NAC Executive Insights

Project Cost Estimating — Introduction

Key Points

- All participants in the project process use cost estimates.
- Cost estimates are prepared over the project life cycle by different participants.
- Project cost estimating is a major challenge for all participant organizations.

The purpose of the Executive Insight is to increase understanding of the critical importance of cost estimating in capital project development and delivery processes. Cost estimates serve as the basis for making financial decisions about moving projects forward based on rate of return or cost-benefit analyses. They also are used to insure that sufficient funds are available for completing the project, determining baseline cost for managing projects, bidding projects, and controlling costs as project funds are expended. All participants in the project process, including owners, architect/engineers, and contractors use cost estimates. The types of estimates and when and how project participants use cost estimates are the subjects of this Insight topic.

The description and application of project cost estimating is covered in more detail through the following sub-topics, which are covered in other NAC Executive Insights:

- Scope development to support cost estimating
- Essential requirements for an effective estimating database
- Early project cost estimating for decision making on project initiation
- Risk analysis and setting contingency to estimate the cost of project uncertainties
- Pricing work for a profit: developing a construction estimate
- Bidding unit price work: low bid Hoover Dam

Beginning the Cost Estimate Process: Front End Planning

Cost estimates are prepared over the project life cycle by different participants. Project development and delivery can be characterized by a model developed by the Construction Industry Institute (CII). The CII model has two major phases: 1) Front End Planning; and 2) Project Execution. Front end planning is comprised of three steps:

1. **Feasibility** – evaluate whether or not a need or idea justifies a project.

2. **Concept** – evaluate alternative solutions if a project is justified; include technologies, major construction methods, and locations; select the best alternative and location.

3. **Scope Definition** – commence engineering on the best alternative to develop the scope to a sufficient level so that a decision can be made on whether to proceed or not or to further evaluate the project. This decision is made as a condition of starting project execution with detailed design and procuring major permanent facility equipment.

Moving to Project Execution

The second major phase is project execution. This phase is comprised of four steps:

1. **Detailed Design** – development of approved plans and specifications for construction
2. **Procurement** – purchasing of major permanent facility equipment (mechanical, electrical, etc.) and bulk materials
3. **Construction** – installation of all equipment and materials
4. **Commissioning** – starting up the facility for operation

When the owner moves into one of these steps that requires expertise from service providers, he or she has to decide what delivery method and contract strategy will be used. A number of delivery methods are available, with the most common being:

- Design-bid-build – the owner works with a separate architect/engineering firm to design the facility and a contractor to build the facility per the design; design and construction are sequential.
- Design-build – the owner works with an organization that is responsible for both design and construction; design and construction frequently overlap.
- Construction Manager at Risk – the owner works with both an architect/engineer and a general contractor simultaneously; the contractor provides input to the designer during the design process.

Each delivery method is contracted using either lump sum fixed pricing, cost reimbursable, guaranteed maximum price (GMP), or some combination of these contracting strategies. The owner must determine which contract strategy works best for the given delivery method on a project-by-project basis.

Understanding the Challenge of Cost Estimating

Project cost estimating is a major challenge for all participant organizations in the construction industry. This challenge is the result of four critical project management and development issues:

- First, definitive project solutions are difficult to define for many of the questions that arise in early project development.
- Second, it is often arduous to quantify major areas of variability and uncertainty in project scope or cost.
- Third, evaluating the completeness and quality of project estimates is formidable.
- Fourth, it is tough to track the cost impact of scope development that occurs between cost estimates.

These four challenges are amplified because of several factors that can influence a cost estimate, for example insufficient knowledge about project location characteristics, permitting and code requirements, environmental mitigation, work-hour restrictions, and skill levels of crafts at the work location. Moreover, process-related factors add to the challenges in cost estimation, with influences such as assessment of the cost impact of engineering complexities and constructability, economic and market conditions fluctuation, changes in regulatory requirements, and stakeholder interests.

Different types of estimating techniques are used to determine project cost during the different phases of project development. The techniques range from order of magnitude estimates using a single project parameter (e.g., building square feet, megawatts delivered, or miles of roadway) to detailed estimates based on a list of items and their quantities of materials from construction drawings. All estimates are influenced to some extent by the four challenges cited above and by the timing of the cost estimate in the project life cycle.

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.