



## **COST ENGINEERING (CE)**

# **AE120 REQUIREMENTS FOR PROJECT & CONSTRUCTION COST ESTIMATING SERVICES**

**September 2022**

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## **Revision Highlights**

The following is a selection of changes from the previous (March 2014) edition. This does not serve as a summary of the full scope of this document.

- **Estimate Narrative (Sec. 6.3)** – AE Cost Consultants to provide detailed estimate Narratives highlighting major cost drivers and assumptions.
- **Site Visit (Sec. 3.3)** – AE Cost Consultants shall visit project site to familiarize themselves with logistical challenges.
- **Quantity Takeoff (Sec. 5.3)** – AE Cost Consultants to provide a copy of detailed Quantity Takeoff with each estimate submission.
- **Software and Format (Secs. 5 & 6)** – Revised software and format requirements.
- **Cost Variance (Sec. 6.3)** – AE to provide information detailing significant variances in cost from one submission to the next.
- **Quality Control (Sec. 3.4)** – AE consultants to provide a signed document with each phase submittal indicating thorough quality control has been performed.
- **Proposed Change Notice (PCN) (Sec. 4.6)** – AE Cost Consultant requirements for PCNs during the construction period.

# 1 Introduction

This document describes the background, policies, and procedures for estimating construction costs and budgets for the Smithsonian Institution (SI). It supplements the SI Office of Planning Design and Construction (OPDC) AE110 AE Special Conditions.

The guidelines and requirements in this document apply to all SI facilities and projects with the following exceptions:

- **Smithsonian Tropical Research Institute (STRI) facilities:** please reference guidelines and requirements in the STRI-specific AE120.
- **Smithsonian Astrophysical Observatory (SAO) facilities: Design, Bid, and Construction phase estimates:**
  - projects with **anticipated construction cost of less than \$5M:** the requirement to use CostOS software (Sec.5.2) is optional, the SI Excel template (available on SI's AE Center site) can be used in lieu of CostOS.
  - projects with anticipated **construction cost of at least \$5M** are required to be submitted in CostOS format.

## 1.1 Goal

The goal of this document is to facilitate OPDC's review of construction budgets and estimates by establishing standard guidelines and formats in cost estimating for use by AEs and other contractors.

## 1.2 Objectives

This document will help the AE or the reader to understand:

- Different kinds of budgets and estimates used by OPDC
- Construction estimate cost factors
- OPDC requirements for construction estimate submissions and deliverables

## 1.3 General Information

### 1.3.1 *Security of Government Estimates*

Access to the estimate and its content will be limited to only those personnel whose duties require an essential need to know. Information in the estimate will not be provided to anyone outside of SI. The Freedom of Information Act does not generally require that information contained in a government estimate be released. This policy is necessary because the estimate contains sensitive information, the release of which could compromise cost estimates for future procurements. It will also eliminate the possibility that an individual project might be re-advertised or negotiated.

### 1.3.2 *Purpose*

Estimates are prepared to provide accurate cost assessments for total project and construction costs. Some specific purposes of estimates are:



- Ensure project design and costs are within the authorized budget amount
- Compare costs against previously constructed facilities
- Compile records and create historical costs
- Establish the "design to cost" limits for the AE
- Provide means of cost control during design
- Determine the necessity and extent for bid alternates
- Serve as benchmark for comparison of bids/offers prior to award of the construction contract
- Serve as benchmark for evaluating the schedule of values submitted by the construction contractor(s)
- Evaluate the availability of funding for proposed change orders
- Basis for negotiation for bids, offers, and other proposals



## **2 Industry Standards and Guiding Principles**

### **2.1 The Federal Acquisition Regulation (FAR)**

The Federal Acquisition Regulation (FAR) 36.203 requires that every Government Estimate be prepared as though the Government were a prudent and well-equipped contractor estimating the project. Therefore, all costs which a prudent, experienced contractor would expect to incur must be included in project cost estimates. This philosophy prevails throughout the entire project cycle from programming to completion of construction. Each estimate should be developed as accurately as possible, in as much detail as can be assumed, and based upon the best information available. A listing of known facts, construction tasks, and supplemental judgments form the basis of the estimate at each stage of design. This provides a realistic approach to estimating and it creates a history of project cost development. This objective is to be maintained at all stages of the project. The cost estimate will in all aspects represent the “fair and reasonable” cost to the Government. The complete FAR can be accessed at <https://www.acquisition.gov/browse/index/far>

### **2.2 GAO Cost Estimating and Assessment Guide**

The U.S. Government Accountability Office is responsible for, among other things, assisting the Congress in its oversight of the Federal Government, including agencies’ stewardship of public funds. To use public funds effectively, the Government must meet the demands of today’s changing world by employing effective management practices and processes, including the measurement of Government program performance. In addition, legislators, Government officials, and the public want to know whether Government programs are achieving their goals and what their costs are. To make those evaluations, reliable cost information is required and federal standards have been issued for the cost accounting that is needed to prepare that information. GAO has developed the Cost Guide to establish a consistent methodology that is based on best practices that can be used across the Federal Government for developing, managing, and evaluating capital program cost estimates. For the purposes of this guide, a cost estimate is the summation of individual cost elements, using established methods and valid data, to estimate the future costs of a program, based on what is known today. The complete GAO Cost Estimating and Assessment Guide (GAO-20-195G) can be accessed at <https://www.gao.gov/products/gao-20-195g>

### **2.3 The Independent Government Estimate**

In compliance with the Federal Acquisition Regulations (FAR) and GAO, an Independent Government Estimate (IGE) of construction costs is required for all contracting actions exceeding \$100,000. The IGE must be prepared and provided to the Smithsonian's Contracting Officer prior to bid/offer opening or negotiations with the Construction Contractor. This estimate is prepared by, or at the direction of, the Office of Planning Design and Construction (OPDC), Facility Investment and Cost Engineering Branch (FICE).



### **3 Requirements: Estimating Professionals and Quality Control**

#### **3.1 Cost Estimating Consultant Qualifications**

Cost Engineering/Estimating Consultants shall be professional estimators having all the necessary education, training, professional capabilities, and experience in estimating projects of similar scope and complexity. Estimators should be trained and proficient in CostOS software.

#### **3.2 Independent Estimates**

All estimates must be prepared independently of the design team by skilled and experienced estimating professionals.

#### **3.3 Site Visit**

Prior to commencing work on any cost estimate the Cost Consultants shall visit the site and fully familiarize themselves with all conditions under which the work will be performed. The Cost Consultant shall coordinate all site visits through the Design Manager COTR (DM).

#### **3.4 Quality Control (QC)**

Each cost estimate submittal shall undergo a QC process review prior to submittal to SI by both the Cost Consultant firm and the AE firm. The AE firm shall submit a signed QC review sheet with each submittal demonstrating that QC has taken place and that the estimate meets standards and requirements laid out in this document. Description of the QC process for the cost estimate submittal will be included within the AE's overall Quality Control Plan. The QC submittal shall include at a minimum a completed checklist of aspects reviewed and quality control comments and responses. SI will complete a Quality Assurance (QA) review and comment on the cost estimate submittals via the SD410 process. The AE shall provide responses and obtain resolution of QA comments in a timely manner. The QC system shall ensure that SD410 comments made on previous submittals are addressed and incorporated as appropriate prior to an estimate's resubmittal or the next submission, whichever comes first.





## 4 Estimate Types

### 4.1 Master Planning Estimates

Preliminary Master Planning project budgets are established by estimating facilities construction costs as well as line items for related fees, contingencies, and other project costs. As programming and preliminary design information becomes available, the preliminary project budget estimate may be refined and updated. Preliminary project budget estimates are used by the SI in long-range project planning and serve as the basis for funding requests.

Planning level estimates shall include building systems estimates utilizing Unifomat II and indicating costs for building construction (architectural +major engineering systems) and site development. Various multipliers or line items are included for: Architect/Engineer fees, construction management, and inspection fees, furniture, furnishings and equipment (FF&E), move-in and occupancy, escalation, and design Construction contingencies, etc.

### 4.2 A Project Prospectus

Major new construction often includes an estimate of First Year Program Expenses and an estimate of Annual Operating Costs as well as the Preliminary Project Budget Estimate. Requirements for the preparation of these Annual Operating Costs will be outlined in the Scope of Work for the Project Prospectus.

### 4.3 Concept Budget Estimate Using Schematic Design

When an estimate based on concept or schematic drawings is required, the Cost Consultant shall prepare a Project Budget Estimate to include building systems estimates utilizing Unifomat II and indicating costs for building construction (architectural + major engineering systems) and site development. Various multipliers or line items may be required for: Architect/Engineer fees, construction management and inspection fees, furniture, furnishings, and equipment (FF&E), move-in and occupancy, escalation, and design contingencies. Augment Unifomat II level 2 estimates with additional detail, to the fullest extent possible, as follows:

- i) Mechanical provide separate identifiable costs for HVAC and Controls/programming, plumbing and fire suppression.
- ii) Electrical provide separate identifiable costs for service and distribution, lighting, power and special electrical systems including security where necessary.

Line-item descriptions shall define included scope elements, assumptions made, and shall reflect the assumed units of measure and include materials, labor, and equipment in unit breakouts.

The following indirect costs shall also be considered and included as appropriate:

- Design development contingency
- Material and labor burden
- Overhead and profit
- Prime commission on subcontract work



- Escalation to the mid-point of construction
- Area factor
- Site factor and logistics (if applicable)
- General conditions and general requirements
- Performance Bond, Liability and Builder's Risk Insurances

Line items shall be included for FF&E, security devices, and special equipment as applicable or as directed by SI.

#### **4.4 Construction Cost Estimates – Design Development and Construction Documents (35% through 100% Final)**

Construction cost estimates shall be prepared throughout the design process, increasing in detail as the design develops from Design Development through Construction Documents to submission of the Final Estimate. A construction cost estimate is a required deliverable along with each design submission (occasionally an intermediate estimate is required, this will be identified in the SOW if required). This helps ensure that the design is within budget and targets problem areas in cost which could affect final design. The requirements for Construction Cost Estimates are as follows:

##### **4.4.1 Design Development (35%)**

Prepare the Design Development estimate using Unifomat II Level 3 based on design development floor plans; outline specifications for principal materials, finishes and building systems and typical unit costs for structural, mechanical and electrical systems. Provide specific allowances (separate from overall Design Contingency) for materials or systems anticipated but not yet defined in the design documents.

##### **4.4.2 Construction Documents (65%, or Intermediate Construction Bid, through 100% Final Sets)**

Levels of completion for construction document phase estimates shall conform to Unifomat II Level 4. Lump sum pricing shall be held to a minimum. Project cost control will be maintained to appropriate limits through the development of the project cost estimates. Complete and detailed line-item estimates for Division 1–General Requirements, shall be provided with all construction document phase estimates. Additionally, each subsequent estimate submission shall have incorporated all comments from previously submitted SD410 reviews, as appropriate. As the design progresses, all parametric estimating shall be eliminated.

#### **4.5 Bid Phase Cost Estimating:**

When the AE revises the plans and/or specifications for incorporation as an amendment during the bidding phase the changes shall be reviewed by the AE Cost Consultant to determine cost-impact to the final estimate submission. If an impact to project cost is anticipated as a result of the changes, the Cost Consultant shall prepare and submit a revised final estimate.



#### **4.6 Construction Phase Cost Estimating:**

During the Construction Phase when the AE makes changes to the drawings and/or specifications which result in Project Change Orders (PCNs) over \$100,000, the AE's Cost Consultant shall prepare an estimate of the proposed changes (PCN).

#### **4.7 Life Cycle Cost Analysis (LCCA) Guidelines:**

Where the performance of Life Cycle Cost Analysis forms part of the scope of work or is being offered in support of proposed design options the following guidelines shall be used:

##### **4.7.1 *Selection of Useful Life Parameters***

A thirty-year (30) useful life is to be used unless otherwise specified on a case-by-case basis.

##### **4.7.2 *Discount/Interest Rate***

A discount/interest rate of three (3) percent is to be used unless otherwise specified.

##### **4.7.3 *Recommended Approaches***

The two most frequent methodologies used to calculate LCCA are discounted rate of return and net present value. Both methods will arrive at an equivalent answer for selection of alternatives. SI recommends the use of the present worth method of Life Cycle Cost Analysis of competing alternative design solutions. The present-worth method requires the conversion of all present and future expenditures to a base line of today's costs. Initial costs are already expressed in present worth.

##### **4.7.4 *Economic Criteria***

The AE consultant shall itemize the economic criteria as part of each LCCA for reference in the final report. The economic criteria shall clearly reference the values of key parameters and for all significant variables in LCCA.

##### **4.7.5 *Technical Guidelines***

An LCCA should be undertaken when the design recommendation has significant impact on future costs. It must be emphasized that the analysis need only to cover those items which vary between options under consideration. Items in common can be ignored.



## **5 Software Requirements for Estimating and Quantity Takeoff**

### **5.1 Master Planning and Concept Phase Estimates**

The format for these estimates will be defined by SI in the AE scope of work. Prior to beginning work on a Master Plan or Conceptual estimate the AE Cost Consultant shall meet with FICE to discuss the format for the estimate. The estimate shall utilize a mutually agreed upon format in either Excel or CostOS.

### **5.2 Design, Bid, and Construction Phase Estimates**

The Cost Consultant shall develop and submit estimates in CostOS software for estimates prepared during these phases (see limited exceptions in Introduction, page 4). The Cost Consultant shall use SI's custom Project Variables (PV) template within CostOS for all design phase, bid phase, and construction phase cost estimates.

The SI PV template is proprietary and should not be used to develop estimates for entities other than SI.

Do not reformat or alter the functionality of the SI PV template without the express prior approval from FICE.

Contact CostOS directly (855-590-4141) to procure the CostOS software, SI Project Variables template, and necessary training.

### **5.3 Quantity Takeoff**

For all estimates during the Design, Bid, and Construction phases (PCNs), detailed quantity takeoffs shall be submitted as part of the estimate package for each estimate submission. Include in your submissions:

1. Drawings where takeoff was performed showing the quantity takeoff performed, and
2. A listing of the detailed takeoff items and quantities in the form of a spreadsheet/table organized by CSI.

Takeoff can be submitted in any of the following formats, in order of preference: CostOS, Bluebeam, or PDF.



## **6 Estimate Format and Standards**

### **6.1 FICE Estimating Criteria**

FICE, in agreement with the Office of Contracting (OCON), establishes and maintains guidance criteria for use by AEs in the preparation of estimates.

### **6.2 General:**

The SI will identify the contracting method and execution strategy to be used for the project delivery. This project-specific information shall be reflected in the estimate including, but not limited to, any identified options, alternates, early packages, project phasing, etc.

### **6.3 Detailed Estimate Narrative**

Each submission shall include a detailed estimate narrative which explains how the estimator envisions the construction work to be accomplished. Each Project Narrative shall additionally include the following:

- Project Description
- Identification of design documents serving as basis for estimate,
- Assumptions (e.g., construction schedule, overtime, acquisition and subcontracting plan, site logistics, construction means and methods, unusual conditions, equipment, environmental concerns, etc.)
- Effective Date for Labor, Equipment, and Material Pricing
- CSI comparison/variance table from the previous submittal for each design phase estimate (e.g., from concept/schematic to 35%, from 35% to 65%, etc.). This table shall be accompanied by detailed descriptions or explanations for major cost changes in a CSI category from one submission to the next.

Additionally, include a description of any special problems or conditions affecting project cost that will be encountered on site, reasons for selecting major plant and equipment, assumptions made for mobilization and demobilization for all equipment, and reasons for unusually high or low contingencies, exclusions, and any other pertinent assumptions. The estimator shall provide detailed notes to explain the basis of such unusual contingencies and how they are derived.

### **6.4 Direct Costs**

Estimate line items shall reflect direct costs for material and labor for the prime and all subcontractors. Utilize the description field to document what is included in the cost line item and any additional pertinent information.

### **6.5 Material and Subcontractor Quotes**

The Cost Consultant shall obtain and provide quotes for significant cost items including unique or specialty material, specialty contractors, and equipment. The quote should state the company name, date of quote and contact phone numbers.



## 6.6 Wage Rates

The Davis-Bacon Act (DBA) establishes the baseline for construction wage rates to be used in SI construction estimates. Current DBA construction wage rate information can be found here: <https://sam.gov/content/wage-determinations>

## 6.7 Indirect Costs

Indirect costs shall be applied with full transparency to direct costs. These include but are not limited to the following:

### 6.7.1 *Labor Burden for supervisory personnel (salaried people working in field and office) shall consist of:*

- Social security and Medicare taxes
- Federal unemployment taxes (FUTA)
- State unemployment taxes
- Major medical, pension, vacation, disabilities, and any other additional benefits provided by the employer
- Workmen's compensation
- General and Excess liability

### 6.7.2 *Labor Burden for Craft Labor (covered by wage scales) shall consist of:*

- Social security and Medicare taxes
- Federal unemployment taxes (FUTA)
- State unemployment taxes
- Health, welfare, and pension (fringes)
- Workmen's compensation
- General and Excess liability

### 6.7.3 *Overhead and Profit*

Generally, estimates shall show appropriate additions to the direct cost of the work for overhead and profit for both the Prime (General Contractor) and all Subcontractors. The AE shall determine the level of overhead by considering the size and complexity of the project, risk factors and current local market conditions. When lump sum quotes from subcontractors are shown in the estimate, they shall be fully inclusive of overhead and profit.

### 6.7.4 *Prime Commission on Subcontractor Work*

Generally, the Prime Contractor is allowed a commission (mark-up) on subcontractor work. The AE shall use his experience and current local market conditions to establish the appropriate level of this mark-up. This factor may be adjusted at the discretion of the OPDC Cost Engineer or OCON.

### 6.7.5 *Escalation*

As required by the FAR the AE will include escalation from the date of the estimate to the mid-point of construction. The escalation factor and mid-point of construction shall be stated in the estimate.

### 6.7.6 *Location Factor*

To the greatest extent possible (dependent on the level of design) costs should accurately reflect location-specific current market conditions. When necessary,



location factors may be used from acceptable historical cost indices, such as Engineering News Record and R.S. Means City Cost Index.

#### **6.7.7 *General Conditions and General Requirements***

This is a variable component considering the various requirements of generic and project-specific conditions. This may include mobilization and demobilization; personnel/property protection and barricades; ingress and egress to the site; demolition and removal of debris; testing; contractor and guard overtime; off-hours work; supervision; project management; field office; office overhead; construction equipment and any other condition affecting the Contractor's ability to perform the Work. Complete and detailed line-item estimates for General and Supplementary Conditions shall be provided with all construction document phase estimates.

#### **6.7.8 *Bonds and Insurances***

The AE shall estimate and include the cost of all Bonds and Insurances the contractor is required by contract to possess. The estimate shall show these amounts as separate line items.

#### **6.7.9 *Design Development Contingency***

The AE shall provide a design development contingency considered reasonable for that stage of design development. The AE shall provide the rationale to support this contingency in his qualifications statement. Design Development Contingency lowers in value as the project design advances and the scope definition is further refined. Generally, SI uses the following values:

##### **6.7.9.1 *Schematic***

Provide a contingency of 20-25%

##### **6.7.9.2 *Design Development***

Provide a contingency of 10-15% and reduced to 0% at 100% Final design

#### **6.7.10 *Construction Contingency***

**Typically, SI will carry the Construction Contingency “below the line” and the AE is not expected to include this in his estimates unless directed otherwise.**

When required this is a variable markup that typically ranges from 5% to 20% in a Project Budget Estimate to allow for a construction reserve to cover unforeseen and unknowable circumstances particular to the project that occur during the construction phase.

### **6.8 *Work Breakdown Structure***

All design, bid, and construction phase cost estimate line items shall be coded using CSI format. Additionally, all design, bid, and construction phase line items shall be categorized by the “Unifomat-SI” WBS in CostOS. Both the CSI designation and Unifomat categorization shall be to the greatest level of detail possible given the level of design development. Additional project-specific WBS structures may be required on a project-by-project basis. Additional WBS structures will be identified as needed in the AE SOW and/or through estimate format discussions with the SI cost manager.

## 6.9 Estimate Documentation

With each estimate submission the estimator shall submit the following:

<b>Deliverable</b>	<b>Format</b>
Signed Quality Control Checklist	PDF
Estimate Narrative	PDF
Estimate Cover Sheet	PDF (CostOS-Generated)
Estimate Summary Report	PDF (CostOS-Generated)
WBS Detail Report	PDF (CostOS-Generated)
Bid Sheet Report	PDF (CostOS-Generated)
Cost Estimate	Native CostOS file
Estimate Take Off	Native CostOS file, Bluebeam, or PDF