Best Practices for Cost Estimating

Guidelines for Developing Accurate Estimates on Major Capital Projects at Washington State Community and Technical Colleges

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Executive Summary

Capital project cost estimates must be completed for all major capital projects. These cost estimates are progressively refined as more information is developed throughout the Predesign and Design process. The level of accuracy and related contingency has been consistent with industry standards and are typically adequate to meet the needs of the projects.

Changes to the project size during design significantly reduce the relevance of previous cost estimates. To improve the accuracy of the cost estimate and likelihood of managing the project within the funding, we recommend that college leadership do not allow increases in project building size after the proposal phase is complete.

Careful scrutiny of consultant’s Extra Services requests may reduce design and related construction costs. However, we are recommending additional review and coordination of electrical-related design elements to avoid costly construction change orders.

Another cost saving strategy is to maximize the number of bidders on a project. The more bidders there are on a project the lower the low bid is likely to be. This might be achieved by providing personal invitations to contractors to bid the work, modifying the bid date based on contractor bidding schedules, or through community outreach through fraternal and service organizations.
What process do we currently use?

In parallel with project design the cost estimate is developed through progressive refinement. As the level of detail in the design increases the estimate is updated and becomes more accurate. When project funding is requested it is based on the best estimate available at that time. Project scope may have to be reduced when managing the project to fit it within available funding.

**Project Request**

One element of a Project’s score is based on a comparison of its estimated cost to OFM expected cost. The score of individual projects and the cumulative cost of all projects are factors in sizing the system’s capital budget request.

A building is sized based on program need. The State Board’s Capital Analysis Model provides allowances for many common spaces. Vocational programs often require an evaluation of how the specific program will be delivered to determine the space needed.

The cost per square foot at this stage of the process is primarily based on previous projects that served similar purpose adjusted for inflation and location using cost indices.

**Predesign**

The program and assumptions about the space needed are reviewed during the Predesign. Building cost per square foot and equipment costs are informed by detail programming, room data sheets, and project features.

Infrastructure costs are also updated based on preliminary investigations of the site.

This estimate is still based on similar projects and typical cost breakdowns opposed to quantity takeoffs.

When Predesign is funded separately from Design, the total cost is loosely constrained by the previous Project Request estimate. When Predesign and Design are funded together, the total cost coming out of the Predesign is more tightly constrained by the Project Request estimate.

**Design**

The Design is accomplished in three steps; Schematic Design, Design Development, and Construction Documents.
Schematic Design is still conceptual in nature but benefits from a broader and deeper look across all of the project components. During Design Development most of the project features are quantified. The final step before bidding the project is to develop Construction Documents. This level of detail allows costs to be estimated based on specific quantities and qualities called for in the specifications.

Specific equipment needs are now identified and their costs updated.

The total cost coming out of the Design is tightly constrained by the Predesign estimate. Only future inflation or new external constraints should change the total cost. Once funded for Construction, the college must manage the total cost within the funding provided.

**Bid**

Prior to bidding the cost estimate for construction is reviewed and updated in light of current market conditions and any proposed bid alternates. This estimate is called the Engineer’s Estimate and is required by public works law but does not change the Project’s funding.

The following table summarizes the use, basis, and expected accuracy of project cost estimate by project phase.

<table>
<thead>
<tr>
<th>Primary Use</th>
<th>Project Request</th>
<th>Predesign</th>
<th>Design</th>
<th>Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget Use</td>
<td>Predesign/Design Funding</td>
<td>Design Budget (if not already funded)</td>
<td>Construction Funding</td>
<td>None</td>
</tr>
<tr>
<td>Design Completed</td>
<td>1% to 15%</td>
<td>10% to 30%</td>
<td>30% to 90%</td>
<td>90% to 100%</td>
</tr>
<tr>
<td>Basis</td>
<td>Preliminary Programming and Previous Projects</td>
<td>Detailed Programming and Previous Projects</td>
<td>Take Off Quantities with Unit Prices based on Market Trends</td>
<td>Take Off Quantities with Unit Prices based on Recent Market Conditions</td>
</tr>
<tr>
<td>Accuracy</td>
<td>+/- 20%</td>
<td>+/- 15%</td>
<td>+/- 10%</td>
<td>+/- 5%</td>
</tr>
<tr>
<td>Contingency</td>
<td>+10%</td>
<td>+10%</td>
<td>+10%</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

| Required RCW 39.04.020 | | | | |
|-------------------------|-----------|--------|-----|

RCW: Revised Code of Washington
How much have estimated project costs changed from the proposal to the construction funding request?

The following chart compares the college’s originally proposed cost (PRR) and building area to the amount included in the final request for construction phase funding (CR).

Cost and Area Change
Increase in Requested Area and Cost of Several Recent Projects

The change in cost of projects where the area did not significantly change is well within the estimating accuracy of +/- 20% expected at the Project Request phase.

There is a strong correlation between increasing area and increasing cost. Since colleges have control over the area throughout the design process, the college has significant control over the project cost.
How accurate have our estimates been?

The following chart compares the Engineer’s Estimate just prior to bid to the low bid before and after the market change in July 2008.

This chart demonstrates that the estimate just prior to bid averages 5% higher than the low bid. This average is consistent with industry standards. However, reducing the range would benefit individual projects.

What contributed to some of the bids being significantly different than the estimates?

There were 5 projects with bids more than 20% above and 21 projects below the Engineer’s Estimates.

All but one of the bids that were more than 20% higher occurred prior to the July 2008 market adjustment and they were in the Seattle area which was experiencing a shortage of skilled workers due to a rapid increase in construction volume. The project with the bid which was the greatest percentage over the Engineer’s Estimate was bid in July 2007 for $1,545,000 and
included overwater repair of Redondo Pier at Highline College’s Marine Science and Technology Center. The labor shortage, specialized work, and relatively small size of the project contributed to the bid significantly exceeding the estimate.

All of the projects with bids that were 20% below the Engineer’s Estimates occurred right before or after the July 2008 market adjustment. This variance was primarily due to the lag in adjusting to the new market condition. It takes several months to collect data and quantify the change and then years to get the new market fully accounted for in project estimates.

The project with the bid which was the greatest percentage under the Engineer’s Estimate was bid in February 2009 for $2,169,461 and included an addition and renovation to Shoreline Community College’s Automotive Training Center. This was a matching fund project and the design was started in July 2007 and the bid was planned for December 2007. However, the college chose to postpone the bid until February 2009 which placed most of the design and estimating before the market adjustment and the bid occurred after the market changed. This timing was the single largest contributing factor to the low bid. The project was also changed from a multi-phase project to a single phase to save on mobilization and avoid further escalation costs. The timing of the bid and acceleration of the project contributed to the bid being significantly below the estimate.
Is there a correlation between the number of bidders and the accuracy of the engineer’s estimate?

This chart compares the Low Bid to the Engineer’s Estimate versus the number of bidders. It also shows the number of community and technical college projects versus the number of bidders included in the analysis.

Both published research and a sample of bid results from the community and technical college system indicates as the number of bidders increases the low bid goes down relative to the Engineer’s Estimate.

There are fewer than ten bid results in the sample data for projects with more than seven bidders and this relatively small number of data points probably explains why the trend does not continue to monotonically decrease and level off as indicated by the research.

The Engineer’s Estimates are closest to the bid results with between two and three bidders.


2 165 SBCTC projects bid July 2011 through December 2013
What are typical change order rates?

The following chart illustrates change orders as a percentage of the original contract amounts for all of our major projects completed between January 2007 and May of 2013.

![Change Order Rates Chart](image)

The State’s method of calculating the amount of contingency dollars in a project is the contingency rate times the estimated cost of the consultant services and construction. However, all projects include other costs that can exceed estimates and create additional demands on the contingency dollars.

For example, additional permit related mitigations are often identified by the Authority Having Jurisdiction after the project has been funded for construction. The cost of the additional mitigations must come from the project contingency even though the base permit and mitigation expenses were not included in the calculation for the amount of contingency in the project. This reduces the contingency dollars and effective rate available for construction below the rate attributed to the project.

Using the State’s method for calculating contingency, most projects can be managed with a 10% contingency rate.
What are the reasons reported for change orders?

The following chart illustrates the reported reasons for change orders on all projects and how they have not changed significantly overtime.

The chart also illustrates that the single largest reason given for change orders are “scope changes.” This classification does not provide any insight into the reason for the change and is not useful for making decisions about how to better manage projects.
How does project cost affect the reason for change orders?

Here we can see there is little difference between the size of the project and the reason for changes.

**Reasons Reported for Community and Technical College Change Orders**

(for projects completed since 2007)

<table>
<thead>
<tr>
<th>Size</th>
<th>Amount</th>
<th># of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
<td>$25k - $2M</td>
<td>627</td>
</tr>
<tr>
<td>Intermediate</td>
<td>$2M - $10M</td>
<td>38</td>
</tr>
<tr>
<td>Major</td>
<td>$10M+</td>
<td>23</td>
</tr>
</tbody>
</table>
What construction components are involved in change orders?

The following chart illustrates the primary construction components cited in change orders.

The most frequent and highest costing changes are in electrical work. This is probably in part due to how prevalent electrical-related components are in modern building construction. However, a focused review of the design specifications for electrical and electronic components prior to bidding have a high potential to reduce change order rates and costs. Projects might also benefit from pre-qualifying electrical sub-contractors to make sure they have experience with the systems in the project and have successfully completed projects of similar size in the past.
Conclusion

Capital project cost estimates play a critical role in the development of a successful project proposal. They not only help frame project scope and budget limitations at the end of the Predesign process, but are also used to help ensure that the project is held within the limitations of the budget throughout the design process.

The community and technical colleges have a long track record of accurate estimates. The estimates are essential to every project and help make many decisions throughout the project. College leadership should pay particular attention to the project’s square footage to avoid scope creep which creates budget challenges.

It is important to fully evaluate the cost estimates to determine if funds are properly allocated for each phase of the project. Consultant services should be reviewed to ensure that only what is necessary is included by considering the benefit of each service.

A proactive approach to bidding construction work can get a lower bid. This cost reduction strategy may allow colleges to fund additive alternates or reduce risks by having a larger contingency when construction starts.