Chapter 1: Introduction

1.1 The Construction Project

A project is defined, whether it is in construction or not, by the following characteristics:

- A defined goal or objective.
- Specific tasks to be performed.
- A defined beginning and end.
- Resources being consumed.

The goal of construction project is to build something. What differentiate the construction industry from other industries is that its projects are large, built on-site, and generally unique. Time, money, labor, equipment, and, materials are all examples of the kinds of resources that are consumed by the project.

Projects begin with a stated goal established by the owner and accomplished by the project team. As the team begins to design, estimate, and plan out the project, the members learn more about the project than was known when the goal was first established. This often leads to a redefinition of the stated project goals.

1.2 The Need for Project Management

The construction industry is the largest industry in the world. It is more of a service than a manufacturing industry. Growth in this industry in fact is an indicator of the economic conditions of a country. This is because the construction industry consumes a wide employment circle of labor.

While the manufacturing industry exhibit high-quality products, timelines of service delivery, reasonable cost of service, and low failure rates, the construction industry, on the other hand, is generally the opposite. Most projects exhibit cost overruns, time extensions, and conflicts among parties. Figure 1.1 is an example of a complicated project.

Table 1.1: Magnificent projects with huge cost overruns

Project	Cost overruns (%)
Suez Canal	1,900
Sydney Opera House	1,400
Concorde Supersonic Aeroplane	1,100
Panama Canal	200
Brooklyn Bridge	100

(Source: Mette K. Skamris, 'Economic Appraisal of Large-Scale Transport Infrastructure Investments', Ph.D dissertation, Aalborg University, 2000).

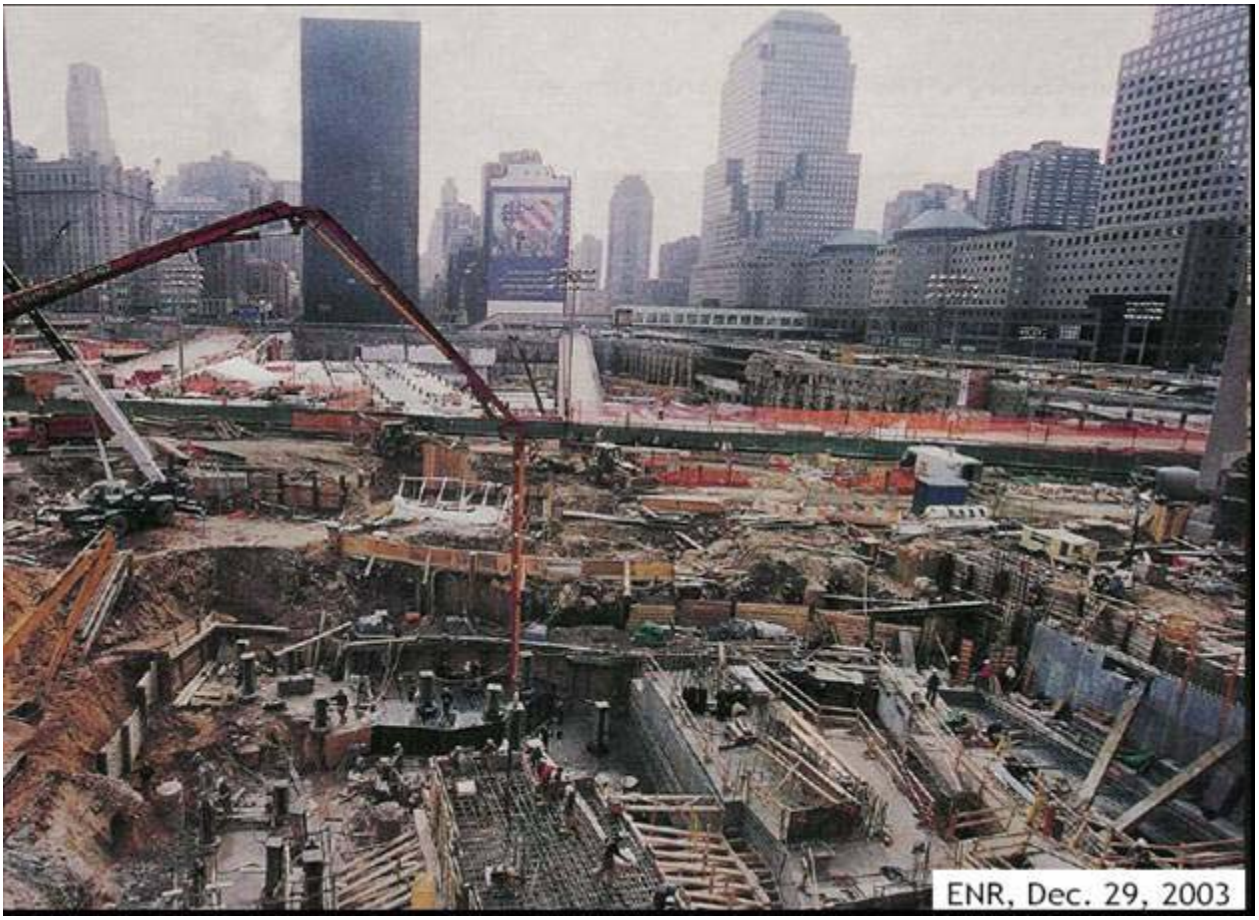

Figure 1.1: Example of a complicated project

In general, the construction industry is more challenging than other industries due to: its unique nature; every project is one-of a kind; many conflicting parties are involved; projects are constrained by time, money and quality; and high risk.

1.3 The Project Life Cycle

The acquisition of a constructed facility usually represents a major capital investment, whether its owner happens to be an individual, a private corporation or a public agency. Since the commitment of resources for such an investment is motivated by market demands or perceived needs, the facility is expected to satisfy certain objectives within the constraints specified by the owner and relevant regulations.

From the perspective of an owner, the project life cycle for a constructed facility may be illustrated schematically in Figure 1.2. A project is expected to meet market demands or needs in a timely fashion. Various possibilities may be considered in the conceptual planning stage, and the technological and economic feasibility of each alternative will be assessed and compared in order to select the best possible project. The financing schemes for the proposed alternatives must also be examined, and the project will be programmed with respect to the timing for its completion and for available cash flows. After the scope of the project is clearly defined, detailed

engineering design will provide the blueprint for construction, and the definitive cost estimate will serve as the baseline for cost control. In the procurement and construction stage, the delivery of materials and the erection of the project on site must be carefully planned and controlled. After the construction is completed, there is usually a brief period of start-up of the constructed facility when it is first occupied. Finally, the management of the facility is turned over to the owner for full occupancy until the facility lives out its useful life and is designated for demolition or conversion.

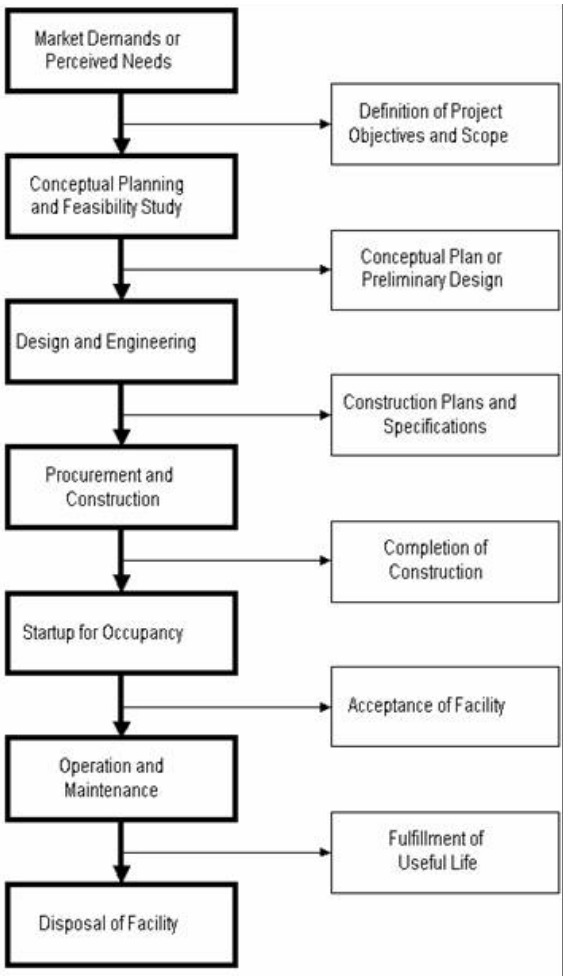

Figure 1.2: Project life cycle

Of course, the stages of development in Figure 1.2 may not be strictly sequential. Some of the stages require iteration, and others may be carried out in parallel or with overlapping time frames, depending on the nature, size and urgency of the project. Furthermore, an owner may have in-house capacities to handle the work in every stage of the entire process. By examining the project life cycle from an owner's perspective we can focus on the proper roles of various activities and participants in all stages regardless of the contractual arrangements for different types of work.

The project life cycle may be viewed as a process through which a project is implemented from beginning to end. This process is often very complex; however, it can be decomposed into several stages as indicated by the general outline in Figure 1.2. The solutions at various stages are then integrated to obtain the final outcome. Although each stage requires different expertise, it usually includes both technical and managerial activities in the knowledge domain of the specialist. The owner may choose to decompose the entire process into more or less stages based on the size and nature of the project. Very often, the owner retains direct control of work in the planning stages, but increasingly outside planners and financial experts are used as consultants because of the complexities of projects. Since operation and maintenance of a facility will go on long after the completion and acceptance of a project, it is usually treated as a separate problem except in the consideration of the life cycle cost of a facility. All stages from conceptual planning and feasibility studies to the acceptance of a facility for occupancy may be broadly lumped together and referred to as the Design/Construct process, while the procurement and construction alone are traditionally regarded as the province of the construction industry.

There is no single best approach in organizing project management throughout a project's life cycle. All organizational approaches have advantages and disadvantages, depending on the knowledge of the owner in construction management as well as the type, size and location of the project. It is important for the owner to be aware of the approach which is most appropriate and beneficial for a particular project. In making choices, owners should be concerned with the life cycle costs of constructed facilities rather than simply the initial construction costs. Saving small amounts of money during construction may not be worthwhile if the result is much larger operating costs or not meeting the functional requirements for the new facility satisfactorily. Thus, owners must be very concerned with the quality of the finished product as well as the cost of construction itself. Since facility operation and maintenance is a part of the project life cycle, the owners' expectation to satisfy investment objectives during the project life cycle will require consideration of the cost of operation and maintenance. Therefore, the facility's operating management should also be considered as early as possible, just as the construction process should be kept in mind at the early stages of planning and programming.

In summary the project phases can be summarized as follows:

1.3.1 Preconstruction phase

The preconstruction phase of a project can be broken into conceptual planning, schematic design, design development, and contract documents.

Conceptual design:

- Very important for the owner.
- During this stage the owner hires key consultants including the designer and project manager, selects the project site, and establish a conceptual estimate, schedule, and program.
- The owner must gather as much reliable information as possible about the project.
- The most important decision is to proceed with the project or not.

Schematic design:

- During this phase, the project team investigates alternate design solutions, materials and systems.
- Completion of this stage represents about 30% of the design completion for the project.

Design development:

- Designing the main systems and components of the project.
- Good communication between owner, designer, and construction manager is critical during this stage because selections during this design stage affect project appearance, construction and cost.
- This stage takes the project from 30% design to 60% design.

Contract documents:

- Final preparation of the documents necessary for the bid package such as the drawings, specifications, general conditions, and bill of quantities.
- All documents need to be closely reviewed by the construction manager and appropriate owner personnel to decrease conflicts, and changes.
- With the contract documents are almost complete; a detailed and complete cost estimate for the project can be done.

1.3.2 Procurement phase (Bidding and award phase)

- The project formally transits from design into construction.
- This stage begins with a public advertisement for all interested bidders or an invitation for specific bidders.
- In fast-track projects, this phase overlaps with the design phase.
- If the project is phased, each work package will be advertised and bid out individually.
- It is very important stage to select highly qualified contractors. It is not wise to select the under-bid contractors.

1.3.3 Construction phase

- The actual physical construction of the project stage.
- This stage takes the project from procurement through the final completion.
- It is the time where the bulk of the owner's funds will be spent.
- It is the outcome of all previous stages (i.e., good preparation means smooth construction).
- The consultant will be deployed for contract administration and construction supervision.
- Changes during construction may hinder the progress of the project.

1.3.4 Closeout phase

- Transition from design and construction to the actual use of the constructed facility.
- In this stage, the management team must provide documentation, shop drawings, as-built drawings, and operation manuals to the owner organization.
- The as-built drawings are the original contract drawings adjusted to reflect all the changes that occurred.
- Assessment of the project team's performance is crucial in this stage for avoiding mistakes in the future.
- Actual activity costs and durations should be recorded and compared with that was planned. This updated costs and durations will serve as the basis for the estimating and scheduling of future projects.

Figure 1.3 shows the increasing cumulative cost as the projects progresses while the influence in the project cost and scope decreases.

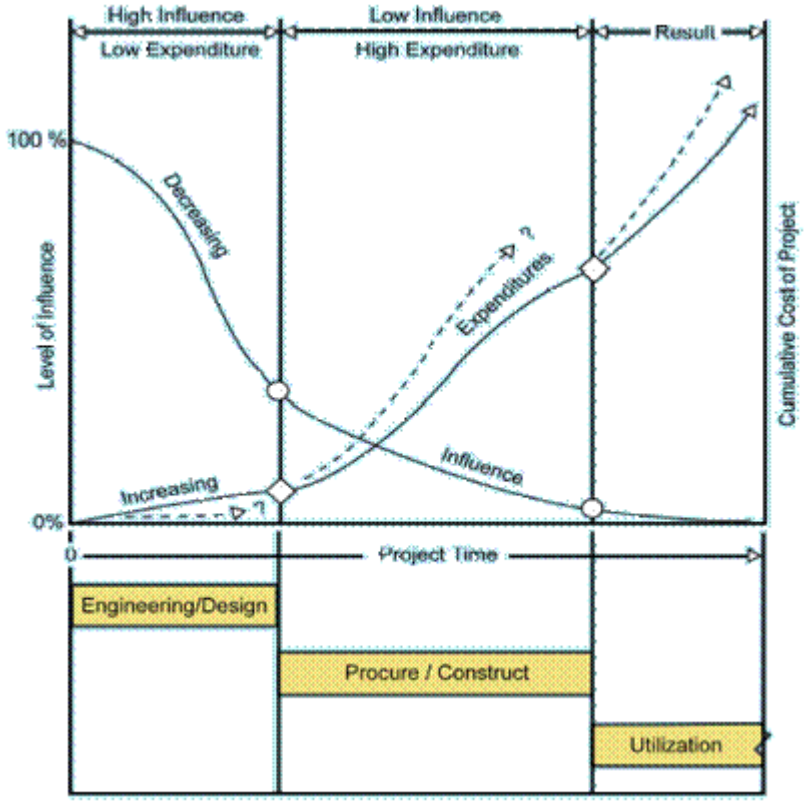

Figure 1.3: Level of influence vs. project duration

1.4 Major Types of Construction Projects

In planning for various types of construction, the methods of procuring professional services, awarding construction contracts, and financing the constructed facility can be quite different. The broad spectrum of constructed facilities may be classified into four major categories, each with its own characteristics.

1.4.1 Residential Housing Construction

Residential housing construction includes houses and high-rise apartments. During the development and construction of such projects, the developers usually serve as surrogate owners and take charge, making necessary contractual agreements for design and construction, and arranging the financing and sale of the completed structures. Residential housing designs are usually performed by architects and engineers, and the construction executed by builders who hire subcontractors for the structural, mechanical, electrical and other specialty work.

The residential housing market is heavily affected by general economic conditions. Often, a slight increase in total demand will cause a substantial investment in construction, since many housing projects can be started at different locations by different individuals and developers at the same time. Because of the relative ease of entry, many new builders are attracted to the residential housing construction. Hence, this market is highly competitive, with potentially high risks as well as high rewards.

1.4.2 Institutional and Commercial Building Construction

Institutional and commercial building encompasses a great variety of project types and sizes, such as schools and universities, medical centers and hospitals, sports facilities, shopping centers, warehouses and light manufacturing plants, and skyscrapers for offices and hotels. The owners of such buildings may or may not be familiar with construction industry practices, but they usually are able to select competent professional consultants and arrange the financing of the constructed facilities themselves. Specialty architects and engineers are often engaged for designing a specific type of building, while the builders or general contractors undertaking such projects may also be specialized in only that type of building.

Because of the higher costs and greater sophistication of institutional and commercial buildings in comparison with residential housing, this market segment is shared by fewer competitors. Since the construction of some of these buildings is a long process which once started will take some time to proceed until completion, the demand is less sensitive to general economic conditions than that for housing construction.

1.4.3 Specialized Industrial Construction

Specialized industrial construction usually involves very large scale projects with a high degree of technological complexity, such as oil refineries, steel mills, chemical processing plants and coal-fired or nuclear power plants. The owners usually are deeply involved in the development of a project, and prefer to work with designers-builders such that the total time for the completion of the project can be shortened. They also want to pick a team of designers and builders with whom the owner has developed good working relations over the years.

Although the initiation of such projects is also affected by the state of the economy, long range demand forecasting is the most important factor since such projects are capital intensive and require considerable amount of planning and construction time. Governmental regulation such as environmental protection can also influence decisions on these projects.

1.4.4 Infrastructure and Heavy Construction

Infrastructure and heavy construction includes projects such as highways, tunnels, bridges, pipelines, drainage systems and sewage treatment plants. Most of these projects are publicly owned and therefore financed either through bonds or taxes. This category of construction is characterized by a high degree of mechanization, which has gradually replaced some labor intensive operations.

The engineers and builders engaged in infrastructure construction are usually highly specialized since each segment of the market requires different types of skills. However, demands for different segments of infrastructure and heavy construction may shift with saturation in some segments. For example, as the available highway construction projects are declining, some heavy construction contractors quickly move their work force and equipment into the field of mining where jobs are available.

1.5 Construction Project Participants

1.5.1 The Owner (The Client)

The owner is the individual or organization for whom a project is to be built under a contract. The owner owns and finances the project. Depending on the owners' capabilities, they may handle all or portions of planning, project management, design, engineering, procurement, and construction. The owner engages architects, engineering firms, and contractors as necessary to accomplish the desired work.

Public owners are public bodies of some kind ranging from agencies from the country level to the municipal level. Most public projects or facilities are built for public use and not sold to others. Private owners may be individuals, partnerships, corporations. Most private owners have facilities or projects built for their own use or to be sold, operated, leased, or rented to others.

In order to achieve success on a project, owners need to define accurately the projects objectives. They need to establish a reasonable and balanced scope, budget, and schedule. They need to select qualified designers, consultants, and contractors.

1.5.2 The Design Professionals

Examples of design professionals are architects, engineers, and design consultants. The major role of the design professional is to interpret or assist the owner in developing the project's scope, budget, and schedule and to prepare construction documents. Depending on the size and sophistication of the owner, the design professional can be part of the owner's group or an independent, hired for the project. In some cases design professional and construction contractor together form a design-build company.

> **Architect**: An architect is an individual who plans and design buildings and their associated landscaping. Architects mostly rely on consulting engineers for structural, electrical, and mechanical work.

Engineer: The term engineer usually refers to an individual or a firm engaged in the design or other work associated with the design or construction. Design engineers are usually classified as civil, electrical, mechanical depending upon their specialty. There are also scheduling, estimating, cost, and construction engineers.

Engineering-Construction Firm: An engineering-construction firm is a type of organization the combines both architect/engineering and construction contracting. This type of company has the ability of executing a complete design-build sequence.

1.5.3 The Construction Professionals

The constructions Professional are the parties that responsible for constructing the project. In traditional management where the owner, design professional, and contractors are separate companies, the contractor would be termed a prime contractor. The prime contractor is responsible for delivering a complete project in accordance with the contract documents. In most cases, the prime contractor divides the work among many specialty contractors called subcontractors as shown in Figure 1.4.

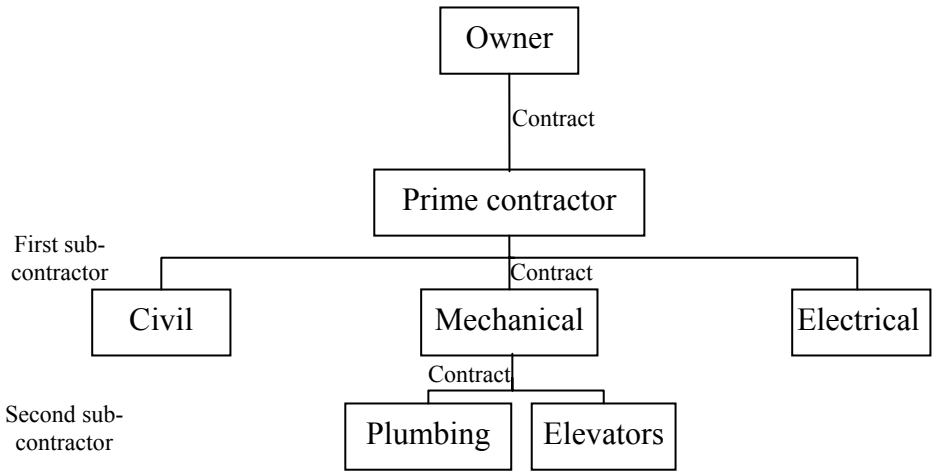

Figure 1.4: Contractor hierarchy

1.5.4 The Project Manager

The project manager is the individual charged with the overall coordination of the entire construction program for the owner. These include planning, design, procurement, and construction. Among his/her duties:

- Clear definitions of the goals of the project.
- Investigate alternative solutions for the problems.
- Develop a detailed plan to make the selected program reality.
- Implement the plan and control the project.

Construction Manager: The construction manager is a specialized firm or organization which administrates the on-site erection activities and the consulting services required by the owner from planning through design and construction to commissioning. The construction manager is responsible for design coordination, proper selection of materials and methods of construction, contracts preparation for award, cost and scheduling information and control.