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REVIEWING, VALIDATING, AND DOCUMENTING THE ESTIMATE

TCM Framework: 7.3 – Cost Estimating and Budgeting

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INTRODUCTION

Scope

This Recommended Practice (RP) of AACE International defines the basic elements of and provides broad guidelines for the cost estimate review, validation and documentation process. Estimate review and documentation is a step in the cost estimating and budgeting process of the *Total Cost Management (TCM) Framework*^[1]. This RP is applicable to all estimate types for any industry and is intended for those responsible for and/or participating in an estimate review. Expert knowledge is not required to understand or use this RP.

Purpose

This RP is intended to provide guidelines (i.e., not a standard) for reviewing, validating and documenting estimates. Most practitioners would consider these guidelines as good and reliable practices. It is recommended to consider using these guidelines where applicable.

Background

Cost estimates typically represent a complex compilation and analysis of input from many project stakeholders. To ensure the quality of an estimate, budget or bid, a review process is required to ensure that the estimate meets project and organization requirements. The project plan typically requires that the cost estimate:

- Reflect the project strategy, objectives, scope and risks
- Be suitable for a given purpose (e.g., cost analysis, decision making, control, bidding, etc.)
- Address the stakeholders' financial and performance requirements
- Ensure that all parties agree on and understand the estimate's basis, content and outcome, including the estimate's probabilistic characteristics (e.g., range, cost distribution, etc.).

RECOMMENDED PRACTICE

General Process

A structured, if not formal, review process is a best practice. The level of detail and diligence used during the estimate review cycle will vary with the strategic importance, total value, and purpose of the particular estimate. The review steps can be easily adapted for any company needs and standards, for any specific project. Figure 1 illustrates the basic estimate review process which has three main steps: review; validate; and document.

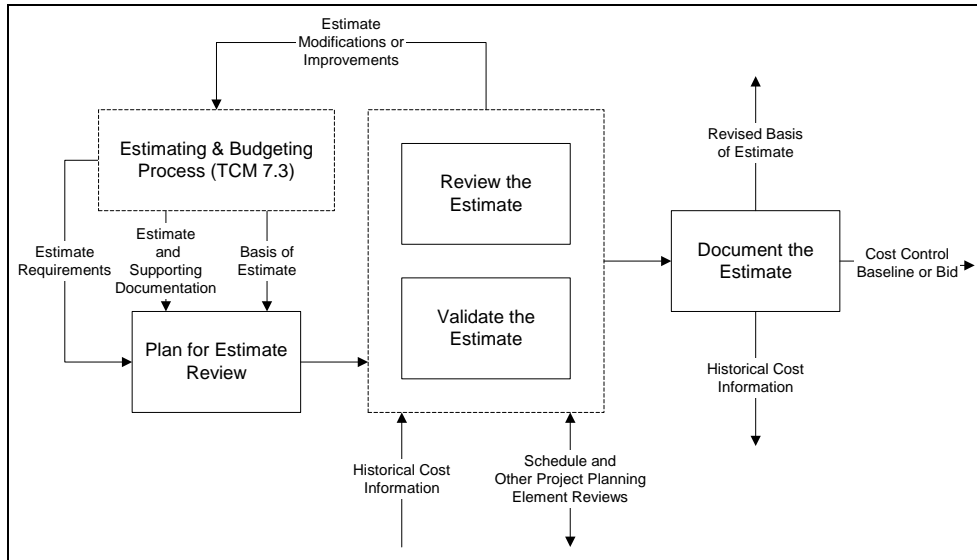


Figure 1 — Estimate Review, Validation and Documentation Process

The estimate “review” is typically qualitative in nature and focused on ensuring that the estimate technically meets requirements (i.e., it serves a quality assurance and control function). This quality review determines if the estimate was:

- Developed using contractually or procedurally required practices, tools and data
- Whether it covers the entire project scope
- Whether it is free from errors and omissions (at a macro level; the validation step should reveal any errors or omissions from the specific details)
- Whether it is structured and presented in the expected format
- Others as deemed applicable

The estimate “validation” is typically quantitative in nature and focused on ensuring that the estimate meets the project expectations and requirements in regards to its appropriateness, competitiveness (i.e., hopefully more accurate!), and identifying improvement opportunities (some estimates are not only for “design/build” but could be for complete life cycle). The estimate is typically benchmarked against or compared to various cost metrics and/or cost targets, including third party published data from the public domain (desired), similar completed projects from company’s historical data (acceptable), or past detailed estimates (not recommended but acceptable if that is all that is available). Validation should be done even if the review team also prepared the estimate (although preference should be given to an independent third party). Validation examines the estimate from a different perspective using different metrics than are used in estimate preparation.

Review and validation may require that all or part of the estimate be iterated through any of the development steps of the estimating and budgeting process. When developing the estimate execution schedule, all required reviews should be considered. Adequate time should be planned in the overall estimating process to allow for corrective actions to be taken.

The end result of an estimate review should be a set of consistent, clear and reliable documentation (i.e., the estimate and its backup) that has the concurrence and understanding of the project team and management and follows industry standards or best practices (e.g., for authorization, control, bid, etc.). Each project team member must accept and take ownership of those parts of the estimate and budget for which they will be responsible.

Estimate Review Cycles

Figure 1 shows a single review cycle. However, the review process should be used at every phase of project scope development (for example, review the estimate at Class 5, 4, 3, etc., as it gets more detailed)^[2]. Furthermore, at a given phase, depending on the detail and importance of the estimate, multiple reviews are performed with varying purposes, scope, and participants. For example, the review process may include internal estimating department reviews, engineering reviews, project team reviews, and continuing with reviews by various levels of management, depending on the importance of the project. Similarly, for large estimates, different parts of the estimate (i.e., divided by work breakdown or cost account) may be reviewed separately. Specialized scope in any estimate should be reviewed by the appropriate specialist or subject matter expert.

During development and at completion, the review team generally conducts its quality reviews and validation without the customer or client (e.g., management) being present. Reviews involving these stakeholders are typically done last, after the team ensures that the estimate meets all defined requirements. Internal and external management reviews tend to be the most focused and structured reviews. Upper management reviews often focus on substantiating the over-all adequacy of the estimate in regards to its intended use. In other words, can management be assured that the quality of the estimate, its basis, the methods employed, and the diligence of the estimating and project teams will support their need to make a decision (i.e., does this project still support the business-case?).

Plan for the Estimate Reviews

A person(s) must be made responsible for planning and managing the review process (i.e., the lead). As was mentioned, the review process may include multiple phases and multiple review sessions. After assessing the requirements and plan, the lead estimator typically identifies a review team and defines their roles and responsibilities. In general, anyone that provided significant input to the project estimate and/or that was involved in its preparation, and/or will be responsible for managing some element of the costs should be considered as a review team participant at the appropriate phase and step. Typically, management is generally only involved in final reviews or when intermediate decisions must be made, however, best practices have proven that continual involvement of company management (owner and contractor alike) make the final reviews much more efficient (and less confrontational). Buy-in during estimate development has a significant contribution towards stakeholder ownership during reviews.

In most reviews (other than final management reviews) the review team will include the lead estimator(s); lead scheduler(s) and planner(s) (given the integrated nature of the project plan), and those that provided significant cost input for that part of the estimate being reviewed such as lead engineers, programmers, or other technical people, procurement leads, construction or other project execution representatives, and so on. There is no limit to who may be involved; anyone with input or expertise in the cost should be considered (e.g., safety, legal, operations, quality, environmental, and so on). A scribe should be designated to keep action items recorded throughout the review meeting. This is an excellent opportunity for a junior member of the estimating team to be involved in the review process. Depending on the estimate phase and how the project is being managed, owner, contractor and vendor representatives may all be involved.

An issue to consider in planning for the estimate review and validation is the issue of “*independence*”; i.e., obtaining objective, unbiased input. In some cases, the project or client may require that an independent third party be involved in the review, separately review the estimate, or prepare an independent check estimate for use as a basis of comparison in the validation (particularly if bank financing is involved). In all cases, those preparing the estimate review should be reasonably free from undue influence by the stakeholders; i.e., their pay or career is not primarily determined by the recipient of the estimate.

Planning should also focus on ensuring that a *basis of estimate* (BOE) is documented to support the review and, after the review, it is updated as needed to support subsequent change management processes. The BOE is a key estimate review input and output and the subject of its own separate RP^[3]. Among other things, the BOE will describe all of the basis documents that served as input to the estimate. This is critical and required for effective change management on every project. Appropriate input documents should be assembled in a review package that should be sent or made available to all review team members in advance of the review. A minimum of 48 hours is recommended to allow review participants time to study the information.

Technical (Engineering/Design) / Scope Reviews

The first estimate review should be held with the technical team (i.e., those who developed the technical basis documents such as project plans, drawings, schedules, equipment lists, etc.). This team should evaluate in depth the estimate and BOE in terms of accurately representing the project scope. The core members of the technical team are key participants in this review, along with the lead estimator and estimating team. In many cases, these team members will be responsible for managing some part of the work that is being estimated and they must buy-in to the estimate for that work.

One of the critical items to review is the listing of all drawings, sketches, specifications, and other technical deliverables used in preparing the estimate to ensure that it is complete and up-to-date. Furthermore, the technical team must develop confidence that the information in the basis deliverables has been appropriately quantified in the estimate (in some cases, the technical team did the quantification). The estimate should also be checked to ensure it is integrated with the schedule (i.e., the basis of schedule document should be reviewed for consistency).

Typically, a complete estimate in the early phases of a project will include an overall estimate of the project representing Class 4 or 5 scope, and an estimate of hours and costs for work to be performed by the technical team in upcoming project phases (e.g., Class 3 detailed estimate to serve as the basis for control of the next phase). Again, the technical team must buy-in to these costs, because this will be their budget going forward.

Estimating Team Reviews

The next review is typically conducted by the estimating team that prepared the cost estimate. An initial screening review will assess if the scope was quantified completely, ensuring that the estimate is documented correctly (i.e., a comprehensive BOE is prepared and the estimate is consistent with it), and that it adheres to project, contract and/or company guidelines. This is generally followed by a math check (extensions of pricing are correct, summaries add up properly, etc.), performed by one or several individuals who is familiar with the company's tools and formats. Typically, these reviews are held by the lead estimator with the members of his or her estimating team. On very large projects, or those of significant importance, this review may be held by the estimating department manager or supervisor. Another consideration would be to establish a "peer review" team, comprised of other experienced estimators within the company. These individuals would rotate as they would not peer review their own estimates. They would provide a "cold eyes" review and bring consistency across all company estimates.

The BOE will describe among other things the design basis of the estimate (e.g., scope, exclusions, etc.), planning basis (e.g., project strategies, milestones, shift assumptions, etc.), cost basis (e.g., sources of pricing, allowances, factors, rates, foreign exchange, escalation, etc.) and risk basis (e.g., contingency estimating method, etc.). The estimating team review will ensure that the estimate is consistent with the BOE.

Similar to the BOE, the estimating team will ensure that the estimate was prepared in accordance with appropriate guidelines. Among other things, these may establish required methods, tools, structure,

formatting and so on. The guidelines may also establish how the review itself is to be held; there should be a statement for the review approach that includes varying degrees of structure and formality depending on the scope, value and importance of the estimate.

Project Manager/Project Team Reviews

Once the estimate has been reviewed closely by the estimating and technical teams, it is ready for review by the project manager and the rest of the core project team. The objective now is to gain the entire project team's support of the estimate; especially that of the project manager. This is also the first point where the estimate should be able to pass overall validation tests, in addition to a quality review.

The first part of this review should be the examination of the estimate documentation by the project team and project manager. This includes the BOE, as well as the estimate summary and estimate detail pages. The purpose is to ensure that the estimate is presented in an understandable manner and that it is complete, consistent, repeatable, traceable and defensible. It is very important that the project manager fully understand how the estimate is prepared, because he/she often becomes the person responsible for presenting (and defending) the estimate to upper management, and later to the eventual customer. The entire project team should also understand the entire estimate package, format, and contents.

Now is the time for the other key members of the project team (project manager, project controls, construction, commissioning, operations and maintenance, etc.) to examine their respective costs that are included in the estimate and to obtain agreement that they are consistent with their understanding of the project safety, execution strategy, schedule, constructability, start-up needs, and so on.

The following paragraphs describe several of the key areas for interest for the project manager.

Estimate Validation

In most organizations, the project manager is ultimately held responsible for the cost outcomes of the project. Therefore, the project manager has a vested interest in performing sanity checks, or otherwise validating the estimate as reasonable and competitive. Most experienced project managers will have various rules-of-thumb that they will want to use to verify against the estimate. Regardless, the estimate should include an estimate review metrics report that summarizes and compares several key benchmark ratios and factors versus historical (and sometimes estimated) values from similar projects, cost targets for the company (such as Key Performance Indicators or KPI's), and/or benchmarks from external sources.

The goal of validation is to ensure that key metrics from the estimate are in line with (or an improvement on) the same metrics from similar projects. It can be considered a top-down view of the estimate that provides a unique, objective perspective. If there is a large discrepancy, it must be explainable. The metrics may include summary measures such as engineering/total project costs as well as detailed measures such as hours/quantity by discipline. Another basis of estimate validation is to prepare a check estimate, usually using more conceptual estimating methods. Again, any significant discrepancies between the estimates should be explained.

Risk Basis of Estimate

It must be recognized that all cost estimates are probabilistic in nature. The cost of a project depends heavily on how specific events (risks) influence its execution, thus the direct correlation between estimated cost and risk analysis. The project manager and project team should review the risk basis of the estimate, and agree with the analysis of cost risk associated with the project. The project manager, in particular, should agree with the risks that were identified, their assessment, the probabilistic outcomes, and the contingency amounts, and be able to defend it in subsequent review to upper or corporate management. Other risk funds such as escalation and management reserves must also be defensible, documented and understood.

Reconciliation to Past Estimates

Often, the project manager will be interested in reconciling the current estimate to the preceding estimate (or estimates). The current estimate can gain credibility by clearly explaining the differences and reasons for the differences. The reconciliation can usually be presented at a high level, without excessive detail, but the backup should be available in case it is required during the review.

The format of the reconciliation change between previous estimates should be expressed as the previous estimate compared to the current estimates, including both monetary values (change) and % variance (change). See ASTM E1804 for more information^[4]. The following is an example of this format:

	<u>Previous Estimate</u>	<u>Current Estimate</u>	<u>Variance \$</u>	<u>Variance %</u>
Sitework	\$250,000	\$275,000	+\$25,000	+9.1%
Concrete	\$525,000	\$475,000	-\$50,000	-10.5%

There may be a change control or cost trending process that specifically tracks scope (including quantities), schedule and cost items. This process may involve the estimating team, scheduler and management level. Sometimes, the trending process will not have captured all the variances; the discrepancies should be explained.

The amount or nature of estimate variance may trigger an additional review document or process, which is a more in-depth review of the significant changes to the estimate, such as review of the quantity changes, unit price changes, scope changes and markup changes.

Management Reviews

The last series of reviews is usually held by various levels of corporate management. The number of upper management reviews, and the level of management they are presented to, typically varies with the strategic importance and/or total estimated cost of the particular project. These reviews are typically held at a very high level of analysis, and usually do not involve the details of the estimate.

As with the project manager review, estimate validation is a key element of the upper management reviews. It is important to be able to explain and demonstrate that metrics for the current estimate are in line with data from other similar projects—i.e., that the estimate is reasonable. It is also important to show where the metrics may be substantially different from other projects, and provide explanations for the differences.

Management will also be interested in the cost risks and escalation. It is important to clearly and concisely explain the probabilistic nature of the estimate, how recommended contingency and escalation amounts were developed, what the respective drivers are and what the cost distribution/ranges are. It may be necessary to distinguish where possible, “hyper-escalation” from typical market demands or market premiums to management. It is then up to management to determine the level of risk (and contingency) they are willing to accept. When reviewing the risk analysis, it is always important to discuss the significant risk drivers, and what has been done to mitigate those risks. It may be necessary to differentiate between “normal” estimate “cost” risks from “abnormal” estimate “event driven” risks. Some event items may not be able to be mitigated. In the end, it is management’s responsibility to set contingency and escalation values in accordance with the level of confidence they want, that the cost outcome will be under the estimated total. Also, if there is a need for management reserves, they must make that decision.

The project team will usually assume the project scope has already been determined. However, many times management will ask questions concerning alternative scopes or designs (this may require life cycle cost analysis to compare designs). Also, management will always be questioning the overall cost of the project, and will probe to determine if there are lower cost options. Therefore, it is important to have

available for the management reviews any earlier design/cost alternatives, value improving practice outcomes, and the decision tree leading to the selected design.

The effectiveness of an estimate review relies on the information that is presented, and the manner in which it is presented. In all reviews held, explicit note-taking is invaluable and highly encouraged, specifically tracking directed changes and by whom. While these notes may not become an official part of the BOE, they will remain in the estimator's back-up for future reference.

The above discussion has concentrated on how to structure a sequence of estimate reviews for internally prepared estimates to ensure that estimates are well documented, consistent, reliable, and appropriate for their intended use. After this review cycle, the level of estimate accuracy should be apparent, reflective of the scope information available for preparing the estimate, and capable of supporting the required decision making process for the project. Techniques for reviewing estimates prepared by others will be discussed next.

Reviewing Estimates Prepared By Others

The foregoing discussion has focused on estimate reviews of internally prepared estimates to support an internal scope development and decision making process. However, it is often necessary to review (and/or approve) estimates prepared by others, and that may or may not have gone through a rigorous internal review cycle as described above.

When reviewing estimates prepared by others, it is important to keep in mind the basic fundamentals previously described. In particular, the purpose of the estimate review is to ensure that it meets requirements. Therefore, to obtain a quality product, it is essential that the client first establish effective requirements in the contract before the third party begins their work. Also keep in mind that the quality of the basis documents is a significant determinant of the estimate quality. Therefore, quality review of those documents (e.g., design reviews) must also use best practices to ensure a quality estimate.

But even with good requirements and good basis documents, a problem with reviewing estimates by other is that that many times the amount of time allowed for an estimate review is very short. The requirements should therefore include an estimating preparation kick-off and intermediate reviews to help minimize late surprises at a final review. The final review of an estimate prepared by others is usually accomplished by a critical assessment of the key elements of the estimate and its documentation. The following discussion centers on those key elements and some key questions to consider.

A key point to remember – in most cases (unless requested by client), you're performing an estimate review, which is not a detailed independent cost estimate. However, there may be times quick check estimates may be required as part of the validation process.

Basis of Estimate

The first thing to assess is the BOE. Is it well organized and complete? Does it provide the required information regarding the design basis, planning basis, cost basis, and risk basis of the estimate? Does it clearly define the project scope and all potential critical activities?

Estimating Personnel and Discipline

Next, you will want to know who prepared the estimate, their level of estimating experience in relation to the scope of the project, and their discipline in regards to quality practices. For example, did they follow established or contracted estimating procedures and guidelines? Did they check and review the estimate before publication?

Estimating Methodology and Procedures

What estimating methods, techniques, and procedures were used in preparing the estimate? Are they appropriate for the level of information available and project type? Were different estimating methods

used for different parts of the estimate? Is the level of detail in the estimate sufficient for the purpose of the estimate? Were parts of the project difficult to estimate and why? Was sufficient time available to prepare the estimate? What adjustments were made to the estimate for location, complexity, etc., and are they reasonable? Was the estimate prepared using the appropriate work breakdown and code of account structure?

Estimate Documentation

Is the estimate documented clearly? Are the estimate summary and detail pages well organized, and presented at an appropriate level of detail? Is every cost appearing on the estimate summary traceable to the estimate detail and other estimate backup?

Estimate Validation

Hopefully, the estimate for review will include a metrics report showing key estimating metrics and benchmark ratios for the estimate and similar past projects. You should review this report, and question any significant differences. You should also have your own set of metrics and statistics (or KPI's) from your own project history to compare against.

At this point, you may also develop your own quick check estimate (using conceptual estimating techniques) for comparison purposes. This is always a good technique to see if the estimate being reviewed is reasonable. If there is a significant difference, then question the estimator and listen to his or her explanations and opinions for the deltas.

Significant differences between the check estimate and the estimate being reviewed may indicate the need for taking a more thorough examination of the estimate detail.

Estimate Detail

Even if the preceding inquiry has gone well, and you are confident that the estimate appears to have been prepared in a professional manner in accordance with requirements, you should delve into some of the estimate details to further verify estimate quality. The goal is to spot check that selected areas of the estimate can withstand further scrutiny. Review of every item is not essential; if the basis, discipline, methods, and metrics are excellent and in accordance with requirements, there is a high probability that the cost estimate result is of high quality.

In detail review, consider the Pareto principle: i.e., 80 percent of the costs come from 20 percent of the estimate line items. Examine in detail selected items or categories of items in the estimate that are likely to have the most significant cost effect if estimated incorrectly. Don't just examine the results, but drill-down through the estimating process applied for that item. For example, have the estimators show from actual drawings how specific quantities were generated. Perform a quick takeoff to verify the quantity. Ask what the basis was for the unit material price and labor workhours. Ask what adjustments were made and why? If the answers to your drill-down questions are evasive or unclear, more thorough review of the entire estimate may be necessary.

In some cases, especially when bank or third-party financing is involved, management may request that a full, detailed independent check estimate be prepared to compare against the estimate prepared by others. In general, this is not a cost effective approach. Again, if the basis, discipline, methods, and metrics are excellent and in accordance with requirements, and verified through detail spot checks and validation against metrics and a conceptual check estimate, there is a high probability that the cost estimate result is of high quality, and preparing another detail estimate will be a redundant, time-consuming exercise.

Documenting the Estimate

As with any quality review, findings should be recorded, and actions assigned to address any errors, deficiencies or improvements identified. These should be corrected or addressed as appropriate (usually

there is very little time). If the changes are significant, all or some part of the estimate review cycle may need to be repeated until the project team, management and other stakeholders concur that the estimate meets requirements. It is particularly important to ensure that the BOE is updated to reflect the current basis because that document will be a key reference supporting project control, change management, and other project execution activities.

Feedback Loop

It is important that the learnings of the review and validation process be incorporated back into the overall estimate. If not, then the review and validation process is incomplete. The estimate review and validation process should include a feedback loop that ensures the major comments that require corrective action have been incorporated in the final cost estimate. This should be a structured process that includes the estimating team, project management and management levels. Figure 1 outlines the feedback for modifying and making improvements to the overall estimate. This feedback loop should include both the estimate and BOE documents.

It seems a simple matter that the original estimator(s) should receive feedback of the changes that are ultimately incorporated into the final estimate; however, this process is often overlooked or not followed.

The proposed changes to the estimate should be reviewed by the estimating team and all reviewers. In general the estimator should agree with these changes to the estimate. However, there may be times when management over-rides the estimator which is management's prerogative. Some companies include a formal sign-off sheet which includes corrections made to the overall estimate. Whatever the company standard is, feedback is an important process that should be followed.

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