NAC **Executive Insights**

Essential Requirements for an Effective Cost Estimating Database

Key Points

1. Match project type.
2. Normalize historical cost to specific location.
3. Normalize historical cost to specific date.
4. Support different estimating techniques
5. Build in flexibility

Owners require different types of historical data when compared to service providers. Owners typically are involved in early scope definition and the need to convert broad scope statements into cost. The historical cost data needed for such an owner estimate is generally focused on dollars per key facility parameters. Generally, service providers require a broader and more detailed set of historical cost data. This data is as general as dollars per key facility parameter and as detailed as specific costs for labor, materials, construction equipment, and other facility project costs (indirect field costs, engineering cost, etc.). Thus, databases are extremely important to preparing accurate and timely cost estimates for both owners and service providers.

Introduction

Accurate development of a cost estimate requires a scope document describing the project objectives and an appropriate cost database for converting the scope requirements into estimated costs. As discussed in the Executive Insight "Scope Development to Support Cost Estimating," the level of scope detail varies depending on the project development phase and whether the owner or contractor is the primary developer of the scope document. In one case, scope is described in terms of approved-for-construction plans and specifications. When plans and specifications are available, a task-level cost database may even be tied to task-cost codes and can be used to develop an estimate of project construction cost. At the other extreme, when scope is described by gross parameters, square feet, or length, a different level of cost data is required, such as the cost per unit (or single parameter) covering the entire facility scope. This Executive Insight covers the essential requirements of cost estimating databases.

Match Project Type

The construction industry is structured around four major sectors: building, infrastructure, industrial, and residential. Each sector is comprised of different types of projects, generally aligned with the characteristics of the facilities typical to the construction sector. Cost databases must reflect the characteristics of projects within each sector. These databases must also reflect different estimating techniques, including bidding approaches when plans and specifications are one hundred percent complete.

Normalize Historical Cost to Specific Location

Cost databases must be normalized for a specific location to be useful. This means that historical costs from completed projects, which are often designed and constructed in different states across the U.S. or in other countries, must be converted back to a specific location. For example, the Gulf Coast often serves as a common location for projects in the industrial sector.

The user of the database can adjust historical data from a common location to a project specific location using specific characteristics of the project's proposed location. On the Gulf Coast, for example, there is a concentration of labor experienced in the delivery of petrochemical facilities. The productivity of the labor force is known and has been recorded in the databases of individual companies as well as in commercially available cost databases. If the new proposed project is in the Northeast, the historical Gulf Coast cost will have to be adjusted for labor skill levels, differences in labor pay scales, and the effects of working in cold weather.

Normalize Historical Cost to Specific Date

Cost databases also must be normalized for a specific date, typically a year or a month. This means the historical costs from completed projects designed and constructed during different years must be converted to a base year (e.g., January 2016). The user of the database then can adjust the historical data from the base year to when a project will be constructed in the future (e.g., mid-2020).

There are two parts to a historical cost adjustment: 1) the general inflation rate for the location of the project and 2) macro-economic changes. The Consumer Price Index (CPI) published by the U.S. Department of Labor is based on a market basket of consumer goods. While the CPI market basket includes energy costs, it does not specifically represent the materials used to build a project. Its purpose is to measure changes in the cost of living. Macro-economic changes in the case of construction refers to the demand for specific materials. The demand and cost of cement is driven by the changes in building activity.

Support Different Estimating Techniques

Project scope develops over time from little to substantial detail. This necessitates the use of different estimating techniques and, as a consequence, different types of databases. The driver behind which estimate technique or combination of techniques is the level of project scope definition. An overview of estimating techniques is presented in Table 1. The focus of this Insight is related to the historical data needed to support each technique.

Table 1. Estimating Techniques Supporting Project Development

TYPE	PROJECT PHASE	PURPOSE	BASIS	COMMENT
Order of Magnitude	Front End Planning — **Feasibility**	Screen for Project Viability	$ per Key Facility Parameter	Owner-Driven
Conceptual — Factored or Ratio	Front End Planning — **Detailed Scope**	Approval for Project Execution	Major Facility Parameters Defined	Owner-Driven with Service Provider Support
Semi-Detailed	Project Execution — **Engineering and Design**	Basis for Cost and Schedule Control	Combination of Factored/Ratio and Quantity Pricing Based on Preliminary Plans and Specifications	Driven by Service Provider with Owner Input
Detailed	Project Execution — **Construction**	Basis for Bidding Construction	Quantity Pricing Based on 100 Percent Plans and Specifications	Driven by Service Provider

An **Order of Magnitude** estimate for a project requires identification of at least one key cost-driving parameter for a facility, such as square foot for buildings or megawatts for a power plant. A Conceptual estimate (often called factored or ratio) requires the identification of key components of a facility, such as the major mechanical equipment in a refinery expansion or major systems of a building or number of lanes and their width and the type of pavement structure for a highway facility.

Once these key components are defined, ratios or factors can be developed to estimate all other facility costs, such as bulk materials, labor, indirect field costs, and engineering/design costs to provide a total cost of a facility. Once detailed engineering and design commence, preliminary plans and specifications are developed. The preliminary plans form the basis for development of rough approximations of material quantities to construct the facility. With definition of quantities, it is possible to prepare a Semi-Detailed estimate. Factors or ratios may be needed to determine some costs until all plans and specifications are one hundred percent complete. Finally, once plans and specifications are one hundred percent complete, detail quantity take offs and pricing of materials, labor, construction equipment, and field indirect costs can be prepared for bidding a project. This is known as a Detailed estimate.

Illustrations of typical detailed estimate content is covered in two Executive Insights: "Pricing Work for a Profit: Developing a Construction Estimate" and "Bidding Unit Price Work: Low Bid Hoover Dam."

Build In Flexibility

Cost databases should be flexible to accommodate different levels of scope definition. A database that reflects total project cost for a specific type of facility based on a single key parameter is one type of database, and is often described in terms of a cost-capacity curve. At the other extreme, a database can reflect task-level historical data typically based on a common cost coding system. This type of database provides specific tasks production rates and may even describe crew composition for completing the tasks, material costs for the tasks, and the cost of construction equipment. Indirect field cost, engineering/design costs, and any other costs must be included to provide a total project cost estimate. This range of estimating techniques is illustrated in Table 1.

About the Author

Stu Anderson was elected to the National Academy of Construction in 2010. He retired from Texas A&M University in 2019, where he served as assistant vice chancellor for facilities planning and management. He also was a tenured professor and held the Zachry Chair in Construction Integration in the Texas A&M College of Engineering. He earned a bachelor's degree in building construction from the University of Washington, a master's of civil engineering from the University of Illinois, and a PhD from The University of at Texas Austin. He was previously with the Fluor Corporation and with Stone & Webster.