CONSTRUCTION PROJECT MANAGEMENT

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Contents

Summary

Construction industry is an important industry globally. Effective management of construction projects leading them to their execution is a critical expertise area to ensure the success of the construction industry. This chapter provides a comprehensive understanding of the construction project management from a construction company's perspective. It starts with an overview of the construction industry including an introduction to various types of construction projects. It, then, provides an overview of construction project management and defines various supporting aspects such as, project, project management, attributes of a successful construction project, project life cycle, project participants, construction project organizations, pre-job planning, project

start up and mobilization, pre-construction meeting, project documentation, and project closeout.

The main body of the chapter is devoted to four key functions of construction project management. These are: cost estimating, project scheduling, project controls and construction contracts and delivery systems. Each function is explained in detail including the description of the process, definitions of various aspects, and illustration of the techniques used to carry out the functions. Some of the techniques are demonstrated with the help of examples. This section should give readers a clear understanding of how these functions are applied to manage a construction project. The last section provides discussion of the applicability of construction project management for the emerging field of green buildings. It introduces green building rating systems and analyzes the role of construction project management techniques and practices in relation to green building requirements.

1. Overview of the Global Construction Industry

The construction industry is an important industry for almost every country in the world irrespective of their economic development status. It serves as a key indicator of economic growth as evident by the focus on this industry in rapidly developing economies of China, India, Brazil, etc. The construction industry contributes around 10% of the global gross domestic product (GDP). The construction industry is also a major employment generator and provides employment to almost seven percent of the working population worldwide (Economy Watch 2010a).

In most countries, the construction industry's emphasis is on projects in the urban areas which generally include construction of real estate properties and associated infrastructure. The repairing and alterations to existing buildings and infrastructure is another aspect of the construction industry. The overall construction industry can be broadly divided into three major segments (**Economy Watch 2010b,** Bureau of Labor Statistics 2012):

- Building Construction: It includes residential (single-family or multi-family), commercial, institutional, industrial and other buildings.
- Heavy, Highway, Infrastructure and Civil Engineering Construction: It includes sewers, roads, highways, bridges, tunnels, and other projects related to infrastructure.
- Specialty Trade Construction: It includes activities carried out by specialty trade contractors such as foundation work, structure, exterior work, equipment, finishing, painting, plumbing, electrical work, etc.

Typically, three major parties are involved in a construction project. These parties are: owners or clients, including home owners, private property developers, and public/governmental agencies; designers who transform the vision of the owner from concept to design and construction documents; and builders or contractors who either construct or manage the construction of the facility.

2. Overview of Construction Project Management

This section provides an overview of various concepts related to construction project management. Since the field of construction project management is a relatively new field, many of its concepts have been adopted from engineering, design and business management. The following sub-sections define and discuss characteristics of construction projects that impact their management from a contractor's point of view. These characteristics include project stages, organizations, participants, responsibilities and documentation required from start-up to closeout (Syal 2011).

2.1. Project, Project Management, and Construction Project Management

A project can be defined as a series of activities and tasks that consume resources and have a specific objective to be completed with certain specifications, defined start and finish dates, and financial limitations. Construction project management has evolved from business project management which is defined as the planning, organizing, staffing, coordinating, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. Construction project management is defined as the process of applying project management principles in managing construction projects leading to their successful execution.

In the United States, the tremendous growth in construction projects during the 1940's and 1950's led to the development of construction project management as an independent and well-defined field. The field of business project management was well-established at that time due to its focus on the manufacturing industry. The main reason for the evolution of construction project management was due to the unique nature of every construction project as compared to the repetitive nature of manufactured products. In addition, construction project management was needed to forecast performance under unfamiliar conditions due to planning for a work force of unknown skill, using a management team brought together for only one project, depending upon material suppliers and subcontractors of uncertain reliability, working for owner's representatives of unknown rigidity, and the lack of a single source of authority and control (Syal 2011).

2.2. Attributes of a Successful Construction Project

As stated in the last section, the concept of construction project management is based on delivering successfully constructed projects. There are certain attributes which make a construction project successful. As shown in Figure 1, success of a construction project is mainly determined by its completion within cost and time. Other attributes that influence the success of a construction project include: high quality, few contractual disputes, safety during construction, and satisfaction or pride among all participants. Participants include all parties connected with the project such as, owners, users, contractors, subcontractors, designers, etc. In recent years, sustainability has also emerged as an attribute of successful construction project. This aspect is discussed in section 4.

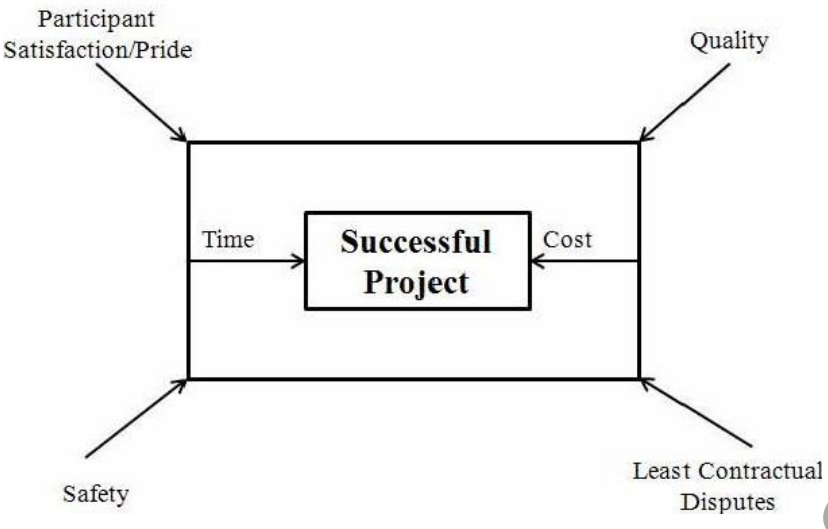

Figure 1. Attributes of Successful Construction Projects

2.3. Project Life Cycle

It is important to understand the entire life-cycle of a construction project in order to manage the successful completion of a construction project. As shown in Figure 2, the entire life cycle of a typical construction project can be broken down into four broad phases: feasibility, design, construction and post construction. Each phase can be further subdivided into several sub-phases as shown in Figure 2. Construction management professionals generally play a major role in the construction phase but may get involved in other stages of the life-cycle of a construction project.

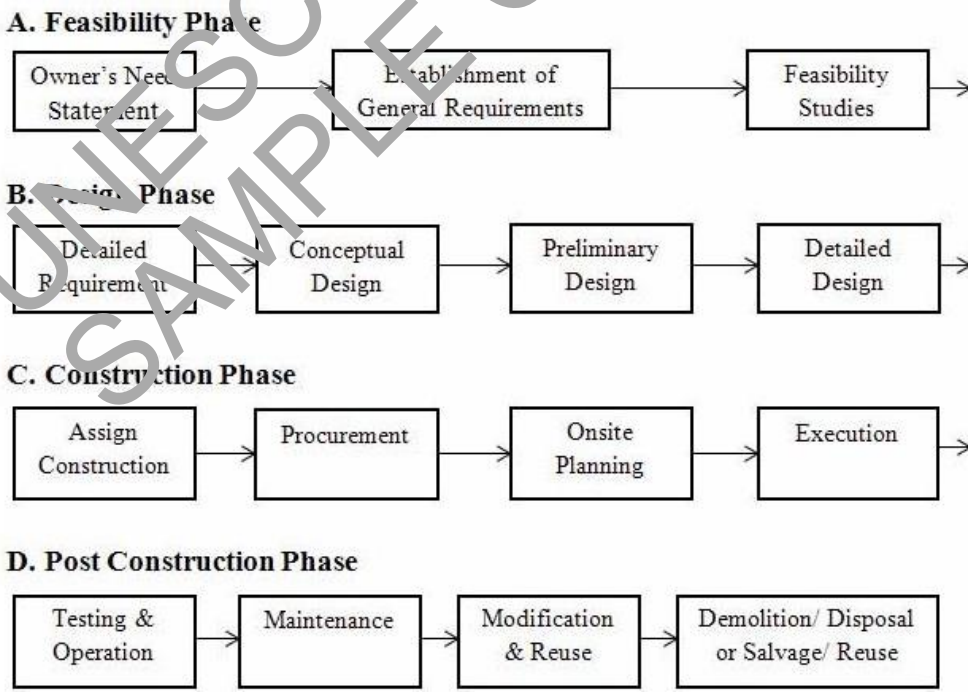

Figure 2. Project Life Cycle

2.4. Assigning / Procuring Construction Contractors' Services

This assignment or procurement of construction contractors' services can be broadly divided into two categories (further details are provided in section 3.4 Construction Contracts and Delivery Systems):

- *Competitive Bid*: generally used for public/government projects where the lowest bidder is selected, in most cases. These contracts are either fixed lump sum price or fixed unit price.
- *Negotiated*: generally used by private owners where they are free to negotiate with selected contractor(s). These contracts can be either fixed price or cost plus fee types.

2.5. Project Participants

There are several project participants involved during the life-cycle of a construction project and all of them have influence on the success of the project. The contractor has to interact with all the participants at one time or another within the above-noted stages of a project. On a typical office building project, the number of participants can well exceed one hundred. The main categories of participants are:

- Owners / Users
- Designers/Consultants including sub-consultants
- Constructors (General Contractors or Construction Managers)
- Subcontractors including sub-subcontractors
- Material and product suppliers
- Governmental/Regulatory/Inspection agencies
- Others: Financial, Insurance, Bonding, Historical Society, Neighborhood Groups, Special Interest Groups, etc.

2.6. Construction Project Organization

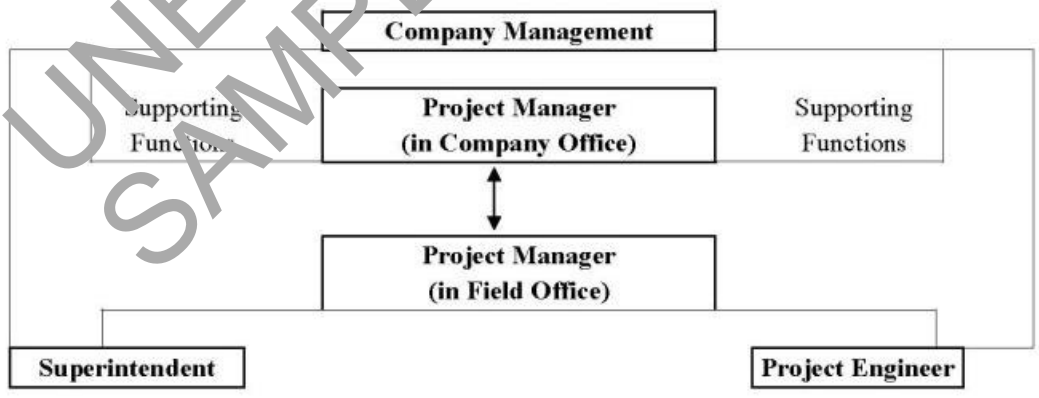

Figure 3. Typical Construction Project organization

The organization of a construction project varies greatly based on both the size of the project and the setup of the construction company responsible for its execution. Generally, a construction project's organization is comprised of separate company office and field management components that complement each other (Figure 3). The

company office component is responsible for pre-construction functions including planning, estimating, bidding, scheduling, contract negotiations, etc., as well as overall project management functions during the project execution including project controls, payment requisitions, material procurement, etc. The field component is mainly responsible for managing on-site construction activities and interacting with subcontractors, suppliers, owner's and designer's representatives.

There are generally the following four broad types of project organizations based on the project size and complexity (Halpin 2006, Syal 2011).

- Dual partner-run projects: These projects are generally very small and the construction company is run by two partners where one partner runs all the company office functions and the other partner runs all field management functions.
- Superintendent/Foreman-run projects: These projects are small projects and each project requires someone on the project to manage the on-site functions. The company partner responsible for field management functions performs overall project management for all projects.
- Traveling project manager-run projects: These projects are typically medium size projects and each project has a project manager in addition to one or more superintendents or foremen. In case of small-medium projects, one project manager might be responsible for multiple projects but in the case of medium-large projects, one project manager is generally responsible for one project. The traveling project manager frequently travels between the company office and the project site.
- On-site project organization: These projects are generally very large projects where almost all the project management functions, including the supporting functions, which are generally performed in the company office for smaller projects, are performed in the field offices.

The key construction company personnel on a typical medium size construction project, as mentioned in the above-noted discussion, are:

- Project Manager: overall in-charge of all aspects of the project for the contractor.
- Project Superintendent: responsible for managing all field construction activities for the contractor.
- Project Engineer (field): generally, an entry-level position for supporting a project's field management activities of contractor's project manager and project superintendent.
- Project Engineer (office): generally, an entry-level position for supporting main office management activities of contractor's project manager, estimator and scheduler.
- Resident Project Representative / Clerk of the Works / Owner's site inspector: This person is the owner's or designer's representative on the project site and is responsible for seeing that the work being inspected is constructed in accordance with the plans and specifications.

2.7. Pre-Job Planning: Project Start-up and Mobilization

After a project is awarded to the contractor and the notice to proceed is received, the initial measures and procedures that are followed have a profound effect on the success of the project. Before work begins on a new project, the first step is to devise a project start-up strategy. The organization and preparation of this project strategy is referred to as "pre-job planning." Depending upon the scope and complexity of the project, pre-job planning will involve a number of factors and variables as well as a number of key people who have been or will be associated with the project. Following are typical actions that help define the overall project start-up strategy.

- Review estimate and schedule prepared during project bid or negotiation
- Administrative requirements of the project
- Project organization setup
- Logistics and special requirements
- Equipment and supportive requirements
- Labor relations and union issues
- Subcontractor negotiation and purchasing (job buyout)
- Procurement of critical materials
- Safety requirements
- Protection against fire, theft and vandalism
- Equal employment opportunity
- Environmental considerations
- Insurance requirement
- Internal progress reporting requirements
- External progress reporting requirements
- Internal cost control reporting requirements
- External cost control reporting requirements
- Subcontractor meetings
- Pre-job meeting with owner

Pre-job planning leads to project mobilization which includes activities that precede the actual start of construction. It involves the organization and mobilization of the contractor's resources, bringing and setting up equipment at the project site, and erecting temporary facilities such as offices, site utilities, storage, etc. Representatives of the project team should make a pre-mobilization visit to the site. However, the owner's permission, in writing, shall be obtained before any company equipment, facilities or personnel occupy the site. The following are the major actions that must be taken to complete the project mobilization:

- All standard project insurances shall be in force before any company equipment, facilities or personnel occupy the site.
- A project site survey, photographic or video, shall be completed prior to setting up any equipment or beginning any work.
- A site utilization plan, including field office location, planned access, material storage, fueling and/or chemical storage areas and subcontractor storage, etc., should be completed.

- Appropriate signage and barricades shall be planned and obtained prior to mobilization.
- The project team shall obtain a job site mailing address and inform the home office of this item mobilization.
- All required permits and/or licenses shall be obtained and verified by the project superintendent prior to starting any work activities.
- All testing requirements should be discussed with the testing laboratory.
- Other areas that may need attention include: security and fencing, traffic, locating and marking underground services, noise and dust prevention requirements, temporary utilities, overhead electrical lines, etc.
- Once the project has been mobilized, access shall be restricted to approved construction traffic vehicles and personnel.

2.8. Pre-Construction Meeting

As part of effective construction project management practices, a pre-construction conference is held after the project is mostly mobilized and before construction operations start. This meeting is generally co-chaired by the owner/designer's representative and contractor's project manager. The purpose of this meeting is to establish project ground rules to make sure that each project team member understands the administrative requirements of the project and agrees to a communication/reporting system. The typical agenda for such meetings includes:

- Identification of key personnel of all parties
- List of subcontractors and sub-subcontractors
- Plans for site meetings
- Correspondence hierarchy and procedure
- Notice to proceed and building permit
- Construction schedule
- Schedule of values
- Application for payment process
- Payroll & pay rates verification procedures
- Shop drawings procedure
- Field decisions and change order procedure
- Progress photographs
- Coordination drawings
- Clerk of the works / resident representative / site inspector
- Maintenance of record documents
- Site and building security
- Safety and first-aid procedures
- Temporary enclosure and heating during construction
- Performance bond and labor and materials payment bond
- Certificates of insurance including liability, property, etc.
- Equal opportunity requirements or other similar requirements

2.9. Project Documentation

A typical construction project has several types of documentation that are required to be maintained. The purpose of project documentation is to record information of the project that can assist with the management of the project. Documents need to be in legal format, factual and consistent so that comparisons can be made to previous reports. Major types of project documents include:

- Daily logs
- Progress reports
- Testing reports
- Photographs
- Accident reporting
- As-built drawings
- Submittals and transmittals
- Requests For Information (RFI)
- Telephone calls and letters
- Construction field office files containing correspondence, job drawings, shop drawings, payment applications, samples, etc.

2.10. Project Closeout

Finishing a project very often proves to be harder than starting it. If a project team does not recognize this problem and develop a realistic completion plan, it can create a very unhappy ending to an otherwise successful project. It is extremely important to a company's reputation to be able to "finish" a project rather than "wear it out." Successful firms have established detailed procedures to manage this process as effectively as they manage the other phases of a project. Following are the key actions to facilitate a successful project close out.

- Prepare a standardized checklist of closeout steps and tasks
- Procedures to closeout subcontracts and purchase agreements by reconciling change orders, back charges, retainages, lien releases and final payments
- Procedures to purge and preserve the project records and files
- Procedures to close project cost accounts when final payment is received and the project is complete
- Establish warranty item accounts for work after "completion."
- Coordinate equipment and facilities training sessions with owner's facilities personnel
- Deliver as-built drawings, operations and maintenance manuals and warranties to owner.
- Systematically demobilize project staff and facilities
- Compile project records for transfer to home office
- Perform pre-punch list, punch list and final inspections with owner's representative
- Prepare keying schedules
- Provide certificates of code compliance
- Lien waivers and consent of surety for final payment
- Submit request for final payment

3. Key Functions of Construction Project Management

This section presents key functions of construction project management. As discussed in Section 2.2 under attributes for successful construction projects, cost and time are the two most critical attributes. Figure 4 presents the construction project management cycle with functions related to time and cost attributes. As shown in the figure, the construction project management cycle includes project planning and project controls as the two main phases. In addition, the development of project control formats and historical records are the two supporting phases of construction project management.

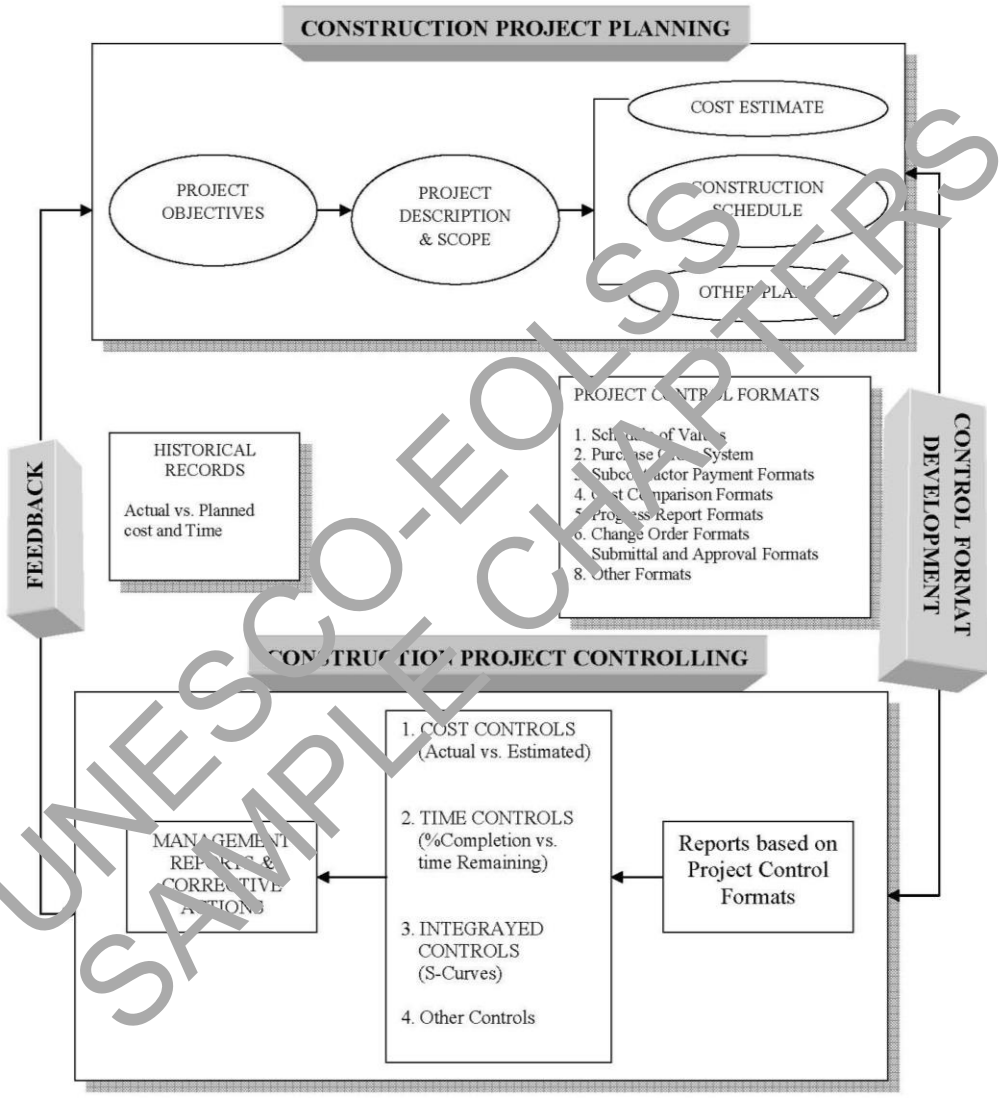

Figure 4. Construction Project Management Cycle with Emphasis on Time and Cost Functions

- Project Planning: This phase involves developing a plan of action for the successful completion of the project. It consists of answering the following questions:
    - What is to be done?

  - Who will do it?
  - How will it be done?
  - When will it be done (scheduling)?
  - How much will it cost (cost estimation)?

- Project Controlling: This phase involves effective implementation of project plans during the execution of the project. It consists of four steps:
  - Continuous monitoring of progress and performance against the plan
  - Reporting of deviations from the plan
  - Enabling management to initiate corrections
  - Updating the project plan

The following section discusses the key functions of the project planning and project controlling phases of the construction project management. These functions include cost estimation, project scheduling, project controls, and construction contracts and delivery systems.

3.1. Cost Estimation

Cost estimation is probably the most important function of construction project management. It establishes the project cost based on the design development. It represents a prediction of the work to be done and the cost of doing the work. The accuracy of the estimated cost depends upon the level of details available about the project.

Types of Estimates:

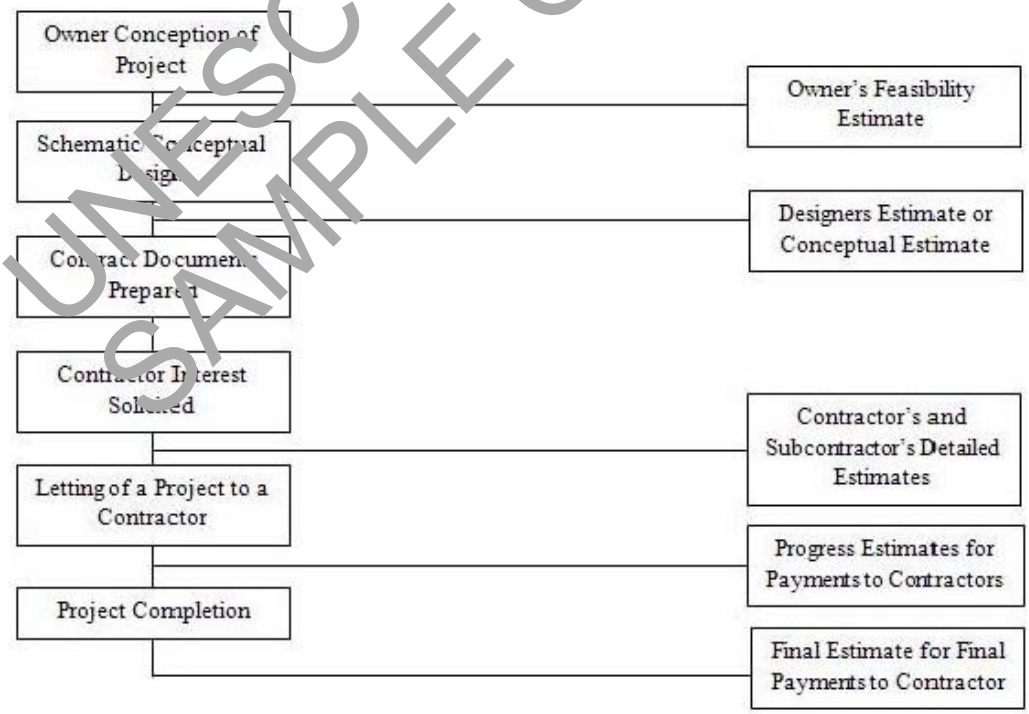

Figure 5. Types of Estimates and Stages of Project Development

The scope and accuracy of an estimate depends upon the stage of the project development. Figure 5 shows the five main types of estimates that can be developed at various stages of project development.

Estimate Development Steps:

The following steps represent typical estimating development steps. Depending on the type and size of the project and the estimate, some of these steps may be consolidated. Among the steps below, four steps that have the potential to be assisted by estimating-related computer software are identified with an *.

- Familiarize with contract documents (drawings & specifications)
- Develop Work Breakdown Structure (WBS) and generate list of work items
- Calculate quantities of work items
- Assign crew (labor and equipment)
- Determine/decide crew productivity
- *Calculate direct cost of work items
- *Add direct costs of all work items
- Determine/decide indirect costs (overhead and profit)
- *Calculate total estimate cost
- *Generate various reports and profiles

The above-noted steps can be divided into two major categories: Quantity surveying or takeoff that involves measuring the quantity of work to be done, and cost estimating that involves calculating the cost required to perform the measured quantity of work.

Quantity Takeoff:

In order to perform the quantity takeoff, the project is broken down into its component parts. The breakdown of a project into its component parts to succeeding lower levels, which are smaller and manageable, is called Work Breakdown Structure (WBS). The breakdown is continued until the project is fully defined in terms of "what" work items need to be done to complete the project. Once these work items are defined, these can be measured in terms of required material, labor and equipment. WBS is generally developed graphically as shown with an example in Figure 6 for a foundation project. In this WBS, quantity for each of the work items under level 3 is calculated and matched with resources (labor, material, equipment, etc.) needed to execute that work item.

Cost Estimating:

It is the prediction of the cost and involves calculating the cost of the quantities of work measured. The costs of a project involve two main categories: direct costs and indirect costs. Together, these two categories of costs provide the overall project cost. Direct costs are the costs directly associated with the execution of the work items where indirect costs are associated with the supporting activities, supervision, overhead and profits. A breakdown of total project costs is shown in Figure 7.

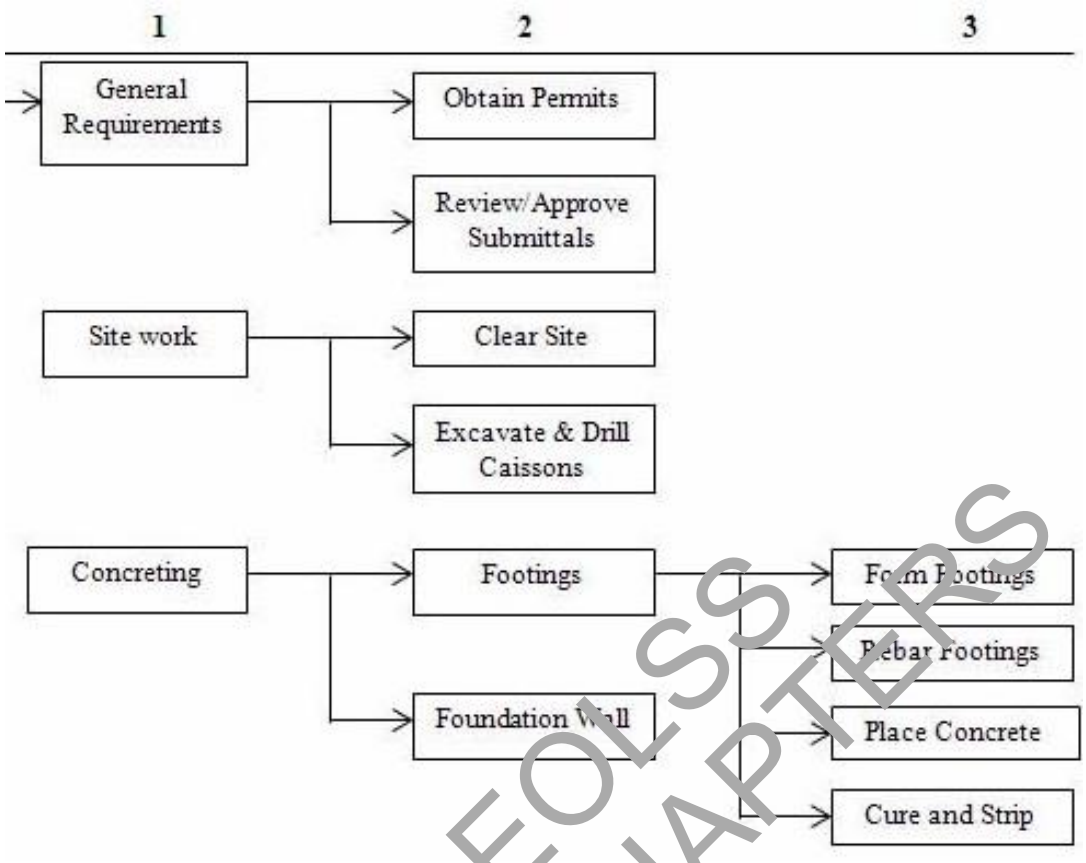

Figure 6. Estimation Work Breakdown Structure Example

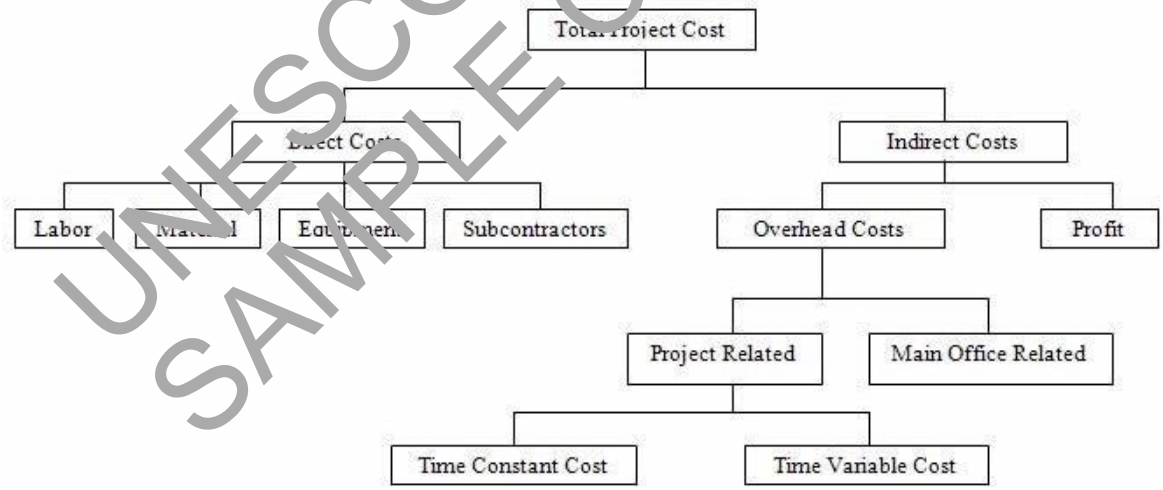

Figure 7. Overall Project Cost Breakdown

In order to calculate the direct costs of work items, first, the quantities are compiled as a result of the quantity take off process. In addition, the estimator needs to make decisions about the composition of the crews, equipment to be used, productivities of the labor and equipment and unit costs of labor, equipment and material. These decisions are based on the prior experience of the estimator, information available from previous projects and information available from published sources.

In the U.S.A. there are several sources of such published information that are updated on an annual basis. One such commonly available source is cost data sources from RS Means Company and generally referred to as the Means Book or the Means Cost Database (R. S. Means 2012). These cost databases are available for various types of construction projects. These are based on national averages of costs in thirty major U.S. cities and are compatible with the many construction estimating computer applications available in the U.S.

The costs of a construction project are generally organized in divisions and subdivisions. A commonly used system of cost organization in the U.S.A. was developed by the Construction Specifications Institute and is called MasterFormat. This consists of 48 divisions with a few divisions left for future expansion as listed below (MasterFormat 2012). Most third party cost data publications, including Means, also use this breakdown.

Division 01 - General Requirements
Division 02 - Existing Conditions
Division 03 - Concrete
Division 04 - Masonry
Division 05 - Metals
Division 06 - Wood, Plastics, Composites
Division 07 - Thermal and Moisture Protection
Division 08 - Openings
Division 09 - Finishes
Division 10 - Specialties
Division 11 - Equipment
Division 12 - Furnishings
Division 13 - Special Construction
Division 14 - Conveying Equipment
(Divisions 15-20 – Not Used)
Division 21 - Fire Suppression
Division 22 - Plumbing
Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
(Division 24 - Not Used)
Division 25 - Integrated Automation
Division 26 - Electrical
Division 27 - Communications
Division 28 - Electronic Safety and Security
(Divisions 29-30 – Not Used)
Division 31 - Earthwork
Division 32 - Exterior Improvements
Division 33 - Utilities
Division 34 - Transportation
Division 35 - Waterway and Marine Construction
(Divisions 36-39 – Not Used)
Division 40 - Process Integration
Division 41 - Material Processing and Handling Equipment
Division 42 - Process Heating, Cooling, and Drying Equipment

Division 43 - Process Gas and Liquid Handling, Purification and Storage Equipment
Division 44 - Pollution Control Equipment
Division 45 - Industry-Specific Manufacturing Equipment
Division 46 - Water and Wastewater Equipment
(Division 47 – Not Used)
Division 48 - Electrical Power Generation

There are always efforts to improve the cost estimation function because of its crucial role in predicting costs of a project. With the development of the computer technology, there have been several software packages that have been introduced in the market to support the comprehensiveness and accuracy of cost estimates. In the U.S.A. the most common estimating software packages, in addition to spreadsheet programs, include Timberline Precision Estimating and MC² (Syal 2011). These software programs combine spreadsheet and database applications and provide construction specific user interfaces.

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Bibliography

1. AGC (2011). "*Construction Contracts – ConsensusDocs*," http://www.agc.org/cs/contracts (accessed in December 2011) [A comprehensive listing of types of construction contracts and agreements].

2. ASTM (2005). "*Standard Terminology for Sustainability Relative to the Performance of Buildings*", ASTM International [This provides commonly accepted definition of sustainable built environment-related terminology].

3. BREEAM (2012). *BREEAM Rating System*, http://www.breeam.org/ (accessed in May 2012) [This provides details of green building systems-BREEAM, used in the U.K.].

4. Brundtland (1987). *Report of the World Commission on Environment and Development*, http://www.un.org/documents/ga/res/42/ares42-187.htm (accessed in May 2012) [A comprehensive discussion of sustainable development in the global context].

5. Bureau of Labor Statistics (2012). U.S. Department of Labor, *Occupational Outlook Handbook*, 2012-13 Edition, Career Guide to Industries, http://www.bls.gov/ooh/about/career-guide-to-industries.htm and http://www.bls.gov/iag/tgs/iag23.htm (Accessed May 2012) [This U.S. Government document provides detailed breakdown of various industries and occupations in the United States].

6. Economy Watch, 2010a. *Construction Industry*. Available from: http://www.economywatch.com/world-industries/construction/. (accessed in December 2011) [This report provides various statistics for the current state and future trends related to the construction industry globally].

7. Economy Watch, 2010b. *World Construction Industry*. Available from: http://www.economywatch.com/world-industries/construction/world.html. (accessed in December 2011) [This report provides various statistics for the current state and future trends related to the construction industry globally].

8. Economy Watch, 2010c. *Construction Industry Trends*. Available from: http://www.economywatch.com/world-industries/construction/trends.html. (accessed in December 2011) [This report provides various statistics for the current state and future trends related to the construction industry globally].

9. Halpin, D. (2006). *Construction Management*, 3rd edition, John Wiley & Sons, Inc. [A textbook covering various aspects of construction management].

10. MasterFormat (2012). *Construction Specification Institute – MasterFormat*, www.csinet.org/numbersandtitles (accessed in May 2012) [Provides coding system for systematic breakdown of various parts of a construction project].

11. Matthews, O., & Howell, G. (2005, April). Integrated Project Delivery an example of relational contracting. *Lean Construction Journal*, 2(1), 46-61[A project report describing integrated project delivery].

12. R.S. Means (2012). "*Means Building Construction Cost Data 2012*," R.S. Means Company, MA., USA [Cost codes for various parts of a construction project].

13. Sears, S. K., Sears, G., and Clough, R.H. (2008). "*Construction Project Management*," 5th ed., John Wiley & Sons, NJ . [A textbook covering various aspects of construction management].

14. Syal, M. G. (2011). "Course Pack," CMP 817 - *Construction Project Management and Information Systems, School of Planning, Design and Construction*, Michigan State University, East Lansing, MI [This course pack is used for an undergraduate and a graduate level course at Michigan State University and contains various aspects of construction project management].

15. Syal, M., Mago, S. and Moody, D. (2007). "Impact of LEED-NC Credits on Contractors," *J. Archit. Eng*., ASCE, 13(4), 174-179 [A research paper summarizing the impact of the requirements of a green building rating system on the construction industry].

16. Syal, M., Abdulrahman, K., Li, Q, and Sezdek, W. (2009). The Role of Electrical Contractors on LEED Projects. Project Report, *ELECTRI International*, MI. [A research report summarizing the impact of the requirements of a green building rating system on the construction management practices of electrical contractors].

17. Syal, M., Mago, S., Abdulrahman, K., Li, Q., and Mago, S. (2011). "*LEED Requirements and Construction Project Management," International Journal of Construction Project Management*, Nova Science Publishers, 3(3), 1-12. [A research paper summarizing the impact of the requirements of a green building rating system on the construction management practices of general contractors and construction managers]

18. USEPA, 2010. United States Environmental Protection Agency. *Definition of Green Building*. Available from: http://www.epa.gov/greenbuilding/pubs/about.htm. (accessed in December 2010) [A U.S. Government document with discussion of terminology and definitions related to green buildings].

19. USGBC (2012).*LEED Rating System*, www.usgbc.org/leed (accessed in May 2012) [This provides details of green building systems – LEED, used in the USA.]

Biographical Sketches

Dr. Matt Syal serves as a Professor of Construction Management and Director of Ph.D. Programs in the School of Planning, Design and Construction at Michigan State University. He is a LEED® accredited professional and received his Ph.D. in Civil Engineering (Construction Engineering and Management) from Penn State University in 1992. Prior to joining the academic world in 1988, he worked as an estimator and project manager for a general contracting firm in the Boston area and earlier, with construction companies in India, Middle East and Africa. Prof. Syal has conducted research and published extensively in the areas of Construction Project Management, Housing, Sustainable Built Environment, and International Project Management. He has been involved in around 50 research/outreach projects funded by the industry, U.S. state and national government agencies, foundations and international agencies. He has published over 90 refereed/professional papers and 45 project reports/monographs. In addition, he has served as an advisor or consultant to over 25 industry, academic and government organizations in the U.S. and worldwide.

Daniel Yaw Addai Duah is a Lecturer in Architecture at the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana where he teaches in the graduate and undergraduate programs. He is also a practicing architect belonging to the professional body, Ghana Institute of Architects and is registered with the Architects Registration Council of Ghana. Daniel has designed and built mainly residential and religious buildings in Ghana. He also taught in the Building Studies Program at Barnfield College, Luton in the United Kingdom. Daniel is currently a doctoral candidate in the Construction Management Program at Michigan State University, USA and his main area of focus for his research is "Energy Efficiency in Buildings". He holds a Master of Science Degree in Construction Management and Economics from the Greenwich University in London, U.K. and a Post Graduate Diploma and Bachelor of Science Degrees both in Architecture from KNUST.