

The Construction Industry (الصناعة الإنشائية):

The construction industry is vast and varied. Just take a look around—from homes to highways to hospitals—and you see the results of this industry.

As our needs expanded, so did our building capabilities. We eventually built political capitals, great cities bustling with business and commerce. Though the means and the methods have changed over the centuries, the construction industry is still about building communities that serve people. Construction is big business, totaling more than \$3.9 trillion annually Worldwide, and there is no slowdown in sight. The industry employs about 7 million people directly (plumbers, carpenters, welders, and so on) and hundreds of thousands more indirectly. It gives rise to the steel industry, the lumber industry, the carpet industry, the furniture industry, the paint industry, the concrete industry, the paving industry, and so on. It goes even further than that if you consider the trucking, shipping, manufacturing, and mining industries.

There are three principal players in any construction project are the owner, the designers (architects and engineers), and the contractor

Owners (اصحاب العمل)

No construction would ever be accomplished without owners. They are the driving force behind the construction industry. Their demands for housing, commercial facilities, industrial products, and infrastructure are the chief motivation to build.

Architects (المعماريون)

Architects design the overall aesthetic and functional look of buildings and other structures. Architectural technicians are typically the drafters of the building plans. They are the ones who actually produce the drawings that are used for construction. Today drafters have become computer operators and produce their drawings electronically using computer-aided design (CAD) software. Some CAD operators have expanded their skills to include 3D building information modeling (BIM) as well. As the trend toward information modeling continues, these technicians will become more and more valuable in the marketplace.

Specification writers accompanying (ارفاق) the plans for a new building is a written project manual that contains the specifications for the project. The

plans and specifications compose two parts of the legal contract for construction.

There are many different engineering specialties; the most common ones associated with construction activities are described next:

Structural engineers Structural engineers design the timber, concrete, or steel structural systems that support a building and basically hold it up to withstand the forces of wind, gravity, and seismic activity. They design the foundations, beams, girders, and columns that make up the skeleton of the structure.

Mechanical engineers Mechanical engineers design the heating, cooling, ventilating, plumbing, and fire suppression systems within a building. They coordinate their efforts with the architectural design, the structural design, and the electrical design.

Electrical engineers Electrical engineers design and calculate electrical loads and determine the circuitry, lighting, motors, transformers, and telecommunications needed for a building. They typically work closely with the architect to ensure that the owner's expectations are met and often coordinate their efforts with the mechanical engineer.

Civil engineers Civil engineers design roads, bridges, tunnels, dams, site drainage, parking lots, runways, and water supply and sewage systems.

General Contractor (المقاول العام)

The general contractor, also known as the *prime contractor*, enters into a contract with the owner to deliver the construction project in accordance with the plans and specifications that have been prepared by the architects and engineers.

Construction Managers

Construction managers may be employed by construction management firms, general contractors, architects, engineers, owners, or specialty contractors. The primary responsibility of the construction manager is to organize the project team to perform the construction management function that is the topic of this entire book.

Subcontractors (المقاول الثانوي)

They perform their work under a contract with another contractor (typically the general contractor) to do a portion of the contractor's work, as opposed to contracting directly with an owner. These subcontractors, in turn, may

engage other subcontractors. Thus, there can be several levels of subcontracting to a general contractor.

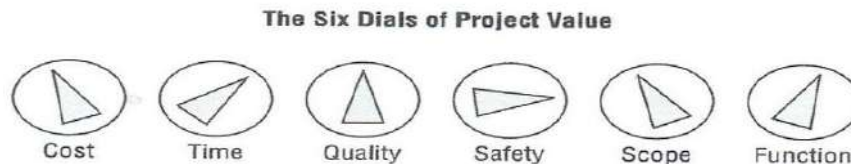
Construction Management Defined

One of the best definitions that I have come across over the years is from Charles Patrick's *Construction Project Planning and Scheduling*. According to Patrick, "Construction management (CM) entails the planning, scheduling, evaluation, and controlling of construction tasks or activities to accomplish specific objectives by effectively allocating and utilizing appropriate labor, material, and time resources in a manner that minimizes costs and maximizes customer/owner satisfaction."

Project Values

In 1996, a group of owners, architects, contractors, and engineers gathered in San Francisco to discuss common goals and opportunities for collaboration in the building industry. They referred to these factors as the *six dials of project value*: cost, time, quality, safety, scope, and function.

The Six Dials of Project Value



Cost It is essential to predict and control what the construction project will cost. Costs are established, targeted, and controlled by means of an estimate or budget. As the work progresses, expenditures for materials, labor, equipment, and subcontracts are tracked and measured against the estimates.

Time :Time is monitored and controlled by a detailed schedule, breaking each item of work down into its component parts.

Quality is the grab bag that covers all the aspects of the building not addressed by the other five values, such as aesthetic impact, user perceptions, and appropriateness of building materials, and so on. Quality is monitored and controlled by a variety of means, including specifications, punch lists, inspections, tests, and user surveys.

Safety No matter how valuable a facility or structure may be, it is never more valuable than the health and welfare of the people who build and use the building. Care must always be taken to ensure that the building process and the building itself do not create unacceptable hazards to workers or users. These hazards range from risks during the building process (for example, falls, accidents, injury, and death) to risks from the completed buildings (for example, toxic gases, biohazards, and structural failure).

Scope is monitored and controlled by means of an architectural program, which identifies the space needs and tracks compliance of the building design with those needs.

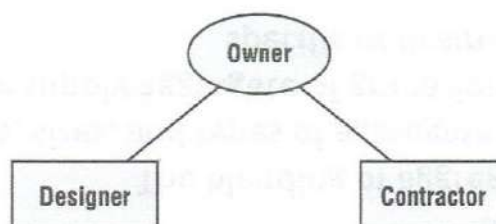
Function Function is monitored and controlled by means of process flow diagrams and utilization analyses, which document the efficiency of the processes that will be performed in the completed facility.

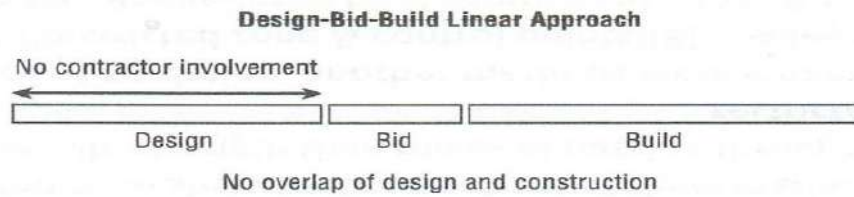
Types of Project Delivery (انواع احالة المشروع)

There are basically three project delivery methods: design-bid-build, construction management, and design-build. Keep in mind that the functions associated with construction management are required in all three methods even though only one of them is actually named *construction management*.

1- Design-Bid-Build

Design-bid-build is commonly referred to as the traditional method of project delivery, and the traditional accountabilities apply. In this scenario, the owner first hires the architect or engineer to design the building or structure. The design professional prepares a design, moving through the three standard design phases: schematic design, design development (the design development drawings are often referred to in the industry as DDs), and finally contract documents (referred to as CDs). Under this arrangement, the design professional is usually selected on a qualifications basis and then is typically paid a fee or a percentage of the building cost for their services.

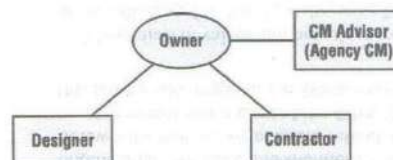




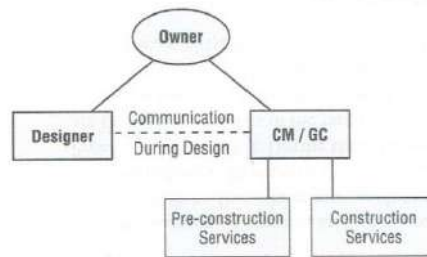
2- Construction Management (الادارة الانشائية)

As you now know, *construction management* may be viewed from several different perspectives, and one of them is as a specific project delivery method. Under this method, construction management services are provided to the owner independent of the construction work itself. There are two options for the owner to consider under this method.

Option 1: agency CM The Construction Management Association of America (CMAA) defines *agency CM* as a fee-based service in which the construction manager is responsible exclusively to the owner and acts in the owner's best interests at every stage of the project. In this case, the construction manager offers advice uncolored by any conflicting interest because the construction manager does not perform any of the actual construction work and is not financially at risk for it.

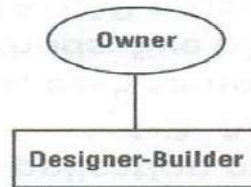


Option 2: at-risk CM (also called CM/GC) The CMAA defines the *at-risk CM* project delivery method as an option that entails a commitment by the construction manager to deliver the project within a guaranteed maximum price (GMP). The construction manager acts as consultant to the owner in the development and design phases but does the work of a general contractor during the construction phase. In this scenario, there are only two contracts, one between the owner and designer and one between the owner and the at-risk CM.



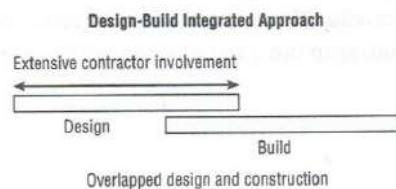
3- design-build

A project delivery method in which there is only one contract between the owner and a design-build entity. The design-builder is responsible for both the design and the construction of the project. This method is often referred to as *single-source project delivery*.

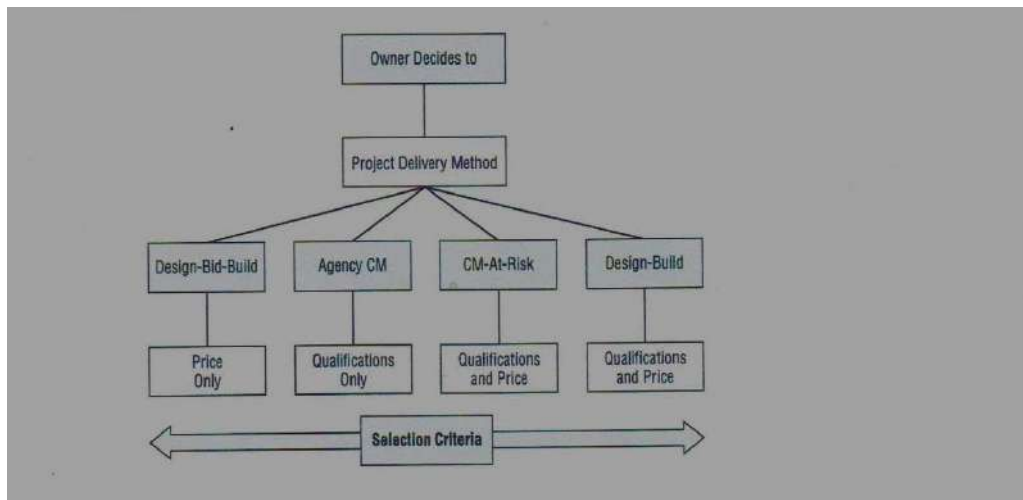


--fast tracking

A practice utilized to speed up a job by overlapping the design phase and the construction phase of a project. It 'soften applied in design-build or construction management project delivery



method and selection criteria. Although there are exceptions to these standard practices, for the purposes of this book, I will stick with the more common situations.



What Does a Construction Manager Do?

- Estimating the project
- Administering the contract
- Managing job site and construction operations
- Planning and scheduling the project
- Monitoring project performance
- Managing project quality
- Managing project safety
- Assessing project risks

Construction Management Functions (وظائف ادارة الانشاء)

The construction management functions are typically performed by a team of construction professionals trained in various aspects of the job. The experienced construction professional will be competent in all of the following management functions.

Estimating the Project (تخمين المشروع)

Estimating entails the calculation and pricing of all materials, equipment, and man-hours needed to complete the work. We use estimating to get the work and also to help us keep score. In other words, we constantly compare the actual cost of the project with the estimated cost of the project and monitor any discrepancies.

Administering the Contract (ادارة العقود)

Contract administration (or project administration) is all about the “red tape” and paperwork associated with a construction project. As you might imagine, there are tons of reports, submittals, shop drawings, time cards, payroll records, change orders, inspection records, and numerous other documents that must be processed in order to manage a project as complex and expensive as a building, bridge, or highway.

Managing Job Site and Construction Operations (ادارة موقع العمل والعمليات الانشائية)

This is where all the action happens and we get to build something! This function considers every detail associated with the logistics of actually doing the work and getting it done. Think about all the activities and needs linked with workers doing their jobs: tools, equipment, traffic, parking, deliveries, storage, security, communications, signage, safety, trash, drinking water, lunch breaks, and so on.

Planning and Scheduling the Project (تخطيط وجدولة المشروع)

Project planning is a critical component for the successful completion of any type of building or structure. Scheduling introduces real time into the plan and is the tool used to communicate the scheme to all parties associated with the project.

Monitoring Project Performance (مراقبة اداء المشروع)

Controlling is the process of measuring, monitoring, and comparing actual efforts with estimated inputs and adjusting the plan accordingly to get the project back on track for completion as intended. Estimates and schedules are the tools used to examine this progress.

Managing Project Quality (ادارة جودة المشروع)

The quality standards on any project are established in the plans and specs prepared by the designer. Within these documents, specific measurable conditions are given. These include dimensions, tolerances, test results, temperatures, and so on. The quality control plan usually very important that the contractor be able to document and report satisfactory compliance because only after the standards (المعايير) have been met will the owner accept the work and release payment.

Managing Project Safety

This function, by necessity, must be a priority on every project regardless of size. The personal and economic costs associated with accidents, injuries, and deaths on the job site are clearly avoidable, and a proactive, rigorous approach to safety planning and management is one of the most important construction management goals.

Assessing Project Risks (تقييم مخاطر المشروع)

Construction is a very risky business, for both the owner and the contractor. Part of the challenge is trying to place the risk in the hands of the party who can best manage that risk (see Table 2.1).

Type of risk	Responsible party		
	Contractor	Owner	Designer
Site conditions		x	
Weather conditions		X	
Project funding		x	
Subcontractor failure	X		
Job site safety	X		
Material deliveries	X		
Quality of the work	X		
Delays in the work	X		x
Defective design			x
Site conditions			x
Defective work	X		
Code compliance	X		x
Estimate errors	X		
Labor strikes	x		

Advertisement for bids (الإعلان عن العطاء)

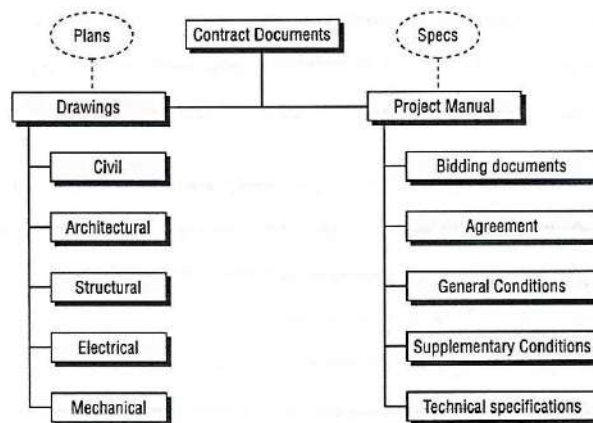
A public notice, usually published in newspapers, trade magazines, and journals, providing information regarding bidding procedures for public projects. The types of information typically included in an advertisement are as follows:

- Project name and description

- Project location
- Owner name and address
- Architect or engineer name, address, and contact information
- Bid due date and time
- Where to access the plans and specs
- Project duration with anticipated start and completion dates
- Bonds required
- Restrictions on bidders
- Project budget or anticipated price range

Contract documents

The drawings, conditions, terms, and specifications setting forth the requirements for constructing the project.



The Project Manual

The project manual Typically has four primary sections:

- Bidding documents (وثائق العطاء)
- General conditions (الشروط العامة)
- Supplemental conditions (شروط اضافية)
- Technical specifications (المواصفات الفنية)

Bidding Documents

the instructions to bidders also include the following:

- Procedures for submitting questions and obtaining clarifications regarding the contract documents.

- Information regarding *addendum* receipt and inclusion as part of the contract documents.
- Rules concerning bid submission including bond requirements, bid opening, rejection of bids, and notification of successful bidder.
- The expectations for post-bid deliverables including such items as the schedule of values, cash flow projections, the construction schedule, payment and performance bonds, or any other documentation requested by the owner prior to the signing of the contract.

General Conditions

The general conditions document is one of the most important documents associated with the contract for construction. the general conditions and give a brief description of each:

General Provisions (احكام عامة) This section provides fundamental definitions for the contract, the work, and the drawings and specifications. It also clarifies the ownership, use, and overall intent of the contract documents.

Supplemental Conditions

The information that may appear in these conditions are listed here: . Soils and soil-testing information provided by the owner

- Survey information provided by the owner
- Materials or other services provided by the owner
- Job signage requirements
- Traffic control and pedestrian safety requirements
- Phasing or special schedule requirements
- Requirements for security
- Temporary facilities and sanitation requirements

Technical Specifications المواصفات الفنية

The primary purpose of the specifications is to clarify and describe the following aspects of the job:

- Quality of materials
- Standard of workmanship
- Methods of installation and erection
- Quality control and quality assurance procedures

The Construction Specification

1. General Requirements
2. Site Construction

3. Concrete
4. Masonry
5. Metals
6. Wood and Plastics
7. Thermal and Moisture Protection
8. Doors and Windows
9. Finishes
10. Specialties
11. Equipment
12. Furnishings
13. Special Construction
14. Conveying Systems

15. Mechanical

16. Electrical

Contract Types (انواع العقود)

1- Lump-Sum Contracts (مقاوله المبلغ المقطوع)

Lump-sum contracts are the most common type of contract, especially for building construction. Under this arrangement, the contractor agrees to complete the work specified in the plans and specs for a single fixed amount of money. Once the contract is signed, both parties must live with the terms of the contract, and any flaws, errors, or omissions in the plans and specs will result in a *change order*. Change orders result in extra work and/or extra time, both of which result in extra cost to the owner.

Contract Amount	Actual Cost	Contractor Impact	Owner Impact
\$2,000,000	\$2,029,000	Contractor suffers a \$29,000 loss.	No impact, because the contract amount Remains the same.
\$2,000,000	\$1,990,000	Contractor earns an additional \$10,000.	No impact, because the contract amount remains the same.

2- Cost-Plus-Fee Contracts (عقود + اجرة ثابتة او نسبة من الكلفة)

Under a cost-plus-fee contract (also referred to as *time and materials*), the owner reimburses the contractor for all actual costs associated with the work plus a fixed fee or percentage of the cost.

Contract Amount	Fee as % cost	Actual Cost	Contractor Impact	Owner Impact
\$1,994,500	\$99,725	\$2,094,225	None. The contractor still Earns a 5% fee.	\$94,225 over budget amount of \$2,000,000

3- Guaranteed Maximum Price Contracts (عقد وحدة السعر مع ضمان الحد الاعلى للكلفة)

The *guaranteed maximum price (GMP)* contract is a variation of the cost-plus-fee contract and has become very popular, particularly with owners using design-build project delivery

Table 4.3 GMP Contract

GMP Contract Amount	Actual Cost Plus Fee	Contractor Impact	Owner Impact
\$2,000,000	\$2,029,000	Contractor suffers \$29,000 loss.	No impact. The contract amount remains the same.
\$2,000,000	\$1,990,000	No impact.	Owner receives benefit of \$10,000 savings.

4- Unit-Price Contracts (عقود وحدة السعر)

Unit-price contracts are used when the work to be performed cannot accurately be measured ahead of time. Unit pricing is common for heavy civil and highway type projects.

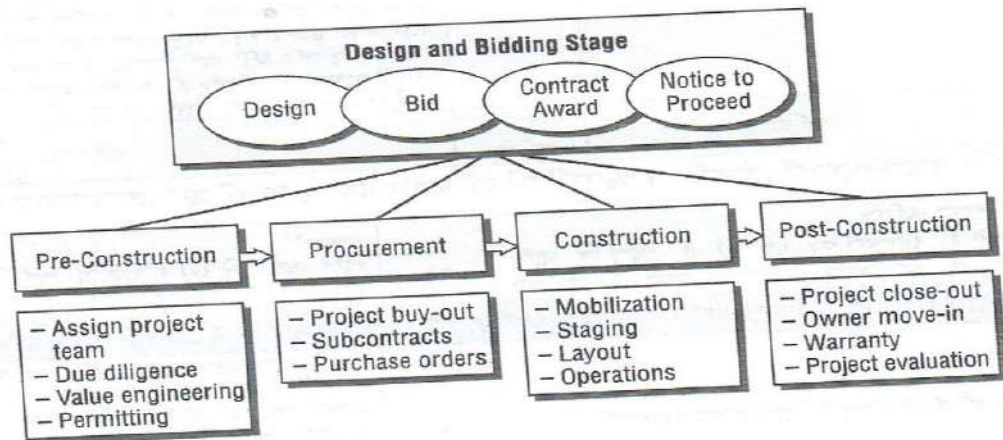
Work item	Estimated quantities	Unit price	Bid amount	Actual quantities	Final cost
Trench excavation	14000 m ³	5.25 \$	73500 \$	13500 m ³	70875 \$
8" pipe	1750 m.L	18.24 \$	31920 \$	1750 m.L	31920 \$
Back fill	9500 m ³	4.00 \$	38000 \$	9800 m ³	39200 \$
			143420 \$		141995 \$

- 5- Turn –key contract (عقد تسليم المفتاح)
 - 6- BOT (Build operate transfer) عقد البناء والتشغيل ونقل الملكية
 - 7- Joint-Venture contract عقد الاتحاد بين شركتين
- ملاحظة العقود من (٥-٦-٧) يقدم به تقرير جميع الطلبة

Project stages (مراحل المشروع)

These stages are as follows:

- Design
- Pre-construction
- Procurement
- Construction
- Post-construction
- Owner occupancy



The Design Stage

Every project starts with a design, and the design process involves an intensive study and a lot of considerations. Architects and engineers basically take ideas combined with certain requirements and develop the two into comprehensible plans and specifications that are used to construct the new building or facility. There are four steps to the design process:

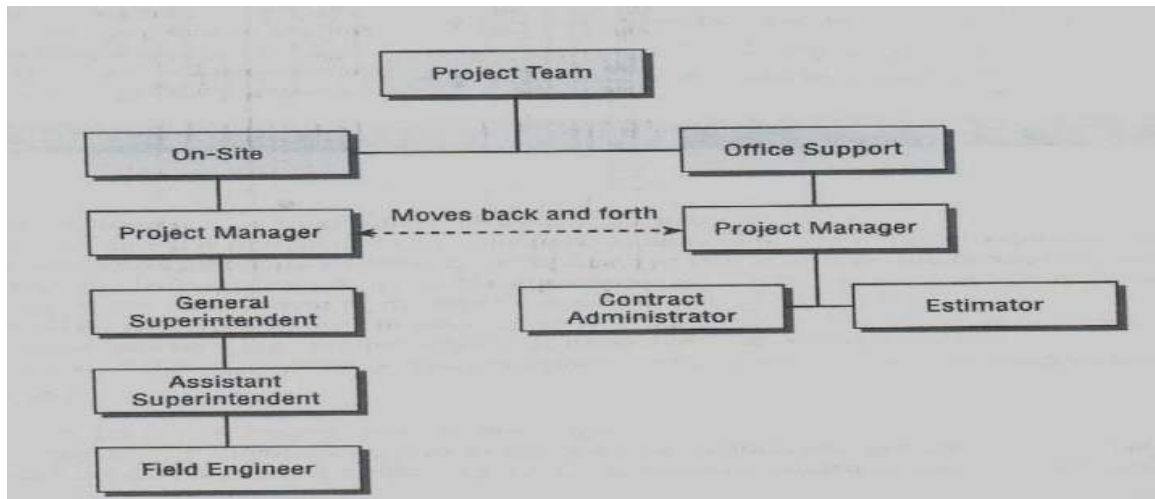
- Programming and feasibility
- Schematic design
- Design development

- drawing documents

The Bidding Stage

The design phase culminates with the competitive bidding stage. The drawings and specifications are complete, and now it's time to select the contract and award the contract.

Assigning the Project Team



Value Engineering (هندسة القيمة)

Value engineering is a process that may or may not be conducted during the preconstruction phase, In this process, a thorough analysis is conducted of the design, products, and materials and their application, installation, and execution to determine whether the proposed design solutions are really the best solutions relative to their cost. The purpose of value engineering is to optimize resources to achieve the greatest value for the money being spent

The Procurement Stage

To procure means to buy or obtain. The procurement stage of construction management is often referred to as “buying out” the job or purchasing the labor, materials, and equipment needed to complete the project. A great deal of the construction management function has to do with managing contracts—contracts to secure the labor and trades needed to perform the work and contracts to secure the materials and equipment that will be placed on the project.

The Construction Stage

Once the work is ready to start, the superintendent will call for a pre-construction meeting with all the subcontractors and major material vendors. This meeting essentially establishes the ground rules for working together

Mobilization الإعدادات

Mobilization is all about setting up and getting ready to start construction. Construction cannot begin until all of the proper personnel, materials, and Equipment are in place.

The following are some of the activities that should be done during the mobilization process:

- Set up field office.
- Set up temporary storage facilities.
- Secure the site.
- Organize adequate parking and site access.
- Develop a materials and handling plan.
- Secure temporary electric, water, and telephone service.
- Arrange for trash and debris removal.
- Provide and place portable toilets.
- Install job signage and barricades.
- Assemble survey and layout personnel.
- Confirm testing agencies and personnel.
- Establish job site management systems.
- Establish safety programs and protocol.

The Project Closeout

The final step in the construction process is the project closeout .The construction management team must complete the following list of final standard procedures before they can celebrate the completion of a job well done:

- Substantial completion
- Final inspection
- Certificate of occupancy
- Commissioning
- Final documentation
- Final completion

some of the typical work items associated with various building elements.

Table 5.1 Building Elements and Work Items

Building Element	Work Included
Site work	Clearing, grading, utilities, layout, landscaping, irrigation, paving, exterior concrete
Foundations	Excavation, standard foundations, special foundations, slabs on grade
Basement construction	Basement excavation, basement walls, basement floors, waterproofing, perimeter drains, backfill
Superstructure	Floor construction, roof construction
Exterior closure	Exterior walls, exterior windows, exterior doors
Roofing	Roof coverings, flashings, roof openings
Interior construction	Partitions, interior doors, specialties
Staircases	Stair construction, stair finishes
Interior finishes	Wall finishes, floor finishes, ceiling finishes
Conveying systems	Elevators, escalators, moving walkers, material-handling systems
Plumbing	Plumbing fixtures, domestic water distribution, sanitary waste, rainwater drainage, special plumbing systems
HVAC	Energy supply, heat-generating systems, cooling generating systems, control and instrumentation
Fire protection	Fire protection and sprinkler systems, standpipe and hose systems, fire protection specialties
Electrical	Electrical services and distribution, lighting and branch wiring, communication and security systems
Equipment	Commercial equipment, institutional equipment, vehicular equipment, other equipment
Furnishings	Fixed furnishings, movable furnishings
Special construction	Special structures, integrated construction, special construction systems, special facilities
Selective building demolition	Building elements demolition, hazardous compounds abatement

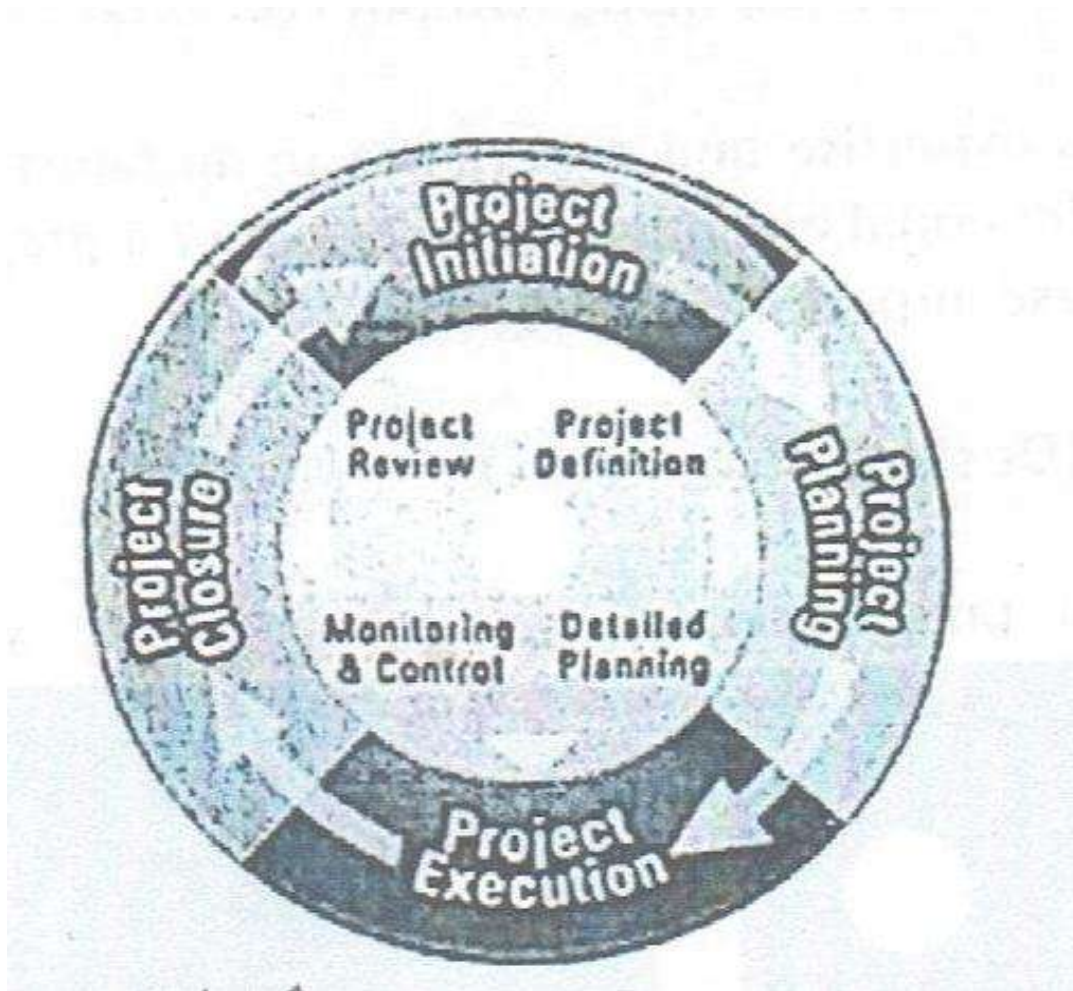


Fig life cycle cost of project