AACE INTERNATIONAL RECOMMENDED PRACTICE

110R-20

COST ESTIMATE VALIDATION

AACE INTERNATIONAL

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COST ESTIMATE VALIDATION

TCM Framework: 7.3 – Cost Estimating and Budgeting

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Any terms found in AACE Recommended Practice 10S-90, *Cost Engineering Terminology*, supersede terms defined in other AACE work products, including but not limited to, other recommended practices, the *Total Cost Management Framework*, and *Skills & Knowledge of Cost Engineering*.

Contributors:

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John K. Hollmann, PE CCP CEP DRMP FAACE Hon. Life (Primary Contributor)
Peter R. Bredehoeft, Jr. CEP FAACE
John J. Ciccarelli, PE CCP PSP FAACE
Larry R. Dysert, CCP CEP DRMP FAACE Hon. Life
Dave Kyle, CCP CEP
Michael Lesnie
John P. Orr, PSP FAACE
Todd W. Pickett, CEP CCP FAACE

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1. INTRODUCTION

This recommended practice (RP) of AACE® International defines the basic elements of and provides broad guidelines for the cost estimate validation process. Validation is a quality-focused sub-element of the estimate review process step [1] in the cost estimating and budgeting process of the *Total Cost Management (TCM) Framework.* [2] It is related to the practice of benchmarking; while both use quantitative metrics, benchmarking is focused more on system performance as opposed to estimate quality. Validation applies to both cost estimates and schedule duration estimates; however, this RP covers only the cost estimate. This RP is applicable to all cost estimate types for any industry and is intended for those responsible for and/or participating in estimate development and review. Expert knowledge is not required to understand or use this RP.

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

2. BACKGROUND

2.1. Relationship to Estimate Review and Benchmarking

As stated in RP 31R-03, *Reviewing, Validating, and Documenting the Estimate*, cost estimates typically represent a 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 strategies (execution, contracting, etc.), objectives, scope and risks
- Be suitable for the given purpose (e.g., cost analysis, decision making, control budget, bidding, reconciliation, etc.)
- Be supported by a comprehensive basis of estimate that provides a clear detailed understanding of the supporting data, methodology, and assumptions behind the estimate. [3]
- 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.)

Validation is part of the review process and is focused on assuring the estimate achieves the project strategies and meets the stakeholder's financial requirements. The following are definitions of estimate review and estimate validation. [4]

- ESTIMATE REVIEW – A quality assurance process, typically qualitative in nature, to test or assure that an estimate of cost or time technically conforms to *project scope and estimating requirements*.

- ESTIMATE VALIDATION –
  (1) A quality assurance process, typically quantitative in nature, to test or assure that an estimate of cost meets the *project objectives and estimate cost strategy* in regards to its appropriateness and purpose (which may include competitiveness or other organizational strategies identified for the estimate).
  (2) A form of benchmarking that compares relevant estimate cost, time and/or resource measures (e.g., metric ratios) to those of a selected basis of comparison.

Figure 1, taken from RP 31R-03 illustrates the relationship of estimate review and estimate validation.

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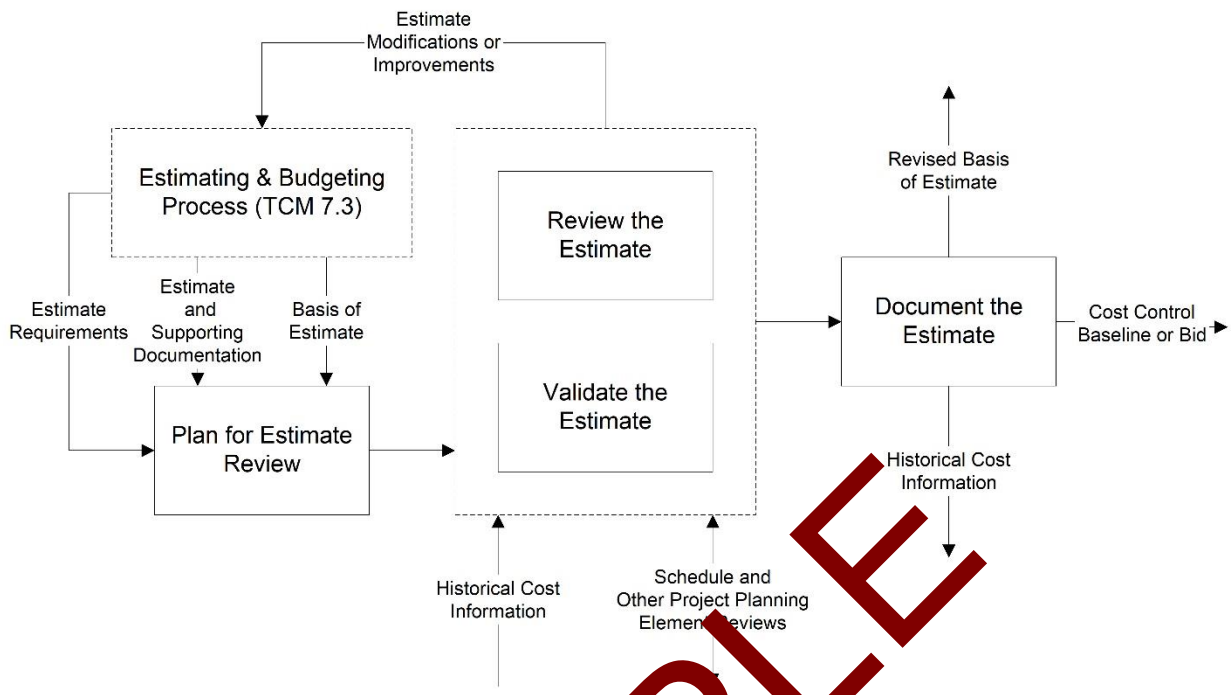

Figure 1 – Estimate Review, Validation and Documentation Process [1]

The main difference between these practices is in their purposes: validation is to assure project objectives are achieved while review is to assure conformance to technical requirements. Validation is also similar to the practice of benchmarking in that they both include comparison to metrics; however, benchmarking is focused on improving system performance as opposed to quality assurance of an estimate. The following is the existing definition per RP 10S-90 [4]:

- BENCHMARKING – A measurement and analysis process that compares practices, processes, and/or relevant measures to those of a selected basis of comparison (i.e., the benchmark) with the goal of improving performance. The comparison basis includes internal or external competitive or best practices, processes or measures. Examples of measures include estimated costs, actual costs, schedule durations, resource quantities, etc.

Given estimate validation's focus on achieving the project strategies and objectives, the following discusses the primary elements of project strategies and objectives that are being assured by validation.

2.2. Project Objectives and Estimate Validation

TCM Framework section 4.1.2.3, *Establish Objectives and Targets,* states that "Objectives usually reflect the general success criteria of the asset owner and/or whoever is funding [or bidding on] the investment." [2] In respect to project cost (or time), success is usually viewed and measured in two ways; predictability and competitiveness [5] If improving *predictability* is an entity's success criteria, the measurement focus is on accuracy; i.e., being on budget and on forecast cash flow. If improving *competitiveness* is an entity's success criteria, the measurement is cost effectiveness; i.e., lower absolute cost (or time) for the same scope (this is similar to the concept of value). It is a challenge to balance predictability and competitiveness. For example, targeting lower cost (better performance than in the past) often means taking risks which results in more uncertainty and less accuracy. [6]

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In estimating, predictability and competitiveness objectives will be expressed as an explicitly planned *bias* in the base estimate (and later the control budget); i.e., an "estimate cost strategy". For example, targeting is a typical competitive strategy wherein planned improvements in cost and performance (supported by improvements in practices) are set as goals. On the other hand, predictability strategies tend to have a financial focus on or bias towards hitting budgets by period (cash flow) and overall. Predictability strategies are common in government projects that are authorized and funded on a fiscal year basis.

In addition to predictability or competitiveness bias, the project *execution strategy* has cost estimating implications in that it should communicate whether the project is *cost-driven* or *schedule-driven*. This strategy guides decision making when changes and risk responses are assessed during execution and earlier in project planning. One major benchmarking firm defines a schedule-driven project as "one in which the business is willing to *trade* capital cost to achieve schedule". [7] The driver implies a bias but does not determine it; for example, while a schedule-driven project may sacrifice cost for schedule, there may still be a target objective for the cost being sacrificed. Assuring this "driver" objective is achieved is done during quality assurance of the change and risk management processes.

In summary, the first step in the practice of estimate validation is to establish and communicate the objectives of the estimate including project objectives, project scope, estimate purpose, financial and performance requirements. The objectives should address predictability and/or competitiveness along with any other goals: i.e., the estimate cost strategy. Without stated, clear objectives, the value of validation is greatly diminished (just as estimate review is less valuable if there are no stated estimate requirements to assure). The place to communicate the objectives is first in the estimate requirements [8] and estimate plan [9] [10] and later in the basis of estimate. [3]

3. ESTABLISH/CONFIRM ESTIMATE COST STRATEGY

3.1. Document an Estimate Cost Strategy for the Base Estimate

As discussed, the first step in validation is to document the estimate cost strategy, which is a statement included in the estimate requirements and the basis of estimate describing the objective of the estimating process in respect to achieving the business's project objectives and the general approach to achieving that objective. The estimate cost strategy is defined by the business, agency, lender or other sponsor and the strategy statement must be agreed by them. Table 1 describes some typical estimate cost strategies (often implied and not documented) that guide or influence the *base* estimating process. Each strategy has a description of its bias toward predictability (conservative) or competitiveness (aggressive) or indeterminate or random (never recommended).

Estimate Cost Strategy	Typical Basis and Bias of the Base Estimate
Targeted	The base represents a defined level of performance relative to past performance based on analysis. Usually aggressive (competitive) but may be conservative (predictable) relative to the past as defined by a documented estimate cost strategy.
Historical Norms (or Analogy)	The average or typical performance of past projects (i.e., *realistic*.) Includes the impact of nominal risk events of the past. This is a conservative (predictable) approach as defined in a documented estimate cost strategy or undefined but consistent approach of estimating function.
Ad-Hoc	Approach left to implicit or explicit bias of the estimator. May use a *de facto* historical norms approach, but it is less consistent and reliable.
Database Reference	Use a reference database with a defined basis, which could be any of the three above. The basis of legacy data is often unknown, and bias may be inconsistent from item to item. Users apply "database markups" that may result in "historical norms" if the database and markups have consistency. If not, the estimate cost strategy is similar to *ad-hoc*.

Table 1 – Typical Cost Strategies That Guide Cost Estimating [6] (with permission)

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If estimating is risk averse (not wanting to take responsibility for overruns), management is in effect defaulting to the "historical norms" approach in Table 1 and in turn defaulting to a predictability culture (especially if it is punitive in respect to cost overruns). Cost competitiveness is more difficult to achieve than predictability and being both predictable and competitive is a very challenging objective. An example of a competitive estimate cost strategy statement that one might find in a basis of estimate where estimating is backed by an excellent historical database is as follows:

> The base cost and duration estimate values will reflect aggressive but reasonably achievable current pricing and performance. "Aggressive but reasonably achievable" means that the assumed performance will reflect the first quartile level (i.e., p25) of historical performance or equivalent for similar strategies and scope excluding the impact of identifiable changes and risks. [6]

The estimate cost strategy for the base estimate should be consistently reflected elsewhere in the basis of estimate as applicable. For example, when describing the basis for equipment costs in a competitive estimate cost strategy, a "the least cost, technically acceptable tender" approach might be chosen as opposed to a more conservative "mid-point of tenders" or other approach. A clear estimate cost strategy statement, endorsed by the sponsor, provides the estimator with guidance as well as assurance that if the base cost is overrun, they will not be held responsible for the project's failure to perform or the impact of risks and so on. Only with a clear, stated estimate cost strategy can validation (i.e., estimate assurance) be effective.

3.2. The Estimate Cost Strategy and Validating (or Benchmarking) the Total Cost

The estimate cost strategy identified for the estimate is intended to guide the estimating function in its base estimating practice. Validation assures that strategy is achieved in the base estimate. The estimate cost strategy reflects an overall business objective established by the business case. As discussed in TCM Framework Chapter 6.1 on *Asset Performance Assessment*, profitability of the capital investment is usually a main objective, and net present value (NPV) and other return on investment (ROI) methods are the most common means of measuring profitability. [2] In the non-profit world, minimizing capital spending will still be an objective even if revenue is not the measured benefit. Having validated the base estimate, there remains the step of validating or, as most would refer to it at this high level, *benchmarking* the total cost.

Even prior to developing a cost estimate, most businesses will have a general idea of the limit of capital spending for an investment that will result in a positive NPV for a given revenue projection (or what will be a successful tender). Experienced estimators are familiar with the tyranny of "*the number*" [7]; i.e., a total cost announced by the business but often of indeterminate basis. The number often reflects a strong bias; usually an optimism bias.

AACE recommended practice for cost engineering professionals is to not accept numbers with an indeterminate basis. The total cost should be a formally estimated base plus the costs for uncertainty and risks; i.e., contingency, management reserves and escalation. AACE RP 40R-08, *Contingency Estimating - General Principles*, establishes the principles for quantifying the risk including providing "probabilistic estimating results in a way the supports effective decision making and risk management". [11] Therefore, unlike the base estimate, the total cost should not be expressed as a *number*, but a probabilistic distribution. Further, in accordance with 40R-08, a recommended quantitative risk analysis (QRA) method employs empiricism; i.e., it will be based on actual practices and results. As such, quantitative risk analysis is inherently a form of validation, albeit reflecting internal data. Based on probabilistic QRA, management decides on a *number* that is in accordance with their explicit bias, otherwise known as risk tolerance expressed as a probability or confidence level of underrun (e.g., "fund at p50").

If the total cost is based on probabilistic QRA, then what remains for estimate validation is to compare the decided upon number, expressed as a metric, to external metrics or benchmarks. As will be discussed later, these overall metrics are usually gross unit costs (cost/quantity such as $/m^2) or cost-capacity ratios (cost/capacity such as