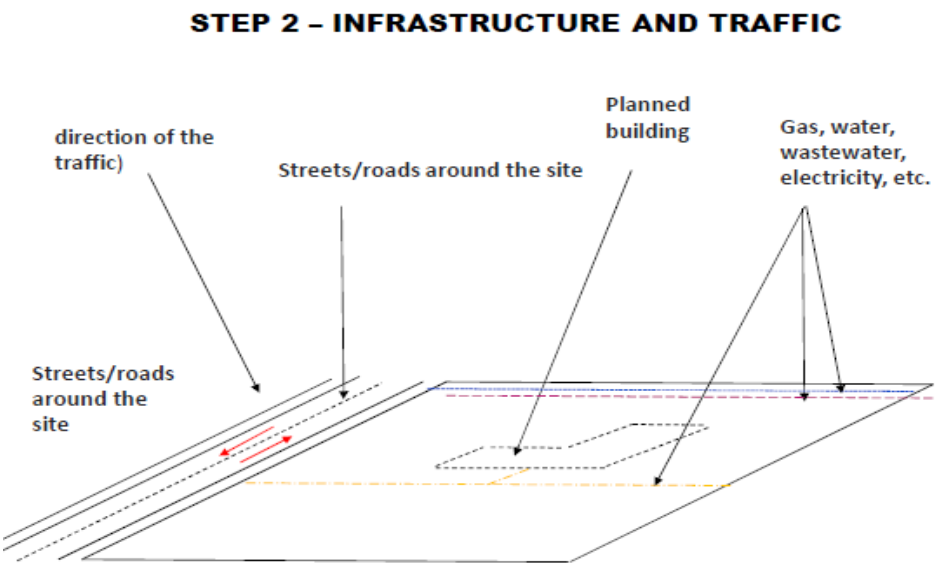

Figure 3 Infrastructure and traffic

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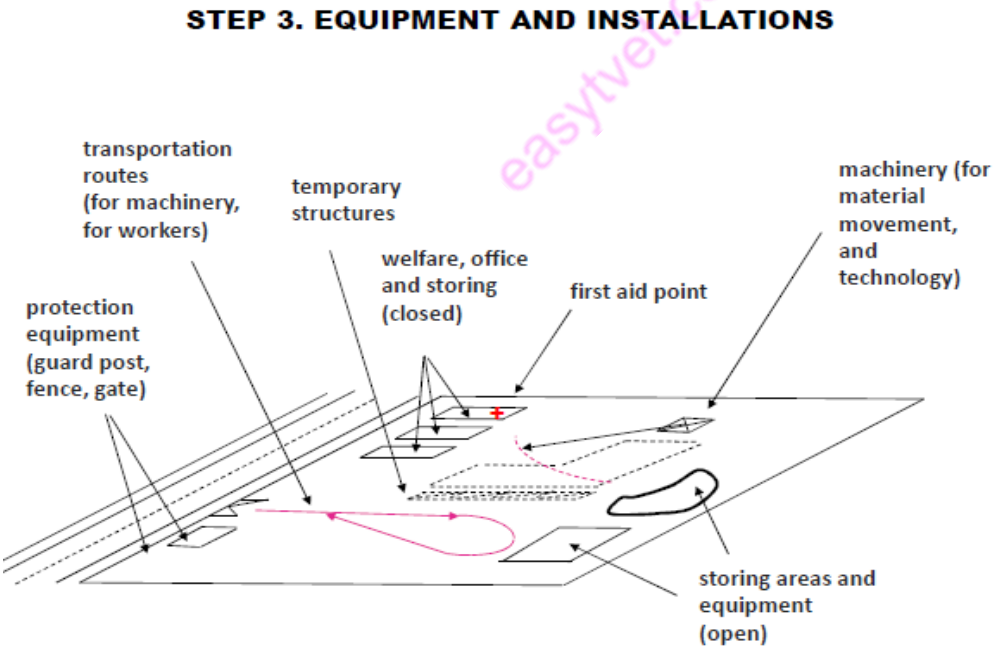

Figure 4 Equipment and installations

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Temporary Facilities Considerations

It is important to understand the characteristics of the temporary facilities before planning the site layout.

1. Satisfying environmental and safety regulations: All temporary facilities should satisfy environmental and safety regulations. Special attention should be paid to temporary facilities like batch plants, which have high pollution potential. Planners have to make proper arrangements to control the air, water, and noise pollution from such facilities.
2. Availability of diverse solutions for the same problem: There are many arrangements that can be made to establish a temporary facility. For example, if a warehouse is required, the planner can build a warehouse on the site, use existing facilities on the site, rent a building near the site, or plan a just in time delivery. Based on the usage of the warehouses, each alternative can be further divided into several sub items. For example, the material of building the facility can vary from wood, bricks, to a steel structure.
3. Relatively short life span of a specific location: The life span of temporary facility depends on the duration of the project. In general, it must be removed as soon as the project is completed
4. Reutilization with a minimum loss for the same or modified function at another location: Due to the shorter life span of temporary facility on site, planners consider reutilization of the temporary facilities. This can result in saving the cost of construction. With appropriate modifications, most of the temporary facilities can be used for more different purposes. Therefore, good maintenance, and storage of the building materials can increase the frequency of reutilization and decrease construction costs significantly.
5. Easy of assembly, dismantling, and exploitation: temporary facilities structures which are easy to assemble and dismantle will reduce both assembly and disassembly time. As mentioned above, temporary facilities will need to be removed in a very short period of time after project completion. Thus, temporary facilities structures should be easy to assemble and dismantle without any damage to the structure components. Prefabricated modules are

ideal for constructing temporary facilities and they are usually easy to assemble and dismantle

6. Standardization of design: Standardization of design and construction of temporary facilities can increase the frequency of reutilization and reduce the work-hours and cost required for construction the facilities. This approach makes the maintenance, transportation and storage of temporary facilities easy. The benefits of the learning curve can be gained from repetitive field operations, which results in increase of productivity and quality. Also, benefits are obtained by providing grater interchangeability of spare parts and reducing the variety of spare parts stored in the warehouse

Temporary Facilities Selection

One of the characteristics of temporary facilities is the availability of diverse solutions for the same function. This section describes some of the considerations when selecting the required temporary facilities for a specific project.

i. **Construction type:** The construction of an industrial plant, such as power plant, requires more storage and fabrication area for process mechanical and electrical work than other projects such as a highway project.
ii. **Type of contract**: For turn-key contract, the contractor can consolidate the administrative and construction operations, means that fewer but larger and more efficient temporary facilities can be selected. On the other hand, if the project is managed under a series of different contracts, this will translate into a higher number of smaller temporary facilities serving each individual contractor.
iii. **Project size**: A relatively small project can be managed from a trailer or portable structure. While a five to ten year project may need temporary facilities of a more permanent nature.

iv. **Project location:** Projects located in uninhabited regions or in places where skilled labor is scarce require additional facilities for eating and living. Project far from industrial centers require more on site services such as batch plant, equipment maintenance shops, long term storage area, and even some other recreational centers for the families. Also, the selection of some of the temporary facilities depends on the manpower permanent resident from the site. The work force can be broken down into three categories as shown in the figure below

Table 1 A List of temporary facilities

1.	Job office
2.	Owner representatives office
3.	Subcontractors office
4.	First aid office
5.	Information and guard house
6.	Toilet on site
7.	Staff/Engineer dormitory
8.	Labor dormitory
9.	Dinning room for labor
10.	Bathroom for labor
11.	Restroom for labor
12.	Equipment maintenance shop
13.	Parking lot for mechanics
14.	Prefabricated rebar storage yard
15.	Rebar fabrication yard

16.	Carpentry shop
17.	Storage yard for lumber
18.	Cement warehouse
19.	Pipe jointing yard
20.	Welding shop
21.	Parking lot
22.	Tank
23.	Electrical shop

Temporary Facilities Sizing

After selecting the temporary facilities that are needed on the site, the size required for them must be estimated. The size of temporary facilities is mainly based on the manpower requirements, estimated quantity of work, production rate of resources, availability of site space, and cost considerations. Some of the rules of thumb, safety regulations, and other criteria for sizing temporary facilities are described below.

Table 2 Area estimates for temporary facilities

Temporary Facility	**Minimum (m^2)**	**Average (m^2)**	**Maximum (m^2)**
Craft change house per worker	0.09	1.02	2.7
Time office per office worker	5.4	8.7	13.5
Number of people per brass alley (with average area per person)	100 Persons	175 Persons	250 persons
Number of workers per parking space	1	1.7	4
Area required for each unit	22.5	30	36

parking			

Table 3 Range of office space requirements

Office	**Size Range (m2)**
Project Manager	12 – 25
Construction Manager	9 – 14
Mechanical/ Electrical/ Civil Engineer per Engineer	9 – 11
Purchasing (total)	46 – 84
Schedule & Cost Control (total)	28 – 93
Accounting (total)	37 – 80
First Aid & Safety per Office	17-19
Clerical (total)	28-74
Estimator	11

The size of sanitary facilities depended on the manpower requirements and it can be entirely temporary or permanent. If portable toilets are used, a minimum of one toilet per twenty persons must be provided. Space required for some facilities as fabrication shops dependent on the amount of on-site fabrication work as well as rate of fabrication dictated by construction schedule. Also, the size of the equipment maintenance shop depends on the amount of construction equipment on the site.

MATERIALS STORAGE

Based on experience, the following general equation is used to determine the material storage area for any type of construction project. The table below shows the parameters that affect this equation. The total required storage area, A_n, is calculated as follows:

$$A_n = (Q_{max}/ I_m)/q_n$$

Where,

$$Q_{max} = q_{daily} \times t \times k$$

$q_{daily} = Q_{total}/T$

Q_{max} ; maximum estimated quantity in storage space

I_m ; utilization index for materials

q_n ; quantity of materials that can be stored per m2;

Q_{total} ; Total quantity of materials required for the project;

q_{daily} ; estimated quantity required per day

T ; construction period (not total project duration);

t ; Average stock (days); and

k ; : Fluctuation factor

SITE LAYOUT

1. Access to site

Although particular circumstances of each site or job will determine the extent to which recommendations can be applied, the builder should provide:

- Such drainage required to keep site reasonably free from standing water. Particular attention should be paid to seasonal changes of the water table and permeability of sub-soil, information of which may be obtained from local knowledge or by trial pits or boreholes. If required, exclusion of water may be done by pumping using the most economical method.
- So that on- and off-site access to parts under construction provide roads, paths or rail facilities. Many projects often have to make new access to sites crossing over existing footways, and whether the access is of a permanent or temporary nature, the permission of the local authorities must be obtained.
- If the site is of a restricted nature (rights of way restrictions, local authority or police restrictions and bridge weight or height limitations on approach routes) the problem of unloading of materials or loading up spoil and rubbish for removal may cause

interference with the flow of traffic. Adequate warning should be given to other road users by the display of notices, danger signs, warning lights or other suitable communications

2. Car Park

Site personnel, visitors or suppliers need adequate and secure parking space on the site. This need to be sited preferably in front of the site offices so that:

- the timekeeper can book in arrival and departure times of vehicles
- a material checker at the entrance to site can easily check and direct material supply
- site security may check and ensure that those leaving the site do not carry materials or components, tools or equipment with them.

3. Site Signboard

Uses of a site identification board include:

- It is an advertising aid, hence it should be clearly displayed
- It saves traffic and visitors problems in finding the site
- In sub-urban or rural locations 'finger boards', a form of signboard, is very useful in directing people to the site as street names are not always easy to locate.

Items appearing on a signboard for a proposed site include: Name of project, name of client, name of contractor, name of architect, name of Chief Engineer, name(s) of mechanical, civil, structural Engineer(s), name of quantity surveyor, name(s) of sub-contractor(s).

4. Amenities

Although minimum requirements covering operatives' welfare facilities on site depends on the size and nature of the site as regards other provisions, most sites will consist of hutments divided into three groups:

(a) Administrative offices

(b) Operatives' huts

(c) Storage and general

(a) Administrative offices

These will vary according to the size of the project, from a single hut for the site supervisor and possibly visiting clerk of works, to a complex of offices to house site supervisors, engineers, surveyors, planners, time clerks etc. Requirements for site administrative offices include:

i) Be constructed of materials that can be easily handled, transported, erected and disassembled.

ii) Be of sound construction

iii) Be water tight at the walls, floor(s), roofs

iv) Have adequate lighting and ventilation

v) Have suitable internal finishes and fixtures to impress visitors and provide suitable surroundings for meetings

vi)Be linked, from a simple sliding panel to a sophisticated intercom system for ready communications.

(b) Operatives' huts

Minimum recommendations for operatives' huts include:

i) Shelter from inclement weather e.g. rain, heat, snow, wind etc.

ii) Accommodation for clothing, provision for meals either from fenders or a serviced canteen

iii) Sanitary conveniences which include provisions for washing hands, drinking water and ablution for calls of nature.

iv) Ambulance room properly constructed and maintained

The above recommendations, if implemented, will improve working conditions on the site, leading to team spirit, high morale and good relations between operatives and management because it creates a feeling that the management is considering the workers. Further there will be reduced labour turnover; giving a more knowledgeable team with reduced need for retraining and higher productivity due to operatives working better if dry clothes can be put on at start of each day and if hot meals can be easily obtained to replenish lost energy.

Operatives' huts should be placed in proximity to the administrative block (foreman's office) to check prolonged breaks or unscheduled visits to huts during the day.

5. Storage Areas

Storage areas for tools and equipment and materials may be manned or unmanned, open or under lock and key depending on:

Physical properties – size, shape, weight and mode of delivery will assist in determining the safe handling and stacking method(s) to be employed on site, which will in turn enable handling and storage costs to be estimated.

Protection – Building materials and components, tools, plant and equipment will usually require some form of weather protection to prevent deterioration, especially those materials classified as non-durable.

Security – many tools and equipment and building materials have a high resale and/or usage value to persons other than those for whom they were ordered and unless site security is adequate, losses due to theft, pilferage and vandalism can become unacceptable.

Organisation – this is the planning process of ensuring that all the materials and equipment are delivered to site at the correct time, in sufficient quantity, the right quality, the means of unloading is available and that adequate space for storage or stacking has been allocated throughout the duration they are on site.

6. Adjoining Property

Many sites are surrounded by other buildings. The precautions the site management ought to consider in relation to adjoining properties like buildings before starting the work include:

i) Maintain good relations with the owners of these properties right from the start. Preliminary information may help to reduce friction if problems with regard to dust, noise etc., occur during the course of the project, leading to dialogue rather than taking stronger, more direct action.

ii) Insure against mishaps and suggested damage to existing property by taking photographs and getting the owner to sign as correct

iii) Placing tell-tales over any faults to avoid legal battles later on if owner accuses builder of damage

7. Site Security

To enhance security at the site for materials, tools, equipment and plant, site personnel, vehicles and the construction work in progress, the site management need to consider local vandalism and pilfering record, security patrol facilities, need for night security, fencing and hoarding requirements**.**

i. Fencing

A building site and the compound can be given a degree of protection by surrounding with a fence. A fence is an erection put to a property to mark its extent without necessarily barring one from seeing inside.

The fence fulfills three functions:

i. Defines limit of the site or compound
ii. Acts as deterrent to would-be trespassers and thieves
iii. Provides protection to the public

A fence can be constructed to provide a physical barrier of solid construction or a visual barrier of open work construction. If the site is to be fenced as part of the contract it may be advantageous to carry out this work at the beginning of the site operations. The type of fencing chosen will depend upon:

i. The degree of security required
ii. Cost implications
iii. Type of neighbourhood, and
iv. Duration of contract

A security fence around the site or compound should be at least 1.8m high above the ground and include the minimum number of access points which should have a lockable barrier or gate.

Figure 5 Fencing

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Figure 6 Wood fencing

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ii. Hoardings

These are close boarded fences or barriers erected adjacent to a highway or public footpath to prevent unauthorized persons obtaining access to the site and to provide a degree of protection for the public from the dust and noise associated with building operations.

Under the Highways Act 1959 (Sec. 147 and 148) it is necessary to obtain written permission from the Local Authority to erect a hoarding. The person, which is in the form of a license, sets out the conditions and gives details of duration, provision of footway for the public and the need for lighting during the hours of darkness

Two forms of hoarding are in common use:

i. Vertical hoardings

ii. Fan hoardings

The vertical hoardings consist of a series of closed boarded panels securely fixed to resist wind loads and accidental impact loads. It can be free standing or fixed by stays to the external walls of an existing building.

Protection should be given to persons from falling objects. A fan hoarding fulfills this function by being placed at a level above the normal traffic height and arranged in such a manner that any falling debris is directed back towards the building or scaffold.

Figure 7 Hoardings

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.beltchiztour.com%2Fdifferent-types-fences-used-construction-sites%2F&psig=AOvVaw1ZDvPMIl8Jy6VCsQllXxDs&ust=1624200081672000&source=images&cd=vfe&ved=0CAoQjRxqFwoTCMC18fv2o_ECFQAAAAAdAAAAABAJ

Site layout planning example

The figure below illustrates the layout of building materials and access roads for the purposes of servicing two hoists for the erection of a low-rise building. Comment on and criticize the present layout in relation to the positioning of both the materials and hoists.

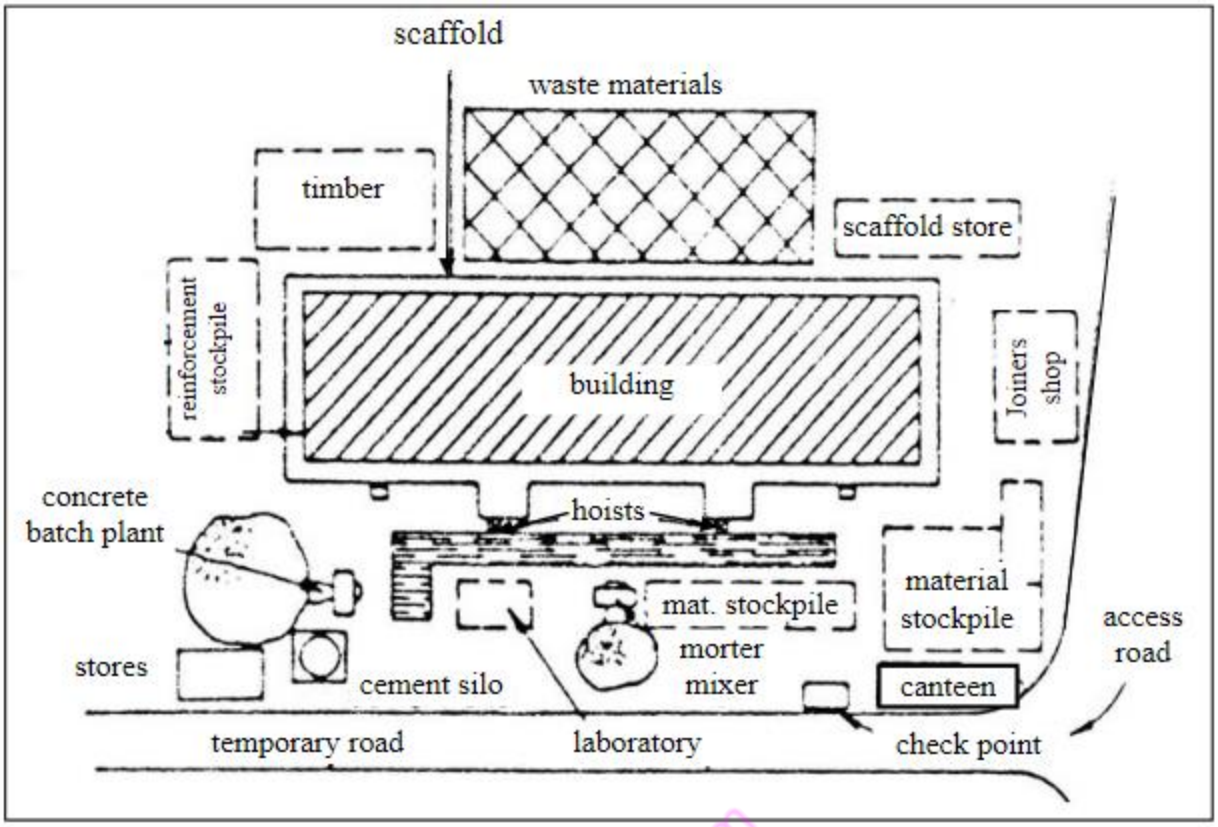


Figure 8 Site layout planning example

Criticism of existing site layout:

i. Both hoists have separate scaffold staging, causing increased costs.
ii. Materials are not stockpiled near hoists.
iii. Entrance to the site is too narrow for truck to pass.
iv. Stores are located behind the batching plant so obscuring store man's view and check point is separated from the stores.
v. Concrete and mortar mixers are located too far from the hoists.
vi. Stockpiles are dispersed and hinder unloading.
vii. Temporary roads are long and narrow.
viii. Some stores are difficult to reach

Suggested improved layout:

i. Both hoists are housed in a common scaffold.
ii. Batching plants have direct discharge into dumpers.

iii. The access has been widened near the site entrance.

iv. The stores are located to give a good view of all materials stockpiles, and are sited near the temporary road.

v. Concrete and mortar mixers are located near the hoists.

vi. The temporary road is shorter and wider.

vii. A compound is provided to police non-bulk materials.

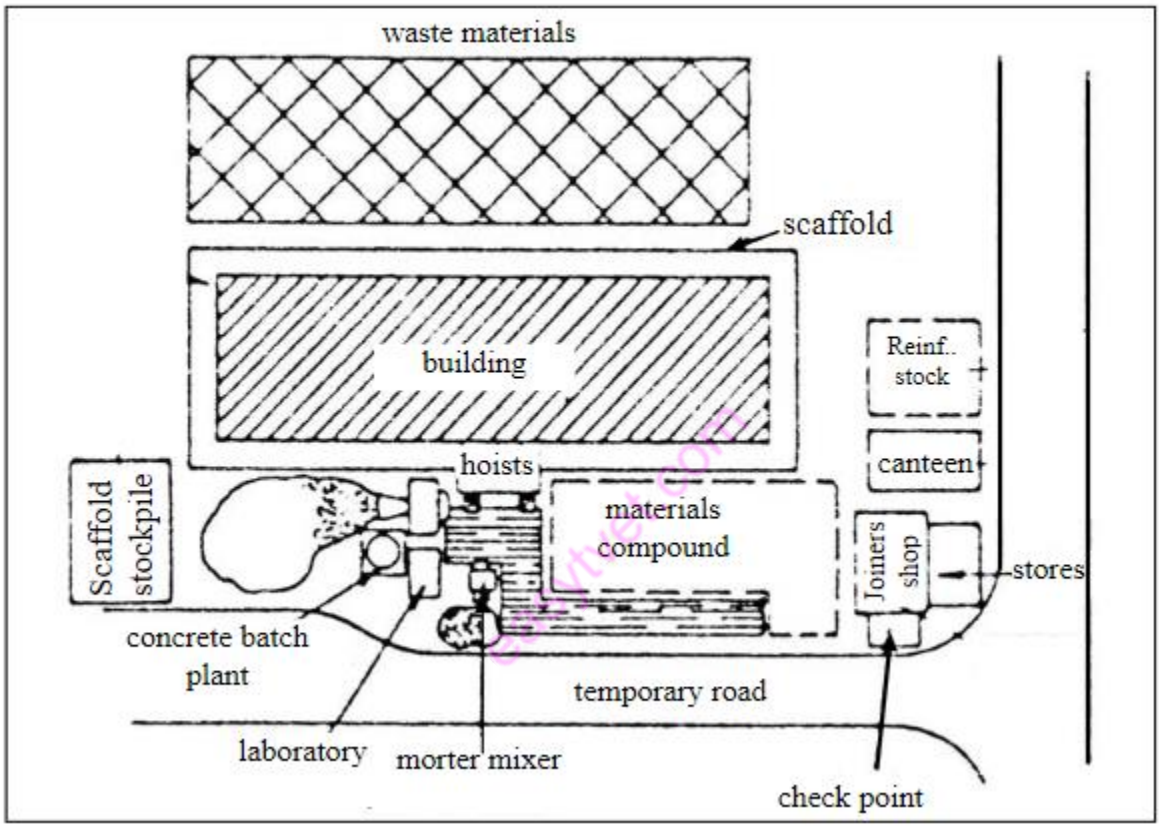


Figure 9 Improved site layout

1.2.1.4 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Sketch a site layout plan of a medium size construction site and show the major details.
2. Visit a construction site and map out all the facilities to scale

Resource Requirements
Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Charts

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.1.5 Self-Assessment questions

1. The contractor prepared the site layout plan as shown in the figure below. In developing this given plan, the contractor collected the following information to layout the site:
   -All equipment was delivered before building foundations were complete. All other fitting also delivered(doors, sanitary, etc.)
   -Generator house completed. Hoist was not available at commencement and has only just delivered.
   -Nearest pure water is in the town 20-km away. Water delivered by tanker and stored in 6 200-litre drums.
   -Pylon bases and sewer/septic tank not yet started.
   -Agents' office is sited on a privileged place and to satisfy the best view for site.
   Criticize the layout given in Figure 5 and prepare another layout to correct the criticism.

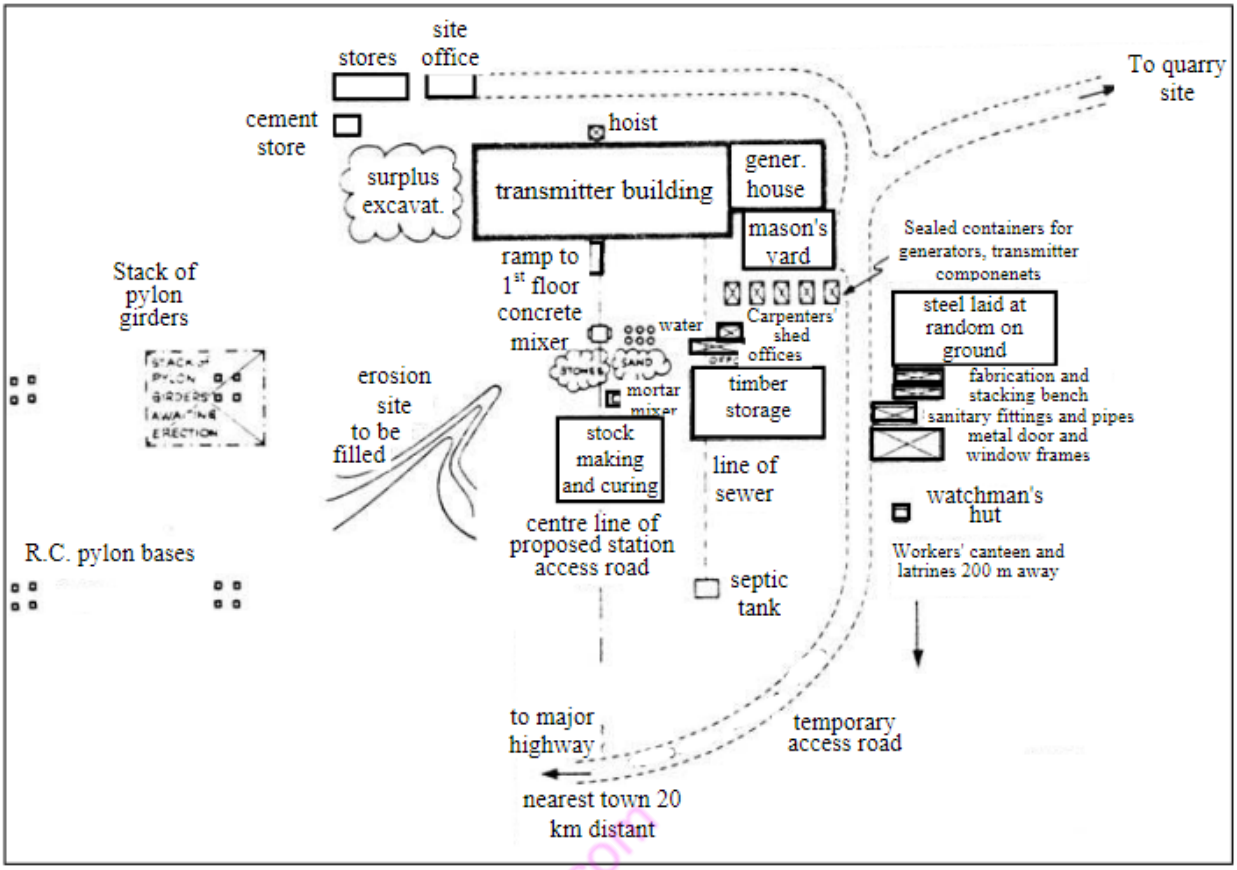


Figure 10 Site layout

2. (i) Define the term site layout
   (ii) Outline SIX objectives of a good construction site layout.

3. Which site amenities would you put consider when planning a construction site?

4. Sketch a site layout plan of a medium size construction site and show the major details.
5. (a) What is the purpose of site identification board on a construction site?
   (b) Which items would appear on a signboard for a proposed construction site?
6. Which are some welfare items that can be provided for workers on a construction site?
7. How can maximum efficiency be achieved in a construction site?
8. (a) How would you define the following terms:
   i.Theft
   ii.Pilfering
   iii.Vandalism

   (b) Which FIVE security measures would you put in place for the protection of a construction site?
9. Which factors would influence the choice of a fence for a site?

10. What is the purpose of hoarding and which are the two types of hoardings commonly used?

Response to self-assessment questions

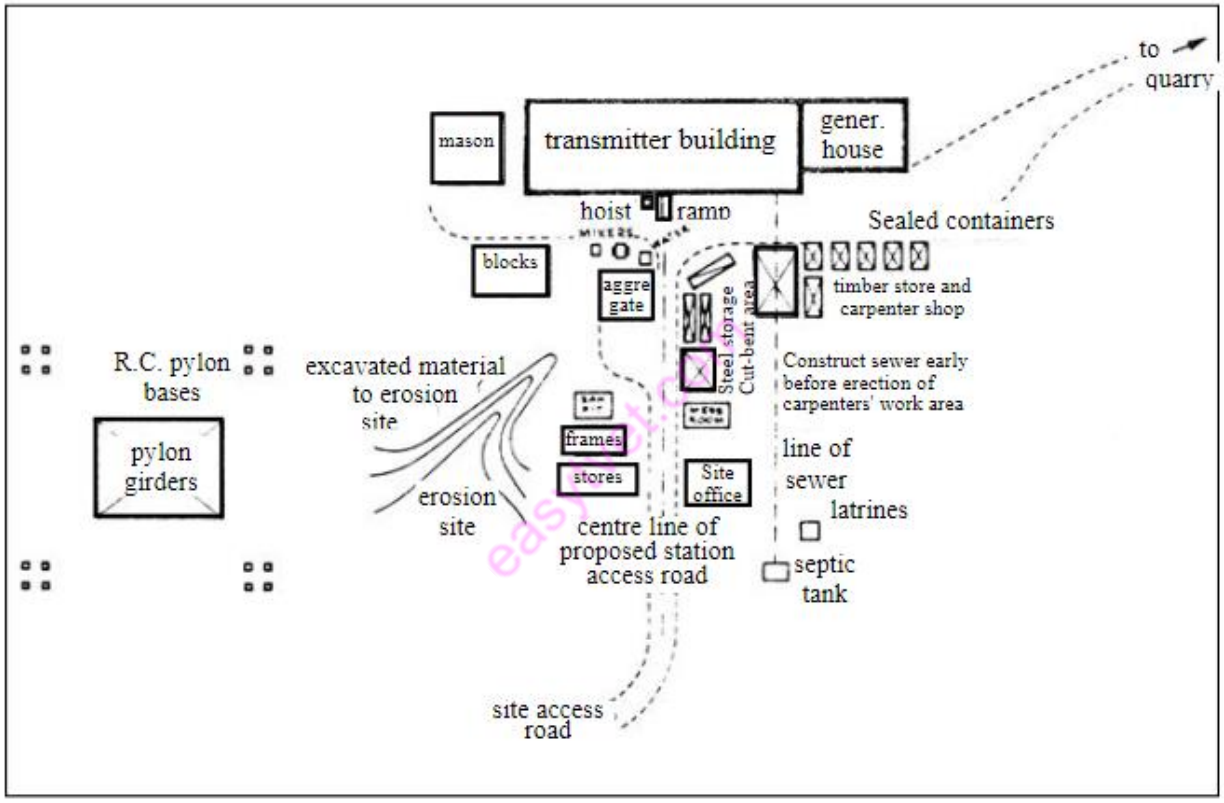
1. The contractor prepared the site layout plan as shown in the figure below. In developing this given plan, the contractor collected the following information to layout the site:
   -All equipment was delivered before building foundations were complete. All other fitting also delivered(doors, sanitary, etc.)
   -Generator house completed. Hoist was not available at commencement and has only just delivered.
   -Nearest pure water is in the town 20-km away. Water delivered by tanker and stored in 6 200-litre drums.
   -Pylon bases and sewer/septic tank not yet started.
   -Agents' office is sited on a privileged place and to satisfy the best view for site.
   Criticize the layout given in Figure 5 and prepare another layout to correct the criticism.

Criticism of existing site layout

i. **In general, the working area is too spread out, making control more difficult and increasing travelling time about the site which will lead to reducing productivity.**
ii. **Site latrines and canteen are too far away, causing loss of time due to unnecessary travelling. There is no apparent supply of drinking water on site.**
iii. **No security fencing is shown.**
iv. **Temporary access road should follow the line of the proposed station access road to avoid duplication of work.**
v. **Surplus excavation should have been led directly to the erosion site to avoid double handling.**
vi. **Pylon girders have been stacked over foundation bases, necessitating double handling.**
vii. **Stonemason's yard interferes with the movement and handling of technical equipment from the sealed containers.**
viii. **Site office is wrongly located. As the building rises the view of the site will be blocked.**
ix. **Cement store is too far from the mixer.**

x. **Hoist is on the wrong the side of the building, too far from the work areas.**
xi. **Mortar-mixing and block-making areas are too far from the building.**
xii. **Temporary buildings and storage areas are sited over the line of the sewer. The sewer should be constructed early to free the ground.**
xiii. **Steel is laid on the ground and not stacked in an orderly manner. Bending and fabrication benches are wrongly placed.**
xiv. **Timber storage area is unorganized.**
xv. **Sanitary fittings, pipes, and frames are stacked too near to the access road violating safety.**

Suggested improved layout:



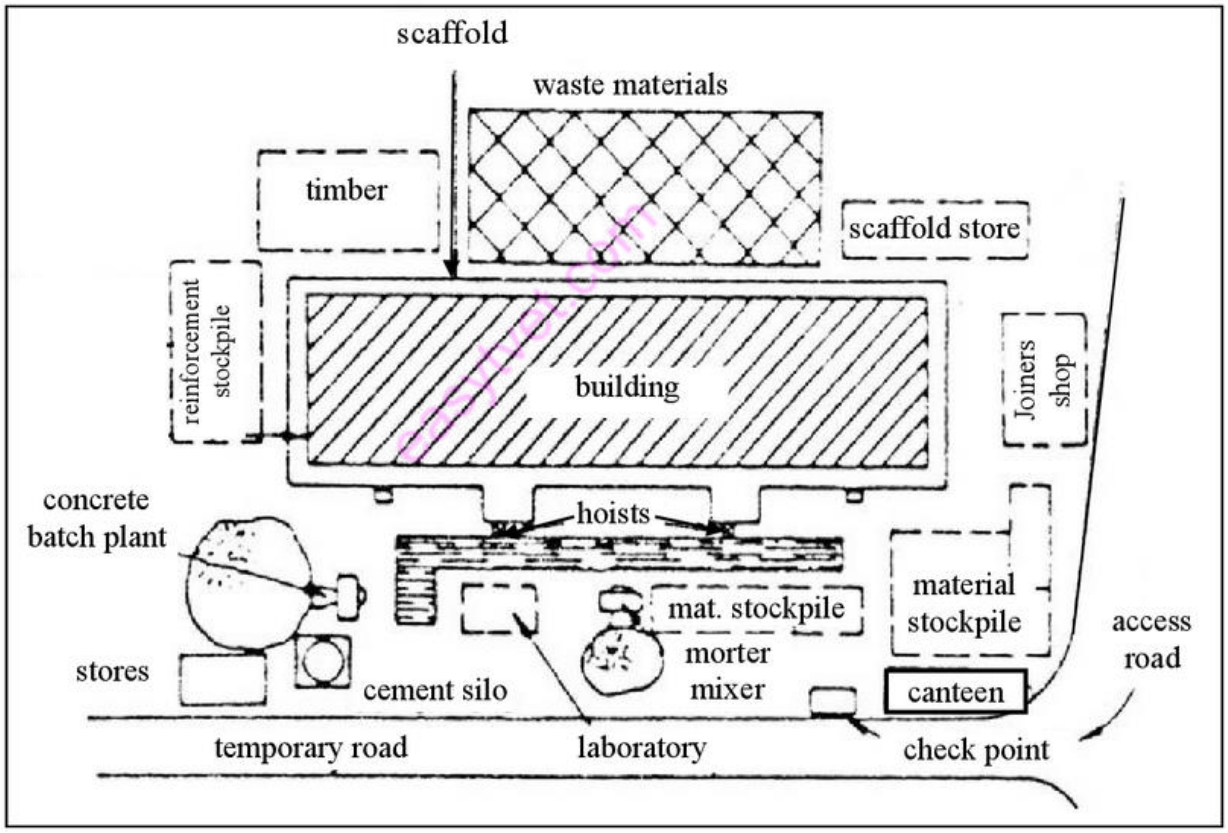
2. (i) Define the term site layout
A site layout is the arrangement of facilities and amenities in a construction site for smooth work flow
(ii)Outline SIX objectives of a good construction site layout

i. **Smooth work flow**
ii. **Prompt and efficient service**
iii. **Effective utilization of space**
iv. **Minimum investment**

v. **Profit maximization**
vi. **Less staff movement**
vii. **Ease of supervision**

3. Which site amenities would you put consider when planning a construction site?
   i. **Drinking water**
   ii. **Changing room and lockers**
   iii. **Sanitary conveniences**
   iv. **Site offices**
   v. **Meeting rooms**
   vi. **Site canteen**
   vii. **Temporary storage**
   viii. **Car parking**

4. Sketch a site layout plan of a medium size construction site and show the major details**.**



5. (a) What is the purpose of site identification board on a construction site?
   i. **It is an advertising aid, when clearly displayed**
   ii. **It saves traffic and visitors problems in finding the site**
   iii. **In sub-urban or rural locations 'finger boards', a form of signboard, is very useful in directing people to the site as street names are not always easy to locate.**

(b) Which items would appear on a signboard for a proposed construction site?

i. **Name of project,**
ii. **Name of client,**
iii. **Name of contractor,**
iv. **Name of architect,**
v. **Name of Chief Engineer,**
vi. **Name(s) of mechanical,**
vii. **Name of civil Engineer(s),**
viii. **Name of structural Engineer(s),**
ix. **Name of quantity surveyor,**
x. **Name(s) of sub-contractor(s).**

6. Which are some welfare items that can be provided for workers on a construction site?
   i. **Provision of drinking water**
   ii. **Washing facilities**
   iii. **Sanitary facilities**
   iv. **Changing rooms**
   v. **Restrooms**
   vi. **Canteens**
   vii. **Temporary housing**
   viii. **Transport from site to residence**
7. How can maximum efficiency be achieved in a construction site?
   i. **Improve workflow to reduce downtime**
   ii. **Use the current technology practices**
   iii. **Maintain and service equipment**
   iv. **Focus on employee training**
   v. **Keep communication efficient at all levels**
8. (a) How would you define the following terms:
   i. **Theft – The action or crime of stealing**
   ii. **Pilfering – the act of stealing items of little value**
   iii. **Vandalism – the deliberate action of destroying or damaging things and property**

(b) Which FIVE security measures would you put in place for the protection of a construction site?

i. **Post a strong perimeter fence around the site**
ii. **Maintain a clearance area along both sides of the perimeter fence**
iii. **Post a clear signpost stating that unauthorized access is not permitted**
iv. **Establish a single entrance point for vehicles**

v. **Use high quality locks to secure the gate, offices and stores**
vi. **Perform routine checks of the site daily**
vii. **Maintain ample lighting around the site**

9. Which factors would influence the choice of a fence for a site?
   i. **Purpose of the fence**
   ii. **Maintenance**
   iii. **Neighborhood regulations**
   iv. **Privacy**
   v. **Climatic conditions**
   vi. **Materials available**
10. What is the purpose of hoarding and which are the two types of hoardings commonly used?

    These are close boarded fences or barriers erected adjacent to a highway or public footpath to prevent unauthorized persons obtaining access to the site and to provide a degree of protection for the public from the dust and noise associated with building operations.

    Two forms of hoarding are in common use:
    i. **Vertical hoardings**
    ii. **Fan hoardings**

    The vertical hoardings consist of a series of closed boarded panels securely fixed to resist wind loads and accidental impact loads. It can be free standing or fixed by stays to the external walls of an existing building.

    A fan hoarding fulfills this function by being placed at a level above the normal traffic height and arranged in such a manner that any falling debris is directed back towards the building or scaffold.

1.2.1.6 Tools, Equipment, Supplies, and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Construction drawings
- Files
- Journals
- Manuals
- Resource persons
- Charts

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.1.7 References

i. Heap, A. (1987). Improving Site Productivity in the Construction Industry. International Labor office, ILO, Geneva.

ii. Chandler, I.E. (1987). Material Management on Building Site. The Construction Press, London.

iii. Harris, F. (1989). Construction Equipment and Methods. Longman Group, UK.

Hedley, G., and Garrett, C. (1983). Practical Site Management: An illustrated Guide. 2ndedition, London.

1.2.2 Learning Outcome 2 Interpret building contract documents

1.2.2.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to interpret building contract documents. It entails reviewing and interpreting building contract documents as well as recording contract information.

1.2.2.2 Performance Standard

2.1 Building contract documents are reviewed.
2.2 Building contracts are interpreted as per the contract type.
2.3 Contract information is recorded as per the contract interpretation.

1.2.2.3 Information Sheet

Definition of terms

Contract - A contract is an agreement that can be enforced by law.

Essentials of a valid Contract

A contract is an agreement enforceable by law. An agreement is an offer and its acceptance. An agreement which can be enforceable by law must have some essential elements. All agreements are contracts if they are made by the free consent of the parties competent to contract, for a lawful consideration and with a lawful object, and are not hereby expressly declared to be void" As per the above section, a contract must have the following elements.

1. **Intention to create legal relationship:** The parties entering into a contract must have an intention to create a legal relationship. If there is no intention to create a legal relationship that agreement cannot be treated as a valid contract Generally there is no intention to create a legal relationship in social and domestic agreements. Invitation for lunch does not create a legal relationship. Certain agreements and obligation between father and daughter, mother and son and husband and wife does not create a legal relationship. An agreement wherein it is clearly mentioned that "This agreement is not intended to create formal or legal agreement and shall not be subject to legal jurisdiction in the law of courts." cannot be treated as a contract and not valid.
2. **Lawful Object:** The objective of the agreement must be lawful. Any act prohibited by law will not be valid and such agreements cannot be treated as a valid contract.

3. **Agreement not expressly declared void:** Section 24 to 30 specify certain types of agreement which have been expressly declared void. For example Restraint of marriage which has been expressly declared void under Section 26.
4. **Proper offer and its acceptance:** To create a valid contract, there must be two or more parties. One who makes the offer and the other who accepts the offer. One person cannot make an offer and accept it. There must be at least two persons. Also the offer must be clear and properly communicated to the other party. Similarly acceptance must be communicated to the other party and the proper and unconditional acceptance must be communicated to the offerer. Proper offer and proper acceptance should be there to treat the agreement as a contract which is enforceable by law.

5. **Free Consent:** According to section 14, *consent is said to be free when it is not caused by (i) coercion, (ii) undue influence (iii) fraud, (iv) misrepresentation, or (v) mistake.* If the contract made by any of the above four reason, at the option of the aggrieved party it could be treated as a void contract.
6. **Capacity of parties to contract:** Parties entering into an agreement must be competent and capable of entering into a contract. If "A" agrees to sell a Government property to B and B agrees to buy that property, it could not treated as a valid agreement as A is not authorized or owner of the property.
7. **Certainty of meaning:** Wording of the agreement must be clear and not uncertain or vague. Suppose John agrees to sell 500 tons of oil to Mathew. But, what kind of oil is not mentioned clearly. So on the ground of uncertainty, this agreement stands void
8. **Possibility of performance:** As per section 56, if the act is impossible of performance, physically or legally, the agreement cannot be enforced by law. There must be possibility of performance of the agreement. Impossible agreements like one claims to run at a speed of 1000km/hour or Jump to a height of 100 meters or constructing a house in the sky etc.
9. **Lawful consideration:** An agreement must be supported by a consideration of something in return. That is, the agreement must be supported by some type of

service or goods in return of money or goods. However, it is not necessary the price should be always in terms of money. It could be a service or other goods.

10. **Legal formalities:** The contract act does not insist that the agreement must be in writing, it could be oral. But, in some cases the law strictly insist that the agreement must be in writing like agreement to sell immovable property must be in writing and should be registered under the Transfer of Property Act, 1882. These agreements are valid only when they fulfill the formalities like writing, registration, signing by the both the parties are completed. If these legal formalities are not completed, it cannot be treated as a valid contract

Types of building contracts

1. **Labour Only Contract**

Labour only contract is a type of contract whereby the owner supplies all the materials while the contractor supplies only the labour and sometimes also the equipment, so the tender is only on the labour terms of the contract. This type of contract suits the small contractor with no financing means or abilities. It is extensively used by cooperatives of skilled laborers which supply a certain part of the labour force, for instance, concreters, masons, plasterers etc.

Such a contract may pose problems and claims in case the owner or main contractor will not be in a position to ensure a steady supply of materials or provide the necessary plans and specifications in time thus causing the labour force to stay idle.

2. **Cost Reimbursement Contracts**

In some occasions, it may not be possible to ascertain by measurement the full extent and nature of the work involved before the contract gets underway. However the client may still wish to appoint a contractor and make a start on the job as soon as possible resulting in decisions and final design work being determined as the contract progresses. In such circumstances, the client reimburses the contractor a suitable cost plus (all labour, sub-contractors, material, plant) basis where the actual cost of construction are paid together

with a fee which represents the contractor's management and technical costs, overheads and profit. A contract of this nature is known as cost reimbursement contract. The features of this type of contract include:

i. It encourages a greater degree of cooperation between the contractor and the client working together closely in the design stages and decision-making.
ii. Since the contractor is paid in accordance with his actual costs incurred (known as prime cost) weekly time sheets verified by the architect/clerk of works submitted to establish labour costs, quotations, delivery tickets and invoices for material costs and plant returns for machinery and equipment used must be carefully kept.
iii. The valuing of variations presents no problems as the cost involved in design changes etc are simply absorbed into the total figure as the work proceeds.
iv. Close coordination must be maintained between the architect and the contractor in establishing the optimum level of manpower and the extent to which plant and equipment is needed at each stage in the development.
v. The contract may be executed not only by the main contractor but also by nominated and private sub-contractors whose work may be valued on a different basis.

3. Target Cost Contracts

In this type of contract a provisional estimate of the prime cost is prepared and the figure agreed as being realistic by both the contractor and client before work commences. To this sum is added the contractor's fee for overheads and profits and the resulting figure is adopted as the "target cost" for the project. However an opportunity for an added "bonus" to be earned by the contractor is introduced in relation to the amount by which the actual cost, including the original fee, either falls short of or exceeds the target figure. The contractor's fee for overheads and profits is fixed neither by a percentage nor a set sum, but with a fee that can be increased or decreased by means of an agreed percentage by the parties.

A contract of this type will provide an incentive to a contractor to complete the works at as low a price as possible for in so doing he will benefit by receiving the agreed percentage of the savings. However, upon the project costing more than the agreed target

cost, he will forfeit some of his fee. It should be noted that in the process of trying to reduce his cost, the contractor could comprise on the quality of work.

Example

(i) Given that the target cost of a project is sh36 million and the increase/decrease percentage is 20%. If it costs sh50 million on completion, calculate the fee paid.

(ii) If on completion the costs total was sh30 million, calculate the fee paid.

(Using the target cost with fixed fee method)

Solution

(i) Target cost = $36\text{m} \pm 20\%$

On completion it cost 50m.

$50 - 36 = 14$

Reduction = $\frac{20}{100} \times 14 = 2.8$ million

Thus if the initially agreed fee was 20% of sh36m

$\frac{20}{100} \times 36 = 7.2\text{m}$

Fee paid = 7.2 – 2.8 = sh4.4 m

(ii) If on completion it cost sh30 m

$36 - 30 = 6\text{m}$

$\frac{20}{100} \times 6 = 1.2\text{m}$

Agreed fee was $\frac{20}{100} \times 36 = 7.2\text{m}$

Actual fee paid = 7.2 + 1.2 = sh8.4 million

4. Package Deal contract

This is so termed because of all-in service it provides. In a contract of this nature only two parties exist i.e. the client and the contractor. The contractor will normally provide all the services, such as architect, quantity surveyor, consultants etc.

Under the package deal a client will provide brief details as to his requirements and either select a contractor or offer it to open or selected methods, leaving the task of design and costs to the builder. Generally this will concern the industrial type of building and may leave the client little choice of design resulting in his not always getting what he hoped for. The client has no independent consultant to advise him on design or costs.

5. Continuity Contract

On occasions where a client foresees further work beyond the immediate project, he may wish to maintain continuity of the work with the same contractor. An ideal opportunity to make use of this sort of arrangement would present itself where a long-term large-scale housing scheme is planned involving for example 300 houses. Such a large contract if attempted as a single job would not only be extremely costly but also difficult to manage with only one contractor having to commit a great deal of resources to that job. The best thing in such a situation is to select the contractor for, say, phase I only by normal means and thereafter negotiating with that contractor for the remaining phases. This is known as continuity contract**.**

6. Serial Contract

This type of contract could be classed as a negotiated contract. A builder is asked to tender for one particular project, bearing in mind that if he is successful he will be asked to negotiate for a number of projects of the same character. For example, a local authority intending to build four or five schools of the same type within their area. The approximate extent of the series of contracts will be known at the tender stage even though the design work on some of them may as yet be incomplete.

With this type of contract, accurate bills of quantities and a careful estimate can be prepared, the builder bearing in mind that if he succeeds in winning the contract he is assured of a continuation of work. He will therefore often cut costs to a minimum in the hope of being successful, resulting in a very competitive selection of tenders. A builder should be able to cut his costs knowing that, as the projects are built, his team should become more efficient so the productivity rate should be raised, also his organization will be attuned to the work owing to its repetitive nature and, of course, any new plant purchased is guaranteed a full working life for the duration of the projects. A safeguard for

the client is generally entered as a clause in the contract, stipulating that if the work is not up to standard, subsequent contracts will be withdrawn.

7. Term Contracts

A term contract is a type of continuity contract which has been adopted to suit situations where a continuous programme of work is required on a particular site or within a certain defined area.

This system is particularly applicable to government establishments, bases for the armed forces, large-scale industrial sites and oil refineries where there will be a constant need for maintenance and repairs together with small-scale and medium-scale extension and alteration work. When tendering, contractors are aware of the nature and approximate value of the work based on previous contracts but at this stage the actual extent of the work cannot be known and tenders are submitted in the knowledge that the successful contract will undertake to carry out all the work given to him over a certain period of time or "term", a typical period being perhaps 2 years.

The tendering documents will normally be a schedule of rates covering most of the work normally encountered with contractor quoting a single percentage addition or reduction on the schedule as a whole to cover preliminaries, overheads and profits. The successful contractor will be issued to him from time to time by the supervising officer or clerk of works and the work valued in accordance with the schedule rates amended by the percentage addition/reduction.

On expiry of the two-year term the contract will be up for a renewal and the contractor selection process adopted once more.

CONTRACT DOCUMENTS

Construction works intended to be awarded to contractors are given wide publicity so that a sufficient number of interested parties may bid for the work. Usually the lowest is accepted unless there are reasons to the contrary. A valid contract which clearly describes the work should also define the rights and obligations of the owner and the contractors in a document called the contract document.

The main components of a typical set of contract documents include:

1. WORKING DRAWINGS

These comprise a complete set of fully dimensioned drawings including plans, elevations, sections, detailed drawings, and site plan.

i. **Plan**: The site plan shows the relationship of the building to the site boundaries and adjoining roads and buildings. The floor plans show the position of the walls, partitions, doors, and windows. The roof plan shows how to place the steel/timber in form of trusses.
ii. **Elevations:** These are external views of the building. They show the general appearance and locations of doors and windows.
iii. **Sections**: These show the depth of the foundation and the levels of floors and roofs as well as sizes of structural elements like trusses, beams, columns, stairs etc.

After the building is designed, the working drawings are produced by the architect, structural engineers, or the architectural technician, and are used by the main contractor and subcontractor on site in construction of building. They are generally considered to be the heart of the contract documents and are used for other purposes such as:

i. Obtaining planning and building control approval from the local authority
ii. Preparing specifications of the work
iii. Preparing bill of quantities
iv. Preparing a tender estimate for the project

Any subsequent amendments, changes or additional drawings may constitute variations to the contract involving the contractor in extra cost and delays for which he will be able to seek payment unless their arrival is not so timed to actually disrupt the execution of the works.

The contract documents must contain a list of all the drawings, each with a brief explanatory title and unique number. Frequently a suffix is added to the drawing numbers in order to emphasize the special status of the set issued for the contract.

2. SPECIFICATIONS

Specifications is a document prepared by the architect that describes the nature and class of work, materials to be used, labour employed, method of work, precautions to be taken and quality of workmanship for the project. It amplifies the contractor's duties and obligations as set out in the conditions of contract.

The drawings of a building or structure show the arrangement of rooms and dimensions and includes a brief description of the different parts but do not furnish the details of different items of work, the quantity of materials, workmanship etc, which are all described in the specifications.

Specifications serve the following purposes**:**

i. Guide the bidders at the time of tendering for arriving at a fair price for the work involved.
ii. Provide guidance for execution and supervision of work and purchase of materials
iii. State the acceptance criteria for different items of work

Typical items included in specification

i. Site description
ii. Restrictions (limited access and working hours etc)
iii. Availability of services (water, electricity, gas, telephone etc)
iv. Descriptions of workmanship – quality, fixing and jointing
v. Description of materials – quality, size, tolerance and finish
vi. Other requirements: site clearance, making good on completion, nominated suppliers and sub-contractors

3. BILL OF QUANTITIES

The bill of quantities is a schedule prepared by the quantity surveyor listing constituent parts of the building with identifying descriptions, estimate quantities and priced rates for each item. This document gives a complete description and measures of the quantities of labour, materials and other items required to carry out the work based on the drawing, specifications and schedules. Its function is to provide data for comparison and assessment of bids at tender stage and thereafter to act as a schedule for rates for valuation purposes and assist the quantity surveyor in assessing the rate for any new or varied work.

The quantity surveyor reads the working drawings and specifications to determine the volumes, areas, linear measurements of works required. When these are written up as the bills of quantities the contractor decides how much to charge for each part of the job and adds up these to determine the total cost of the building work. To this he then adds an amount for overheads and profit. As far as the contract is concerned errors in extending a rate (i.e. multiplying it by the quantity) or in totaling up the various elements of the bill are of no effect. The rate themselves however, are binding and even if they contain mistakes then the contractor will be held to them unless there are exceptional circumstances.

Bills of quantities normally contain the following information:

i. Preliminaries: Deal with the general particulars of the work such as the names of the parties involved, details of the work, description of the site and conditions of contract.
ii. Preamble: Introductory clauses to each trade concerning description of the materials and workmanship similar to those stated in the specifications.
iii. Measured Quantities: A description and measurement of an item of work, the measurement being given in metre (m), metres squared (m^2), kilograms (kg) or just enumerated as appropriate.
iv. Provisional Quantities: Where an item cannot be accurately measured and approximate quantity to be allowed for can be stated. Adjustments will be made when the full extent of the work is known.

v. Provisional Sum: A sum of money to be included in the tender work which has not yet been finally detailed or for a "contingency sum" to cover the cost of any unforeseen work.

vi. Prime Cost Sum: An amount of money to be included in the tender for work for services or materials provided by a nominated sub-contractor, supplier or statutory body.

4. CONDITIONS OF CONTRACT

This is a document that describes the rights and obligations of all parties under a given contract. The parties should be thoroughly conversant with the precise provisions and true importance of each clause in the contract agreement. The following are the important conditions of contract**:**

i. Time of Completion: The contractor is required to complete the project within the agreed time of completion which is specified in a suitable unit of time (years, months, weeks etc) depending upon the nature and scope of the work.

ii. Delay and extension of time: Delay in completion of the project not attributed to the contract should be brought to the notice of the owner by the contractor in writing within the time specified in the contract for seeking the extension of time. The owner will satisfy himself that the delay is not on account of a lapse on the part of the contractor before granting suitable extension of time.

iii. Penalty: It is a fine imposed on the contractor for not fulfilling his contractual obligations such as failure to maintain the required progress of work, delay in completion, poor quality of work etc.

iv. Compensation of delay in Completion of Project: The contractor is liable to pay compensation to the owner for delay attributed to him in completion of the project. The amount of compensation may be stated as a percentage of the estimated cost of work for each unit of time of delay.

v. Liquidated damages: It is a fixed stipulated sum payable by the contractor on account of penalty for delays and does not bear any relationship to the real damage to the owner.

vi. Variations: A modification of the specification by the client/architect. The contractor must be issued with a written variation order or architect instruction.

vii. Valuation of variations: The valuation of variations is based on change orders issued in writing by the owner. Generally the variations in individual items of work should not be more than 25% and variation in total cost should not exceed 10%.

viii. Interim payment: A monthly or periodic payment made to the contractor by the client.

ix. Defects liability period: A period of normally six months after practical completion to allow any defects to become apparent. Where the contractor is called upon to repair any defects therein, he will be entitled to the retention fee after any defects have been rectified to the architect's satisfaction.

x. Retention fee: A sum of money which is retained by the client until the end of any agreed defects liability period.

xi. Settlement of disputes: Efforts should be made to resolve disputes amicably between the owner and the contractor through mutual discussions and negotiations. Disputes may arise between the contractor and the owner because of several factors: defective work, excess consumption of materials etc. The disputes can be settled through litigation in a court of law or, where the contract permits, through arbitration. Arbitration is the process of hearing and determination of a dispute by an impartial referee selected or agreed upon by the parties concerned.

xii. Natural disasters: These are acts of nature such as unprecedented rainfall/floods, earthquakes, hurricanes, fire etc. These disasters along with occurrence of riot, civil commotion, revolts etc. are beyond the control of the contractor and may lead to financial or time loss. The contractor should obtain an insurance policy for such risks as can be covered by insurance. In the event of financial or time loss the contractor can claim financial compensation from the owner for risks that are not insurable and an extension of time for all such risks.

xiii. Price escalation: During execution of the work, labour, wages and materials prices may increase as a result of inflation. The contract conditions should therefore include an appropriate clause for payment of escalation to the contractor.

5. FORM OF TENDER AND AGREEMENT

It is a pro-forma letter addressed to the client and requiring signature by the contractor which promises to contract and complete the whole of the works, for such sum as may be ascertained in accordance with the conditions of contract. It comprises bill of quantities, contractor's rates, total cost of work, time for completion, security money to be deposited and penalty clauses. Usually the form of tender and agreement refers to an attached appendix which sets out such essential details as:

i. The value of the bond which the contractor may be required to arrange through a bank or insurance company to guarantee performance of the contract and which would be forfeited to the client in the event of the contractor failure.
ii. The time for completion of the work.
iii. The liquidated damages payable to the client for each day or week of delay in completion ("liquidated" means that the likely loss to the employer has been ascertained and expressed in monetary terms)
iv. The length of time for which the contractor must maintain the work after completion (defects liability period).
v. The minimum value of work, which must be completed in any month before the client will accept an account for payment.

As most forms to tender state that the form itself plus the client's letter of acceptance constitute a binding contract unless and until a formal agreement is prepared and executed there is no need in law to do more.

6. SCHEDULE OF RATES

A schedule of rates is a list in a contract setting out the staff, labour and plant hire rates etc that a contractor will use for pricing cost reimbursable work. It does not contain any quantities for the specific work items and is typically used when the nature of work required is known but it cannot be quantified, or if continuity of programme cannot be determined.

The advantages of schedule of rates term contracts include:

- Variations are easier to estimate and normally cheaper than on fixed price traditional contracts.
- The client can stop and start work at a pace that might be determined by cash flow or funding.
- A larger pool of contractors can be asked to tender as the process is inexpensive and quick.
- It is flexible in relation to scope and contractual commitment.
- As a fully-detailed design is not required the client can obtain tenders at the early stages of a project and begin construction before completion of the design. So to this extent it is 'fast track'.

The disadvantages include:

- Additional resources are required to measure work and certify payments.
- The client does not have a final price when committing to starting work.
- It is difficult for contractors to plan long-term resources and so might mean changes to personnel with loss of continuity.
- Contractors may be tempted to front-load costs in case later work does not materialize.
- There is no real incentive for contractors to treat such work with any sense of urgency and its best staff will be placed on the projects where the contractor is carrying more risk.

1.2.2.4 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Prepare a simple bills of quantities
2. Prepare a sample specifications for the bills of quantities above

Resource Requirements

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Chats

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.2.5 Self-Assessment questions

1. How would you define the term contract?
2. Which are the main essentials of a valid contract?
3. What is meant by labour only contract and how does it function?
4. Which are the main components of working drawings?
5. What is target cost contract?
6. What are the main purposes of specifications?
7. Which are the main components of bills of quantities?
8. Which are the important conditions of contract?

9. Which are the details found in form of tender?
10. Which are some items found in specifications?

Response to self-assessment questions

1. How would you define the term contract?

   A contract is a verbal or written legal agreement between two or more parties that says what each must do for, or give to, the other

2. Which are the main essentials of a valid contract?

   i. **There must be an offer and acceptance**
   ii. **There must be an intention to create legal relations**
   iii. **The contract must be either under seal or consideration: each party to the contract must receive some sort of benefit or gain from the contract.**
   iv. **The parties must have capacity to contract (capacity in law, e.g. of age, of sound mind).**
   v. **There must be genuine consent by the parties to the terms of the contract e.g. not entered into by mistake, fraud etc.**
   vi. **The contract must be legal and possible.**

3. What is meant by labour only contract and how does it function?

   Labour only contract is a type of contract whereby the owner supplies all the materials while the contractor supplies only the labour and sometimes also the equipment, so the tender is only on the labour terms of the contract. This type of contract suits the small contractor with no financing means or abilities. It is extensively used by cooperatives of skilled laborers which supply a certain part of the labour force, for instance, concreters, masons, plasterers etc.

4. Which are the main components of working drawings?

   i. **Plan: The site plan shows the relationship of the building to the site boundaries and adjoining roads and buildings. The floor plans show the position of the walls, partitions, doors and windows. The roof plan shows how to place the steel/timber in form of trusses.**

ii. **Elevations: These are external views of the building. They show the general appearance and locations of doors and windows.**

iii. **Sections: These show the depth of the foundation and the levels of floors and roofs as well as sizes of structural elements like trusses, beams, columns, stairs etc.**

5. What is target cost contract?

   In this type of contract a provisional estimate of the prime cost is prepared and the figure agreed as being realistic by both the contractor and client before work commences. To this sum is added the contractor's fee for overheads and profits and the resulting figure is adopted as the "target cost" for the project

6. What are the main purposes of specifications?

   a **Guide the bidders at the time of tendering for arriving at a fair price for the work involved.**
   b **Provide guidance for execution and supervision of work and purchase of materials**
   c **State the acceptance criteria for different items of work**

7. Which are the main components of bills of quantities?

   i. **Preliminaries: Deal with the general particulars of the work such as the names of the parties involved, details of the work, description of the site and conditions of contract.**

   ii. **Preamble: Introductory clauses to each trade concerning description of the materials and workmanship similar to those stated in the specifications.**

   iii. **Measured Quantities: A description and measurement of an item of work, the measurement being given in metre (m), metres squared (m2), kilograms (kg) or just enumerated as appropriate.**

   iv. **Provisional Quantities: Where an item cannot be accurately measured and approximate quantity to be allowed for can be**

stated. Adjustments will be made when the full extent of the work is known.

v. **Provisional Sum: A sum of money to be included in the tender work which has not yet been finally detailed or for a "contingency sum" to cover the cost of any unforeseen work.**

vi. **Prime Cost Sum: An amount of money to be included in the tender for work for services or materials provided by a nominated sub-contractor, supplier or statutory body**

8. Which are the important conditions of contract?

a **Time of Completion: The contractor is required to complete the project within the agreed time of completion which is specified in a suitable unit of time (years, months, weeks etc) depending upon the nature and scope of the work.**

b **Delay and extension of time: Delay in completion of the project not attributed to the contract should be brought to the notice of the owner by the contractor in writing within the time specified in the contract for seeking the extension of time. The owner will satisfy himself that the delay is not on account of a lapse on the part of the contractor before granting suitable extension of time.**

c **Penalty: It is a fine imposed on the contractor for not fulfilling his contractual obligations such as failure to maintain the required progress of work, delay in completion, poor quality of work etc.**

d **Compensation of delay in Completion of Project: The contractor is liable to pay compensation to the owner for delay attributed to him in completion of the project. The amount of compensation may be stated as a percentage of the estimated cost of work for each unit of time of delay.**

e **Liquidated damages: It is a fixed stipulated sum payable by the contractor on account of penalty for delays and does not bear any relationship to the real damage to the owner.**

f **Variations: A modification of the specification by the client/architect. The contractor must be issued with a written variation order or architect instruction.**

g **Valuation of variations: The valuation of variations is based on change orders issued in writing by the owner. Generally the variations in individual items of work should not be more than 25% and variation in total cost should not exceed 10%.**

h **Interim payment: A monthly or periodic payment made to the contractor by the client.**

i **Defects liability period: A period of normally six months after practical completion to allow any defects to become apparent. Where the contractor is called upon to repair any defects therein, he will be entitled to the retention fee after any defects have been rectified to the architect's satisfaction.**

j **Retention fee: A sum of money which is retained by the client until the end of any agreed defects liability period.**

k **Settlement of disputes: Efforts should be made to resolve disputes amicably between the owner and the contractor through mutual discussions and negotiations. Disputes may arise between the contractor and the owner because of several factors: defective work, excess consumption of materials etc. The disputes can be settled through litigation in a court of law or, where the contract permits, through arbitration. Arbitration is the process of hearing and determination of a dispute by an impartial referee selected or agreed upon by the parties concerned.**

l **Natural disasters: These are acts of nature such as unprecedented rainfall/floods, earthquakes, hurricanes, fire etc. These disasters along with occurrence of riot, civil commotion, revolts etc. are beyond the control of the contractor and may lead to financial or time loss. The contractor should obtain an insurance policy for such risks as can be covered by insurance. In the event of financial or time loss the**

contractor can claim financial compensation from the owner for risks that are not insurable and an extension of time for all such risks.

m Price escalation: During execution of the work, labour, wages and materials prices may increase as a result of inflation. The contract conditions should therefore include an appropriate clause for payment of escalation to the contractor.

9. Which are the details found in form of tender?

i. The value of the bond which the contractor may be required to arrange through a bank or insurance company to guarantee performance of the contract and which would be forfeited to the client in the event of the contractor failure.
ii. The time for completion of the work.
iii. The liquidated damages payable to the client for each day or week of delay in completion ("liquidated" means that the likely loss to the employer has been ascertained and expressed in monetary terms)
iv. The length of time for which the contractor must maintain the work after completion (defects liability period).
v. The minimum value of work, which must be completed in any month before the client will accept an account for payment.

10. Which are some items found in specifications?

i) Site description
ii) Restrictions (limited access and working hours etc)
iii) Availability of services (water, electricity, gas, telephone etc)
iv) Descriptions of workmanship – quality, fixing and jointing
v) Description of materials – quality, size, tolerance and finish
vi) Other requirements: site clearance, making good on completion, nominated suppliers and sub-contractors

1.2.2.6 Tools, Equipment, Supplies, and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Chats

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.2.7 References

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1.2.3 Learning Outcome 3: Prepare construction work plan

1.2.3.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to prepare construction work plan. It entails determining project scope of work, allocating project equipment and preparing project time schedules.

1.2.3.2 Performance Standard

3.1 Projects scope of work is determined as per the project documents.
3.2 Projects work equipment is allocated as per the time schedule.
3.3 Projects time schedule is prepared as per the scope of work.

1.2.3.3 Information Sheet

Definition of terms

Project – a project is an activity aimed at producing a unique goods or services

The concept of planning

Planning is a well thought out guess which aims to lay down directions in which a move is made forward, taking into account the resources available. In order to make logical satisfactory plans, all the relevant information has to be collected, analyzed critically, and used to make calculated plans to a high degree of accuracy and foresight of the problems and possible delays. In the building industry, there are a number of types and methods of planning.

Policy Planning

Concerned with the operation of an organization as a commercial undertaking, it is the task of the top management and considers the past and the present and survival to plan for the future as far as trends, markets, and finance are concerned. Some policies are necessary for the success of any organization. A policy of any organization will generally include:
The objective of the business: what will the company do?
Financial structure e.g. total working capital and the expected profit returns relative to the number of projects that the company could undertake
Time scale: regular reference is made to policy to ensure that the forecast is going ahead as planned
Overall activities of the business: whether to be general building contractors, a plumbing sub-contractor, or a specialist in carpentry and joinery
Purchases: a policy in purchase of plant, equipment, formwork, scaffold etc with special consideration on whether to buy or hire
Organization: the general set up of a business to include the allocation of the heads of departments, the personnel policy (to include items on training, promotions, pensions schemes etc.) and the like with special emphasis on the need to keep overheads as low as possible yet remain efficient.

Technical Planning

Associated with the technical processes, and concerned with the various methods of arranging and employing money, materials, personnel and plant (all of which are called resources) to carry out the day-to-day operations of the company.

The use of planning methods may be divided, very broadly, amongst the following two stages of the overall construction period:

Pre-tender period – the period between the receipt of the tender enquiry at the contractor's office (or advertisement) and his submission of the tender

Contract period – the period between the acceptance of a tender and the completion of the site works. (Sometimes this later period is divided into the **pre-contract period**, which is between the tender acceptance and the commencement of work on the site, and the **contract period** of work on the site)

Planning stages in the contruction process

A. Pre-tender planning

All that a builder will skillfully do, after the receipt of tender notice and before submitting the bid, in order to win a competitive approval to perform a construction activity.

Activities involved include:

The client advertises the work in the media or may invite certain contractors to tender for a project. The architect and his team of professionals are involved.

The contractor decides on whether he wishes to tender for the project or not. If he decides to tender, he responds by

i. Paying a given fee
ii. Collecting and carefully studying the tender documents and drawings to find out the quantities of each item of work, materials, time limit and other conditions of work
iii. Visit the proposed site
iv. Submit back the costed tender documents

At pre-tender stage, all the facts that are possible to gather are collected and critically examined for the intended purpose of preparing estimates – estimate build-up. Various departments are normally involved in order to reduce the risks of inaccurate decisions. An example of a systematic procedure of a tender is as follows:

i. The pre-tender report (site investigation)
ii. Method statement
iii. Plant schedule
iv. Site organization structure and site on-costs
v. Sub-contractors and suppliers
vi. Outline programme
vii. Final estimate (for Board's decision)

i. Pre-tender report

This is a comprehensive document detailing all the required information regarding the area and general site conditions. Though in most cases it would give general basic information, each company would develop its own to suit the nature of the company and the types of contracts undertaken. A typical example is as follows:

A.N. OTHER GENERAL CONTRACTORS
PLANNING DEPARTMENT
SITE INVESTIGATION REPORT

PROJECT
PREPARED BY **DATE**

SITE
General description of project
Local Authority
Access
Temporary roads
Distance of site from main road
Working space for siting offices
Trespass precautions
Police regulations
Concealed services
Nearest Bench Mark
Photographs

SUB-STRATA
Types of soil
Stability
Anticipated water table
Source of water
Pumping
Disposal of water

SERVICES	**AUTHORITY**	**NEAREST SUPPLY**
Water		
Electricity		
Telephone		
Gas, petrol/diesel, oils & lubricants		

LABOUR
Availability -Skilled
- Semi-skilled
- Unskilled

TIPPING FACILITIES AND RESTRICTIONS

LOCAL SUB-CONTRACTORS

OTHER SPECIAL DETAILS
Local weather

ii. Method statement

This is a worked out best way and means of carrying out a process of construction, carefully weighing the various alternative methods that could be adopted; what plants to be used and what qualities are involved. In developing a method statement, consideration has to be given to whether the cheapest or fastest method is required for a particular construction activity for it may be expedient to spend a little extra at one stage to finish early so that other operations can be started. A typical method statement is shown below:

METHOD STATEMENT CONTRACT PREPARED BY CONTRACT NO. SHEET NO. DATE			
ACTIVITY	**METHOD**	**PLANT OUTPUT**	**REMARKS**
EXCAVATION Site Stripping	Bulldozer - CAT D4	$50m^3/hr$	Soil to be moved approx. 30m
Foundation and Drain trenches	CAT 950E 2.5m^3 bucket shovel loading 5m^3 tipper	$30m^3/hr$	Haul to land fill 1km away in a disused quarry
CONCRETE Foundations	7NT mixer with loading hopper concrete discharged direct to wheelbarrows	$2.4m^3/hr$	Required for first 5 weeks

iii. Plant schedule

Prepared on the completion of the method statement and gives a detailed summary of all the plants of and equipment required for the construction to completion of the works, repair of machines, testing facilities etc., shown below:

PLANT SCHEDULE

CONTRACT PREPARED BY
CONTRACT NO.
SHEET NO. DATE

No.	DESCRIPTION	WEEKS	AVAILABILITY		MAINTENANCE	REMARKS
			OWN	HIRE		
1	Tractor CAT Type D4 Bulldozer	1	-	√	-	
1	CAT 950 E 2.5 m bucket shovel	2	√	-	Daily and weekly routine	
1	7NT Bedford Concrete mixer	10	√	-	-Do-	

iv. Site organization and on-cost

These are items covered as site overheads and cannot be priced in the course of normal productive work but still have to be charged to the project. Included are the site staff required for administration, temporary roads, site huts, hoardings, offices, stores, power, water, telephone etc. Site supervisory or technical staff costs are calculated in relation to their administrative time. An example of site on-costs is shown:

SITE ON-COSTS

CONTRACT
CONTRACT NO. 10/07 CONTRACT PERIOD 16 WEEKS

SITE STAFF PERSONNEL	FOREMAN
General Foreman	16 weeks
Site foreman (Brickwork)	8 weeks
Site foreman (C&J)	6 weeks
Quantity Surveyor	6 weeks
Site Clerk	14 weeks
General Office Cleaner	16 weeks

SITE HUTS, OFFICES AND ACCOMMODATION

1 No. Foreman's Office 16 weeks Telephone installed

1 No. COW's Office	16 weeks	-Do-
1 No. General Office	16 weeks	-Do-
1 No. Operatives Hut	16 weeks	Tables and chairs
1 No. Plant Stores	8 weeks	
1 No. General Stores	16 weeks	Include lock up box
3 No. Latrines	16 weeks	
Compound	16 weeks	$20m \times 20m$ Open mesh
2 No. NOTICE BOARDS		
PLANNING DPT		
PREPARED BY		
DATE		

v. Sub-contractors and suppliers

A list of the required sub-contractors and suppliers is drawn up and enquiry forms are sent out to ascertain their availability on dates required and their ability to complete work in whatever time has been roughly allocated on the pre-tender programme and to obtain quotations. More detailed questionnaires are sent to selected sub-contractors if a tender is successful for the purpose of obtaining more detailed and definite information for producing a master plan. Enquiries to supplies should be more specific about prices, delivery dates and whether the quantity and quality can be maintained. A sample of sub-contractor's questionnaire is shown below:

SUB-CONTACTORS QUESTIONNAIRE SHEET

JOB FIRM TRADE DATE

	QUESTION	**ANSWER**
i.	How long will it take you to complete the whole works?	
ii.	What is your proposed sequence of work?	
iii.	What labour strength do you intend to employ on site?	
iv.	How many visits would you have to make to complete the works?	
v.	Do you require additional information before commencement on site?	
vi.	What is the minimum notice which may be given for commencement?	
vii.	State your storage requirements	
viii.	What attendance of facilities do you require?	
ix.	Do you agree to comply with conditions of the main contract?	
x.	Do you agree to enter into a standard form of sub-contract?	

vi. Outline programme (pre-tender plan)

Produced from estimated information. It is not a detailed plan but an outline of the main operations and sub-contractor's work. It enables all parties concerned in the pre-tender preparation to coordinate their activities and to assess the times required for plant, use of site huts and supervisor's duration on site. It is based on a bar or Gantt chart, developed by Henry Gantt around 1919.

PRE-TENDER PROGRAMME

CONTRACT No. **FOR:** **PLANNING DPT**

DATE: **SHEET No.**

PREPARED BY

DURATION IN WEEKS		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
1	Setting out																				
2	Exc. of Found & Drains																				
3	Drainage																				
4	Siteworks to d.p.c.																				
5	Framework, B'work struct																				
6	Roof																				
	Installations, 1st Fix																				
7	plaster																				
8	2nd Fix, Decoration																				
9	Services																				
10	External works, clear																				

B. Pre-contract planning

A successful tenderer upon signing the contract documents, becomes a contractor for the project and will be allowed a short period of time, "the pre-contract period" to make preparations and organize his resources before actual commencement of work.

During the pre-contract period, the parties concerned: client, builder and architect on one hand and planning department and other departments within the company on the other, usually get very busy in meetings to streamline all matters relating to the contract. The site supervisor is involved in most of these meetings and in those other departmental meetings within the contractor's organization in order to get to grips with problems and matters relating to the contract, as he is the one to deal with all parties concerned. From all the above and the past planning, a sound planning for the contract period can be done. The major items considered at this stage include:

Site layout and general organization

Labour and plant requirements schedules finalized

Contract (Master) programme preparation

The use of a checklist at this stage is important as possibilities of items being forgotten are minimized.

A.N. OTHER CONSTRUCTION COMPANY LTD
PLANNING DEPARTMENT
CONTRACT CHECK LIST

DATE
JOB No.

	Responsibility	Action By	Date	Termination Clearance
INSURANCES	Company Secretary			
Guarantee bond				
All risks				
Fire/third party				
Value of contract				
Period of contract				
Special				
Demolition				
Difficult excavation etc				
WATER FOR WORKS	Supervisor			
Application				
Value of contract				
Block plan				
Offices supply				
Information to plumber				
TELEPHONE	Supervisor			
Application				
CROSS OVERS				
Application				
Hoardings				
Gantries				
SEWER CONNECTION	Supervisor			
Application or quote from L.A.				
Notice required				
Sketch of drains run				
NOTICES	Supervisor			
Commencement notice to LA.				
Factory Act Form	Safety Officer			
Registration of office Form	Company Secretary			
SERVICES	Supervisor			
Electrical				
Supply to offices				

Building Service shops
Gas and fuels
Services as necessary

SIGN BOARD Supervisor
Sign required
Architect details
Sub contractors' names

SAMPLES
Name of suppliers Buyer
Type required
Dates for approval

FIRST AID Safety Officer
As per construction Regul.

SITE RECORD BOX Planner
As check list

Contract Programme

The more complex the job, the more difficult it is to complete within the specified time, the more the risks involved. In order to minimize this, a **master plan** is prepared which shows all concerned what should happen, when it should happen and by whom it is carried out. This is carried out using any of the many forms of planning techniques, which ultimately shows the project activities and their related information. The outline programme worked out in the pre-tender stage will be used as a foundation in the preparing of the more detailed master plan. Two forms of the master programme:

Bar / Gantt chart
Arrow network (critical path diagram)

Whichever method is used, certain characteristics are essential to both.

Characteristics of a Good Plan

i. It should be based on clearly defined objectives
ii. Simple to understand
iii. Flexible, so that alterations and alternatives can be easily made
iv. Provide standards so that control can be maintained
v. Provide a suitable balance of work so that labour, once off the job, need not return
vi. All resources should be used to the full and not left standing waiting for other activities to be completed.
vii. It must be suitable for use as a control tool against which progress can be measured
viii. It must be sufficiently accurate to enable its use for forecasting requirements of materials, manpower, machinery and money
ix. It must provide for difficulties likely to be encountered in future in respect of quantity, scope, processes etc and for making remedial measures.

PROGRAMME CALCULATION SHEETS (Preparation Of Programme)

The more information available to the planner at this point, the more reliable and accurate will be his forecast and resulting programme. The use of the bills of quantities to prepare a list of programme elements generally proves very satisfactory. To assess the duration of an element the itemized details produced by the quantity surveyor in the bill be collected under the general heading. For example, under the heading of "Brickwork" would also be collected damp-proof course, reveals to openings, placing of airbricks and lintels, etc. It will be realized that these items will have an effect on the output per hour in laying bricks and it is the planner's job to assess this output. This will occur for all project elements and takes the form of a **calculation sheet**, an example of which is shown below. (A calculation sheet is a proforma into which a master programme elements are entered, i.e. all interrelated items in the bill of quantities are collected under a general heading in the calculation sheet)

CALCULATION SHEET

CONTRACT…….. PREPARED BY. ……

CONTRACT No……

SHEET No…….. DATE …….

ACTIVITY	QUANTITY	OUTPUT	PROD. HOURS	LABOUR/PLANT REQUIREMENTS	DURATION DAYS	REMARKS

Preparation of Contract Budgets

Just as site production is programmed so that progress can be checked, i.e., estimated time against actual time, so must the cost of actual work be checked against estimated (tender) price. Having the master plan now prepared, labour requirements estimated, materials and plant assessed, a weekly or monthly estimated cost can be calculated. To this must be added such items as overheads, on-costs, insurance etc.

Short Term Planning

During the course of a project problems, delays, alterations, shortage of labour, bad weather, etc, may seriously affect the running and completion of the job. This will be shown in the loss of progress on the master plan. To keep up with this plan each operation is examined in fine detail by taking a 'Forward View' of work to be carried out over a shorter period of time, generally 4 – 6 weeks under the direction of site agent or general foreman.

The assessment of labour, plant and materials, plus the careful co-ordination of sub-contractors, is a vital part of short term planning if work is to be carried out economically so that the careful balancing and phasing in sequence, the various operations and labour are essential. The reason for preparing programmes every **4 weeks** for a **6-week** period is to give an overlap at the end of each period because of difficulties that would be met if programmes were end on; it also provides a buffer period. In this system of planning, the workers are provided with **weekly plans**, the object being to ensure that progress is being

maintained, that targets set the previous week have been accomplished and new targets set.

Daily planning forms part of weekly planning. The overall aim of short term planning is **updating of progress** of the master plan.

Construction programming methods

Network analysis

Network analysis is the term used to embrace a number of techniques for the planning and control of complex projects. The two most frequently used forms of network planning are CPM - Critical Path Method – and PERT – Programme Evaluation and Review Technique. CPM was developed in 1957 by James E. Kelley, then of Remington Rand and Morgan R. Walker of Du Pont Engineering Services to help schedule maintenance in chemical plants. PERT was developed in 1958 by the US Navy's Special Projects Office in cooperation with Booz, Allen and Hamilton, a Management Consulting firm. It was developed as a network flow chart with time as the critical factor for planning and controlling the development of the Polaris missile, a massive project with about 3000 contractors and agencies, and its application is credited with saving two years from the original of five years required to complete the project.

The major difference between these two forms is that CPM assumes that the time required to complete an activity can be predicted fairly accurately, and thus the costs involved can be quantified once the critical path has been identified, whereas PERT assumes that time has to be estimated in drawing up the critical path. CPM tends to be used in large or complex projects in construction and manufacturing. PERT tends to be applied to one-off projects of a complex nature or to projects where time or costs are of overriding importance.

The basis of both CPM and PERT systems is the network diagram.

Network (or Arrow) Diagram

When the sequence or logical order of activities has been worked out, the duration times for each separate activity can be calculated and a critical path determined (a path that governs the project duration).

Advantages of Critical Path Method (over Gantt Chart Method)

i. To the programmer, the job sequence or logic can be completely divorced from the time element in the preparation of the plan.
ii. The critical activities are clearly shown and can be altered easily if other activities become critical because of delays.
iii. The non-critical activities can, with due examination, result in a more economical use of resources.
iv. Non-critical activities can be delayed or performed more slowly so that resources may be used for more critical events, provided that they are not delayed so long that they in turn become critical.

v. The interrelationship between all the activities is clearly shown by the flow of the network.

Principles of Network Construction

The sequence or logic diagram is set out by a series of connecting arrows, the planner questioning each activity as follows:
What other activities must be completed before this one can start?
What other activity can be done at the same time?
What activity cannot start until this one is completed?

Basic definitions

Activity – is a time-consuming element of the programme. Also represents the consumption of certain resources such as labour, money, or the use of plant or materials. Represented by arrow of any length; each operation having its arrow. The length of the arrow has no bearing on the duration of the activity. Direction of the arrow simply indicates the direction of workflow. Its tail marks the starting point, and the head the completion point.

Events or Nodes – are circles at the start and end of an activity. They have no duration. Inside is an identity number of the activity. This enables operations to be identified easily by their start and finish numbers instead of lengthy titles. These are termed **i-j numbers**.

Sequential Activities – Activities that can proceed in correct order, one after the other.

Parallel Activities – Activities that can be carried out independently of others at the same time. It is possible that an event in a diagram will not be reached until a number of activities preceding it have been completed. B and C are parallel activities but they both depend on activity A finishing first.

Dummy Activities

Consider the network below.

ACTIVITY	i-j Number
A	1 – 2
B	2 – 3
C	2 – 4
D	3 – 5
E	4 – 6
F	5 – 6

If the activities are identified by their i-j notation it will be seen that three of the activities bear the same i-j configuration. To correct this situation, logical restraints called *dummies* are added to the diagram to maintain the unique numbering system. The dummy represents no consumption of time or resource (itself it is not an activity). It is shown in a diagram by a broken line

Float – The difference between the time available to do activity and the time required to complete the activity. It is thus time by which the activities can be delayed without delaying the completion of the project.

PREPARING AN ARROW DIAGRAM

Logic

This is the procedure or order in which a project is to be tackled. It is arrived at by discussion with all the concerned parties taking into account no time durations.

Time

After the logic diagram, time elements are added to suit the project. This requires accurate determination of the activity times.

Analysis Sheet

Produce an analysis of event times to see along which path of activities the critical line must follow.

Starting Times

Earliest Starting Times (EST)

This is the earliest time an event can occur and is the first calculation to be worked out; this is done by taking into account all preceding activities on the logic diagram and adding them together. For example: from the figure given, event 3-4 cannot start until events 0-1, 1-2, 1-3 and 2-3, have been completed, remembering that the longest duration times or longest path on the logic diagram gives the EST for preceding activities. This is because the shortest time activities can be done in the longest time but the longest path activities cannot be done in the shortest time!

e.g. Event 0-1 = 0 days EST

Event 1-2 = 5 days EST

Event 1-3 = 5 days EST

Event 2-3 = 5+2 = 7days EST

Event 3-4 = 5+2+4 = 11days EST

Table 4 Activity analysis sheet

ACTIVITY ANALYSIS SHEET								
Events i-j	**Description**	**Dur**	**Earliest**		**Latest**		**Critical Path**	**Total Float**
			Start	**Finish**	**Start**	**Finish**		
0-1	Site Preparation	5	0	5	0	5	*	0
1-2	Exc. Drain Trenches	2	5	7	5	7	*	0
1-3	Exc. Founds	3	5	8	8	11		3
2-3	Drains & M. Holes	4	7	11	7	11	*	0

3-4	Founds	4	11	15	11	15	*	0
4-5	Brickwork	12	15	27	15	27	*	0
5-6	Roof Structure	3	27	30	27	30	*	0
5-7	Partitions	2	27	29	28	30		1
5-8	Frames	3	27	30	29	32		2
6-7	Dummy	-	-	-	-	-		-
6-11	Roof Finish	2	30	32	40	42		10
7-10	First Fix	4	30	34	30	34	*	0
8-9	Glazing	2	30	32	32	34		2
9-10	Dummy	-	-	-	-	-		-
9-13	External Painting	3	32	35	42	45		10
10-12	Plaster	6	34	40	34	40	*	0
11-13	Ex. Plumb	3	32	35	42	45		10
12-13	Int. Finish	5	40	45	40	45	*	0
13-14	Clean	4	45	49	45	49	*	0

Activity 3-4, therefore, cannot start until day 11, for this is the shortest time that all the preceding activities can be completed; i.e., path 0-1, 1-2, 2-3, NOT path 0-1, 1-3, as this only takes 8 days and 11 days' work is to be done before activity 3-4 can be started.

b) Latest Starting Times (LST)

This is the latest time an activity can start in order to be completed on time. It is found by a process identical to that used for EST, only now working backwards (**backward pass)** through the diagram from the completion date.

An activity is critical if the earliest and latest starting times are the same, as in events 0-1, 1-2, 2-3, etc. If a difference occurs in time between the two times, as in event 1-3, this is called the "**float**"; in this instance, event 1-3 gives LST 8 – EST 5 = 3 days float time. The float will enable:

Resources to be used to the full

Rearrangement of labour to complete more critical activities if production falls below the set rate but so long as it is not overdone i.e. to an extent that other activities become critical.

The completed arrow diagram indicates how relevant information can be shown. As site supervisory staff may not be familiar with CPM, a bar chart may be produced from the arrow diagram to show activities in a similar form as the Gantt or bar chart. Advantage of the bar chart is it clearly indicates critical activities, slack or float time and non-critical activities.

1.2.3.4 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Visit a local construction site and prepare a work plan
2. Prepare a Gantt chart using the information above.

Resource Requirements

1.2.3.5 Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Chats

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.3.6 Self-Assessment questions

1. What is the significance of a calculation sheet in planning?
2. Which are the characteristics of a good master plan?
3. What is the essence of planning in the construction industry?
4. Which is the general procedure adopted in tendering?
5. What is a pre-tender report?
6. What is the importance of a plant schedule?
7. What is network analysis and how is it used in planning?
8. Which factors make the Critical Path Method a good planning strategy?
9. Which are the main activities carried out by a contractor during pre-cintract period?
10. How would you define the terms
    i. Project
    ii. Planning

Response to self-assessment questions

1. What is the significance of a calculation sheet in planning?
   A calculation sheet is a proforma into which master programme elements are entered, i.e. all interrelated items in the bill of quantities are collected under a general heading in the calculation sheet
2. Which are the characteristics of a good master plan?

   i. **It should be based on clearly defined objectives**
   ii. **Simple to understand**
   iii. **Flexible, so that alterations and alternatives can be easily made**
   iv. **Provide standards so that control can be maintained**
   v. **Provide a suitable balance of work so that labour, once off the job, need not return**
   vi. **All resources should be used to the full and not left standing waiting for other activities to be completed.**
   vii. **It must be suitable for use as a control tool against which progress can be measured**
   viii. **It must be sufficiently accurate to enable its use for forecasting requirements of materials, manpower, machinery and money**
3. What is the essence of planning in the construction industry?
   a. ***The objective of the business:*** **what will the company do?**

b. ***Financial structure*** **e.g. total working capital and the expected profit returns relative to the number of projects that the company could undertake**
c. ***Time scale:*** **regular reference is made to policy to ensure that the forecast is going ahead as planned**
d. ***Overall activities of the business:*** **whether to be general building contractors, a plumbing sub-contractor, or a specialist in carpentry and joinery**
e. ***Purchases:*** **a policy in purchase of plant, equipment, formwork, scaffold etc with special consideration on whether to buy or hire**
f. ***Organization:*** **the general set up of a business to include the allocation of the heads of departments, the personnel policy (to include items on training, promotions, pensions**

4. Which is the general procedure adopted in tendering?
   i. **The pre-tender report (site investigation)**
   ii. **Method statement**
   iii. **Plant schedule**
   iv. **Site organization structure and site on-costs**
   v. **Sub-contractors and suppliers**
   vi. **Outline programme**
   vii. **Final estimate (for Board's decision**)

5. What is a pre-tender report?
   This is a comprehensive document detailing all the required information regarding the area and general site conditions
6. What is the importance of a plant schedule?
   This is a schedule prepared on the completion of the method statement and gives a detailed summary of all the plants of and equipment required for the construction to completion of the works, repair of machines, testing facilities etc.,
7. What is network analysis and how is it used in planning?
   Network analysis is the term used to embrace a number of techniques for the planning and control of complex projects. The two most frequently used forms of network planning are CPM - Critical Path Method – and PERT – Programme Evaluation and Review Technique.
8. Which factors make the Critical Path Method a good planning strategy?

i. **To the programmer, the job sequence or logic can be completely divorced from the time element in the preparation of the plan.**
   ii. **The critical activities are clearly shown and can be altered easily if other activities become critical because of delays.**

iii. **The non-critical activities can, with due examination, result in a more economical use of resources.**
iv. **Non-critical activities can be delayed or performed more slowly so that resources may be used for more critical events, provided that they are not delayed so long that they in turn become critical.**
v. **The interrelationship between all the activities is clearly shown by the flow of the network.**

9. Which are the main activities carried out by a contractor during pre-contract period?
    i. **Paying tender fee**
    ii. **Collecting and carefully studying the tender documents and drawings to find out the quantities of each item of work, materials, time limit and other conditions of work**
    iii. **Visit the proposed site**
    iv. **Submit back the costed tender documents**

10. How would you define the terms
    i. Project **– this is a planned endeavor with a specific goal**
    ii. Planning - **is a well thought out guess which aims to lay down directions in which a move is made forward, taking into account the resources available.**

Tools, Equipment, Supplies and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Charts

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat

- First aid kit

1.2.3.7 References

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1.2.4 Learning Outcome 4; Prepare project accounts

1.2.4.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to prepare project accounts. It entails obtaining information from ledger accounts, preparing income and expense accounts, as well as preparing method statements.

1.2.4.2 Performance Standard

4.1 Information is obtained from ledgers and journals.
4.2 Income and expense account is prepared.
4.3 Information is balanced and agreed upon
4.4 Method statement for works is prepared

1.2.4.3 Information Sheet

Definition of terms

Accounting is defined as the process of identifying, measuring and reporting economic information to the users of this information to permit informed judgment

Many businesses carry out transactions. Some of these transactions have a financial implication i.e. either cash is received or paid out. Examples of these transactions include selling goods, buying goods, paying employees and so many others.
Accounting is involved with identifying these transactions measuring (attaching a value) and reporting on these transactions. If a firm employs a new staff member then this may not be an accounting transaction. However when the firm pays the employee salary, then this is related to accounting as cash involved. This has an economic impact on the organization and will be recorded for accounting purposes. A process is put in place to collect and record this information; it is then classified and summarized so that it can be reported to the interested parties.
The main *purpose* of Accounting is to provide financial information about an economic entity. It provides a means where the steward reports to the owner how the funds entrusted to him are used to enhance the wealth of the business.

Business Transaction is an event which involves the transfer of money or money's worth of financial events. The following summarizes the business transaction that a firm might have:

- Acquisition of assets from owners and other creditors
- Investing resources in assets to produce goods or services
- Using resources to produce goods and services

- Selling goods or services of the firm
- Paying those to whom money is owned
- Returning assets to owners

A business can be set up in two ways-

i. Owner supplying all the resources

ii. Owner supplying some of the resources and the rest being supplied by outside parties

The two cases bring out the *accounting equation* also called book- keeping equation

Case one: owner supplying all the resources

In this case we say that-

Resources in the business = Resources supplied by the owner**…… (i)**

Resources in business are called *assets* and resources supplied by the owner are called *capital*

Therefore equation (i) can be re -written as-

ASSETS = CAPITAL

Case two: resources supplied by owner and outside parties

In this case we say that-

Resources in business = Resources supplied by the owner + Resources supplied by out- side parties…… (ii)

The new term in the equation is *resources supplied by outside parties*, in accounting, we call them *liabilities.*

Therefore equation (ii) can be re-written as-

ASSETS = CAPITAL + LIABILITIES…… **(ii)**

Assets: An asset is a resource controlled by a business entity/firm as a result of past events for which economic benefits are expected to flow to the firm.

An example is if a business sells goods on credit then it has an asset called a debtor. The past event is the sale on credit and the resource is a debtor. This debtor is expected to pay so that economic benefits will flow towards the firm i.e. in form of cash once the customers pays.

Assets are classified into two main types:

i. Noncurrent assets (formerly called fixed assets).

ii. Current assets.

Non current assets are acquired by the business to assist in earning revenues and not for resale. They are normally expected to be in business for a period of more than one year.

Major examples include

- Land and buildings
- Plant and machinery
- Fixtures, furniture, fittings and equipment
- Motor vehicles

Current assets are not expected to last for more than one year. They are in most cases directly related to the trading activities of the firm. Examples include:

- Stock of goods – for purpose of selling.
- Trade debtors/accounts receivables – owe the business amounts as a resort of trading.
- Other debtors – owe the firm amounts other than for trading.
- Cash at bank.
- Cash in hand.

Liabilities: These are obligations of a business as a result of past events settlement of which is expected to result to an economic outflow of amounts from the firm. An example is when a business buys goods on credit, then the firm has a liability called creditor. The past event is the credit purchase and the liability being the creditor the firm will pay cash to the creditor and therefore there is an out flow of cash from the business.

Liabilities are also classified into two main classes.

i. Non-current liabilities (or long term liabilities)

ii. Current liabilities.

Non-current liabilities are expected to last or be paid after one year. This includes long-term loans from banks or other financial institutions. Current liabilities last for a period of less than one year and therefore will be paid within one year.

Financial statements

These are prepared at the end of a given trading period to determine the profit and losses of the business, and also to show the financial position of the business at a given time.

They includes; trading account, profit and loss account, trading profit and loss account and the balance sheet.

They are also referred to as the final statements.

The trading period is the duration through which the trading activities are carried out in the business before it decides to determines it performances in terms of profit or loss. It may be one week, month, six months or even a year depending on what the owner wants.

Most of the business use one year as their trading period. It is also referred to as the accounting period.

At the end of the accounting period, the following takes place;

- All the accounts are balanced off
- A trial balance is extracted
- Profit or loss is determined
- The balance sheet is prepared

Determining the profit or loss of a business

When a business sells its stock above the buying price/cost of acquiring the stock, it makes a profit, while if it sells below it makes a loss. The profit realized when the business sell it stock beyond the cost is what is referred to as the gross profit, while if it is a loss then it is referred to as a gross loss.

It is referred to as the gross profit /loss because it has not been used to cater for the expenses that may have been incurred in selling that stock, such as the salary of the salesman, rent for the premises, water bills, etc. it therefore implies that the businessman cannot take the whole gross profit for its personal use but must first deduct the total cost of all other expenses that may have been incurred.

The profit realized after the cost of all the expenses incurred has been deducted is what becomes the real profit for the owner of the business, and is referred to as Net profit. The net profit can be determined through calculation or preparation of profit and loss account.

In calculating the gross profit, the following adjustments are put in place

- Return inwards/Sales return: - these are goods that had been sold to the customers, but they have returned them to the business for one reason or the other. It therefore reduces the value of sales, and is therefore subtracted from sales to obtain the net sales

  Therefore Net sales = Sales – Return inwards

- Return outwards/purchases return: - these are goods that had been bought from the suppliers to the business and have been returned to them for one reason or the other. It reduces the purchases and is therefore subtracted from the purchases to obtain the net purchases.

- Drawings: - this refers to goods that the owner of the business has taken from the business for his own use. It reduces the value of purchases, and is therefore subtracted from purchases when determining the net purchases. It is different from the other drawing in that it is purely goods and not money
- Carriage inwards/Carriage on purchases: - this is the cost incurred by the suppliers in transporting the goods from his premises to the customers business. It is treated as part of the purchases, and therefore increases the value of purchases. It is added to purchases to determine the actual value of purchases/Net purchases.

  Therefore Net Purchases = Purchases + Carriage inwards – Return Outwards - Drawings

- Carriage outwards/Carriage on sales: - this is the cost that the business has incurred in transporting goods from its premises to the customers premises. The cost reduces the business profit that would have been realized as a result of the sale, and is therefore treated as an expense and is subtracted from the gross profit, before determining the net profit.
- Opening stock is the stock of goods at the beginning of the trading period, while the closing stock is the stock of the goods at the end of the trading period

  Gross profit is therefore calculated as follows;

  Gross Profit = Sales – Return inwards – (Opening stock + Purchases + carriage inwards – Return outwards – Closing stock)

  Or

  Gross profit = Net sales – Cost of Goods Sold (COGS)

  COGS = Opening Stock + Net Purchases – Closing stock

  Net Profit = Gross profit – Total expenses

Trading Account

This is prepared by the business to determine the gross profit/loss during that trading period

The trading account is completed by the time the gross profit b/d is determined

For example

The following balances were obtained from the books of Ramera Traders for the year ending may 31st 2010

Sales	670 000
Purchases	380 000
Return inwards	40 000
Carriage outwards	18 000

Return outwards	20 000
Carriage inwards	10 000

Additional information;

- During the year the owner took goods worth sh 5 000 for his family use
- The stock as at 1st June 2009 was shs 60 000, while the stock as at 31st May 2011 was shs 70 000
    - Required; Prepare Ramera Traders trading account for the period ending 31st May 2010

Ramera Traders

Trading Account

For the period ending 31/5/2010

Dr	Shs	Shs		Shs	Shs	Cr
Opening stock		60 000	Sales	670 000		
add Purchases	380 000		Less Return inwards	40 000		
add Carriage inwards	10 000		Net sales		630 000	
less Return Outwards	20 000					
less Drawings	5 000	365 000				
Goods available for sale		425 000				
Less Closing Stock	70 000					
Cost Of Goods Sold (COGS)		355,000				
Gross profit c/d	275,000					
		630,000			630 000	
			Gross profit b/d		275 000	

NB: Carriage outwards is not an item of Trading account, but profit and loss account as an expense.

Importance of trading account

i. It is used to determine the gross profit/loss for a given trading period for appropriate decision making by the management.
ii. It is used in determining the cost of goods that was sold during that particular accounting period.
iii. It is used to reveal the volume of turnover i.e net sales
iv. May be used to compare the performance of the business in the current accounting period and the previous periods. It can also compare its performance with other similar businesses
v. It facilitates the preparation of profit and loss account, since the gross profit is carried forward to the profit and loss account.

Profit and Loss account

In preparation of this account, the gross profit is brought down on the credit sides, with all other revenues/income of the business being credited and the expenses together with the net profit being debited. *Net profit = Total Revenues (including Gross Profit) – Total expenses*

Name of the business

Profit and Loss Account

Dr For the period (date) Cr

	Shs		Shs
Expenses		Gross profit b/d	xxxxxx
Insurance	xxx	Discount received	xxx
Electricity	xxx	Rent income	xxx
Water bills	xxx	Commission received	xxx
Carriage Outwards	xxx	Any other income received	xxx
General expenses	xxx		
Provision for Depreciation	xxxx		
Discount allowed	xxx		
Commission allowed	xxxx		
Rent paid	xxxx		
Any other expense	xxxx		
Net profit c/d	xxxx		
	xxxxxx		xxxxxx
		Net profit b/d	xxxx

The Profit and Loss Account is complete when net profit b/d is obtained. In the trial balance, the revenues/incomes are always credited, while the expenses are debited, and the same treatment is found in the Profit and Loss Account. (Any item that is taken to the Profit and Loss Account with a balance appearing in the Debit (Dr) side of a trial balance is treated as an expense, while those appearing in the Credit (Cr) side are revenue e.g. discount balance appearing in the Dr Side is Discount Allowed, while the one on Cr side is Discount Received)

Example

The following information relates to Akinyi's Traders for the period ending March 28th 2010. Use it to prepare profit and loss account.

Gross profit	100 000
Discount received	12 000
Salaries and wages	20 000
Power and lighting	10 000
Opening stock	150 000
Rent income	10 000

Commission allowed	15 000
Commission received	16 000
Repairs	10 000
Discount allowed	8 000
Provision for depreciation	6 000
Carriage outwards	4 000

Solution

Akinyi Traders

Profit and Loss Account

For the period ending 28th March 2010

Dr			Cr
	Shs		Shs
Expenses		Gross profit b/d	100 000
Power and lighting	10 000	Discount received	12 000
Carriage Outwards	4 000	Rent income	10 000
Salaries and wages	20 000	Commission received	16 000
Provision for Depreciation	6 000		
Discount allowed	8 000		
Commission allowed	15 000		
Repairs	10 000		
Net profit c/d	65 000		
	138 000		138 000
		Net profit b/d	65 000

In case the expenses are more than the income, then the business shall have made a net loss, and the loss will be credited.

Net profit/loss can also be found through calculation as follows;

Net profit/loss = Gross profit + Total other revenues – Total expenses

For the above example;

Total other revenues = 12 000 + 10 000 + 16 000

= 38 000

Total expenses = 10 000 + 4 000 + 20 000 + 6 000 + 8 000 + 15 000 + 10 000

= 73 000

Therefore; Net profit = Gross profit + Total other revenues – Total expenses

= 100 000 + 38 000 – 73 000

= 65 000

Importance of Profit and Loss account

- ✓ It shows the revenue earned, and all the expenses incurred during the accounting period
- ✓ It used to determine the net profit/net loss of a given trading period
- ✓ It is a requirement by the government for the purpose of taxation
- ✓ May be used by the employees to gauge the strength of the business, in terms of its ability to pay them well
- ✓ It is vital for the prospective investor in the business, in terms of determining the viability of the business
- ✓ The creditors or loaners may use it to asses the business ability to pay back their debts
- ✓ It is used by the management to make a decision on the future of their business.

Trading, Profit and Loss Account

This is the combination of trading account and trading profit and loss account to form a single document. It ends when the net profit/loss brought down has been determined. That is;

Name of the business

Trading, Profit and Loss Account

For the period (date)

Dr	Shs	Shs	Cr	Shs	Shs
Opening stock		xxxxxx	Sales	xxxxxx	
add Purchases	xxxxx		Less Return inwards	xxx	
add Carriage inwards	xxx		Net sales		xxxxxx
less Return Outwards	xxx				
less Drawings	xx	xxxxx			
Goods available for sale		xxxxxx			
Less Closing Stock		xxx			
Cost Of Goods Sold (COGS)		xxxxxx			
Gross profit c/d		xxxx			
		Xxxxxx			xxxxxx
			Gross profit b/d		xxxx
Expenses					

Insurance	xxx	Discount received	xxx
Electricity	xxx	Rent income	xxx
Water bills	xxx	Commission received	xxx
Carriage Outwards	xxx	Any other income received	xxx
General expenses	xxx		
Provision for Depreciation	xxxx		
Discount allowed	xxx		
Commission allowed	xxxx		
Rent paid	xxxx		
Any other expense	xxxx		
Net profit c/d	xxxx		
	xxxxxx		xxxxxx
		Net profit b/d	xxxx

End Year Adjustments

The following items may require to be adjusted at the end of the trading period

- Revenues/Income
- Expenses
- Fixed assets

Adjustment on revenues

The revenue may have been paid in advance in part or whole (prepaid revenue) or may be paid later after the trading period (accrued revenue).

Prepaid revenue is subtracted from the revenue/income to be received and the difference is what is treated in the profit and loss account or trading profit and loss account as an income, while the accrued revenue is added to the revenue/income to be received and the sum is what is treated in the above accounts as the actual revenue.

Only the prepaid amount and the accrued amounts are what are then taken to the balance sheet.

Adjustment on the expenses

The expenses may have been paid for in advance in part or whole (prepaid expenses) or may be paid for later after the trading period (accrued expenses).

Prepaid expenses is subtracted from the expenses to be paid for and the difference is what is treated in the profit and loss account or trading profit and loss account as an expense, while the accrued expenses is added to the expenses to be paid for and the sum is what is treated in the above accounts as the actual expenses.

NB: Only the prepaid amount and the accrued amounts are what are then taken to the balance sheet.

Adjustment on fixed assets

The fixed assets may decrease in value, due to tear and wear. This makes the value to go down over time, what is referred to as depreciation. The amount of depreciation is always estimated as a percentage of cost.

The amount that shall have depreciated is treated in the profit and loss account or T,P&L as an expense, while the value of the asset is recorded in the balance sheet, less depreciation.

For example;

1. 1997 The following Trial balance was prepared from the books of Paka Traders as at 31st December 1995. Trial balance December 31st 1995

	Dr. (shs)	Cr. (shs)
Sales		980,000
Purchases	600,000	
Returns	80,000	20 000
Carriage in		40,000
Carriage out	3,000	
Stock (Jan 1st 1999)	120,000	
Rent	60,000	45 000
Discount	15,000	25 000
Motor vehicle	150 000	
Machinery	250 000	
Debtors	120,000	
Salaries	18,000	
Commission	7,000	12 000
Capital		178,000
Insurance	15 000	
Creditors		240,000
Cash	122 000	
	1 540 000	1 540 000

Additional information

i. Stock as at 31st December was 100,000
ii. the provision for depreciation was 10% on the cost of Motor vehicle, and 5% on the cost of Machinery

Required: Prepare trading profit and loss account for the period ending 31st December 1999

Adjustments: Provision for depreciation;

$$\text{Machinery} = \frac{5}{100} \times 250\,000 = 7\,500$$

(New balance of machinery = 250 000 – 7 500 = 242 500. The 242 500 is taken to the balance as Machinery (fixed asset), while 7 500 is taken to the trading profit and loss account as expenses)

$$\text{Motor vehicle} = \frac{10}{100} \times 150\,000 = 15\,000$$

(New balance of Motor Vehicle = 150 000 – 15 000 = 135 000. The 135 000 is taken to the balance as Motor Vehicle (fixed asset), while 15 000 is taken to the trading profit and loss account as expenses)

Paka Traders

Trading, Profit and Loss Account

Dr For the period 31/12/1995 Cr

	Shs	Shs		Shs	Shs
Opening stock		120 000	Sales	980 000	
add Purchases	600 000		Less Return inwards	80 000	
add Carriage inwards	40 000		Net sales		900 000
less Return Outwards	20 000	620 000			
Goods available for sale		740 00			
Less Closing Stock		100 000			
Cost Of Goods Sold (COGS)		640 000			
Gross profit c/d		260 000			
		900 000			900 000
Expenses			Gross profit b/d		260 000
Insurance		15000	Discount received		25 000
Carriage Outwards		30000	Rent income		45 000
Salaries		18 000	Commission received		12 000
Provision for Depreciation					
Motor vehicle	15 000				
Machinery	7 500	22500			
Discount allowed		15 000			
Commission allowed		7 000			
Rent paid		60 000			
Net profit c/d		174 500			
		342 000			342 000
			Net profit b/d		174 500

The net profit/loss may be taken to the balance sheet.

The items that have been adjusted will be recorded in the balance sheet less the adjustment.

The Balance Sheet

The balance sheet will show the business financial position in relation to assets, capital and liabilities. The adjustment that can be made will be on Fixed assets and capital only. That is; Fixed assets are recorded less their depreciation value (should there be provision for depreciation) as the actual value.

Actual value of assets = Old value – depreciation.

Capital is adjusted with the following; Net capital, Drawings and additional investment. i.e.

Closing Capital/Net capital (C.C) = Opening/initial capital (O.C) + Additional Investment (I) + Net profit (N.P) or (less Net Loss) – Drawings

$$CC = OC + I + NP - D$$

Where:

Opening Capital: - the capital at the beginning of the trading period

Closing capital: - the capital as at the end of the trading period

Additional Investment: - any amount or asset that the owner adds to the business during the trading period

Net profit: - the profit obtained from the trading activities during the period. Incase of a loss, it is subtracted.

Types of Capital

The capital in the business can be classified as follows

- Capital Owned/Owner's Equity/Capital invested; - this is the capital that the owner of the business has contributed to the business. It is the Net capital/Closing capital of the business (C = A – L)
- Borrowed capital: - the resources brought into the business from the outside sources. They are the long term liabilities of the business.
- Working capital: - these are resources in the business that can be used to meet the immediate obligation of the business. It is the difference between the total current assets and total current liabilities

  Working Capital = Total Current Assets – Total Current Liabilities
- Capital employed: - these are the resources that has been put in the business for a long term. i.e.

  Capital Employed = Total Fixed assets + Working Capital

  Or

  Capital employed = Capital Invested + Long term liabilities

Name of the business

Balance Sheet

As at (date)

	Shs	shs		Shs	shs
Fixed Assets					
Land	xxxxx		Capital	xxxxx	
Buildings	xxxxx		Add Net profit	xxxx	
Motor Vehicle	xxxxx		Add additional investt	xxx	
Any other fixed assets	xxxxx	xxxxxx	Less drawings	xxx	
Current Assets			Net Capital		xxxxx
Stock	xxxx		Long term liabilities		
Debtors	xxxx		Long term loan	xxxx	
Bank	xxxx		Any other	xxxx	xxxx
Cash	xxxx		Current liabilities		
Prepaid Expenses	xxxx		Creditors	xxxx	
Accrued revenues	xxxx		Short term loan	xxxx	

Any other current assets	xxxx	xxxxxx	Accrued expenses	xxxx	
			Prepaid revenues	xxxx	
			Any other	xxxx	xxxxx
		xxxxxx			xxxxxx

Example : The following information were extracted from the trial balance of Mwema traders on 31st December 2010

Sales	750 000	Furniture	288 000
Purchases	540 000	Electricity expenses	16 000
Sales return	24 000	Motor vehicle	720 000
Return outwards	30 000	Rent expenses	2 500
General expenses	72 000	Capital	842 500
Commission received	24 000	Bank Loan	250 000
Cash	156 000	Creditors	216 000
Debtors	244 000		

Additional Information

a) Stock as at 31/12/2010 was ksh 72 000
b) Electricity prepaid was shs 4 000
c) Rent expenses accrued shs 3500
d) Depreciation was provided for as follows

-Motor Vehicle 15% p.a. on cost -Furniture 6% p.a. on cost

Required

(i) Prepare Trading, profit and loss account for the year
(ii) Prepare a balance sheet as at 31st December 2012
(iii) Determine the following:

-Owner's equity -Borrowed capital -Working capital -Capital employed

Adjustments:

Motor Vehicle = $\frac{15}{100} \times 720\,000 = 108\,000$

Therefore Motor vehicle = 612 000

Furniture = $\frac{6}{100} \times 288\,000 = 17\,280$

Therefore furniture = 270 720

Mwema Traders

Trading, Profit and Loss Account

Dr For the period 31/12/2010 Cr

	Shs	Shs		Shs	Shs
Purchases	540 000		Sales	750 000	
less Return Outwards	30 000	510 000	Less Return inwards	24 000	
Goods available for sale		510 000	Net sales		726 000
Less Closing Stock		72 000			
Cost Of Goods Sold (COGS)		438 000			
Gross profit c/d		288 000			
		726 000			726 000
Expenses			Gross profit b/d		288 000
General expenses		72 000	Commission received		24 000
Electricity expenses	16 000				
Less Electricity prepaid	4 000	12 000			
Rent expenses	2 500				
Accrued rent exp	3 500	6 000			
Provision for Depreciation					
Motor vehicle	108 000				
Furniture	17 280	125 280			
Net profit c/d		96 720			
		312 000			312 000
			Net profit b/d		96 720

Mwema Traders
Balance Sheet
As at 31/12/2010

	Shs	shs		Shs	shs
Fixed Assets			Capital	842 500	
Motor Vehicle	612 000		Add Net profit	96 720	
Furniture	270 720	882 720	Net Capital		939 220
Current Assets			Long term liabilities		
Stock	72 000		Bank Loan		250 000
Debtors	244 000				
Electricity prepaid	4 000		Current liabilities		
Bank	50 000		Creditors	216 000	
Cash	156 000	526 000	Accrued rent	3 500	219 500
		1 408 720			1 408 720

Trial balance

-A trial balance is a statement prepared at a particular date showing all the debit balances on one column and all the credit balances on another column.

NOTE: A trial balance is not an account but merely a list of assets, expenses and losses on the left and capital liabilities and incomes (including profits) on the right.

-The totals of a trial balance should agree if the double entry has been carried out correctly and there are no arithmetic errors both in the ledger as well as in the trial balance itself.

-If the two sides of a trial balance are not equal, it means there is an error or errors either in the trial balance or in the ledger accounts or in both.

Errors that may cause a trial balance not to balance

i. *Partial omission;* A transaction was recorded on only one account i.e. a debit or a credit entry might have been omitted in one of the affected accounts.
ii. *Transfering (posting);* a wrong balance to a trial balance.
iii. Different amounts for the same transaction might have been entered in the accounts(Amount Dr.different from amount cr)
iv. Failure to post a balance to the trial balance (omission of a balance from the trial balance.
v. Posting a balance to the wrong side of the trial balance

vi. Recording a transaction on the same side of the affected accounts(partial reversal entry)

vii. Arithmetic mistakes might have been made when balancing the ledger accounts

Purpose of a trial balance

The purpose of a trial balance include;

i. *Checking the accuracy in the ledger accounts as to whether;*
   - The rule of double entry has been adhered to or observed/ complied with.
   - There are arithmetical errors in the ledger accounts

ii. Gives a summary of the ledger i.e. summary of the transactions which have taken place during a given period

iii. Provide information (account balances) for preparing final accounts such as the trading account, profit and loss account and the balance sheet.

iv. Test whether the ledger account balances have been posted to the right side of the trial balance.

Limitations of a trial balance

Even when the trial balance totals are equal, it does not mean that there are no errors made in the ledgers. This is because there are some errors that do not affect the trial balance.

A trial balance only assures the book keeper that the total of debit entries is equal to total credit entries. The errors that do not affect the trial balances are;

Error of total omission; This occurs when a transaction takes place and nothing about it is recorded in the books of accounts i.e. it is completely omitted such that neither a credit nor a debit entry is made in the ledgers.

Error of original entry; this occurs where both the debit and credit entries are made using similar but erroneous figures. As the wrong amount is recorded in the two accounts.

Error of commission; This occurs where double entry is completed but in the wrong persons accounts especially due to a confusion in names e.g. a debit entry of shs.2000 was made in Otieno's account instead of Atieno's account.

1.2.4.4 Learning activities

Practical assessment

This practical activity should be conducted in a workplace.

You are required to complete the following tasks

1. Enter transactions in books of original entry
2. Post the transactions in the relevant books of accounts
3. Prepare financial statements

Resource Requirements

1. An existing business enterprise

1.2.4.5 Self-Assessment questions

1. Differentiate between the following terms as used in accounting.

   a) A debit entry and credit entry
   b) Return inwards and return outwards
   c) An asset account and liability account
   d) An expense account and revenue account
   e) A trail balance and a balance sheet

2. The following is a trial balance of ABC Ltd.

Kshs	Kshs	
Stock 1 Jan 2009	2,368,000	
Carriage inwards	200,000	
Carriage outwards	310,000	
Return outwards	205,000	
Return outwards		322,000
Purchases	11,870,000	
Sales		18,600,000
Rent	3,862,000	
Salaries & Wages	304,000	
Insurance	78,000	
Motor expenses	216,000	
Lighting and heating expenses	166,000	
General expenses	314,000	

Premises	500,000	
Motor vehicles	1,800.000	
Debtors	3,896,000	
Fixture and fittings	350,000	
Creditors		1,731,000
Cash at Bank	482,000	
Drawings	1,200,000	
Capital		8,132,000
	28,785,000	28,785,000

Stock at 30 December 2009 was Sh. 2,946,000

Required:

Draw up a statement of comprehensive income for the year ended 31st Dec. 2009 and statement of financial position as at 31/12/2009.

3. Define the following terms as used in Business.

    i. Business transactions
    ii. Credit transaction
    iii. Initial capital
    iv. Final capital
    v. Drawings

4. Outline circumstances under which the capital of a business may change
5. What is the purpose of a trial balance?
6. Which are some common errors in a trial balance?
7. Which are some categories of capital?
8. What is the importance of a profit and loss account?
9. Which are some examples of financial statements of a business?
10. What is the significance of a trading account?

Response to self-assessment questions

1. Differentiate between the following terms as used in accounting.

   a) **A debit entry- an entry made on the debit side of an account**
      Credit entry made on the credit side of an account
   b) **Return inwards and return outwards –**
      Return inwards-also called sales returns. Goods returned to the business by their customers.
      Return outwards also called purchase returns Goods returned to suppliers by the business.
   c) **An asset account and liability account - An account having a resource of a business. E.g. motor vehicle accounts, debtor account.**
   d) **An expense account and revenue account - An account having what the business has incurred when running business e.g salary account, electricity account**
   e) **A trail balance and a balance sheet - This is a list of debit and credit balance of a business for particular date.**

2. The following is a trial balance of ABC Ltd.

Kshs	Kshs	
Stock 1 Jan 2009	2,368,000	
Carriage inwards	200,000	
Carriage outwards	310,000	
Return outwards	205,000	
Return outwards		322,000
Purchases	11,870,000	
Sales		18,600,000
Rent	3,862,000	
Salaries & Wages	304,000	
Insurance	78,000	
Motor expenses	216,000	
Lighting and heating expenses	166,000	
General expenses	314,000	
Premises	500,000	
Motor vehicles	1,800.000	
Debtors	3,896,000	
Fixture and fittings	350,000	
Creditors		1,731,000
Cash at Bank	482,000	

Drawings	1,200,000	
Capital		8,132,000
	28,785,000	28,785,000

Stock at 30 December 2009 was Sh. 2,946,000

Required:

Draw up a statement of comprehensive income for the year ended 31st Dec. 2009 and statement of financial position as at 31/12/2009.

Solution

ABC Ltd.

Statement of comprehensive income for the few ended 31/ 12/2009

Shs (000)

Sales (net) (w1)	18,385
Cost of sales (w2)	11170
Gross profit	7225
Carrying outwards	310
Rent	3,862
Salaries & wages	304
Insurance	78
Motor expenses	664
Office expenses	216
Lighting and heating expenses	116
General expenses	314
Operating profit	**1,361**

3. Define the following terms as used in Business.

   i. **Business transactions -Exchange of goods and services for payment**
   ii. **Credit transaction – exchange of goods and services where payments are made at a future date.**
   iii. **Initial capital - terms used to describe any funds and other assets invested into the business by the owner at the beginning of the trading period**

iv. **Final capital - business capital at the end of the trading period**
v. **Drawings - money or other assets taken from the business by the owner for personal use**

4. Outline circumstances under which the capital of a business may change
   i. **Additional investment by owner**
   ii. **Drawings by owner**
   iii. **Losses**
   iv. **Profit**

5. What is the purpose of a trial balance?
   i. ***Checking the accuracy in the ledger accounts as to whether;***
      - **The rule of double entry has been adhered to or observed/ complied with.**
      - **There are arithmetical errors in the ledger accounts**
   ii. **Gives a summary of the ledger i.e. summary of the transactions which have taken place during a given period**
   iii. **Provide information (account balances) for preparing final accounts such as the trading account, profit and loss account and the balance sheet.**
   iv. **Test whether the ledger account balances have been posted to the right side of the trial balance**.

6. Which are some common errors in a trial balance?
   i. **Error of total omission; This occurs when a transaction takes place and nothing about it is recorded in the books of accounts i.e. it is completely omitted such that neither a credit nor a debit entry is made in the ledgers.**
   ii. **Error of original entry; this occurs where both the debit and credit entries are made using similar but erroneous figures. As the wrong amount is recorded in the two accounts.**
   iii. ***Error of commission;*** **This occurs where double entry is completed but in the wrong persons accounts especially due to a confusion in names**

7. Which are some categories of capital?
   i. **Capital Owned/Owner's Equity/Capital invested; - this is the capital that the owner of the business has contributed to the business. It is the Net capital/Closing capital of the business (C = A – L)**
   ii. **Borrowed capital: - the resources brought into the business from the outside sources. They are the long term liabilities of the business.**
   iii. **Working capital: - these are resources in the business that can be used to meet the immediate obligation of the business. It is the difference between the total current assets and total current liabilities**
      a. ***Working Capital = Total Current Assets – Total Current Liabilities***
   iv. **Capital employed: - these are the resources that has been put in the business for a long term. i.e.**
      a. ***Capital Employed = Total Fixed assets + Working Capital***

b. **Or**

c. ***Capital employed = Capital Invested + Long term liabilities***

8. What is the importance of a profit and loss account?
   i. **It shows the revenue earned, and all the expenses incurred during the accounting period**
   ii. **It used to determine the net profit/net loss of a given trading period**
   iii. **It is a requirement by the government for the purpose of taxation**
   iv. **May be used by the employees to gauge the strength of the business, in terms of its ability to pay them well**
   v. **It is vital for the prospective investor in the business, in terms of determining the viability of the business**
   vi. **The creditors or loaners may use it to asses the business ability to pay back their debts**
   vii. **It is used by the management to make a decision on the future of their business.**

9. Which are some examples of financial statements of a business?
   i. **Profit and loss account**
   ii. **Trading account**
   iii. **Balance sheet**

10. What is the significance of a trading account?
   i. **It is used to determine the gross profit/loss for a given trading period for appropriate decision making by the management.**
   ii. **It is used in determining the cost of goods that was sold during that particular accounting period.**
   iii. **It is used to reveal the volume of turnover i.e net sales**
   iv. **May be used to compare the performance of the business in the current accounting period and the previous periods. It can also compare its performance with other similar businesses**
   v. **It facilitates the preparation of profit and loss account, since the gross profit is carried forward to the profit and loss account**.

1.2.4.6 Tools, Equipment, Supplies and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals

- Resource persons
- Charts

1.2.4.7 References

1. Wood, Frank, *Business Accounting* (17th Edition), International Thompson. Pages 334-345 75

2. Honrgren and Sundem, G. L, *Introduction to Financial Accounting,* (6th Edition), New York; Prentice Hall. pages 143-148

1.2.5 Learning Outcome 5 Manage projects human resource

1.2.5.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to manage projects human resource. It encompasses identifying project roles and responsibilities, project evaluation and project monitoring.

1.2.5.2 Performance Standard

5.1 Projects roles and responsibilities are identified.
5.2 Reporting relationship and staffing management plan are documented
5.3 Organisation charts and position descriptions are defined
5.4 Project team is developed as per organisational standards.
5.5 Personnel is identified depending on tasks.
5.6 Project performance is monitored as per laid down organisational standards.
5.7 Project evaluation is carried out.
5.8 Project report and results are analysed.

1.2.5.3 Information Sheet

Definition of terms

Monitoring- this is the action of carrying out surveillance or regular observation in order to detect changes of state or quality.

Evaluation – this is an assessment to determine value

Human Resource Management

The human resources requirement at various levels and during different stages of the project must be defined as well as their availability and cost. On the basis of the quantitative human resource requirement of the project, the availability of personnel and training needs, the cost estimates for wages, salaries other personnel-related expenses and training are prepared for the financial analysis of the project. In this respect, the following aspects of human resources need special attention:

i. Categories and functions
ii. Social economic and cultural environment
iii. Project related requirements
iv. Organizational set-up

v. Availability and recruitment

vi. Training plan

1. Categories and functions

Human resources as required for the implementation and operation industrial project need to be defined by categories such as management as supervision personnel and skilled and unskilled workers and by functions such as general management, production management and supervision, administration (accounting, purchase etc.) production control, machine operation and transport. The numbers skills and experiences required depend on the type of industry the technology used, plant size, the cultural and socio-economic environment of the project, location as well as proposed organization of the enterprise.

i. *Managerial and Supervisory Staff*

The provision of qualified and experienced managers is basic prerequisite for successful project implementation and operation. In many projects, key senior personnel need to be associated with the project during the pre-production stage and even during the prior stage of project formulation and the feasibility study. The timely provision of qualified staff to manage all the functions of the plant is most important. Many poorly performing investment projects suffer mainly from bad management. Thus before approving a new project the source and cost of managerial and supervisory staff should be determined. Local entrepreneurial and managerial capabilities, social factors (for example, the cultural environment and social policies) and sectoral and project-specific requirement including training and intercultural transfer of such capabilities should be covered in the feasibility study.

ii. *Skilled and Unskilled Workers*

The timely provision of skilled and unskilled workers is of equal importance to the availability of managerial and supervisor staff. A definition of the kinds of profession staff, skilled labor and unskilled workers needed should be provided

in order to specify the minimum training and professional experience required in order to qualify for the different posts identified. This is even more necessary because of the substantial difference in the availability public training programs for skilled workers in developing countries.

2. Socio-Economic and Cultural Environment

Human resources requirement not only depends on techno-economic and financial or commercial factors but also are determined to a certain extent by socio and socio-economic conditions in the country and location of the project.

i. Legislation and labor terms

Labor terms can be regulated by legislation of trade union contracts or be based on common practice. The prevailing rules regarding leave will have an impact on the effective numbers of working hours and days per year and therefore affect the human resources requirement s given the production targets and other conditions.

ii. *Labor norms*

A common error in the definition of human resource requirement is the adoption of labor norms prevailing in industrialized countries. Realistic estimates should instead be made on the basis of experience of and comparison with similar industrial projects in the project country and region

iii. *Occupational safety*

In many developing countries minimum standards of occupational safety have not been established or are not enforced strictly enough. A feasibility study must therefore also assess the relevant existing regulations on occupations safety including future trends and analyze their impact on investment and production costs.

iv. *Health care and social security*

The project analyst should also identify and consider necessary plant components regarding arrangements for health care and social security for the human resources to be employed. The cost of such components will have to be estimated and include in the cost tables of the study.

3. Project Related Requirements

i. ***Identification of requirements***

Staff and labor requirements have to be planned for the implementation or pre-production phase as well as for the start-up and operation phases. Particular attention should be paid to those enterprise functions which are essential for the feasibility of the investment and for which special professional skills and experience of employment and workers are required as in the areas of enterprise management (entrepreneurial and management functions), marketing, raw material and factory supplies, production processes and product characteristic, organization, and personnel and construction management. The identification of these significant requirements already at the stage of the feasibility study is both difficult and important. Some common examples of mistakes and their consequence are:

i.) Failure to provide the project implementation team with experienced and committed personnel often leads to delays and additional costs.

ii.) Bad timing of recruitment may lead to delays and poor utilization of production capacity during the first operating years. Over optimistic estimates regarding duration and quality of training as well as bad timing often have similar consequences.

iii.) Inadequate maintenance and supply of raw materials and utilities may lead to unplanned and costly production stops that could have been avoided with more experienced and skilled personnel.

iv.) Bad timing of marketing and sales, inexperienced sales persons and sales managers lack of legal advice before signing of contracting etc may result in sales volumes and revenues not keeping pace with production;

v.) Unskilled drivers may cause transport delays damages, losses and deteriorations in quality of the products being transported.

ii. ***Timing of requirements***

Pre-production phase: During the pre-production phase, it may be assumed that labor requirements occur mainly in conjunction with preparatory measures needed to start the operational phase. Thus the managerial staff, supervisors, some foremen, and special machine operators have to be recruited in advance, not only to be trained, but also to attend to the construction of building and the installation of equipment that they will later be operating.

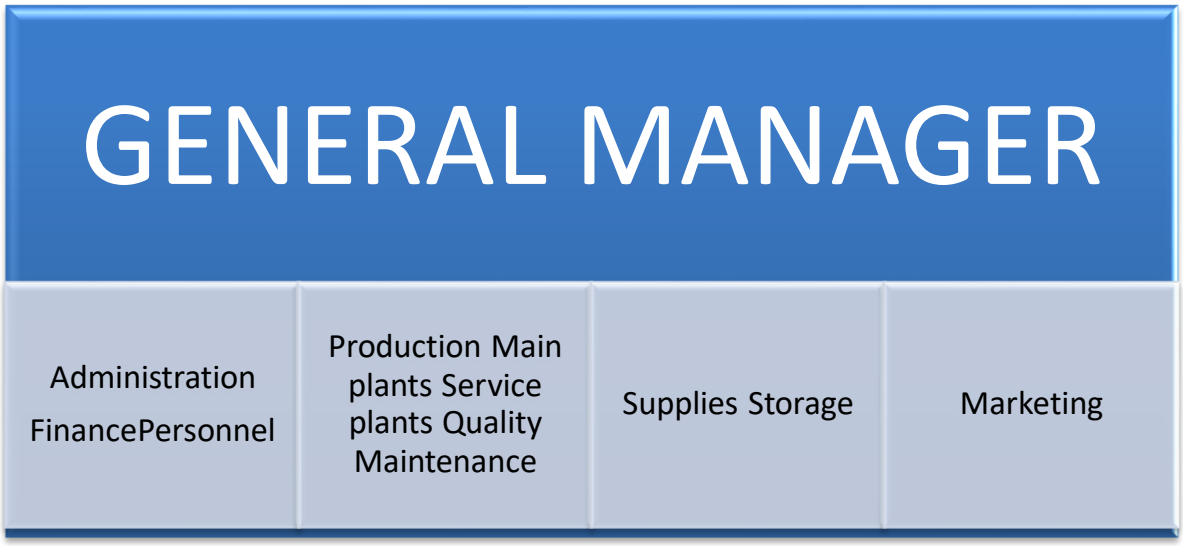
Operational phase: Requirements during the operating phase may vary over time capacity utilization is usually improved gradually and additional shifts may be introduced bringing about production and possibly additional requirements in certain personnel categories. A distinction should be made between variable and fixed wage and salary costs as well between the local and foreign labor components.

4. *Organizational Set-Up*

Human resource requirements will obviously also depend on the management structure, organizational layout, operating plan and other factors related to the financial and commercial features of the project. Organization is the means by which the operational functions and activities of the enterprises are structured and assigned to organizational, units represented by managerial staff, supervisors and workforce, with the objective of coordinating and controlling the performance of the enterprises and the achievement of its business targets.

The organizational structure of an enterprise indicates the delegation of responsibilities to the various functional units of the company and is normally shown in a diagram often referred to as an *organigram*. Usually, the organization is designed primarily in line with the different functions in the enterprise such as finance marketing purchasing and manufacturing. However, there is no unique organization pattern. It is also possible to base organizational structures on products or productions lines (for instance profit or cost centers) or on geographical areas or markets; the latter are typical for marketing organizations.

Example of an Organogram for an Industrial Enterprise



The organization design for both the construction and the operating phase depends on internal and external project requirements and conditions and is prepared for the following two reasons: First, the organization of the project and enterprises should aim at the optimal coordination and control of all project inputs, which make it possible to implement the project strategic economically. Secondly, the organizational set up serves to structure the investment and production costs and to determine the costs linked with the corresponding organization units.

The design of the organization usually includes the following steps

i.) The goals and objectives for the business are stated;

ii.) The functions that are necessary to achieve the goals are identified;

iii.) The necessary functions are grouped or related;

iv.) The organizational framework or structure is designed;

v.) All key jobs are analyzed designed and described,

vi.) A recruitment and training program is prepared.

The organizational planner will then have to consider some of fundamental aspects of optimal organization. These may include:

i.) The span of control that is the numbers of employees reporting of supervisor.

ii.) The number of organization levels

iii.) A subdivision of activities by functions process, equipment, location, product or classes of customers.

iv.) The distribution of responsibilities and authority

Later, once the project is approved all information applicable to the organization will be collected in an organization manual, which may include:

i.) An overall description and identification of the strategies, objectives and policies of the company.

ii.) A description of the various functional units sections or divisions of company, specification in man tasks to be performed by the individual units.

iii.) Job description for at least all key personnel

iv.) Administration procedures according to which transactions are to be carried out both internally and externally and covering all function and all levels of the company.

***The organization structures are discussed below*:**

a) General management

Depending on the type and is of an enterprise the general managers with his office is responsible for the entrepreneurial function. These are management functions that are fundamental for the existence of an enterprise and are not be delegated.

b) ***Administration (Accounting and financial control)***

An administrative unit or department has to be planned to provide the management with the financial and accounting information required for the efficient and economic operation of the enterprise. To facilitate cost planning and control during the pre-investment phase the project should be divided into cost centers. *Production cost centers* are those areas of activity where all major an industrial operations are performed. *Service centers* are those areas of activity that render supplementary service necessary to the smooth running of the plant. *Administrative and financial cost centers* comprise all activities related to managerial planning, control and performance evaluation.

c) Marketing organization

The marketing department is the organizational unit carrying out the marketing function description was established a marketing organization of a new project (or product) required the prior careful determination of both the marketing objectives and the means required and available

d) Organization of supplies

The supply system includes the provisions of inputs of materials and service shipping of the goods, storage and inventory control. It is the responsibility on the purchasing department to contribution to the overall profit generation of the company by obtaining the best possible prices while avoiding the storage of larger quantities for input materials than are required for reasonably safeguarding the production requirement. Purchasing will normally cover the providing of both goods and services from domestic and over areas suppliers.

Typical tasks will therefore include:

i.) Selection and evaluation suppliers

ii.) Requesting bids or arranging international competitive bidding

iii.) Shipping and clearing, quality control of incoming goods

iv.) Warehousing

v.) Invoice control and payments of suppliers.

e) Organization of storage

Stock control must aim at keeping stocks of materials and products low to avoid unnecessarily high net working capital requirements, while maintaining the minimum stock required for safe and uninterrupted operation. Often the control of the entire materials and product flow including storage remains within production department. In this case the production program as well as products in stock would be planned jointed with the market in department and supplies would be ordered through the purchasing department.

f) Organization of quality assurance

The quality assurance department is responsible for the total quality of a product from its conception to its delivery to the end-user. The type and scope of quality assurance depends however on the industry and the size of the project. It may be part of production department or be subordinated to the purchasing department in the later cases the responsibilities of the quality assurance department are usually more restricted and the task limited to the control of production incoming goods and outgoing products.

g) Organization of maintenance

The maintenance function is often placed within the production department. However, the placement of the maintenance unit within the individual company organization depends on where it can best fulfill its main objectives of ensuring that the plant and equipment is ready and functioning as required in accordance with the production program. If a maintenance unit is wholly dependent on its own resources it will be responsible for both preventive and corrective maintenance of all plant equipments, auxiliary equipments and buildings. The unit should be mainly staffed with the technicians who would be directly involved in the daily maintenance operations.

h) Organization of personnel

The personnel unit deals with all subjects related to human resources such as recruitment and training of personnel and updating and developing skills and knowledge. The social-cultural environment of the project usually has a great impact on the organization and overhead costs of the personnel department. For example labor laws directly applicable to the hiring and laying-off of personnel, local cultural habits or customs may have a decisive impact on recruitment, employment and development of the human resources requirement in the project. In other projects potential conflict between different ethic or social groups may require social measures and entail significant costs.

Human resources development may be important task of a personnel department. Training may have to be organized to increases skills of staff and workers to secure increase the quality of products etc. Other important subjects could be training related to health protection, the introduction and maintenance of safety measures and the operational of

machinery and plants in accordance with environment protection measures. *Manning tables:* labor planning should start at the departmental level defining the labor and staff requirements by function and categories (workers –skilled, semi-skilled and unskilled; staff –managerial, supervisory, administrative and sales). The manning table of the entire project can be obtained by simply aggregating the departmental manning tables**.**

5. ***Availability and Recruitment***

a) Assessment of supply and demand

The following factors should be given due consideration when the availability and employment of human resources are analyzed:

i.) The general availability of relevant human resource categories in the country and the project region

ii.) The supply and demand situation in the project region

iii.) Recruitment policy and methods

iv.) Training policy and program

The study should indicate the current supply and demand situation in the region as well as possible shortages in relevant categories strong demand from existing industries and expected demand from projects under construction might make it more difficult for the project in question to recruit human resources with the professional background and skills required.

b) Recruitment planning

Recruitment policy and methods and means of the retaining key personnel for long periods, probable terms or employment and possible fringe benefits to employees and their families should be identified. Difficulties in the recruitment of key personnel (such as managers, supervisors and skilled labor) can be dealt with in different ways:

i.) Recruitment is combined with intensive training of key personnel in order to meet quality requirements:

ii.) Foreign expertise is recruited.

An attempt is often made to compensate for the lack of experience of local managerial latent through the employment of foreign personnel, either by hiring individual

expatriate or by signing management contracts with foreign companies. Although this is an expensive course and does not immediately serve the important aim of developing indigenous managerial skills (especially if it extends over long period as is often the case) the employment of expatriates may be necessary for the successful implementation of a project.

Training Plan

Since the lack of experienced and skilled personnel can constitute a significant bottleneck for project implementation and operation in developing countries, extensive training programme should be designed and carried and out at part of the implementation process of investment projects. Training can be provided at the factory by managerial and technical personnel and others, by specially recruited experts or by expatriate personnel. The timing of training programs is of crucial importance since personnel should be sufficiently trained to be able to take up their positions as and when required training requirements should be defined separately for the preproduction and for the operation phase in order in provide adequately for production and operational training costs.

A training program can be prepared through the following steps:

i.) ***Analysis of personnel characteristics and conditions.*** Verifiable capacities, numbers, experiences and other characteristics are to be analyzed. Restrictions relating to unions and labor laws may be relevant .Socio-cultural characteristics (such as religion, tribal tradition regarding women and men working together tradition regards stability and working hours) should be considered.

ii.) ***Analysis of training requirements*** A job (task) analysis will provided information about the different tasks to be carried out. This is related to judgments regarding performance characteristics of different personnel categories. This knowledge will together with estimates regarding learning curves form a basis for defining the scope of the training required.

iii.) ***Formal training is usually related to managers and supervisory personnel.*** It can be carried out at the in the country or abroad depending on training facilities industrial traditional trainers available and other factors.

iv.) ***On the job training can be carried out in the form of individual or group training*****.** It is usually out at the plant in question but can take place partly in other industries. This kind of training should not be exclusively technical but should also cover administrative and other duties.

v.) ***Updating during future plant operations may be required for management and administration staff as well as labor*****.** The introduction of new plant equipment and methods of work will require motivated staff to maintain high standards on proficiency and productivity.

Cost Estimates The manning tables prepared for each department can be used for estimating labor costs. The costs are to be divided in to foreign and local currency components. When estimating the total wage and salary costs provision should be for the following personnel overhead costs

i.) Socio security fringe benefits and welfare costs

ii.) Installation grant, subsistence payment and similar each costs that occur in connection with recruitment and employment

iii.) Annual deposits to pension funds

iv.) Direct and indirect costs of training

v.) Payroll taxes

1.2.5.4 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Visit a local firm and draw the organizational setup
2. Identify the roles and responsibilities of each member in the organization above

Resource Requirements

1. A firm or institution
2. Resource persons

1.2.5.5 Self-Assessment questions

1. Which are the social economic and cultural factors that influence project human resource requirements?
2. How would you describe the organizational set up of a project?
3. How would you explain the rationale for identification of project related human resource requirements?
4. Which are the steps involved in designing a training program for project human resource?
5. Explain the categories and functions of project human resource requirements
6. Which factors would you consider when estimating the total wage and salary costs provision of labour?
7. Which are the considerations of availability and employment of human resources?
8. The design of the organization usually includes several steps. Which are these steps?
9. What is monitoring?
10. What is evaluation as used in project management?

Response to self-assessment questions

1. Which are the social economic and cultural factors that influence project human resource requirements?
    a. **Legislation and labor terms**
    b. **Labor norms**
    c. **Occupational safety**
    d. **Health care and social security**
2. How would you describe the organizational set up of a project?

    Organization is the means by which the operational functions and activities of the enterprises are structured and assigned to organizational, units represented by managerial staff, supervisors and workforce, with the objective of coordinating and controlling the performance of the enterprises and the achievement of its business targets.

    The organizational structure of an enterprise indicates the delegation of responsibilities to the various functional units of the company and is normally shown in a diagram often referred to as an organigram.
3. How would you explain the rationale for identification of project related human resource requirements?

    Staff and labor requirements have to be planned for the implementation or pre-production phase as well as for the start-up and operation phases. Particular attention should be paid to those enterprise functions which are essential for the feasibility of the investment and for which special professional skills and experience of employment and workers are required as in the areas of enterprise management
4. Which are the steps involved in designing a training program for project human resource?

    i.) Analysis of personnel characteristics and conditions. **Verifiable capacities, numbers, experiences and other characteristics are to be analyzed. Restrictions relating to unions and labor laws may be relevant .Socio-cultural characteristics (such as religion, tribal tradition**

regarding women and men working together tradition regards stability and working hours) should be considered.

ii.) Analysis of training requirements **A job (task) analysis will provided information about the different tasks to be carried out. This is related to judgments regarding performance characteristics of different personnel categories. This knowledge will together with estimates regarding learning curves form a basis for defining the scope of the training required.**

iii.) Formal training is usually related to managers and supervisory personnel**. It can be carried out at the in the country or abroad depending on training facilities industrial traditional trainers available and other factors.**

iv.) On the job training can be carried out in the form of individual or group training**. It is usually out at the plant in question but can take place partly in other industries. This kind of training should not be exclusively technical but should also cover administrative and other duties.**

v.) Updating during future plant operations may be required for management and administration staff as well as labor**. The introduction of new plant equipment and methods of work will require motivated staff to maintain high standards on proficiency and productivity.**

5. Explain the categories and functions of project human resource requirements

i. **Managerial and Supervisory Staff**

The provision of qualified and experienced managers is basic prerequisite for successful project implementation and operation. In many projects, key senior personnel need to be associated with the project during the pre-production stage and even during the prior stage of project formulation and the feasibility study. The timely provision of qualified staff to manage all the functions of the plant is most important. Many poorly performing investment projects suffer mainly from bad management. Thus before

approving a new project the source and cost of managerial and supervisory staff should be determined. Local entrepreneurial and managerial capabilities, social factors (for example, the cultural environment and social policies) and sectoral and project-specific requirement including training and intercultural transfer of such capabilities should be covered in the feasibility study.

ii. Skilled and Unskilled Workers

The timely provision of skilled and unskilled workers is of equal importance to the availability of managerial and supervisor staff. A definition of the kinds of profession staff, skilled labor and unskilled workers needed should be provided in order to specify the minimum training and professional experience required in order to qualify for the different posts identified. This is even more necessary because of the substantial difference in the availability public training programs for skilled workers in developing countries.

6. Which factors would you consider when estimating the total wage and salary costs provision of labour?

   i.**) Socio security fringe benefits and welfare costs**

   ii.) Installation grant, subsistence payment and similar each costs that occur in connection with recruitment and employment

   iii.) Annual deposits to pension funds

   iv.) Direct and indirect costs of training

   v.) Payroll taxes

7. Which are the considerations of availability and employment of human resources?

   i.) The general availability of relevant human resource categories in the country and the project region

   ii.) The supply and demand situation in the project region

   iii.) Recruitment policy and methods

   iv.) Training policy and program

8. The design of the organization usually includes several steps. Which are these steps?

   i.) The goals and objectives for the business are stated;

   ii.) The functions that are necessary to achieve the goals are identified;

   iii.) The necessary functions are grouped or related;

   iv.) The organizational framework or structure is designed;

   v.) All key jobs are analyzed designed and described,

   vi.) A recruitment and training program is prepared

9. What is monitoring? **this is the action of carrying out surveillance or regular observation in order to detect changes of state or quality.**

10. What is evaluation as used in project management?

    Evaluation is an assessment to determine value

1.2.5.6 Tools, Equipment, Supplies and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Chats

1.2.5.7 References

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1.2.6 Learning Outcome 6; Keep site records

1.2.6.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to keep site records. It involves identifying record parameters, applying data entry methods and regular updating of records.

1.2.6.2 Performance Standard

6.1 Record parameters are identified based on project requirements

6.2 Data entry methods are identified and applied

6.3 Regular updates of records are maintained according to the job requirement

1.2.6.3 Information Sheet

Definition of terms

Data – raw facts and figures collected and ready for processing

Types of records

1. **Drawings**

First and foremost important records to be maintained on site are the working drawings approved by the clients and design engineer, based on which all the construction activities takes place on site. There are different types of drawings required for construction; some of the basic required drawings are,

- Architectural drawing
- Structural drawing
- Plumbing & sanitary drawing
- Electrical drawing
- Finishing drawing etc**.**

2. Contract Agreement

Contract agreement documents including all sets of drawings, including amendments, a copy of approval of municipality, corporation or urban development authorities need to be maintained at construction sites till the completion of construction projects.

3. **Time and Progress Charts or CPM Charts**

These charts help in tracking the construction activities from time to time and help in effective planning, scheduling, and controlling the construction projects activities. These charts need to be approved from the concerned authorities.

4. **Work Orders Book**

All the orders given by clients to the contractors need be maintained with serial numbers, signatures, and dates. These orders should be specific for works. This order should also have a compliance column.

5. **Works Diary**

Works diary of a construction project should indicate contract agreement number, name of work, amount of contract, date of commencement of work, date of completion and extension time granted. All the relevant details need be entered daily in the works diary. This diary serves as an authentic record. Following details need to be entered in this diary with due care:

- Weather at site
- Important materials brought to site with their approximate quantity
- Types of transport working at site
- Types of tools and plants being used at site
- Important items of works completed and passed on the particular date
- Visits of VIPs and their remarks if any.

6. **Works Passing Records**

This record maintains all the activities to be carried out at construction site. It consists of an index page with details of all items of works to be done under the contract and other pages with details of progress of each works.

7. **Tests Results Record**

This is an important record to be maintained at construction site as a proof for construction quality. This record consists of tests of various materials such as cement, sand, aggregates, water, steel reinforcement used at construction site, test records of concrete cubes, concrete cylinders, slump tests etc. All the tests carried out at site or in laboratory are recorded in this record book.

Some of the tests carried out at construction sites for civil works are:

- Cube tests for concrete works for each location or structural members.

- Sieve analysis of coarse aggregates, impact or abrasion tests.
- Sieve analysis of coarse sand for concrete works, masonry sands for masonry works, plastering and pointing works etc.
- Tests for impurities of aggregates and sands.
- Bulking of sand test for concrete and masonry works.
- Slump tests and compacting factor tests for concrete works.
- Crushing strength test, tolerance, water absorption test, efflorescence tests of bricks, stones, or masonry work.
- Moisture contents of timber.
- Manufacturer tests reports provided by the vendors for admixtures, reinforcing steels etc.

8. **Cement Register**

This record is maintained with details of receipts, daily consumptions, and remaining balance of cement at site. This record also consists of manufacturing dates of cement, date of receipt and test reports of cement at site or manufacturers test reports.

9. **Register for Approval of Samples**

This record provides details of all the samples for construction materials that has been approved or rejected by the clients. Approvals from the client are necessary for the construction materials to be used before commencement of the project. All the samples approved by the clients need to be kept separately along with their tests reports with approvals of the clients and contractors till the completion of the work.

10. **Records of Changes, Deviation Orders and Amendments**

Many a times during the construction projects, there are deviations or changes or amendments to the contract documents and work activities from time to time during construction project as required by the clients. These changes can be in a drawing, specifications, or additional works.

A record of all such deviation orders and amendments to contract agreement together with their financial effect should be maintained along with approval or signatures from the clients. If these changes involves in any extension of time of the contract, these should also be recorded.

1. Measurement Books

The measurement book is a record for all the construction activities carried out and approved by the client. These records are important for a contractor to maintain and help during billing claims. Any extra work done is also recorded in this book with notes.

12. Labour Attendance Record and Daily Wages Sheet

Generally for labour contractor payments, daily or every shift attendance record is kept. Apart from the above, technical staff attendance, engineers, supervisors, and attendance register is kept.

13. Periodic Bills Record

Bills on work till date from the previous bill and work checked by engineer-in-charge put up for the payment

Office machines and equipment

Although it is possible for office work to be carried out manually without the use of any machines, the output of this effort would be of poor quality and high cost that it would not be accepted by any business firm today. Machines do perform several office tasks than what can be produced by some office staff.

Advantages of office machines

1. Labour saving – Work performed by a machine requires very few staff and thus there is labour saving and reduction of salaries and wages.
2. Speed – Machines are much faster, thus save time.
3. Accuracy – They are more accurate, although the accuracy is partly contributed by one who feels data into it.
4. Control – They assist in avoiding errors and frauds.
5. Economical – Cost per unit of job done by machines usually work out to be less than that done manually.

Disadvantages and Limitations of office machines

1. Need the operation of a human being
2. Costly – Machines may be more uneconomical if the volume of work is small
3. Breakdowns – Machines are subject to breakdowns which disrupt work.

Factors to consider when Buying Machines

(a) Initial cost – Amount required for purchasing and installing them
(b) Operation cost – Maintenance and running cost
(c) Importance of accuracy
(d) Purpose – the need for a particular feature
(e) Adaptability to meet future development

Common Machines used in a general office

(a) Typewriters

These may be manual or electric. The latter requires little physical effort to use and the typist can do continuous work without getting tired.

(b) Calculators

These may be manual or electric. The simplest one will add and subtract. The more complicated electric machines will add, subtract, divide and multiply and give subtotal and total. Widely used and basically required to save time and mental effort in the process of addition, subtraction, multiplication and division plus many other tasks.

(c) Duplicating Machines

The type and amount of work required to be carried out will dictate the type of machine that is wanted from the many available. There are many types of duplicators:

- Stencil duplicator
- Offset litho duplicators
- Spirit hectograph

In many offices today, these have been largely replaced by inkjet and laser jet printers.

(d) Photocopiers

Depend upon the use of sensitive paper which is quite expensive. The system is ideal for small quantities of high quality copies. There are various types, some using chemical, others using heat or light. The copy is produced in a few seconds. The big advantage with this system is that the production of a stencil is not necessary for reproduction and can be made direct from the original document.

(e) Computers

The computer is a 'tool' of management and an aid to administration. A computer is a very fast calculating machine with the ability to store a huge volume of data which can be got at quickly when required.

Use of computers in the building industry is in the field of stock-control, payrolls and planning (critical path analysis), as these are the areas in which standardization occurs. For example, with pay-rolls, all the relevant details of each employee can be stored by the computer: name, age, tax code number, all deductible contributions such as pensions, wage rates, union dues, etc. When the wages are due, the computer is asked to calculate the necessary amounts, any non-standard performances being fed into the computer separately. The computer will then sort out each employee's details in turn, working out the wages to be received from its memory, resulting in a printed pay slip for each employee with all the details shown.

With appropriate software and hardware computers are increasingly being used in manufacturing of high quality building materials and equipment and are replacing the manual drawing office. Software such as AutoCAD and ArchiCAD and hardware such as printers, plotters, scanners, satellite and robots and services such as Internet, e-mail etc have revolutionized the construction industry in the last 10 years; what with the reduction in size of computers.

FILING SYSTEMS

Correspondence files together with site diaries form the heart of any record system. The original of every incoming letter and a clear copy of every outgoing one with any enclosures are placed on file under the appropriate subject heading. Each site team will develop its own filing system but a good starting point is to set up a file for each section of the bill of quantities and specifications and for such essential subjects such as land ownership, statutory undertakers, site safety, programme, setting out, sub-contractors, suppliers and public relations to ensure the files are complete. All incoming and outgoing correspondence must be logged in a register and given file reference. The register should be checked against the files at frequent intervals to ensure that nothing goes astray.

Filing is a process of classifying and arranging records so that they can be obtained without delay. The objective is to enable the officers to locate a document, which they may need easily, conveniently and quickly. An efficient filing system is that in which the records required at any time can be located easily and protected adequately and the cost of keeping the record is reasonable.

In large firms, all files belonging to the firm are kept in one room and maintained by trained personnel. This is called centralized filing and a centralized filing office is called a registry. Where every department within a firm has its own filing system this is called department filing.

Characteristics of a good filing system

A good filing system should have the following characteristics:

(a) Simple: The system should be simple to understand and operate.

(b) Compactness: It should not take too much space especially floor space for the filing system.

(c) Accessible: It should be sited such that it is easy to file records and extract them, without having to disturb others.

(d) Safety: The right degree of safety should be given to document according to their importance.

(e) Elasticity: The system should allow for growth in relation to future needs.

(f) Economy: The system should be economical to install and maintain in terms of money and labour costs.

There are different systems of filing. The classification refers to the basis of arrangement of documents in a folder.

1. Alphabetical Filing

This is where documents are arranged (filed) according to the first letters of either the name of sender or the subject. The arrangement is similar to the words in an English dictionary or names in a telephone directory.

Advantages

1. Convenient for grouping papers by name of company
2. Direct filing with no need for separate index system i.e. the first letter will tell you where the document is located
3. Simple and easy to understand even to new employees
4. It is possible to open one file for miscellaneous papers which cannot make up their own files

Disadvantages

1. In large systems it takes longer time to find papers
2. Congestion under common names
3. There are possibilities of a document being filed under a different name due to differences in spelling etc.

2. Numerical Filing

As the name implies correspondence are arranged according to numbers rather than letters. This system is useful for filing orders or other items kept in a numerical sequence.

Advantages

1. Highly accurate system

2. New documents are added to files as they arise without having to rearrange the system by just starting a new folder and adding a number to the card index
3. The file number can be used as a reference for correspondence.
4. The filing index may be used for other purposes (e.g. a mailing list) as well.

Disadvantages

1. It takes large file materials as it involves two operations i.e. the recording of paper number on the card index and the filing of the document.
2. A separate card index must be provided.
3. It takes time for a new employee to fully understand the system.

3. Subject Filing

Similar to alphabetical filing but now files are classified according to subject headings or topics e.g. bricks, bonding agents etc. Although both headings begin with the letter "B" these would be separated in a different file.

Advantages

1. All documents referring to a particular subject or matter are kept together in one place.
2. The files can be easily expanded or contracted by simply adding or subtracting old ones.

Disadvantages

1. Determining the list of division is different and requires someone with a knowledge of the business and its files
2. Determining under which subject heading it should be filed requires a careful employee

4. Geographical Filing

Under this system files are divided according to their places of origin e.g. countries, counties or districts. Files within each group are arranged alphabetically.

Advantages

1. Suitable for companies that have several branches spread over different parts of the world e.g. oil companies, commercial banks
2. Direct access for filing purposes
3. Convenient for reference where location is known

Disadvantages

1. Possibility of errors where knowledge of geography is weak
2. Geographical location must be known in addition to the correspondent's names
3. Index necessary for occasional reference

5. Chronological Filing

Under this system all documents are filed in order of their dates of receipt. This system is rarely used absolutely but it is the usual method of filing papers inside each folder.

Advantages

1. Useful if dates are known
2. It provides for unlimited scope of expansion.

Disadvantages

1. It is not always suitable.
2. Incoming letters might become separated from outgoing ones.

Data entry methods

1. Manual Data Capture:

In manual data capture process, the data is entered manually by an operator using input devices like keyboard, touch screens, mouse etc. for keying in data in the form of figures or text into particular software such as Excel or any other data or word processing program. This method of data collection is labor intensive, time consuming and so businesses find it

efficient to migrate to automated methods of data capture. However, the manual method is not totally extinct and still finds application in many business processes. Briefly, the methods of manual data capture include using:

- Mouse
- Graphics tablet
- Keyboard
- Touch-screen – e.g. PDA
- Tracker ball

2. **Automated Data Capture:**

Automated data capture involves the use of computerized technology to capture data. This method has a high initial cost on account of the initial investment required as for instance, the purchase of technology but as the project proceeds, is found to lower the operating costs significantly on account of low manpower requirement. Further, with the majority of data today existing in electronic forms, the cost of using such automated technology has also reduced. Hence, there has been proliferation of techniques and technology of automated methods of data capturing, each suitable for a particular type data or source of data. Automated data capture includes the use of different technologies such as OCR, ICR, OMR and others, which are individually described here.

3. **Optical Character Recognition (OCR):**

OCR technology is used to convert different types of machine-printed documents including image files, PDF files or scanned paper documents, into searchable and editable data.

3. **Intelligent Character Recognition (ICR):**

ICR technology helps to recognize and capture handwritten printed characters from image files. As handwritten text caries significantly, so ICR is less accurate and complicated as compared to other technologies. However, the technology evolves continuously by itself and as the number of samples processed increases, the accuracy increases. This self-learning process differentiates it from others and gives it the name of 'intelligent'

4. **Optical Mark Reading (OMR):**

OMR technology is used to capture human marked data from documents such as forms and surveys. The technology has the capacity to differentiate between marked and unmarked boxes and so, is used for capturing data through boxes that are checked manually on documents.

5. **Magnetic Ink character Recognition (MICR):**

It is a data capture technology capable of recognizing characters. It involves the recognition of specially formatted characters that are printed in magnetic ink, by a machine. The technology is mainly used by banking industry to speed up the processing of cheques and other documents. The added advantage of this method is that humans can also read the data as well.

6. **Magnetic Stripe Cards:**

Magnetic stripe cards store data using magnetic properties of certain materials. They possess stripes of iron-based magnetic materials on the card.

They are used for electronically storing particular numbers related to credit cards, identity cards and they enable automated data transfer when they reswiped in magnetic readers.

7**. Smart-Cards:**

Smart cards are pocket-sized cards with embedded integrated circuits. They can function on contact or can be contactless. They contain more memory than magnetic cards and can be used for data related to personal identification, authentication, biometrics etc. Upon interaction with suitable reading devices they enable automated information transfer and data access.

8. **Web-Data Capture:**

Data capture from web involves the capture of data from electronic forms through internet or intranet.

9. **Voice- Recognition:**

Voice recognition is the process of converting speech into text. The text can be simple text or can be a set of commands. It finds application in dictation systems, small controlling systems and certain processes of data entry and word-processing environment.

Record management systems

Step 1: Complete inventory of all records

Before you put a new process in place, you should understand the scope of your project. By doing a complete inventory of all the records you want to manage, you will be able to implement processes that coincide with your business and your data management needs of your team.

Step 2: Determine who is going to manage the process and records

Once you have determined the way you want to manage your records, you need to determine two things:

- Who is going to manage each step of the process?
- What steps of the process need to be managed?

By clearly defining these two things, you can ensure that your system is going to be sustainable with the ability to scale**.**

Step 3: Develop a records retention and destruction schedule

It's important to identify and monitor the various retention times for all the records in your company. A records retention program provides for the review, retention and destruction of records received or created in the course of regular business activities. It contains and helps maintain the guidelines for how long certain records should be kept and the conditions in which they should be destroyed.

This outlined schedule will help eliminate the risk of older documents causing legal problems and will cut costs by reducing storage needs of old and unneeded documents.

Step 4: Determine the best way to store and manage your records

Most companies use several different systems to store and manage their records depending on the type of business that they're in and the workflow of their office.

Some companies prefer a document management system and a cloud storage service, eliminating the need to store paper files. All their documents are scanned and indexed, making them easier to manage and find.

Other companies prefer to utilize a hard-copy storage system through a records management company and secure off-site records storage to manage their papers.

This allows them to have access to their documents any time they need them, and still maintain hard-copy records for legal or regulatory purposes.

Step 5: Create and document proper procedures

By creating a thorough procedure for your new records management plan, you can verify that the proper steps are taken in the future and can distribute this knowledge throughout the workplace. Keeping everyone on the same page with their records management eliminates any mistakes that can lead to inefficiency or loss of data.

Step 6: Create a disaster recovery plan

Accidents and natural disasters happen so make sure you have a disaster recovery plan in place to help eliminate any issues in case of a natural disaster, fire, or flood.

A solid backup plan will give you the peace of mind in knowing your data is recoverable in the case of any emergencies.

Step 7: Training and implementation

Training your employees after implementation of your new records management plan is the next step. By selecting the right team and ensuring you have well-defined processes and procedures, your records management will be a success.

8: Maintaining and auditing the program

Once the system is implemented and you've completed all your training, monitor and document any issues or inefficiencies that tend to happen with any large-scale implementation. Maintaining a regular process update and audit procedure will ensure that you correct any problems as quickly as possible.

ISO Certification

ISO 9001 in the construction industry:

Leaving aside commercial projects for the time being, most of us are familiar with the average cost of a new home in the area we live. Given the amount of money involved, there are several reasons for ISO 9001 to become a valuable accreditation for companies in the sector. Let's examine them:

- Standardize services and product quality: Application of the standard could ensure that build quality, methodology, and adherence to legislation are consistent, therefore ensuring consistent quality of product.
- Reduce costs for the builder: Improvement of supply chain management and purchasing processes through ISO 9001-approved methods can reduce costs and increase profit margins.
- Ensure continual improvement: Application of the standard should ensure that your business and associated processes improve year after year, increasing profits and growing the business accordingly.

ISO 9001 elements:

Obviously, a company in the construction sector – the same as in any other sector – will have to satisfy all clauses of the ISO 9001 standard to become accredited. Some of the the standards that would specifically help the performance of a construction sector company are:

i. **Planning:** The planning element of ISO 9001 would encourage more specific strategic planning on complex building projects. An enhanced focus on how risks and opportunities can be addressed to help meet stated objectives can bring great efficiencies to many construction projects – given the costs of contractors, equipment, and material – the financial benefits of finishing a 12- week project in 11 are massive when multiplied out over the course of a trading year.

ii. **Supply chain management**: "Control of external services" is mentioned in the 9001 standard, and this critical element can be used to performance manage contractors and also ensure that your supply chain meets your price requirements and quality objectives simultaneously. Concentrating on this aspect, developing processes and

criteria to both select and manage your supply chain can provide massive financial, quality, and time benefits to your construction company.

iii. **Performance evaluation:** This clause allows a construction company to analyze its performance with a view to allowing it to achieve continual improvement by improved planning and subsequent improved processes and performance. The article How to implement the check phase (performance evaluation) in the QMS according to ISO 9001:2015 can provide more detail on this topic.

iv. **The process approach:** The ability to pull all factors of a complicated construction project together would be extremely valuable in this sector, in terms of managing aggressive timelines and financial budgets. Many public construction projects run over budget and time targets, and this vital element of the ISO 9001 standard can help prevent this. You can read more on this topic in the article ISO 9001: the importance of the process approach.

v. **Leadership:** One of the key changes in the 2015 version of the standard is leadership. Enhanced leadership providing clear guidance on objectives and shared goals allied to excellent communication channels can help build a "get it right first time" culture within a construction project, ensuring both financial and time target are met. You can find out more by reading How to comply with new leadership requirements in ISO 9001:2015.

vi. **Win new customers**: Use ISO 9001 as a selling point. If not everyone in the construction sector has yet adopted ISO 9001 principles, use this as one of your unique selling points with a full explanation of its benefits. Reading 10 steps to attract a major customer using ISO 9001 can give you guidance on this element.

1.2.6.4 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Prepare sample files with folios ready for data recording
2. Prepare a softcopy data capture file using a computer

Resource Requirements

- Computers
- Printers
- Photocopiers
- Printing papers

1.2.6.5 Self-Assessment questions

1. Which are the basic types of drawings used in the construction industry?
2. What are the main advantages of office machines?
3. Which are the common machines used in offices?
4. Which are some factors you would consider when planning to buy an office machine?
5. Which are the characteristics of a good filing system?
6. Which are some examples of records that require storage in the construction industry?
7. Which are some data entry methods used for data capture?
8. What are test records and what is their significance?
9. What are the advantages of alphabetical filing system?
10. Which details are normally recorded in a site diary?

Response to self-assessment questions

1. Which are the basic types of drawings used in the construction industry?
    i. **Architectural drawings**
    ii. **Electrical drawings**
    iii. **Civil engineering drawings**
    iv. **Mechanical drawings**
2. What are the main advantages of office machines?
    i. **Labour saving – Work performed by a machine requires very few staff and thus there is labour saving and reduction of salaries and wages.**
    ii. **Speed – Machines are much faster, thus save time.**
    iii. **Accuracy – They are more accurate, although the accuracy is partly contributed by one who feels data into it.**
    iv. **Control – They assist in avoiding errors and frauds.**
    v. **Economical – Cost per unit of job done by machines usually work out to be less than that done manually**

3. Which are the common machines used in offices?
    i. **Printers**
    ii. **Computers**
    iii. **Photocopiers**
    iv. **Calculators**
4. Which are some factors you would consider when planning to buy an office machine?
    a. **Initial cost – Amount required for purchasing and installing them**
    b. **Operation cost – Maintenance and running cost**
    c. **Importance of accuracy**
    d. **Purpose – the need for a particular feature**
    e. **Adaptability to meet future development**
5. Which are the characteristics of a good filing system?
    (a) Simple: The system should be simple to understand and operate.

(b) Compactness: It should not take too much space especially floor space for the filing system.

(c) Accessible: It should be sited such that it is easy to file records and extract them, without having to disturb others.

(d) Safety: The right degree of safety should be given to document according to their importance.

(e) Elasticity: The system should allow for growth in relation to future needs.

(f) Economy: The system should be economical to install and maintain in terms of money and labour costs.

6. Which are some examples of records that require storage in the construction industry?
   - **i. Drawings**
   - **ii. Progress charts**
   - **iii. Contract agreements**
   - **iv. Work order book**
   - **v. Works diary**
   - **vi. Test records**

7. Which are some data entry methods used for data capture?
   - **i. Manual data capture**
   - **ii. Automated data capture**
   - **iii. Optical data recognition**
   - **iv. Intelligent data recognition**

8. What are test records and what is their significance?

   Test records are a proof for construction quality. This record consists of tests of various materials such as cement, sand, aggregates, water, steel reinforcement used at construction site, test records of concrete cubes,

concrete cylinders, slump tests etc. All the tests carried out at site or in laboratory are recorded in this record book.

Some of the tests carried out at construction sites for civil works are:

- **Cube tests for concrete works for each location or structural members.**
- **Sieve analysis of coarse aggregates, impact or abrasion tests.**
- **Sieve analysis of coarse sand for concrete works, masonry sands for masonry works, plastering and pointing works etc.**
- **Tests for impurities of aggregates and sands.**
- **Bulking of sand test for concrete and masonry works.**
- **Slump tests and compacting factor tests for concrete works.**
- **Crushing strength test, tolerance, water absorption test, efflorescence tests of bricks, stones, or masonry work**.

9. What are the advantages of alphabetical filing system?
   i. **Convenient for grouping papers by name of company**
   ii. **Direct filing with no need for separate index system i.e. the first letter will tell you where the document is located**
   iii. **Simple and easy to understand even to new employees**
   iv. **It is possible to open one file for miscellaneous papers which cannot make up their own files**

10. Which details are normally recorded in a site diary?
    i. **Weather at site**
    ii. **Important materials brought to site with their approximate quantity**
    iii. **Types of transport working at site**
    iv. **Types of tools and plants being used at site**
    v. **Important items of works completed and passed on the particular date**
    vi. **Visits of VIPs and their remarks if any.**

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Charts

1.2.6.7 References

i. Chandra Prasanna, (2002), "Projects: Planning, Analysis Financing Implementation and Review", 5th Ed, Tata McGraw-Hill New Delhi

ii. Phil Baguley (2009), Project Management, Hodder & Stoughton

iii. Choudhury S. (2004), Project Management, Tata Mgraw Hill

iv. Hansen, (1992), "Manual for the Preparation of Industrial Feasibility Studies", UNIDO

v. Phil Baguley (2009), Project Management, Hodder & Stoughton

1.2.7 Learning Outcome 7; Monitor site activities

1.2.7.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to monitor site activities. It involves identifying construction requirements, analyzing project status and preparing project reports.

1.2.7.2 Performance Standard

7.1 Construction requirements are identified as per building code, public health act and local government requirements.

7.2 Construction activities progress is noted against performance standards.

7.3 Project status/task performance is analyzed against manager's specification.

7.4 Efficiency and effectiveness of site activities are analyzed.

7.5 Project report is prepared.

1.2.7.3 Information Sheet

Definition of terms

Project Monitoring refers to the process of keeping track of all project-related metrics including team performance and task duration, identifying potential problems and taking corrective actions necessary to ensure that the project is within scope, on budget and meets the specified deadlines.

Monitoring and Controlling

Monitoring and controlling consists of those processes performed to observe project execution so that potential problems can be identified in a timely manner and corrective action can be taken, when necessary, to control the execution of the project. The key benefit is that project performance is observed and measured regularly to identify variances from the project management plan. To do this the project management plan is used. Monitoring and controlling includes:

i. Measuring the ongoing project activities *(where are we, against where we should be?)*
ii. Monitoring the project variables *(cost, effort, scope)* against the project management plan and the project baseline *(where should we be?)*
iii. Identifying corrective actions to address risks and issues *(how can we get back on track?)*

iv. Managing changes using our change control process *(what is the impact of this change?)*

Monitoring and controlling cycle

Figure 11 Monitoring and controlling cycle

In multi-phase projects, the monitoring and control process also provides feedback between project phases, in order to implement corrective or preventive actions to bring the project into compliance with the project management plan.

The monitoring and controlling process group ends once the project has achieved its goals and objectives as detailed in the project contract. A project may be stopped before completion for various reasons, including changes in the business, lack of resources or higher priorities.

Project Control

Project control is that part of a project that keeps it on-track, on-time and within budget. Project control begins early in the project with planning, and ends late in the project with post-implementation review. Projects should be assessed for the right level of control needed: too much control is time-consuming, too little control is risky. If project control is not carried out correctly, the cost to the business should be clarified in terms of errors, fixes and added costs.

Typical elements of project control are:

a) Overall business strategy
b) Standards for new systems
c) Project management policies
d) Change management
e) Quality control

The following methods of project controlling can be applied:

i. investment analysis
ii. cost–benefit analyses
iii. value benefit Analysis
iv. expert surveys
v. simulation calculations
vi. risk-profile analyses
vii. surcharge calculations
viii. milestone trend analysis
ix. cost trend analysis
x. target/actual-comparison

Control systems are needed for cost, risk, quality, communication, time, change, procurement, and human resources. In addition, auditors should consider how important the projects are to the financial statements, how reliant the stakeholders are on controls, and how many controls exist. Auditors should review the development process and procedures for how they are implemented. The process of development and the quality of the final product may also be assessed if needed or requested. A business may want the auditing firm to be involved throughout the process to catch problems earlier on so that they can be fixed more easily. An auditor can serve as a controls consultant as part of the development team or as an independent auditor as part of an audit

Building code

Clause 352 of the National Construction Authority Act states that an inspection of a building shall be conducted every five years after the completion of a building.

Clause 353 of the National Construction Authority Act states that the following types of inspections shall be carried out on a building—

(a) A visual inspection;

(b) A full structural or civil inspection;

(c) A full building condition survey;

(d) A full building services (electrical and mechanical) inspection; and

(e) A specialized building investigation.

(2) A licensed building surveyor shall carry out the inspection referred to in sub-paragraph (1) (c).

(3) A licensed building surveyor shall coordinate the inspections referred to in sub-paragraph (1).

(4) An inspection referred to in sub-paragraph (1), except a full building services (electrical and mechanical) inspection, shall be carried out in the first instance and subsequent inspections after the issuance of a certificate of occupation for a building.

(5) An inspection referred to in sub-paragraph (1) (a) shall consider—

(a) A visual observation of the condition of a building, its structural elements and an addition or alteration to the building and its structural elements; and

(b) A visual observation of the surrounding areas including the slopes and drainage system and an alteration to the slope structures.

(6) A building surveyor shall submit to an owner the visual inspection report prepared pursuant to an inspection conducted in accordance with sub-paragraph (5).

(7) The visual inspection report referred to in sub-paragraph (6) may recommend that the inspection referred to in sub-paragraph (1) (b), (c) and (d) to be carried out and shall specify—

(a) That the information relating to the design, construction, maintenance and history of the building shall be obtained;

(b) Reasonable due diligence, checking the structural plans of the building and related calculation or, if the plans are not available, reconstruct the structural plans;

(c) Carrying out of non-destructive tests; and

(d) Carrying out tests on the materials used in the construction of the buildings; and

(e) Recommendations that involve a professional carrying out remedial works necessary to ensure the structural condition, stability or integrity of the building.

Construction projects involve the co-ordination of a great number of people, materials and components. Regular inspection is a crucial part of ensuring that the works progress as intended, both in terms of quality and compliance. Inspections will be carried out for a number of different purposes throughout the duration of a project.

The inspection process is separate from the contractor's own supervision of the works. Inspection is carried out purely to give an independent view of the works either for the client or a third party, the term supervision might imply taking some responsibility for the works, when in fact contractual responsibility lies with the contractor.

Quality and progress

Inspection of the construction works will be carried out as they proceed to verify compliance with the requirements of the contract documents.

Site inspectors (or clerks of works) may be provided as an additional service by the existing consultant team, or could be new appointments. They may be based on site permanently or may make regular visits. On large projects it may be appropriate to have separate site inspectors for mechanical and electrical services, structural works and architectural works. Specialist inspections may also be necessary for specific aspects of the project such as; the client's environmental policy, site waste management plan, accessibility, and so on.

Site inspectors provide an independent assessment of the works and will generally report to the contract administrator. They are likely to keep a site diary, attend construction progress meetings and to produce regular written reports.

Traditionally on the larger projects a clerk of works was appointed to be the eyes and ears of the consultants and be resident on site. They had limited power other than to inspect; they could condemn work but any instructions would be issued by the architect or the contract administrator.

Specific inspections may also be carried out during the construction phase as part of the general contract administration process:

- Condition surveys of neighboring structures prior to commencement of the works.
- Regular valuation inspections to assess progress of the works in order to value interim payments.

- Inspecting mock ups and samples and witnessing tests.
- Witnessing commissioning.
- Inspection prior to certification of practical completion.
- Inspection after handover of the site to the client on certification of practical completion.
- Inspection at the end of the defects liability period to prepare a schedule of defects.
- Inspection on completion of the rectification of defects set out on the schedule of defects.

Design consultants generally have a responsibility to provide periodic inspection under the terms of their conditions of engagement. However, the fact that it is periodic, and inspection not supervision, can relieve them of liability for specific workmanship defects that result in court action.

If the design team remains with the client, its members are the most likely candidates to conduct these inspections. However, if the design team is novated to the contractor, a shadow design team may be appointed to monitor construction. In addition to 'walking the site' to inspect the ongoing works, those undertaking this role typically produce a monthly quality report to record issues identified and to monitor progress… The increasing use of digital surveying tools allows real-time comparisons of actual progress against planned progress, providing indisputable and granular information. On smaller projects, a more hands-on approach might be required with frequent site visits and immediate identification of areas where Construction Quality is not being achieved.'

Health and safety

Inspections are also necessary to ensure compliance with health and safety regulations. These can be internal inspections carried out by the contractor, third party audits or external inspections by the NEMA

Other health and safety inspections may be necessary in relation to:

- Prevention of falls and personal fall protection systems.
- Work at height.
- Work platforms such as scaffold and mobile platforms.
- Ladders and stepladders.
- Personal protection equipment, including head protection.
- Plant, vehicles and other equipment.
- Storage.
- Electrical systems.
- Asbestos risk.
- Provision of welfare facilities such as toilets and handwashing facilities.
- Site conditions and order.
- Avoidance of obstructions.
- Management of respiratory risks.
- Structural stability.

- Prevention of unauthorized access to the site.

It is important that inspection timing and frequency is properly organised, that proper reports are prepared and that action is taken if necessary.

Inspection reports might contain the following information:

- Details of the person making the report.
- Details of the person the inspection was carried out for.
- Location of the inspection.
- Date and time of the inspection.
- Description of the nature of the inspection.
- Details of health and safety risks identified.
- Details of any action taken.
- Details of any further action required.

Building control

Building control inspections are carried out to verify compliance with the building regulations. These can be carried out by a local authority building control inspector or by an approved inspector. Inspections may be required for:

- Excavations, before filling.
- Foundations before covering up.
- Damp proof course.
- New drains before covering up.
- Ground beams and steelwork.
- Insulation.
- Roof construction.
- Completion.

Advance notice must be given to arrange these inspections.

Very small projects can obtain building regulations approval purely by inspection. This is a building notice application rather than a full plans application.

Other inspections

Other inspections might include:

- Planning inspections to verify compliance with planning permissions, conditions and obligations.

- Inspections by funding bodies for the release of money.
- Inspections by insurers.
- Highways Authority inspection and adoption of roads and sewers.
- Environmental Health Officer inspections related to pollution (mud, noise, smoke, water) and certain installations (such as drainage and kitchens).
- Fire Officer inspection of fire escapes, and for hazards, storage of certain materials and protection systems.
- Archaeological inspection of excavations.
- Factory inspectorate.
- Health and safety inspectors.

Project reports

Generate a title page for the report. Include the report's title, the authors of and contributors to the report and the date the report was submitted.

Compose an abstract of the report. The abstract summarizes the report, indicating the conclusions the report attempts to provide, the construction and engineering methods the authors used to complete the project and brief analysis of the success of the project's construction. Abstracts are typically limited to 200 to 250 words.

Provide a table of contents for the entirety of the report. Though the title page and abstract occur before the table of contents, include them

Introduce the project. In many ways, the introduction follows the report's title by introducing the specific topic and scope of the project. Employ the introduction to define key terms of the reports, whether they relate specifically to the subject being examined or the methods of construction. For example, you might define a school-sized gym and a small state university, as well as the engineering principles, such as infrastructure.

Detail the results of the report. As construction and engineering project reports typically focus on the effectiveness of pre-building engineering procedures and the actual construction procedures and timeliness of both, split your results section into "pre-building engineering" and "construction." Split each of these sections into "employment effectiveness" and "time effectiveness."

Discuss the results of the report in the "discussion" section. Discussion sections in reports involve analysis and evaluation. Highlight effective procedures and explain the reason for their effectiveness. Similarly, highlight ineffective procedures, explain the reason for their ineffectiveness and identify ways in which such procedures can be improved upon for future construction projects.

Summarize and conclude your report with a bulleted list of recommendations regarding your results and discussion sections. For example, you might suggest that future projects

employ a specific pre-building engineering tool, be it a program such as AutoCAD or a method like design swapping. Similarly, you might suggest the future projects avoid construction techniques and pitfalls like under-scheduling or over-scheduling workers.

List your references in accordance with the citation guidelines called for in your report. Most often, with construction and engineering projects, APA citation guidelines will dictate references citations.

A report typically has four elements:

- **Executive Summary**. Your report will begin with the summary, which is written once the report is finished. As the first item the reader encounters, this is the most important section of the document. They will likely use the summary to decide how much of the report they need to read so make it count!
- **Introduction:** Provide a context for the report and outline the structure of the contents. Identify the scope of the report and any particular methodologies used
- **Body:** It's now time to put your writing skills to work! This is the longest section of the report and should present background details, analysis, discussions, and recommendations for consideration. Draw upon data and supporting graphics to support your position
- **Conclusion:** Bring together the various elements of the report in a clear and concise manner. Identify the next steps and any actions that your reader needs to take.

1.2.7.4 Learning Activities

Practical assessment

1. You are required to conduct a site visit in a local construction site and note down the observations
2. Prepare a report from the observations above

Resource Requirements

1. A fully functional construction site
2. Stationery
3. Files
4. Journals
5. Manuals
6. Computers

1.2.7.5 Self-Assessment questions

1. What does monitoring and controlling of a project entail?
2. Which are the typical elements of project control?
3. What is the significance of project control?
4. Which methods can be used for project control?
5. What is the importance of site inspection?
6. How is site inspection conducted?
7. Which information is contained in a site inspection report?
8. Which are the health and safety measures which are supposed to be observed?
9. Which are the main elements of a project report?
10. Which are some areas of construction which should be inspected carefully?

Response to self-assessment questions

1. What does monitoring and controlling of a project entail?
    a. **Measuring the ongoing project activities *(where are we, against where we should be?)***
    b. **Monitoring the project variables *(cost, effort, scope)* against the project management plan and the project baseline *(where should we be?)***
    c. **Identifying corrective actions to address risks and issues *(how can we get back on track?)***
    d. **Managing changes using our change control process *(what is the impact of this change?)***

2. Which are the typical elements of project control?
    a. **Overall business strategy**
    b. **Standards for new systems**
    c. **Project management policies**
    d. **Change management**
    e. **Quality control**

3. What is the significance of project control?

    Project control is that part of a project that keeps it on-track, on-time and within budget. Project control begins early in the project with planning, and ends late in the project with post-implementation review. Projects should be assessed for the right level of control needed: too much control is time-consuming, too little control is risky. If project control is not carried out correctly, the cost to the business should be clarified in terms of errors, fixes and added costs.

4. Which methods can be used for project control?
    i. **investment analysis**
    ii. **cost–benefit analyses**
    iii. **value benefit Analysis**
    iv. **expert surveys**

v. **simulation calculations**

vi. **risk-profile analyses**

vii. **surcharge calculations**

viii. **milestone trend analysis**

ix. **cost trend analysis**

x. **target/actual-comparison**

5. What is the importance of site inspection?

i. **To verify compliance with the requirements of the contract documents**.
ii. **To verify compliance with health and safety regulations**

6. How is site inspection conducted?

i. **Condition surveys of neighboring structures prior to commencement of the works.**
ii. **Regular valuation inspections to assess progress of the works in order to value interim payments.**
iii. **Inspecting mock ups and samples and witnessing tests.**
iv. **Witnessing commissioning.**
v. **Inspection prior to certification of practical completion.**
vi. **Inspection after handover of the site to the client on certification of practical completion.**
vii. **Inspection at the end of the defects liability period to prepare a schedule of defects.**
viii. **Inspection on completion of the rectification of defects set out on the schedule of defects.**

7. Which information is contained in a site inspection report?

i. **Details of the person making the report.**
ii. **Details of the person the inspection was carried out for.**
iii. **Location of the inspection.**
iv. **Date and time of the inspection.**
v. **Description of the nature of the inspection.**
vi. **Details of health and safety risks identified.**
vii. **Details of any action taken.**
viii. **Details of any further action required.**

8. Which are the health and safety measures which are supposed to be observed?

i. **Prevention of falls and personal fall protection systems.**
ii. **Work at height.**
iii. **Work platforms such as scaffold and mobile platforms.**
iv. **Ladders and stepladders.**
v. **Personal protection equipment, including head protection.**
vi. **Plant, vehicles and other equipment.**
vii. **Storage.**
viii. **Electrical systems**.

9. Which are the main elements of a project report?

i. **Executive Summary. Your report will begin with the summary, which is written once the report is finished. As the first item the reader encounters, this is the most important section of the document. They will likely use the summary to decide how much of the report they need to read so make it count!**
ii. **Introduction: Provide a context for the report and outline the structure of the contents. Identify the scope of the report and any particular methodologies used**
iii. **Body: It's now time to put your writing skills to work! This is the longest section of the report and should present background details, analysis, discussions, and recommendations for consideration. Draw upon data and supporting graphics to support your position**
iv. **Conclusion: Bring together the various elements of the report in a clear and concise manner. Identify the next steps and any actions that your reader needs to take.**

10. Which are some areas of construction which should be inspected carefully?

i. **Excavations, before filling.**
ii. **Foundations before covering up.**
iii. **Damp proof course.**
iv. **New drains before covering up.**
v. **Ground beams and steelwork.**
vi. **Insulation.**
vii. **Roof construction.**
viii. **Completion**.

1.2.7.6 Tools, Equipment, Supplies and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Charts

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.7.7 References

1. The National Building Code, 2020.The National Construction Authority Act (No. 41 Of 2011)
2. Chandra Prasanna, (2002), "Projects: Planning, Analysis Financing Implementation and Review", 5th Ed, Tata McGraw-Hill New Delhi
3. Phil Baguley (2009), Project Management, Hodder & Stoughton
4. Choudhury S. (2004), Project Management, Tata Mgraw Hill
5. Hansen, (1992), "Manual for the Preparation of Industrial Feasibility Studies", UNIDO
6. Phil Baguley (2009), Project Management, Hodder & Stoughton

1.2.8 Learning Outcome 8; Coordinate quality standards

1.2.8.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to co-ordinate quality standards. It includes reviewing quality standard manuals, performing quality tests and conducting site visits.

1.2.8.2 Performance Standard

8.1 Quality standard manuals are reviewed.

8.2 Samples of materials are taken and Quality tests performed.

8.3 Site work progress is observed through regular visits and errors corrected.

8.4 Qualified staffing is ensured as per their performance.

8.5 Right quality equipment and tools are ensured.

8.6 Technical personnel representative is placed on site

1.2.8.3 Information Sheet

Definition of terms

Quality standards - defined as documents that provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that materials, products, processes, and services are fit for their purpose.

Quality

The International Organization for Standardization (ISO) defines quality as;-

1) The totality of characteristics of an entity that bear on it's ability to satisfy stated or implied needs.

2) "The degree to which a set of inherent characteristics fulfills requirements" (ISO9000:2000)

Some goals of quality programs include:

a) Fitness for use. (Is the product or service capable of being used?)

b) Fitness for purpose. (Does the product or service meet its intended purpose?)

c) Customer satisfaction. (Does the product or service meet the customer's expectations?)

d) Conformance to the requirements. (Does the product or service conform to the requirements?)

What is Project quality management?

Project quality management ensures that the project will satisfy the needs for which it was undertaken

The project team must try to understand the key project stakeholders expectations especially what quality means to them. Thus it is important for them to create a good working relationship with them and understand their stated and implied needs.

Project Quality processes

Processes include:

a) Quality Planning

b) Quality Assurance

c) Quality Control

Quality Planning

It involves Identifying which quality standards are relevant to the project and determining how to satisfy them.

- Implies the ability to anticipate situations and prepare actions to bring about the desired outcome
- Modern quality management involves prevention of defects through a program of selecting proper materials and indoctrinating people in quality and planning a process that ensures the appropriate outcome

It involves

- Design of experiments – quality planning technique that helps identify which variables have the most influence on the overall outcome of a process.
- Communicating the correct actions for ensuring quality in a format that is understandable and complete eg. Organizations policies, project scope statements, product description and related standards and regulations.

Project Characteristics/Attributes of Scope that bears on quality

It is often difficult for customers to explain exactly what they want in a project. Important scope management aspects of project that affect project quality include;

1) Functionality; the degree to which a system performs its intended function.

2) Features; the systems special characteristics that appeal to users. It is important to specify which are required and which are optional

3) System output: the screens and reports the system generates. It is important to define clearly what screen and reports.

4) Performance: addresses how well a product or service perform the customers intended use. Need to know volumes of data and transactions, number of simultaneous users, required response time, etc.

Issues include;

- Volume of input data
- Simultaneous log-ins
- Projected growth in number of users
- Equipment requirements
- Response time etc

5) Technology required

Ability of a product or service to be produced within the existing technology, human resources, skills, knowledge, and materials at a cost compatible with market expectations.

6) Usability (effort expended to use)

The ability of a product to perform its intended function for the specified user under the prescribed conditions. Usability is determined by examining performance, function and condition of a product.

7) Reliability

The degree to which a unit of equipment performs its intended function under specified conditions for a specified period of time

Importance of Quality Planning

Important to prevent defects by:

- Selecting proper materials

- Training and indoctrinating people in quality
- Planning a process that ensures the appropriate outcome
- **Design of experiments** is a quality planning technique that helps identify which variables have the most influence on the overall outcome of a process
- Computer chip designer would determine what combination of materials and equipment will produce the most reliable chips at a reasonable cost
- Also applies to project management issues, such as cost and schedule trade-offs

Quality Assurance

Quality assurance includes all the activities related to satisfying the relevant quality standards for a project. It involves periodically evaluating overall project performance to ensure the project will satisfy the relevant quality standards. Its goal is continuous quality improvement.

Tools for Quality Assurance

1. **Benchmarking:** the process of identifying, understanding and adapting outstanding practices and processes from an organization anywhere in the world to help an organization improve its performance.

Benchmarking generates ideas for quality improvements by comparing specific project practices or product characteristics to those of other projects or products within or outside the performing organization

2. Q**uality audit** is a structured review of specific quality management activities that help identify lessons learned that could improve performance on current or future projects

Performed by in-house auditors or third parties and can be scheduled or rand

Quality Control

Involves monitoring specific project results to ensure that they comply with the relevant quality standards

The main goal is to improve quality. Its main outcomes are:

- *Acceptance decisions*- determine if the products/services produced as part of the project will be acceptable or be rejected and rework is then necessary

  Accepted products are called validated deliverables

  Rejected products are called re-work

- *Rework* – action taken to bring rejected items into compliance with products requirements and specifications or other stakeholder's expectations. Re-work can be very expensive
- *Process adjustments* – activities used to correct or prevent further quality problems based on quality control measurements (eg. purchase faster server if response time is too slow)

Tools and Techniques for Quality control

There are Seven Basic Tools of Quality that help in performing quality control

1. **Pareto analysis**: involves identifying the vital few contributors that account for the most quality problems . 80-20 rule ie. 80% of the problems are caused by 20% causes. Pareto diagram are histograms, column charts representing frequency distribution that helps identify and prioritize problem areas.

2. Statistical Sampling: involves choosing part of the population of interest for inspection. The sample size depends on how representative one wants the sample to be

Formula

Sample size = 0.25 x (certainty factor / acceptance factor)^2

Commonly used certainty factors

Desired Certainty	Certainty factor
95%	1960
90%	1645
80%	1281

Example

For 95% = 0.25 x (1960/0.5)^2 = 385

For 80% = 0.25 x (1281 /.20)^2 = 10

3. **Six Sigma:**

Six Sigma is "a comprehensive and flexible system for achieving, sustaining, and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes."

Basic Information

- The target for perfection is the achievement of no more than **3.4 defects per million opportunities**
- The principles can apply to a wide variety of processes – design and production of a product, a Help Desk or other customer-service process
- Six Sigma projects normally follow a five-phase improvement process called DMAIC Define, Measure, Analyse, Improve and Control.

DMAIC

- **DMAIC** is a systematic, closed-loop process for continued improvement that is scientific and fact based
- **D**efine: Define the problem/opportunity, process, and customer requirements. Tool used include project charter, requirements, Voice of the Customer data.
- **M**easure: Define measures (in terms of defects per million), then collect, compile, and display data
- **A**nalyze: Scrutinize process details to find improvement opportunities; seeks root cause of problems
- **I**mprove: Generate solutions and ideas for improving the problem; pilot test the solution
- **C**ontrol: Track and verify the stability of the improvements and the predictability of the solution

Benefits of Six Sigma

- It requires an organization-wide commitment at all levels. Often huge training investments but pay off in higher quality goods and services at lower costs
- Training follows the "Belt" system as in a karate class
- Six Sigma organizations have the ability and willingness to adopt contrary objectives: *reducing errors and getting things done faster; creative and rational; focus on the big picture and minute details; make customers happy and make a lot of money*
- Leads to customer-focus and strives to drive out waste, raise levels of quality, and improve financial performance at *breakthrough* levels

Six Sigma and Project Management

- Joseph M. Juran stated, "All improvement takes place project by project, and in no other way"*
- It's important to select projects carefully and apply higher quality where it makes sense; companies that use Six Sigma do not always boost their stock values
- Minimizing defects does not matter if an organization is making a product that no one wants to buy. As Mikel Harry puts it, "I could genetically engineer a Six Sigma goat, but if a rodeo is the marketplace, people are still going to buy a Four Sigma horse."**

Six Sigma projects must focus on a quality problem or gap between the current and desired performance, not have a clearly understood problem, the solution should not be predetermined and an optimal solution should not be apparent

Six Sigma Projects Use Project Management

- The training for Six Sigma includes many project management concepts, tools, and techniques
- For example, Six Sigma projects often use business cases, project charters, schedules, budgets, and so on
- Six Sigma projects are done in teams; the project manager is often called the team leader, and the sponsor is called the champion
- Six Sigma projects are projects that focus on supporting the Six Sigma philosophy by being customer-focused and striving to drive out waste, raise levels of quality and improve financial performance at breakthrough levels

Six Sigma and Statistics

- The term *sigma* means standard deviation
- **Standard deviation** measures how much variation exists in a distribution of data
- Standard deviation is a key factor in determining the acceptable number of defective units found in a population.
- A small S.D means the data clusters closely around the middle of a distribution and there is little variability in the data.
- Six Sigma projects strive for no more than 3.4 defects per million opportunities, yet this number is confusing to many statisticians

1. **Cause-and-effect diagrams** trace complaints about quality problems back to the responsible production operations

- They help you find the root cause of a problem
- Also known as **fishbone** or **Ishikawa diagrams**
- Can also use the **5 whys** technique where you repeat the question "Why" (five is a good rule of thumb) to peel away the layers of symptoms that can lead to the root cause
    - i. Why the users cannot get into the system
    - ii. Why they keep forgetting passwords
    - iii. Why didn't they reset their passwords
    - iv. Why didn't they check the box to save their password, e

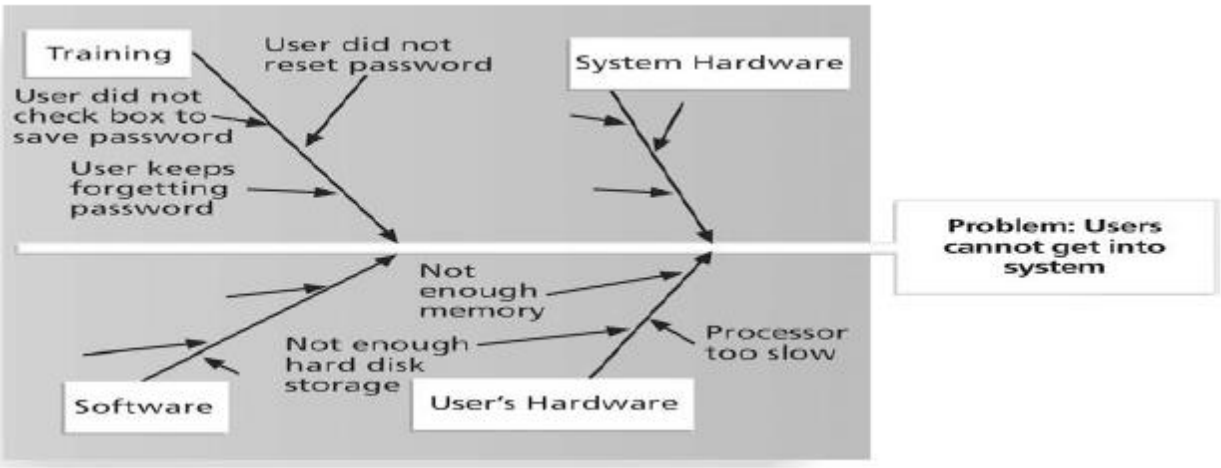

Figure 12 Sample Cause-and-Effect Diagram

2. **Quality Control Charts**

A **control chart** is a graphic display of data that illustrates the results of a process over time

- The main use of control charts is to prevent defects, rather than to detect or reject them
- Quality control charts allow you to determine whether a process is in control or out of control
- When a process is in control, any variations in the results of the process are created by random events; processes that are in control do not need to be adjusted
- When a process is out of control, variations in the results of the process are caused by nonrandom events; you need to identify the causes of those nonrandom events and adjust the process to correct or eliminate them

Seven run rule

- You can use quality control charts and the seven run rule to look for patterns in data
- The **seven run rule** states that if seven data points in a row are all below the mean, above the mean, or are all increasing or decreasing, then the process needs to be examined for nonrandom problems
- Example: The following slide is a control chart for the manufacture of 12" rulers
    - Upper and lower specifications are 12.10" and 11.9" – this is the range specified as acceptable by the customer for purchase
    - The controls limits of 11.91" and 12.09" mean that the manufacturing process is designed to produce rulers within that range

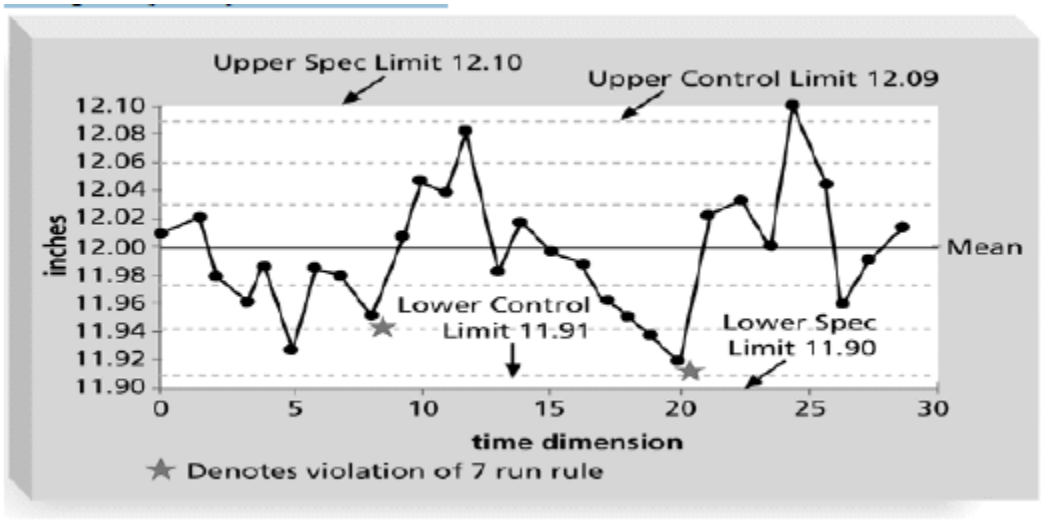

Figure 13 Sample Quality control chart

Run chart

- A run chart displays the history and pattern of variation of a process over time
- It is a line chart that shows data points plotted in the order in which they occur
- Can be used to perform trend analysis to forecast future outcomes based on historical patterns e.g., of defects

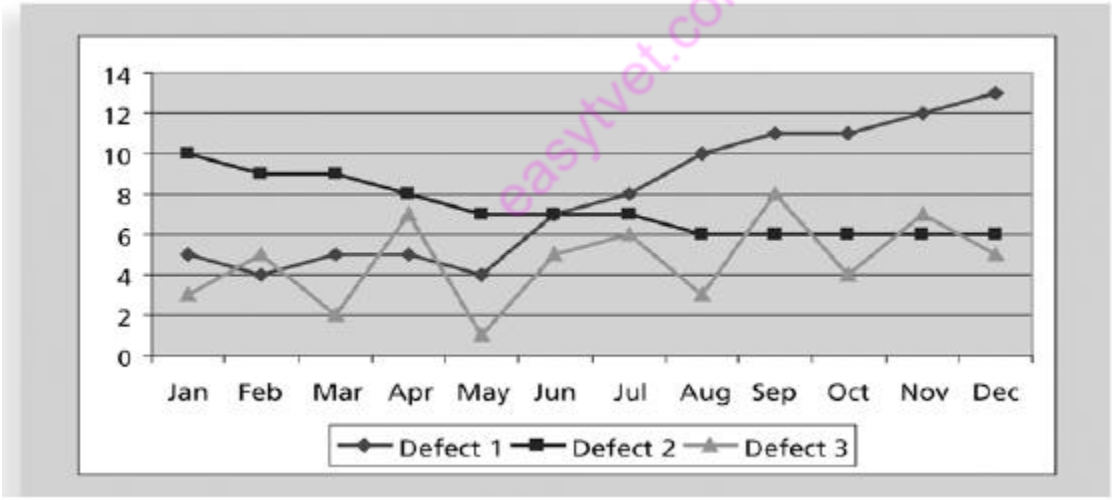

Figure 14 Run chart

3. **Scatter diagrams**

- A **scatter diagram** helps to show if there is a relationship between two variables
- The closer data points are to a diagonal line, the more closely the two variables are related

Cost related to Quality

Cost of Quality

Cost of quality is the total price of all efforts to achieve product or service quality. The cost of quality considers the expense of all the activities within a project to ensure quality. This includes all work to build a product or service that conforms to the requirements as well as all work resulting from nonconformance to the requirements. The typical project should have a goal of between 3-5% of the total value as the cost of a quality program depending on the type of project and its total dollar value.

The cost of quality is broken into two major categories:

1. Cost of Conformance
2. Cost of Non-Conformance

Cost of Quality = Cost of conformance + Cost of non-conformance

1) **Cost of conformance to requirements**: This approach is the cost of completing the project work to satisfy the project scope and the expected level of quality.

Examples of this cost include

i. Planning
ii. Training and indoctrination
iii. Process control
iv. Field testing
v. Product design validation
vi. Process validation
vii. Test and evaluation
viii. Quality audits
ix. Maintenance and calibration

2) **Cost of nonconformance**: This approach is the cost of completing the project work without quality. The biggest issue here is the money lost by having to redo the project work; it's always more cost effective to do the work right the first time.

i. Scrap
ii. Rework
iii. Expediting
iv. Additional material or inventory
v. Warranty repairs or service
vi. Complaint handling
vii. Liability judgments
viii. Product recalls

ix. Product corrective actions

Other cost includes;
1). Cost of Non-Quality:

i. Waste of time and materials
ii. Rework of poor quality products
iii. Additional material
iv. Delays in schedule
v. Product and service image
vi. Corporate image

Major Cost Types of Quality

1) Prevention Cost - cost to plan and execute a project so that it will be error-free

2) Appraisal Cost - cost of evaluating the processes and the Output of the processes to ensure the product is error-free

3) Internal Failure Cost - cost incurred to correct an identified defect before the customer receives the product

4) External Failure Cost - cost incurred due to errors detected by the customer. This includes warranty cost, field service personnel training cost, complaint handling, and future business losses.

5) Measurement and Test Equipment - capital cost of equipment used to perform prevention and appraisal activities.

Opportunities for Reducing Cost

i. Just-in-Time - concept of zero inventory in a manufacturing plant. Reduces cost of storing and moving parts; cost of inventory; cost of parts damaged through handling, etc.
ii. Product Life Cycle Cost - concept of reducing overall product life cycle cost by linking the cost areas of the product life cycle (R&D, acquisition, and operations and maintenance) and considering each one's cost implications for the other.
iii. Product Maturity - Identifying, documenting, and correcting failures early helps products achieve stability earlier in the life cycle.

Quality control standards

Quality control (QC) is the part of quality management that ensures products and services comply with requirements. It is a work method that facilitates the measurement of the quality characteristics of a unit, compares them with the established standards, and analyses the differences between the results obtained and the desired results in order to make decisions which will correct any differences.

Technical specifications define the type of controls that must be undertaken to ensure the construction works are carried out correctly. They include not only products and materials, but also the execution and completion of the works.

One way of controlling quality is based on the inspection or verification of finished products. The aim is to filter the products before they reach the client, so that products that do not comply with requirements are discarded or repaired. This reception control is usually carried out by people who were not involved in the production activities, which means that costs can be high, and preventative activities and improvement plans may not be effective.

It is a final control, located between producer and client, and although it has the advantage of being impartial, it has a large number of drawbacks, such as slow information flows, and inspectors are not familiar with the circumstances of production and are not responsible for the production quality.

When tests are destructive, the decision to accept or reject a full batch must be made on the basis of the quality of a random sample. This type of statistical control provides less information and contains sampling risks. However, it is more economical, requires fewer inspectors, and speeds up decision-making, while the rejection of the whole batch encourages suppliers to improve their quality. This type of control can also identify the causes of variations and, so establish procedures for their systematic elimination.

Statistical control can be applied to the final product (acceptance control) or during the production process (process control). Statistical controls at reception establish sampling

plans with clearly-defined acceptance or rejection criteria, and complete batches are tested by means of random sampling. The sampling control can be based on inspection by attributes in line with the ISO 2859 standard (Sampling procedures for inspection by attributes), or on inspection by variables in line with the ISO 3951 standard (Sampling procedures for inspection by variables).

A construction company should reduce the costs of bad quality as much as possible, and ensure that the result of its processes comply with the client's requirements. Both internal and external controls can be carried out. For example, the control of concrete received by the contractor can be carried out by an independent entity; the execution of steelworks can be controlled by the project manager (on behalf of the client), or the construction company can establish an internal control for the execution of the building work.
Quality assurance in accordance with ISO 9001

Quality assurance is a set of planned and systematic actions to ensure that products and services comply with specified requirements. It not only involves checking the final quality of products to avoid defects, as is the case in quality control, but also checking product quality in a planned way in all the production stages. It is the development of work and product design procedures to prevent errors from occurring in the first place, based on planning backed up by quality manuals and tools.

When a consensus has been reached on the requirements of a quality management system, it is possible to define a series of generic standards applicable to any type of organisation. The international standards, generically called ISO 9000, are the most widespread and generally accepted in developed countries. The ISO 9000 standards consists of four basic interdependent standards supported by guides, technical reports and technical specifications:

i. ISO 9000: Quality management.
ii. ISO 9001: Quality management systems - Requirements.
iii. ISO 9004: Managing for the sustained success of an organization - A quality management approach.

iv. ISO 19011: Guidelines on internal and external audits of quality management systems.

Companies can only be certified under the requirements of the ISO 9001 standard. It is a standard that can be used to certify the efficiency of a quality management system. If the aim is to improve efficiency, the objectives of the ISO 9004 standard are broader in scope. The principles that underlie the management of quality in these standards are the following: customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making and mutually beneficial supplier relationships.

The ISO 9001 standard specifies requirements for a quality management system where an organisation needs to demonstrate its ability to consistently provide products that meet the requirements of clients and applicable regulations requirements. Regulatory requirements focus on the quality management system, management responsibility, resources management, product realisation and measurement, analysis and improvement.

When a quality system is applied to a product as complex and unique as construction, a specific quality plan must be drafted by applying the company's global system to the specific project. The plan must be drafted by the contractor before the start of the construction works and will be reviewed throughout its execution.

The quality plan is applicable to the materials, work units and services that have been specifically chosen by the construction company in order to comply with the quality requirements stipulated in the contract. The quality plan is drafted for the construction works when a preventive strategy is needed to guarantee the construction quality, even though there might also be a quality manual, in compliance with the ISO 9001 standard requirements.
The construction company determines the need to prepare execution documents, work instructions, inspection regimes, process files, action plans, etc., for the execution and control of processes, depending on the complexity of the activity, the qualifications of the

personnel and the experience of the team. The plan establishes the resources required and associated documents (lists, purchasing documentation, machinery, equipment, etc.).

The control activities (verification of compliance with specifications, validation of specific processes, monitoring of activities, inspections and tests), which the units, materials or services undergo must also be established. These activities can be defined through inspection, testing plans, action plans and where applicable specific tests (for example, load tests for structures).
Standards and procedures

When the aim is to guarantee the uniformity of a system, process or product, reference patterns are established in documents called standards or norms. The general objectives of standards are simplification, communication between the parties involved, production economy, safety and health, protection of consumer interests and the removal of trade barriers.

In any type of company, the set of tasks carried out is so complex that they have to be written down to ensure internal consistency, to preserve them and to make sure they are methodically applied. These documents are called procedures, and describe the way in which an activity or process must be carried out.

Therefore, standards establish the requirements of products or processes. Procedures are documents drawn up by the company itself and take into account the requirements established in the standards. These documents must include the purpose of the procedure, references to other documents, scope, method and sequence of tests, acceptance and rejection criteria, key control points and time of inspection. In all cases the control of a procedure should be documented in the quality records and filed in the quality log at the construction site.

Technical or administrative procedures can also be part of a quality management system. In this case, the manual provides a generic description of the company's quality system,

while procedures, whether general or specific, establish what is required to attain the objectives listed in the manual. Procedures must link the ISO standards' requirements and the activities of the company. They should include the people involved, information about materials and equipment, and a description of key activities. Each organisation should decide which processes should be documented on the basis of client and regulatory requirements, the nature of its activities, and its corporate strategy.

Certificates and technical approvals

The quality control of a product or process can sometimes be replaced with certification of the quality characteristics by third parties. Products that have received officially recognised quality marks may be exempt from controls and reception tests, increasing batch size and improving safety systems.

However, the scope and aim of these quality marks are variable and an in-depth understanding is required to know what they mean. Below are different types of quality certificates, starting with the least reliable:

i. **Certificate of origin:** in this case the manufacturer states that the product complies with some specifications. Although the certificate might not be very reliable, failure to comply with the specifications can be legally actionable.
ii. **Accredited laboratory test certificate**: the test is performed on a small sample, and therefore cannot guarantee all production. These certificates should be used with caution due to their limited scope.
iii. **Product type approval certificate**: this approves a prototype and therefore does not guarantee the quality of the subsequent manufacturing process.
iv. **Standard compliance seal or mark**: its scope includes continual production and therefore it is more reliable than other certificates. When the product is very new and there is no specific standard to regulate it, the certificate is issued in the form of technical suitability documentation.

1.2.8.4 Learning Activities

Practical assessment

1. You are required to visit a construction site and conduct concrete cube strength test
2. Prepare a report from the observations above

Resource Requirements

1. A fully functional construction site
2. Quality testing machine and equipment
3. Resource persons

1.2.8.5 Self-Assessment questions

3. What is quality as defined by ISO?
4. Which are the goals of quality control?
5. What is project quality management?
6. Which are elements of project quality management?
7. What does quality planning involve?
8. Which are the main characteristics of a quality project?
9. What is the importance of quality planning?
10. What do you understand by the term quality assurance?
11. Which are some of the tools used for quality assurance?
12. Which are some tools used for quality control?

Response to self-assessment questions

1. What is quality as defined by ISO?

   The International Organization for Standardization (ISO) defines quality as;-

   - **The totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs.**
   - **"The degree to which a set of inherent characteristics fulfills requirements" (ISO9000:2000)**

2. Which are the goals of quality control?

   a. **Fitness for use. (Is the product or service capable of being used?)**
   b. **Fitness for purpose. (Does the product or service meet its intended purpose?)**
   c. **Customer satisfaction. (Does the product or service meet the customer's expectations?)**
   d. **Conformance to the requirements. (Does the product or service conform to the requirements?)**

3. What is project quality management?

   Project quality management ensures that the project will satisfy the needs for which it was undertaken

   The project team must try to understand the key project stakeholders expectations especially what quality means to them. Thus it is important for them to create a good working relationship with them and understand their stated and implied needs.

4. Which are elements of project quality management?

   a. **Quality Planning**
   b. **Quality Assurance**
   c. **Quality Control**

5. What does quality planning involve?

   a) **Design of experiments – quality planning technique that helps identify which variables have the most influence on the overall outcome of a process.**

b) Communicating the correct actions for ensuring quality in a format that is understandable and complete eg. Organizations policies, project scope statements, product description and related standards and regulations

6. Which are the main characteristics of a quality project?
   - **i. Functionality; the degree to which a system performs its intended function.**
   - **ii. Features; the systems special characteristics that appeal to users. It is important to specify which are required and which are optional**
   - **iii. System output: the screens and reports the system generates. It is important to define clearly what screen and reports.**
   - **iv. Performance: addresses how well a product or service perform the customers intended use. Need to know volumes of data and transactions, number of simultaneous users, required response time, etc.**
   - **v. Technology required**

7. What is the importance of quality planning?

i. Selecting proper materials
ii. Training and indoctrinating people in quality
iii. Planning a process that ensures the appropriate outcome
iv. Design of experiments is a quality planning technique that helps identify which variables have the most influence on the overall outcome of a process
v. Computer chip designer would determine what combination of materials and equipment will produce the most reliable chips at a reasonable cost
vi. Also applies to project management issues, such as cost and schedule trade-offs

8. What do you understand by the term quality assurance?

Quality assurance includes all the activities related to satisfying the relevant quality standards for a project. It involves periodically evaluating overall project performance to ensure the project will satisfy the relevant quality standards. Its goal is continuous quality improvement.

9. Which are some of the tools used for quality assurance?
   - **i. Benchmarking: the process of identifying, understanding and adapting outstanding practices and processes from an organization anywhere in the world to help an organization improve its performance.**

ii. **Quality audit is a structured review of specific quality management activities that help identify lessons learned that could improve performance on current or future projects**

10. Which are some tools used for quality control?
    i. **Pareto analysis:**
    ii. **Statistical Sampling**
    iii. **Six sigma**

1.2.8.6 Tools, Equipment, Supplies and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Charts

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.8.7 References

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1.2.9 Learning Outcome 9; Cost construction project

1.2.9.1 Introduction to the learning outcome

This learning outcome specifies the competencies required to cost construction projects. It entails determining project scope of work, dividing project items and describing project items.

1.2.9.2 Performance Standard

9.1 Project scope of work is determined as per working drawings.

9.2 Project work is divided into items and sub items.

9.3 Project items are described as per mode of performance.

9.4 Rates are inserted against the items as per building standard costing rates and site location.

1.2.9.3 Information Sheet

Definition of terms

Project scope

Initial investment costs

Initial investment costs are defined as the sum of *fixed assets* (fixed investment costs plus pre-production expenditures) and *net working capital* with fixed assets constituting the resources required for constructing and equipping an investment project, and net working capital corresponding to the resources needed to operate the project totally or partially**.**

Investment required during plant operation

The economic life time is different for the various investments (buildings, plant, machinery and equipment, transport equipment etc). In order to keep a plant in operation, each item must therefore be replaced at the appropriate time and the replacement costs must be included in the feasibility study**.**

Pre-production expenditures

In every industrial project certain expenditure due, for example, to the acquisitions or generation of assets are incurred prior to commercial production. These expenditures, which have to be capitalized, include a number of items originating during the various stages of project preparation and implementation**.**

***a) Preliminary capital-issue expenditures*.** These are expenditures incurred during the registration and formation of the company, including legal fees for preparation of the memorandum and articles of association and similar documents and for capital issues.

***b) Expenditures for preparation studies*.** There are three types of expenditures for preparatory studies: Expenditures for pre-investment studies; consultant fees for preparing studies, engineering and supervisor of erection and construction; other expenses for planning the project

c) Other pre-production expenditures*.* Included among other pre-production expenditures are the following:

i. Salaries, fringe benefits and social security contributions of personnel engaged during the pre-production period.
ii. Travel expenses
iii. Preparatory installation, such as worker‟s, camps, temporary offices and stores.
iv. Pre-production marketing costs, promotional activities, creation of the sales network etc.
v. Training costs including fees, travel, living expenses, salaries and stipends of the trainees and fees payable to external institutions;
vi. Know-how and patent fees
vii. Interest on loans accrued or payable during construction
viii. Insurance costs during construction

d) ***Trial runs, start-up and commissioning expenditures*.** This item includes fees payable for supervision of starting-up operation, wage, salaries, fringe benefits and socio security contributions of personnel employed, consumption of production materials and auxiliary supplies, utilities and other incidental start- up costs. Operating losses incurred during the running period up to the stage when satisfactory levels are achieved also have to be capitalized.

In allocating pre-production expenditures one of two practices is generally followed:
i.) All pre-production expenditures may be capitalized and amortized over a period of time that is usually shorter than the period over which equipment is depreciated.

ii.) A part of the pre-production expenditures may be initially allocated, where attributable to the respective fixed assets and the sum of both amortized over a certain number of years

***e) Plant and equipment replacement costs*.** Such costs included all pre-production expenditure as described above and related to investment needed for the replacement of fixed assets. A gain the estimates include the supply, transport, installation and commissioning of equipment, together with any costs associated with down time, production losses as well as allowance for physical contingencies.

***f) End-of life costs*.** The costs associated with the decommissioning of fixed assets at the end of the project life, minus any revenues from the scale of the assets are end of life costs. Major items are the costs of dismantling, disposal and land reclamation. It is often reasonable to assume that these costs can be offset against the salvage value of the corresponding asset

Fixed assets As indicated above fixed assets comprise fixed investment costs and pre-production expenditures *Fixed investment costs* Fixed investment should include the following main cost items, which may be broken down further, if required

i.) Land purchases, site preparation and improvements

ii.) Building and civil works

iii.) Plant machinery and equipment, including auxiliary equipment

iv.) Certain incorporated fixed assets such as industrial property rights and lump – sum payments for know-how and patents

Net working capital Net working capital is defined to embrace ***current assets*** (*the sum of inventories, marketable securities, prepaid items, accounts receivable and cash)* ***minus current liabilities*** (*accounts payable*). It forms an essential part of the initial capital outlays required for an investment project because it is required to finance the operations of the plant.

a) Accounts receivable (debtors)

Accounts receivable are trade credits extended to product buyers as a condition of sale; the size of this item is therefore determined by the credit sales policy of the company. It is given by the following formula

$$\text{Debtors} = \frac{credit,terms(in\ months)}{12} \times \text{value of annual gross sales}$$

b) Inventories

Every attempt should be made to reduce inventories to as low as justifiable. Inventories include the following items:

i.) ***Production material*****.** If the materials are locally available and in plentiful supply and can be rapidly transported, then only limited stocks should be maintained unless there are special reasons for keeping a higher stock (such as price fluctuations). If the materials are imported and import procedures are dilatory, then inventories equivalent to as much as six months consumptions may have to be maintained. Other factors influencing the size of investors are the reliability and seasonality of supplies, possibilities of substitutions and expected price changes.

ii.) ***Spare parts*****.** Levels of spare parts inventors depend on the local availability of supplies, import procedures and maintenance facilities in the area, and on the nature of plant itself. The plant is usually provided with an initial set of spare parts.

iii.) ***Works-in-progress.*** To assess capital requirement for covering work-in-progress a comprehensive analysis should be performed of the production process and of the degree of processing already reached by the different materials inputs during each stage. The requirements are expressed in months (or days) of production depending on the nature of the product

iv.) ***Finished products.*** The inventory of finished products depends on a number of factors, such as the nature of the product and trade usage. The valuation is based on factory costs plus administrative overheads.

c) Cash-in-hand and cash-in-bank

The surplus of receipt over payment may not fully cover the interest payments, addition short term finance would be required. It may also be prudent to provide for a certain amount of cash in hand. This should be done by including a contingency reserve on working capital which depending on the case could be around 5 per cent.

d) Account payable (creditors)

Accounts payable will depend on credit terms provided by suppliers. Hence raw materials factory supplies and services are usually purchased on credit with a certain period elapsing before payment is affected. Accrued taxes are also paid after a certain period has elapsed, and may be another source of finance similar to accounts payable. The same holds true for wages payable. Such credited payments reduce the amount of net working capital required.

Calculation of net work capital requirements

When calculating the working capital requirements the minimum coverage of days of for current assets and liabilities has to be determined first. Annual factory costs, operating costs, and costs of products sold should then be computed since the values of some components of the current assets are expressed in these terms. The next step is to determine the coefficient of turnover for the components of current assets and liabilities by dividing 360 days by the number components of current of days minimum coverage. Subsequently, the cost data for each item of the current assets and liabilities are divided by the respective coefficient of turnover. Finally, the net working capital requirements for the different production stages are obtained by deducting the current liabilities from the sum of current assets. The required cash-in hand is calculated separately.

Production Costs

It is essential to make realistic forecasting of production or manufacturing costs for a project proposal in order to determine the future viability of the project

Definition of production cost items: The definition of production costs divides production costs in to four major categories; factory costs, administrative overhead costs, depreciation costs, and cost of financing. The sum of factory and administrative overhead costs is defined as operation costs. ***Factory costs*:**

Factory costs include the following:

i.) Materials predominantly variable costs such as raw materials factory supplies and spare parts.

ii.) Labor (production personnel) fixed or variables costs depending on type of labor and cost elements)

iii.) Factory overheads (in general fixed costs).

Administrative overheads: This include salaries and wages, social costs rents and leasing costs etc

Depreciation costs*.* Depreciation costs are charges made in the annual net income statement (profits loss account) for the productive use of fixed assets. Depreciation costs present investment expenditures (cash outflow during the investment phase) instead of production expenditures (cash outflow production) depreciation charges must therefore be added back of net cash flows are calculated from the net profits after corporate tax, as obtained from the net income statement. Depreciation costs do have an impact on net cash flows because higher the depreciation charges, the lower the taxable income and the lower the cash outflow corresponding to the payable on income.

Financial costs. Financial costs (interests) are sometimes considered as part of the administration overheads.

Unit costs of production

For the purpose of cash flow analysis it is sufficient to calculate the annual costs. At the feasibility stage, however, an attempt should also be made to calculate unit costs to facilitate the comparison with sales prices per unit. For single product projects units costs are calculated simply by dividing production costs by the number of units produced (therefore unit costs usually vary with capacity utilization)

Direct and indirect costs

Direct costs are easily attributable to a production unit or service in terms of costs of production, materials and production labor. Since indirect costs (factory administration overheads such as management and supervision, communications, depreciation and financial charges) cannot be easily allocated directly to a particular unit of output, they must first be apportioned to cost centers and thereafter to the units cost price by way of surcharges obtained from the cost accounting department. Direct costing is a method that avoids the problem of determining. Direct costing is an accounting method that avoiding the problem of determining surcharge rates. The direct variables and direct fixed costs are deducted from the revenue generated by a certain products (or product group) and the remaining surplus or margin together with the margins generated from other products is then available to cover the indirect costs. The surplus then remaining is called the *operational margin* (excluding including costs of finance).

Marketing costs

Marketing cost comprises the costs for all marketing activities and may be divided into ***direct marketing costs*** for each product or product group, such as packaging and storage (if not included in the production costs) sales costs (salesmen commissions, discounts, returned products, royalties, product advertisement etc) transport, and distribution costs. ***Indirect marketing costs*** such as overhead costs of the marketing department (personnel material and communications, markets research, public relations, and promotional activities, not directly related is a product etc).The analysis of these costs involves their

assignments to various cost group such territories certain classes of customers (wholesalers, retailers, government institutions etc) and products to product group.

Marketing and distribution costs fall into the category of period costs even if variable and as such are charged against the operations of the accounting period in which they are occurred. For depreciable investments as required, for marketing and distribution (for example delivery trucks), depreciation charges are to be included in the computation of total marketing costs

Project cash flows Cash flows are basically either receipt of cash (cash inflow) or payments (cash outflows) Typical operational cash flows for a project are shown below

Operational cash outflows

i.) Increase in fixed assets (investment)

ii.) Increase in net working capital

iii.) Operating costs (less depreciation)

iv.) Marketing expenses

v.) Production and distribution losses

vi.) Corporate (income taxes)

Operational cash inflows

i.) Revenues from selling of fixed assets

ii.) Recovery of salvage value (end of project)

iii.) Revenues from decrease of net working Capital

iv.) Sales revenues

v.) Other income due to plant operations

Financial Evaluation

Basic assumptions underline cash flow discounting in financial evaluation

The basic assumption underlying the discounted cash-flow concept is that money has a time value in so far as given a sum of money available now is worth more than an equal sum available in the future. This difference can be expressed as a percentage rate indicting the relative change for a given period which, for practical reasons, is usually a year. Considering that a project may obtain a certain amount of funds *(F)* if this sum is repaid

after one year including the agreed amount of interest *(I)* the total sum to be paid after one year would be *(F+I)* where, *F+I= F (1+r)* and *r* is defined as the interest rate (in percentage per year) divided by 100 (if the interest rate is, for example 12.0 per cent then *r* equals 0.12)

Methods of Financial Evaluation

Net Present Value (NPV) Method

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+K)^t} - Io$$

Where; C = cash flow at the end of period

K = required rate of return

n = useful life of project

Io = initial cost of project

NPV = present value of cash flow – present value of initial cost

Decision criteria for NPV

NPV > 0, Accept the project – it maximizes investors wealth

NPV < 0, Reject the project

NPV = 0, Indifferent

Advantages of NPV

i) Considers time value of money

ii) Gives a decision criteria

iii) Recognizes uncertainty of cash flow by discounting

iv) Uses all project cash flows

Disadvantages of NPV

i.) Gives absolute values which cannot be used to compare project of different sizes

ii.) There is difficulty in selecting the discount rate to use

iii.) It does not show the exact profitability of the project

Internal Rate of Return (IRR)

IRR is the discount rate that equates the NPV of a project to zero. It is the project rate of return (Yield)

$$\sum_{t=1}^{n} \frac{C_t}{(1+R)^t} - I_o = 0$$

Where; R = IRR

It should be noted that IRR is computed using a trial and error method. However, financial calculators are programmed to compute IRR

Steps in the IRR trial and error calculation method

(i) Compute the NPV of the project using an arbitrary selected discount rate

(ii) If the NPV so computed is positive then try a higher rate and if negative try a lower rate.

(iii) Continue this process until the NPV of the project is equal to zero

(iv) Use linear interpolation to determine the exact rate

Advantages of IRR

(i) Can be used to compare projects of different sizes

(ii) Considers time value of money

(iii) Indicates the exact profitability of the project

(iv)Uses project cash flows

Disadvantages of IRR

(i) Some project have multiple IRRs if their NPV profile crosses the x-axis more than once (project cash flow signs change several time)

(ii) Assumes re-investment of cash flows occurs of project's IRR which could be exorbitantly high

(iii) Doesn't provide a decision criteria

(iv) Not conclusive for mutually exclusive project

1.2.9.4 Learning Activities

Practical assessment

You are required to complete the following tasks

1. Visit a construction site and determine the project scope of work as per working drawings
2. Prepare a cost analysis plan

Resource Requirements

1. A fully functional construction site
2. Resource persons

1.2.9.5 Self-Assessment questions

1. A firm is considering investing in a project which costs 6,000 Ksh. and has the following cash flows

YR	1	2	3	4
C.F.	1500	3000	2000	2500

The cost of capital is 10% and the project has no salvage value. Using the NPV method advise the firm on whether to invest in the project

2. A project has the following cash flows

YR.	C.F.
1	300
2	400
3	700
4	400

If the required rate of return is 9% and the project initial cost is 1500 Ksh., calculate the PI of the project and advice if the project is acceptable

3. Assume a company wants to invest in two mutually exclusive projects of 1000 Ksh. each generating the following cash flows. If the required rate of return is 10%. Which of the projects should the company invest in?

Year	A	B
1	500	100

2	400	200
3	300	300
4	400	400
5	-	500
6	-	600

4. What are the main disadvantages of payback method?
5. What is the difference between direct and indirect costs of a production unit?
6. What is depreciation?
7. Which are some examples of fixed assets?
8. Which are some expenditures included in pre-production expenditures?
9. How would you define initial investment cost?
10. What are the main benefits of NPV method of cost analysis?

Response to self-assessment questions

1. A firm is considering investing in a project which costs 6,000 Ksh. and has the following cash flows

YR	1	2	3	4
C.F.	1500	3000	2000	2500

The cost of capital is 10% and the project has no salvage value. Using the NPV method advise the firm on whether to invest in the project

Solution

YR	**CF**	**PVIF (10%)**	**P.VS**
1	1500	0.9091	1363.65
2	3000	0.8264	2479.20
3	2000	0.7513	1502.60
4	2500	0.6830	1707.50
		TOTAL P.VS	7053.00
		LESS PROJECT COST	(6000.00)
		NPV =	1053.00

Decision: Accept the project since NPV >0

2. A project has the following cash flows

YR.	C.F.
1	300
2	400
3	700
4	400

If the required rate of return is 9% and the project initial cost is 1500 Ksh., calculate the PI of the project and advice if the project is acceptable

YR	CF	PVIF 9%	PVs
1	300	0.9174	275.52
2	400	0.8417	336.68
3	700	0.7722	540.54
4	900	0.7084	637.46
Total PV =		1790.00	

$$PI = \frac{PV\ of\ CF}{Initial\ Cost} = \frac{1790}{1500} = 1.193$$

Decision: The project is acceptable since PI > 0

3. Assume a company wants to invest in two mutually exclusive projects of 1000 Ksh. each generating the following cash flows. If the required rate of return is 10%. Which of the projects should the company invest in?

Year	A	B
1	500	100
2	400	200
3	300	300
4	400	400
5	-	500
6	-	600

Year	Discounted cash flows of A	Cumulative frequency of A	Discounted cash flows of B	Cumulative frequency of B
1	454.51	454.54	90.91	100
2	330.58	785.09	165.29	256.20
3	225.40	1010.49	225.40	481.60
4	273.21	1283.70	273.21	754.81
5		1283.70	310.46	1065.46
6		1283.70	338.68	1403.95

Pay back for A = $2+(\frac{214.91}{225.40})$= 2.95 years

Pay back for B = $4+(\frac{245.19}{310.46}$ = 4.79 years

The management should undertake project A since it has a lower pay bock period

4. What are the main disadvantages of payback method?
   i. **Does not use all project cash flows**
   ii. **Does not consider the performance of the project after the payback period**

5. What is the difference between direct and indirect costs of a production unit?
   Direct costs are easily attributable to a production unit or service in terms of costs of production, materials and production labor

Indirect costs (factory administration overheads such as management and supervision, communications, depreciation and financial charges) cannot be easily allocated directly to a particular unit of output

6. What is depreciation?

   Depreciation costs are charges made in the annual net income statement (profits loss account) for the productive use of fixed assets. Depreciation costs present investment expenditures (cash outflow during the investment phase) instead of production expenditures (cash outflow production) depreciation charges must therefore be added back of net cash flows are calculated from the net profits after corporate tax, as obtained from the net income statement

7. Which are some examples of fixed assets?

   i.) Land purchases, site preparation and improvements

   ii.) Building and civil works

   iii.) Plant machinery and equipment, including auxiliary equipment

   iv.) Certain incorporated fixed assets such as industrial property rights and lump – sum payments for know-how and patents

8. Which are some expenditures included in pre-production expenditures?

   i. **Salaries, fringe benefits and social security contributions of personnel engaged during the pre-production period.**

   ii. **Travel expenses**

   iii. **Preparatory installation, such as worker‟s, camps, temporary offices and stores.**

   iv. **Pre-production marketing costs, promotional activities, creation of the sales network etc.**

   v. **Training costs including fees, travel, living expenses, salaries and stipends of the trainees and fees payable to external institutions;**

   vi. **Know-how and patent fees**

   vii. **Interest on loans accrued or payable during construction**

   viii. **Insurance costs during construction**

9. How would you define initial investment cost?

   Initial investment costs are defined as the sum of fixed assets (fixed investment costs plus pre-production expenditures) and net working capital with fixed assets constituting the resources required for constructing and equipping an investment project, and net working capital corresponding to the resources needed to operate the project totally or partially.

10. What are the main benefits of NPV method of cost analysis?

    i) Considers time value of money

    ii) Gives a decision criteria

    iii) Recognizes uncertainty of cash flow by discounting

    iv)Uses all project cash flows

1.2.9.6 Tools, Equipment, Supplies and Materials

Tools and equipment

- Computers
- Calculators

Materials and supplies

- Stationery
- Files
- Journals
- Manuals
- Resource persons
- Charts

Personal protective equipment (PPEs)

- Safety goggles
- Dust coat
- First aid kits

1.2.9.7 References

i. Choudhury S. (2004), *Project Management,* Tata Mgraw Hill

ii. Chandra Prasanna, (2002), *"Projects: Planning, Analysis Financing Implementation and Review",* 5th Ed, Tata McGraw-Hill New Delhi