

**AACE**  
INTERNATIONAL  
**RECOMMENDED  
PRACTICE**

**34R-05**

**BASIS OF ESTIMATE**

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AAACE® International Recommended Practice No. 34R-05

## BASIS OF ESTIMATE

TCM Framework: 7.3 – Cost Estimating and Budgeting

Rev. October 5, 2021

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October 5, 2021

**TABLE OF CONTENTS**

Table of Contents ..... 1

1. Introduction ..... 3

2. Estimate Basis Development Process ..... 4

    2.1. Inputs to the BOE ..... 4

3. Estimate Basis Format and Content ..... 5

    3.1. General ..... 5

        3.1.1. Purpose ..... 5

        3.1.2. Project and Estimate Objectives ..... 5

        3.1.3. Project Scope Description ..... 5

        3.1.4. Project Execution Plan Summary ..... 6

        3.1.5. Construction, Fabrication, and Operating Parameters ..... 6

        3.1.6. Estimate Classification ..... 6

    3.2. Methodology ..... 7

        3.2.1. Estimating Tools ..... 7

        3.2.2. Coding Structure ..... 7

    3.3. Design Basis ..... 7

        3.3.1. Units of Measure ..... 7

        3.3.2. Currency and Exchange Rates ..... 7

        3.3.3. Rounding ..... 7

    3.4. Quantity Basis ..... 8

    3.5. Cost Basis ..... 8

    3.6. Planning Basis ..... 9

    3.7. Bulk Commodity Material ..... 9

    3.8. Labor ..... 9

    3.9. Demolition ..... 9

    3.10. Allowances ..... 10

    3.11. Assumptions ..... 10

    3.12. Exclusions ..... 10

    3.13. Exceptions ..... 10

    3.14. Risks and Opportunities ..... 10

    3.15. Containments ..... 10

    3.16. Contingencies ..... 11

    3.17. Management Reserve ..... 11

---

October 5, 2021

3.18. Reconciliation .....11

3.19. Benchmarking .....11

3.20. Estimate Quality Assurance .....11

3.21. Estimating Team .....11

3.22. Attachments .....12

    3.22.1. Attachment A: Estimate Deliverables Checklist.....12

    3.22.2. Attachment B: Reference Documents .....12

    3.22.3. Additional Attachments .....12

4. Level of Detail in the Basis of Estimate .....12

    4.1. Level of Project Definition .....12

    4.2. Cost Value of the Project .....12

    4.3. Type of Project .....13

    4.4. Other Factors .....13

References .....13

Contributors .....13

October 5, 2021

## 1. INTRODUCTION

AACE International's *Total Cost Management (TCM) Framework* [1] identifies a basis of estimate (BOE) document as a *required* component of a cost estimate. As a recommended practice (RP) of AACE International, the template outlined in the following sections provides guidelines for the structure and content of a cost basis of estimate.

In the *TCM Framework*, the BOE is characterized as *the one deliverable that defines the scope of the project*, and ultimately becomes *the basis for change management*. When prepared correctly, any person with capital project experience can use the BOE to understand and assess the estimate, independent of any other supporting documentation. A well-written BOE achieves 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. In addition, the BOE is a documented record of pertinent communications that have occurred and agreements that have been made between the estimator and other project stakeholders.

A well-prepared basis of estimate will:

- Document the overall project scope.
- Communicate the estimator's knowledge of the project by demonstrating an understanding of scope and schedule as it relates to cost.
- Communicate the uncertainty associated with the estimate and alert the project team to potential cost risks and opportunities.
- Provide a record of key communications made during estimate preparation.
- Provide a record of all documents used to prepare the estimate.
- Act as a source of support during dispute resolutions.
- Establish the initial baseline for scope, quantities and cost for use in cost trending throughout the project.
- Provide the historical relationships between estimates throughout the project lifecycle.
- Facilitate the review and validation of the cost estimate.
- Highlight deficiencies in estimate preparation that may impact the estimate.
- Be aligned with the estimate plan document.

Although the primary intent of this RP is to provide a guideline for the topics and contents to be included in a typical BOE, there are a few points of significance worth noting. A basis of estimate should:

- Be factually complete, but concise.
- Be able to support facts and findings.
- Identify estimating team members and their roles.
- Describe the tools, techniques, estimating methodology, and data used to develop the cost estimate.
- Identify other projects that were referenced or benchmarked during estimate preparation.
- Be prepared in parallel with the cost estimate.
- Establish the context of the estimate, and support estimate review and validation.
- Qualify any rates or factors that are referenced either in the estimate or BOE; e.g. productivity can be expressed as either units/time (linear feet/hour) or time/units (hours/linear foot).

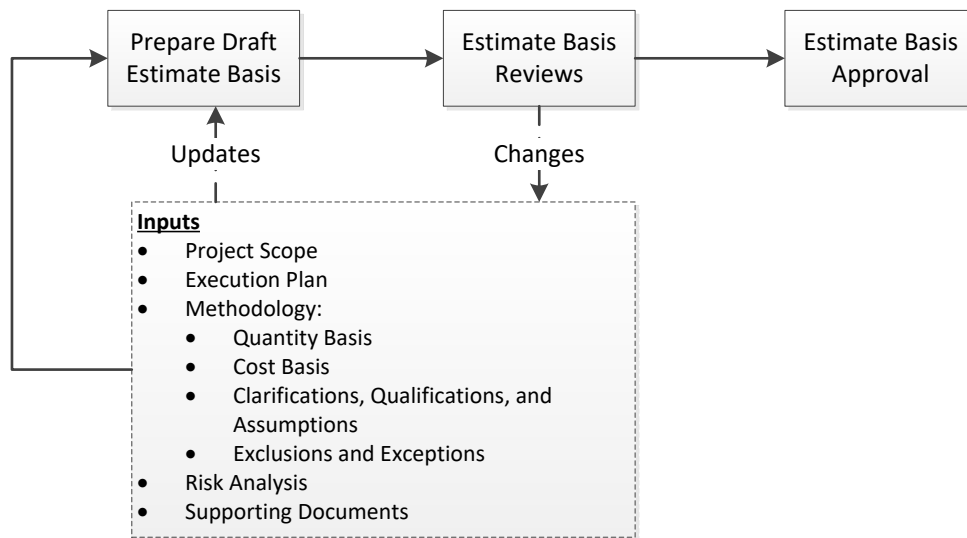
This RP is intended to be a guideline, not a standard. It is understood that not all organizations that prepare estimates employ the same processes and practices, and therefore, may opt to use this information either in part or in its entirety.

October 5, 2021

## 2. ESTIMATE BASIS DEVELOPMENT PROCESS

This section defines the main steps and discusses issues to be considered while preparing a BOE. In general, a separate BOE will be developed for each individual estimate, but the content for projects within a program should be integrated where appropriate. Some projects may lend themselves towards having a single estimate basis for all individual scopes of the project.

Figure 1 highlights the requirements of the estimate basis development process.



**Figure 1. – Estimate Basis Development Process**

### 2.1. Inputs to the BOE

The BOE should leave the reader with a clear understanding of the information and assumptions the estimator has used in developing the estimate. It should clearly define:

- Scope of the estimate.
- Methodologies used to develop the estimate.
- Sources and quality of supporting data.
- All inputs to the estimate.
- All required outputs.
- Any areas of uncertainty within the estimate including significant risks.

The quality of the estimate and BOE should be such that the reader can make clear business decisions based on the provided information and support project system analyses (lessons learned, claims, historical, etc.)

The BOE should reflect the owner's specifications for the BOE. It is the responsibility of the lead estimator to develop an estimate basis which will satisfy the owner's needs. Where multiple contractors are involved, the BOE must clearly define the scope of the estimate. The basis should note portions of the overall project scope that fall outside of the estimate, which the reader may otherwise expect to be included (e.g., mining equipment is included, but the initial mine excavation is executed by another contractor and is excluded from the estimate).

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October 5, 2021

The final version of the estimate plan may be used as the starting point for the BOE by carrying over common elements, wording, and formatting from the estimate plan. Estimate requirements should be reviewed to assure consistency.

Preparation of the BOE document during the estimate preparation process is essential as key information may later be forgotten and not documented.

It is important to note that there can be a significant difference in a BOE for a deterministic estimate (Class 3, 2 and 1) – where the primary method of cost development is through the use of semi-detailed or detailed unit costs – and a conceptual estimate (Class 5 and 4), which is primarily developed through the use of cost estimating relationships (e.g., equipment factoring). The extent to which the following sections of the basis of estimate document are completed will be dependent on the type of project, the class of estimate, and other variables. It is recommended to keep the document concise, but to include as much of the following relevant information as possible.

Additional information regarding the level of detail in the BOE is provided later in this document.

### **3. ESTIMATE BASIS FORMAT AND CONTENT**

This section describes the suggested topics and contents included in a typical BOE. The extent to which each of the sections below can be completed as indicated is highly dependent on the intended class of estimate, and the level of definition available.

The following describes the suggested topics and contents included in a typical BOE.

#### **3.1. General**

##### *3.1.1. Purpose*

In this initial section of a basis of estimate, the estimator should provide a brief and 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 facility, the location of the facility, and the overall timing of the project.

The purpose of the estimate sets the focus for the remainder of the document. Identify whether the estimate is a part of a requirement for approval to proceed to the next phase of the project, a special study, to update the cost control baseline, etc. Secondary purposes are to establish a basis for project control, to quantify resource requirements, and provide owner decision-makers with an appropriate level of confidence in the estimate.

##### *3.1.2. Project and Estimate Objectives*

Describe the alignment of the cost estimate with project objectives (i.e., cost or schedule driven); and cost, pricing, and risk strategy.

##### *3.1.3. Project Scope Description*

The intent of this section is to provide the reader with a clear understanding of the major components within the scope of the project, and major components not included in the project. This section should be organized to correspond with the project's work breakdown structure (i.e., plant, building, floor, etc.). A semi-detailed

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October 5, 2021

description of the scope of work should be provided for each major segment of the project. Identify any major pieces of 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.

#### *3.1.4. Project Execution Plan Summary*

Identify the execution assumptions that the estimate is based upon including:

- The contracting strategy including the labor type (union, open shop, mixed, or other) and the planned labor work week and applicable shift schedules (e.g.: 8 hours per day x 5 days per week.) used in the estimate. Explain how overtime hours and related cost allowances were determined.
- Labor sources (number of local, travel cards, temporary foreign workers, etc.).
- The procurement strategy including identification of free issued equipment or material (and whether included in the estimate) and overseas purchases.
- The fabrication strategy including locations of off-site fabrication.
- Modularization strategies identifying module construction locations, and possible double or triple handling costs of modules, or off-site assembly of models into super-modules.
- All project breakdown structures used to identify the work activities in the estimate.
- Ensure alignment with the cost estimate and schedule assumptions and requirements.
- The summary schedule (by facility, phase, unit, and commodity/discipline). Note any special schedule events that impact costs and are reflected in the estimate. Examples are:
  - weather windows (shipping and site)
  - operating outages
  - tie-ins
  - work week
  - extended overtime
  - union contract expiration dates
  - peak manpower periods
  - planned downtime (e.g., holidays, planned evacuations in existing facilities)
  - known and pending regulatory/environmental issues

#### *3.1.5. Construction, Fabrication, and Operating Parameters*

Note all assumptions and information sources relating to items such as average annual weather conditions at the job site along with maximums, minimums and time of year they occur. Known soil conditions are summarized (e.g., clay/rock, topsoil depth, permafrost, water table, underground aquifers, etc.). Distance to nearest major population centers, infrastructure availability, material sourcing locations, etc. should be documented. A checklist may be used for identifying other applicable location parameters.

#### *3.1.6. Estimate Classification*

The AACE International estimate classification should be identified for the type of estimate being prepared, along with reasons or justification used in the selection of the estimate classification.

AACE Professional Guidance Document PGD-01 (Guide to Cost Estimate Classification Systems) [2] provides a roadmap and annotated table of contents for finding the AACE recommended practice (RPs) relating to the type of cost estimate being prepared.



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October 5, 2021

### **3.2. Methodology**

The BOE should indicate the primary estimating methodology used to prepare the cost estimate. This should include documentation of the use of cost resources, historical data and project benchmarking. Documenting the level of effort or man-hours used in preparation of the estimate is also recommended.

#### *3.2.1. Estimating Tools*

Describe all software applications, including version, and how they were used (e.g., simulated quantities, internal database, interface software to load productivity rates into estimating program).

#### *3.2.2. Coding Structure*

Attach the final project code of accounts, project work breakdown structure (WBS), cost breakdown structure (CBS), or other specified coding and formatting requirements as an appendix. Include a table in the appendices showing all attributes assigned to each code.

### **3.3. Design Basis**

Company standards will typically specify the technical and project information 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 technical basis assumptions. Two attachments to the estimate basis should be referenced: 1) an estimate deliverables checklist that is aligned with the company's standard project process; and 2) a listing of all engineering drawings (including revision number and date), a well as other design information, such as specifications, equipment lists, units of measure (imperial vs. metric), etc.

In addition, it may be useful to document specific quantity metrics for particular projects, such as overall excavation and backfill quantities, overall concrete volumes, overall piping quantities, etc.

#### *3.3.1. Units of Measure*

State the type of units of measure (i.e., metric, imperial) and any exceptions that were used.

#### *3.3.2. Currency and Exchange Rates*

State the currencies used (e.g., US Dollars - USD). Indicate the exchange rates and basis for foreign purchases used.

#### *3.3.3. Rounding*

Define the rounding principles used.

October 5, 2021

### 3.4. Quantity Basis

For each commodity, clearly define the final source of all quantities and the methodology used to develop them such as: detailed material take-offs, based on sketches, standard detail designs, and computer-simulated take-offs, or factored. The extent of input from vendors, discipline specialists/experts and project execution personnel should be stated. State the design stage that the quantities reflect. State the method used to calculate any quantity allowances. The portion of quantities taken from a 3D model for each commodity will be defined. Quantities taken from computer models must include an explanation of safeguards that were in place to ensure quality, consistency, and verification of the completeness of the quantities extracted from the model. Clearly identify all quantities that are not developed from engineering design including:

- Sketch based quantities
- Forced detail quantities from software applications
- Factored quantities

A table summarizing the final quantity development and take-off basis for each commodity can be a helpful quick reference.

Ensure that external providers of quantities (e.g., engineering) provide a clear basis of their assumptions for inclusion in the BOE.

### 3.5. Cost Basis

Describe the methods and sources used for determining all material, labor and subcontract 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, as well as the stability and/or volatility of rates.
- Escalation indices used, and the method of calculation (including duration).
- Contingency development and basis.
- Location factors used and the basis for these factors.
- Influence of local market conditions.
- Capital costs vs. expense costs, or other categorization as necessary.
- Any other pricing factors or external influences that may have a significant impact on project cost should be identified.

October 5, 2021

### 3.6. 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 workweek schedule (hours worked per day, days worked per week, shifts worked per day, etc.) and planned use of 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.

### 3.7. Bulk Commodity Material

Indicate the percent of bulk material costs which were from budget quotes, firm quotes, in-house pricing or other sources. Separately address material supplied to fabricators and material for site installation. A table could be used to summarize this as well.

Address any special considerations such as whether a concrete batch plant will be used at site. Bulk material is to be separately identified as owner, contractor, or sub-contractor supplied.

### 3.8. Labor

- **Construction Labor Costs**

Describe how crew mixes, union contracts, non-union wages, benefits and other factors were used to build-up the labor rates. Attach a copy of the craft labor agreements when available. Identify crew mixes including portions of apprentices, foremen, general foremen, journeymen. For each commodity, identify the crew mix used including the portion for each trade (i.e. the mix of pipefitters, welders, carpenters, electricians, etc.)

- **Construction Labor Productivity**

Explain how labor productivity was determined for each commodity. It should address items such as: adjustments to a base productivity for labor density, facility complexity, excessive overtime, weather, shifts, labor quality, labor availability, worker facilities (e.g., lockers, washrooms, lunchrooms) proximity to work areas and support facilities (e.g., tool crib, warehouse, material staging area), greenfield vs. brownfield vs. revamp vs. shutdown conditions, soil conditions, elevated work, geographic location, and any other factors affecting productivity. Provide a description of the basis of the base productivity including the types of projects included, 3<sup>rd</sup> party software database, in-house data, etc. A table should be provided in the estimate plan showing how each factor was applied.

- **Construction Work Week and Overtime**

The provider should specify the final basis regarding the construction work week schedules and use of shifts and overtime.

### 3.9. Demolition

This addresses general demolition of decommissioned and/or abandoned facilities. Demolition for revamps is typically included with each commodity/discipline. Describe the general demolition scope and how the quantities and costs were developed.

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October 5, 2021

### **3.10. 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, 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.

### **3.11. 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. Minor assumptions may become major assumptions throughout the life of the project; therefore, it is recommended to document all assumptions regardless of their anticipated impact.

### **3.12. Exclusions**

In this section, the estimator should document all potential items of cost which a reviewer might associate 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, etc. are examples of potential items that may need to be identified.

### **3.13. Exceptions**

The estimator should identify any anomalies or variances to your organization's estimating practices. This section should document any significant deviations from the project and/or engineering deliverables normally 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 your organization's estimating practices.

### **3.14. 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 then it should be described (e.g. methodology, technique, etc.). In particular, this section should identify those cost elements that have been identified with high or very high risk or opportunity values. The risk analysis report (or summary) should be provided as an attachment to the BOE.

### **3.15. Containments**

Containments are cost elements in the estimate related to measures included to prevent and/or mitigate the identified risks. The activities are identified in the risk analysis report. These may impact not only cost but also duration.

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October 5, 2021

### **3.16. Contingencies**

Contingency is a cost element of the estimate used to cover the uncertainty and variability associated with a cost estimate, and unforeseeable elements of cost within the defined project scope. Contingency covers inadequacies in complete 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 utilized to develop the contingency amount, the associated confidence level should also be identified.

### **3.17. Management Reserve**

Contingency is not intended to cover the costs associated with 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.

The intended purpose and use of management reserve should be clearly identified. The approval process, management and tracking of the management reserve should also be clearly identified.

### **3.18. Reconciliation**

Provide an overview of the major differences between the current 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 or cost trending report can be provided as an additional attachment if necessary.

### **3.19. Benchmarking**

This section should document any comparisons of overall estimate metrics, ratios, and factors with similar projects, historical data, and industry data. References used in the benchmark comparisons should be similar in process type and overall value. If significant variations of the estimated values versus the benchmarks exist those inconsistencies should be identified, explained, and/or reconciled. A more detailed benchmark analysis report may be included as an attachment to the BOE.

### **3.20. Estimate Quality Assurance**

Since estimate reviews are the means for testing the quality of the estimate, this section of the BOE should identify all estimate reviews that have taken place to date, and any additional reviews that are proposed to take place. All review comments or analysis should be included as an attachment to the BOE. In case of an external review this section should include who executed the review, when it was conducted, and what references were used.

### **3.21. Estimating Team**

In this section, all members of the estimating team should be identified, including roles and responsibilities.

October 5, 2021

### 3.22. Attachments

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

#### 3.22.1. Attachment A: Estimate Deliverables Checklist

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

#### 3.22.2. 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.

#### 3.22.3. Additional Attachments

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

## 4. LEVEL OF DETAIL IN THE BASIS OF ESTIMATE

It is often not a simple matter to determine the amount of detail that should be provided in a BOE. Several factors may come into play during the preparation of the estimate that will help determine the level of detail. However, it is the estimator's best judgment that will ultimately determine the appropriate level.

### 4.1. Level of Project Definition

Estimates are prepared at various stages of a project. A more detailed estimate will generally require a more detailed BOE, however that is not always the case.

A conceptual estimate will most likely be based on a limited amount of scope but may require a more detailed BOE. It's not uncommon for a BOE for a conceptual estimate (e.g. Class 5 or Class 4) to be more thorough than one prepared for a more detailed estimate (e.g. Class 1 or Class 2) because there are often more assumptions made at the conceptual stage of an engagement that require greater documentation.

Conversely, there may be times when the project definition is so complete or simplistic that a BOE does not require a great amount of detail. A three or four page document may be sufficient to convey the information provided in the BOE.

### 4.2. Cost Value of the Project

Typically, a more expensive project will require a more detailed BOE. However, projects of lesser cost can require an extensive BOE to fully communicate major assumptions that constrain or reduce the cost.

October 5, 2021

### 4.3. Type of Project

The type of project can also affect the BOE. For example, the BOE for a direct purchase (e.g., single piece of large equipment) may be less detailed than a BOE for a construction project

### 4.4. Other Factors

Other factors that affect the level of detail in a BOE are: work breakdown structure (WBS), consideration for new technologies, contracting strategy, etc.

The BOE should contain a concise level of detail to fully support the review of the estimate by those that have not been involved in the preparation of the estimate. The BOE provides a definition of the scope of the engagement as estimated and should establish the basis for change management subsequent to publication of the estimate.

## REFERENCES

- [1] H. L. Stephenson, Ed., Total Cost Management Framework: An Integrated Approach to Portfolio, Program and Project Management, 2nd ed., Morgantown, WV: AACE International, Latest revision.
- [2] AACE International, Professional Guidance Document (PGD) 01, Guide to Cost Estimate Classification, Morgantown, WV: AACE International, Latest revision.
- [3] AACE International, Recommended Practice No. 10S-90, Cost Engineering Terminology, Morgantown, WV: AACE International, Latest revision.

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