

COURSE TITLE
**CONSTRUCTION ENGINEERING AND
MANAGEMENT**

Chapter 1
**INTRODUCTION TO CONSTRUCTION
MANAGEMENT**

Lecture 1 (week 1)

**Introduction, Construction Industry,
Categories of construction project,
Characteristics, Relation between client,
contractor and consultant**

Lecturer: Associate Prof. Ishwar Adhikari

Learning Objective

The main objective of this lecture is to understand about:

- 1.1 Introduction of construction management.
- 1.2 Construction industry.
- 1.3 Categories of a construction project.
- 1.4 Characteristics of construction project.
- 1.5 Relation between client contractor and consultant.

1.1 INTRODUCTION OF CONSTRUCTION MANAGEMENT

The basic requirements of human beings are: (i) Food (ii) Clothing and (iii) Shelter. In the ancient times man used to live in caves, on trees. With the advancement of knowledge and civilization, man started constructing huts and houses and started living in groups. With the passage of time, the new technique of construction developed and construction activity turned into an industry contributing the economy of a nation. As design and material technologies have evolved, distances that can be spanned, heights that can be reached and loads that can be carried have all increased. [1] For example: Hydropower cable –stayed bridge, 500-foot skyscrapers, high speed bullet train etc. The single individual cannot do all works, so he joined hand with other people to achieve the goal. With the passage of time, the need of human increased, which gave birth to the ideas of organized management to achieve the goal. Construction is a process of building or assembling of infrastructure within the constraint of budget, time and quality. [2]

Definition 1

“It is an organization in which different class of people work together to produce qualitative and economical products with available resources such as capital, material and equipment etc.”

Definition 2

“Construction Management is a professional service that applies effective management techniques to the planning, design, and construction of a project from inception to completion for the purpose of controlling time, cost and quality.”[3]

Necessity of Construction Management

- To check the wastage of material and labor.
- To arrange the completion of the work in the minimum possible time.
- To effect the economy in the cost of construction by adopting new techniques of construction and supervision etc.
- To improve the quality and speed of work by using modern equipment and machinery on the construction.
- The aim of the management is to effect utmost economy in the cost and time of construction of the project.

Role of Construction Management

- The first step in the management process is to arrive at a clear definition of goals and to understand what problems the project is designed to solve.
- The second step is to investigate alternate solution to the sated problems.
- The next step is to develop a detailed plan to make the selected program a reality.
- The next step is to implement the plan and control the project.
- As the project draws to an end, the project team needs to make all necessary final adjustments and evaluate the final performance of the project.

1.2 CONSTRUCTION INDUSTRY

Construction industry refers to the industrial branch of manufacturing and trade related to building, repairing, renovating, and maintaining infrastructures. [4]. In a construction industry, on a major project, many business and agencies of varying size come together for one project. They work together for few years then go on to another project with another group of participants. These agencies may be client, contractor, consultant, government, suppliers, financial institutions, consumers, designers and many more. Construction is also a service industry than a manufacturing or product based industry [1]. The construction industry greatly contributes to social and economic development of most countries and hence regarded as one of the most important industries.

The construction industry has registered an enormous growth world-wide during the last few decades. The growth is characterized by a wide range of diversity in the nature of operations performed. Industrialized countries, with their technological advancements, have invested more on civil work projects associated with nuclear energy, space research, etc. The developing countries have been engaged in infrastructure development necessary for their economic growth and social betterment. Based on the CIC's (Construction Intelligence Center), the size of the world construction market is around US\$10.3 trillion. It means that this industry is providing the greater employment opportunity compared to any other industry. Over 100 million workers are engaged in the construction trades around the globe. Construction workers constitute 6 to 7 percent of the world labor force; the figures climb to as high as 20 percent in some countries.

The major consideration to be made in construction industry are: (Brian cooke)

- Time and money pressure
- Labor – Contractor and sub-contractor
- Health and safety management legislation
- Procurement methods and the influence of major clients
- Public sector procurement legislation.

The Players

The owner

The owner, also called client, is the person or organization that will pay the bills as well as receive the ultimate benefits of the finished project. The owner is responsible for determining the scope of the project, the schedule of the project and the budget of the project. Owner organizations can be broken into two major categories, i.e. public and private. A public agency exists for the ultimate benefit of the citizenry, the general public. Public project is paid for from public funds, statues exist that describe how the project is to proceed. Examples - highway, irrigation, water supply etc. A private organization can be described as any individual, partnership, corporation, or institution that builds a project for its own use or resale. Private organizations often invite selected designers and builders to compete for their projects. Example – individual homes, shopping malls, housing complex, etc.

The Designer Professionals

Examples of design professionals are architects, engineers, and design consultants. The major role of design professional is to interpret or assist the owner in developing the project's scope,

budget, and schedule. Design professional assist owner to prepare construction documents that will be used by the contractor to build the project. The design professional and construction contractor together form a design-build company. In almost all cases the design professional is a licensed, registered professional who is responsible for the physical integrity of the project.

The construction professional

The responsibility for the interpretation of the contract documents and the physical construction of the project rests with construction contractor. In traditional arrangement where the owner, design professional, and contractor are separate companies, the contractor is termed as prime contractor. Prime contractor is responsible for delivering the completed project in accordance with the contract documents.

In most cases the prime contractor divides the work among many specialty contractors called subcontractors. On a large project these subcontractors may also divide up the work into even smaller work packages. Owner initiates contract with prime contractor. Prime contractor signs contract with 1st tier subcontractors. 1st tier subcontractors may sign contracts with 2nd tier subcontractors.

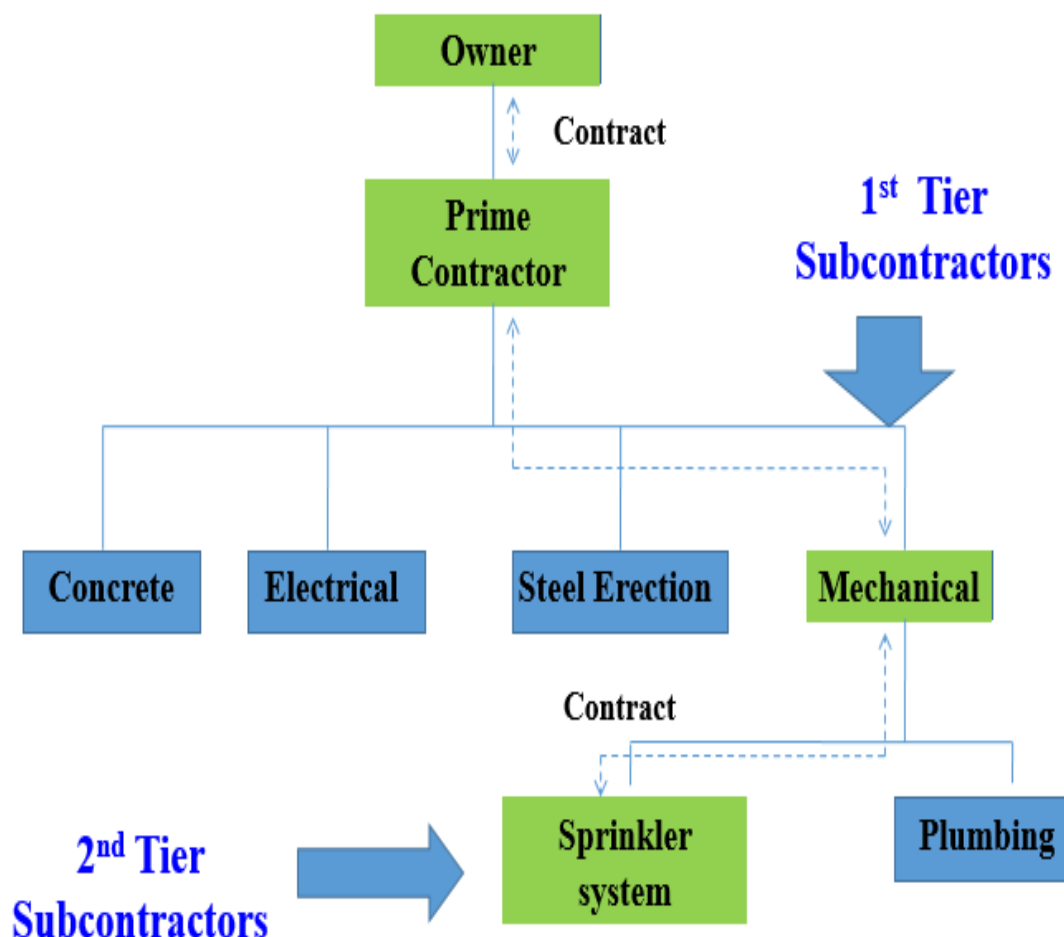
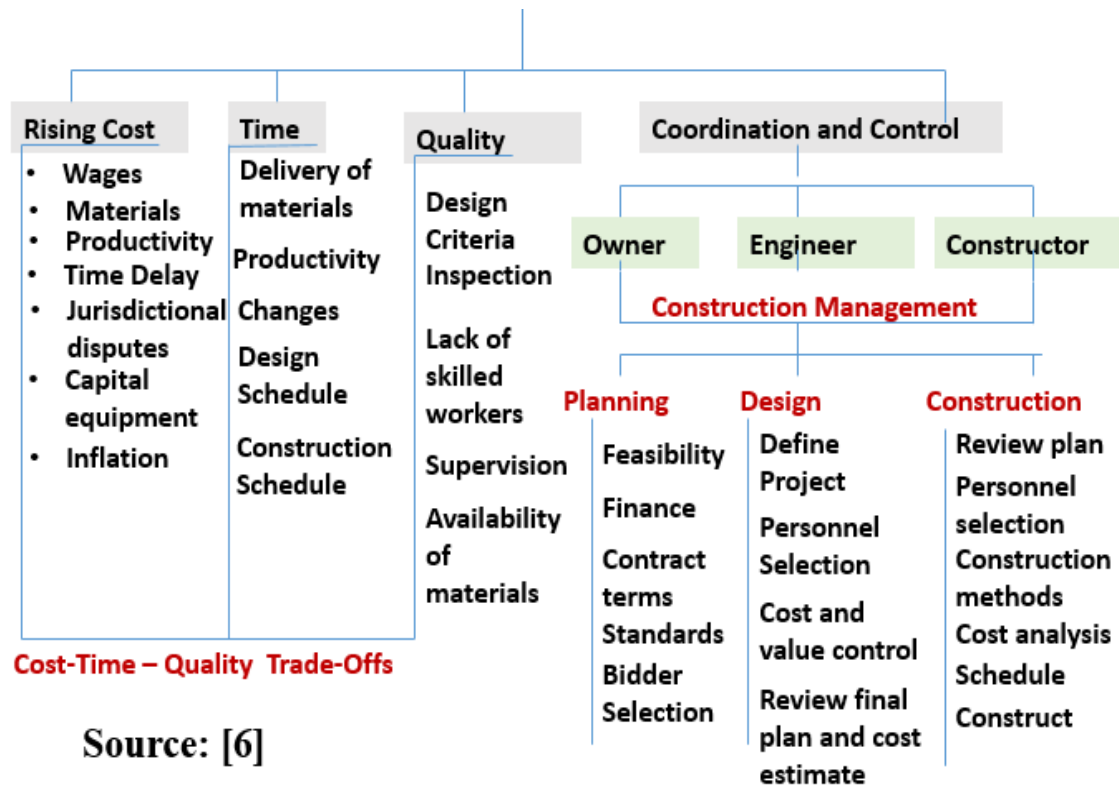


Fig: Contractor Hierarchy [1]

The Challenges of Construction



1.3 CATEGORIES OF CONSTRUCTION PROJECT

Basically four informal categories of Construction are:

Residential

Building Construction

Infrastructure and Heavy Construction

Industrial

These distinct type have evolved because major differences exist in the way

- **The projects are funded,**
- **Technologies involved and**
- **The manner in which the designers, builders and owner interact.**

Residential Construction

Residential construction describes structures built for habitation. [10]Includes the construction of individual homes as well as small condominium (flats individually owned) and apartment building complexes. These projects tend to be privately funded by individual owners for their own use or developers for profit. This type of construction requires little investment and fairly low technologies.

Building Construction

Includes office buildings, large apartment buildings, shopping malls, and theaters. In terms of annual construction expenditures this category is the largest, although it is heavily dependent on the economy of particular region. These projects are designed by architects with engineering support and are generally built by general contractors. Privately funded, though some projects like schools, courthouses, and government offices are publicly funded. Technical sophistication is greater than the residential construction and requires high investment.

Infrastructure and Heavy Construction

Includes roadways, bridges, dams and tunnels. These projects are designed principally by civil engineers and built by heavy construction contractors having engineering background and support. Usually publicly funded and therefore are sensitive to government policy. These project tend to be long in duration and less sensitive to the ups and downs of the economy and involve heavy use of equipment. [6]

Industrial

These projects are defined more by the production activities within the facility than by the facility itself. Example includes Steel mills, petroleum refineries, chemical processing plants, and automobile production facilities. The design and construction of shell is dependent on the needs of the process and production equipment. Quality and time are extremely important because they are most technical of all: only a few designers and builders are qualified to bid on any type of facility. [6]

1.4 CONSTRUCTION PROJECT CHARACTERISTICS

1. A Defined Goal/ Objective

Clearly defined goals are essential so that each stakeholder understands the purpose and vision of the project team. A project has clearly defined specific objectives or mission. It is focused on end results. It ceases to exist when the goal have been achieved. For Example: The goal of a construction project is to build an infrastructure or facility.

2. Unique

No two projects are absolutely similar to each other. Project involves doing something which has not been done before and therefore it is unique. [7] One project is different from another due to its cost, time, design, geographical location, set of people etc.

3. Specific task not routinely performed

No works are repeated again and again in the project. For example: foundation work is performed only once in a building project.

4. Temporary (Life Span)

A project cannot go forever. Once its declared objectives are met, project ceases. Project starts with the definite certain date and ends in the definite certain date. The duration or life of the project depends upon its nature or scope. Therefore project has a fixed time span and it's temporary.

5. Team Work

In a project, there are number of people involved and participating, generally called as stakeholders. Projects work through team work. A project consists of multi-functional team. Team members are temporarily assigned from other functional departments. They come from various disciplines with varied experiences. The key stakeholders in a project are:

- (a) **Project manager:** the individual responsible for managing the overall project.
- (b) **Customer:** the individual or organization that will use the project's product or services.
- (c) **Performing organization:** the enterprise whose employees are most directly involved in doing the work of the project.
- (d) **Sponsor:** the individual or group that provides the financial resources in cash or in kind, for the project.
- (e) **Client:** the individual or group which specifies the requirements.

6. Resource being consumed

Project consumes tremendous quantities of resources, all of which are paid for by the owner. 5M-Money, Material, Manpower, Machine and Minute are examples of the kinds of resources that are managed and controlled by the project team. The project team has to perform the task on limited resources. Efficiently managed projects minimize, balance and forecast resource consumption for the owner.

7. Risk and Uncertainties

Risk and uncertainty go hand in hand with project. Even if a project appears to be risk free, it only means that the risk element is not apparently visible on the surface and it will be hidden underneath. The risk factor will come to surface when conditions become conducive to it. On the other hand, risk gets managed as the project phase's proceeds.

8. Planning and Control

Projects work to a plan. A project requires effective and efficient planning and control systems. Standards are set for project activities through planning. They serve as yardsticks for measuring project performance. [6] Actual performance is compared with standards to find out deviations. Corrective actions are taken to control deviations.

9. Constraints

All projects have constraints. A project operates within the constraints of time, cost and quality performance. It has a time schedule for various activities and a completion date as deadline. It has its own budget to control costs. It has clearly laid down quality specifications. The scope and boundaries of a project are clearly described. Project schedule sets deadlines.

10. Contracting and subcontracting

Most projects are contract-based. The project work is characterized by high level of contracting and subcontracting. [9]Complexity increases the need for subcontracting. Contracts can be of various types, such as lump- sum contract, unit price contract, negotiated cost plus fixed fee

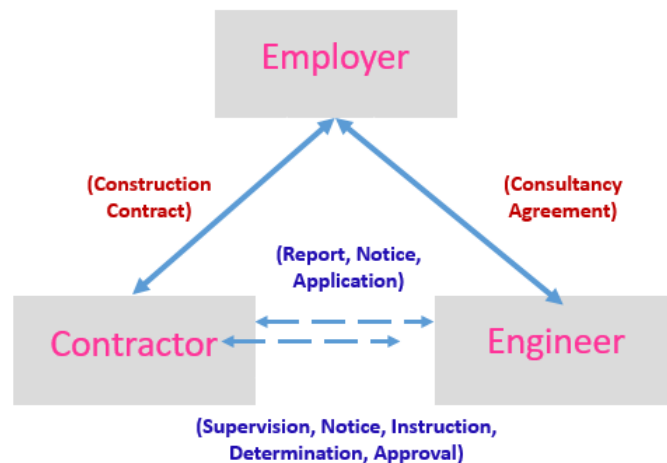
contract and turnkey contract. Proper contract planning and management is the key to effective project management. [8]

1.5 RELATION BETWEEN CLIENT CONTRACTOR AND CONSULTANT

Three main parties involved ---Employer, Engineer Contractor. The client is one who is owner and ultimate user of the constructed facilities. The consultant, in general is an engineer who is involved in planning, designing and the cost estimation of the infrastructure facilities in close coordination with client. The contractor is responsible for the quality control of work and builds the facilities as per the consultant’s design and in close supervision and monitoring from client and consultant both.

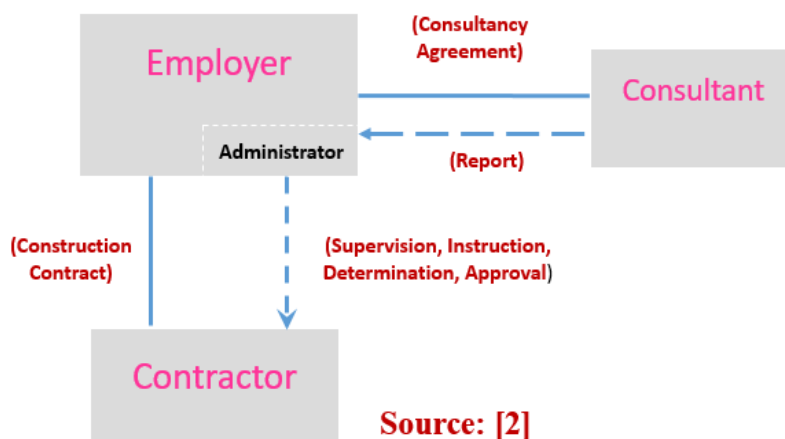
The major relation between these three parties are governed by the type of contract and the nature of work. [2] Client is investor who invest the money for the project. The consultant plays the bridge between the payment to contractor and the owner. According to the nature of role, the relation between the parties can be divided into either two party system or three party system.

THREE ACTOR SYSTEM (FIDIC CONTRACT)



Source: [2]

TWO ACTOR SYSTEM (JAPANESE SYSTEM)



Source: [2]

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