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.

The Development and Organisation of Construction Projects

Construction projects are an expensive and time bound undertaking with certain fixed performance goals, which are needed to be achieved. It involves the construction of all sorts of infrastructure such as, sports facility, 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 gets 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 categorize the development of a project into four phases namely; 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 kicks in. During the project's lifecycle, some workers leave after completing their assigned tasks, while others continue to the next phase of the construction, and 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 and 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 lifecycle is the sequential arrangement of the various phases of construction projects from the beginning to the ending of the whole project. The time taken to complete the project lifecycle is referred to as the lifespan.

During the initial phase of the project lifecycle, few resources are normally employed which steadily increase with time. This is followed by a long period of stable and constant use of resources (the plateau stage). Resource requirements decrease getting to the end of the project. Some projects may not necessarily follow the pattern of resources usage described above but invariably, most of the projects tend to display these trends or patterns.

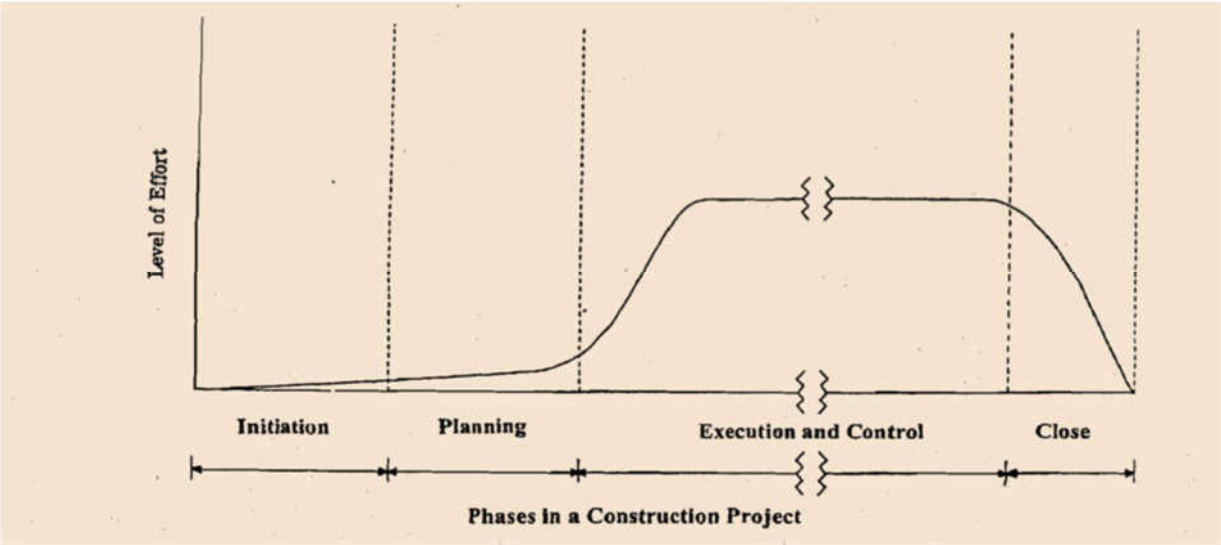

Fig 1.1

Product Lifecycle

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

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 of the product, expensive production, or the product becomes outdated. At this stage of the product lifecycle, the product has reached its "kill point".

It is important to note that the product lifecycle includes the project lifecycle (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 lifecycle 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 at the early phase of a project's lifecycle 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 getting to the end of the project.

Project Phases and Processes

To enable effective management, each construction phase may be divided into sub-sections consisting of several sequential stages; the time for starting and ending the project and details of works that need to the done 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, then, the next one begins. This sequential step continues until the last phase is finally finished. The number of stages or phases for each project will depend on a number of factors such as the nature, purpose, and the size or manner for executing the project.

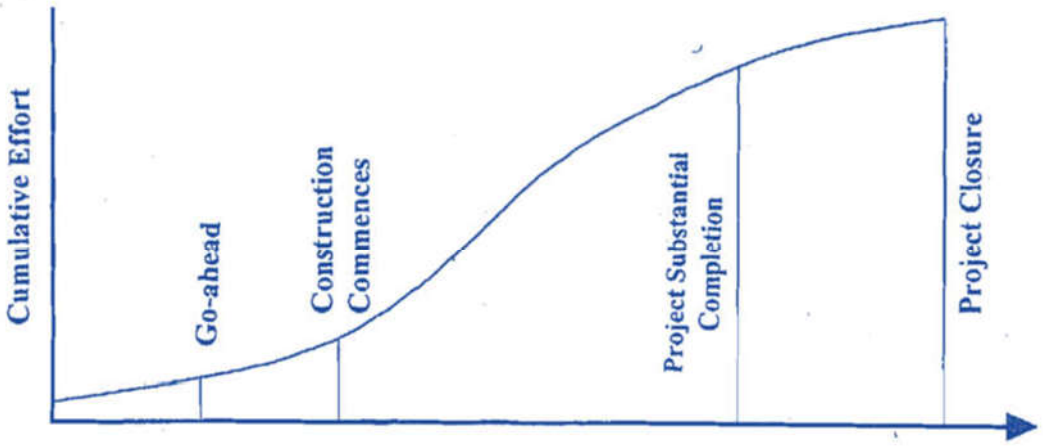

Fig 1.2

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 can then authorize the project to start or even decide to terminate it altogether.

Planning and Designing Phase

During this phase, a realistic plan is developed to serve as a guide for execute the objectives to the project. By the end of this phase, contracts are awarded to the successful bidding contractor.

Executing and Control Phase

On reaching this phase, the site managers and supervisors organise and coordinate all resources (human beings, 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 inspection and tests on the structure to ensure all objectives have been met before accepting the final product.

Each project phase is made up of processes which consist of a number of tasks to undertake to produce a specific result or outcome. A process requires making supplying inputs comprising of resources. The inputs are converted into tangible and verifiable outputs or products during the lifecycle of the project.

Orthodox Construction Approach

Orthodox Construction Projects are normally carried out in sequential manner. The sequential steps begin with the owner's conception of building a structure, then, architects and engineers produce the designs and drawings and finally, the contractors are given the go ahead 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 the Fast track approach. Figure 1.3 shows the pictorial representation of the two approaches used in construction management process.

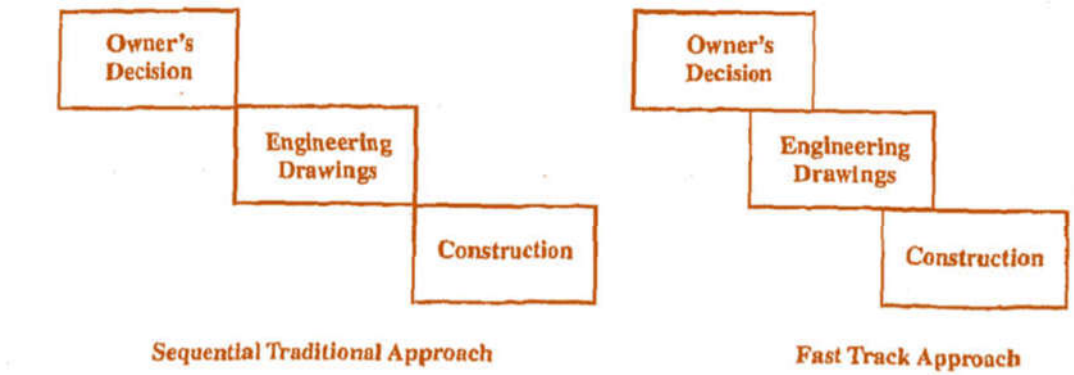

Fig 1.3

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 lots of delay since the project does not commence until the last detail of designs are completed before tendering
iii) This type of construction results in increasing cost to the client due to the main contractor including the fee quotations of sub-contractors in addition to his own.

iv) The contractor's perception of the minimum quality required may be in 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 risks are quite minimal. The fast track approach involves the overlapping of phases. The main advantage of this method is the reduction of construction time. For instance, instead of waiting for the whole building drawing to be ready, work on the foundation can start immediately the foundation drawing becomes available. The key to the success of 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 also mapped out based on several processes involving identification of needs, feasibility studies and financial and investment appraisals. Below, we explain some of the initial processes undertaken during the initiation phase.

Need Identification

Needs identification has to do with the reasons for wanting to undertake a construction project. This could 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 sis undertaken bases 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.

Having and maintaining a successful business requires starting the right business with an ideal time frame. Several tools are needed for starting a new business:

i) Generating Ideas: The S.W.O.T (Strength, Weakness, Opportunity, and Threats) analysis tool can be used to generate ideas. It involves brainstorming to come up with ideas on completely new technologies or synthesizing 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: 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:

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 projects end product and plant capacity
- Materials and inputs
- Location and site
- Project engineering and investment costs
- Plant organization 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 much data and details to assist in 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. Guideline 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 the 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 the size, location, and the physical condition of the site ground, etc.

Things 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 equipments 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 require ecological analysis to determine the effect of operating these structures on the environment and ensuring 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) Prepare a summary sheet for every component
xi) Make a top sheet covering all components, providing separate columns for foreign exchange, local cost and total cost

The following profitability indicators must also be calculated during 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 program.

Investment Appraisal

- This is the next step once the feasibility report has been accepted and approved. The investment appraisal is done to gain more insight into the feasibility report finding and to make object assessment before committing to investing in the project. It involves:
- Demand analysis
- Technical specifications feasibility
- Strength, Weaknesses, Opportunity, and Threat (S.W.O.T.) analysis
- Environmental implications
- Financial analysis
- Economic analysis

The feasibility study enables client to:

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

The groups of workers mentioned above provide assistance to 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 takes off.

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 make projects successful.
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. Technical and statutory clearances that have to be secured that 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 organization
- Potential risks and problem areas

The Project Charter

Executive order in the form of “Project Charter” is issued when the go-ahead is given for the construction to occur. 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 actions 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
- Organizational planning
- Risk management planning
- Procurement planning
- Project development integrated plan

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

- Take part in the finalisation of design, drawings and specifications so as to formulate construction methodology
- Prepare project execution preliminary plan and formulate the schedule for processing various contracts
- Advise the client on an early purchase of plants and equipments needing a long lead time for procurement
- Develop the pre-tender construction plan for each tender package
- Scrutinise the tender packages, including drawings and specifications, so as to minimize the discrepancies
- Conduct the pre-tender briefing to contractors to ensure that the bidders understand the tender documents and the work involved in each tender
- Evaluate project costs and compile project budget including preliminary allocations for the various heads of expenditures
- Compile a project directive covering the scope of work, work plan, organization, 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 with 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 as follows:

Schematic Design Process

The design architect assesses the client's requirements and them 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 the mechanical, structural, and electrical among others. The design document essentially describes the project scope, project duration, the cost and the construction method to use.

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 as well. Drawings for the plan, elevation and various sections of the facility are provided during this phase. For instance, design of a housing project under this process may 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 electric services
- Fire alarm system
- Clock system

Drawings and Specifications Documentation Processes

These consist of drawing sets and specifications:

Drawing Sets

Two dimensional representation 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, sizes of all elements etc.

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

Specifications

Specification provides the client with guidelines on the quantity of materials, final product and the size workforce which form the basis of the project design. It also highlights 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 specification can be used. These include:

- Word description of the whole construction work
- Using specification standard of standards publishing institutions such as the British Standard Institute and International Standard Organisation
- 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 which are needed 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 and 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 a specific area 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 Contractual Approach

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

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

Project Execution and Control Phase

Project Execution Processes

For 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 to work may result in injuries and loss of limbs. Accidents may even result in death. The negative impact of accident may be financial, emotional and psychological.

In order to avoid all accidents, an effective prevention programme must be in operation at the construction site. Policies geared toward 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 attain the project objectives. It may involve some elements of re-planning when it becomes 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 with a project. These units are regarded as subsystems which depend on each other and are widely 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. Some of 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 the need to maintain correct record 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 completion certificate and making final payment to the contractor, the client makes sure that his interest is protected.

The client's project team is responsible for handing over the project to the client upon completion of the project. The projection completion report has to be completed and handed over. This report details the scope of work and the schedules used to complete the works, important events that transpired, the contract executed, the contact details of material and equipment suppliers, the maintenance manual, costs of the projects, 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 specialized expertise and responsibilities by coordinating activities synchronously to achieve a desired outcome. It is the responsibility of the project manager and his team to motivate workers to get the job done using all available resources at the right time.

The project organisation terminates on completion of the project. It usually goes through any changers during different phases of the project in order to accomplish specific objectives. 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 project size affect the nature of organisation design that could be adopted for a particular project - there is no single 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***