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Preparing a Basis of Estimate

Mr. Todd Pickett, CCC

www.ccg-estimating.com

Within seconds of answering the phone, those ominous words were muttered by the project manager, "do you remember that estimate you did for me a few months ago? Well the project is way over budget." Your immediate reaction is one of impending doom, but your anguish quickly disappears as you realize that you have nothing to worry about—your estimates are always expertly prepared. Each and every one of your estimates contains appropriate detail, is sufficiently supported by history, and most importantly, is accompanied by a well documented Basis of Estimate (BOE).

You soon discover that instead of being months old, the estimate in question was actually prepared well over a year prior to the phone call; and with a little effort you easily locate all of the documentation that was safely tucked away in a project estimate file. Much to your relief, everything is there, including all of the technical documents, applicable project plans and schedules, and, of course, the basis of estimate.

A meeting is quickly convened to review the basis of estimate and to reconcile the estimate with the project's actual execution and costs. Discrepancies and warning flags appear almost immediately. Scope has changed and different drawings were used for construction, alternate subcontractors were employed, and the quote for a major piece of equipment significantly differed from that used in the estimate. All of this had been well documented in the basis of estimate, but had been ignored during project execution. Someone had not done their job, but fortunately it wasn't the estimator.

In this paper, I will describe in detail the content and layout of a properly prepared basis of estimate. Keeping in mind that projects vary in value, complexity, intent, and nature, I will discuss how the BOE should be prepared on a fit-for-use basis and the amount of effort that should be expended during its preparation. A general outline of a BOE will also be provided that can be used as a template for almost any industrial or commercial application.

Purpose of a Basis of Estimate

So exactly what is a basis of estimate? And what purpose does it serve? In a nutshell, it is a succinct method of documenting the critical aspects of a project cost estimate for the purpose of mitigating project cost risk. The US Federal Aviation Administration (FAA), in their *Cost Basis of Estimate Guidelines* state that, "A cost BOE should be sufficiently complete and well organized such that a cost estimating professional can use the documentation by itself to understand and assess the estimate." A well-written BOE will achieve those goals by clearly and concisely stating the purpose of the estimate being prepared (i.e., cost study, project options, funding, etc.), the project scope, pricing basis, allowances, assumptions, exclusions, cost risks and opportunities, and any deviations from standard practices. It is also a documented record of pertinent conversations that have occurred and agreements that have been made between the estimator and other members of the project team. Let's examine a few reasons why it is imperative that the estimator prepare a good basis of estimate.

Display Your Knowledge of the Project

When it comes right down to it, the intent of every project is to provide a solution to a problem. The basis of estimate is the instrument used to convey to the owner and other members of the project team that the estimator understands the problem, the proposed solution, and how much that particular solution is going to cost. To make matters more interesting, there may be multiple solutions to the problem in which case the estimator must understand each and every alternative and the resulting costs. Preparing a good BOE will assure the customer and all members of the project team that the estimator truly understands the purpose of the project and is providing the best estimated cost for the proposed solution.

Alert the Project Team to Potential Cost Risk and Opportunities

As the project estimate is being developed, any and all potential cost risks should be documented. During the preparation of a typical project estimate, the estimator will undoubtedly encounter a number of items that could present potential cost risk to the project. The list of cost risks is unlimited, but can include such things as unquoted equipment, unidentified engineering or construction resources, potential labor issues (such as looming strikes or shortage of qualified labor), unknown site conditions, etc. All of these risks should be clearly identified within the basis of estimate to ensure that all project team members are made aware of their existence.

It is also possible that potential cost or time saving opportunities will be discovered along the way. In many cases, the estimator (or estimators) preparing the estimate may have served in other

roles on the project team in the past— as a craft worker, a construction manager, or project manager. It is certainly not uncommon for an estimator to suggest a quicker, cheaper, or easier way to execute some facet of the project. If the estimator hasn't already raised these issues with the project team all of these opportunities can, and should, be documented within the basis of estimate.

Record of Communications

Over the course of estimate preparation, several meetings will have taken place with one or more of the project team members. During these meetings it is not uncommon that key decisions and assumptions may be made that will impact the end result of the estimated cost. It is imperative that these discussions are documented and ultimately agreed upon by the pertinent members of the project team. During the final estimate review these key decisions should once again be revisited and a consensus of agreement of the project team members should be obtained.

Record of Documentation

Many documents will be collected and referenced during the development of the estimate. Since these documents ultimately form the basis for the resulting estimated cost, the basis of estimate should contain a record of each of these documents. All project plans, technical documents, and drawings should be itemized and accurately described in the appropriate section of the basis of estimate.

Legally Supporting Document

One last, but certainly not least, reason for preparing a complete and concise basis of estimate is that it can be a valuable source of support during any legal proceedings that may arise during the course of the project. Although not common, it is certainly possible for litigation to be brought that can be directly attributed to an "assumed" poor estimate. As an estimator, any evidence that you can provide to support your assumptions and other decisions in preparing the estimate will aid in the defense of your estimate.

How Much Detail should be in the BOE?

It's claimed that the H.J. Heinz Company adopted the slogan '57 Varieties' because at that time (late 1890s) their product line consisted of exactly 57 different products. Makes sense, but it's simply not true. The fact is, it was a slogan that was merely made up by Henry Heinz because it sounded "catchy" and had absolutely no bearing on anything else.

In many cases, the same holds true with regard to the level of detail that should be included in a BOE. Although it might appear to be obvious, it is often not that simple to determine just how much detail should be provided. Several factors may come into play during the preparation of the estimate that will help determine that answer but, at the end of the day, it will be the estimator's best judgment that will ultimately decide the appropriate level of detail. So, how much detail should the BOE contain? Let's take a look at some of the elements that may provide the resolution to that question.

Estimate Classes

We all know that estimates are prepared at various stages of a project. In the early stages of the project, a conceptual estimate will most likely be assembled, followed later by more detailed estimates as the project progresses through its lifecycle. It's inherent then that a different level of detail will be required for each of the accompanying basis of estimates.

A more detailed estimate will generally require a more detailed BOE. But don't be fooled into thinking that is always the case-in-point. It is true that a conceptual estimate will probably be based on a limited amount of scope, but contrary to what you may think that can actually result in a more detailed basis of estimate. It's not all that uncommon for a BOE for a conceptual estimate to be more thorough than one prepared for a more detailed estimate, simply because there are almost always more assumptions made at the conceptual stage of a project that consequently require greater documentation.

On the flip side, there will be times when the project definition and scope is so well prepared, or it is so simplistic in nature, that a BOE for a final funding estimate does not require a great amount of detail. A three or four page document may well be sufficient to convey the true basis of the estimate.

With regard to the different classes of estimates, what the estimator is obligated to do in the BOE is to provide as much detail as necessary to support, justify, and confirm the information presented in the cost estimate.

Cost Value of the Project

The value of the estimated costs can help determine the level of detail that should be contained in the BOE. Some would argue that this is not good practice and that all basis of estimate documents should strive to contain the same level of detail. It is more correct to assert that all basis of estimates should capture the appropriate level of detail. The reality is that much greater detail should be provided in the basis of estimate for a new multi-million dollar facility then would be included in a BOE for a twenty-thousand dollar retrofit.

Type of Project

The one are that will be a primary determinant of the level of detail provided in the BOE. What type of project are you estimating? Is it a direct purchase? Is it a retrofit of an existing facility or process? Is it a green-field project? Direct purchases typically require very little documentation. Whereas, a retrofit type project that is a modification to an existing facility or process will certainly require a greater level of detail. An estimate for a brand new project may require the highest level of documentation— especially if it involves new technologies.

Other Determining Factors

There are several others factors that help determine how thorough to be in completing the basis of estimate. Does the project cover multiple geographical areas or process units? Does the project involve multiple or new technologies? Is sufficient historical data available to support the estimated costs? What estimating tool was used? And what cost database or information sources were used? Each of these factors should be taken into consideration when determining the amount of detail included in the BOE.

What Information Should a BOE Contain?

So, exactly what should be included in a basis of estimate? And, what would be a good format for presenting this information? Currently, there are no established standards that describe what a BOE should specifically contain. To make matters worse there is a hodge-podge of formats—in essence each company or organization does it "their way." But, for the most part, even though they are laid out in a variety of different manners, the information contained in these BOE documents is fairly consistent. In the next few sections I'll provide a standard template that any company can use for their basis of estimates.

Purpose

In this initial section of a basis of estimate the estimator should provide a brief, concise description for the total project. The type of project should be identified (i.e., new facilities, addition to existing, revamp of existing, etc.), as well as the type and capacity of the process units, the location of the facility, and the overall timing of the project. The author should also indicate the primary estimating methodology used to prepare the cost estimate, as well as the purpose and classification of the cost estimate.

Project Scope Description

This section of the estimate basis should be organized to correspond with the project's work breakdown structure (i.e., plant, train, building, etc.). A semi-detailed description of the scope of work should be provided for each major segment of the project. Identify any major pieces of process equipment or components. It's also good practice to indicate the primary trades that will be involved with the project. Be as thorough as necessary, without being overly descriptive, so as to adequately explain the scope of work being estimated.

Design Basis

Company standards will typically specify what information is required for the classification of the estimate that is being prepared. In this section, the estimator will identify the types and status of engineering and design deliverables that were provided to prepare the estimate including any design basis assumptions. Two attachments to the estimate should be referenced here as well. The first is an estimate deliverables checklist that is aligned with the company standard project processes. The second attachment should be a listing of all engineering drawings (including revision number and date), a well as other design information, such as specifications, equipment lists, etc.

Planning Basis

This section documents the project management, engineering, design, procurement, fabrication, and construction approaches to the project. The contracting and resource strategies should be identified, as well as any assumptions that were made with regard to the work week and overtime. Any assumptions made regarding constructability, modularization, use of specialized construction equipment should also be noted here.

The overall project schedule and key milestones should be identified.

Cost Basis

Describe the methods and sources used for determining all material and labor pricing. Identify the following:

- Pricing sources for all major equipment (vendor quotes, historical data, etc,).
- Bulk material and commodity pricing sources, including any discount strategies.
- The pricing source for all labor hours, and all labor productivity adjustments. Provide appropriate detail if productivities vary by trade and/or location within the project (plant, etc.).
- All wage rates used (including crew/craft rates, craft mix, etc.). Identify all items included in all-in rates (if used).
- Pricing source and methodology for construction indirects.
- Pricing source for all start-up costs.
- Pricing source and methodology for all home office costs (project management, engineering, design, etc.). Document the basis for any contractor fee costs.
- Pricing source and methodology for costs such as freight, taxes, duties, etc.
- Pricing source for any owner's costs included in the estimate.
- Currency exchange rates if applicable.
- Pricing and calculations for any escalation costs provided.
- Any other pricing factors or external influences that may have a significant impact on project cost should be identified.

Allowances

In this section, identify the level and types of allowances used in the estimate. Describe the basis for the common estimating allowances such as material take-off allowances, overbuy allowances, design allowances for engineered equipment, process technology development, congestion allowances, working height allowances, etc.

This section should also describe any other costs that have not been detailed in the body of the estimate, such as lump-sum allowances for specific areas of scope or any other factored costs not described elsewhere in the estimate basis.

Assumptions

Any other assumptions made by the estimator, but not documented elsewhere in the estimate basis, should be included in this section. This may include such assumptions as an adequate labor supply being available, adequate funding available, site conditions, etc.

Exclusions

In this section the estimator should document all potential items of cost which might be associated with the project but for which no costs have been included in the estimate. Asbestos abatement, removal of hazardous wastes, acquisition of land, taxes, financing costs, licensing costs, are examples of potential items that may be identified.

Exceptions

Here the estimator should identify any anomalies to standard estimating practices that are defined by the company for which you are providing the estimate. This section should document any significant deviations from the project and/or engineering deliver-

ables required for the applicable class of estimate. A good practice is to provide a checklist as an attachment to the BOE that will document any exceptions that are identified. This checklist should correspond to the company's standard estimating practices.

Risks and Opportunities

Any areas of the estimate containing significant risk or opportunity should be identified. If a formal risk analysis study has been prepared it should be described here. In particular this section should identify those cost elements that have been identified with high or very high risk or opportunity values.

Contingencies

Contingency is a cost element of the estimate used to cover uncertainties and unforeseeable elements of cost within the defined project scope. Contingency covers inadequacies in project scope definition, estimating methods, and estimating data. Contingency specifically excludes changes in project scope, and unforeseen major events such as earthquakes, prolonged labor strikes, etc.

The amount of contingency included in the estimate should be identified, as well as the methods used to determine the contingency amount. If risk analysis techniques were used to develop the contingency amount, the associated confidence level should also be identified.

Management Reserve

Contingency is not intended to cover the costs for changes in project scope. If the project needs to provide an allowance for anticipated changes in scope, or to cover the costs for items that may be required but have not yet been specifically identified as being included in the current project scope, then that amount of cost, typically referred to as management reserve, should be identified here.

Reconciliation

Provide an overview of the major differences between this estimate and the last published estimate prepared for this project. Identify the cost impacts due to scope changes, pricing updates, labor productivity adjustments, estimate refinement, etc. A more detailed reconciliation report can be provided as an additional attachment if necessary.

Benchmarking

This section should document any comparisons of resulting metrics, ratios, and factors with similar projects, historical data, and industry data. Projects used in the benchmark comparisons should be similar in process type and overall value. If significant variations of the estimated project costs versus the benchmarks exist, those inconsistencies should be identified and commented upon. A more detailed benchmark analysis report may be included as an attachment to the basis of estimate document.

Estimate Quality Assurance

Since estimate reviews are the vehicle for testing the quality of the estimate, this section of the document should identify all estimate reviews that have taken place to date, and any additional reviews that are proposed to take place.

Estimating Team

In this final section of the basis of estimate all members of the estimating team should be identified.

Attachments

Several supporting documents will generally be included with the basis of estimate.

Attachment A: Estimate Deliverables Checklist

Attach a completed estimate deliverables checklist indicating the project and engineering deliverables to be supplied for the associated estimate classification, and whether they were in fact available during preparation of the estimate.

Attachment B: Reference Documents

Document the drawings, manuals, texts, notes, specifications, and other references used in developing the estimate. Identify the revisions and date of issue for key documents.

Additional Attachments

Include any other attachments that may be necessary or required (reconciliation report, benchmarking report, risk analysis report, etc.).

Important Points to Remember When Preparing the BOE

- Be complete but be concise. Detail is always good. But be careful—if it's too long or too wordy it won't be read.
- Be able to support your facts and findings—Don't say it if you don't mean it.
- Identify estimating team members. They may be able to answer questions regarding the estimate if you're not available.
- Describe the techniques and data used to develop the cost estimate. The BOE (along with the project scope) should provide the information necessary for another estimator to replicate the estimated cost.
- Identify other projects that were referenced—History truly does repeat itself where projects are concerned.
- Make every effort to develop the BOE while the estimate is being prepared. It is always easier to record your facts and findings while they are fresh in your mind.
- Always remember—for many reviewers, the BOE is the only document used to judge the quality of the estimate.

In this paper, I have discussed the importance of preparing a cost basis of estimate, how much detail should be included in the BOE, and also laid out a systematic approach for preparing a complete and concise document. There are many benefits from the preparation of a high quality, standardized basis of estimate. A well written BOE will be easy to review; it will identify risks and opportunities; and it will be a record (probably the only record) of findings to support and justify the estimate. Another benefit that often goes unrecognized is that it can be a time saver. The **FAA Life Cycle Cost Estimating Handbook**

notes that "a disciplined approach to documentation and presentation frees the estimator's time for creating the estimate." Preparation of the BOE should be second nature to estimators, which in turn allows them to save their true artistic talents for the more important task of actually producing the cost estimate.

In the introduction, I described a hypothetical situation where an estimator was called upon to justify their cost estimate long after it had been completed. This scenario could easily happen to any estimator, and probably has happened to many. But, whether the cost estimate was completed last week, last year, or several years ago, as long as it contains appropriate detail, is sufficiently supported by history, and is accompanied by a well documented cost basis of estimate—the estimator can rest easy knowing that they did their job.

References and Resources

1. *Documentation Guidance for FAA Cost Estimates* (Cost Basis of Estimate [BOE]), January 2003, US Federal Aviation Administration (Investment Cost Analysis Branch, ASD-410), World Wide Web (fast.faa.gov/investment/cboe.htm)
2. *Estimating Techniques and Tools for Project Managers*, September 2004, Keane, World Wide Web (www.nysfirm.org/documents/html/pmo-9-30-04).

Mr. Todd Pickett, CCC
Conquest Consulting Group
13215-C8 SE Mill Plain Blvd., #205
Vancouver, WA 98684-6991

E-mail: tpickett@ccg-estimating.com