

The Right Details at the Right Time

A Competitive Advantage in Conceptual Estimating

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Conceptual estimating is in the spotlight today as EPCs scramble to put forth the best possible bids for highly contested capital project competitions. EPC executives are putting estimates under constant scrutiny in today's buyers' market, especially in the oil and gas markets where there is a drive toward more fixed-price (or "lump sum") bids, which ups the pressure to make the right decisions based on having better estimates earlier. One large fixed-price project that runs over cost can severely impact an EPC's profit. This is exacerbated by the shrinking timeframes to put together bids, a systemic shortage of skilled and experienced estimators, and business processes which do not support the need to be more agile.

The conventional and easiest response to these pressures is for estimating teams to "hunker down" and focus more attention on adding to the level of detail as early as possible in estimates, which necessitates more manpower and effort. As we will further explain in this white paper, this response is often flawed. The focus on detail is often applied to the wrong aspects of an estimate. At best, there is minimal impact on estimate quality, but at worst, that level of detail might decrease the estimate quality.



When an estimate is missed, or is perceived to have been missed, it is far more productive to improve the higher level view of the entire estimate to understand where to focus time and attention to address those elements with the biggest impact on cost. The model-based approach represented by Aspen Capital Cost Estimator (ACCE) provides the power, flexibility and management transparency to support that philosophy. Of most importance, the ACCE model-based approach supports an estimator's imperative to avoid wasting time on relatively trivial details and to focus on getting the big items right.

Breaking the Pattern of Getting Lost in the Details

Everyone wants detail - large, complex and easy to fill spreadsheets have proliferated. With brute-force help from junior estimators, it's often viewed that by creating lists that contain more detail, it will improve the bid. There is a belief that the more the detail, the better the result. Executive management responds to lost bids or project overruns by demanding more scrutiny along every step of the road (Figure 1). Individual line item counts end up being the main focus, with consequences including:

1. Too much detail for anyone to fully take in or meaningfully evaluate.
2. Extensive time spent enumerating and reviewing detailed counts for item types with a small overall impact on capital cost.
3. Loss of confidence when there are discrepancies in these quantities for small impact items (which in the overall budget are unimportant).
4. Insufficient time spent on strategic scope and quantities that have the largest impact on cost.

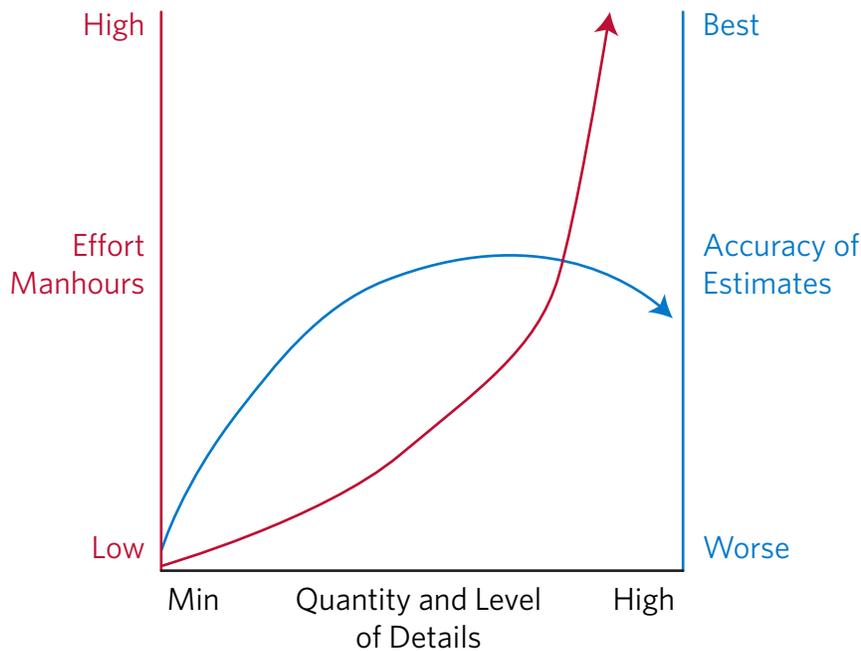


Figure 1: The impact of increased focus on level of details on accuracy of estimates¹.

Several fallacies creep in during this quest for more detail. First, there's the assumption that all details are correct. This isn't always true, especially when the assumptions or parameters behind the creation of the detail is wrong because it is too early in the design to know or the detailed analysis is applied too early in the design process. Second, the time required to create and analyze the level of detail prescribed can often be insufficient, leading to rushed work and errors. Third, when details are introduced early in the estimating process it can lead to conflicting indications such as how to improve the estimate. Fourth, the more detail, the greater the difficulty for one expert estimator to sort out the details from the essential scope and give their overall viewpoint.

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The Impact on Cost and Effectiveness

Executives should be concerned, far beyond the downward Accuracy of Estimates curve in Figure 1, with the organizational implications of the detail/accuracy relationship on cost and effectiveness of the bidding process. The pursuit of additional, unnecessary detail introduces manpower, effort, cost and additional elapsed time. The elapsed time impacts agility and the ability to optimize designs and bid strategies. Senior management time is diverted into reviewing these non-strategic details. Furthermore, the detail-focused conceptual estimating process is challenging to mobilize to dynamic customer requests and requirements. This forces the use of large contingencies or guesswork in the bid strategy.

Which Elements of Scope Have the Biggest Impact?

There are certain elements of the estimate that, on average, have the largest impact on the overall cost. Counterintuitively, some large impact areas are normally subjected to the quickest and most abbreviated analysis, while some of the smaller impact items are frequently the focus of extensive scrutiny, with common culprits that include electrical wiring line lengths and control and instrumentation system details.

Take a look at the breakdown of typical direct project costs for a large capital process plant project managed by Fluor Corporation in Figure 2 below. Equipment and piping costs represent the largest percent of project cost; while estimators have reported that equipment layout and pipe rack configuration, which greatly influences those costs, often represent very short discussions as opposed to an in-depth review of details that are present in other areas.

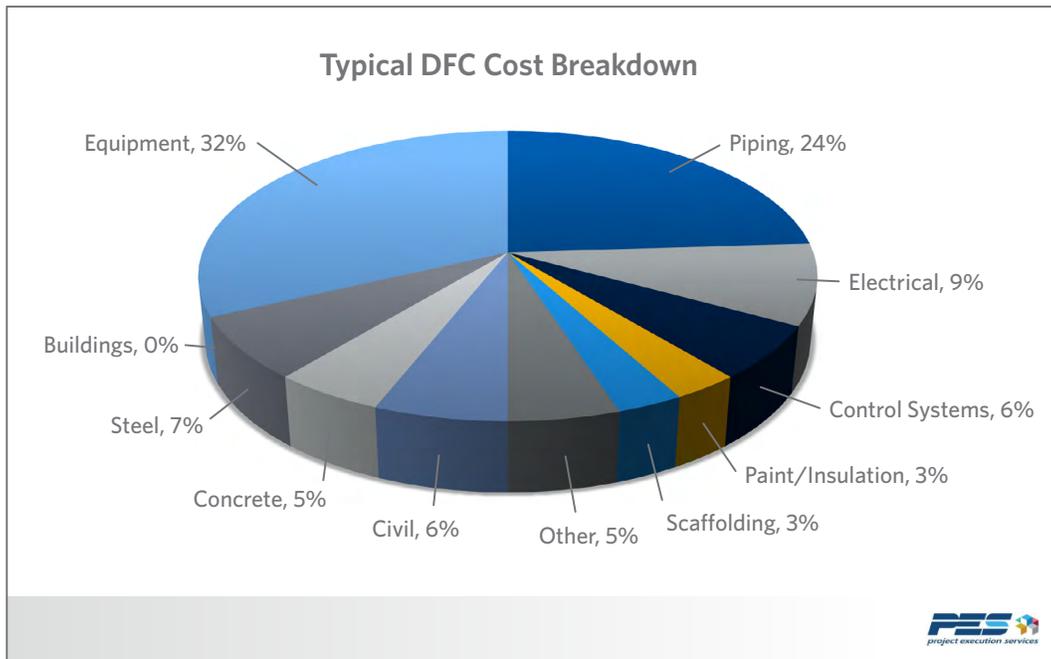


Figure 2: Typical breakdown of direct project costs in an estimate by category. Piping and equipment have the largest overall impact on the estimate¹.

To understand the full implication of this cost breakdown, one must look further than these top-level cost categories. During an estimating process, there is typically an analysis of one component of these larger categories. For instance, as shown in Figure 3, welding is one of the key variables, which relates to accuracy in elbow counts. By contrast, enumerating details for a specific component of electrical or controls will relate to a very small overall variability in the total installed capital estimate.

Strategic Estimating Systems (SES) performed a sensitivity analysis on three different types of process plant projects. Their analysis achieved a result consistent with the data reported by Fluor, as shown in Figure 4. SES' analysis of a hydrogen plant, a chemical plant and delayed coker units demonstrated that the factors with the biggest influence on cost are field labor productivity, construction indirects, equipment costs and counts, and piping. Other areas (such as control wiring schedules, electrical wiring and smaller equipment such as pump spares) which often attracts microscopic focus, bear a much less important impact on cost estimates.

Much discipline is required to avoid the "too much detail" trap in this context. The key management discipline is to balance the reward (in terms of uncertainty reduction and accuracy) and cost of enumerating quantities at the early stage (bid or FEL) of a project. Effort and analysis should be applied only to those areas which have the biggest percentage impact on cost. Areas such as sizing, definition of equipment and equipment arrangements and piping are three prime examples.

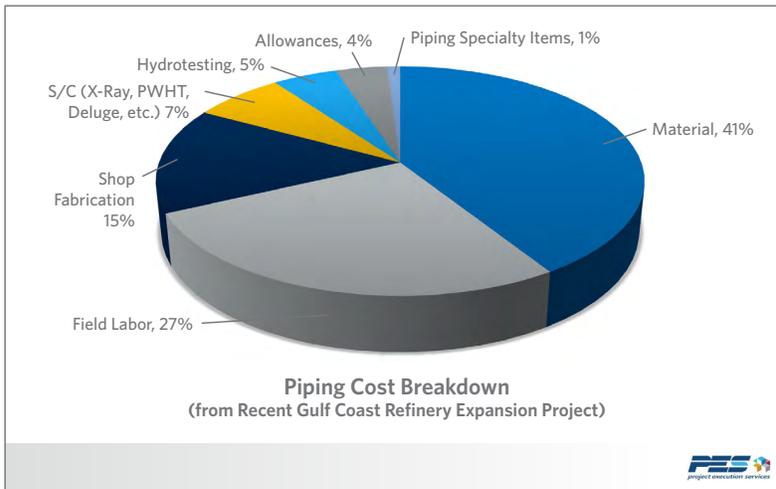
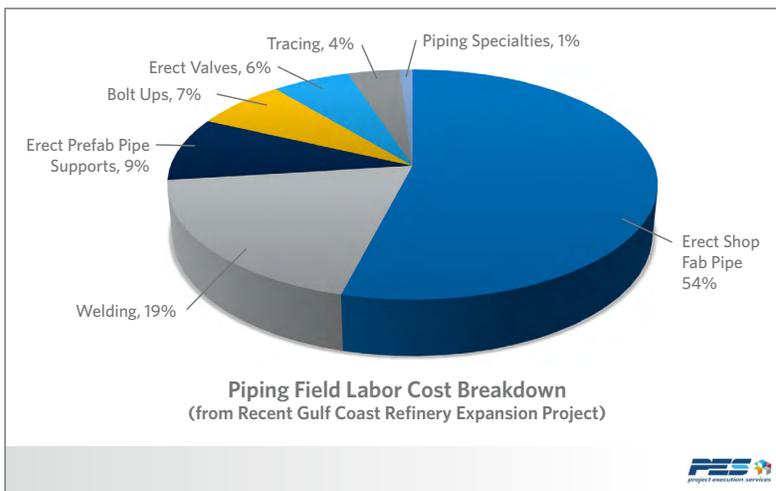


Figure 3: Typical breakdown on piping costs and % impact on cost as reported by Fluor¹.



Delayed Coker Unit

- ▶ Highest Variations:
 - Productivity Multiplier 9% TIC
 - Equipment Qty
 - Equipment Cost
 - Construction Indirects
 - Piping Qty 4%
- ▶ Other Points:
 - Scaffolding %, Civil Mhrs, Steel Qty, Civil Qty, and Piping Mhrs all significant
 - Most variables < 1% TIC Impact
 - even though range is +/- 20%
 - includes E&I bulks quantities

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Figure 4: Sensitivity analysis of a typical delayed coker project with capital cost influencers.

The Fallacy of Detail During FEL and Bidding

Understanding key capital cost influencers and independent variables is crucial to ensure an estimating team stays focused on those key elements. The estimating and bid lead should have a clear understanding of which factors are the important ones, depending on the type of process and type of technology. Time should be concentrated on those elements and not on refining the counts for elements which account for significantly less than 1% of the total project cost. Too frequently do executive teams, proposal managers and estimating managers spend considerable time reviewing and refining these smaller contributors. The introduction of estimating systems described for the detailed estimating stage during conceptual estimating often promotes this strategic error, because they introduce the very strong temptation of establishing, reporting on, and reviewing at a level of detail that both wastes time and introduces false confidence.

A good conceptual estimating approach should provide the lead estimator with an overview of the key project scope elements and cost without confusing things with too much detail. This gives an overview to the estimator, providing them with both the birds-eye-view and the time to get an important “feel” for the estimate. Many of the world’s best estimators talk about the “gut feel” of an estimate, which lets them identify any gaps or errors in the capital estimate.

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All-In with Aspen Capital Cost Estimator

Model-based estimating overcomes the problems that have been identified above. The bottoms-up models within Aspen Capital Cost Estimator generate scope encompassing inside-battery-limit (ISBL) and outside-battery-limit (OSBL) that enables a high level of estimating consistency. The key scope elements required to achieve high quality conceptual estimates with ACCE include a complete equipment list

and site parameters. The engineering models built into the system generate quantities, all direct and indirect costs, and, consequently, a total installed cost in a bottoms-up, accurate manner. Practitioners refer to ACCE as an “engineer in a box” for its ability to substitute about 80% of the engineering man-hours and about 50% of the time during conceptual estimating.

Next Steps

Breaking the pattern of countless details during the bid and FEED stage of products requires organizational recognition that alternative approaches are required to achieve, such as higher estimating quality, the ability to contend with rapidly contracting estimating time scales, and the unprecedented dynamic and changing requirements imposed by owners. To assess the impact of this model-based estimating approach, and the “right details at the right time” mindset, a few steps can be taken:

1. Evaluate current process engineering and estimating work processes and the extent to which they support bidding agility, including how to improve industry best practices.
2. Evaluate current estimating methodologies and how they can support the timeframes and changes in direction required in today’s environment.
3. Follow a structured evaluation and improvement methodology, such as the SES ACCE Implementation Methodology to develop an action plan to improve bidding and estimating performance.

Leading estimating organizations in both the EPC and owner-operator world have undergone such an evolution in approach and achieved strong improvements in their estimating functions. Companies who have reported on the success of this evolution include, Flint Hills Resources, Linde Engineering, Reliance Industries, and S&B engineers and constructors.

Sources:

1. Blok, Arjen (2011):
The presentation, “The Right Details at the Right Time,” was presented by Arjen Blok at the AspenTech Global Conference in Washington, D.C., in May 2011, who at the time was the estimating manager at Fluor Corporation in Haarlem, Netherlands. This presentation provided substantial source materials and ideas for this white paper.
2. Monteith, Mike (2009):
The presentation, “What Really Matters: Sensitivity Analysis for Class 2 and 4 Process Plant Estimates.” Houston Gulf Coast Section, AACE, October 2009.

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