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BASIS OF ESTIMATE – AS APPLIED FOR THE SOFTWARE SERVICES INDUSTRIES
TCM Framework: 7.3 – Cost Estimating and Budgeting

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Note: As AACE International Recommended Practices evolve over time, please refer to www.aacei.org for the latest revisions.

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INTRODUCTION

AACE International's *Total Cost Management (TCM) Framework* 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 specific to the software services industries (i.e. software development, maintenance & support, infrastructure, research & development, etc.).

This document is based upon AACE International Recommended Practice 34R-05, *Basis of Estimate* [1]. It identifies a basis of estimate (BOE) document as a required component of a cost/effort/duration estimate.

In the *TCM Framework*, the BOE is characterized as *the one deliverable that defines the scope of the engagement* and ultimately becomes *the basis for change management*. Note: In the software services industries, the term "engagement" is commonly used and synonymous with "project". 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/effort/duration study, project options, funding, etc.), the project scope, cost basis, allowances, assumptions, exclusions, cost risks and opportunities, contingencies, and any deviations from standard practices. For software services the effort expended is the main driver for cost and duration. 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 stakeholders.

A well prepared BOE will:
- Document the overall engagement scope.
- Communicate the estimator's knowledge of the engagement by demonstrating an understanding of scope, quality and duration as it relates to cost.
- Provide a record of all the hypothesis and assumptions taken into account for deriving the BOE.
- Alert the stakeholders 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, effort, duration and cost for use in engagement control.
- Provide the historical relationships between baselined estimates throughout the project lifecycle.
- Facilitate the review and validation of the estimates.

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. However, in all cases this RP supports creating consistent estimate documentation that provides a high degree of traceability and repeatability for the estimate.

RECOMMENDED PRACTICE

The primary intent of this RP is to provide a guideline for the topics and contents to be included in typical BOE. However, before describing the template contents there are a few points of significance worth noting. A BOE should:
- Be factually complete, but concise.

- Be able to support facts and findings (traceability).
- Identify estimating team members and their roles.
- Describe the tools, techniques, estimating methodologies, and data used to develop the estimates (repeatability).
- Identify scenarios and constraints that influenced the estimates.
- Identify other projects that were referenced or benchmarked during estimate preparation.
- Be prepared in parallel with the estimate.
- Establish the context of the estimate, and support estimate verification and validation (V&V).
- Qualify any rates or factors that are referenced either in the estimate or BOE; e.g. productivity can be expressed as either units/time (function points/hour) or time/unit (hours/function point).

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

Purpose

In this initial section of a BOE, the estimator should provide a brief and concise description for the total software architectural solution for the engagement. The types of services should be identified (e.g., new development, addition to existing, migration, infrastructure, etc.), as well as the type and capacity of the staffing, the location (onshore/offshore/mix), and the overall duration of the engagement.

Engagement Scope Description

This section of the estimate basis should be organized to correspond with the engagement's product breakdown structure (PBS). The BOE should identify what is to be provided; how it will be provided; and the activities necessary to deliver it. It's also good practice to indicate the primary staffing roles that will be involved with the engagement. Be as thorough as necessary without being overly descriptive, so as to adequately explain the scope of work being estimated.

Methodology

The BOE should indicate the estimating methodology/methodologies (functional size based, expert based, analogy based, process metrics based, parametric, etc.) used to prepare the estimate or components of the estimate. This should include documentation of the resources used to support the engagement, and any historical and/or benchmarking data that is applied. Documenting the level of effort or man-hours used in preparation of the estimate is also recommended.

Preferably apply metrics/units in the BOE that can be collected at the appropriate level of granularity during operation (control) and project/program closure.

Estimate Classification

The AACE International estimate classification should be identified, along with reasons or justification used in the selection of the estimate classification. (See: AACE International Recommended Practice 17R-97, *Cost Estimate Classification System* [2])

Design Basis

Company standards will typically specify the functional, non-functional, 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 design basis assumptions. Two attachments to the estimate basis should be referenced:
1. Estimate deliverables checklist: Aligned with the estimating process.
2. Reference documents: A listing of all software architectural documents (including revision number and date), as well as other design information, such as functional and non-functional requirements, hardware and software lists, units of measure, etc.

In addition it may be required to document specific quantity metrics for particular services, such as training quantities, ticket volumes, work space volumes, database size, etc. These may be organized by facilities, training partners or data centers.

If commercial off-the-shelf (COTS) or dedicated solution (subcontracted) components are provided, the estimator should identify specifically how this will integrate within the total solution.

Sizing Basis

This section documents the methods used to measure the size of the individual PBS components. The methods used for measuring the unit sizes are:
- Requirements: number of use cases, number of backlog items, service level agreement, etc.
- Functional size: number of function points (measurement methods: IFPUG, NESMA, COSMIC, FiSMA, etc.)[3]
- Technical size: (source) lines of code, number of interfaces, modules, etc.
- Service size: number of incidents, tickets, users, locations, applications or functional modules, databases, infrastructure components, messages and message types, etc.

The overall assumptions should be identified. For functional size identify the method of measurement (e.g., backfired or detailed measured).

Effort Basis

This section documents the methods (and tools) used to convert size(s) into effort. The effort will be based on the required activities to deliver the required product/services related to the engagement criteria (delivery constraints, service level and service type) and basis (benchmarks, historical data).

Planning Basis

This section documents the management, engineering, design, procurement, and execution approaches to the engagement. The contracting and resource strategies should be identified, as well as any assumptions that were made with regard to the schedule: gross or net hours, hours worked per period, shifts worked per day (24/7 services), holidays, etc., and planned use of overtime. Any assumptions made regarding architecture, quality criteria, delivery constraints (deadline, fixed price, etc.) and use of critical resources should also be noted here.

The overall engagement schedule and key milestones should be identified.

Cost Basis

Describe the methods and sources used for determining the costs of all units, effort, subcontracts, materials, and expenditures. The structure and categorization should be aligned with the financial restrictions of the organization or the engagement (direct vs. indirect, fixed vs. variable, funding, etc.).

Identify the following (if used):
- The cost per unit, effort hours and all productivity adjustments. Provide appropriate detail if costs vary by role and/or location within the project (architecture, process, sourcing construction, etc.) and reference data.
- All wage rates used (including sourcing construction). Identify all items included in all-in rates.
- Pricing sources for all major hardware and software (vendor quotes, historical data, etc.) including any discount strategies.
- COTS pricing sources.
- Pricing source for all start-up costs.
- Pricing source and methodology for overhead costs (management, housing, etc.). Document the basis for any contractor fee costs.
- Pricing source and methodology for costs such as freight, taxes, duties, etc.
- Pricing source for liabilities.
- Currency exchange rates if applicable, as well as the stability and/or volatility of rates.
- Contingency development and basis.
- Reservations (warranty, transfer, etc.) methodology and basis.
- Location factors used and the basis for these factors.
- Influence of local market conditions.
- Capital costs (inflation, cash flow charge) expense costs, or other categorization as necessary.
- Any other pricing factors or external influences that may have a significant impact on engagement cost should be identified.

Allowances

This section should describe any allowances that have not been detailed in the body of the estimate.

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 assumptions such as the availability of key resources, parametric settings (tool settings), dependencies on other projects, 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.

Exclusions

Potential items of cost which a reviewer might associate with the engagement, but for which no costs have been included in the estimate, should be documented. Examples of potential items that may need to be identified, include: acceptance tests, conversion, migration, implementation, training, extended warranty, changes of scope, taxes, financing costs, licensing costs, etc.

Exceptions

The estimator should identify any anomalies or variances to your organization's estimating practices (organizational standards, tender standards). This section should document any significant deviations from the engagement 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.

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 elements that have been identified with high or very high risk or opportunity values (e.g. related to cost, duration, quality and/or safety-critical measures, etc.). The risk analysis report (or summary) should be provided as an attachment to the BOE.

Containments

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

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.

Management Reserve

Contingency is not intended to cover the costs associated with changes in engagement scope. E.g. if the engagement 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 engagement 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.

Reconciliation

Provide an overview of the major differences between the new or re-baselined estimate and the last published estimate prepared for this engagement. Identify the cost/duration impacts due to scope changes, pricing updates,

progress, productivity adjustments, estimate refinement, etc. A more detailed reconciliation or cost trending report can be provided as an additional attachment if necessary.

Benchmarking

This section should document any comparisons of overall estimate metrics, ratios, and factors with similar engagements, historical data, and industry data (e.g. International Software Benchmarking Standards Group (ISBSG)[4]). 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.

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 (models) were used.

Estimating Team

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

Attachments

Several supporting documents will generally be included with the BOE.

Attachment A: Estimate Deliverables Checklist
Attach a completed estimate deliverables checklist indicating the engagement 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.

Attachment B: Reference Documents
Document the sizing report, requirements, designs, 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, escalation calculations, etc.).

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.

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Level of Engagement Definition

Estimates are prepared at various stages of an engagement. 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 engagement 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.

Cost Value and/or Impact of the Engagement

Typically, an engagement with more impact (high cost, critical duration, high quality) will require a more detailed BOE. However, engagements with lesser cost value and/or less impact can require an extensive BOE to fully communicate major assumptions that constrain or reduce the cost.

Type of Engagement

The type of engagement can also affect the BOE. For example, the BOE for a partial software development engagement (e.g. develop and test only) may be less detailed than a BOE for a full life-cycle engagement.

Other Factors

Other factors that affect the level of detail in a BOE are: product breakdown structure (PBS) and associated work breakdown structure (WBS), consideration for new technologies, delivery strategy (agile, spiral, waterfall, Kanban, etc.), 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

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