UNIT-2

The Development and Organisation of Construction Projects

Learning Outcomes

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

- ✓ Describe the Project Life Cycle
- ✓ Explain the phases involved in a Construction Project.

Unit 2

The Development and Organisation of Construction Projects

Construction projects are expensive and time-bound undertakings with certain fixed performance goals to be achieved. They include the construction of all sorts of infrastructure such as sports facilities, bridges, airports, factories, highways and residential buildings. Each project begins with the conception of the idea by the owner or client and ends when the project is completed and handed over to the client.
The development of a construction project is affected by factors such as the building site, the size of the building, the purpose of the building, design-readiness, project organisation and the manner of project execution. We can categorise the development of a project into four phases: organisation, planning and design, execution and control, and, finally, the close-up phase.
One or more processes exist under each phase. When the project is fully completed, the product's operational phase begins. During the project's life cycle, some workers leave after completing their assigned tasks, while others continue to the next phase of the construction; sometimes, new personnel may join in at an intermediate or advanced stage depending on the requirements of the project. The project manager or supervisor is expected to take charge of all activities at each phase and motivate the workforce to achieve the project's objectives on time. The organisation of the different phases and activities is temporary and comes to an end when the project is completed.
In this unit, we will highlight some processes occurring during the different phases and provide brief details on the project phases and how the project is organised from start to finish.

Project Life Cycle

Project life cycle is the sequential arrangement of the various phases of a construction project from the beginning to the end of the whole project. The time taken to complete the project life cycle is referred to as the lifespan.
During the initial phase of the project life cycle, a few resources are normally employed, growing steadily over time. This is followed by a long period of stable and constant use of resources (the plateau stage). Resource requirements decrease as the project nears completion. Some projects may not necessarily follow the pattern of resources usage described above but, invariably, most projects tend to display these trends or patterns.

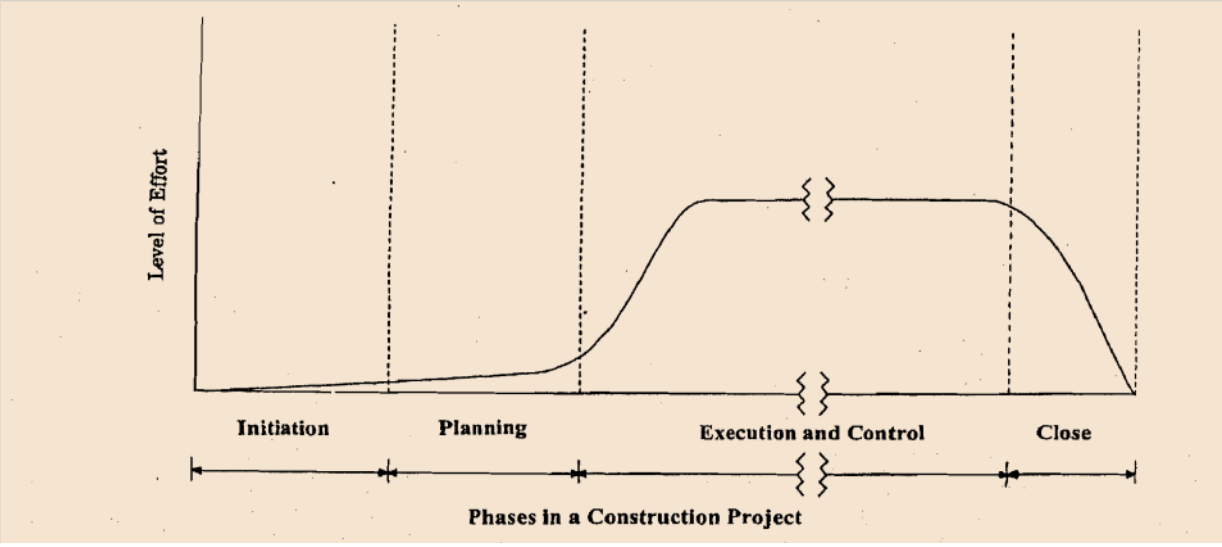

Fig: 2.1

Product Life Cycle

The term 'product life cycle' refers to the period from the start of the project development immediately followed by the construction of facilities. Product life cycle is also known as the project-product life cycle. In other words, the product life cycle is concerned with the product that will be produced after the construction has been completed. The construction project may be undertaken for a factory or a manufacturing company and the product from these organisations is what is known as the product's life cycle.

Production of the product starts when the construction phase is over and it will continue until the producers experience unfavourable conditions, such as a low demand for the product, expensive production costs, or the product becoming outdated. At this stage of the product life cycle, the product has reached its "kill point".

It is important to note that the product life cycle includes the project life cycle (which has already been defined above) and the operation duration of the facility that has been constructed for the purpose of producing a product or service.

The project's life cycle can be classified into three phases:

i) Pre-Investment Phase
ii) Investment Phase
iii) Product Operation Phase

Risk analysis shows that the chances of completing the project are quite low at the beginning of the project. During this phase, risks and uncertainties are known to be very high, but as the project continues to progress, the probability of its completion becomes higher and higher and the risks simultaneously decrease eventually. You will find that, in the early phase of a project's life cycle, shareholders (such as the owner) tend to have a strong influence on the final product and the associated costs. However, their influence on the project trajectory diminishes as the project nears its completion.

Project Phases and Processes

To enable effective management, each construction phase may be divided into subsections consisting of several sequential stages; the time for starting and ending the project and details of work that needs to be carried out are also specified. Some special projects requiring a quick completion date may have some of these stages or phases overlapping.

The key requirement to bear in mind is that, when one phase is completed, the next one begins. These sequential steps continue until the last phase is completed. The number of stages or phases for each project will depend on a number of factors such as the nature, purpose and size of the project or the manner of its execution.

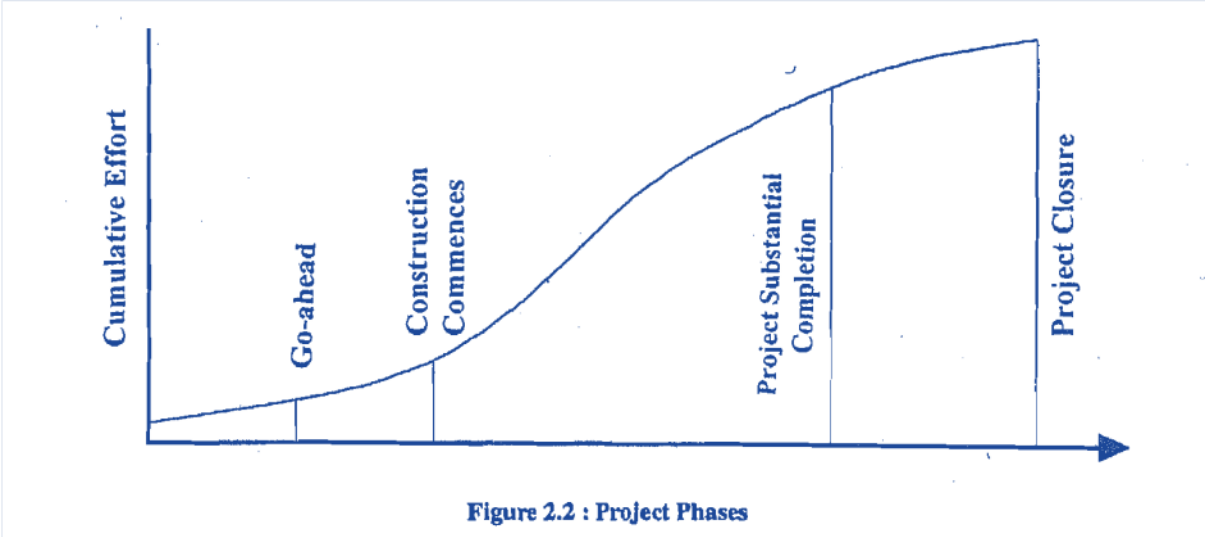

Figure 2.2 : Project Phases

Construction projects may be classified in a sequential manner as follows:

a) The initial phase
b) The planning and design phase
c) The execution and control phase
d) The completion phase

Project Initiation Phase

This phase defines the overall outlook of the project and how it will be implemented. Approval is sought from the necessary authorities for the project. The client may then authorise the commencement of the project or even terminate it completely.

Planning and Designing Phase

During this phase, a realistic plan is developed to serve as a guide to executing the objectives of the project. By the end of this phase, contracts will have been awarded to the successful bidding contractor.

Executing and Control Phase

On reaching this phase, the site managers and supervisors organise and coordinate all resources (labour, materials and equipment) to complete the construction of the facility.

Closing Phase

All necessary final tasks are undertaken before formally handing the project over to the client. The client conducts inspections and tests on the structure to ensure that all objectives have been met before accepting the final product.

Each project phase is made up of processes consisting of a number of tasks to be undertaken to produce a specific result or outcome. A process requires the supply of inputs comprising resources. The inputs are converted into tangible and verifiable outputs or products during the life cycle of the project.

Orthodox Construction Approach

Orthodox Construction Projects are normally carried out in a sequential manner. The sequential steps begin with the owner's conception of building a structure, after which architects and engineers produce the designs and drawings; finally, the contractors are authorised to execute the designs and deliver the final product under the supervision of a consultant chosen by the client. The orthodox approach requires the completion of a particular phase before the next one can begin. The phases do not overlap, unlike in the Fast-Track approach. Figure 2.3 is a pictorial representation of the two approaches used in the construction management process.

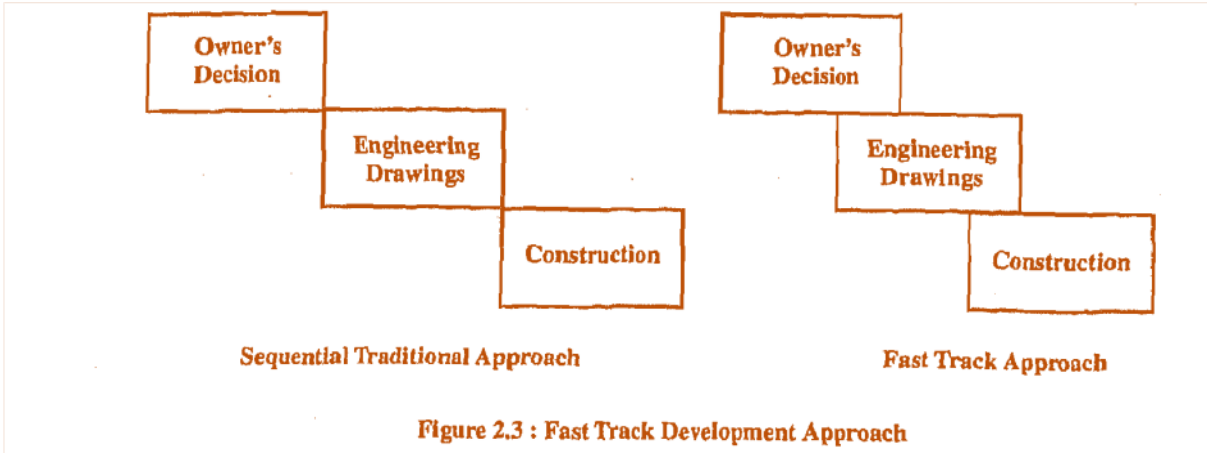

Figure 2.3 : Fast Track Development Approach

Disadvantages of using the orthodox sequential approach:

i) The initial cost of construction is based on estimates from the feasibility report without any input from the contractors. Therefore, the cost may not accurately reflect the reality on the ground.
ii) It is riddled with delays since the project does not commence until the last detail of the designs are completed before tendering.
iii) This type of construction results in increasing costs for the client due to the main contractor including the fee quotations of subcontractors in addition to his own.

iv) The contractor's perception of the minimum quality required may conflict with the client's perception.

With the sequential approach adopted in Orthodox Construction, it is the owner who must bear the cost of the delays and take responsibility for the low quality of work.

The Fast-Track Approach

There are certain occasions when the fast-track approach can be adopted for construction projects, provided the risks are fairly minimal. The fast-track approach involves the overlapping of phases. The main advantage of this method is the reduction in construction time. For instance, instead of waiting for the whole building drawing to be ready, work on the foundation can start as soon as the foundation drawing becomes available. The key to the success of the fast-track approach is to have a high level of organisation, coordination and swift information-handling to keep up with construction work. Although this approach saves time, it must be noted that it can add another layer of complexity to the already complex nature of construction projects

Project Initiation Phase

During this phase, the project scope is formulated and the implementation strategy is mapped out based on several processes involving the identification of needs, feasibility studies and financial and investment appraisals. Below, we explain some of the initial processes undertaken during the initiation phase.

Needs Identification

Needs identification is concerned with the reasons for wanting to undertake a construction project. These might range from setting up factories, building new national infrastructures such as highways, expanding on existing businesses or providing large-scale housing for communities. Identification of needs is undertaken based on national economic and developmental policy direction in order to make the facility useful and appropriate to the goals of the government's planning and development departments.

To maintain a successful business, it is necessary to start the right business within an ideal time-frame. Several tools are needed to start a new business:

i) Generating Ideas: The S.W.O.T (Strengths, Weaknesses, Opportunities and Threats) analysis tool can be used to generate ideas. It involves brainstorming to produce ideas on completely new technologies or synthesising existing ideas for a successful business venture.
ii) Monitoring the Environment: This involves knowing which business areas will provide the best advantage to perform well in a competitive market.
iii) Corporate Appraisal: This involves identifying profitable investment opportunities. S.W.O.T. can be used for appraising corporate strengths and weaknesses in terms of market share, the

capacity to operate, state of plants and machinery, location advantages, cash flow, the effectiveness of management, and the brand's appeal.

Pre-Feasibility Report:

The government or board of directors are provided with the pre-feasibility documents for clearance or consent to proceed with the project. The main reasons for this include:

- Market demand for the project's end product and plant capacity
- Materials and inputs
- Location and site
- Project engineering and investment costs
- Plant organisation and overhead costs
- Manpower
- Implementation schedule
- Financial and economic evaluation
- Statutory clearance

Pre-feasibility reports may not provide complete details of the project but it is important to provide as many data and details to aid correct decision-making. Crucial areas that require extra attention in the decision-making process should be adequately highlighted.

Feasibility Study

Here, all material requirements and cost estimates are determined. Guidelines for undertaking such feasibility studies can be obtained from publications of various institutions such as the World Bank Planning Commission. The different aspects inherent in feasibility studies include **market analysis, technical analysis, financial analysis, economic analysis and ecological analysis**.

Market Analysis

This type of analysis is performed mainly to determine aggregate demand and the market share.

Technical Analysis

This is important as it considers whether the best choice has been made in terms of size, location, and the physical condition of the site ground, etc.

Items to consider in technical analysis include:

- Initial investigations, tests and studies
- Availability of manpower, raw materials, power and other inputs
- Method of construction
- Types of equipment and machines to use
- Auxiliary equipment and supplementary works

- Treatment of effluents
- Layout of the site, buildings and plants
- Work schedules

Financial Analysis

This is used to determine whether the project will be financially viable. This entails:

- Determining investment and project costs estimates
- Determination of cost of capital
- Profit projections
- Break-even point calculations
- Projected cash flow estimation
- Projected financial position
- Determining the level of risks

Economic Analysis

This involves analysing the whole project from the viewpoint of cost-benefit considerations.

Ecological Analysis

Some prominent projects may have ecological impacts. For example, the construction of dams and power plants requires ecological analysis to determine the effect of operating these structures on the environment and ensuring that measures are designed to mitigate any adverse effects on the ecosystem.

Feasibility Study Report

The feasibility report should contain the following information:

i) Project background and description
ii) Market and plant capacity
iii) Materials and input
iv) Location and sites
v) Project engineering and investment cost
vi) Plant organisation and overhead cost
vii) Manpower
viii) Implementation schedule
ix) Financial and economic evaluation
x) Prepared summary sheets for every component
xi) A top sheet covering all components and providing separate columns for foreign exchange, local cost and total cost

The following profitability indicators must also be calculated during the feasibility study and be included in the feasibility report:

- The Net Present Value of cash flow (NPV)
- Internal Rate of Return (ROR)
- The Payback Period (PBP)
- The Break- Even Point (BEP)
- Sensitivity Analysis (SA)

All of these aspects should be covered in the capital budgeting programme.

Investment Appraisal

- This is the next step once the feasibility report has been accepted and approved. The investment appraisal is carried out to gain more insight into the feasibility report findings and to make an objective assessment before committing to investing in the project. It involves:
- Demand analysis
- Technical specifications feasibility
- Strengths, Weaknesses, Opportunities and Threats (S.W.O.T.) analysis
- Environmental implications
- Financial analysis
- Economic analysis

The feasibility study enables the client to:

- Make decisions on all aspects of the project
- Provide procedures for executing the project
- Appoint a representative such as the project manager to act on his/her behalf
- Choose architects, consultants and other professionals with the special skills to undertake certain aspects of the job

The groups of workers mentioned above help the owner to make the right decisions during the lifespan of the project.
The process of formulation of needs, collection of information etc. should be repeated several times over before the project commences.

Sources of Finance

When projects are started without adequate financial backing they may experience difficulties and eventually stall or fail altogether. It is important to provide timely and adequate funding to ensure a project's success.
The main sources of project finance are as follows:

- Commercial banks
- Public Banks
- Debenture or bonds
- Suppliers' credit

Project Statutory Clearance

Technical and statutory clearances must also be obtained from government agencies in addition to financial clearance. The technical and statutory clearances that have to be secured may vary from country to country. A general list is provided below:

- Soil investigation report
- Industrial License/Letter of Intent, basic designs and drawings planning
- Environmental/ Health & Safety Clearances
- State Industries Department Clearances

Project Scope Definition

The project scope is defined after the preliminary stages described above. The scope should take into consideration the following points:

- Broad scope of work involved
- Project objectives
- Outline execution methodology
- Preliminary time plan
- Resources forecasts
- Cash flow pattern and sources of funding
- Outline organisation
- Potential risks and problem areas

The Project Charter

An executive order in the form of a "Project Charter" is issued when approval is given for the construction to proceed. The charter sanctions the implementation of all aspects of the project contained in the project definition.

Project Planning and Design Phase

This involves formulating plans of action to coordinate processes within specific timelines in order to achieve the goals of the project.

Planning Processes

The Planning Process involves:

- Basic design and drawing planning
- Time planning
- Resource planning
- Cost planning and budgeting
- Communications planning
- Quality planning
- Organisational planning
- Risk management planning
- Procurement planning
- Project development integrated plan

The project manager with the help of the chief planner undertakes key developmental functions in the planning stage, including the following:

- Take part in the finalisation of the design, drawings and specifications in order to formulate the construction methodology
- Prepare the project execution preliminary plan and formulate the schedule for processing various contracts
- Advise the client on an early purchase of plant and equipment involving a long lead time for procurement
- Develop the pre-tender construction plan for each tender package
- Scrutinise the tender packages, including drawings and specifications, in order to minimise the discrepancies
- Conduct the pre-tender briefing for contractors to ensure that the bidders understand the tender documents and the work involved in each tender
- Evaluate project costs and compile the project budget including preliminary allocations for the various heads of expenditures
- Compile a project directive covering the scope of work, work plan, organisation, and the policies and procedures for implementing the project

Designing Processes

As already discussed, the project scope is defined by the designs, drawings and specifications. It is from the design that the various components of the proposed facility can be determined. The designs also help in the development of drawings, the estimation of project cost, the amount of work involved, the duration of construction and even the prediction of the financial dynamics of the whole project.

The design phase involves the collection of project information which is analysed, shared with the appropriate teams and then stored for use in the project scope framework. The three sequential

processes involved in designing are the schematic design process, the design development process and drawings and specification documentation. More information is provided on these processes below:

Schematic Design Process

The design architect assesses the client's requirements and then discusses the alternative options available with the client. A conceptual design is subsequently generated for the client to approve. The schematic design portfolio consists of the site plan, facility drawings, the outlined specification and the design for major constituent systems such as mechanical, structural and electrical systems among others. The design document essentially describes the project scope, project duration, the cost and the construction method to be used.

Design Development Process

The design development phase begins immediately after the schematic drawings described above have been approved. This process provides detailed information on constructability, system integration and the aesthetic element. Drawings for the plan, elevation and various sections of the facility are provided during this phase. For instance, the design of a housing project under this process might include the following:

- Design of foundation and structure of the buildings
- Structural design of precast elements of the building
- External filtered and unfiltered water supply
- External sewerage system and storm water drain
- External gas supply
- External electrical services
- Fire alarm system
- Clock system

Drawings and Specifications Documentation Processes

These consist of drawing sets and specifications:

Drawing Sets

Two-dimensional representations of the design intention in the form of drawings are provided to illustrate or highlight data about a particular section of the project. Drawings show the location, identity, documentation and sizes of all elements, etc.

Drawings are important assets for people connected to the project. Owners, engineers, contractors, architects, subcontractors, government institutions, lenders, Licensing Authorities and insurance agencies all make use of the drawings.

Specifications

Specifications provide the client with guidelines on the quantity of materials, the final product and the size of the workforce; these form the basis of the project design. They also highlight procedures for inspection and acceptance when the project is completed. Some examples of technical specification documents include construction method and acceptance, material specifications, and construction requirements.

Several methods of presenting technical specifications can be used. These include:

- Written description of the whole construction work
- Using the specification standard of standards publishing institutions such as the British Standards Institute and the International Standards Organisation
- The client's own standards

Project Procurement Process

Project Procurement is an important practice in the construction sector. It involves the acquisition of services, materials and goods required for the entire project. The approach adopted for procurement of essential components for the project can be classified into three categories: contractual (client engaging the services of contractor), departmental (client setting up an organisation to execute the project) and consultancy (construction manager is approved to manage the project).

The competitive construction business of the day requires special resources for different types of construction work and the contractors tend to specialise in specific areas of construction. From this functional angle, the contractors can be classified into different categories. These include general contractors, building contractors, specialist heavy infrastructure contractors, specialist industrial works contractors and contractors offering specialist utility services including electrical, water supply, sewage disposal and HVAC services.

Advantages of the Contractual Approach

- It costs much less compared to the departmental approach
- There is no need for the owner to train his/her own staff because he/she can rely on the contractor's workforce to do the job
- It provides cost stability
- The client is able to limit the size of his/her workforce to supervisory functions
- The client does not have to invest in expensive equipment

Due to the multifaceted dimension of construction projects, contractors with specialised skills are often called upon to work on specific areas of specialisation. There are general contractors, utility contractors, and contractors dealing with water, HVAC, electrical and industrial work.

Project Execution and Control Phase

Project Execution Processes

In a large construction project, the project manager is assigned the position of project leader. He is expected to provide directions, vision, motivation and inspiration for the workforce. Other personnel are also expected to assist the project manager with leadership responsibilities in their various areas of expertise.

The functions of project executives include:

- Project organisation
- Resources mobilisation
- Quality Assurance organisation
- Site mobilisation
- Team development
- Safety management
- Information distribution

Construction works are usually risky undertakings in dangerous environments or conditions. This renders projects susceptible to various forms of accidents and safety hazards. Any accident at work may result in injuries and loss of limbs. Accidents may even result in death. The negative impact of accidents may be financial, emotional and psychological.

In order to avoid accidents, an effective prevention programme must be in operation at the construction site. Policies geared towards ensuring workers' safety on work sites make the employer the sole person responsible for maintaining a safe working environment. The policies ensure that the workers' safety always comes first in all circumstances at the site.

Project Control Phase

During this phase, the key players ensure that the project is executed according to plan in order to achieve the project objectives. It may involve some elements of re-planning when necessary. The project control phase involves:

- The overall scope change control
- Resources control
- Schedule control
- Cost control
- Quality Control
- Risk response
- Performance reporting
- Contract administration

There are organisational units in a project. These units are regarded as interdependent subsystems and are also known as Responsibility Centres. Each subsystem has certain parameters, such as time, resource productivity, and targets that need to be controlled. The performance of each subsystem is measured and the actual results and deviations from the norm are transmitted to the monitor. The monitor is responsible for converting data into useful information that can be used as a remedial tool to achieve project objectives when deviations occur.

Project Close-Up Phase

Various activities are undertaken to ensure that the newly constructed structure functions properly after completion of the project. These activities include:

- Administrative close
- Contract Close-out
- Lessons learnt

The following steps can be adopted for effective closing of the project:

- A contractor who is familiar with the newly finished structure is chosen to provide maintenance when the project is completed and handed over
- There is a need to maintain correct records of operating instructions as well as the construction drawings
- Before building takeover, staff are trained in operating and maintaining the building
- Unwanted and unused materials must be removed from the site
- Before issuing a completion certificate and making final payment to the contractor, the client makes sure that his/her interest is protected.

The client's project team is responsible for handing over the project to the client upon completion of the project. The project completion report must be completed and handed over. This report details the scope of the work and the schedules used to complete the works, important events that occurred, the contract executed, the contact details of material and equipment suppliers, the maintenance manual, costs of the project, problems during construction, any lessons learned and minor defects detected at the time of handing over.

Project Organisation

It is important to ensure a successful project by implementing a robust organisational form and structure to bring together the diverse group of people with diverse specialised expertise and responsibilities by coordinating activities synchronously to achieve the desired outcome. It is the responsibility of the project manager and his team to motivate workers to finish the job using all available resources at the right time.

The project organisation terminates on completion of the project. It usually undergoes changes during different phases of the project in order that specific objectives might be accomplished. Project organisation requires innovative solutions to problems using the extensive experience of the project manager to make the right decisions. Factors such as technology, the number of workers and the project size affect the nature of the organisation design that might be adopted for a particular project - there is no single best fit for all projects.

Further Reading:

- ✓ **Barbara J. Jackson (2010), *Construction Management JumpStart***
- ✓ **Stephen Emmitt, Christopher A. Gorse (2010), *Barry's Introduction to Construction of Buildings***
- ✓ **Frank Harris, Ronald McCaffer (2013), *Modern Construction Management***