

Owner Cost Estimate Reviews

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ABSTRACT—

A critical point in the progression of any project is the decision to commit significant resources and implement the project. Before proceeding for approval, project teams find it useful to have a third party review the cost estimate. The review is to ensure the technical basis; cost data and assumptions are consistent with expected project outcomes and identify any areas of concern. The paper will primarily address the appropriation estimate but other cost estimate reviews will be covered. The planning, interviews, reviews and report for the cost estimate review will also be discussed. The author will present his extensive experience and hands on work in the understanding of these activities.

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Introduction

The purpose of this paper is to present a suggested methodology for the review of cost estimates. During the authors 30 year career he has reviewed a large number of capital cost estimates. These reviews have been on both internal projects and on third party projects. The reviews have included multi-million dollar projects and multibillion dollar projects throughout the world. The emphasis of the paper will be from the point of view of the owner, the methodology can also be used by contactors. The reference documents used in the review can be obtained from AACE International. The methodology will cover the review by estimate classification as it is important to review project as they progress through the stage gate system.

The methodology will also outline the preparation for the cost review as many reviews suffer because of lack of preparation. Some simple and useful advice for preparation is to **be prepared and be flexible**. The preparation will automatically enable the reviewer to implement the review with the tools which we will outline. Finally the content of the report will be discussed and this will also reflect the preparations.

Why Cost Estimate Reviews

Why do we need to review a cost estimate? First and foremost the organization needs to know that the estimate was prepared in a certain way and with a certain quality. If the project group presents the estimate as suitable for appropriation then the supporting information will need to be present. Second, many organizations employ a stage gate project review system in order to make decisions if a project should continue or be cancelled. Project personnel feel that if a project fails to meet the stage gate and it is cancelled that it is a reflection on their competence. Cancelled projects should preserve the company's resources for better opportunities. Some of the most successful companies are known to employ predictable and consistent evaluations of projects and if necessary cancel the ones that do not meet the criteria. Third, if project teams realize that a review will be performed the opportunity for shortcuts will be seriously considered. The knowledge that someone will ask what you did in the estimate and why, should provide the project personnel with incentives to perform the estimate correctly.

What is an Owner Cost Estimate Review?

A cost estimate review as presented in this paper is the formal presentation of a cost estimate to a third party for the purpose of confirming and validating the indicated quality or estimate class. The reviewer will communicate with the project team with requirements including documentation, location, personnel to be interviewed and the report to be produced. By owner we mean the company making the capital investment or having a material interest in the project (bank or surety).

Estimate Review by Estimate Classification

AACE International (AACE) Recommended Practice No. 18R-97 [1] outlines the Cost Estimate Classification System in the process industry. There are 5 classes defined by AACE called Class 1 to Class 5. In order to simplify the discussion in this paper the ANSI Standard Z94.0 [1] of three classes will be used. The ANSI is descriptive and generally used in the industry. Both the AACE & and the ANSI estimate classes are shown below:

Table 1 - Estimate Classification Matrix [1]

AACE Estimate Class	End Usage Typical Purpose	ANSI Standard Z94.0
Class 5	Concept Screening	Order of Magnitude (OOM) Estimate
Class 4	Study or Feasibility	Budget Estimate
Class 3	Budget, Authorization, or Control	
Class 2	Control or Bid	Definitive Estimate
Class 1	Check Estimate or Bid	

Cost estimate reviews can take place at any stage of the estimating process. The stage gate project review process generally requires the project teams to document and or demonstrate that estimate meets established criteria for passing the gate. With or without a formal a stage gate process all estimates should be reviewed. This can be a memo, a document sent to a distribution list or a presentation at a meeting. Cost estimate reviews are most often done prior to authorization. The financial authorization is a critical point for any project as it is the turning point for commitments of resources and money. Independent reviews are less often done at the Order of Magnitude (OOM) Estimate stage or the Definitive Estimate stage. Complex projects may justify a review at an OOM estimate stage. If a review is done at the definitive estimate stage it may be because there is a problem such as significant scope creep or cost increases significantly beyond the contingency allowance.

Cost Estimate Review Criteria

Cost estimate reviews can be performed with custom checklists or with recognized independent standards such as those from AACE. The advantages of AACE Recommended Practices and Standard are their wide distribution within the cost management profession. A recommended practice developed by a professional association has a perceived independence and objectivity. The practices and standards within AACE have a long history of support including updating and revising. The author has been a contributing author for some of the recommended practices. The AACE Recommended Practices and Standards that are typically referenced in a cost estimate review are as follows:

- 10S-90: Cost Engineering Terminology

- 16R-90: Conducting Technical and Economic Evaluations: As Applied for the Process and Utility Industries
- 17R-97: Cost Estimate Classification System
- **18R-97: Cost Estimate Classification System: As Applied in Engineering, Procurement, and Construction for the Process Industries**
- 20R-98: Project Code of Accounts
- 21R-98: Project Code of Accounts: As Applied in Engineering, Procurement, and Construction for the Process Industries
- 22R-01: Direct Labor Productivity Measurement: As Applied in Construction and Major Maintenance Projects
- 28R-03: Developing Location Factors by Factoring: As Applied in Architecture & Engineering, and Engineering, Procurement & Construction
- **34R-05: Basis of Estimate**
- 40R-08: Contingency Estimating: General Principles

Reviews are best if they recognize the uniqueness and variability of a given project. Standard checklist needs to be modified for the particular project being reviewed. For example OOM estimates for unique process technologies justify a more intense look at the technical basis. If there are unique pieces of equipment that are essential to the project, the check list can be altered to focus questions.

Who Performs the Cost Review?

The question of who performs the cost review is important. It has been demonstrated that an independent party not connected with the project team has the best opportunity to make an objective review. The stakeholders that will receive the review will want to know if the cost estimate has any issues that need to be addressed by the team. An independent and objective review will confirm and communicate to the stakeholders what quality the estimate represents. Most important is the communication of deficiencies and this is better handled by a third party.

Two types of individuals are best qualified to perform the review. First, a third party consultant hired by the company will have a fresh unbiased view of the information being presented. Consultants do not have a history with the project and their evaluations and conclusions should focus on the content and not on the politics. Consultants may also be viewed as a friendly outlet to discuss the challenges of a project that may be difficult to discuss with an internal person. The consultant may also be viewed as an ally to discuss any issues that need to be presented in a constructive way to management. Second, an independent internal person not connected with the project may be considered. This type of individual works best if the organization is large enough to draw people from other company divisions. Large organizations with a matrix structure including project or cost functional groups are well prepared for this type of review. It should be stressed the reviewer should be independent and objective.

Review Team vs Individual Reviewer

The need for a review team composed of multiple members vs. an individual is dependent on a number of characteristics of the review including:

- Project Size
- Project Complexity
- Owner Request
- Project Development – OOM, Budget, Definitive Estimate
- Normal Quality Assurance & Validation Review
- Catastrophic Cost Overrun Review
- Legal Implications of the Cost Review
- Cost Claim Implications of the Cost Review

Most of the author's cost estimate reviews have been with 1-2 members and a few with a team. Usually the owner needs a cost estimate quality assurance/validation and an individual can perform this request. The individual will need to be generally familiar with the industry if they are reviewing the technical, cost and implementation basis. However, an experienced competent cost professional can review a cost basis on any project.

Review Location

Order of Magnitude (OOM) Estimate – The review for this type of estimate will usually take place in the offices of the owner or the contactor tasked to perform the early basic engineering and design. A site visit is usually not required unless there is an issue with a proposed location where the cost is tied to key location specifics.

Budget Estimate – The review for this type of estimate takes place at the office of the engineering company. The review should take place at the office where the engineering, cost and implementation are performed. It is not recommended for the engineering company to go to the owner's offices for the review. During the review, access to the engineering staff and documentation is important. One technique is to ask for supporting documents to be retrieved. Although with the use of data bases and distributed document access, the task might be just a click on the screen. It may also develop that discussions indicate supporting staff may be called to clarify items under review. Being physically present at the office where the work takes place simplifies the access and prevents the excuse that the document or person is at another office.

It is recommended the review of a budget estimate require a site visit. For a new undeveloped site this may be brief but should be made. For a plant modification, revamp or expansion a site visit is essential. The site visit should include interviews of the project management team.

Cost Review Preparation

The cost estimate review should begin and end with the client request. A written description of the request should be received from the client. The request should specify the work to be performed, the project to be reviewed and the cost estimate to be evaluated. The coordination contact should be identified. The coordination contact may be a business manager but should reference the project manager. If there is no written request and the communications have been verbal, a description of the request should be assembled and sent to the client as a confirmation of the request. It would be unusual not have the request in writing but the timing may be rushed. Tell the client what they requested and tell them what you are going to do.

The second part of the preparation is to talk with the key responsible parties. This will include the owner representative, owner project manager, engineering manager and the estimating manager. On smaller jobs this may include the owner representative and the engineering manager. On larger jobs this may include other key parties. The calls will be high level discussions of the review, the timing and expectations. At a minimum, have a coordination discussion with the owner representative and the engineering representative. If a non-disclosure agreement has not been signed it would be appropriate for the reviewer to suggest one be completed prior to receiving any documents.

Third, the client and engineering company will need to be informed of the general and specific documents that need to be sent to the reviewer prior to the visit and the documents that need to be available when the interviews will be done. The documents that will be sent in advance of the interviews include:

- Summary of the project business plan
- Summary technical description
- Latest project report
- Cost summary latest milestone
- Cost summary prior milestone
- Cost backup for sub projects by major code of accounts
- Summary implementation plan
- Schedule, Level One bar chart

The client and the engineering company will also need to be informed of the documents that will be available during the interviews. The documents include full versions of the line items listed above. These documents include but are not limited to:

- Business Plan
- All documents related to the scope of work
- All project reports
- Cost estimate summary and all supporting details
- Bid tabulations for all major equipment
- Implementation Plan
- Schedule, Levels 1,2,3

Fourth, the interview plan with respect to when and who will be interviewed should be sent to the client and engineering coordinator. The request should include the interviews at the engineering office and the site visit. The prior coordination calls will have established the best mutually agreeable interview time and schedule. It is also advisable to inform all parties to complete all essential tasks to facilitate a productive review. The interviews should include, depending on the project specifics, the project manager, technical manager or project engineer, estimating manager or estimator, and the scheduling manager or scheduler.

The interview locations should be agreed based on the location of the staff and the documents. The interviews should take place where both elements are present. One technique of the interviews is to request documents based on the interviews and request they be brought to the meeting. If the documents are a hard copy then the interview location has to take this into account. If most or all the documents are electronic then this is not as important.

Plan the interviews for early to mid-week and leave time for extra days in the event of delays and interviews taking longer than expected. It is recommended to inform the parties that there is flexibility for the interviews but that they will take place as planned. It is not recommended to end the planned interviews on a Friday or prior to a holiday.

If an engineering contractor is being interviewed and a third party consultant is performing the review, it is recommended a representative of the owner attend the interviews. The owner representative usually participates in responses to the questions and is helpful in clarifying responses to the questions. In the event the contractor becomes defensive the support of the owner representative is helpful.

The timing of the interviews should recognize the availability of the staff being interviewed and the receipt of the advance information. All of the key staff being interviewed should be available. The personnel who will answer questions on the cost and technical basis are particularly important. Some supporting members may be absent but the key managers should be present. It is recommended the interview wait until these individuals are available. One option is to perform telephone interviews if the supporting staff needs to answer key questions.

Review Sections

A cost estimate depends on three essential elements:

- technical basis
- implementation basis
- the cost basis

Some may mistakenly think the cost basis is the most important or even sole element but this is not true. First a project has to define the technical basis or scope which will need to be acquired for the project to achieve its goal. Second, the basis for when and how the project will be implemented needs to be defined. Third the definition of the way in which the cost estimates will be carried out needs to be

defined. All three of these elements are interrelated and any deficiencies in one will impact the quality and accuracy of the final cost.

Technical Basis

It is best to start the interview with the technical basis. The technical basis naturally leads into the implementation and cost. The other two sections will depend on the degree of completeness of the scope. The implementation plan and the schedule can go next. The cost basis should be last as the discussion will reference the scope, implementation and schedule.

One of the first questions of the technical basis is what is the size of the team which was discussed earlier in *Who Performs the Cost Review & Review Team vs. Individual Reviewer*. It is assumed the approach has been decided. The cost expert or the technical expert will lead the discussion on the technical basis.

The technical basis is the documents which define the scope of work to be estimated. Depending on the project size there may be separate sections for business, marketing, environmental and scope. In this section we are primarily concerned with the documents related to defining the scope of work to be included in the cost estimate. These documents may include but not limited to specifications, drawings, sketches, equipment lists, process flow diagrams (PFD), piping & instrument diagrams (P&ID), and one line electrical diagrams. They may be actual paper documents but an increasing amount of project information is electronic. Furthermore the electronic information is in a network and may be controlled by content management software such as Documentum or similar.

Prior to the interviews inform the group which will be interviewed for the technical scope will be informed the discussion of the scope will be based on:

**AACE International Recommended Practice No. 18R-97
Cost Estimate Classification System
As Applied in Engineering, Procurement, and Construction for the Process Industries
TCM Framework: 7.3 Cost Estimating and Budgeting [2]**

An electronic copy should be sent to the concerned groups and reference made to the Estimate Input Checklist and Maturity Matrix.

Table 2 – Estimate Input Checklist and Maturity Matrix [2]

	ESTIMATE CLASSIFICATION				
	CLASS 5	CLASS 4	CLASS 3	CLASS 2	CLASS 1
MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	0% to 2%	1% to 15%	10% to 40%	30% to 75%	65% to 100%
General Project Data:					

Project Scope Description	General	Preliminary	Defined	Defined	Defined
Plant Production/Facility Capacity	Assumed	Preliminary	Defined	Defined	Defined
Plant Location	General	Approximate	Specific	Specific	Specific
Soils & Hydrology	None	Preliminary	Defined	Defined	Defined
Integrated Project Plan	None	Preliminary	Defined	Defined	Defined
Project Master Schedule	None	Preliminary	Defined	Defined	Defined
Escalation Strategy	None	Preliminary	Defined	Defined	Defined
Work Breakdown Structure	None	Preliminary	Defined	Defined	Defined
Project Code of Accounts	None	Preliminary	Defined	Defined	Defined
Contracting Strategy	Assumed	Assumed	Preliminary	Defined	Defined
Engineering Deliverables:					
Block Flow Diagrams	S/P	P/C	C	C	C
Plot Plans		S/P	C	C	C
Process Flow Diagrams (PFDs)		P	C	C	C
Utility Flow Diagrams (UFDs)		S/P	C	C	C
Piping & Instrument Diagrams (P&IDs)		S/P	C	C	C
Heat & Material Balances		S/P	C	C	C
Process Equipment List		S/P	C	C	C
Utility Equipment List		S/P	C	C	C
Electrical One-Line Drawings		S/P	C	C	C
Specifications & Datasheets		S	P/C	C	C
General Equipment Arrangement Drawings		S	C	C	C
Spare Parts Listings			P	P	C
Mechanical Discipline Drawings			S/P	P/C	C
Electrical Discipline Drawings			S/P	P/C	C
Instrumentation/Control System Discipline Drawings			S/P	P/C	C
Civil/Structural/Site Discipline Drawings			S/P	P/C	C

The Estimate Input Checklist is the primary document to use for the technical basis review. The advantages of the checklist is that it is published by a professional society, generally accepted by the industry, and is part of a group of documents dealing with the cost management of projects. The further advantage of the checklist is that it can be used in the report to score the estimate based on satisfying the technical criteria for a given class of estimate.

Prior to the interview based on the receipt and review of the preliminary project documents the project technical basis can be evaluated with the checklist. During the interview the check list is used as the actual questions. For the General Project Data in the checklist the degree of completeness is as follows:

None → Assumed / General → Preliminary / Approximate → Specific / Defined

The interview can proceed at the top of the checklist with the General Project Data and continue with Engineering Deliverables. In the Check List the line items starting with the Integrated Project Plan and continuing thru Contracting Strategy are covered in the cost and implementation sections. The transmittal of documents prior to the interviews will make the discussion of each technical line item more efficient and effective. For example, block flow diagrams are usually limited in number and content. They are useful in giving a high level picture of the project. Depending on the stage of development of the project and the interest of the interviewer the document can be requested to be seen and retrieved if necessary. The individuals being interviewed should be able to answer all questions related to the technical basis.

Implementation Basis

The second major review area is the implementation basis. The implementation basis is the plan to manage the development of the project from design to start-up. The implementation basis would include the planning and resources for:

- Project Management Team
- Design
- Contracting
- Engineering
- Procurement
- Construction
- Start-up

All of the areas above apply to the three estimating types; OOM, Budget and, Definitive. The implementation basis would be assembled in a document referred to here as the Implementation Plan (IP). The IP would range from 5 pages for a small OOM type project to hundreds of pages and references to many other documents including the cost and schedule for a complex project.

The organization being reviewed would have been notified prior to the interview that the implementation basis would be reviewed. It is possible the IP could be transmitted prior to the interviews or a table of contents. It is possible the implementation basis sections would be segregated in separate sections maintained by functional groups. The lack of an IP that integrates all the sections would be a deficiency in the estimate review. The review would need to establish if the lack of an IP was a serious deficiency that jeopardized the viability of the cost estimate.

The IP sections would vary from a complete outline and descriptions to summary sections that referred to the details. The design and engineering sections would contain enough content to ensure clearly

supporting the goals of the project as indicated in the other sections. The IP would contain the following items depending on the estimate class:

- Project Management Team
 - Coordination Procedure
 - Organization Charts
 - Responsibility Flow Diagrams
 - Cost Development Plan
 - Schedule Development Plan
 - Reporting/Control Procedures
 - Cost
 - Schedule
- Design
 - Job Specification
 - Design Basis/Specification
 - Block/Process Flow Diagram
 - Conceptual Process Design
- Contracting
 - Contracting Plan
 - Subcontracting Plan
 - Bidders Lists
 - Change Order Procedures
- Engineering
 - Detailed Engineering
- Procurement
 - Inspection & Expediting Plan
- Construction
 - Constructability Reviews
 - Field Engineering
 - Safety Planning
 - Mechanical Completion/Turnover Plan
- Start-up
 - Commissioning Procedures
 - Operating Manual

The review of the implementation basis would emphasize the presence of the above documents and a demonstration of the content which supports the objectives and goals of the project. The implementation basis would need to explicitly support the cost basis. For example the completion basis used to calculate escalation in the Estimate Basis Memo would need to match the procurement and construction schedule.

An additional aspect of the implementation plan is issues it addresses with respect to the location and region of the project. Is the project remote and are there issues that are present and addressed in the planning? Are appropriate shipping, logistics, taxes and duties address in the implementation and cost basis? If the project required a large construction force has the project recognized where the people will come from and how they will be housed? For some locations permitting is a scheduling issue, if this is the case has it been recognized in the cost and schedule?

What are the planning assumptions for the contracting of the project? Is the primary contracting basis direct hire, lump sum? Will the project be contracted as an EPC basis or split vertically or horizontally. If the contracting is split, is the coordination of the contracts noted. Does the work break down structure support the contracting plan & the schedule?

The review of the implementation basis answers the question of how the company is able to fit all the pieces together in a coherent document. The evaluation of this question is how it supports the cost estimate.

The schedule review is an essential part of the cost estimate review. The schedule should support the information indicated in the technical and implementation plan. The review should cover the scheduling tools and the way in which these tools are used in the project. Is Primavera or MS Project being used? What version of the tools is being used for the schedule? How many discrete activities are in the project schedule? How many activities are applicable to engineering, procurement and construction? How is the schedule organized with respect to the implementation plan and the work breakdown structure? What does the schedule say about the current stage of project completion?

It is important to have the schedule review with the scheduler and not the project manager.

Cost Basis

Many people think a cost estimate is a number or summary sheet of estimate categories and subtotals adding up to a grand total. The cost estimate is composed of the following:

- What technical basis the estimate represents → **Scope of Work**
- What quality the estimate is intended to represent → **Estimate Classification**
- Where the estimate applies and the source of information → **Pricing**
- When the estimate was intended to reference → **Pricing & Escalation**
- How the costs were derived → **Techniques & Methods**
- What risk methods are used → **Contingency**

The estimate as describe above should be outlined in a document which specifies the sources of cost information and the key parameters to be used in the estimate such as wage rates and escalation. This document may be called the **Estimate Basis Memo** (estimate memo) or similar title. The estimate memo details will reflect the estimate classification. The length of the memo can vary from a few pages to over one hundred. An estimate memo for a definitive estimate should be thorough and proscriptive in providing instructions to the estimators as to what should be done in the estimate, where the

information is coming from, what techniques and methods apply and how to file the results. Most successful estimating organizations will issue the estimate memo before the estimate starts. It is not as useful to develop the estimate memo on an ad hoc basis. The estimate memo should be updated at the conclusion of the estimate to reflect any departures from the original memo.

The information used in the cost estimate review should include the estimate to be reviewed and the prior estimate. The primary reason to have the prior estimate is that many reviews are requested because of significant differences between the current and prior estimates. A cost comparison is useful to get a quick look at changes, but a cost reconciliation is preferred. A cost reconciliation will establish equivalencies between estimate groups and include more accurate reasons for differences.

The estimating guidelines, checklists and procedures established in the planning will be implemented for each of the three basis sections including the cost basis. Two AACE recommended practices, 18R-97 Cost Estimate Classification System and 34R-05 Basis of Estimate were addressed earlier. These two are key reference documents in the review of the cost basis.

Scope of Work - The first questions are to establish the link between the technical basis and the cost basis. The value of the cost estimate is undermined if there is no explicit link between the technical basis and the cost basis. Is there a list of drawing, specifications, equipment lists, P&IDs that are the reference documents to the cost estimate? These documents are frequently called base line documents, although base line is more frequently applied to cost control documents during construction. Another category of documents that will refer to the cost estimate is Issued for Design (IFD), Issued for Engineering (IFE) and Issued for Construction (IFC). Each has application to OOM Estimates, Budget Estimates, and Definitive Estimates. The definitive document linking the technical basis is a listing of all documents, their title, date and revision and the estimate it defines.

Estimate Classification - Next the estimate basis should support an estimate classification and perceived quality. It is necessary to link any company or internal classification system to an industry standard. AACE Recommended Practice 18R-97 Cost Estimate Classification System (2005) shown below has a matrix to compare the various standards.

Table 3 – Comparison of Classification Practices [1]

	AACE Classification Standard	ANSI Standard Z94.0	AACE Pre-1972	Association of Cost Engineers (UK) ACostE	Norwegian Project Management Association (NFP)	American Society of Professional Estimators (ASPE)
	Class 5	Order of Magnitude Estimate -30/+50	Order of Magnitude Estimate	Order of Magnitude Estimate Class IV -30/+30	Concession Estimate	Level 1
					Exploration Estimate	
					Feasibility Estimate	
	Class 4	Budget Estimate -15/+30	Study Estimate	Study Estimate Class III -20/+20	Authorization Estimate	Level 2
	Class 3		Preliminary Estimate	Budget Estimate Class II -10/+10	Master Control Estimate	Level 3
	Class 2	Definitive Estimate -5/+15	Definitive Estimate	Definitive Estimate Class I -5/+5	Current Control Estimate	Level 4
Class 1	Detailed Estimate		Level 5			
					Level 6	

Any classification system from a company has to be linked to a standard, it may be necessary for the reviewer to evaluate any differences between the internal classification and the standard. The AACE documentation should resolve these questions.

Pricing – The estimate in its details is a collection of prices for various categories of costs. The source and reference for all should be established.

What is the **equipment pricing** and did it originate from an internal source or an external source? The internal source could be a company library or data base. If it is an internal library or data base is the data normalized and indexed? Normalizing would convert the equipment to a standard item that could be used for any future project. Indexing would convert the pricing of the equipment pricing to a reference date and then could be used with an index for any future date. The external sources would be third party estimating programs, vendor quotes or purchase orders. The third party estimating programs should have appropriate application to the industry or modified for use by the user. The use of vendor quotes should be clearly noted as budget quotes or firm quotes. Quotes can be tested to establish the technical quotation basis and the values in the estimate.

What is the **bulk material pricing**, where did it originate and how was it used in the estimate? The internal vs. external questions are similar to the discussion about equipment pricing above. An

additional question about bulk material pricing is the magnitude of quantities and discounts that are applied. Does the pricing include or exclude discounts. If excluded where are the discounts calculated and applied.

What is the **labor** pricing basis, where did it originate and how was it used in the estimate? Is the labor on a direct hire or all-in-subcontract basis? If an all-in-subcontract basis is used what cost elements are included in the rate, especially small tools and construction equipment? Is the wage rate applied as a project or location average or are there rates by trade? If an average rate is used what is the weighting of trades used to derive the average? Is there a reference of the wage rate to prior projects? Is there a reference to union agreements that can be verified? What is the labor productivity basis and can it be referenced to prior projects, third party estimating program or an industry standard? Can the wage rates and productivities be tested and validated?

Pricing & Escalation – All pricing for equipment, bulks and labor should be clearly indicated as to the time period. For OOM estimates and some budget estimates it is common for a reference date to be used for the estimate details such as 4Q2013. Escalation is then applied overall or by estimate element to an expenditure period. The escalation would then represent the monies expended to achieve a project completion. The escalation rates should be justified and substantiated and validated to external values. There are various third party sources of information available in the technical publications or for purchase. The highest level is economic forecasting companies.

Techniques & Methods – What are the estimating techniques and methods, where did they originate and how where they used in the estimate? Is the estimate organized with the use of a work breakdown structure (WBS) and a code of accounts? Does the WBS apply, support or reference the schedule? Is the WBS and schedule planned to be integrated? Do the techniques and methods support the estimate classification? The level of detail should be reflected in the expected accuracy. An OOM estimate may show techniques such as unit cost proration from other projects and time periods. A budget estimate may have a mix of high level estimating and semi-detailed estimates. A definitive estimate will have a majority of detailed estimating. Sophisticated estimating organizations can quantify the methods used in the estimate by summary, proration, semi-detailed, quotes and detailed. The use of allowances should be specified in the estimate memo and be appropriate to the estimate class. Exclusions are important if they potentially have an impact on the project or are under the control of external parties.

Contingency – What is the estimate approach to risk and how is it calculated? The reviewer should establish the way in which contingency was calculated and is it appropriate to the estimate class. Does the estimating group have a history of performance on similar projects which reflects the contingency? Are tools used to statistically derive the contingency such as Monte Carlo simulation? How was the simulation performed and derived? Has the company tracked the performance of projects including the comparison of appropriation value vs. final project cost? Does the company employ any continuous improvement process such as Total Cost Management?

The final analysis of the cost basis is the question of how the project compares to other projects. It is frequently referred to as benchmarking or project metrics. The principle of benchmarking is that similar

activities in projects will conform to a reference value or band of reference values. Values outside of the reference will require investigation or explanation. Some of these values are strategic such as dollars invested per unit of output. Other benchmarks are semi-detailed such as overall labor productivity. Other benchmarks may be keyed to code of accounts such as average work hours to install a cubic yard of concrete. Another code of account benchmark is average pipe diameter on the project and average work hours to install a diameter inch of pipe. The benchmark parameters are calculated and compared to other similar projects. In the event there are differences an explanation should be available. If a potential problem exists, it should be resolved.

Interview Briefing & Report

Prior to departing the interviews, the reviewer will want to brief the concerned parties. The briefing should include general comments as to how the review proceeded. If there are any deficiencies it may be appropriate to express concern about the issue. An objective & balanced briefing that will be supported in the report will serve to alert the concerned parties as to what is coming. It may be necessary to analyze some content before coming to a conclusion about a given issue. In that case it would be appropriate to withhold it from the briefing. The politics of the review will be evident when it is requested and performed and will inform the reviewer the extent that the briefing can extend.

The report is the key document in the process of the estimate review. It serves to record what was requested, what was revealed in the review and what the reviewer recommends needs to be followed up. It is the author's experience that most reviews with competent owners and contractors serve to confirm and validate the cost estimate. The question that is frequently unasked but evident is "Do we have anything to worry about with this project?"

The report should as a matter of thoroughness outline the request, the dates, times and content of the reviews. The parties interviewed should be documented. The review materials should be included or referenced such as AACE 18R-97 Estimate Classification and AACE 34R-05 Basis of Estimate. Key tables and figures should be included. Reports of this nature are usually sent as draft in the event content needs to be modified.

Report scoring _> meets criteria, cautionary note, deficiency

Conclusion

Projects reach key points where the decision to proceed and spend significant monies is reached. These decisions are often meaningful in the company achieving financial success. Many projects fail because of the lack of a critical review at periodic points of a projects development history. It has been clear in many post mortems on a project failure that a project cost review would have shed light on risk and deficiencies. The expense of a project review should also not be avoided because of the lack of any significant failures. Total Cost Management and continuous improvement stresses the need to confirm success and correct failure.

The paper has also stressed the need for an independent third party to review the cost estimate such as an outside consultant. The reviewer should not be on the project team.

The cost review should confirm and validate the work performed is consistent with project development and control criteria. This criterion is well represented by AACE Recommended Practices and Standards. The two standards key to this review is: 18R-97 Cost Estimate Classification System and 34R-05 Basis of Estimate.

References

1. Cost Estimate Classification System – As Applied in the Engineering, Procurement, and Construction for the Process Industries, AACE Intl. Recommended Practice No. 18R-97, February 2, 2005, Page 6, Figure 3a
2. Cost Estimate Classification System – As Applied in the Engineering, Procurement, and Construction for the Process Industries, AACE Intl. Recommended Practice No. 18R-97, November 29, 2011, Page 8-9, Table 3



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