Dos, Don'ts and Whys for Basis of Estimate

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Agenda

- Business System Rule
- DCMA impact

- WHAT is a BOE?

- WHY is it necessary?

- WHO reviews it?

- WHAT is it used for?

- BOE basic elements:
  - Header
  - Task Description
  - Basis Of Estimate
    - Historical similar task performance data
    - Parametric data
    - Firm Quotation
    - Level of Effort
    - Engineering Estimate
  - Bid Detail

- EXAMPLES of the King and the Frog (as reviewed by the Prince)

Business System Rule

Business Systems

- Accounting System
- Estimating System
- Purchasing System
- Earned Value Management System (EVMS)
- Material Management and Accounting System
- Property Management System

Business Systems: DFARS 252-242-7005

- Initial Proposal Dec. 3, 2010.

- Interim Rule with request for comments issued May 11, 2011.

- Final Rule effective February 24, 2012.

- Applies to all CAS –covered contracts.

- Significant deficiency in any system requires ACO to reduce payments on covered contracts by 5% and if multiple deficiencies, max withholding of 10%.

Estimating System: DFARS 252-215-7002

- "Estimating system" means the Contractor's policies, procedures, and practices for budgeting and planning controls, and generating estimates of costs and other data included in proposals submitted to customers in the expectation of receiving contract awards.

- "Significant deficiency" means a shortcoming in the system that materially affects the ability of officials of the Department of Defense to rely upon information produced by the system that is needed for management purposes.

System Requirements of an Adequate Estimating System

- The Contractor shall disclose its estimating system to the Administrative Contracting Officer (ACO), in writing.

- An estimating system disclosure is acceptable when the Contractor has provided the ACO with documentation that—

    (i) Accurately describes those policies, procedures, and practices that the Contractor currently uses In preparing cost proposals; and

    (ii) Provides sufficient detail for the Government to reasonably make an informed judgment regarding the acceptability of the Contractor's estimating practices.

- The Contractor shall—

    (i) Comply with its disclosed estimating system; and

    (ii) Disclose significant changes to the cost estimating system to the ACO on a timely basis.

- The Contractor's estimating system shall provide for the use of appropriate source data, utilize sound estimating techniques and good judgment, maintain a consistent approach, and adhere to established policies and procedures.

Characteristics of an Adequate Estimating System

- Establish clear responsibility for preparation, review, and approval of cost estimates and budgets.

- Provide a written description of the organization and duties of the personnel responsible for preparing, reviewing, and approving cost estimates and budgets.

- Ensure that relevant personnel have sufficient training, experience, and guidance to perform estimating and budgeting tasks in accordance with the Contractor's established procedures.

- Identify and document the sources of data and the estimating methods and rationale used in developing cost estimates and budgets.

- Provide for adequate supervision throughout the estimating and budgeting process.

- Provide for consistent application of estimating and budgeting techniques.

- Provide for detection and timely correction of errors.

- Protect against cost duplication and omissions.

- Provide for the use of historical experience, including historical vendor pricing information, where appropriate.

Characteristics of an Adequate Estimating System

- Require use of appropriate analytical methods.

- Integrate information available from other management systems.

- Require management review, including verification of compliance with the company's estimating and budgeting policies, procedures, and practices.

- Provide for internal review of, and accountability for, the acceptability of the estimating system, including the budgetary data supporting indirect cost estimates and comparisons of projected results to actual results, and an analysis of any differences.

- Provide procedures to update cost estimates and notify the Contracting Officer in a timely manner throughout the negotiation process.

- Provide procedures that ensure subcontract prices are reasonable based on a documented review and analysis provided with the prime proposal, when practicable.

- Provide estimating and budgeting practices that consistently generate sound proposals that are compliant with the provisions of the solicitation and are adequate to serve as a basis to reach a fair and reasonable price.

- Have an adequate system description, including policies, procedures, and estimating and budgeting practices, that comply with the Federal Acquisition Regulation and Defense Federal Acquisition Regulation Supplement.

DCMA 'Trip Wires'

Primary Trip Wires		Secondary Trip Wires					
System Indicators	**Baseline Indicators**	**BEI**	**SPI <.95**	**CPLI**	**CPI/TCPI 10%**	**Contract Mods 10%**	**Baseline Revs 5%**

System Indicator (Primary)
- EV Certification withdrawn
- Major Subcontractors do not hold EV Certification
- DCMA Level 3 or higher CAR's issues

Baseline Indicators (Primary)
- Was initial review conducted within 180 days
- On-going reviews triggered by major modifications and/or OTB
- Outcome of the reviews
  - Is scope fully & mutually understood
  - Does the baseline capture all work
  - Is MR adequate given expected risk
  - Does the contract have an executable , time phased baseline

New Schedule Metrics
- **Baseline Execution Index** – used to measure efficiency with which actual work has been accomplished when measured against the plan

Critical Path Length Index - used to measure the realism of completing the contract on time.

Standard EV Metrics – SPI, CPI, TCPI

Revision Metrics
- **PMB Revisions** – changes to monthly time-phased PMB value of 5%
- **Contract Mods** – contract mod to original base value of 10% or more

Provided BOE (Simple Government Guidance)

CATEGORY	CHARACTERISTICS	COLOR CODE GRADING
Unsupported Estimate	• "Engineering Judgement" • "Company Experience" • No Substantive Supporting Information	**RED**

Based on Specific Experience	• Judgement, Including Qualification of "Judge"
	• Previous Project Experience
	  - Identify Project(s), but Provide No Actual Data
	• Cost Estimating Relationship
	  - No Supporting Information
		YELLOW

Scaled Actuals, Work Not Shown	• Use Historical Actual Data - General Description of Scaling, but no Details	**YELLOW**
Scaled Actuals, Work Shown	• Historical Actual Data • Justify, In Detail, the Scaling Factors Used	**GREEN**
Multiple Scaled Actuals	• Same as above, but Cite Multiple Sources • Cost Estimating Relationship - Document Model / Inputs	**BLUE / GREEN**

YELLOW requires:

• Previous experience but no actual detail data provided

• Analogous experience provided but no actual detail task and cost data.

• Scaling factors defined but not supported by justification.

GREEN requires:

• Detailed task breakdown

• Detailed and thorough comparison of analogous and estimated tasks

• Justification is thorough for the scaling factor(s) derived to account for estimate task variances from the analogous task

BLUE requires:

• Multiple analogous historical tasks and cited and analyzed

• Multiple sources are provided to validate the integrity of the relationship between estimate details and past experience tasks and performance actuals

Responsibility & Risk

Accepting controlled risk typically means the difference between "winning" and "loosing". What does controlled mean?

- Every BOE author is responsible to review and challenge proposed task approaches to minimize execution cost.
- Ensure that all key assumptions and risks accepted are captured in the program risk register, and mitigation planning has management visibility.
- Continuously evaluate options planning and executing tasks in more cost effective ways.
- Continuously work with interfacing work tasks to eliminate redundancies and comply with dependencies requirements.

Results of a Recent DCMA Audit

- DCMA has staffed the EVM Center of Excellence
- Deep Dive DCMA Review teams are targeting programs and Companies across the industry based on Trip Wire Metrics
- Bad EV review could result in loss of approved EV system which can result in:
  - Stoppage of progress payments
  - Inability to bid on major contracts requiring EV
  - Significant Company internal cost to gain approval back
- Recent Industry review results have caused the DCMA teams to question
  - The ability of current management processes and practices to assess emerging issues of cost & schedule in a timely manner
  - The accuracy and validity of the PMB data
  - The adequacy of the Estimate At Complete information
  - Commitment of the Company to use EV as a management process
  - Adequacy employees training to understand the need for EVMS, what has changed, and the rules under which to execute it.

The lack of EV culture can lay the foundation for failure

Basis of Estimate – WHAT is it?

BOE = Explanation & justification of your estimate to do the work.

- Documents the thought process, approach, and rationale used to arrive at the estimate being proposed

- Explains the logic, rationale method, data and calculations used to estimate the resources required to perform the work

Basis of Estimate - WHY Is It Necessary?

External Solicitations may require it.
- **New opportunity** solicitation responses
- Existing contract **new work scope** control

Internal Management may require it.
- Evaluate bids before **committing the company**
- Review **program baseline** setting or updates

Does your process require BOEs?

Would you do them if it were not "required"?   WHY?

Basis of Estimate – WHO Reviews it?

External (solicitation response) Someone who:
- Does not work for your company
- Does not necessarily understand your products or business practices
- Does not always understand your job
- Will decide whether your BOE is justifiable and awardable
- Will negotiate award value based upon your BOE

Internal (baseline or estimate justification) Someone who:
- Does work for your company
- Does understand your products or business practices
- Does not always understand your job
- Will help decide your baseline budget

Food for thought . . WHICH one is more difficult to do?

Basis of Estimate – WHAT Is It Used For?

To evaluate the Cost Reasonableness and Realism of your estimate.

- **Realism** – Compatibility of estimate with scope (as defined in the estimate Task Statement)

- **Reasonableness** – Justification for estimate development methodology, and Completeness and Accuracy of the mathematics applied.

Basic BOE Components (format can vary greatly)

1. Header Information

2. Task Description

3. Basis of Estimate

4. Bid Detail

Basic BOE Components - Header

1.Header Information

- **WBS or Task ID:** Where this estimate fits/maps to the CWBS

- **Period of Performance (Start / End):** When this activity will happen within the program schedule – and for how long

VERY easy way for auditor to check bid validity

Basic BOE Components - Task Description

2. Task Description

- **WHY is this task being done?**
  Reference "driving" document (Spec, SOW, etc.)

- **WHAT will be done?** Provide a complete & clear explanation of the tasks included.
  - EQUALLY important to state the tasks NOT included.
  - Provide detail to fully describe the tasks to be performed.
  - Provide detail to a level that bid hours/task will be small.

- **ASSUMPTIONS for this estimate?** Identify assumptions that the estimate is based on.
  - Can lead directly to identification and mitigation of risk.

- **PLAN INTEGRATION:** Define inputs and outputs of tasks when appropriate.
  - Key tasks & deliverables should align with schedule.

Do not do work that is not required, unless authorized by stakeholders with the authority to do so.

Avoids requirement misinterpretations, and clarifies the "gray" areas.

The more detail . . . the better the plan, the estimate, and the ultimate performance.

Defines boundary conditions that can impact the estimate (GFE receipt, IRAD product arrival, number of re-tests, etc.

Assists in plan and IMS integration.

This information defines the work (tasks) you are committing to do

3. Basis Of Estimate

- RATIONALE: **HOW you derived** the estimate to execute the effort described in the Task Description section.

- TYPICAL RATIONALE TYPES:
  - Historical Program(s) task and cost data.
  - Historical Program or Organizational Productivity parametric data
  - Firm Quotation (from a subcontractor or supplier)
  - Level of Effort
  - Engineering Estimate

Most Desired

Least Desired

Basic BOE Components - Basis of Estimate cont'd

3. Basis Of Estimate

A. Historical Programs (s) task and cost data – comparison of estimated scope to analogous work previously performed.

- ANALAGOUS PROGRAM SELECTION
  - WHY program selected is validly comparable to estimated effort
  - Detailed comparison of program and tasks to estimated effort
  - Can be directly analogous "factored" (scaled to reflect differences)

- RELATIVE FACTOR – Adjusted actuals from similar task.
  - Compares complexity (or other characteristic) to analogous task
  - Factor selection methodology (detail of rationale & reasonableness)

- RELATIVE LABOR MIX -
  - Detailed rationale for how accounted for in the estimate (compare historical program mix to estimate mix, with rationale)
  - Discuss hours & equivalent heads, not headcount or staffing levels.

Basic BOE Components - Basis of Estimate cont'd

3. Basis Of Estimate

B. Historical Programs or Organizational Productivity Data

HISTORICAL PRODUCTIVITY DATA (parametric estimates)

- Functional productivity data (SE, SW, HW, etc.)
- Rate based (Rqmts/Hr, ELOC/Hr, Hrs/Drawing, etc.).
- Calibrated by historical experience

- SIMILARITY DETERMINATION
  - Select similar programs (products, technology, etc.)

- RANGE DETERMINATION
  - Forecast position where program estimate should fall within the family of similar program productivities (at estimate launch).
  - Show position where program estimate productivities do fall within the family of similar program productivities (as estimate review).

Basic BOE Components - Basis of Estimate cont'd

3. Basis Of Estimate

C. Firm Quote

D. Level Of Effort

- Most common guidance is that LOE estimate value should not exceed 15-20% of project value (they are difficult to manage and mask performance data).

- Segregate discrete tasks - move definable/discrete tasks and products out of the LOE task whenever feasible)

- Analogous LOE work used for estimate basis of LOE tasks:
  - Must detail the analogous tasks to significant detail, and provide direct correlation to corresponding estimate tasks.
  - Must examine the skill mix of the analogous and current estimate task, and explain how analyzed and reflected in the estimate.

3. Basis Of Estimate

E. Engineering Estimate

- Not desired. Only used when other methods are impractical and historical data is not available (least preferred method)
- Educated guess not backed by documented previous experiences.
- Guidance:
  - Need step-by-step explanation of activities to be performed
  - Break activities into small tasks, with small number of hours for each (easy to understand)
  - Caution . . Credibility is very difficult to achieve because the detail is not based on any quantitative program or organizational measures or experience.

Basic BOE Components - bid Detail

4. Bid Detail

- Show ALL calculations for how your arrive at your final hour total

- Provide summary tables of ALL tasks, hours by labor group, and totals

- Show totals for ALL areas of estimate (for WBS elements)

This information defines the cost (budget) you are committing to!

BOE Format – best practice

2. "Basis of Estimate/ Supporting Data" details
   – All BOEs should have same format with these four sections
     1. <u>Hour Summary</u>
     2. <u>Task Comparison</u> – Compare to "similar-to" task on similar domain program or same program
     3. <u>Rationale</u> – explain why task is similar-to and any complexity factor (backed up of course)
     4. <u>Task Calculation</u> – spell out the summary of components with simple equations
   – Exception – Refer to the contract for specific BOE requirements/guidelines/templates

BOEs - Guidelines

- **BOEs must be specific with rationale**
  - Based on similar-to program, or previous actual on same program is an ECP
  - Provide reference charge numbers for similar-to comparisons
  - Avoid the use of "engineering estimates". No WAGs!
    - Do NOT have rationale statements saying "as directed by engineering management

- **Explain why "5 drawings", "288 requirements", or other such quantitative statements**

- **Explain efficiency factors. Examples:**
  - 25% efficiency gain due to update of existing document
  - 10% efficiency gain due to application of lessons learned from original production contract

BOEs – Guidelines (cont'd)

- Eliminate Assumptions (put into risk if not confirmed)

- Check Math
  - Provide equations. Spell it out (40 + 20 + 4 = 64 Hours)
  - Totals should match in Summary (top) and BOE (bottom)

- BEST PRACTICE: Program should provide guidance on minimum hours/BOE and 'bogeys'
  - Rarely used
  - Benefit is greatly reduced number of BOEs and estimates within the desired value of the offer.

BASIS OF ESTIMATE					
Prime ID #:		**Date:** 8/7/06 2:40		**Assist ID #:**	
Program Name:	XYZ			**WBS:** 1.2.2.3.4.5	
Task Title: Test Readiness Review			**Option:**	**CLIN/SLIN:**	
Location: Timbuktu			**Prepared By:**	**SOW Ref:** 1.1.1.3	
Perf Org: 30034			Bob Boe	**Approved by:**	
Period of Performance:	**Start:** 5/2007		**End:** 5/2008	**Other:** F009	

Summary:

Material $ 0

Labor (by skill mix):

SE										Total Hrs
244										244

ODC $

PoP and SOW Reference Very Important

BASIS OF ESTIMATE(SPECIFY) :   5

(1) COMPARISON METHOD (SIMILAR TO SPECIFIC TASK)   (6) ENGINEERING ESTIMATE

(2) UNIT METHOD (ESTIMATED HOURS PER DRAWING)   (7) PARAMETRIC

(3) FACTOR METHOD (SPECIFY HOW FACTORS WERE DERIVED)   (8) LEVEL OF EFFORT (LOE)

(4) TIME & COST EST APPROACH (TIME STUDY,REGRESSION ANAL.)   (9) SUPPLIER QUOTATION TO BOE CODE

(5) HISTORY (BE SPECIFIC, IDENTIFY PROGRAM, DSO, ETC.)

BID METRIC CODE :   GGAA

Task Description (include list of subtasks if appropriate):

Prior to formal testing a Test Readiness Review (TRR) is held. This review is to ensure that the
hardware, software, and test procedures are ready for formal testing.

Subtasks

ID	Title	Description	Hours

Scope
Since much of the testing is time phased there will be multiple TRR's. This BOE covers TRR's for
Performance DVT, Environmental DVT, EMI/EMI, and RGT.

Basis of Estimate / Supporting Data

Hours
Total   340 hours

Task Comparison
These TRR's are similar to the TRR held under Bob the Builder program, (reference charge number ABC
61 hours).

Rationale
Four TRR's will be held due to the time phasing of the testing using different terminal
configurations/baselines.

Task Calculation
  4 TRRs x 85 hours = 340 hours

Note method (5) – No WAGs (6)

BOE Examples – Acceptable

Task Description (include list of subtasks if appropriate):			
Integrated Product Development System reference OH MY.05.01, PREPARE VERIFICATION/VALIDATION PROCEDURES.			

Subtasks

ID	Title	Description	Hours

Scope

Creation/Update of widget procedures applicable to program. The widget
procedures will cover CDRLs B097 and B040.

Basis of Estimate / Supporting Data

Hours Summary
Total - 1646 Hrs (10.6 MM)
Task Comparison
This task can leverage from existing procedures. Therefore a high productivity was chosen (Bob the Builder program)
Rationale
There are 1176 total widgets (1367 total widgets
for act I (1117) & act II (250), minus 191 duplicate I & II widgets.

Bob the Builder program productivity was 1.4 Hrs/widget under Charge number XYZ
Task Calculation
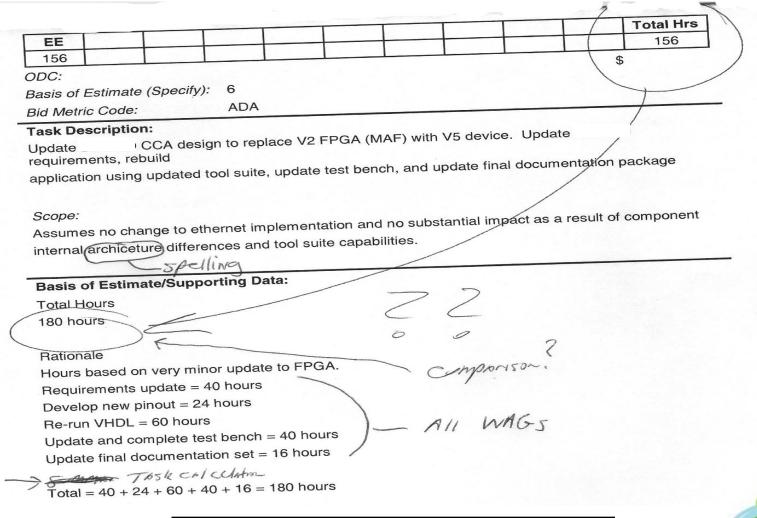1176 widgets x 1.4 hrs/widget = 1646 Hrs (10.6 MM)

BOE Examples – Acceptable

Task Description (include list of subtasks if appropriate):			
Task covers the support for Moving Demonstration (M-Demo).			

Subtasks

ID	Title	Description	Hours

Scope

M-Demo covers the integration of 120 parts of the electronics portion of program XYZ.

Basis of Estimate / Supporting Data

```
Hours Summary
Total = 480 Hrs (3.1 MM)
Task Comparison
This task is similar to the system integration task for similar Toy programs (Able builder, Toy builder).
Rationale
The M-demo integration is similar to system integration with a complexity of 0.5 (toy has completed
integration and road tests), This effort is to integrate fault insertions into a working system and to
monitor and verifying truck responding to these faults.
Integration Productivity: Able builder (65148722641 14.0 hrs/widget).
Using the highest productivity program (We will use the highest productivity at 8.0 hrs per widget due
to task is integrate toy versus truck integration effort).
Required Fault on this task = 120 faults
Task Calculation
8 hrs/fault x 120 faults x 0.5 complexity = 480 hrs
```

BOE Examples – Flawed

Task Description (include list of subtasks if appropriate):			
Task covers the Road Noise Test of the widget.			
Subtasks			

ID	Title	Description	Hours

Scope

Basis of Estimate / Supporting Data

Hours Summary
Total = 91 Hrs (0.6 MM)
Task Comparison
This task is similar to a road test conducted for a similar toy development to conduct
test and including engineering support. Based on road test cost from a similar toy program, charge number ABC program, , TO-
40 4006 = 182 hrs for
2 tests (91 hrs/test).
Task Calculation
1 road test @ 61 hrs (0.6 MM)

SCOPE missing, no Rationale, hours don't match, no Number history

BOE Examples – Flawed

										Total Hrs
EE										156
156									$	

ODC:

Basis of Estimate (Specify): 6

Bid Metric Code: ADA

Task Description:

Update _____ CCA design to replace V2 FPGA (MAF) with V5 device. Update requirements, rebuild

application using updated tool suite, update test bench, and update final documentation package

Scope:

Assumes no change to ethernet implementation and no substantial impact as a result of component

internal (archiceture) differences and tool suite capabilities.

~ spelling

Basis of Estimate/Supporting Data:

Total Hours

(180 hours)

? ?

o   o

Rationale

Hours based on very minor update to FPGA.   comparison ?

Requirements update = 40 hours

Develop new pinout = 24 hours

Re-run VHDL = 60 hours

Update and complete test bench = 40 hours   — All WAGs

Update final documentation set = 16 hours

Task calculation

Total = 40 + 24 + 60 + 40 + 16 = 180 hours

Hour mismatch, spelling, WAGs

BOE Examples – Flawed

ODC:

Basis of Estimate (Specify): 6 ← Engineering Estimate. No WAGS In bid $

Bid Metric Code: AX

Task Description:

Coordinate with the ___ Vendor from Phase 1A to develop producibility improvements

prior to the EDM production program. Producibility improvements may include manufacturing, reliablity, cost, or performance design enhancements.

Scope:

The existing ___ vas developed specifically for ___ Task includes a ___

review, and vendor trips for multidisciplined teams (travel costs not included here) in order to provide engineering support, close monitoring of vendor progress, and participation in vendor design reviews, integration and DVT as required.

Basis of Estimate/Supporting Data:

Engineering estimate based on Phase 1A actuals at 2MM = 312 hours.

(handwritten annotations:)

WHERE ARE THEY?

NEED DETAILS

IE - 4 TRIPS @ 20HRS X 3 PEOPLE = 240 hrs

RTC?

Format?
1 - Summary
2 - Task comparison
3 - Rationale
4 - Task calc.

WAG is entire BOE, format, travel details

36

BOE Examples – Flawed

Basis of Estimate (Specify): 6
Bid Metric Code: AE

Task Description:

Electrical design of all new and modified module

* Generation of CCA layout.
* Generation of CCA Gerber's

Scope:

Layout of Gerber's and material for prototypes

Basis of Estimate/Supporting Data:

Based c......_C bids for RF coupon PWBs and component kits:

PWB: 1 week turn @ 1.5K per prototype run for proto Gerber's 3*1.5k=4.5k. Material for 3 prototype based on ...LC which had the same number of prototypes, Component Kits: $3.5k (XLC Actual) 4.5k+3.5k=8.0k

Hours Summary
Labor Total OMH
Material Total $8,000

Task Comparison

Rationale

Task Calculation
O hours

Format, NWA, material quote used?

Summary

- Follow Program guidance for many things, including Task Function Matrix, Bogey, BOE Format, R&O Guidance, Management review timeframe, and more
- Adjust R&O according to changes required by bogey
  - Adjust risk up if need to be more aggressive
  - Adjust opportunity up if head room
  - Work the R&O during the bid, vs. afterthought
- BOE needs to be defendable by
  - using metrics
  - Valid similar-to task with Charge Numbers
  - backed up complexity factors

Q&A