Reliable Construction Cost Estimating Practices

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Efficient and best management practice construction cost estimating, and ongoing construction project/program management involves early and ongoing planning, inclusive of the collaborative and competent involvement of all construction project participants and stakeholders.

Within this structure the Real Property Owner demonstrates appropriate leadership skills and manages the selected internal and external service delivery teams. Continuous monitoring, process improvement, and resource development with the objective of common best value outcomes are primary responsibilities.

In general terms are an *actionable construction cost estimate* must be *reliable.*
A reliable estimate is one that reflects the approximate project cost developed using ***locally researched*** *detailed construction line unit price tasks/activities.* Many owners, architects, engineering, and builders inappropriately refer to the "accuracy" of construction cost estimates. This is simply unfortunate as estimates are, by their very nature, approximations. The ability to determine accuracy requires a known data point, a datum. Many, if not most, assume that the final "as built cost" is the datum. That assumption is faulty due to the numerous aspects that typically affect the final cost outcome (planning, procurement and project delivery method…). A reliable and verifiable construction cost estimate, however, is not only possible, but should be the primary consideration. As noted, the most reliable form of construction cost estimate is one developed using granular local labor, material, and equipment costs that have be researched to reflect specific construction tasks. Each task should be totaled and presented in a cost per unit of measure (square foot, cubic foot, each, etc.). Using this approach, a reliable total coast and complete schedule of detailed construction line-item tasks/activities can be prepared after consideration of all physical and functional requirements and potential cost variations.

Overall, the process of generating a reliable construction cost estimate can be defined as a

quantitative assessment process that generates a detailed line-item construction cost estimate base upon locally researched information.

There are multiple alternative forms of estimates including conceptual, square foot, building, system, life cycle, etc. The primary focus here is upon reliable construction cost estimating that can be used to quantify, bid, procure, and execute repair, renovation, maintenance, or new build projects. The alternative methods should never be used for these purposes. A detailed locally researched line-item construction cost estimate should be considered mandatory before any final construction project is approved and begun.

A few general principles greatly assist in the development of reliable construction cost estimates:

- Early and ongoing participation, transparency, collaboration of all stakeholders (designers, architects, engineers, construction contractors, facilities management, building users, oversight groups, etc.)
- Full line-item descriptions in plain English using industry standard terms.
- Organization by a standard data architecture (CSI Masterformat)
- Independently and locally researched cost information (No use of national average cost data, localization factors, area cost factors, etc.) Full details of locally researched specific labor, material, and equipment costs and type, as well as crew composition and productivity.
- Line-item modifiers (adds/deducts from the parent line item) to account for quantities, means and methods, location, etc.)
- Separate demolition line items
- Separate repair line items
- Separate repair and replace line-items.
- All cost information is updated (annually at a minimum and more frequency as needed) to reflect current location, time, requirements, and conditions.

General review of the Cost Types

Variable Cost - Any cost that changes with the amount of production or the amount of work. Examples: cost of materials, power, water, labor

Fixed Cost - Cost that does not change as production changes is a fixed cost. Examples: mobilization/set up cost, rental or rental of equipment or machinery.

Direct Cost- Costs are directly attributable to the work on the project. Example: team travel, team wages, recognition, and costs of materials used on the project.

Indirect Cost - Overhead items or costs incurred for the benefit of more than one project are indirect costs. Example: Corporate Tax, Fringe Benefit Tax.

Opportunity Cost – Cost associate by choosing a particular method or project over another an opportunity cost.

Sunk Cost - Costs are the ones which were already spent on the project earlier and generally not considered when future decisions are made.

Types of Estimating and Associated Key Terms

Analogous Estimating - Using the actual cost of previous or similar projects as the basis for estimating the cost of the current project.

Researched Costs/Cost Rates - Actual per unit labor and material resource rates are that are collated or estimated. May include subcontractor quotes, current/previous relevant contracts, and commercial cost databases.

Bottom-up Estimating (also detailed line item estimating- Individual schedule activities, and/or task, that are estimated to the smallest reasonable level of detail to provide the greatest level of confidence. All costs are then aggregated and used for reporting, tracking and control purposes. Individual activity/task cost is clearly defined.

Parametric Estimating - This technique uses historical cost with current project variables that are determined.

Cost Estimating Software – Purpose built construction costing technology in lieu of paper, spreadsheets, etc. Minimum capabilities should include the ability to house, store, and recall a construction cost database, provide a collaborative environment, create, copy, share, compare, review, add line-item notes, and export (csv., PDF) detailed line-item cost estimates.

Contingency or Reserve Analysis - Allowances used to deal with uncertainty and added to the cost estimates, and which generally overstate construction project costs.

Cost Budgeting - Aggregating the estimated costs of individual schedule activities or work package to establish a total cost baseline for measuring project performance. The project scope of work statements is prepared prior to the summary budget. Schedule activity or work package cost estimates are prepared prior to the detailed budget requests and work authorization.

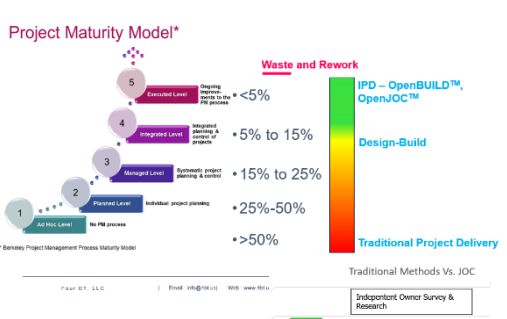
Cost Aggregation - Schedule activity cost estimates are aggregated and grouped by work packages, which may be then grouped by higher levels as per levels set by the WBS, then finally by the entire project.

Parametric Estimating – Using construction project characteristics (parameters) in a mathematical model to predict total project costs. Both the cost and reliability parametric models vary widely. Parametric estimating should not be used for final project bidding, procurement, or execution.

Funding Limit / Budget Reconciliation - Funds are reconciled and based on the results and new limits are set and WBS components are adjusted. This may impact allocation of resources to the project. If costs are used in the schedule development process, the process is repeated with new constraints and a new baseline is derived.

Primary Causes of Cost Variation

Cost control and/or the level of confidence associated with a construction cost estimate can be affected by several factors…
1. Level of collaboration, information source, detail, and format with which the scope of work is communicated, shared, and discussed among all participants and stakeholders,
2. The construction planning, procurement, and delivery method. (A proven, robust integrated planning, procurement, and project delivery environment impacts overall project outcomes more than any other factor. It is this environment, combined with owner leadership and competency that sets the overall tone of project and defines all roles, responsibilities, workflows, information, deliverables, levels of risk, etc.)



3. The experience level and competency of the team, especially the levels of owner leadership and competency.
4. The amount experience that the team has had working together in the past (A factor that highlights the benefits of long-term, mutually beneficial relationships.)

5. The degree and/or number of uncertainties.

Tools and Techniques of Construction Estimating and Associated Cost Control

Project / Program / Contract Execution Plan and//or Operations Manual – The integrated construction planning, procurement, and project delivery method also included a multi-party contract and an associated Operations Manual or Execution Guide as part of the contract.

These documents provide a written, detailed, and agreed upon definition of roles, responsibilities, documents, costs data types/formats, specifications, outcomes, deliverables, processes, workflows, approvals/approval levels, etc., and tools associated with cost management and project delivery management.

Collaborative Construction Cost Estimating and Project Management System - Cloud based systems enable the transparent creation, modification, use, updating, and storage. Inclusive of a locally researched construction cost line-item database.[1]

Key Performance Indicators, KPIs, and Performance Measurement Analysis - Performance measurement methods, metrics, and techniques help to assess the magnitude of any variance that will invariably occur with any construction estimate, or construction project/program. For example, the earned value technique (EVT) compares the cumulative value of the budgets cost of work scheduled (planned) to the actual cost control, resource management, and production. An important part of cost control is to determine the variance, the magnitude of the variance, and to decide if the variance requires corrective action. The earned value technique uses the cost control contained in the project management plan to assess project performance, and the magnitude of any variations that occur. The earned value technique

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[1] Additional Technology Feature Considerations

- User administration – Assign users and user privileges.
- Dashboard View of Open, In Process, and Complete Projects, Work Orders
- Access to all JOC Forms and Project/Work Order Documents
- Contractor Management
- Coefficient Management – Lock and track multiple coefficients per contractor/per contract.
- Built in Forms with appropriate approval authorities.
- MBE/WBE Tracking
- Export to PDF/Excel
- Automatic estimate comparisons
- Multiple line-item search capabilities (Navigation tree, Masterformat number, and Keyword)
- Copy/Paste Estimates/Projects Copy/Paste Estimates/Projects
- On-line collaborative proposal review
- Tracking of all non-prepriced (NPP) line items
- Full data export
- Support for multiple UPBs
- Internal Messaging and Notification (No issues associated with “email-based” systems)
- Secure Log-in, Data Encryption, Data Backups, Server/Location Redundancy
- User Profile - User Information-Name, Title, Photo, Contact Info, Language, Time Zone, Units of Measure, Date/Time Formats, Currency Time/format, Privacy, Security
- Building/Site Information
- Team Information and Team Management
- Document Management (Check-in/Check-out and Version Control)
- Issues Creation and Management
- Tasks Creation and Management
- Space Management
- BIM model viewing and information access (Real time access to drawings using the integrated DWG Viewer and to BIM (Building Information Modelling) data. (RVT and IFC file formats)

involves developing key values for each schedule activity, work package, or control account.

Planned value (PV) - PV is the budgeted cost for the work scheduled to be completed on an activity or WBS component up to a given point in time.

Earned value (EV) - EV is the budgeted amount for the work actually completed on the schedule activity or WBS component during a given time period.

Actual cost (AC) - AC is the actual cost incurred in accomplishing work on the schedule activity or WBS component during a given time period. This AC must correspond in definition and coverage to whatever was budgeted for the PV and the EV (e.g., direct hours only, direct cost only, or all costs including indirect costs).

Estimate to complete (ETC) and estimate at completion (EAC) - The PV, EV, and AC values are used in combination to provide performance measures of whether or not work is being accomplished as planned at any given point in time. The most commonly used measures are cost variance (CV) and schedule variance (SV). The amount of variance of the CV and SV values tend to decrease as the project reaches completion due to compensating effect of more work being accomplished. Predetermined acceptable completion can be established in the cost management plan.

Cost Variance (CV) - CV equals earned value (EV) minus actual cost (AC). The cost variance at the end of the project will be the difference between the budget at the completion (BAC) and the actual amount spent. Formula: CV=EV-AC

Schedule Variance (SV) - SV equals earned value (EV) minus planned value (PV). Schedule variance will ultimately equal zero when the project is completed because all of the planned values will ultimately equal zero when the project is completed because all of the planned values will have been earned. Formula: SV=EV-PV. The values CV and SV can be converted to efficiency indicators (KPIs) to reflect the cost and schedule performance of any project.

Cost performance index (CPI) - A CPI value less than 1.0 indicate accost overrun of the estimates. A CPI value greater than 1 indicates a cost under-run of the estimates. CPI equals the ratio of the EV to the AC. The CPI is the most commonly used cost-efficiency indicator. Formula: CPI=EV/AC

Cumulative CPI (CPI^c) - The cumulative CPI is widely used to forecast project costs at completion. CPIC equals the sum of the periodic earned values (EV^c) divided by the sum of the individual actual costs (AC^c). Formula: SPI=EV/PV. The earned value technique in its various forms is a commonly used method of performance measurement. It integrates project scope, cost (or resource) and schedule measures to help the project team assess project performance.

Forecasting - Making estimates or predictions of conditions in the project's future based on the information and knowledgeable available at the time of the forecast. As the project progresses, the forecasts are adjusted. The earned value technique parameters of BAC, actual cost (AC^c) to date, and the cumulative CPI^c efficiency indicator, are used to calculate ETC and EA, where the BAC is equal to the total PV at completion for a schedule activity, work package, control account, or other WBS component. Forecasting technique parameters to assess the cost or the amount of work to complete schedule activities is called the EAC. Forecasting techniques also help to determine the ETC, which is the estimate for completing the remaining work for a schedule activity, work package, or control account. While the earned value technique of determining EAC and ETC is quick and automatic, it is not as valuable or accurate as a manual forecasting technique based upon the performing organization providing the estimate to complete. ETC is based on the new estimate. ETC equals the revised estimate for the work remaining as determined by the performing organization. This more accurate and comprehensive completion for all the work remaining considers the performance estimate to complete all the work remaining and the performance

or production of the
resource to date. Alternatively, to calculate ETC using value data, one of the two formulas is typically used: ETC based on atypical variances. ETC equals the BAC minus the cumulative earned value to date (EVC). Formula: ETC= (BAC - EVC)

ETC based on typical variances - ETC equals the BAC minus the cumulative EVC (the remaining PV) divided by the cumulative cost performance index (CPIC). EAC using a new estimate. EAC equals the actual costs to date (AC^c) plus a new ETC is provided by the performing organization. Formula: EAC=AC^c + ETC