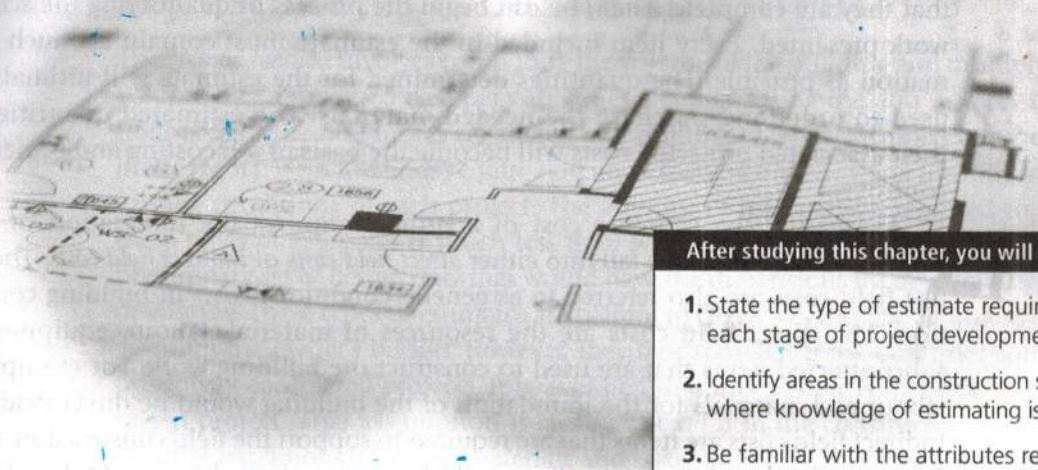
CHAPTER 1

Introduction to Estimating



After studying this chapter, you will be able to:

1. State the type of estimate required at each stage of project development.
2. Identify areas in the construction sector where knowledge of estimating is necessary.
3. Be familiar with the attributes required to be a successful construction estimator.
4. Have knowledge of the documents required for bid preparation.

1.1 General Introduction

Building construction estimating is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project, and each item must be analyzed, quantified, and priced. Because the estimate is prepared before the actual construction, much study and thought must be put into the bid documents (drawings and specifications). The estimator who can visualize the *project from this information and accurately determine its cost will become one of* the most important persons within any construction company.

In most instances, it is necessary to submit a competitive bid for the project. The competition in construction bidding is intense, with multiple firms vying for a single project. To stay in business, a contractor must be the lowest qualified bidder on a certain number of projects while maintaining an acceptable profit margin. This profit margin must provide the general contractor an acceptable rate of return and compensate for the risk associated with the project. The estimator must account for site planning, staff organization, scheduling, temporary facilities, material handling systems, safety/environmental issues, and quality control. The ability of the estimator to visualize all the different phases of the construction project becomes a prime ingredient in successful bidding.

The working drawings usually contain information relative to design, location, dimensions, and construction of the project, while the specifications are a written supplement to the drawings that include information pertaining to materials and workmanship. The working drawings and specifications constitute the majority of the contract documents, define the scope of work, and *must* be considered together when preparing an estimate. The two complement each other and they often

overlap in the information they convey. The submitted bid must be based on the scope of work provided, and it is the responsibility of the estimator to account for everything depicted by the drawings and described in the specifications. Due to the complexity of the drawings and specifications, coupled with the potential costs of an error, the estimator must read and understand everything thoroughly and recheck all items. Initially, the plans and specifications must be checked to ensure that they are complete. Then, he can begin the process of quantifying the scope of work presented. Every item included in the estimate must contain as much information as possible. The quantities determined for the estimate will ultimately be used to order and purchase the needed materials. The estimated quantities and their associated projected costs will become the basis of job costing and project cost control.

Estimating the ultimate cost of a project requires the integration of many variables. These variables fall into either *direct field costs* or *indirect field costs*. The indirect field costs are also referred to as general conditions costs in building construction. The direct field costs are the resources of material, labour, equipment, or subcontracted items that are used to construct the building work. For example, the labour and materials for the foundation of the building would be direct field costs. Indirect field costs are items that are required to support the field construction efforts. For example, the project site office would be a general conditions cost. In addition, risk factors, such as weather, transportation, soil conditions, labour strikes, material availability, and subcontractor availability, need to be integrated into the estimate. Regardless of the variables involved, the estimator must strive to prepare as accurate an estimate as possible. Since subcontractors may perform much of the work in the field, the estimator must be able to articulate a scope of work in order for these companies to furnish a quotation. The complexity of an estimate requires organization, the estimator's best judgment, the analysis of subcontractors' bids, accurate quantity takeoffs, and accurate records of completed projects.

1.2 Types of Estimates

The stage of project development and the required level of accuracy, together with the amount of information about the project that is available, will dictate the type of estimate that can be prepared.

Detailed Estimate

The detailed estimate includes determination of the quantities and costs of everything required to complete the project. This includes the resources of the contractor's self-directed (own forces) work, subtrades, general expenses, as well as an estimate of profit. To perform this type of estimate, the contractor must have a complete set of bidding documents. The estimator must break down each item of the project into its parts for the estimate. Each piece of work that is to be performed by the contractor has a distinct labour requirement that must be estimated. The items that are to be installed by others need to be defined and priced. The contractor must exercise caution to ensure that there is agreement between him and the subcontractor as to what they are to do and if they are to install or both supply and install the items. Additionally, there needs to be an agreement about who is providing support items, such as cranes, scaffolding, and so on.

The detailed estimate must establish the projected quantities and costs of material, the time required for and the costs of labour, the equipment required and its cost, the items required for overhead and the cost of each item, and the percent of profit desired, considering the investment, the time to complete, and the complexity of the project.

Preliminary Estimates (Volume and Area)

The *volume method* involves computing the volume of the building and multiplying that volume by an assumed cost per cubic metre (foot). Using the *area method,* the gross floor area of the building is calculated and multiplied by an assumed cost per square metre (foot). Both methods require skill and experience in adjusting the unit cost to the varying conditions of each project. The amount of information required to produce these types of estimates is much less than with the detailed estimate. For example, a preliminary set of design drawings would have the dimensions for determining the area or volume. These types of estimates are helpful to check whether the project as designed is within the owner's budget; however, they lack accuracy. If the unit price comes from previously completed projects, it is assumed that this project is identical to the completed project. That assumption is clearly not valid in the construction of buildings. Weather conditions, building materials and systems, as well as design and construction team members change from project to project, all contributing to the uniqueness of every project. Annual publications, such as Hanscomb's "Yardsticks for Costing," published by RSMeans, contain a range of unit costs for a wide variety of building types in seven cities in Canada. These guides provide a number of adjustments to compensate for varying building component systems.

Conceptual Estimates

Typically, no drawings are available when a conceptual estimate is done. What exists is a vague verbal or written description of the project scope. When preparing this type of estimate, the estimator makes assumptions about virtually every aspect of the project. These types of estimates are usually prepared using some unit of measurement that has little to do with actual construction materials or measurements. A typical unit of measurement would be cost per apartment dwelling unit in a multifamily housing project or cost per parking space for a parking garage.

This type of estimate is used early in the design process to check how realistic the owner's wants are in terms of the budget. In addition, these estimates are required during the design and working drawings stages primarily to keep the cost of the project within predetermined limits. In order to control costs, estimates for projects are analyzed and each major building element and subelement is identified as a cost per square metre (foot) of the gross building area. In addition to providing a means of identifying elements of unusually high cost or potential budget over-runs, elemental cost estimates provide useful reference data when estimators prepare preliminary estimates for other similar projects.

The Canadian Institute of Quantity Surveyors' format for elemental cost analysis defines an element as a major component common to most buildings, fulfilling the same function irrespective of its design, specification, or construction. The standardized elemental breakdown used by estimators and quantity surveyors across the country is detailed in the institute's publication *Elemental Cost Analysis—Method of Measurement and Pricing.*

Contemplated Change Order Estimates

Under the terms of the stipulated lump-sum contract, the consultant must issue a notice of proposed change or contemplated change, together with any revised drawings or specifications, to the contractor to obtain a quote. These changes may include additions, deductions, and alterations to part of the work that may or may not have been completed. These may be due to a change in the owner's requirements, unforeseen conditions, emergencies, or regulatory requirements and may affect the contract price or contract schedule. The estimate for these notices must incorporate any additions or deductions from the original contract documents and include adjustments in contract price and contract time. Unit rates, including levels of profit and overhead, may be established prior to the signing of the contract. Alternatively, the consultant may assess them on a fair and reasonable basis.

1.3 Estimating and Quantity Surveying Opportunities

The Canadian Institute of Quantity Surveyors (CIQS), established in 1959, is the national professional body representing the Quantity Surveying and Construction Estimating professions in Canada. The CIQS is the governing body for the six provincial associations in Alberta, British Columbia, Newfoundland and Labrador, Nova Scotia, Ontario, and Quebec. In 1988, the institute obtained the official mark *Professional Quantity Surveyor* and subsequently has also registered the initials *PQS* and the French equivalents of *Économiste en Construction Agréé* and the initials *ECA*. The Construction Estimator Certified (CEC) designation was developed and implemented in 1999 to continue to promote the profession of construction estimating in Canada. Throughout North America, the construction estimator is a well-known professional. Quantity surveying in the context of the property development process is not well understood. This can be frustrating for those who carry the title quantity surveyor, since some do not recognize it as a universal professional title within the construction industry. The international body representing quantity surveyors, the Royal Institution of Chartered Surveyors (RICS), has established links across the continents in its goal to globalize the quantity surveying profession.

This section will review some of the career areas in which a knowledge of estimating is necessary. Generally, a knowledge of the procedures for estimating is required by almost everyone involved in or associated with the field of construction. From the estimator who may be involved solely with estimating quantities of materials and pricing the project to the carpenter who must order the material required to build the framing for a home, this knowledge is needed to do the best job possible at the most competitive cost. Other careers include project designers, architectural technologists, engineers, contractors, subcontractors, material suppliers, and technical sales representatives. In the following sections, a few of the estimating opportunities are described.

Architectural Offices. The architectural office will require estimates to plan and control costs in the four stages of the pre-tender period: the program or concept stage (based on costs per unit of gross floor area), the schematics stage (costs of major elements per square metre or square foot), the design development stage

(setting a cost target for all the components of the building), and the contract document stage (trade-by-trade breakdown of costs to evaluate the lowest acceptable bid).

In large and/or collaborative design offices, estimates might be done by a professional quantity surveyor or an estimator hired primarily for that purpose. In many offices, the senior architectural technologist or the head or lead architect may do the estimating or, perhaps, there may be someone else in the office who has developed the required estimating skills. There are also estimating services or cost consultants who work on a for-fee basis.

Engineering Offices. The engineering offices involved in the design of building construction projects include civil, structural, mechanical (plumbing, heating, air conditioning), electrical, and soil analysis. All these engineering services require preliminary estimates, estimates while the drawings are being prepared, and final estimates as the drawings are completed.

General Contractors. Typically, the general contractor makes *detailed* estimates that are used to determine what the company will charge to do the work required. The estimator will have to "take off" the quantities (amounts) of each material, determine the cost to furnish (procure and ship to the site) and install each material in the project, assemble the bids (prices) of subcontractors, as well as determine all the costs of insurance, permits, office staff, and so on. In smaller companies, one person may do the estimating, whereas in larger companies, several people may work to negotiate a final price with an owner or to provide a competitive bid. Many times, the contractor's business involves providing assistance to the owners, beginning with the planning stage and continuing through the actual construction of the project (commonly called *design-build* contractors). In this type of business, the estimators will also provide preliminary estimates and then update them periodically until a final price is set.

Estimating with Quantities Provided. Estimating for projects with a schedule of quantities involves reviewing the specifications for the contract and material requirements, reviewing the drawings for the type of construction used, and assembling the materials used. The estimator will spend part of the time getting prices from subcontractors and material suppliers and the rest of the time deciding how the work may be accomplished most economically.

Subcontractors. Subcontractors may be individuals, companies, or corporations hired by the general contractor to do a particular portion of the work on the project. Subcontractors are available for all the different types of work required to build any project and include excavation, concrete, masonry (block, brick, stone), interior partitions, drywall, acoustical ceilings, painting, steel and precast concrete, erection, windows and metal and glass curtain walls, roofing, flooring (resilient, ceramic, and quarry tile, carpeting, wood, terrazzo), and interior wall finishes, such as wallpapering, wood panelling, and sprayed-on finishes. The list continues to include all materials, equipment, and finishes required.

The use of subcontractors to perform all the work on the project is becoming an acceptable model in building construction. Its advantage is that the general contractor can distribute the risk associated with the project to a number of different entities. In addition, personnel of the subcontractors' trade perform the same type of work on

The designer/architectural technologist should plan and produce the house drawings using standard material sizes when possible (or be aware of it when they are not using standard sizes). In addition, they will need to give preliminary and final estimates to the owner. Workers need to have a basic knowledge of estimating so that they can be certain that adequate material has been ordered and will be delivered by the time it is needed.

Computer Software. The use of computers throughout the world of construction offers many different types of opportunities to the estimator. Job opportunities in all the areas mentioned earlier will be centred on the ability to understand, use, and manipulate computer software. The software available today can integrate the construction drawings, estimating, bidding, purchasing, and management controls of a project.

1.4 The Estimator

Most estimators begin their career doing quantity takeoffs; as they develop experience and judgment, they develop into estimators. A list of the abilities most important to the success of an estimator follows, but it should be more than simply read through. Any weaknesses affect the estimator's ability to produce complete and accurate estimates. If individuals lack any of these abilities, they must (1) be able to admit it, and (2) begin to acquire the skills they lack. Those with construction experience, who are subsequently trained as estimators, are often most successful in this field.

To be able to do quantity takeoffs, the estimator:

1. Must be able to read and interpret design and working drawings.
2. Must have knowledge of mathematics and a keen understanding of geometry. Most measurements and computations are made using linear, area, and volume concepts. The quantities are usually multiplied by a unit price to calculate costs.
3. Must have the patience and ability to do careful, methodological, and thorough work.

To be a successful estimator, an individual must go a step further. He or she:

1. Must have an eye for detail and be able, from looking at the drawings, to visualize the project through its various phases of construction. In addition, an estimator must be able to foresee problems, such as difficulty in the placement of equipment or material storage, then develop a solution and determine its estimated cost.
2. Must have enough construction experience to possess a good knowledge of job conditions, including methods of handling materials on the job, the most economical methods of construction, and labour productivity. With this experience, the estimator will be able to visualize the construction of the project and, thus, get the most accurate estimate on paper.
3. Must have sufficient knowledge of labour operations and productivity in order to convert them into costs on a project. The estimator must

understand how much work can be accomplished under given conditions by given trades. Experience in construction and a study of projects that have been completed are required to develop this ability.

4. Must have the ability to keep a database of information on costs of all kinds, including those of labour, material, overhead, and equipment, as well as a knowledge of the availability of all the required items.
5. Must be computer literate and know how to manipulate and build various databases and use spreadsheet programs.
6. Must be able to meet bid deadlines and still remain calm. Even in the rush of last-minute phone calls and the competitive feeling that seems to electrify the atmosphere just before the bids are due, estimators must "keep their cool."
7. Must be able to deal with a number of bids in various stages of the bidding process.

People cannot be taught experience and judgment, but they can be taught an acceptable method of preparing an estimate—items to include in the estimate, calculations required, and how to make them. They can also be warned against possible errors and alerted to certain problems and dangers, but the practical experience and good judgment required cannot be taught and must be aquired over time.

How closely the estimated cost will agree with the actual cost will depend, to a large extent, on the estimator's skill and judgment. Their skill enables them to use accurate estimating methods, while their judgment enables them to visualize the construction of the project throughout the stages of construction.

1.5 Schedule of Quantities

A Schedule of Quantities is used mainly in civil engineering projects, where the work is repetitive and the actual quantities are indeterminate. The estimated quantities of materials required on the project are determined by a professional quantity surveyor or engineer and provided to interested bidders. Figure 1.1 is an example of the quantities that would be provided by a quantity surveyor or engineer.

In this method of bidding, the contractors are all bidding on the basis of the same quantities, and the estimator spends time developing the unit prices. For example, the bid may be \$123.26 per cubic metre (m^3) of concrete. Because the contractors are all bidding on the same quantities, they will work on keeping the cost of purchasing and installing the materials as low as possible.

As the project is built, the actual number of units required is checked against the original number of units on which the estimates were made. For example, in Figure 1.1, the original schedule of quantities called for 715 linear metres (m) of concrete curbing.

No.	Quantity	Unit	Item
02525	715	m	Curb, type A
02525	75	m	Curb, type B
04220	12,500	each	100 mm concrete block
04220	5,280	each	200 mm concrete block
04220	3,700	each	300 mm concrete block

FIGURE 1.1 Quantity Survey