1.0 BASIS OF ESTIMATE (BOE) "HOW TO"

1.1   Definition

A **Basis of Estimate** (BOE) is a document that identifies the logic, data, methodology and calculations used to estimate the resources required to perform a specific task or group of related tasks. BOEs detail the thought process and calculations used to arrive at the estimate. BOEs are used to provide proposal evaluators with a reasonable, credible and defendable technical and cost narrative that supports the proposed effort for the estimated resources.

A BOE includes the following content:
- ✓ *Work Breakdown Structure (WBS) element number and title*
- ✓ *Statement of Work (SOW)[1] requirement being addressed (where applicable)*
- ✓ *Technical activities required to meet the SOW requirement*
- ✓ *Task description including the disciplines required to perform the scope(the description of tasks and the technical approach shall be consistent with other parts of the proposal)*
- ✓ *WBS element/task contract deliverables*
- ✓ *Planned risk mitigation activities (where applicable)*
- ✓ A staffing plan to show the ramp up and roll off of resources over the period of performance.
- ✓ *Recurring/Nonrecurring effort will be segregated where required (separate BOEs for NR/REC not mandatory)*
- ✓ *Estimating methods. Provide methods and calculations, used to develop the specific estimate*

The BOE demonstrates to the proposal evaluator that the contractor has reviewed and understands the RFP, including the SOW and deliverables, and has assessed the required resources by cost element (Labor, Material, Subcontractor and/or Other Direct Cost) for the product and/or services to be provided. When done properly, a BOE demonstrates cost credibility and realism based on the analysis provided in written narrative.[2]

1.2   Technical/Cost/Schedule Inter-relationship

The BOEs must be fully aligned and integrated with all aspects of the offering including the technical solution, teaming relationships with geographic locations, and the proposed programmatic plans and processes. This integration ensures the BOEs provide a solid foundation for cost and schedule performance measurement.

1.3   BOE Development

There are seven (7) basic steps in the development of high quality and fully compliant BOEs. Central to the BOE development process is assigning the appropriate estimating method to be used, the relevant historical programs to utilize in the development of the BOE, and the applicable adjustments made (if required). Table 1.3-1 outlines the seven step process.

Table 1.3.1 Seven Steps of a Quality and Compliance BOE

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[1] Statement of Work is also sometimes referred to as a Performance Work Statement (PWS). For the purposes of this Guidebook we will refer to a "SOW" as it is the predominant name used in Request for Proposals (RFPs)

[2] Estimating, of course is not an exact science. A "good" BOE is one that demonstrates cost realism and reasonableness to a majority of independent knowledgeable evaluators. For a definition of cost realism reference FAR Subpart 2.1.

✓ The time and resources invested in each step will vary from one BOE to another but all stages are important in developing a compliant BOE of high quality.
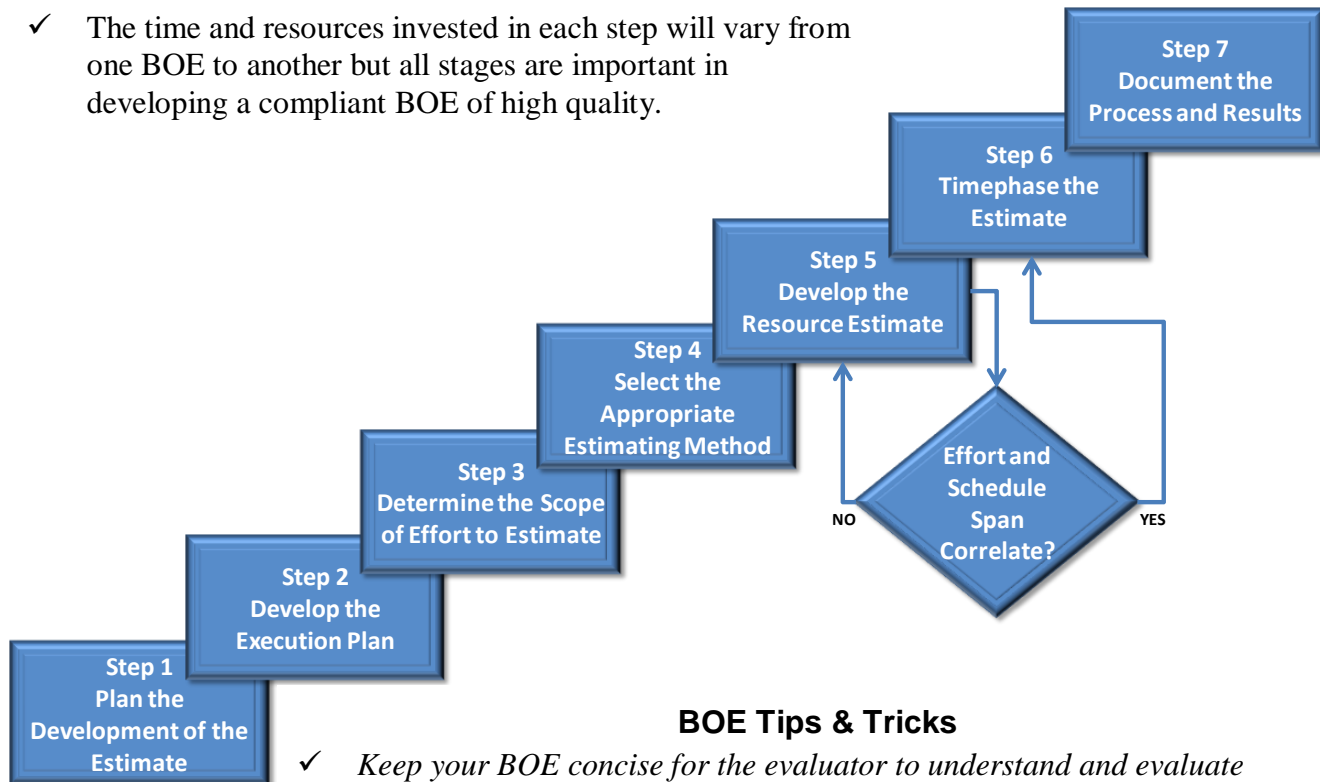
BOE Tips & Tricks

✓ *Keep your BOE concise for the evaluator to understand and evaluate*
✓ *Start with actual data from completed programs and adjust appropriately as warranted with appropriate justification and rationale*
✓ *Minimize the use of engineering judgment whenever possible*

1.3.1 Plan the Development of the Estimate

To develop a high quality and compliant BOE, it is important to determine the availability of relevant historical data and analyze applicable historical data for potential incorporation into the BOE. In addition, continuous validation of the integration of other proposal products is required (i.e. programmatic and technical baseline, IMP/IMS, etc). Ensuring that required processes and tools are available to the BOE team early in the proposal process is mandatory for success. Estimate organization (including BOE product prerequisites), a well defined scope of work, and methodology development planning enable high quality and fully compliant BOEs.

Use the following check list during the planning stage to ensure proposal compliance and integration
✓   *Estimate Organization and BOE Prerequisites*
  o *WBS Structure and Dictionary - Review and or/develop the WBS and an (Organizational Breakdown Structure) OBS – WBS should be developed in accordance with MIL-STD-881C, OBS is company unique*
  o *CLIN structure - Review CLIN cost accountability requirements (if required)*
  o *Request for Proposal (RFP) Program overview, specifications, system availability requirements, schedule constraints, etc.*
  o *Ground rules and assumptions – generate the underlying assumptions required for your estimate to be valid*

- o *Responsibility Assignment Matrix - Develop a Proposal Responsibility Assignment Matrix (RAM), providing a full accounting of tasks, deliverables, and responsible parties*
- ✓ *Integrated Master Plan (IMP) and Integrated Master Schedule (IMS) or Program Schedule - Develop hierarchy of program events and the schedule (IMP/IMS)Scope of Effort Estimated depicting vertical traceability from Master Schedule and horizontal relationships between all dependent tasks.*
  - o *Buying customer, prime contractor, and all subordinate subcontractor schedules are in concert with the requirements contained in the highest-level master schedule*
  - o *Statement of Work (SOW) / Statement of Objectives (SOO) / Technical Requirements Document (TRD), etc. as applicable*
  - o *Contract Data Requirements List (CDRL)*
  - o *Government Furnished Properties/Items (GFP/GFI) - Review GFP/GFI*
  - o *Deliverables - Product and/or Services to be provided*
- ✓ *Estimating Development Support*
  - o *Identify relevant past performance programs that can be used for historical data, technical and programmatic attributes, or metrics that support cost credibility and realism and development of applicable estimate attributes*
  - o *Identify and present any unique Strategies, Value Propositions (VPs), process improvements, and/or cost efficiencies that are not present in historical data and drive affordability*
  - o *Provide a Basis for the Proposed Labor Skill Mix (include a Labor Category Dictionary with the proposal)*

1.3.2 Develop the Execution Plan

Early and sufficient planning is critical to success. Identifying and generating the requisite reference materials and identification of specific proposal requirements reduces re-work, prevents schedule delays, and ensures availability of the required resources and tools.   Early communication with cognizant proposal and functional personnel can aid in building a BOE team early and is critical for success.

1.3.3 Determine the Scope of Effort to Estimate

The scope of work estimated including program planning, scheduling, WBS/OBS, CLIN and other organizational elements must all be fully integrated. The BOEs must be fully aligned and linked with all aspects of the offering.

1.3.4 Select the Appropriate Estimating Method

Selection of an appropriate estimating method (Analogy, Cost Estimating Relationship (CER), Cost Models, Level of Effort, Engineering Judgment or Task Based) begins with the type and availability of data to support the estimate. Consider that a well supported data-driven estimate utilizes verifiable information traceable to approved Business Systems (e.g. Accounting System, Procurement System, Time Keeping System, etc.) and applies adjustments as warranted with appropriate, concise, and complete justification and rationale. Table 1.3.4.1 defines the estimating methods and the minimum information required for each one.

Table 1.3.4.1 Estimating Method Requirements

Analogy	• Analogy is an estimate derived from the historical actual cost/hours of a similar system/subsystem/end item. Factors may be applied for scope, technical and programmatic differences.
	• Identify the analogous program that has already been completed and why it is relevant to the same or similar task estimate. Include the relevant project name, project/contract number, period of performance, and task definition
	• Describe the CWBS element from which the analogous historical data is derived and make a subjective evaluation and identification of the differences between the new system and historical system(s). The hours and cost impact of the technical differences must be identified.
	• Describe a clear trace to how the analogous data was used to derive the current estimate.
	• This method is appropriate very early in the program life cycle when the system is not yet fully defined.
Cost Estimating Relationship (CER)	• A CER estimate is based on relevant historical, statistically correlated relationships. The mathematical equation represents the statistical relationship between independent and dependent variables of historical data. An assessment defines the degree of similarity, enabling the estimator to develop comparative values (e.g. hours per drawing design). Percentage relationships, which are also a form of a CER, are based on cost history, the results crosschecked with similar programs, and a graph or a table backs up the percent relationship in the BOE to show the proportion of the relationship.
	• Identify the base (i.e. independent variables) to which the CER is applied. Describe the database used to create the CER and provide the relevant statistics, such as mean and standard deviation of independent variables, number of data points, data range, standard error of the CER, R^2, t-statistics, F-statistic, and prediction intervals.
	• List the equation, input variables used for the estimate, and the output value calculated.
	• If any discrete adjustments are made to the output value, describe and provide rationale for the adjustment and the resultant estimate.
	• Annotate if the CER is reviewed and approved by DCMA or another government agency.
	• If the CER is published or provided by another organization, identify the source. Contractor in-house CERs will be documented and provided as part of the proposal.

Cost Model	• A Cost Model is a mathematical compilation of one or many estimating techniques that derives project cost or effort from attributes/metrics of the subject project. Examples of project metrics include weight, power, complexity, quantity, source lines of code (SLOC), and COTS product characteristics. The measurement is based on the technical, physical, or other end item characteristics. Cost Models may be internally developed or commercially available.
	• State the cost model used and describe the appropriateness of the model.
	• Include the name of the model and version number.
	• List the types and values of primary model input parameters used for the estimate.
	• Describe the method in which the model was calibrated and validated using historical company data.
	• Provide the model output and relate it to the proposed resource estimate.
	• Cost estimates using models shall be broken into labor, materials, subcontract and other direct cost elements using reasonable and supportable allocation techniques, if applicable. Labor costs shall be further broken out into equivalent labor hours using reasonable and supportable labor rates.
	• This method is appropriate early in the program life cycle when detailed specifications are not available, but a database of like systems, performance specifications and costs is available. This method often serves as a useful check of an estimate made using another method.
Level of Effort	• Level of Effort is an estimate based on identifying resource requirements to support specific identified tasks that are often based on a predetermined level of support for a given period of time. This estimate type is minimally affected by product scope and/or quantity changes.
	• Include allocation of personnel by account to cover specific tasks for a pre-determined length of time.
	• Provide rationale for period of performance.
	• Use appropriate Manpower Conversion Factor (MCF) such as hours per month, hours per day, hours per shift.
Engineering Judgment	• Engineering Judgment is an estimate based on subject matter expert experience with no specific relevant historical actual cost/hours identified. The subject matter expert develops the estimate based on the product description and tasks and operations required to be performed by the responsible department to manufacture/produce the product.
	• Provide a detailed explanation of the basis of the engineering judgment.
	• Include the qualifications of the individual making the judgment.

	• Be specific and detailed enough to demonstrate to an evaluator that the individual is qualified to make this estimate.
	• Most often used late in the development or early in the production phases. This technique encourages the contractor to do his homework early on and define all work down to the lowest level of the WBS. It is also a great process control technique at the production facility.
Task Based	• Task Based is an estimate developed at the lowest level of the WBS (at the detail, sub-assembly and assembly levels) based on a standard and/or historical performance of accomplishing comparable tasks.
	• The direct labor hours required to complete the work are estimated from engineering drawings and specifications, usually by an industrial engineer using company or general industry standards. The engineers may also estimate raw materials and purchase parts requirements. The remaining cost elements, such as tooling, quality control, other direct costs, and various overhead charges including systems engineering and project management must also be factored in.
	• Provide the basis and applicability of any labor standard proposed. Ensure standards account for all paid time to perform the required tasks (e.g. personal, fatigue, and delay) and other non work time.
	• Provide historical basis or other methods used to estimate the costs of raw materials and purchased parts by WBS element.

1.3.5 Develop the Resource Estimate

Use an appropriate estimating method and provide rationale for the estimating method chosen. Provide rationale for the historical programs relied upon in developing the BOE and any adjustments. Provide rationale for any adjustments made to historical data including (but not limited to) historical hours and labor mix. Where applicable, include all other applicable estimate resources (i.e. material, ODC, etc.)

1.3.6 Time Phase the Resource Estimate to Meet Proposal Requirements

Review the schedule for proper time-phasing of the resources. Impacts of any schedule *constraints* (whether driven internally, by the solicitation, or from high probability/relaxed schedule spans) shall be reflected in resource estimates.

1.3.7 Document the Process and Results in the BOE

Each BOE should be fully documented to demonstrate to the proposal evaluator that the contractor has reviewed and understands the Statement of Work (SOW) and deliverables and has assessed the required resources by cost element (Labor, Material, Subcontractor and/or Other Direct Cost) to support the efforts to complete the work to be performed or product to be provided. Documentation should:

• Be based on verifiable historical data to the greatest extent possible and cited/referenced in the

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BOE.

- Justify the estimating methodology used to develop the estimate and present all mathematical calculations used to show how the estimate was derived. If an adjustment is made to any historical data, describe the adjustment applied, how it was derived, why it is relevant, and show the resulting estimate.

- Provide a clear and concise explanation and understanding to a non-technical reader of the relationships between the resource requirements estimated and their necessity.

- Clearly walk the evaluator through the thought process for the development of the estimate on the BOE.

1.4   BOE Checklist

Finally, the following is a recommended check list to ensure compliant, high quality BOEs

- ✓ *Does the estimate discuss the estimate on a step-by-step basis?*
- ✓ *Is the estimate consistent with the technical offering and proposed schedule?*
- ✓ *Does the estimate discuss selected methodology, applicability, and selection rationale?*
- ✓ *Does the estimate thoroughly identify the methodology describing input data, analyses, computations, and conclusions?*
- ✓ *Does the estimate reference source data and quantify all factors, calculations, assumptions, and conditions used in the estimating process?*