CONSTRUCTION PROJECT MANAGEMENT

A Complete Introduction

Third Edition

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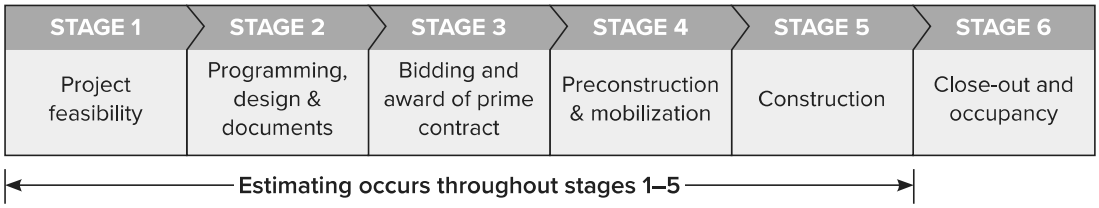
CHAPTER

12

Fundamentals of Estimating



What is an estimate?

An **estimate** is an educated guess, based on the best available information, of what something is going to cost, usually in dollars or time. Most of us are familiar with getting estimates for everyday actions such as repairing the car or painting the house. We make informal estimates ourselves almost daily—how long it will take to drive to Grandma's or how much the utility bill is going to be this month.

In construction, estimates are made to determine the probable real time—and, from that information and more, the probable cost—of building a project. Estimates are completed at various stages and provide important information to the owner, to the designer, and to the builder.

Because estimates are done before a project is built, they are, at best, an approximation of what the actual costs are going to be. The true costs of a

project will not be known until the project has been completed and all the costs recorded. An estimate done before much design work is complete is very rough; an estimate done after the drawings and specifications are available is far more accurate. Both types of estimates are valuable and serve different purposes at different times during the development of a project. In this chapter, we'll look at the fundamentals of estimating and in Chapters 13 and 14 we look more closely at how estimates are developed.

Why estimate?

Owners, designers, and contractors all need to know what a project will cost. The owner needs to balance project goals against costs and establish a realistic and workable budget, the designer needs to make decisions that keep the project within that budget, and the contractor needs to establish an amount that the owner will pay for the work. For all parties, the stakes can be high, and inaccurate or incomplete cost estimates can have serious implications.

Estimates are done throughout the life of a project, beginning at the feasibility phase, continuing throughout the design (during schematics, design development, and final design), before the general contractor is hired, and whenever changes occur during construction. Different types of estimates are done at different phases of a project as the amount of design information is refined. Not surprisingly, estimates completed early in the process are quicker to do but much less accurate than the detailed estimates developed when the drawings and specifications are complete.

For the owner, an estimate early in the process enables him to answer important questions:

1. Is the project financially feasible?
2. Do adjustments to size or quality need to be made?
3. Which project options make the most sense?

The owner will look at the initial, rough estimate to get an overview of the project feasibility and cost options. Maybe the estimate will indicate that a project

Contractor and owner estimates When we talk about a construction estimate, it's helpful to understand that the owner's project estimate is not the same as the contractor's project estimate. Let's see how they differ.

As we might expect, an owner is involved with, and responsible for, an entire project—from feasibility to occupancy or sale. The costs associated with actually constructing the project are only one piece of the project expenses. The owner is concerned with *all* the costs, which, in addition to the physical construction, might include: purchasing the property, paying for the design work, paying for permits and fees, hiring marketing personnel, neighbor relations expenses, paying for attorneys and accountants, interest payments on loans, and other costs. All the anticipated project expenses are estimated and monitored by the owner throughout the process. Estimates are important to an owner because they are the major tools the owner will use to make key determinations about the project: its affordability, its size, and its quality.

The contractor's concern is narrower. The contractor's estimate includes only the expenses involved in the portion of the overall project for which they have been hired—typically, the labor, materials, equipment, and supervision necessary to complete the structure and fulfill the contract with the owner. The contractor's detailed estimate provides the basis for the bid price to the owner.

is just too expensive and should be abandoned. Perhaps the owner will change the scope or make adjustments to the anticipated quality. Perhaps the owner will determine that project goals or the budget need to change.

Estimates made during the design phase provide the architect with important information too. The role of the designer is to create a project that is responsive to the owner's requirements and budget. The process for doing so is a back-and-forth between the design team and the owner and, as the design proceeds, the architect will make size, material, and systems adjustments so the project fits within the owner's budgetary requirements.

At the end of the design phase, the bidding contractors complete detailed estimates, which are the basis for bids to the owner. The contractor's goal is to predict costs accurately and have this estimate be low enough to win the job.

Andrea Young

Types of estimates

As noted, there are different types of estimates, which are developed at different times in the process and are primarily distinguished by their level of detail and accuracy. Also as noted, estimates are used throughout a project: during feasibility to assist an owner in making conceptual decisions, during design to ensure that the project meets the owner's budget, and after design is complete to develop bid prices. Estimates are also tools to help manage costs once construction begins.

When the design of a project is incomplete, it is still possible to estimate what it will cost to build, but the estimate will, of course, be approximate. We defined an estimate as an educated guess. Such an early estimate may be completed by the owner or an architect. There are also programs available to create early estimates. One of these is a property valuation program by Marshall & Swift Valuation Service. Their segregated cost method, which makes valuations for each of the major components of a building, allows for very rough conceptual estimates without detailed quantity take-offs.[1]

As the owner and architect move ahead in the process, more sophisticated estimating information sources are used. Progressively more detailed estimates are generated and the educated guess becomes increasingly accurate. These early estimates are tools for the owner and architect to make adjustments in the program while it's still relatively easy. It is always cheaper and less stressful to make changes during the design process than to find out, after contractors' bids come in, that the project is unaffordable and needs to be changed.

Once the drawings are 100% complete (or close), it is possible for contractors to develop very accurate cost estimates. These estimates identify the amount of money that the owner will pay to the contractor, and all contractors who are competing for the work will complete their own estimate.

Estimates can be grouped according to when in the design/construction process they are developed. Thus we have:

- Conceptual estimates
- Design estimates (square foot and assemblies estimates)
- Detailed (bid estimates)

Let's look at each of these.

Conceptual estimates

Also referred to as rough-order-of-magnitude (ROM) estimates or feasibility estimates, conceptual estimates are based on the conceptual design of a facility. They rely on the cost data of similar projects built in the past and typically use *gross service unit* pricing to determine the project cost. Estimates that use service unit costs might quote a cost per room (for a hotel), a cost per pupil (for a school), a cost per bed (for a hospital), and so on. Conceptual estimates are used during the early phase of a project when there are no drawings. Adjustments are often necessary for location and inflation but typically do not include costs for unconventional or unusual design features, land, design fees, or financing.

Design estimates

Design estimates are developed after some design parameters are known but decisions are still being made. They are more detailed and more accurate than conceptual estimates and are used by the owner and architect to drive decision-making and budget decisions. There are several methods for developing this type of estimate, including:

- Square foot estimating
- Assemblies estimating

A square foot estimate is one in which costs are projected based on *area*. Square foot estimating is similar to ROM estimating (and is also used to

develop conceptual estimates), except that costs are tabulated per square foot instead of per service unit and are typically based on more detailed data. As a result, design estimates are more accurate than conceptual estimates.

Assemblies estimating involves the analysis and estimating of the systems that make up a project and is typically more detailed than square foot estimating. Pricing systems—everything that together make up a facility, the mechanical systems, the foundation, the interior wall partitions, and so on—provide the cost data that enable the team to make design adjustments.

We'll look at conceptual and assembly estimating in more detail in the next chapter.

Detailed estimates

Also called **final, bid, or unit price estimates**, detailed estimates are based on the most detailed design information and are developed by bidding contractors in a traditional lump sum delivery method. Bid estimates are developed after the design drawings and specifications are completed and there are detailed scopes of work. They are prepared by determining the price of labor, materials, and equipment necessary for the work and include subcontracts, overhead costs (the costs associated with running the contractor's business), taxes, and the contractor's profit. The contractor prepares the detailed estimate prior to submission of the bid to the owner. We'll look at detailed estimates in Chapter 14.

As noted, conceptual and design estimates can be sufficiently accurate for the owner to evaluate design alternatives (e.g., the project size and configuration) and, depending on when in the design process they are done, to provide quite accurate cost data. They are typically insufficient, however, for the very detailed cost estimate that a contractor develops at the completion of design, which forms the basis for the amount the contractor will be paid for the work.

Before we move forward in the next chapter to discuss the methodologies used to develop estimates, let's review what conditions are of concern to the estimator and where the numbers come from.

Considerations when developing an estimate

The estimator will take into account the fact that, irrespective of when an estimate is developed, not all project components may be at a comparable level. For example, while design may be at 90% completion, the mechanical systems may be significantly less detailed. No matter at what stage of a project an estimate is created—whether at the earliest conceptual phase or at the completion of construction documents—there are several factors affecting costs that the estimator takes into account. These factors include:

- Project size, complexity, and special requirements
- Quality of building materials/performance goals
- Location of the project
- Schedule and time frame
- Market and labor conditions
- Management conditions
- Special risks

Let's look at each of these factors.

Project size, complexity, and special requirements

Typically, the bigger the job the more it will cost in terms of materials and labor. Larger projects also provide an economy of scale not present in smaller projects, however. A larger project provides workers with an opportunity to find their rhythm. Once a contractor has mobilized onto a site—set up tools and equipment and prepared the area—it is generally cost effective to be there for a while rather than having to demobilize and move to another project. This is why, for example, painters charge a premium for using different colors: it costs time and money to clean the brushes and close and open different cans. An additional factor is that repetition increases speed. If a tile setter has 5,000 square feet of floor tile to install, it typically takes longer to lay the first 1,000 square feet than the second 1,000, and so on. As square footage increases, cost

per square foot decreases. The estimator must factor in these aspects of size and productivity.

Another characteristic that impacts worker productivity is project complexity. Anytime a structure has complications—oversized heights, bay windows, odd shapes—productivity goes down and labor costs go up. It is easier for an electrician to put fixtures in an 8-foot-high ceiling than to install them 15 feet up, for example. When complexity requires nonstandard sizes, then the price climbs too. Straightforward, simple buildings are easier to build and cost less (that's why so many buildings are so plain!).

Special requirements, often noted only in the specifications, such as mock-ups and water testing, also can add significant costs to the work. These must be accounted for in the bid.

Quality of building materials and performance goals

The quality of products and expectations regarding sustainability and performance play a significant role in costs. Most of this is common sense: it costs more to install specially sized wood windows with jamb extensions than off-the-shelf aluminum windows with drywall returns; Italian marble costs more than standard ceramic tile; 40-ounce nylon carpet costs more than 28-ounce. Some projects just meet code requirements and include very basic finishes; others include fine craftsmanship and superior materials. In addition, if, due to owner preference or jurisdictional requirements, it is anticipated that the project will be certified as a green building under a program such as LEED or will need to meet strict energy standards (e.g., those in California and elsewhere), the estimator will adjust the numbers accordingly. The estimator reviews the specifications for information regarding the quality requirements of a product.

Location of the project

Location impacts many aspects of an estimate. Labor costs vary from place to place. For example, an inaccessible site (such as a house built in the mountains) means delivery costs are likely to be high, and if the project site is at a distance

from the contractor's office, then overhead costs typically rise. Another example would be an urban site, with zero lot lines, which may require special protections for adjacent properties, special techniques to work on lot line wall finishes, pedestrian protections, and parking permits. These considerations all add costs to the bid.

Location can impact the availability and cost of labor. It can also increase the contractor's difficulty in hiring qualified subcontractors and those available might be operating under different licensing requirements and with different viewpoints and experience. If there is a shortage of local workers, the general contractor might be obligated to bring workers in, which can be expensive.

Costs vary from area to area too, even between areas within a reasonable proximity to each other. It's more expensive to build something in Boston than in Worchester, Massachusetts, and more expensive in Denver than in Greeley, Colorado. Contractors working outside their normal location adjust for that in the estimate.

Two other problems associated with location are traffic and parking. Inner-city sites with vehicular and pedestrian traffic increase the costs of access and protection of the jobsite, and sites without parking may require making costly alternative arrangements for workers and staff (such as renting spaces). These issues are factored into the estimate.

Finally, each municipality has their own local ordinance compliance costs, permit requirements, and fees. Sometimes the owner will pay these costs, but often the contractor must add these into the bid. If so, the contractor must research and make certain all expenses are included.

Schedule and time frame

If a project has an extremely tight time frame, of course, workflow streamlining is a major consideration. (Sometimes the contractor might also be forced to accelerate the work by adding crews or overtime, thus increasing labor and other costs. This is called crashing the schedule which we'll look at it in Chapter 22.) If a project is expected to have an extended duration this will increase supervision costs, which add indirect costs (see the following). Furthermore,

if a contractor expects the project to continue over a long period of time, the estimate needs to take into account the likelihood that material prices will fluctuate. The time of year that work will take place also impacts the estimate, as there may be delays due to weather and the necessity for taking measures to protect materials from rain and/or cold.

Market and labor conditions

Market forces beyond the control of contractors can have a significant impact on costs. If the local economy is in a slump and competition for jobs is tough, for example, the estimator sharpens their bid and likely reduces the amount identified as profit. Sometimes a contractor accepts a job even though there is no profit to be had, in fact, simply to keep in-house crews busy. Conversely, if work is plentiful and it's more difficult to hire experienced crews, this will be reflected in higher bids. Additional considerations include supply-chain disruptions at the supplier or transport levels. Even less predictable are the more politically related tariffs such as those imposed by the U.S. on some Canadian lumber in 2021.

Management conditions

Management considerations include the general tone and effectiveness that might be expected on a project. Is the owner likely to be difficult? Does the architect respond quickly to requests for information? Is there skilled management among all the parties? Is the job likely to require additional paperwork such as one typically finds on a federal job? Extra work takes extra time and should be accounted for in the estimate.

Special risks

A risk is an uncertain event or condition that, if it occurs, typically has a negative impact on a project such as on schedule and cost. As we have learned, there are multiple risks in construction: weather events, price escalations, unexpected underground conditions, and more. The estimator compiles a

list of and assesses possible risks, and then determines the probability of a risk occurring and the impact to the project if it does so. Adding insurance can reduce risk. Another method used by estimators is to add a contingency allowance to the estimate. The allowance is a dollar amount designed to cover risk (and subject to approval by the architect and owner). Another strategy to reduce risk is to clearly outline out-of-scope work within the bid.

Understanding risks associated with labor and market conditions, the project location, the time frame, and so on is insufficient. In order to understand how a cost estimate is created, it's important to understand the different ways that job costs are categorized.

Categories of costs

To be sure that all costs are included and to organize the hundreds of costs associated with a project so that they can be tracked, costs are customarily identified as being in one of two categories:

- Direct project costs
- Indirect project costs

Every expense on a job is classified as one of these categories and assigned a cost code to enable it to be tracked and managed. In addition, there is a third category of costs, consisting of those not directly linked to specific projects but necessary to maintain the contractor's business: indirect business costs. Let's take a look at all three of these types of costs.

Direct project costs

Direct project costs are the labor, materials, equipment, and subcontractor expenses directly associated with the items that become part of the physical structure. These include:

- Materials
- Labor

- Equipment
- Subcontracts

Direct project costs are billable to a specific task and/or subcontractor. Examples of direct project expenses include the cost of excavating for foundations, pouring concrete, building walls, supplying and laying kitchen tile, and installing the landscaping. Let's see how the estimator calculates direct costs. We'll begin with materials as their costs don't vary much from contractor to contractor and, consequently, are the easiest to calculate. (It's worth noting, however, that suppliers can, and do, give variable price quotes to different contractors based on their history with the contractor and the contractor's ability to pay by specified discount dates.)

Direct costs: materials

The first step in pricing materials is to calculate how much is needed. The quantity of materials in a project is determined from the drawings. Each sheet of the drawings must be analyzed, with the materials identified and total amounts calculated.

The process of measuring plans to quantify materials is called doing the **take-off**. This process is completed in the same sequence as the building is built—from the ground up—to reduce the chance of missing something. Completing an accurate take-off is important because other costs are calculated based on quantities. For example, if the estimator calculates (through measurement) that 11,850 square feet (SF) of drywall is going to be required, when labor costs are assigned to the task of hanging the drywall, the numbers are based on an estimate of how many labor hours it is expected to take to hang 11,850 square feet. If the estimator has miscalculated the quantity of drywall, then the labor hours as well as the material costs will be wrong.

Knowing just the quantity of materials isn't sufficient, however; the estimator also needs to know exactly what the product quality requirements are. The specifications provide the information necessary to price the correct product. In our drywall example, the quantity of drywall needed doesn't tell the estimator what grade of drywall the architect wants and other critical pieces of information. For example, is the drywall fire or water or mold resistant? How

thick is the product? Does it have to meet a standard such as ASTM? What are the requirements regarding how to finish the installed drywall? The specifications provide this information. (For details on specifications, see Chapter 19.)

Once the quantity and quality of the material has been determined, the cost can be calculated by multiplying the quantity of the materials times the unit cost. For example, a contractor is estimating the cost of an addition on a house. The take-off indicates that 2,050 linear feet (LF) of 2×6 construction heart S4S redwood decking will be required. A quote from the supplier indicates that it will cost $3.12 per LF (a linear foot is the unit cost) for the wood. The total estimated cost for the lumber is therefore 2,050 LF × $3.12/LF = $6,396 (plus applicable taxes).

Direct costs: labor

Estimating labor costs is more difficult because these costs can vary substantially from contractor to contractor. Labor costs are calculated by multiplying an hourly **wage rate** (which includes costs such as social security, unemployment taxes, and health benefits in addition to the worker's direct pay) by **productivity** (how much a worker can accomplish in a given period of time). For example, let's assume a $45/hour wage rate for a drywall installer who is likely to be on a two-person crew with a productivity rate of 2,000 square feet per eight-hour day. If the contractor's take-off indicates that there are 11,850 square feet of drywall, how much will the labor cost? The calculation is quite simple:

11,850 SF (total units of drywall) ÷ 2,000 SF (units installed per 8 hours) = 5.9 days (we'll round up to 6 days)

Each worker's wage rate is $45/HR, therefore the cost is $90/HR × 8 HR/day = $720/day × 6 days = $4,320 total labor cost

Determining labor costs isn't always so straightforward, however, because these costs are highly variable. As we've said, the productivity rate identifies the number of units of work (such as the square feet of drywall) a person is able to install in a specified period of time (usually hourly or daily). But productivity rates can vary greatly from contractor to contractor, and they are impacted by the skill and experience of the worker as well as the conditions

in the field: Is there sufficient coordination and supervision? Is all necessary equipment in place? Is the job especially complicated or does it require working in less-than-optimal conditions? Are there efficiencies of scale in the work? All of these can impact a worker's productivity.

Andrea Young

In addition, hourly labor rates are variable among the trades; electricians and plumbers are generally more highly paid than painters, for example. The "going rate" for a particular trade and worker is a function of whether the rate is based on prevailing wage rates, union rates, or open shop rates. A **prevailing wage** is the hourly wage, plus benefits and overtime, paid to the majority of workers in the local area. Most workers on publicly funded jobs are paid a prevailing wage because of the **Construction Wage Rate Requirements statute (formerly the Davis-Bacon Act)**. This statute requires that most federal construction projects pay workers the local area's prevailing wage.[2] **Union rates** are paid to workers who are members of a labor union and are paid a wage rate established by the union and a project's management. Workers who are not in a union are paid **open shop wages**. Open shop wage rates are agreed to by the individual worker and his employer. The estimator needs to understand how wages for each trade, on each job, have to be calculated. In addition, if union and nonunion workers are on a jobsite together, special requirements, such as separate gates to access the jobsite, can add to the costs.

☑ **The Construction Wage Rate Requirements statute (formerly the Davis-Bacon Act)** Congress enacted the Davis-Bacon Act (DBA) in 1931 to assure workers a fair wage, provide local contractors an equal opportunity to compete for local government contracts, and preserve the government's ability to distribute employment and federal money equitably through public works projects. Among other things, the law states that labor on federal projects or federally assisted projects must pay workers no less than the local prevailing wages and benefits. This ensures that contractors bidding on public works projects will not lower wages in order to achieve a lower bid.

The statute has been amended several times in its history and has faced controversy, including that it was a way to keep nonunion and small black and immigrant contractors from participating in federal contracts.[3] In addition, some have long tried to repeal the act on the grounds that the regulations are outdated, expensive, and bureaucratic. There have also been several times when the act was temporarily suspended, such as in 2005 after Hurricane Katrina, when President George W. Bush suspended the act *indefinitely*[4] in designated areas along the Gulf Coast. After pressure from both Democrats and Republicans, Bush rescinded his emergency order and restored the prevailing wage requirement.[5] The DBA is currently being reevaluated to ensure that it reflects the current needs of the construction industry and its workers. In 2022, the Department of Labor proposed amendments in several areas of the act, including how prevailing wage rates are determined. Part of the updates reflect the desire to improve the speed and accuracy of wage determinations and to make adjustments for projects that span multiple counties such as highway projects.[6]

Direct costs: equipment

Equipment can be rented or purchased; the contractor may or may not own it. If contractors own their equipment, the usual practice is to charge an hourly rate for its use. The cost for equipment includes the rental cost for the piece of equipment plus the operating cost (gas, setup, maintenance, etc.). Equipment operators may or may not be rolled into base equipment costs; typically, when the equipment is owned by the contractor and rented to the job, the cost for operators is included under labor costs.

Direct costs: subcontractors

Subcontracted work is a direct project cost to the general contractor. All the labor, material, equipment, taxes, overhead, and profit are included as part of the subcontractors' bids to the GC. Typically, the general contractor itemizes the costs for subcontracted work and adds a markup to those costs.

The estimator has now calculated the costs of materials, labor, equipment, and subcontractors—the direct costs. Once these costs are known, the indirect project costs are calculated.

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Indirect project costs

The second category of job cost is **indirect project costs** (also called general requirements or general conditions costs). These are the job expenses that are directly linked to the cost of the work as a whole but *not to a specific task or subcontract*. Indirect project costs include such items as the general contractor's job supervision, setting up a jobsite office (typically a trailer), temporary water and power for the job, scaffolding, cleaning the site, the costs incurred in organizing meetings, and much more. Some of these costs are required by the terms of the contract (an example would be a requirement that a full-time superintendent be at the jobsite), some are required by law (such as certain testing requirements), and some are the result of good construction practice (such as keeping the site clean). Indirect project costs are not physically incorporated into the building.

The cost of the superintendent is an example of why a cost might be categorized as an indirect project cost rather than a direct cost. The general contractor's superintendent on a project is on the jobsite full-time, managing and coordinating the work. This person works with *all* the subcontractors, facilitates meetings, updates the schedule, helps track costs, and works closely with both the contractor's project manager and the architect. The superintendent is involved with most, if not all, aspects of the work; the cost of their salary and benefits is therefore not billable to any one specific task. The superintendent is an indirect project cost. Compare this to the supervisory staff for the electrical subcontractor on the job. All the supervisor's time is focused on the specific tasks involved with the electrical work and can be billed against this cost. This supervision is *not* an indirect project cost.

Indirect project costs are typically, although not always, incurred only by the general contractor. Other examples of indirect project costs include safety management, project bonding and insurance costs, jobsite office supplies, and waste management.

There is a direct time-cost relationship between indirect project costs and how long the work continues: the longer the job the higher the indirect project costs. Once the construction is over, the jobsite trailer is removed, the portable toilets are returned, and the general contractor's superintendent goes on to another job; the work is done and so are all indirect project costs.

Indirect business costs (overhead)

There is a second category of indirect costs that are critical to the success of a contractor's business but are not classified as job costs: **indirect business costs**, more commonly referred to as **overhead**. These are the costs associated with running the contractor's business and *have no direct relationship with any specific job*. Overhead expenses include the cost of staffing the home office, telephone and fax machines, office rent, dues and memberships, continuing education, licensing fees, and so on.

Although overhead costs occur away from the jobsite, they are critical contractor expenses and must be paid for with proceeds from each job. How they are calculated is highly variable and depends on the contractor's fixed costs (such as rent and home office staff), the number of projects the office is

working on, and other factors. Sometimes contractors prorate overhead according to their volume of work; sometimes they charge a set percentage on all jobs. Typically, indirect business costs are simply added to the total estimated direct and indirect project costs. All contractors and subcontractors have overhead expenses that are at least partially funded through individual jobs.

Figure 12.1 shows a simple comparison of how different costs might be classified as either direct, indirect project, or overhead costs.

EXPENSE	DIRECT PROJECT COST	INDIRECT PROJECT COST	OVERHEAD
Roofing	✓		
Superintendent		✓	
Home office			✓
Telephone at jobsite		✓	
Telephone at home office			✓
Contractor's attorney			✓
Site excavation	✓		
Solar panels on the new building	✓		
Solar panels on the home office			✓
Drinking water at jobsite		✓	
Documentation		✓	

Figure 12.1. Comparison of costs.

Now that we understand in general terms how estimates are created, let's look at where contractors get their numbers and what makes a good estimate.

Where does the estimator get the numbers?

We know the types of costs estimators need to calculate, but where, exactly, do they get the numbers? There are three basic sources:

- In-house data from previous jobs (field-generated data)
- Purchased cost data
- Subcontractors and suppliers

The data contractors get from their own experience, called in-house data, is the best way to estimate costs. These are a contractor's tested, real costs, using known crews. This historical data—how much the same task for a similar project cost the contractor in the past—is the best way for the contractors or their estimators to price labor costs accurately. Estimators must remember to calculate price increases (inflation) since the work was performed. However, not even the best estimator can predict materials cost and market volatility caused by supply-chain issues or governmental acts (i.e., punitive tariffs).

There are sometimes items in an estimate for which the contractor does not have adequate data. Several companies specialize in compiling and publishing cost data. Although not as reliable as a contractor's own field data, purchased data can be accurate, because the costs may be adjusted for project conditions and location. One commonly used source of published data is RSMeans, a division of the Gordian Group, Inc., RSMeans is one of North America's leading suppliers of construction cost information and publishes estimating guides for all sectors of the industry and for different types of projects—residential, industrial, commercial, and institutional. They publish several dozen cost estimating and reference programs and books that are readily available. We'll examine some of the Means data in the next chapter.

There are other online and printed estimating resources and computer software such as Saylor's Construction Cost Index, BNi Building News Costbooks, DeWalt Estimating References, National Estimators, and many more. Finally, estimators can get pricing help from subcontractors and suppliers. Companies that supply materials, called vendors, gladly provide material and equipment costs to the estimator, as do potential subcontractors.

As recent experience has shown, however, supply chain issues contribute to cost volatility and may impact final project costs. Contractors often account for this volatility in their bids by specifying a narrow time frame for the estimate, using wording similar to "...cost is good for xx months (usually 3 to 6) from the date of this estimate…"

What makes a good estimate?

Sometimes it doesn't matter much if an estimate is not absolutely accurate. For example, if you are adding a bathroom in your house, miscalculate the plumbing costs, and end up spending more than you had planned, it could be expensive, but the loss may not make a substantial difference in your life. But if you're a subcontractor for all the plumbing in a 500,000-square-foot skyscraper and you make a mistake on your estimate, it could have catastrophic implications for your business, with lost reputation, litigation, and, in extreme cases, bankruptcy.

The goal of the estimate is to include *everything*, and for everything to be priced *accurately* so the estimated cost is as close as possible to the final, actual costs for the work. Because the contractor typically bears any cost overruns caused by errors or omissions in the estimate, it is crucial that the bid estimate be both accurate and complete. To ensure this, the estimator asks the following questions:

1. Has everything been accounted for and priced?
2. Are labor costs and material prices based on accurate data that reflect local conditions?
3. Are the quantity, quality, model numbers, and color of all products correct?
4. Does the price of materials and equipment include taxes and delivery?
5. Will the owner pay for materials that need to be stored before they're installed or used? (Note: Sometimes an owner will only pay for materials once they have become part of the structure.)
6. Do the manufacturer's warranties match what is required by the specifications? If not, the contractor will need to purchase an extended warranty.
7. Does the supplier offer a price discount for speedy payment? If the contractor can pay promptly for materials, many suppliers offer price breaks.

8. Have risks been carefully analyzed and does the estimate reflect this? (An example of a risk is escalating material costs for projects with a long construction time.)

9. Is there adequate overhead and sufficient profit?

Another question: is the contractor responsible for permits and fees? This is typically the case, and, if so, the fees, which vary by project location, need to be added to the estimate as well.

✔ **Value engineering** The increasing cost of materials, labor, overhead, and maintenance is making it necessary to get the most value out of our construction, and reducing costs is increasingly important. Many projects—from small houses to large industrial and commercial buildings—may be "value engineered" to minimize overall costs. Value engineering (VE) is not the same as "cost cutting" but is a methodical analysis of ways to reduce the costs of a project or structure over its entire life. Value engineering can be done at any time but is best done during the design phase when it's easier to make design adjustments. This is more often, however, done by the owner and architect after bids on a project come in higher than expected. At that time, VE is performed and new bids are solicited, becoming a whole separate phase of the work.

VE is a systematic process of analyzing specific building components and systems to find ways to perform the same function(s) at a lower life cycle cost without sacrificing reliability, performance, and design goals. It is possible that the initial cost for something (e.g., an expensive geothermal cooling system) will be higher than a conventional system but will save costs over the life of the project. Value engineering must balance the up-front costs with the long-term cost savings—and the budget and vision of the owner.

Now that we have a basic understanding of the components of and reasons for estimating, we're ready, in the next chapter, to take a look at different types of estimates.

Chapter vocabulary

Bid estimate (final, detailed, unit price estimate)—a cost estimate based on the most detailed design information developed by the contractor (or bidding contractors) after the design drawings and specifications are completed.

Construction Wage Rate Requirements statute (formerly Davis-Bacon Act)—a law stating that labor on federal projects or federally assisted projects must pay workers no less than the local prevailing wages and benefits.

Design estimates—estimates that are developed after some design parameters are known but decisions are still being made.

Detailed estimate (bid estimate, unit price, or final estimate)—a cost estimate based on the most detailed design information developed by the contractor (or bidding contractors) after the design drawings and specifications are completed.

Direct project costs—the labor, materials, and equipment expenses directly associated with the items that will become part of a physical structure.

Discount—a reduced price offered by suppliers for prompt payment by the contractor.

Estimate—an educated guess, based on the best available information, of what something is going to cost, usually in dollars or time.

Fee—the amount paid as remuneration for services; in construction, the fee is typically overhead plus profit.

General conditions costs (general requirements costs, indirect project costs)—expenses that are directly linked to the cost of the work but not to a specific task or subcontract.

Indirect business costs (overhead)—costs associated with running the contractor's business and not directly billable to any specific job expense.

Open shop wage rate—wages paid to workers who are not in a union or on a federal project, and as agreed to by the individual worker and their employer.

Overhead (indirect business costs)—the costs associated with running the contractor's business and not directly billable to any specific job expense.

Prevailing wage—pay rates set by the Department of Labor based on wages in a specific locality.

Productivity—how much a worker can accomplish in a given period of time.

Risk—something that can go wrong on a project, leading to potential financial loss.

RSMeans—a primary supplier of construction cost data.

Take-off ("doing the take-off")—the process of measuring construction drawings in order to quantify materials.

Union rates—wages paid to workers who are members of a labor union and whose pay rate is established by the union and a project's management.

Unit cost—the cost of materials based on a typical unit for that product such as tons, square feet, linear feet, or cubic yards.

Unit price estimate (bid, final, or detailed estimate)—a cost estimate based on the most detailed design information developed by the contractor (or bidding contractors) after the design drawings and specifications are completed.

Value engineering—a methodical analysis of ways to reduce the costs of a project or structure over its entire life.

Wage rate—rate (typically, by the hour) for labor, including costs such as social security, unemployment taxes, and health benefits in addition to the worker's direct pay.

Topics for discussion

1. You are an owner who plans to develop a new 24-unit housing complex and early estimates show that the overall project costs are too high for the type of housing. Discuss your possible responses to this news.
2. You have seen an invitation to bid for a large hotel/spa and have determined that you will try and get the job. There are two things that concern you about your ability to put together an accurate cost estimate that will

get you the job and still be profitable: 1) the owner wants the facility to open for the following Christmas holiday, which will require a tight schedule; and 2) you've never worked with the architect. Discuss why you think these might impact your cost estimate.

3. A contractor who is putting an estimate together is inexperienced at doing foundation work and therefore has no in-house cost data. How might they get cost figures for this portion of the job?
4. Why are labor costs more difficult to calculate than material costs?