

CHAPTER 15

ESTIMATING METHODS

1. INTRODUCTION

Several techniques are available to help the estimator estimate the cost of a project. Guidance on techniques may be found in the DOE Order 5700.2, COST ESTIMATING, ANALYSIS, AND STANDARDIZATIONS. Based on the project's scope, the purpose of the estimate, and the availability of estimating resources, the estimator can choose one or a combination of techniques when estimating an activity or a project. Estimating methods, estimating indirect and direct costs, and other estimating considerations are discussed in this chapter.

2. ESTIMATING METHODS

The following briefly describes techniques used to estimate.

A. Bottoms-Up Technique

Generally, a work statement and set of drawings or specifications are used to “take off” material quantities required to perform each discrete task performed in accomplishing a given operation or producing an equipment component. From these quantities, direct labor, equipment, and overhead costs are derived and added. This technique is used as the level of detail increases as the project develops.

B. Specific Analogy Technique

Specific analogies depend upon the known cost of an item used in prior systems as the basis for the cost of a similar item in a new system. Adjustments are made to known costs to account for differences in relative complexities of performance, design, and operational characteristics.

C. Parametric Technique

Parametric estimating requires historical data bases on similar systems or subsystems. Data is derived from the historical information or is developed from building a model scenario. Statistical analysis is performed on the data to find correlations between cost drivers and other system parameters, such as design or performance parameters. The analysis produces cost equations or cost estimating

relationships that can be used individually or grouped into more complex models. This technique is useful when the information available is not very detailed.

D. Cost Review and Update Technique

An estimate is constructed by examining previous estimates of the same project for internal logic, completeness of scope, assumptions, and estimating methodology and updating them with any changes.

E. Trend Analysis Technique

A contractor efficiency index is derived by comparing originally projected contract costs against actual costs on work performed to date. The index is used to adjust the cost estimate of work not yet completed.

F. Expert Opinion Technique

When other techniques or data are not available, this method may be used. Several specialists can be consulted repeatedly until a consensus cost estimate is established.

3. DATA COLLECTION AND NORMALIZATION

When estimating, cost data is collected. Data may be collected from similar projects, data bases, and published reports. The basis of the cost data should be documented as part of the detailed backup for the estimate. The amount of data collected will depend on the time available to perform the estimate and the type of estimate, as well as the budget allocation for the estimate's preparation.

When using the collected cost data, the estimator must be aware of the source of the data and make adjustments where necessary. Data from one project may not be consistent or comparable with data from a different project. For example, if historical costs data is used, the costs may not be applicable due to escalation, regulatory changes, or geographical differences. The data should be reviewed and adjustments (normalization) should be made before it is used in the estimate. Chapter 19 of this Guide provides more specific information on data normalization techniques.

4. HOW TO ESTIMATE DIRECT COSTS

In the initial stages of project development, estimates must be derived by using various relationships. As the project develops and more detail is available, the estimate also will be in more detail. Following are some general steps that may be used for developing the direct costs of a detailed estimate.

A. Material Takeoff

A material, labor, and equipment takeoff is developed from the drawing and specification review. The amount of detailed takeoff will vary with the amount of design detail. A planning estimate has minimal detail, while a Title II estimate has a great deal of detail. The takeoffs are divided into categories or accounts, and each account has subaccounts. Each project or program should have an established code of accounts. An example of accounts is shown in cost codes for construction projects in Chapter 16. By listing the accounts, a checklist of potential items, and activities that should be included in an estimate is formed. Each account should be considered, even when developing planning estimates, to help eliminate any omissions or oversights.

B. Pricing the Material and Equipment

On fixed price or lump sum contracts, the material cost should be the cost a contractor will pay for the material and does not include any markup for handling by the contractor. Freight at the job site is included in the material cost. Material and equipment that is specified as government furnished equipment (GFE) should be identified and kept separate from contractor furnished material.

Once the quantity takeoff is complete, the next step is to price the individual items. Several acceptable ways of pricing material are by verbal or written vendor quotations, up-to-date catalog price sheets, estimating manuals, and historical data. The current material price should be used whenever possible. If old prices are used, escalation must be added to make the prices current as of the estimate date. Escalation beyond the date of the estimate is included as a separate item.

C. Construction Equipment

Equipment and tools are required to install the materials. Databases can be used to obtain an equipment usage relationship with the materials. Large equipment may be estimated on an activity basis or may be estimated for the duration of the project. Pricing can be obtained from verbal or written vendor quotes, estimating manuals, and from historical data. Current prices should be used whenever possible, or prices should be adjusted to reflect prices at the time of the estimate date.

Some fixed price or lump sum contract projects require special tools or equipment for completion of the work. An example of this is a heating, ventilation, and air conditioning project that might require a large crane for setting an air handling unit on the roof of a building. The cost of the crane would be considered a direct cost. Examples of construction equipment are small tools and pickup trucks. These costs would be included as an indirect cost.

On cost-plus-fixed-percentage contracts, all costs for construction equipment and small tools are considered as direct costs.

D. Labor

Several good publications provide an estimate of the labor hours required for a task that the estimator should use unless adequate experience has given the estimator a more accurate base for determining labor hours required. One important item that must be remembered when using general estimating publications is that these publications are based on a national average construction project for private industry. The situation at various DOE sites may not be the same as an average construction site. Some examples of possible differences are: (1) security areas, (2) remote locations, (3) nuclear radiation areas, (4) degrees of inspection, (5) documentation, etc. For reasons like these, local productivity studies should be conducted to monitor the productivity at the specific site versus the labor hours given in the general estimating publications. If an estimate is derived using the publications, the site productivity factor must be incorporated into the estimated labor-hours. This should be done prior to multiplication of the labor-hours by the labor rate.

When estimating labor costs, the worker's base rate plus all payroll indirect costs, such as Federal Insurance Contributions Act and payroll insurance, are multiplied by the estimated labor hours to generate the labor cost. Typically, this sum is handled as a direct labor cost. For ease of estimating, an average crew rate can be used and rounded to the nearest even dollar hourly rate.

E. Special Conditions

Consideration must be given to all factors that affect construction. Some of these factors are:

- availability of skilled and experienced manpower and their productivity;
- the need for overtime work;
- the anticipated weather conditions during the construction period;
- work in congested areas or in radiation areas;
- security requirements imposed on the work area; and
- use of respirators and special clothing.

Special conditions may be estimated by applying a factor; for example, 10 percent was applied to the labor hours for loss of productivity due to work in a congested area. Other items may be calculated by performing a detailed takeoff. An example of this would be an activity that could only be performed over a 2-day period. Overtime would be required to complete the activity and the number of hours and rates could be calculated.

F. Government Furnished Material

Labor and equipment costs for installation of Government-furnished materials must be included for each item. They may be estimated as previously discussed. These costs should be kept separate from the labor and equipment costs for the materials the contractor is supplying.

G. Sampling and Analysis Costs

In some remediation projects, sampling and analysis costs are a part of the operations. They may be estimated by using the technical scope requirements to determine the type of sampling and analysis that will be performed and the project schedule to calculate the quantity of samples that will be collected. Costs can be obtained from current vendor quotes or from historical data.

H. Transportation and Waste Disposal

If waste disposal is required as part of a project, the waste classification must be identified. Based on the waste classification, disposal options can be identified. If waste is landfilled, the nearest appropriate landfill can be identified so transportation and disposal costs can be calculated.

I. Environmental Management Considerations

The same principles used for the determination of direct costs associated with construction estimates can be applied to environmental restoration and waste management estimates. In addition to the factors to consider for construction projects, the following factors should also be considered for an EM project.

- EM activities are often required to adhere to multiple regulations; most, if not all, of DOE's EM activities will be required to adhere to guidelines established by different regulatory regimes.
- EM activities usually require considerable sampling and analysis throughout the course of the project.

- EM usually includes waste transportation and disposal, which can be quite costly. The classification of the waste should always be identified as the basis of the estimate.
- The estimates developed are usually more parametric in nature than conventional construction estimates.
- Some projects may have on-site capabilities such as laboratories. This can affect the project cost if it is to be set up for this project or if it is an existing facility. Special facilities such as decontamination units are required. These are a direct cost to the project.

5. HOW TO ESTIMATE INDIRECT COSTS

A. Each Indirect Cost Account

The indirect costs may be included as part of the code of accounts for a project. One method to estimate the indirect costs is to assign a cost to each cost account. This must be based on the size and type of contract and could be a lengthy list. This method requires a great deal of experience and a working knowledge of the construction firm's experience.

B. Percentage

A multiplier from a local data base or from published cost manuals can be developed. Figure 15-1 is a chart that was developed over a set time frame for the average indirect costs of various fixed-price contractors working at the Idaho National Energy Laboratory. To use the chart, the ratio of direct cost material to labor must be determined. This ratio is plotted at the bottom of the graph. A vertical line is drawn from this point to intersect with the curve. The multiplier is read on the left-hand side of the graph and this multiplier is applied to the direct cost to determine the estimated indirect cost. All field offices and laboratories are encouraged to develop these local charts.

C. Government Furnished Equipment

If a project has “government furnished equipment and materials” that the contractor must install, an additional amount of 5 to 10 percent of the value of the GFE must be added to cover the contractor’s risk, insurance, and paperwork.

D. Special Considerations

Landlord costs for conventional construction projects include field support activities and are funded by Headquarters. If more than one tenant is located on a site, some of the infrastructure (i.e., indirect costs) may be shared. These costs should be kept separate where they can be easily identified in order to avoid “double-dipping” these indirect costs.

For EM projects, landlord costs can include provisions for compliance oversight and long-term surveillance and monitoring. As an example, assume that groundwater contamination had occurred at a site. Groundwater remediation will be required long after a site’s surface has been remediated. The project estimate should include costs for long-term sampling associated with of the groundwater remediation.

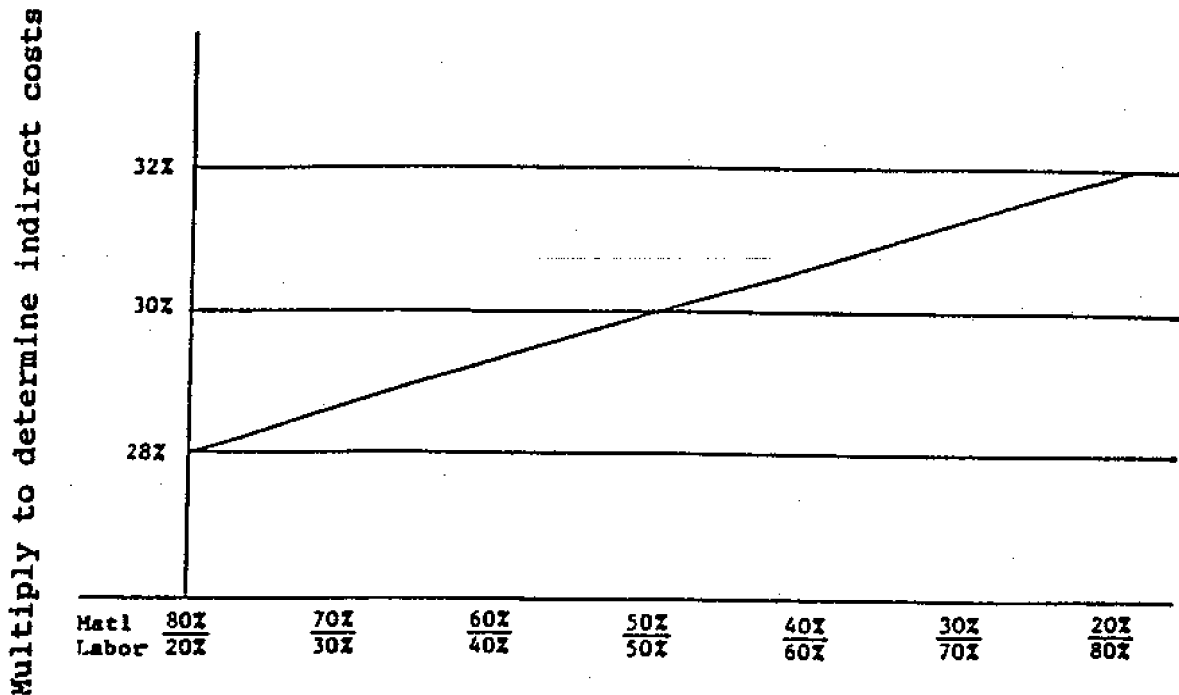


Figure 15-1. Idaho National Energy Laboratories Indirect Costs (1988)

6. GUIDELINES FOR MANAGEMENT COSTS

The estimate for management costs is largely a function of the duration of the project from the start of Title I through completion of construction.

A. Construction Management

A construction manager (CM) is responsible for construction activities. This responsibility includes subcontracting, purchasing, scheduling, and a limited amount of actual construction. Chapter 3 is intended as a guideline for determining whether cost elements should be included as project management, construction management, or project support, and should be followed by all DOE Field Offices and contractors.

Generally, CM costs are approximately 5 to 15 percent of the sum of the direct costs, indirect costs, and GFE whose installation is under the direction of the CM.

B. Project Management

The estimate for project management must consider the time element from start of Title I design through completion of the construction for the project. Other factors to consider are the complexity of the project, the design group, the organization for which the project is to be performed, and the extent of procured items. Projects involving travel must also include those costs. Typically, project management costs range from 2 percent to 5 percent of the total project cost.

C. Construction Coordination

Construction coordination includes a field engineer. The field engineer should be involved in the review of the Title I and II documents, as well as coordinate field construction. This function is generally estimated to be about .5 to 1 percent of the construction costs.

D. Quality Engineering

For the quality engineering estimate, the tasks for the project must be defined, and the man-hour effort with the quality organizations should be negotiated. The estimate will depend upon the quality level of the project, the amount of procurement effort, and level of involvement of the quality inspection organization. Where the latter is involved, quality engineering is responsible for the preparation of the quality plan. Travel must also be considered. The portion of quality engineering that is an audit function is not funded by construction and need not be included in the estimate.

E. Health and Safety

This function is involved with the review and approval of the design package as well as the safety audits and health physics surveillance throughout the course of the construction period. Factors affecting this element are the type of project, operational area where the construction takes place, the amount of work requiring radiation surveillance, and any other special health and safety requirements. The portion of health safety that is an audit function is not funded by construction and need not be included in the estimate. This is typically estimated by taking from .5 to 1 percent of the total construction costs for conventional projects and would be more than that for a remediation job.

F. Environmental Restoration Management Contractor

Construction management costs for environmental restoration projects are those activity management services required to manage construction or cleanup activities, including review and approval of cleanup bid packages, review and acceptance of construction test procedures, control of field design change requests, and review and approval of contractor pay requests. The Environmental Restoration Management Contractor manages and executes the Environmental Restoration Program for a site.

G. Program Management

Activity management associated with environmental restoration parallels construction project management. However, when estimating activity management, consideration must also be given to program management.

Program management consists of those services provided to the DOE on a specific program for planning, organizing, directing, controlling, budgeting, and reporting on the program. Program management will be provided as multiple levels within the EM program including the Headquarters, Operations Office, and installation. Program management includes program support. Program support covers those activities performed for internal management and technical support of the program by part-time or full-time personnel.