CECW-EC

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

Technical Letter
No. 1110-2-573

30 September 2008

EXPIRES 30 SEPTEMBER 2013
Engineering and Design
CONSTRUCTION COST ESTIMATING GUIDE
FOR CIVIL WORKS

1. Purpose. This engineer technical letter establishes uniform guidance to describe methods, procedures, and formats for the preparation of construction cost estimates and construction contract modification estimates and total project costs.

2. Applicability. This engineer technical letter applies to U.S. Army Corps of Engineers commands having design and/or construction responsibilities for civil works projects.

3. Distribution Statement. Approved for public release, distribution is unlimited.

4. References. See appendix A.

10 Appendixes
(See Table of Contents)

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CHAPTER 1

Introduction

1.1 Purpose. This engineer technical letter (ETL) establishes uniform guidance to describe methods, procedures, and formats for the preparation of construction cost estimates, Independent Government Estimates (IGEs), construction contract modification estimates and the Total Project Cost (TPC). The definitions and appropriate policies applicable to the wide variety of projects encompassed in the Civil Works Program are described in Engineer Regulation (ER) 1110-2-1302, Civil Works Cost Engineering, and ER 1110-2-1150, Engineering and Design for Civil Works Projects. The technical details for preparing cost estimates are provided in this ETL to accomplish the requirements of ER 1110-2-1302.

1.2 Applicability. This ETL applies to U.S. Army Corps of Engineers (USACE) commands having design and/or construction responsibilities for civil works projects.

1.3 Distribution Statement. Approved for public release, distribution is unlimited.

1.4 References. Required and related references are at appendix A.

1.5 Scope.

1.5.1 This ETL provides technical guidance and addresses all phases of construction cost estimating from planning phases through modification estimates during construction through to project completion for all civil works projects. The term “construction” includes remedial action environmental projects, dredging, and other construction and fabrication-related work often implemented within all types of contracts.

1.5.2 This ETL includes guidance for preparing and reporting the TPC and computing maximum project cost legislated by Section 902 of the Water Resources Development Act of 1986. The basis for computing maximum total project cost is in appendix G of ER 1105-2-100, Planning Guidance Notebook.

1.5.3 For the purposes of this document, the term cost engineer applies to all individuals, whether employed by the Government or under contract to the Government, who are engaged in the preparation or review of cost estimates.

1.6 Program Specific Requirements. To support the civil works missions addressed in ER 1105-2-100, guidance for civil works estimates is provided in ER 1110-2-1302 and ER 1110-2-1150. Appendix A contains other pertinent references. Other regulations govern military estimates and hazardous, toxic, and radioactive waste and will not be discussed in this ETL.

1.7 Document Organization. The ETL consists of 9 chapters, 10 appendixes, and a glossary.

1.7.1 Chapter 1 provides the scope, civil works project requirements, background, and responsibilities of construction cost estimating.

1.7.2 Chapter 2 discusses the types of cost estimates employed during construction cost estimating. Virtually every study, project, or activity funded under the civil works project requires a project cost estimate. The cost estimate is an essential tool that serves as a foundation in accomplishing management objectives, budgetary submissions, and economic analysis.

1.7.3 Chapter 3 applies to construction estimates and describes the basic principles and responsibilities for developing any cost estimate.

1.7.4 Chapters 4 and 5 provide direct and indirect cost development guidelines.

1.7.5 Chapter 6 provides guidance on identifying other costs that must be included in the cost estimate, i.e., risk, contingency, and escalation.

1.7.6 Chapters 7 and 8 discuss IGEs and IGEs for contract modifications.

1.7.7 Chapter 9 discusses various levels of review. Certain reviews are mandatory and directed by headquarters (HQ).

1.7.8 The following appendixes contain supportive material to the main text in this ETL: Appendix A, References; Appendix B, Total Project Cost Summary; Appendix C, Tri-Service Automated Cost Engineering Systems; Appendix D, Preparation of Dredge Cost Estimates; Appendix E, Sample Estimate Sheets and Forms; Appendix F, Sample Quality Review Checklist; Appendix G, Cost and Schedule Risk Analysis; Appendix H, Sample Checklist for Cost Estimate Preparation or Reviewer Checklist; Appendix I, Protests or Litigation Concerning the Independent Government Estimate; and Appendix J, Job Office Overhead Template.

1.8 Background. Project cost estimates shall 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, should be included in the cost estimate. This philosophy prevails throughout the entire project cycle--from planning through completion of the project. Without an accurate estimate or schedule, successful project management can be compromised. Each estimate shall be developed as accurately as funding and time constraints allow, in as much detail as can be assumed, and based upon the best information available. The objective through all phases of project planning, design, and construction is to develop cost estimates to serve as a project management tool as well as establish a “fair and reasonable” cost to the Government.

1.9 Project Delivery Team.

1.9.1 USACE is committed to effective management of the scope, quality, cost, and schedule of each project by using project delivery teams (PDT). ER 5-1-11, USACE Business Process, presents the requirements for establishing a PDT for all projects. Each PDT is led by a project manager (PM) and composed of everyone necessary for successful development and execution of all phases of the project. The PDT may be drawn from more than one USACE district and may include specialists, consultants/contractors, stakeholders, or representatives from other Federal and state agencies. Team members are chosen for their skills and abilities to successfully execute a quality project. The project cost estimate shall be recognized as a major management tool for establishing, monitoring, and managing costs from the study phase through project completion.

1.9.2 Civil works projects are planned and approved following ER 1105-2-100 and are designed following ER 1110-2-1150.

1.9.3 The efforts of all PDT members shall be coordinated to ensure that sufficient project information is provided for all cost estimates.

1.9.4 Cost engineers are an important member of the PDT. The cost engineer is expected to have a clear understanding of those responsibilities and areas where he or she can contribute. It is imperative that the team concept be enhanced and supported by each PDT member. As such, the cost engineer is encouraged to lead in cost issues and provide ideas for cost control and sharing measures.

1.10 Responsibilities.

1.10.1 Division Cost Engineer

- Act as Major Subordinate Command (MSC) point of contact in communicating with HQUSACE cost engineering offices.
- Receive, interpret, disseminate, and implement cost engineering guidance, direction, and correspondence from higher authority in a timely manner.
- Conduct field reviews of district commands execution of cost quality management and recommends necessary corrective actions when warranted.
- Support PM in the certification for project cost estimates and cost changes and provide Project Review Board technical support on project costs as required.

- Review proposed awards of negotiated contracts and modifications requiring award approval above the authority delegated to district commanders.
- Review bid results, protests, and mistakes in bids. Evaluate and make recommendations on district actions for bid protests and mistakes in bid. Provide analysis and recommendations and take necessary actions as required.
- Participate in HQUSACE Cost Engineering Steering Committee and lead in subcommittee efforts.
- Provide technical assistance to districts and MSC elements on cost engineering issues. Consolidate and disseminate MSC-wide historical cost data.
- Provide technical support to HQUSACE on development, upgrade, maintenance, and implementation of Microcomputer Aided Cost Estimating System (MCACES).

1.10.2 Chief, Cost Engineering

1.10.2.1 The chief of each district cost engineering office is responsible for providing cost engineers to support the PDT. The chief shall ensure that all appropriate estimating activities, including site visits prior to construction and during construction, have been adequately funded and scheduled in the Project Management Plan (PMP) for the estimate development. When cost engineering products are to be obtained by architect-engineers (A-E) contracting, the chief shall ensure that the A-E contract statement of work requires the A-E to comply with USACE estimating policies of ER 1110-2-1150, ER 1110-2-1302, and this ETL.

1.10.2.2 The cost engineer should serve in an advisory capacity to the PDT, contracting office, and office of counsel related to contract acquisition strategy, bid schedules and biddability, TPC, value engineering, disputes, and claims.

1.10.2.3 Preparation and review of construction cost estimates from design start through project completion is the responsibility of the district cost engineering office. In concert with this responsibility, the cost engineer must be accountable for the completeness, quality, accuracy, and reasonableness of the cost estimate. This relates to all respective estimates, whether developed by the cost engineering office, other governmental offices, or by contracted estimating firms.

1.10.3 Estimating by Non-USACE or Engineering Firms. Preparation of Government estimate products are always inherently the responsibility of the Government. When it is necessary to contract services for estimate products, such services will be provided by competent firms or agencies experienced in cost and schedule engineering. The key responsibilities of any contracted estimate by other firm or agency include:

- Adherence to ER 1110-2-1150, ER 1110-2-1302, and this ETL.
- Providing an experienced cost engineer as lead for the product(s).
- Coordination with Corps cost engineering office during product development.
- Developing construction estimates at feasibility and beyond in the latest approved MCACES software.
- Developing construction schedules at feasibility and beyond utilizing industry accepted software programs.
- Receiving and adhering to Government approval of the Civil Works Work Breakdown Structure (CWWBS) in the early stage of estimate development.
- Maintaining and conducting an internal quality control/quality assurance (QC/QA) program addressing cost, schedule, and risk as contractually applicable.
- Preparing cost reports addressing contract scope, product development processes, assumptions, methodologies, concerns, and results.

1.10.4 Project Delivery Team

1.10.4.1 Members of the PDT shall provide the cost engineer estimates for the CWWBS feature codes 01 (Lands and Damages), 30 (Planning, Engineering, and Design), and 31 (Construction Management) for incorporation into the Total Project Cost estimate. All costs for these activities will be developed by the appropriate office and coordinated with the PM to ensure all schedules and commitments for the project are fulfilled.

1.10.4.2 Each PDT member is responsible for defining confidence/risk levels associated with their office products. The PDT shall assist the cost engineer in identifying cost-related project items including but not limited to:

- Project risks.
- Project contingencies.
- Project schedule.
- Construction schedules.
- Contract phasing.
- Bid schedule.
- Contract completion dates.

1.11 <u>Technical Reviews</u>. In accordance with ER 1110-2-1150, technical reviews are required and/or recommended during various phases of project development through the life of the project. These review requirements are more thoroughly discussed within ER 1110-2-1302. Technical reviews are to be coordinated by the PM and supported by the PDT. The reviews are instrumental in ensuring adequate product quality for the project phase under development. There are various cost quality processes that are utilized for this purpose and are discussed more thoroughly in chapter 9. They include a district quality control review or DQC (also known as a peer review), an independent agency technical review (ATR), and an independent external peer review (IEPR).

CHAPTER 2

Types of Civil Works Cost Estimates

2.1 General.

2.1.1 Virtually every study, project, or activity funded under the Civil Works Program requires a cost estimate. The cost estimate is an essential tool that serves as a foundation in accomplishing management objectives, budgetary submissions, and economic analysis. In a typical project life, cost estimates may be divided into two types: budget estimates or Independent Government Estimates. The types of estimates and civil works phases are identified below:

2.1.1.1 Budget estimates for reconnaissance phase reports.

2.1.1.2 Budget estimates for feasibility phase reports.

2.1.1.3 Budget estimates during planning, engineering, and design phase.

2.1.1.4 IGEs for contract award and for contract modifications during the construction phase.

2.1.2 Budget estimates reflect the early stages of design. As designs evolve and improve in scope and detail, so shall the estimates in detail and quality. The IGE is the most detailed estimate and must be a stand-alone document reflecting scope and basis of estimate.

2.1.3 Regardless of the type of estimate, detailed estimating methods are to be employed as much as possible in relationship to the known and assumed design scoping information. Details can be reasonably assumed for many projects from experience gained in past designs and estimates. When details cannot be reasonably assumed, then historical bid unit prices shall be used, but updated to current market costs. While cost quotes can be used, caution should be exercised to establish those costs as reliable, fair, and reasonable. Verification of reasonable quotes can be achieved by receiving several quotes, making parametric comparisons, or developing a rough estimate for comparison.

2.2 Estimate Structure.

2.2.1 The estimate structure is strongly related to feature levels and accounting, contracts, and acquisition; construction costs and unit pricing; project schedules and escalation; and risk and contingency development in the endeavor to establish the TPC (paragraph 2.3.4) that becomes the baseline cost estimate (BCE) upon approval (higher authority or Congress). It is important that the structure of all estimates be as consistent as possible. The purpose for a consistent estimate structure is to: (1) serve as the basis for establishing the TPC; (2) provide an organized manner of collecting project cost data for cost reporting and cost tracking; (3) provide a checklist for categorizing costs; (4) provide a basis to maintain historical cost data; and (5) portray logical sequence of work to support work preparation of a construction schedule.

2.2.2 The CWWBS is a standard product oriented structure that identifies all civil works related project requirements that include construction costs and the non-construction activity costs for Planning, Engineering, and Design and Construction. The CWWBS groups the products by feature (table 2-1) and requires further expansion to the appropriate title and detail level necessary to ensure all product specific work tasks are included for preparation of the TPC estimate.

Table 2-1. Civil Works Work Breakdown Structure

(Feature and Subfeature Levels)

CWWBS Number		Description of Item
01	**--**	**LANDS AND DAMAGES**
01	18	GENERAL REVALUATION REPORT (GRR)
01	19	LIMITED REVALUATION REPORT (LRR)
01	20	PROJECT DESIGN MEMORANDUM
01	21	FEATURE DESIGN MEMORANDUM
01	23	CONSTRUCTION CONTRACT(S) DOCUMENTS
02	**--**	**RELOCATIONS**
02	01	ROADS, Construction Activities
02	02	RAILROADS, Construction Activities
02	03	CEMETERIES, UTILITIES, AND STRUCTURES, Construction Activities
03	**--**	**RESERVOIRS**
04	**--**	**DAMS**
04	01	MAIN DAM
04	02	SPILLWAY
04	03	OUTLET WORKS
04	04	POWER INTAKE WORKS
04	05	AUXILIARY DAMS
04	06	MUNICIPAL AND INDUSTRIAL WATER DELIVERY FACILITIES
05	**--**	**LOCKS**
06	**---**	**FISH AND WILDLIFE FACILITIES**
06	01	FISH FACILITIES AT DAMS
06	02	FISH HATCHERY, (Including Trapping and Release Facilities)
06	03	WILDLIFE FACILITIES AND SANCTUARIES
07	**--**	**POWER PLANT**
07	01	POWERHOUSE
07	02	TURBINES AND GENERATORS
07	03	ACCESSORY ELECTRICAL EQUIPMENT
07	04	MISCELLANEOUS POWER PLANT EQUIPMENT

(Feature and Subfeature Levels)

07	05	TAILRACE
07	06	SWITCHYARD
08	**--**	**ROADS, RAILROADS, AND BRIDGES**
08	01	ROADS
08	02	RAILROADS
09	**--**	**CHANNELS AND CANALS (Except Navigation Ports and Harbors)**
09	01	CHANNELS
09	02	CANALS
10	**--**	**BREAKWATERS AND SEAWALLS**
11	**--**	**LEVEES AND FLOODWALLS**
11	01	LEVEES
11	02	FLOODWALLS
12	**--**	**NAVIGATION, PORTS AND HARBORS**
12	01	PORTS
12	02	HARBORS
13	**--**	**PUMPING PLANT**
14	**--**	**RECREATION FACILITIES**
15	**--**	**FLOODWAY CONTROL AND DIVERSION STRUCTURES**
16	**--**	**BANK STABILIZATION**
17	**--**	**BEACH REPLENISHMENT**
18	**--**	**CULTURAL RESOURCE PRESERVATION**
19	**--**	**BUILDINGS, GROUNDS, AND UTILITIES**
20	**--**	**PERMANENT OPERATING EQUIPMENT**
30	**--**	**PLANNING, ENGINEERING, AND DESIGN**
30	11	PROJECT COOPERATION AGREEMENT
30	12	PROJECT MANAGEMENT PLAN
30	18	GENERAL REEVALUATION REPORT (GRR)
30	19	LIMITED REEVALUATION REPORT (LRR)
30	20	PROJECT DESIGN MEMORANDUM
30	21	FEATURE DESIGN MEMORANDUM
30	23	CONSTRUCTION CONTRACT(S) DOCUMENTS
30	24	VALUE ENGINEERING ANALYSIS DOCUMENTS
30	25	PROJECT OR FUNCTIONAL ELEMENT CLOSEOUT
30	26	PROGRAMS AND PROJECT MANAGEMENT DOCUMENTS
31	**--**	**CONSTRUCTION MANAGEMENT**
31	12	PROJECT MANAGEMENT PLAN
31	23	CONSTRUCTION CONTRACT(S) DOCUMENTS
31	26	PROGRAMS AND PROJECT MANAGEMENT DOCUMENTS
32	**--**	**HAZARDOUS AND TOXIC WASTE**
32	01	MOB, DEMOB & PREPARATORY WORK
32	02	SYSTEMS STARTUP/OPERATIONS/MAINTENANCE
32	03	INSTITUTIONAL ACTIONS
32	04	SURFACE WATER CONTROL
32	05	COLLECTION & INJECTION OF GROUND WATER
32	06	COLLECTION & DISPOSAL OF WASTES
32	07	CONTAIN & RESTORE CONTAMINATED GROUND WATER
32	08	CONTAINMENT FOR WASTES
32	10	TREAT-WASTES/CONTAMINATED SOIL & WATER
32	11	AIR POLLUTION AND LANDFILL GAS CONTROL

(Feature and Subfeature Levels)		
32	12	INNOVATIVE TECHNOLOGIES
32	13	SUPPORTING FACILITIES
32	14	PRIME CONTRACTOR'S INDIRECT COST

2.3 Estimates for Reconnaissance Phase.

2.3.1 Preliminary Cost Estimates

2.3.1.1 During the reconnaissance study phase of various alternatives, the cost engineer shall prepare the preliminary construction cost estimates of those alternatives. The estimates shall be in constant dollars and based on the probable type and size of the project. They will include the following construction features: Lands and Damages; Relocations; environmental compliance and required mitigation; Planning, Engineering, and Design; Construction Management; and contingencies. Refer to the CWWBS.

2.3.1.2 The assignment of contingencies is very important at the reconnaissance stage of project study. Contingencies are necessary to assure that unforeseen items of work or level of detail discovered later will not jeopardize the project recommended in the reconnaissance study report as one worthy of progressing to the feasibility phase. Contingency values may vary between various alternatives and should be considered if the various alternatives technically differ and carry significant risk differences.

2.3.1.3 While not required, escalation may be considered if the project alternatives differ significantly in duration or if they carry forward into multiple years.

2.3.1.4 For cost estimates prepared manually, rounding of costs is desirable to avoid using decimals.

2.3.2 Design Detail. Design detail will be limited at this stage of project development. The cost estimating method used must establish reasonable costs sufficient to support a planning evaluation process for determining whether a study should continue into the feasibility phase. Alternative plans may need to be considered before an acceptable plan is selected. Good judgment and experience of the estimating team is needed and required for preparing estimates in a method and format suitable for comparing the various alternatives studied.

2.3.3 Preparation and Content

2.3.3.1 Once it has been determined that a Federal interest is appropriate, a method of development and format must be determined. A cost estimate for the selected plan may be prepared using the latest HQUSACE approved MCACES software in the CWWBS format to a level of detail necessary to support the preliminary scope.

2.3.3.2 The reconnaissance report will contain the cost estimate and will include:

- Title page.
- Table of contents.
- Narrative.

2.3.4 Basis of Reconnaissance Estimates

2.3.4.1 Construction cost estimates for the reconnaissance phase may be developed using quotes, calculations, unit prices, or historical data as backup

2.3.4.2 As an alternate method to detailed task-by-task estimate preparation, especially in the early phases of project and budget development when details are not available, the use of parametric estimating may be incorporated. Parametric estimating is the process of using various factors to develop an estimate. The factors are based on engineering parameters, developed from historical databases, construction practices, and engineering/construction technology. Parameters include physical properties that describe project definition characteristics (e.g., building size, building type, foundation type, exterior closure material, roof type and material, number of floors, functional space requirements, interior utility system requirements, etc.). The appropriateness of selecting the parametric method depends upon the extent of project definition available, the similarity between the project and other historical data models, the ability to calculate details, and known parameters or factors for the project. Appendix C provides additional information on automated parametric systems.

2.4 Estimates for Feasibility Phase.

2.4.1 Comparative Cost Estimates

2.4.1.1 Comparative cost estimates of the viable alternatives used in selecting the National Economic Development (NED) plan must be prepared in the CWWBS structure to at least the subfeature level. A screening process may be used in the feasibility phase to review all the initial alternatives. Different levels of cost estimating detail may be appropriate at each level of screening. Typically, this screening process will narrow the number of alternatives to a final list, i.e., two to five viable alternatives for a more detailed assessment.

2.4.1.2 Historical bid cost data, experience, and/or unit prices adjusted to expected project conditions are acceptable methods of developing project costs for these alternatives. The cost estimate for each viable alternative will include appropriate comments describing the method of construction, assumptions used in developing the estimate, and the technical/design data available. For the recommended plan (normally the NED plan), sufficient engineering and design are performed to refine the project features.

2.4.2 Recommended Plan Cost Estimate and Schedule

2.4.2.1 The cost estimate supporting the NED plan will be prepared using the latest HQ approved MCACES software and the established CWWBS to at least the subfeature level of detail. In general, the unit costs for the construction features will be computed by estimating the equipment, labor, material, and production rates suitable for the project developed.

2.4.2.2 Detailed estimating methods are to be employed whenever adequate design information is known or can be reasonably assumed. This requirement is related to total project scope or specific scope portions that are developed adequately for detailed estimating in any product phase. Detail can be reasonably assumed for many projects from experience in past designs, cost engineer experience, and use of parametric models or templates. When details cannot be reasonably assumed, then historical bid unit prices shall be used, but updated to current market costs. While cost quotes can be used, caution should be exercised to establish those costs as reliable, fair, and reasonable. Verification of reasonableness can be achieved by receiving several quotes, making parametric comparisons, or developing a rough estimate for comparison.

2.4.2.3 Upon completion of the construction estimate, a representative construction schedule shall then be developed in support of the escalation calculations for the Total Project Cost Summary (TPCS). The schedule and its logic can be used as a quality check of the estimate as related to duration, overtime, and the number of crews and shifts. The schedule logic may cause the estimate to be revised based upon the schedule needs established for the project. The schedule shall be developed in enough detail to portray the critical and near critical path construction elements as well as critical concurrent activities.

2.4.3 Total Project Cost and Summary

2.4.3.1 The TPC reflects the costs for all features of the CWWBS specifically related to the project. The TPCS provides a summary of the TPC estimate and should reflect the CWWBS feature levels as presented in table 2.1 for the feature costs. A TPCS shall be prepared in conjunction with the preparation of the BCEs, which support major project milestones. Guidance and preparation details are presented in appendix B. The TPCS relates the cost estimate and identified price level date to the fully funded cost estimate by applying the appropriate adjustments for contingency and escalation in accordance with the developed project schedule. In a sense, it is a reflection of three estimates: Current price level of the Baseline Estimate, Budget Year Baseline Estimate, and Fully Funded Estimate. Appendix B includes a representation of the three estimates.

2.4.4 The TPCS is the required cost estimate document to be submitted with all projects sent for either division or HQUSACE approval. Both the PM and chief of the cost engineering office shall review, approve, sign, and date all TPCS documents. Real estate estimates included in the TPCS shall be reviewed and approved, and the TPCS signed by the chief or designee of the real estate office. Signature by the chief of the cost engineering office affirms that the construction feature costs are correct and that the backup data provided for the non-construction features (Lands and Damages; Planning, Engineering, and Design; and Construction Management) have been included.

2.4.5 Baseline Cost Estimate. The TPCS accompanying the feasibility report is used for project authorization and is the basis for allowable cost increases without reauthorization (ER 1110-2-1150). The TPC at the time the project is authorized by Congress becomes the BCE. The BCE represents the scope and schedule established in the feasibility report. The cost estimate based on constant dollars is used for authorization purposes (ER 1105-2-100).

2.4.6 Baseline Project Schedule. The primary engineering objective during the feasibility phase is to provide engineering data and analyses sufficient to develop the complete project schedule and cost estimate. Engineering data and analyses in the feasibility phase shall be sufficient to develop the complete project schedule and TPC with reasonable contingency factors for each cost item or group of cost items (ER 1110-2-1150).

2.4.7 Preparation and Content. The cost engineering appendix of the feasibility report will contain the MCACES cost estimate developed by the cost engineer and will include:

- TPCS (all feature levels).
- Title page.
- Table of contents.
- Narrative presentation of the estimate, schedule, qualifications, project concerns, risks, and contingencies.
- Summary Sheets for Owner, Indirect, and Direct Costs reported at all levels down to the subfeature level.

2.5 Estimates During Engineering and Design Phase.

2.5.1 General

2.5.1.1 Engineering and design is performed during the early phases of project development and during construction. First, engineering occurs in the preconstruction engineering and design phase during which all detailed technical studies and design needed to begin construction of the project are completed, e.g., award of the first construction contract. After initial contract award, engineering continues and includes the completion of all design for the remaining contracts and the design to support ongoing construction required during the construction period.

2.5.1.2 ER 1110-2-1150, appendix D states, "…the baseline estimate in the defined work breakdown structure must be continuously updated, as the design is refined." It also states, "A total current working estimate must be prepared at each major milestone in the project development."

2.5.2 Value Engineering Estimates

2.5.2.1 Value engineering has been defined as a systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. It is a primary tenet of value engineering that basic functions be preserved and not be reduced as a consequence of pursuing value improvements. Value engineering also applies to life cycle cost (LCC) analyses. Value engineering is specifically discussed within Public Law (PL) 104-106, which states, "Each executive agency shall establish and maintain cost-effective value engineering procedures and processes."

2.5.2.2 Districts and divisions have established a value engineering officer in response to these requirements. During the course of design and estimate development, there will likely come a period of opportunity where scope development warrants a value engineering study. The cost engineer may be called upon to participate in these value engineering studies.

2.5.3 Total Project Cost Estimates

2.5.3.1 Project cost estimates during preconstruction engineering and design are primarily revisions to the TPC due to refinements or changes in the design and/or progress schedule developed in the feasibility study. As the project is developed and the design is refined, the BCE must be used as a guide in managing the engineering and design process. A cost estimate represented by a TPCS must be prepared and included as a part of any required Design Documentation Report, Engineering Documentation Report, GRR, or LRR. The cost estimate documentation required for any of these project submissions requiring HQUSACE or higher approval will be the same as discussed above for estimates for the feasibility phase.

2.6 Independent Government Estimates for Contract Award.

2.6.1 Requirement

2.6.1.1 An IGE is required for award of each construction contract, in excess of $100,000 (Federal Acquisition Regulation [FAR]/ Engineer FAR Supplement [EFARS]. Chapter 7 provides detailed information on IGEs.

2.6.1.2 PL 95-269 requires that no work of river and harbor improvement will be performed by private contract if the contract price is more than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or more than 25 percent in excess of a fair and reasonable estimated cost (without profit) of a well-equipped contractor performing the work.

2.6.2 Preparation and Content

2.6.2.1 The IGE shall be prepared by the cost engineer using the latest HQ approved MCACES software. The cost engineer will participate in all negotiated contracts including, but not limited to, Small Business and Small Business Section 8(a), Service and Supplies, and/or cost plus contracts.

2.6.2.2 IGE detailed estimates shall 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, should be included in the cost estimate in as much detail as possible. The detailed estimate remains “For Official Use Only” (FOUO) until the construction contract is closed.

2.6.2.3 The IGE for bidding purposes is comprised of the title page, signature page and the bid schedule. It does not include the detailed estimate. The IGE shall be designated FOUO until after bid opening (paragraph 7.7.2).

2.6.3 Directives. Those responsible for the preparation of estimates should be thoroughly familiar with the requirements of the appropriate ERs, FARs, Defense FAR Supplements (DFARS), and EFARs. While this ETL discusses IGE preparation, the FARs present the processes related to IGE preparation as well as bid evaluation, protests, modifications, disputes, claims and resolution.

2.6.4 Approvals. Approval signatures signify that the estimate was prepared by qualified personnel, independently reviewed by qualified personnel, and reflect the requirements and processes of the pertinent regulations. IGEs for contracts or modifications exceeding $100,000 shall be approved by the chief of cost engineering.

The IGE shall be approved, dated, and signed by the district commander or approved designee. The IGE will be included in the contract documentation and is subject to the final approval of the contracting officer (EFAR 1.602).

2.7 Estimates for Contract Modifications and Other Negotiated Procurement.

2.7.1 Requirement. FAR Part 36 requires an independently prepared Government estimate for modifications in excess of $100,000. Normally, estimates are not required for changes less than $100,000 but are recommended to support negotiations. IGEs are required by the contracting officer for unilateral modifications. Further, for contract modifications, the amount refers to the sum of the absolute value of increases and decreases. For example, a modification containing an increase of $60,000 and decrease of $45,000 has an absolute value of $105,000, therefore, an IGE would be required.

2.7.2 Preparation and Content. IGEs for contract awards and contract modifications are treated the same. In some cases, portions of the cost estimate may be revealed only to the extent determined necessary by the negotiator to settle disputed items of work. The total of the IGE will not be released during negotiations. On occasion, important information has been revealed through negligence by allowing the estimate to lay open upon the negotiation table. The FOUO (paragraph 7.7.2) designation will be removed after issuance of a signed modification.

2.7.3 Approvals. IGEs for contract actions less than $100,000 that occur during construction shall be approved by the administrative contracting officer or appointed designee. For other contract actions including those exceeding $100,000, the approval of the estimate shall be the chief of cost engineering (as appropriate) or the contracting officer's appointed designee. When the IGE is changed during or subsequent to conferences or negotiations, the details of the basis for the revision or changes in price shall be fully explained and documented in the price negotiation memorandum. The IGE will be included in the contract documentation and is subject to the final approval of the contracting officer or administrative contracting officer.

2.8 Dredging Estimates.

2.8.1 Dredging estimates are developed somewhat differently, but still prepared by cost engineering as part of construction estimates. General guidance is provided in appendix D and ER 1130-2-250. The recommended software for dredge estimating is the USACE Cost Engineering Dredge Estimating Programs (CEDEP), which is developed within an Excel format.

2.8.2 Dredging estimates may be prepared electronically using the CEDEP software. CEDEP contains a narrative documenting reasons for decisions and selections made by the cost engineer. Software distribution is restricted because

CEDEP is considered proprietary to the Government and should not be distributed to A-Es or to contractors.

2.8.3 The CEDEP estimate results are then loaded into the latest MCACES software to support the total construction estimate. Each cost engineer should be aware of various techniques that have proven to produce the most accurate results for specific dredging projects. It is highly recommended that cost engineers are properly trained for estimating dredging projects. The methodology for cost estimating of pipeline, hopper, and mechanical dredging should be part of the course training.

2.8.4 Associated work items, such as clearing and grubbing, dike or weir construction, disposal area operation and maintenance, drilling and blasting, and environmental protection, are not included within CEDEP and should be estimated separately in accordance with other parts of this ETL and included within the MCACES estimate.

2.9 Life Cycle Cost Study Support.

2.9.1 LCCs encompass all costs associated with the product's life cycle. These include all costs involved in acquisition (research and development, design, production and construction, and phase-in), operation, support, and disposal of the product.

2.9.2 ER 1150-2-1150 and ER 1110-2-8159, Life Cycle Design and Performance and Civil Works Missions and Evaluation Procedures, require LCC analyses be performed to evaluate system alternatives. These analyses are the responsibility of the design team. The cost engineer may be required to support the analysis by providing cost input. As preparation to such responsibility, the cost engineer should be familiar with the LCC requirements in ER 1110-2-8159 and appendix E of ER 1105-2-100.

2.10 Estimates for Operation, Maintenance, Repair, Rehabilitation, and Replacement. This project phase is managed by operations division and is divided into two categories: major rehabilitation and all other work.

2.10.1 Major Rehabilitation. The development of major rehabilitation projects is based on an evaluation report, which is similar to a feasibility report in economic justification, evaluation of alternatives, and identification of a recommended plan. Cost estimates developed to evaluate alternatives considered in the report may be based on historical data. The cost estimate for the recommended plan shall be developed using MCACES and the CWWBS in the same format as a cost estimate for a feasibility report.

2.10.2 All Other Work. All Operation, Maintenance, Repair, Rehabilitation, and Replacement projects not meeting the criteria for major rehabilitation fall in this category. The recurring nature of these projects facilitates the development of a historical database. This historical data lends itself well to use in MCACES for development of the cost estimates for these projects. The cost estimate for the recommended plan shall be developed using MCACES and the CWWBS in the same format as a cost estimate for a feasibility report.

2.11 Estimates to Support Other Programs.

2.11.1 Continuing Authorities Program. Continuing Authorities Program projects are often limited in scope, and initial planning studies are usually limited in time. Cost estimate preparation should still follow the guidance within this ETL, developing the estimates to the greatest level of detail as possible related to scope (reference paragraph 2.1.3) and utilizing the latest approved version of MCACES. These estimates must fully support the report recommendations with accurate cost data documented with the appropriate narrative.

2.11.2 Dam Safety Assurance Program. As stated within paragraph 2.1.3, detailed estimating methods are to be employed as much as possible in relation to the known and assumed design scoping information. An MCACES estimate shall be developed for the recommended plan. The level of the cost detail will vary with the design information available to support the project scope but shall be at least to the subfeature level of detail. A higher level of detail is recommended where possible to achieve the greatest accuracy to confidently establish the BCE. Although this baseline estimate is not subject to reauthorization if the Section 902 limit (of the Water Resources Development Act of 1986) is exceeded, the goal is to make every effort to adhere to the criteria of the 20 percent growth limitation. A program estimate shall be reflected within a TPCS structure with the costs separated to the subfeature level of the CWWBS. The MCACES estimate shall be accompanied by a narrative summary for the recommended plan.

CHAPTER 3

Preparing Construction Cost Estimates

3.1 General.

3.1.1 This chapter applies to the construction estimates within the responsibility of the cost engineering office. In the normal sequence of events throughout the preparation of any estimate, it is important to understand basic principles and responsibilities. This includes an understanding of the scope of work, the acquisition plan, determining the quantities, types of feature level costs and CWWBS, the cost and pricing sources, cost development, and supporting documentation. Basic elements of each estimate consist of:

3.1.1.1 Descriptions of work elements (tasks) to be accomplished.

3.1.1.2 Quantity of work required for each task.

3.1.1.3 Unit cost for each task quantity.

3.1.2 A unit cost for each task is developed to increase the accuracy of the estimating procedure and should provide a reference comparison to historic experience. Lump sum unit cost and unit pricing when used at the task level is discouraged, but if used must be documented. As design scope evolves, those lump sum costs should then be better defined.

3.2 Planning the Estimate.

3.2.1 Project Scope. The cost engineer must thoroughly understand the project scope of work, the biddability, constructability, and operability of the project being estimated. The cost engineer must also review drawings, specifications, and construction sequences and durations to determine total construction costs. A site visit is strongly recommended to enable the cost engineer to relate the physical characteristics of the project to the available design parameters and details. This is particularly important on projects with unusual site conditions, major maintenance and repair projects, alteration/addition projects, environmental projects, and dredging projects. The construction sequence must be developed as soon as possible and should be used to provide a checklist of construction requirements throughout the cost estimating process. The overall format of major cost elements in an estimate should be compatible with current standards, management needs, the anticipated price/bid schedule, and the appropriate CWWBS.

3.2.2 Project Acquisition Plan. It is strongly advised that the project acquisition plan or strategy be determined early within the project planning. This is normally established by a management Corporate Board or Contract Acquisition Board. The planned acquisition can influence cost. Acquisition examples include a competitive bid, a small disadvantage business, a sole source negotiated procurement, a design-build project lacking complete design, a construction or services contract, etc. If no plan has been established, the estimator must make a major assumption, based on experience and consultation with the PDT, as to the likely acquisition plan. The estimate should document this major assumption.

3.2.3 Format and Supporting Documentation. The cost engineer must plan the structure of all tasks of each estimate so that the data is logical and traceable. The overall structure of the cost estimate should be in accordance with the appropriate CWWBS as described in chapter 2. The cost engineer shall always remain mindful of the documentation necessary to support the cost estimate submission requirements specified for each phase of project development, such as reconnaissance, feasibility, and IGE (refer to chapter 2). Support documentation includes a project narrative, construction schedule, plan of construction, plan of work (subcontracting), backup data, and drawings and sketches. In the case of IGEs and negotiated procurements, the estimate structure may have to be reformulated to reflect the bid schedule or to support a likely negotiation.

3.2.4 Identify Types of Feature Level Costs. Various types of cost elements must be evaluated in detail.

3.2.4.1 Total construction cost is the sum of all direct costs plus applicable indirect costs to reflect the total construction cost.

3.2.4.2 Non-construction costs of all other feature levels within the CWWBS, such as Lands and Damages, Planning Engineering and Design, and Construction Management may be added to the construction costs to determine the TPC as required by program specific requirements.

3.2.5 Degree of Estimate Detail

3.2.5.1 Construction Tasks. All cost estimates within the scope of this ETL will be prepared based on calculated quantities and unit prices that are commensurate with the degree of detail of the design known or assumed. This is accomplished by separating construction into its incremental parts. These parts are commonly referred to as construction tasks and are the line-by-line listings of every estimate. Each task is then defined and priced as accurately as possible. Construction tasks are seldom spelled out in the contract documents but are necessary to define the construction requirements and develop the construction cost. It is highly recommended that critical construction tasks reflect a standard unit price enabling historic and reasonable price comparisons.

3.2.5.2 Analyzing Construction Tasks. When analyzing construction tasks in an estimate, the cost engineer should identify the tasks that account for the major costs in the estimate. These tasks can be identified by applying the 80/20 rule (Pareto Principle), which states that approximately 80 percent of the project cost is contained in 20 percent of the tasks. Because these significant tasks account for most of the project cost, they should receive prime emphasis and effort in both preparation and review. This approach is generally applied in early budget estimates. As the scope evolves, a more detailed cost emphasis can then be placed on all project scope. The final estimate should capture all scope at a detailed level to support the independent estimate that is used for bidding purposes.

3.2.6 Most Detailed Estimate Level

3.2.6.1 At the most detailed level, each task is usually related to, and performed by a crew. The cost engineer develops or selects the task description by defining the type of effort or item to be constructed. Task descriptions should be as complete and accurate as possible to lend credibility to the estimate and aid in later review and analysis.

3.2.6.2 Whenever a significant amount of design assumptions are necessary, such as during the reconnaissance phase and in design-build process, the cost engineer should use historical cost data from previous similarly designed projects and/or use parametric estimating models.

3.2.6.3 Estimates should include notes that clarify the design, cost, crew, productivity, and unit price assumptions. It is important that the estimate demonstrate the basis of cost, the basic assumptions, and traceability for defense of the estimated costs.

3.3 Quantity Development.

3.3.1 The quantity "takeoff" is an important part of the cost estimate. It must be as accurate as possible and should be based on all available engineering and design data. Use of appropriate automation tools is highly recommended. Accuracy and completeness are critical factors in all cost estimates. An accurate and complete estimate establishes accountability and credibility of the cost engineer, therefore, providing greater confidence in the cost estimate. The estimate contingencies for programming purposes reflect the estimate confidence.

3.3.2 After the scope has been analyzed and broken down into construction tasks, each task must be quantified prior to pricing. Equal emphasis should be placed on both accurate quantity calculation and accurate pricing. Quantities should be shown in standard units of measure and should be consistent with design units. Assistance for preparing "takeoffs" may be provided by others within the organization in support of cost engineering or by A-E contracts; however, the responsibility for the accuracy of the quantities remains with the cost engineer. Distinction should be made between "hard-line" or "net" quantities without waste versus quantities that include waste or loss. This is necessary to ensure duplication does not occur within the estimate.

3.3.3 The detail to which the quantities are prepared for each task is dependent on the level of design detail. Quantity calculations beyond design details are often necessary to determine a reasonable price to complete the overall scope of work for the cost estimate. A simple example would be fabrication waste material that is a material cost to the project. Project notes will be added at the appropriate level in the estimate to explain the basis for the quantity calculations, to clearly show assumed quantity allowances or quantity contingencies, and to record quantities determined by cost engineering judgment that will be reconciled upon design refinement. Use the following recommended guidelines in quantity development:

- Coordinate the quantity takeoff process and plan with the lead estimator.
- Ensure full project scope is reflected within the estimate.
- Include a list of materials in quantity takeoffs.
- Utilize a process that easily records the quantity development, i.e., document source and date, estimator name and date, location within the project, demonstrated calculations, separation of hard quantities, and additions such as waste or loss.
- Use a systematic approach similar to the construction methodology required.
- Check scales and dimensions on each drawing sheet; dimensions govern.
- Highlight or mark drawing areas where quantities have been determined to ensure all scope is captured but not double counted.
- Consider items that have no material but still require cost, e.g., job office overhead (JOOH), task setup, training and certifications, and labor preparation.
- Develop quantities within a reasonable range for the work using decimals where critical.
- Add a certain amount of waste, loss, drop off, or length related to the material purchases for a bulk order. Ensure this addition is separate from the original quantity measured.
- Select a natural stopping point during work interruptions.
- Provide a QC check of high cost and volume items.
- Coordinate with designers if the design appears in error, is unbiddable, if a better approach is discovered, or a value engineering process is warranted.

3.4 Construction Unit Costs. Whenever possible, the cost engineer should obtain multiple pricing sources. In pricing from any source, experience and ability to relate data in hand to a specific circumstance is important. The following paragraphs discuss commonly used pricing sources and price development.

3.4.1 Cost Book

3.4.1.1 The Cost Book is the common name for the Tri-Services Automated Cost Engineering Systems construction direct costs database (see appendix C and https://www.hnd.usace.army.mil/TRACES/). Another common term of the Cost Book as related to the MCACES supporting databases is the Unit Price Book (UPB). In generic terms, “cost book” refers to any cost-related commercial books that depict direct costs in the fashion of labor, equipment, material, crew, and productivity. For the purposes within this ETL, the Cost Book is considered synonymous with the UPB. The Cost Book is organized in accordance with the Construction Specification Institute numbering system. Some Cost Book line items may include quotes for work that is fully provided and installed by a subcontractor. Each office may use the Cost Book as well as refine the database by obtaining quotes to more accurately reflect local costs at the project site.

3.4.1.2 Commercial unit cost books are common sources typically available through subscription or purchase. Basis of costs shown are typically explained along with adjustment methodology. Such publications are valuable for verification and appropriate for commercial type work item pricing. Caution is advised, however, since the costs are averages that may not reflect special applications for specific project scopes.

3.4.2 Historical Data. Historical costs from past similar work are excellent pricing sources as long as two criteria are met: adequate details of the basis for the historical costs must be known, and the historical costs must be adjusted to account for project specifics. When these two criteria are met, portions of other estimates having similar work can be retrieved and repriced to the current project rates. Such repricing includes adjustments for project location, work methodology, quantity of work, and other dissimilarities, which affect prices. Additionally, historical costs must be escalated on a constant dollar basis to the current estimate effective price level. Cost engineering automated systems enable the collection and analysis of historical costs. Automated historical databases are discussed in appendix C.

3.4.3 Parametric Database. Parametric Cost Engineering System is a parametric database of predefined-assemblies for buildings and site work (see appendix C). This is more commonly applied to military works; however, this can also be a useful tool in certain civil works estimates or portions of estimates.

3.4.4 Development of Unit Costs for Specific Tasks

3.4.4.1 When standard tasks from published price sources do not meet project needs, a unit cost for a specific task may need to be developed. Such development requires experience. Descriptions developed must adequately define the scope and requirement for each task. A unit cost for each task is developed as a direct cost (see chapter 4) with separate costing for labor, equipment, and material components, This is also true for certain unit prices related to the indirect costs (see chapter 5), usually found within the JOOHs. Notes, which explain key factors in the pricing, methodology, and assumptions, should accompany the task development. Comparison with existing pricing guides is recommended.

- Labor unit cost. This cost is based on a defined crew from the Cost Book or on a newly developed crew, which performs the tasks at an assigned production rate. Hourly wage rates for each craft are applied to the crew labor to arrive at the hourly crew labor cost. The total crew labor cost/hour is divided by the expected production rate (units/hour) to derive the labor cost per unit or "labor unit cost."
- Equipment unit cost. This cost is derived similar to labor unit cost. Hourly equipment rates are obtained from the appropriate regional pamphlet, Engineer Pamphlet (EP) 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, or developed according to the methodology as described in that pamphlet.
- Material unit cost. This cost is developed using vendor quotes, historical costs, commercial pricing sources, or component calculations. The price should include delivery to the project site.

3.4.4.2 The unit cost for each developed specific task is the sum of the direct cost elements for labor, equipment, and materials resulting in the direct cost per unit.

3.5 <u>Safeguarding Cost Estimates</u>. Project cost estimates should be safeguarded and handled in a discretionary manner. The estimates may contain proprietary information. Access to each estimate and its contents will be limited to those persons whose duties require knowledge of the estimate. Estimates prepared by contract will also be similarly handled. Any request by the public for information and pricing in the estimate will not be provided until coordination, verification of data, and approvals have been given by the commander or the responsible cost engineer.

CHAPTER 4

Direct Cost Development

4.1 General. Direct costs are those costs that can be attributed to a single task of construction work that are applied to the prime contractor's cost. These costs are usually associated with a construction labor crew performing a task, using specific equipment and materials, or subcontracted efforts for the respective task. Subcontracted costs shall be considered as direct costs to the prime contractor in estimates. Subcontracted costs include the direct costs, which the subcontractor would perform, plus the indirect costs the subcontractor would incur such as subcontractor markups.

4.2 Crews. Direct labor cost requirements are broken into tasks of work. Since each task is usually performed by a labor crew including equipment, the crew must be defined, costed, and a production rate established for the task. Crews may vary in size and mix of skills. The number and size of each crew should be based on such considerations as having sufficient workers to perform a task within the construction schedule and the limitation of workspace. Once the crews have been developed, the task labor costs can be determined based on the production rate of the crew and the labor wage rates.

4.3 Labor. Direct labor costs are defined as base wages plus labor cost additives including payroll taxes, fringe benefits, travel, and overtime allowances paid by the contractor for personnel who perform a specific construction task. In addition to the actual workers, there are generally working crew foremen, who receive an hourly wage and are considered part of the direct labor costs. Certain trades may require travel or subsistence, depending upon trade availability and duration.

4.3.1 Wage Rates

4.3.1.1 A wage rate must be developed for each labor craft, which will represent the total hourly cost rate to the construction contractor. This total rate will include the base wage rate plus labor overtime, payroll taxes and insurance, fringe benefits, and travel or subsistence costs as further described in this chapter. The composite wage rate for each craft will be used for development of the estimate. The computation can be prepared similar to forms found in appendix E.

4.3.1.2 Wage rates are generally well defined. The Davis-Bacon Act, PL 74-403, requires a contractor performing construction in the United States for the Government to pay not less than the prevailing rates set by the Department of Labor. Information on prevailing rates can be found at http://www.wdol.gov/. A schedule of minimum rates is included in the project specifications and is normally kept on file for each location by each local office of counsel. The cost engineer should consult with the contracting officer on any questions regarding determination coverage, specific definitions, or concerns. Where labor is in short supply for certain crafts in the area, the work is in a remote area, or it is well known that rates are higher than the set rate scale will be paid, these higher wage rates should be used instead of the minimum wage, since this would be required of the contractor in order to attract labor to the job. The wage rate should be adjusted to include travel time or night differential where these are a customary requirement.

4.3.1.3 For a long duration project, where future wage rates are known and used, care must be taken to avoid duplication by also applying an escalation rate to such costs.

4.3.2 Overtime and Shift Differential. The cost engineer should carefully consider the available working time in the construction schedule for each task accomplishment in a normal time period. The efficiency of both the second and third shifts should be adjusted to recognize that production will not be as high as the day shift for most types of construction operations. A three-shift operation should normally be avoided due to lower labor efficiency and the requirement to include equipment maintenance.

4.3.3 Overtime. Overtime should be included in the labor cost computation when work in excess of regular time is required by the construction schedule or is the custom of labor in the local vicinity. Overtime labor cost is normally calculated as a percentage of the base wage rate. It is usually based on time and one-half, but may be double time depending on the existing labor agreements. Tax and insurance costs are applied to overtime, but fringe benefits and travel and/or subsistence costs are not. Example 4-1 illustrates the overtime percentage calculation for 40 hours regular time, plus 8 hours overtime at time and one-half:

Example 4-1**:**

48 hours at straight time	= 48.00 hours
8 hours at ½ time	= 4.00 hours paid
Equivalent straight time	= 52.00 hours
(52 hrs paid/48 hrs worked = 8.33%	= 1.0833) -1 x 100%

Note: See example estimate sheets in appendix E for method of application.

4.3.3.1 Shift Operations. Many construction projects utilize multiple shift operations. When estimating direct labor costs for multiple shift operations, the cost engineer should estimate the number of hours to be worked (include shift differential work loss) and the number of hours to be paid for each shift based upon the developed construction schedule. Differential shift premiums may need to be added to the hourly rate.

4.3.3.2 Tabulation of Overtime Percentages. A tabulation of overtime percentages for most conditions is shown in table 4-1. The percentage also includes an allowance for the direct work loss of multiple shift or shift differential, where applicable.

Table 4-1. Overtime and Shift Differential

					Percentages for Overtime and Shift Differential		
	Actual Hours Worked		Hours Paid		1.5x Week/Sat 2x	1.5x Week 2x	Week 2x
Shift	Day	Week	Regular	Overtime	Sun	Sat/Sun	All Overtime
One-shift operation							
5-Day Week	8	40	40	0	0	0	0
	9	45	40	5	**5.56**	**5.56**	11.11
	10	50	40	10	10.00	10.00	20.00
	11	55	40	15	13.64	13.64	27.27
	12	60	40	20	**16.67**	**16.67**	33.33
6-Day Week	8	48	40	8	8.33	16.67	16.67
	9	54	70	14	12.96	**21.30**	25.93
	10	60	40	20	16.67	25.00	33.33
	11	66	40	26	19.70	28.03	39.39
	12	72	40	32	22.22	30.56	44.44
7-Day Week	8	56	40	16	21.43	28.57	28.57
	9	63	40	23	25.40	32.54	36.51
	10	70	40	30	28.57	35.71	42.86
	11	77	40	37	31.17	38.31	48.05
	12	84	40	44	33.33	40.68	52.38
Two-Shift Operation (one 8 hours and one 7.5 hours)							
5-Day Week	15.5	77.5	80	0	3.23	3.23	3.23
	18	90	80	12.5	9.72	9.72	16.67
	20	100	80	22.5	13.75	13.75	25.00
	22	110	80	32.5	17.05	17.05	31.82
	24	120	80	42.5	19.79	19.79	37.50
6-Day Week	15.5	93	80	16	11.83	20.43	20.43
	18	108	80	31	17.13	25.69	31.48
	20	120	80	43	20.42	28.96	38.33
	22	132	80	55	23.11	31.63	43.94
	24	144	80	67	25.35	33.85	48.61

					Percentages for Overtime and Shift Differential		
	Actual Hours Worked		Hours Paid		1.5x Week/Sat 2x	1.5x Week 2x	Week 2x
Shift	Day	Week	Regular	Overtime	Sun	Sat/Sun	All Overtime
7-Day Week	15.5	108.5	80	32.0	25.35	32.72	32.72
	18	126	80	49.5	29.76	37.10	42.06
	20	140	80	63.5	32.50	39.82	47.86
	22	154	80	77.5	34.74	42.05	52.60
	24	168	80	91.5	36.61	43.90	56.55
Two-Shift Operation (each 7.5 hours)							
5-Day Week	15	75	80	0	6.67	6.67	6.67
	18	90	80	15	13.89	13.89	22.22
	20	100	80	25	17.50	17.50	30.00
	22	110	80	35	20.45	20.45	36.36
	24	120	80	45	22.92	22.92	41.67
6-Day Week	15	90	80	16	15.56	24.44	24.44
	18	108	80	34	21.30	30.09	37.04
	20	120	80	46	24.17	32.92	43.33
	22	132	80	58	26.52	35.23	48.48
	24	144	80	70	28.47	37.15	52.28
7-Day Week	15	105	80	32	29.52	37.14	37.14
	18	126	80	53	34.13	41.67	47.62
	20	140	80	67	**36.43**	43.93	52.86
	22	154	80	81	38.31	45.78	57.14
	24	168	80	95	39.88	**47.32**	60.71
Three-Shift Operation							
5-Day Week	22.5	112.5	120	0	6.67	6.67	6.67
6-Day Week	22.5	135.0	120	24	15.56	24.44	24.44
7-Day Week	22.5	157.5	120	48	29.52	37.14	37.14

4.3.4 Taxes and Insurance

4.3.4.1 Rates. Rates for all taxes and insurance applied to labor should be verified prior to computation. Insurances may include costs applied to longshoreman work near water, diving work, etc. Local unions can be a source of information for these peculiar insurance applications.

4.3.4.2 Workman's Compensation. Workman's compensation and employer's liability insurance costs applicable for the state in which the work is performed should be included in the composite wage rate. Insurance rates may be obtained from the state if the state law provides a monopoly or from insurance companies providing this type insurance. The project compensation rate is based on the classification of the major construction work and applies to all crafts employed by the contractor. Typically, the actual rate that a contractor will pay is also adjusted annually based upon the company safety record and the number of claims submitted.

4.3.4.3 Unemployment Compensation Taxes. Unemployment compensation taxes are composed of both state and Federal taxes. Unemployment compensation tax will vary with each state while the Federal unemployment tax will be constant for all projects. Insurance rates can be obtained from the state unemployment office, commercial publications, or the Bureau of Labor Statistics.

4.3.4.4 Social Security Tax Rates. The social security tax rates and the income ceilings on which social security taxes must be paid vary from year to year. Therefore, the cost engineer must verify the rate to be used in the cost estimate. Current and future rates can be obtained from the Social Security Administration.

4.3.4.5 Total Percentage of Taxes and Insurance. The total percentage of the above taxes and insurance is summed and then applied to the basic hourly wage rate plus overtime for the various crafts. Example 4-2 illustrates the method for deriving the total tax and insurance percentage. Since rates are subject to change and in some cases vary by region, the calculations shown are presented as an example only. Actual values must be determined by the cost engineer for the specific project.

Example 4-2:

Workman's compensation and employer's liability

(varies with state and contractor) 7.60%

State unemployment compensation

(varies with each state) 3.20%

Federal unemployment compensation 0.80%

Social Security & Medicaid 7.65%

Total taxes and insurance 19.25%

Note: Foreman and overhead labor rates must also include these applicable costs. See example estimate sheets in appendix E for method of application.

4.3.5 Fringe Benefits and Travel/Subsistence

4.3.5.1 Fringe benefits may include health and welfare, pension, and apprentice training depending on the craft and the location of the work. These summed costs are usually expressed as an hourly cost with the possible exception of vacation, which may be easily converted to an hourly cost. The type of fringe and the amount for the various crafts can usually be found with the Davis-Bacon Act wage determination in the specifications. Non-union contractors pay comparable fringe benefits directly to their employees.

4.3.5.2 Example 4-3 illustrates the calculations for fringe benefits. Since the values change and vary by region and union agreement, the calculations shown are presented as an example only. Actual values must be determined by the cost engineer.

Example 4-3

Health and welfare	$0.70/hr
Pension	0.75/hr
Apprentice training	0.00/hr
(N/A in this case)	
Total fringe benefits	$1.45/hr

4.3.5.3 Travel and subsistence costs are normally expressed as a daily or weekly cost. When included in the cost estimate, they should be converted to an hourly cost and excluded from an overtime premium unless travel and subsistence are part of an increased hourly wage. See example estimates in appendix E for methodology.

4.3.5.4 Some fringe benefits and travel/subsistence are subject to payroll taxes. For example, vacation benefits are taxable and should be added to the basic wage rate.

4.4 Labor Productivity.

4.4.1 General. Estimating labor productivity is subject to many diverse and unpredictable factors. There is no substitution for the knowledge and experience of the cost engineer when estimating labor productivity. For some types of work, the task productivity of crewmembers such as equipment operators, helpers, or oilers is determined by the productivity of the equipment. For some labor-based crews, the task productivity of craftsman, such as carpenters, steel workers, and masons, may be based on average experience in the Cost Book, tempered with the experience of the cost engineer, historical records, or other appropriate reference manuals.

4.4.2 Productivity Adjustment Considerations

4.4.2.1 Labor Effort. The labor effort needed to perform a particular task varies with many factors, such as the relative experience, capability and morale of the workers, the size and complexity of the job, the climatic and topographic conditions, the degree of mechanization, the quality of job supervision, amount of similar task repetition, and the existing labor-management agreements and/or trade practices. The effort from these labor efficiency factors and work practices that exist in the project locality must be considered in each productivity assignment.

4.4.2.2 Civil works projects are normally heavy equipment oriented, and care should be used based on the tasks performed to ensure reasonable production rates are used. Operational requirements for pumping on dredges are unique and appropriate details are covered in appendix D for preparing dredge estimates.

4.4.2.3 Complexity of the Variable. The complexity of the variables affecting productivity makes it difficult to estimate a production rate. Therefore, production rates should be based on averaging past production rates for the same or similar work. The cost engineer must incorporate particular job factors and conditions to adjust historical data to the project being estimated. Other sources for production rates include reference manuals, field office reports, construction logbooks, and observation of ongoing construction.

4.4.2.4 Long Periods of Overtime. It is widely accepted that protracted overtime can result in lost productivity. The effect on worker productivity from long periods of overtime is shown in figure 4-1. Several tables and averaging charts have also been developed by private industry to show this effect. There are certain projects where multiple shifts are not possible due to environmental or public concerns. There are also certain large projects where overtime may be an advantage regarding schedule needs and the project appeals to industry for bidding competition. Many skilled trades prefer and seek projects promising overtime as a means of increasing their income. Relating to a specific project, the cost engineer should carefully consider other alternatives such as schedule duration change instead of overtime or multiple shift work and discuss the impact of these options with the PDT.

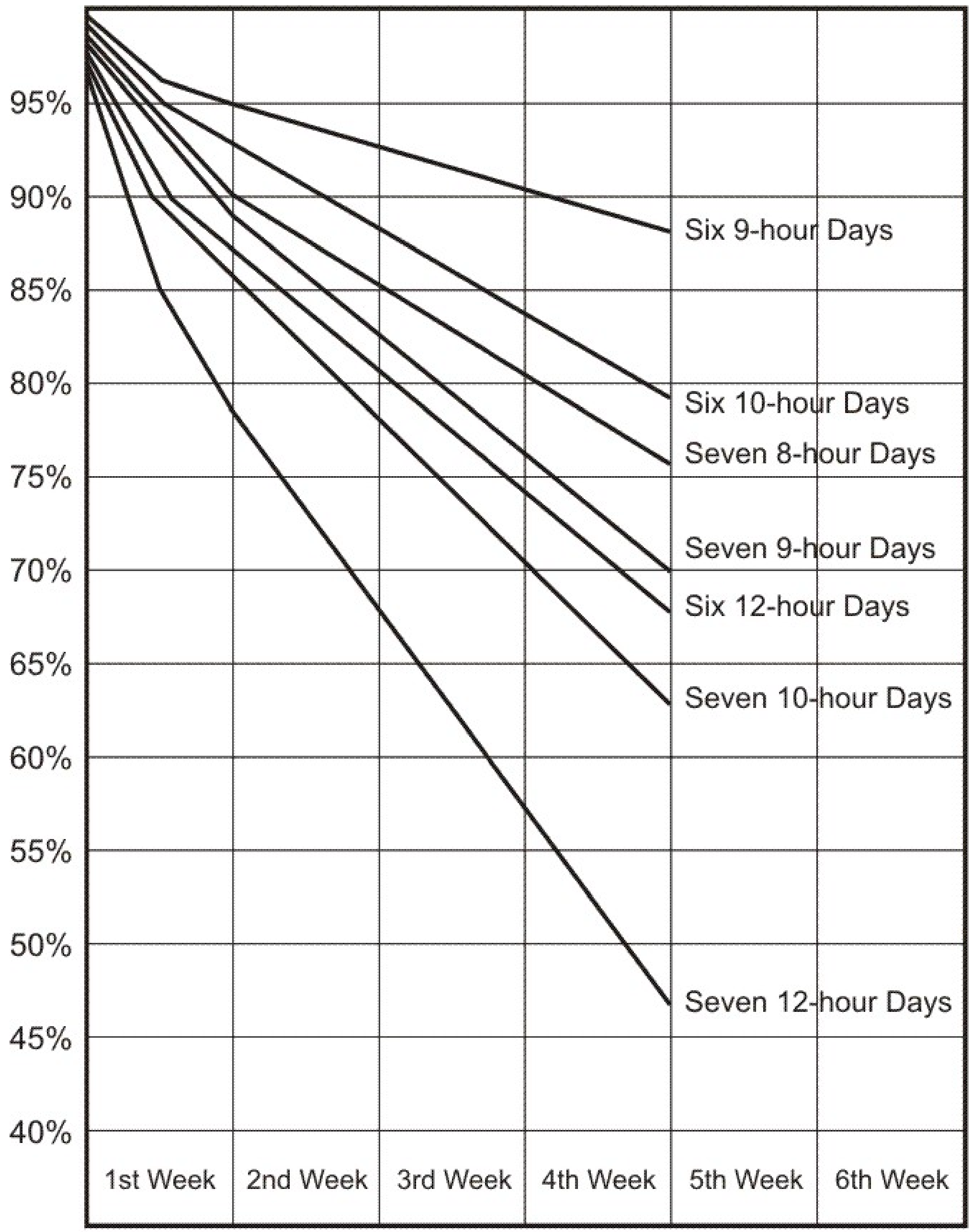


Figure 4-1. Effects on Worker Productivity from Long Periods of Overtime

4.5 Construction Equipment and Plant. Construction equipment and plant refers to the tools, instruments, machinery, and other mechanical implements required in the performance of construction work. Construction plant is defined as concrete batch plants, aggregate processing plants, conveying systems, and any other processing plants, which are erected in place at the job site and are essentially stationary or fixed in place. Equipment is defined as items, which are portable or mobile, ranging from small hand tools through tractors, cranes, and trucks. For estimating purposes, plant and equipment are grouped together as equipment costs.

4.5.1 Selection of Equipment

4.5.1.1 An important consideration in the preparation of an estimate is the selection of the proper equipment to perform the required tasks. The cost engineer should carefully consider number, size, and function of equipment to arrive at optimum equipment usage. Some factors to consider during the selection process are:

- Conformance to specification requirements.
- Job progress schedule (production rate).
- Magnitude of the job; type of materials.
- Availability of space and site access.
- Mobility and availability of equipment.
- Suitability of equipment for other uses.
- Onsite batch or production plants.
- Equipment capabilities.
- Loading and unloading of freight.
- Number of shifts.
- Distances material must be moved.
- Steepness and direction of grades.
- Weather conditions.
- Hauling restrictions.
- Standby time.
- Mobilization and demobilization costs.

4.5.1.2 The cost engineer preparing the estimate must be familiar with construction equipment and job-site conditions. The equipment selected should conform to contract requirements and be suitable for the materials to be handled and conditions that will exist on the project. A good source of information to assist in earthwork equipment choices is Field Manual 5-434, Earthmoving Operations.

4.5.2 Equipment Productivity

4.5.2.1 The "crew concept" for project cost estimates requiring detailed estimating is to also be considered in costing equipment. For each significant work task, workers and equipment are expressed in the hourly cost and expected production rate. Where a major piece of equipment serves more than one crew, the total equipment time should be prorated between both crews.

4.5.2.2 After determining the type of equipment to be employed, the cost engineer should select the specific equipment size that has a production rate suited to the efficient and economical performance of the work. The size and number of units required will be influenced by equipment production rate, job size, availability of space for equipment operations, the project construction schedule for the various work tasks, number of shifts to be worked, and the availability of equipment operators. Emphasis must be placed on the importance of establishing a reasonable production rate. Production may be based on actual performance data, commercial manufacturer tables, or rates from MCACES historical equipment models and assemblies, or adjusted for project conditions. A certain level of standby costs may be necessary if the equipment chosen is used on a part-time basis, remaining dormant without operator attendance for a significant period of the operation.

4.5.3 Mobilization and Demobilization

4.5.3.1 Mobilization costs for equipment include the cost of loading at the contractor's yard, transportation cost from the yard to the construction site, including permits, unloading at the site, necessary assembly and testing, and standby costs during mobilization and demobilization. Trucks for the project capable of highway movement are usually driven to the site and are often used to transport minor items. All labor, equipment, and supply costs required to mobilize the equipment should also be included in the mobilization cost. When the equipment location is unknown, the mobilization and demobilization distance should be based on a circular area around the project site, which will include a reasonable number of qualified bidders. Demobilization costs should be based on that portion of the equipment that would be expected to be returned to the contractor's storage yard and may be expressed as a percentage of mobilization costs. All labor, equipment, and supply costs required for cleaning/prepping the equipment so that it is in the same condition as it was when it arrived at the site should also be included in the demobilization cost. Transporting rates should be obtained periodically from qualified firms normally engaged in that type work.

4.5.3.2 Mobilization and demobilization costs for plant should be based on the delivered cost of the item, plus erection, taxes, and dismantling costs minus salvage value at the end of the project. Maintenance and repair are operating costs and should be distributed throughout work accomplishment.

4.5.4 Equipment Ownership and Operating Expense Cost Rates

4.5.4.1 The EP 1110-1-8 establishes the methodology for calculating hourly rates for equipment ownership and operating expense. Similar methodology and hourly rates can be found in the Cost Book and used in the preparation of cost estimates for owned equipment. The EP 1110-1-8, volumes 1 through 12, has been developed for different geographic regions in the United States, and the appropriate volume or Cost Book should be used based upon project location. Rented and leased equipment is appropriate for inclusion in the estimate at competitive rates if judgment determines this to be a reasonable approach by a prudent contractor. The cost engineer may also use current commercially available publications for assistance in determining rates.

4.5.4.2 When the cost engineer develops costs for the actual equipment being used at a job site exceeding 40 hours per week, the rates shall be adjusted as described by EP 1110-1-8.

4.5.5 Plant Cost. In cases of highly specialized plant, 100 percent write off of the total value of the plant may be justified for a particular project. For less highly specialized plant, some salvage may be anticipated, depending on storage cost, resale value, and probability of sale or reuse in the immediate future. The total project charge including operation, maintenance, and repair should be distributed in proportion to the time and item the plant is used on the various contract items. Cost of plant required for the production of concrete, aggregates, ice or heat for cooling or heating of concrete, etc., should normally be included in the estimate as part of the cost of these materials or supplies manufactured or produced at the site.

4.5.6 Small Tools. The cost of small power and hand tools and miscellaneous non-capitalized equipment and supplies may be estimated as a percentage of the labor cost. The allowance must be determined by the cost engineer in each case, based upon experience for the type of work involved. The small tool cost will be considered as part of equipment cost. Such allowance can range typically up to 12 percent of direct labor cost. Another acceptable approach is to apply an actual small tools cost within the respective crew where it is applicable. The cost engineer must ensure that this cost is not duplicated in the overhead rate percentages. The crew's database in the Cost Book does not contain a small tools allowance.

4.6 Materials and Supplies. Materials and supplies are defined below and, for the purpose of estimating, both can be considered materials unless they need to be separated because of different tax rates. Materials are physically incorporated into and become part of the permanent structure. Supplies are items used in construction but do not become physically incorporated into the project such as concrete forms, welding rod, etc.

4.6.1 Sources of Pricing Data. Prices for materials and supplies may be obtained from pricing services, the Cost Book, commercial cost books, catalogs, quotations, and historical data records. Each office should review the source of the pricing contained in these publications and assess the reasonableness prior to use. Standard unit prices from these sources are considered satisfactory only after an applicability determination has been made. Care should be taken when using this type of cost data to make proper allowances for quantity discounts, inflation, and other factors affecting contractor cost.

4.6.2 Waste Allowance. Waste and loss considerations may be included in material unit price computations. This methodology when computing material costs results in a quantity takeoff of work placement, which is not altered to reflect material losses. However, the alternative methodology of increasing the measured quantity by waste and loss quantity is acceptable if the excess quantity will not be used for any other purpose. If quantities are provided by others, it must be determined whether those quantities include waste or loss to avoid a double counting. The methodology used by the cost engineer should not include charging labor on the excess quantity. In either case, a note statement is required in the estimate explaining the methodology used.

4.6.3 Quotes from Manufacturers and Suppliers. Quotes should be obtained for all significant materials and installed equipment and for specialized or not readily available items. Quotations may be received either in writing or telephonically. It is preferable to obtain quotes for each project to ensure that the cost is current and that the item meets specifications. If possible, more than one quote should be obtained to be reasonably sure the prices are competitive. The cost engineer should attempt to determine and ensure that contractor discounts are considered in the estimate. The cost engineer should ascertain whether the quote includes delivery and sales tax. Quotes should be kept proprietary to preserve the confidentiality entrusted. A sample telephone quotation data sheet similar to that shown in appendix E, figure E-5, should be utilized for recording quoted information. The cost engineer should also take into consideration FAR Subpart 25.2, *Buy* American Act-Construction Materials, and FAR Subpart 6.1, Full and Open Competition, for the materials specified.

4.6.3.1 Forward Pricing. Sometimes quotes are requested in advance of the expected purchase date. However, suppliers are reluctant to guarantee future prices and often will only quote current prices. It may, therefore, be necessary to adjust current prices to reflect the cost expected at the actual purchase date. This cost adjustment, if required, must not be included as a contingency but should be clearly and separately defined in each estimate. Adjust current pricing to future pricing using escalation factors. This is applicable when there will be an extended construction period. Computations of adjustment should be clear and should be maintained as cost estimate backup support.

4.6.3.2 Freight. The cost engineer should check the basis for the price quotes to determine if they include delivery. If they do not include delivery, freight costs to the project site must be determined and included. The supplier can usually furnish an approximate delivery cost. For delivery charge, Free on Board (FOB) refers to the point to which the seller will deliver goods without additional charge to the buyer.

- FOB Factory or Warehouse - if the materials or supplies are FOB factory or warehouse, freight costs to the construction site should be added to the cost of the materials or supplies.
- Unloading and Transporting Materials or Supplies - if the cost of materials or supplies includes partial delivery, FOB to the nearest rail station, the cost of unloading and transporting the materials or supplies should be included in the estimate.

4.6.4 Handling and Storage

4.6.4.1 If the materials or supplies are a large quantity in bulk that would require extensive equipment for unloading and hauling, it may be desirable to prepare a labor and equipment estimate for the material handling and delivery.

4.6.4.2 The contractor is usually required to offload, handle, and stockpile or warehouse materials on site. These costs should be included in the estimate. An item of electronic equipment requiring special low-humidity storage might have this special cost added to the direct cost of the equipment. For common items, such as construction materials or equipment needing secure storage, the cost for the security fencing, temporary building, and material handling should be considered as an indirect cost and be included in the job site overhead cost.

4.6.5 Taxes. When applicable, state and local sales tax should be added to the materials or supplies cost. In some states, material incorporated into Federal construction is exempt, but supplies are not. Care should be taken, therefore, that the sales tax rate is applied as required. The cost engineer should verify the tax rates and the applicability of these rates for the project location. Sales tax is considered a direct cost of the materials and supplies and should be applied to Government-furnished equipment and included in the estimate. In certain projects that are on the dividing line between states, such as roads, bridges, and dams, tax application may vary for the same material.

4.6.6 Materials or Supplies Manufactured or Produced at Site. If it is likely the contractor will manufacture or produce materials or supplies at the project site, a separate estimate component should be developed for this work. This estimate should be detailed and include all equipment, labor, materials, and supplies to produce the product and should conclude with a unit cost of material or supplies delivered to the stockpile, storage yard, or other end point.

4.6.7 Government-Furnished Materials or Equipment. On some projects, the Government may provide some of the project materials. Government-furnished materials and equipment should be estimated in the same manner as other materials, except that the purchase price is not included. The estimate should include an allowance for transporting handling, storage from point of delivery and assembly, sales tax, and installation if applicable. There may be special costs associated with Government-furnished materials such as insurance to cover loss until final installation, special storage costs, or special security measures. Note that these materials and procurement costs are normally to be included as part of the TPC.

4.7 Subcontracted Work.

4.7.1 In construction, specialty items such as plumbing, heating, electrical, roofing, and architectural finishes are usually more effectively performed by subcontract. With so many specialties being performed, subcontract work becomes a very significant portion of the total costs of construction. Since each estimate should be prepared as practically and as realistically as possible, subcontract costs become a necessary consideration.

4.7.2 On major rehabilitation projects, such as dams, locks, or power generating facilities, the cost engineer must ensure that costs for mobilization and demobilization, access to site, tear down or demolition work, and contractor markup are included with the subcontractor costs or added to the prime contractor. This is particularly important for rebuilt or replacement of permanent equipment (e.g., turbines, generators, and navigation lock gates) for previously constructed projects where ancillary costs, in addition to the rebuilt costs, can be significant (e.g., exceed $1 million).

4.7.2.1 Parts of Work to be Subcontracted. The cost engineer must first determine those parts of the work that will probably be subcontracted. When the work to be subcontracted has been determined, those items will be identified in the estimate. The appropriate subcontractor overhead and profit costs should be applied to subcontractor direct cost items in addition to the appropriate prime contractor overhead and profit.

4.7.2.2 Cost of Subcontracted Work. The cost of subcontracted work is the total cost to the prime contractor for the work performed. Subcontractor's costs include direct labor, materials and supplies, equipment, second tier subcontracts, mobilization and demobilization, transportation, setup, and charges for overhead and profit. Particular attention should be given to large items such as turbines, generators, and incinerators. The total subcontract cost is considered a direct cost to the prime contractor.

4.7.2.3 Use of Quotations. While not the preferred method, the cost engineer may utilize quotes for the expected subcontracted work when reviewed and verified as reasonable. This is more acceptable if the subcontracted work is not considered a major task in the estimate and not intended for use as an IGE where the IGE independence may be compromised Verification is normally established by obtaining several quotes or by developing a rough order estimate or by making comparison with historical or parametric data. In lieu of a quotation, each task of the subcontract should be priced as a direct cost with an appropriate rate of subcontractor's overhead and profit added.

CHAPTER 5

Indirect Costs

5.1 General. Indirect costs are those costs, which cannot be attributed to a single task of construction work. These costs include the prime contractor markups such as overhead, profit, bond, and certain taxes. Indirect costs are also referred to as distributed costs. The following discussions present the indirect costs in the order they are applied within the prime contractor markup structure. This is critical, because the values typically are compounded rates applied against the previous rates.

5.2 Overhead Costs.

5.2.1 Overhead costs are those costs that cannot be attributed to a single task of construction work. Costs, which can be applied to a particular item of work, should be considered a direct cost to that item and are not to be included in overhead costs.

5.2.2 For large civil works projects, the various tasks for overhead should be developed for each project rather than using flat overhead percentage rates. Flat rates may be used during the preliminary studies or when alternatives must be prepared if design is limited or not available.

5.2.3 The overhead costs are customarily divided into two categories:

5.2.3.1 JOOH also referred to as general conditions or field office overhead.

5.2.3.2 General home office overhead commonly referred to as general and administrative (G&A) costs or home office overhead (HOOH).

5.2.4 Duplication of Overhead Costs. The cost engineer must be sure that overhead costs are not duplicated between the two categories. Because of the nature of overhead costs, it is not practical to discuss all overhead items. Specific considerations must be carefully evaluated for each project. The cost engineer must use considerable care and judgment in estimating overhead costs. Many indirect cost items are frequently described in the General Requirements Section (Construction Specification Institute Division 01) of the contract specifications. If not related to a specific work task, these costs must be identified and appropriately assigned as overhead costs.

5.2.5 Previously Determined Overhead Rates. The application of a previously determined overhead rate for either category may be used for early project phases, but it is not an accurate or reliable method of forecasting costs. Overheads will vary from project to project and may even vary from month to month within any given project.

JOOH items for the prime contractor should be estimated in detail for all IGEs. Detailing of JOOH costs for subcontract work is recommended when the impact of these costs is significant.

5.2.6 Job Office Overhead. JOOH costs are those costs at the project site that occur specifically as a result of the particular project. In early estimate stages, a percentage near 5 percent is acceptable; however, from feasibility level forward, a detailed estimate should be developed. Table 5-1 provides general descriptions of typical costs encountered and appendix J is a template listing more detail; however, each project should be considered on its own merit.

Table 5-1. Job Office Overhead Costs

ADMINISTRATION JOB OFFICE
Includes all field administrating, accounting, purchasing, inventory, and security personnel and expenses. Also, consider subsistence and travel, offices, vehicles, supplies, and miscellaneous items to run the field office. Subsistence amounts may vary depending upon seniority and job classification.
WAREHOUSE AND MATERIALS HANDLING
Includes all field warehouses, stockyards, personnel, and equipment to handle, receive, unload, store, and transport materials around the project site. Also, consider subsistence and travel, vehicles, supplies, and miscellaneous cost items.
ENGINEERING AND SURVEYING
Includes all engineering, drafting, submittals, scheduling, surveying, and change order personnel. Also, consider subsistence and travel, vehicles, miscellaneous computer expenses, shop drawings, submittals and Critical Path Method schedules, operation and maintenance manuals, and miscellaneous cost items. **Note:** Personnel costs and supplies may cover submittal development and required contract document costs.
QUALITY CONTROL AND TESTING
Includes personnel, vehicles, equipment, and supplies to produce all QC reports, QC inspections, and all other contract quality requirements. Also, consider subsistence and travel, vehicles, supplies, and miscellaneous cost items. **Note:** Personnel costs and supplies may cover submittal development and required contract document costs.
SAFETY, TRAFFIC CONTROL, FIRST AID, AND FIRE
Includes all personnel, supplies, and vehicles needed for safety, traffic control, first aid, safety training, and fire prevention. Also, consider subsistence and travel, vehicles, supplies, and miscellaneous cost items. **Note:** Personnel costs and supplies may cover submittal and required contract document costs.

SANITATION FACILITIES AND TEMPORARY BUILDINGS
Includes all sanitation facilities miscellaneous, buildings, yards, and building costs not otherwise classified. This grouping does not include all project utilities costs.
GENERAL EQUIPMENT EXPENSES
Includes equipment not required by specific work items. Also, consider testing and rental of equipment when not charged to a specific bid item or items of work. Inspection fees and permits are included in mobilization and demobilization items.
PROJECT UTILITIES SITE AND CLEANUP
Includes all project costs not otherwise classified.
WINTERIZE PROJECT
Includes all items needed for a winter shutdown of the project or for construction activities during the winter months.
CAMP FACILITIES, WORKER SUBSISTENCE, AND TRAVEL
Includes costs to operate a camp to support construction workers. If no camp is furnished and subsistence is not included in the worker's hourly wage, show the number of subsistence days and daily cost. However, it is preferred to include subsistence with the hourly wage. Also, consider kitchens, camp vehicles, supplies, and miscellaneous items.
INSURANCE, INTEREST, PERMITS, AND FEES
Includes insurance costs, permits, and fees required by the contract. Business and occupation taxes, tribal taxes, and bid bond cost are not included in the JOOH but are included in other indirect cost markups.
MOBILIZATION AND PREPARATORY WORK (Optional)
Includes all items needed for the contractor mobilization and site preparatory work. Also, consider trucks, trailers, pilot cars, inspection fees, highway permits, loading, unloading, equipment standby and setup, and surveys. *USE ONLY if the project does NOT have a mobilization bid item.*
DEMOBILIZATION WORK (Optional)
Includes all items needed for contractor's demobilization from the project site and halfway to another project. Also, consider trucks, trailers, pilot cars, inspection fees, highway permits, loading, unloading, equipment standby, and take down. *USE ONLY if the project does NOT have a demobilization bid item.*
GOVERNMENT INSPECTION COSTS (In Alaska only)
Includes all items needed to keep Government Inspectors on site excluding salary.

5.2.7 General Home Office Overhead

5.2.7.1 G&A expenses are those incurred by the contractor in the overall management of business associated with all costs at the home office. These overhead expenses are not incurred for any one specific project and must be apportioned to all the contractor’s projects.

5.2.7.2 Many expenses such as interest and entertainment are not allowable. Construction equipment depreciation is included in the EP 1110-1-8 cost rates and should not be included in the G&A rate. An accurate percentage of G&A can only be determined by an audit. On major changes requiring an audit, it is important to request that the G&A rate be determined through the contracting officer.

5.2.7.3 Of all the categories of costs, the contractor's G&A costs are the least definable. Each contractor organizes his company differently from any other. Each incurs costs differently from varying sources and manages operations of that home office by their own methodology. There may be more than one home office employed. It is important to understand that home office costs are not standard and fixed. Even though the cost for a specific contractor varies from period to period, a rate is normally averaged as a computation of total home office costs over a sufficient period divided by the total volume of business during that specific period. This rate computation methodology allows distribution and projection to future project estimates. When more specific data is not available, the cost engineer may include empirical rates. Home office costs are typically included in the estimate of overhead as the product of an average experienced percentage rate times the expected contract amount. Typical categories of HOOH are:

- Main office building, furniture, equipment, etc.
- Fabrication shop and yard.
- Management and office staff salary and expense.
- Main office utilities.
- General communications and travel.
- Main office supplies.
- Corporate vehicles.
- General business insurance.
- Taxes.

5.2.8 Duration of Overhead Items. After the overhead items have been listed, a cost must be determined for each. Each item should be evaluated separately. Some items such as erection of the project office may occur only once in the project. The cost engineer should utilize the developed job schedule in estimating duration requirements. Costs reflective of each particular item during the scheduled period should then be applied. The product of duration and unit cost is the overhead cost for the item. In the case of construction modifications, overhead should be re-addressed as related to the cost items and durations in the original contract.

5.2.9 Sources for Pricing. The cost engineer must rely on judgment, historical data, and current labor market conditions to establish overhead costs. Sources for information can be obtained from current or past contractor’s bid data and audits. Other sources include previously negotiated modifications and review of organizational charts of construction firms for staffing and overhead costs evaluation. Overhead salaries should include an allowance for payroll taxes and fringes such as Federal Insurance Contributions Act, health benefits, and vacation.

5.2.10 Distribution of Overhead. The prime contractor's overhead costs, which have been costed in an organized format, should be summed and distributed to the various bid items. A proportionate distribution is commonly made by percentage ratio of total direct costs to those direct costs in each item. When additive, option, or split-bid items are included, only those overhead costs that relate directly to the additive work should be distributed to those additive items. Those overhead costs, which the contractor will incur regardless of additive or deductive items, should be distributed to base bid schedule items only. Selective distribution ensures recoupment of costs if only the basic contract scope is awarded. Regardless of the method of distribution, the estimates should clearly demonstrate the procedures and cost principles applied. As a refinement to distribution, the cost engineer may reasonably and justifiably reduce the prime overhead distribution on subcontract work items. The balance of the total prime overhead should then be distributed as discussed above to the remaining prime items of work. For modification estimates, overhead requirements should be itemized and costed to reflect the actual net change in cost of overhead, i.e., costs before and after the modification work.

5.3 Profit.

5.3.1 Profit is defined as a return on investment. It is what provides the contractor with an incentive to perform the work as efficiently as possible. The proper approach to use will depend on the type of contractual acquisition action and the supplemental regulations that apply to the type of contract activity. For example, A-E contracting profit is calculated differently than construction profit. Refer to FAR, Subpart 15.404-4, prescribing the use of a structured approach for determining the profit or fee objective for construction projects. Consultation may be in order with the contracting officer in regards to profit application for various procurement actions.

5.3.2 The DFAR, Subpart 215.404-4, prescribes three structured approaches for determining a profit or fee objective on any negotiated contract action (with exceptions); the weighted guidelines method, the modified weighted guidelines method, and an alternate structured approach. Generally ,the latter two are for contract actions with nonprofit organizations and A-E respectively. Construction cost estimating shall use the weighted guideline method and is discussed further in this chapter.

5.3.3 Prime contractor profit is not included in civil works IGEs prepared for contract award. However, prime contractor profit is included in all estimates prepared for programming of funds for projects and for contract modifications. Profit may be included for projects funded by non-Federal users in work for others.

5.3.3.1 Weighted Guidelines Method. The weighted guidelines method yields a reasonable profit value and should be used to determine profit for all contracts that include profit. Since contract modifications are considered contracts, this rule still applies. This methodology should also be used wherever a detailed direct costing method is used for preparing construction estimates. A rate of profit may be used based on historical experience for reconnaissance or comparative estimates for alternative analysis during feasibility studies.

5.3.3.2 Weighted Guideline Factors. Based on the circumstances of each procurement action, each of the factors listed in table 5-2 will be weighted from 0.03 to 0.12 as discussed in the following text and provided in figure 5-1. Statements in sufficient detail to explain the reasons for assigning the specific weights shall be included on the profit computation sheet. The value will then be obtained by multiplying the rate column by the weight column. The value column when totaled indicates the fair and reasonable profit percentage.

- Degree of risk. Where the work involves no risk or the degree of risk is very small, the weighting should be 0.03; as the degree of risk increases, the weighting should be increased up to a maximum of 0.12. Lump sum items will have, generally, a higher weighted value than unit price items for which quantities are provided. Other things to consider include the nature of work; where the work is to be performed; the reasonableness of negotiated costs; the amount of labor included in the costs; and whether the negotiation occurs before or after the period of performance of work.
- Relative difficulty of work. If the work is difficult and complex, the weighting should be 0.12 and should be proportionately reduced to 0.03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider include technical nature of the work by whom work is to be done; location of work; and time schedule.
- Size of the job. Work not in excess of $100,000 will be weighted at 0.12. Work estimated between $100,000 and $5,000,000 will be proportionately weighted from 0.12 to 0.05. Work from $5,000,000 to $10,000,000 shall be weighted at 0.04 and work in excess of $10,000,000 at 0.03.
- Period of performance. Jobs in excess of 24 months are to be weighted at 0.12. Jobs of lesser duration are to be proportionately weighted to a minimum

of 0.03 for jobs not to exceed 30 days. No weight is given for modification estimates when additional performance time is not required.

- Contractor's investment. Jobs are to be weighted from 0.03 to 0.12 on the basis of below average, average to above average of contractor investment. Things to consider include amount of subcontracting; mobilization payment item; Government-furnished property; method of making progress payments; and front-end requirements of the job.
- Assistance by Government. Jobs are to be weighted from 0.12 to 0.03 on the basis of below average to above average. Things to consider include use of Government-owned property, equipment and facilities, and expediting assistance.
- Subcontracting. Jobs are to be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be 0.03 and such weighting proportionately increased to 0.12 where all work is performed by the contractor's own forces.

5.3.4 Separate Profit Calculation. A separate profit calculation should be performed for the prime contractor and for each subcontractor. When the subcontractor assumes the risk and responsibility for significant portions of the work, the prime contractor's profit rate on that work should be decreased. As a general rule, profit is applied as a percentage rate to the total of all costs required by the contract or modification scope. For early design stage estimates, a rate of profit may be assumed based on past experience.

Weighted Guidelines Profit Sheet

Project:		Estimated By:	
Contract No:		Checked By:	
Change Order No.:		Date	9/14/05

Profit Objective For: (Prime Contractor, Subcontractor)

Factor	Rate (%)		Weight		Value
			(0.03 - 0.12)		
1. Degree of Risk		x		=	
2. Difficulty of work		x		=	
3. Size of Job		x		=	
4. Period of Performance		x		=	
5. Contractor's Investment		x		=	
6. Assistance by Government		x		=	
7. Subcontracting		x		=	
	%		Profit Factor		%

COMMENTS (Reasons for Weights Assigned):

1.
2.
3.
4.
5.
6.
7.

Figure 5-1. Weighted Guidelines Profit Sheet

Table 5-2. Factors for Profit Determination

FACTOR 1	Degree of Risk (Judgmental)	
	Degree	**Weight**
	Small	0.03
	High	0.12

FACTOR 2	Relative Difficulty of Work (Judgmental)	
	Degree	**Weight**
	Difficult	0.12
	Simple	0.03

FACTOR 3				Size of Job			
Value (x 1000)			**Weight**	**Value (x 1000)**			**Weight**
$ 0	to	100	0.120	$ 2,701	to	2,800	0.081
101	to	200	0.119	2,801	to	2,900	0.080
201	to	300	0.117	2,901	to	3,000	0.079
301	to	400	0.116	3,001	to	3,100	0.077
401	to	500	0.114	3,101	to	3,200	0.076
501	to	600	0.113	3,201	to	3,300	0.074
601	to	700	0.111	3,301	to	3,400	0.073
701	to	800	0.110	3,401	to	3,500	0.071
801	to	900	0.109	3,501	to	3,600	0.070
901	to	1,000	0.107	3,601	to	3,700	0.069
1,001	to	1,100	0.106	3,701	to	3,800	0.067
1,101	to	1,200	0.104	3,801	to	3,900	0.066
1,201	to	1,300	0.103	3,901	to	4,000	0.064
1,301	to	1,400	0.101	4,001	to	4,100	0.063
1,401	to	1,500	0.100	4,101	to	4,200	0.061
1,501	to	1,600	0.099	4,201	to	4,300	0.060
1,601	to	1,700	0.097	4,301	to	4,400	0.059
1,701	to	1,800	0.096	4,401	to	4,500	0.057
1,801	to	1,900	0.094	4,501	to	4,600	0.056
1,901	to	2,000	0.093	4,601	to	4,700	0.054
2,001	to	2,100	0.091	4,701	to	4,800	0.053
2,101	to	2,200	0.090	4,801	to	4,900	0.051
2,201	to	2,300	0.089	4,901	to	5,000	0.050
2,301	to	2,400	0.087	5,001	to	10,000	0.040
2,401	to	2,500	0.086				
2,501	to	2,600	0.085	Over		10,000	0.030
2,601	to	2,700	0.084				

Table 5-2. Factors for Profit Determination (Cont.)

FACTOR 4	Period of Performance	Weight
	23 to 24 Months	0.120
	22 to 23 Months	0.116
	21 to 22 Months	0.112
	20 to 21 Months	0.109
	19 to 20 Months	0.105
	18 to 19 Months	0.101
	17 to 18 Months	0.098
	16 to 17 Months	0.094
	15 to 16 Months	0.090
	14 to 15 Months	0.086
	13 to 14 Months	0.082
	12 to 13 Months	0.079
	11 to 12 Months	0.075
	10 to 11 Months	0.071
	9 to 10 Months	0.068
	8 to 9 Months	0.064
	7 to 8 Months	0.060
	6 to 7 Months	0.056
	5 to 6 Months	0.052
	4 to 5 Months	0.049
	3 to 4 Months	0.045
	2 to 3 Months	0.041
	1 to 2 Months	0.038
	Under 30 Days	0.034
		0.030

FACTOR 5	Contractor's Investment (Judgmental)	
	Degree	**Weight**
	Below average	0.03
	Average	0.07
	Above average	0.12

FACTOR 6	Assistance by Government (Judgmental)	
	Degree	**Weight**
	Below average	0.12
	Average	0.07
	Above average	0.03

Table 5-2. Factors for Profit Determination (Cont.)

FACTOR 7	**Percent of Subcontracting**	**Weight**
	80% or more	0.030
	70% to 80%	0.042
	60% to 70%	0.055
	50% to 60%	0.068
	40% to 50%	0.080
	30% to 40%	0.092
	20% to 30%	0.105
	10% to 20%	0.118
	0	0.120

5.4 Surety Bonds. Surety bonds are three-way agreements between a bidder or contractor (the principal), and a second party (the surety), to assure fulfillment of the principal's obligations to a third party (the obligee). If the principal obligations are not met, the bond assures payment to the extent stipulated of any loss sustained by the obligee. In most Government construction contracts, the three parties are as follows:

Three Parties	Under General Contract	Under Subcontract
1. Principal	Contractor	Subcontractor
2. Obligee	Government	Contractor
3. Surety	Surety	Surety

5.4.1 Types of Bonds. The purpose of surety bonds varies with the type of bond:

5.4.1.1 Bid Bonds or Bid Guarantee. These types of bonds provide an assurance that the bidder will not withdraw his bid within the specified period for acceptance and will execute a written contract and furnish the required bonds if the bid is accepted.

5.4.1.2 Payment Bonds. A payment bond assures payments to all persons supplying labor or material of the work provided for in the contract. These type of bonds protect subcontractors, suppliers, and laborers against nonpayment by the prime contractor.

5.4.1.3 Performance Bonds. A performance bond ensures the contractor will complete the project as specified and for the agreed price. It does not shift responsibility for administering the contract to the surety. A performance bond provides a financial guarantee for the work and provides the contractor with a method of freeing his working capital and other assets, which might otherwise be tied up by other forms of surety such as certified checks, retainage, or deposits.

5.4.2 Surety Bond Requirements

5.4.2.1 The amount included in the estimate should be based on the contract requirements, the bond rules, premium rates, and, if known, the actual contractor bond cost. A bid guarantee is required on Federal projects whenever a performance bond and/or a payment bond is mandated. Performance and payment bonds are required for all construction contracts of $100,000 or more and some form of payment guarantee for lesser value contracts (FAR 28.102). For contracts under $100,000, Congress directed agencies to develop alternatives to surety bonds for contracts between $25,000 and $100,000. These statutory requirements are implemented in FAR part 28.

5.4.2.2 The cost of all performance bonds, payment bonds, and other types of bonds determined to be appropriate by the cost engineer are allowable costs.

5.4.3 Classes of Bonds. Bonds are classified as Class A, Class B, or Class A-1, depending on the type of construction to be performed. Most types of civil works projects are classified as Class B. Table 5-3 illustrates the various types and classes of bonds.

Table 5-3. Classes of Bonds

CLASS A (Contracts for furnishing and installing, or installing only, certain services or equipment)		
Airport runways	Greenhouses	Ski lifts
Aluminum siding	High-pressure power piping	Sprinkler systems
Athletic fields	Janitorial service	Stone (furnishing, delivering only)
Beacon or floodlights	Machinery made to special order	Storage tanks metal
Burial contracts	Map making	Tennis courts
Ceilings (metal or acoustical tile)	Millwork	Water carnage of freight
Certain walls (nonstructural)	Murals	Water proofing (except with gunite)
Coal storage	Parking areas	Wind tunnels
Ducts (underground power, light, phone)	Planting and cultivation of land	
Elevators/escalators	Playgrounds and parks	

Table 5-3. Classes of Bonds (Cont.)

CLASS B		
Airport buildings	Gas piping	Sand blasting
Aqueducts	Golf courses	Sculptures
Atomic energy plants	Grain elevators	Sea walls
Breakwaters	Gunite contracts	Sewage disposal plants
Canals and canal lining	Heating systems	Sewers/septic tanks
Carpentry	Hospital buildings	Shipyards
Coal stripping	Incinerators	Spillways
Commercial buildings	Industrial buildings and plants	Stone
Concrete work	Jetties	Subways
Dams	Landscaping	Swimming pools
Dikes	Locks	Terminals-buses
Ditches	Masonry	Test boring
Docks and drydocks	Missile installations	Tile and terrazzo
Drilling contracts	Nuclear reactors	Transmission or distribution lines
Educational buildings	Office buildings	Tunnels
Electrical	Offshore platforms	Underwater cables
Embankments	Painting	Ventilation systems
Excavations	Piers	Water works
Filling stations	Pilings	Wells
Filtering plans	Pipelines for water	Wharves
Fountains	Plastering	
Garbage disposal plants	Plumbing	
Gasoline cracking plants	Power plants	
Gas compressor stations	Public improvements	
Gas mains and laterals	Railroad roadbeds	
CLASS A-1 (Contracts for furnishing and installing, or installing only, certain services or equipment)		
Arms	Guardrails	Repair of automobiles and trucks
Ash conveyors	Heating	Re-smelting old metal
Automatic strokers	Incinerator operations	Riprap stone (furnishing only)
Automatic telephone exchange and equipment	Insulation contracts	Rolling stock
Automotive service contracts	Kitchen equipment	Scaffolding cost engineer should
Band concerts	Laboratory equipments	Sidewalks
Bird control	Leasing of motor vehicles	Signaling systems on railroads
Boiler re-tubing and repair	Lightning rods	Signs (all)
Bookbinding	Lock gates	Stack rooms
Cataloging	Mail handling machinery	Standpipes
Coal handling machinery	Metal windows and shutters	Street and subway lighting systems
Computers and data processing equipment	Mosquito control contracts	Temporary personnel services
Conveyors	Movies	Thermostat equipment
Data processing and computer works	Office personnel	Tollgates

Table 5-3. Classes of Bonds (Cont.)

Doors/dynamos	Organ repairs	Track laying
Exterminating contracts	Ornamental ironworks	Traffic control systems on highways
Fire alarm systems	Parking meters	Training manuals
Fire escapes	Photogrammetric work	Tree trimming and removal
Flagpoles	Pipelines for oil or gas	Watchmen and signal services
Floats	Police alarm systems	Water towers
Floors	Projectiles	Weather stripping
Furnishing food services	Public address and music systems	Weed mowing
Gas tanks	Radio towers	Window cleaning
Generators	Radiological equipment	Work and Labor
Grain doors, salvage, and disposal	Recapping automobile tires	X-Ray inspections

5.4.4 Determining Bond Rates. If the contract is susceptible to two classifications, normally the higher rate is applicable. Separate contracts take the same classification as a general contract. Neither the classification nor the rate is changed by subdividing the work or by the Government providing certain materials. Subcontracts use the same classifications and rates as general contracts. Bond rates may change and should be verified on an annual basis and verified for the specific locale. A good source for verification is construction branch, which commonly receives the bond rate calculations for specific projects.

5.4.4.1 Non-Deviating States Exceeding 12 months Stipulated Time. For states in conformance (non-deviating) with the Surety Association of America (SAA) rates (table 5-4) where the construction time exceeds the bond stipulated time of 12 months, add 1 percent of the bond premium for each month in excess of 12 months.

5.4.4.2 Deviating States Exceeding Stipulated Time. For states not conforming (deviating) with the SAA rates (table 5-5) where the construction time exceeds the bond stipulated time of 12 months, add one-half percent of the basic premium for each month in excess of 12 months up to 24 months and 1 percent of the basic premium for each month in excess of 24 months.

5.4.4.3 Non-Deviating States Exceeding 24 Months Stipulated Time. For states in conformance (non-deviating) with the SAA rates (table 5-6) where the construction time exceeds the bond stipulated time of 24 months, add 1 percent of the basic premium for each month in excess of 24 months.

5.4.5 Consent of Surety

5.4.5.1 Not required. If the consent of the surety is not required and given for changes or extras, first and renewal premiums for the additional cost thus caused are computed at manual rates from the date of the bond.

5.4.5.2 Required. If the consent of the surety is required and given for changes or extras, premium for the additional cost thus caused, is computed at manual rates from the date of such surety cost.

5.4.6 Cost of Performance and Payment Bonds. Performance and payment bonds are normally obtained as a single package. The premium is the same as for the performance bond alone. Rates vary with the type of the contract work, the dollar value, and the length of the contract.

5.4.6.1 Coverage Limit of Performance Bonds. The coverage limit of performance bonds is specified in each contract and is usually for the full amount of the contract price (bid amount). The premium is adjusted at the completion of the work for any modification changes in the contract price other than changes due to time bonuses or penalties. If the original contract price is increased through change order, the contractor must pay an additional premium. Conversely, if any part of the original work is deleted and the original price thereby reduced, the contractor will receive a refund from the surety.

5.4.6.2 SAA Issues Advisory Rates. It should be noted the surety industry has become a state-regulated industry. The SAA issues advisory rates, but these rates may or may not be accepted by the state involved. Therefore, actual rates charged by surety corporations may vary from state to state.

5.4.6.3 Calculation of Bond Premium Cost. The following example illustrates the calculation of bond premium cost. Since the rates are subject to change and may vary by state, the calculations are to be used as a sample only. The cost engineer is responsible for ensuring the rates used are accurate and current. This example assumes a canal excavation project in Tennessee to be accomplished at an estimated cost of $2.5 million, including profit, with a duration of 11 months. From table 5-3, “excavation” is found in Class B. Referring to the Class B rate schedule in table 5-4, the premium for a performance-payment bond written in the full amount of the contract price (including bond) and by a non-deviating Surety Association Company would be calculated as follows:

Example of Class B Bond Premium Calculation:

Estimated Bond	Amount	x	Rate =	Premium
First	$100,000	x	$25.00/M	$2,500
Next	$400,000	x	$15.00/M	$6,000
Next	$2,000,000	x	$10.00/M	$20,000

Anticipated Estimated Amount (inc. bond)
$2,500,000 $28,500

(20 mos. - 12 mos. = 8 mos. surcharge)

Eight additional months @ 1%/MONTH

(8 mo × 1% × $28,500) $2,280

TOTAL PREMIUM $30,780

Table 5-4. Performance and Payment Bond (completion time not over 12 months) with Non-Deviating Rates

Amount of Contract Price		Class B	Class A	Class A-1
First $	100,000	$25.00/M	$15.00/M	$9.40/M
Next	400,000	15.00	10.00	7.20
Next	2,000,000	10.00	7.00	6.00
Next	2,500,000	7.50	5.50	5.00
Next	2,500,000	7.50	5.00	4.50
Over	7,500,000	6.50	4.50	4.00

Note: SAA advisory rates per $1,000 of contract value for all jurisdictions except South Carolina, Louisiana, Delaware, Hawaii, and Arkansas.

Table 5-5. Performance and Payment Bond (completion time not to exceed 12 months) with Deviating Rates

Amount of Contract Price		Class B	Class A	Class A-1
First $	100,000	$10.00/M	$7.50/M	$4.90/M
Next	400,000	8.00	5.50	4.50
Next	2,000,000	7.00	5.00	4.10
Next	2,500,000	6.00	4.40	3.80
Next	2,500,000	5.00	3.80	3.50
Over	7,500,000	4.50	3.25	2.95

Note: Deviating rates from companies that may or may not belong to the SAA and are dependent on competition and contractor net worth. The rates per $1,000 of contract value are typical of a large contractor having a preferred rate structure.

Table 5-6. Performance and Payment Bond (not to exceed 24 months) with Non-Deviating Rates

Amount of Contract Price		Class B	Class A	Class A-1
First $	500,000	$14.40/M	$10.80/M	$7.20/M
Next	2,000,000	8.70	6.72	6.00
Next	2,500,000	6.90	5.28	4.92
Next	2,500,000	6.30	4.92	4.44
Over	7,500,000	5.76	4.44	3.96

Note: Non-deviating SAA advisory rates per $1,000 of contract value are for South Carolina, Louisiana, Delaware, Hawaii, and Arkansas.

5.5 Taxes. Indirect costs may include certain tax applications and are dependent upon the state wherein the project is located. The cost engineer should ensure those taxes are covered within the prime contractor markups, within the indirect costs. Examples include the business and occupation tax and the gross receipts tax. Consideration should be made when applying these rates when profit is not included within the estimate, since these rates are applied on total construction cost, including profit.

CHAPTER 6

Risk, Contingency, and Escalation

6.1 General. While the cost engineer is responsible for developing the construction cost and schedule estimates, the risk, contingency, and escalation must address all cost and schedule estimates of all features within the CWWBS. For this reason, it is recommended that the MCACES estimate includes all feature levels within the CWWBS. This chapter provides guidance regarding other costs not specifically identified in the previous chapter but costs that must be included in the preparation of TPC estimates for all feature level costs.

6.2 Risk Analysis.

6.2.1 A risk analysis is a formal process used to calculate or project the cost and schedule contingency at a selected confidence level for project execution success. The process must include the PDT since it addresses all perceived risks and benefits to TPC and schedule. The civil works risk analysis process is based upon the Monte Carlo methods related to probability of occurrence for the risk areas of concern, both positive and negative influences. HQUSACE mandates the use of the nationally recognized software Crystal Ball, an Excel-based Monte Carlo risk simulation software. Further guidance and procedures to conduct risk analysis is presented in appendix G.

6.2.2 A risk analysis should be provided on the TPC, including all features of the project, but excluding escalation and contingency. Too often, risk focuses on just the construction activities, which can result in critical risk elements remaining unidentified. Through early determination of potential project risks, management can then focus efforts in those areas for potential risk mitigation, resulting in cost and schedule savings. A formal risk analysis should be accomplished as a joint analysis between the cost engineer and the other PDT members that have specific knowledge and expertise on all possible project risks for all features, internal and external.

6.2.3 To accomplish this process, it is vital to first establish the method or process in risk identification. A recommended process is provided in the flow chart in figure 6-1. The current HQ guidance requires a formal analysis on all projects where the TPC exceeds $40 million. For projects where the TPC is less than the $40 million, a formal risk analysis is not mandatory, but may be prudent. Another accepted method for assessing risk and contingency for projects valued at less than $40 million is to evaluate on the merit of scope definition, quantity, and estimate confidence by feature, subfeature, major cost elements, and technical complexity.

6.2.4 Upon PDT formulation and instruction of the risk analysis process, the PDT addresses scope, identifying those areas that significantly contribute to cost and schedule uncertainty. During this process, it is important that a risk facilitator lead the PDT risk discussions. It is also important that the cost engineer discuss the current estimate and schedule, the methodologies, and assumptions, because they will have bearing on the risk discussions and impacts. Figure 6-2 provides what is commonly referred to as a risk register. This sample is extremely helpful in guiding the PDT through the initial risk discussions. The outcome of those discussions is a preliminary risk register that indicates the perceived risks and the perceived impacts.

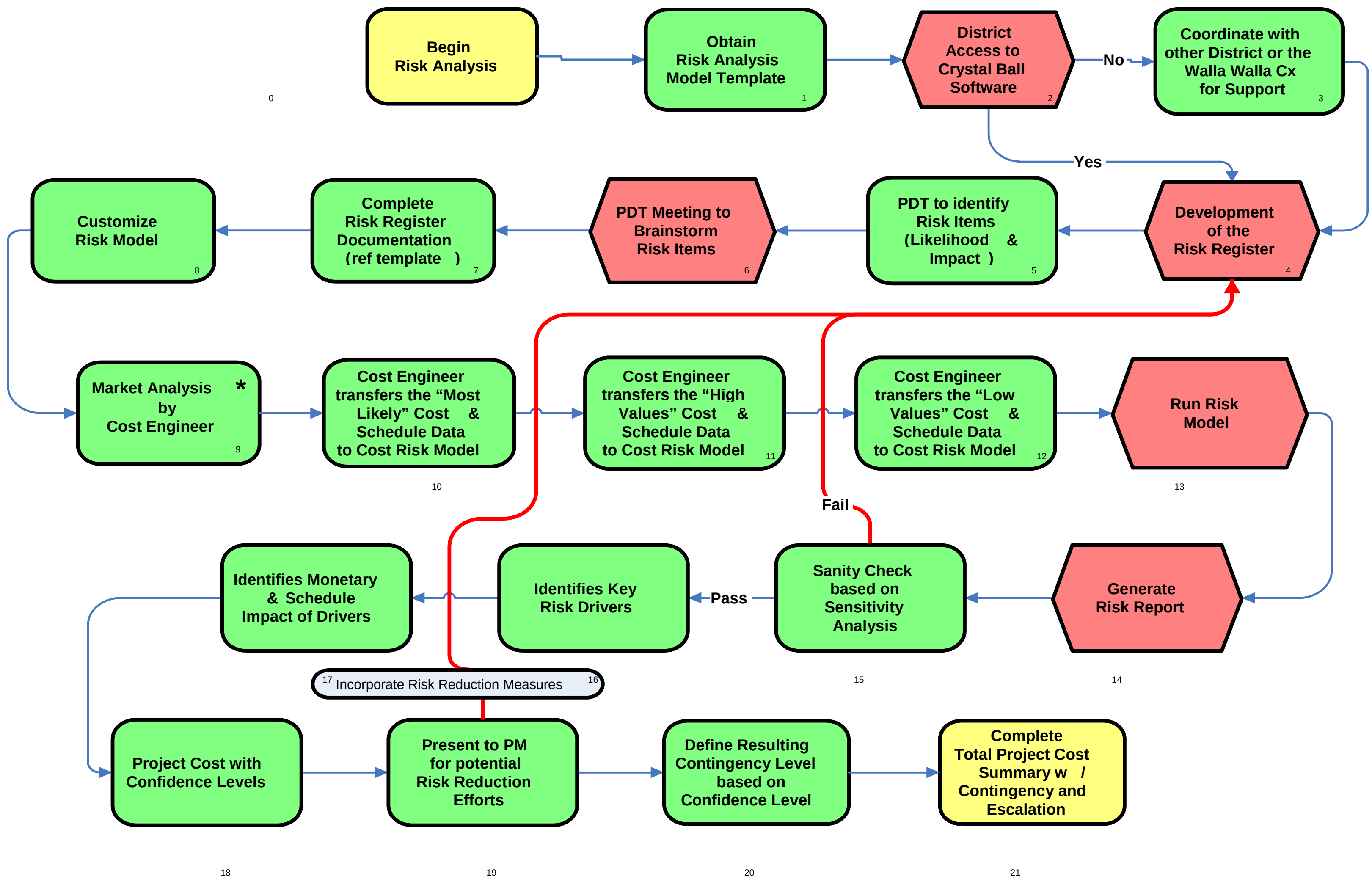


Figure 6-1. Recommended Risk Analysis Process

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

			Project Cost				Project Schedule								
Risk No.	Risk/Opportunity Event	Discussion and Concerns	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component	Project Implications
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
I-1	Scope Definition	Scope is fairly well defined for standard civil works features. The pumping plant requires considerable design and approximates 20% of the cost.	LIKELY	SIGNIFICANT	HIGH	$1,200,000	LIKELY	SIGNIFICANT	HIGH	8	UNIFORM	I-2	Project Manager/Planner	Construction Cost	Cost & Schedule
I-2	Scope Growth / Reduction	Scope is fairly well defined for standard civil works features. The pumping plant has potential of VE savings through better data and VE.	LIKELY	MARGINAL	MODERATE	($275,000)	LIKELY	MARGINAL	MODERATE	10	UNIFORM	I-1, I-16	Project Manager/Planner	Construction Cost	Cost & Schedule
I-3	Labor Availability/Pricing	$3 Billion construction will be occurring in locale over the next 5 years.	LIKELY	SIGNIFICANT	HIGH	$3,000,000	LIKELY	MARGINAL	MODERATE	9	TRIANGULAR		Project Manager/Planner	Labor/ Production Rates	Cost & Schedule
I-4	Equipment Availability/Pricing	Large cranes required, but available. Pump plant equipment long lead time.	UNLIKELY	NEGLIGIBLE	LOW	$900,000	UNLIKELY	MARGINAL	LOW	6	TRIANGULAR	I-15	Cost Engineering	Equipment/ Production Rates	
I-5	Material Availability/Pricing	Needed aggregates in short supply locally. This affects concrete, rip rap, base course and asphalt	VERY LIKELY	SIGNIFICANT	HIGH	$2,300,000	VERY LIKELY	MARGINAL	MODERATE	4	TRIANGULAR		Cost Engineering	Material Costs	Cost & Schedule
I-6	Fuel Prices	$2.65 per gallon was used in the Oct 06 MCACES, increases will effect equipment and delivery or materials	VERY LIKELY	SIGNIFICANT	HIGH	$1,750,000	VERY LIKELY	NEGLIGIBLE	LOW	0	TRIANGULAR		Cost Engineering	Equipment	Cost
I-7	Utility Relocations	Location is rural. However, several unmarked and abandoned farm related utilities are prevalent at this location.	LIKELY	MARGINAL	MODERATE	$870,000	LIKELY	MARGINAL	MODERATE	3	TRIANGULAR		Civil Design	Construction Cost	Cost & Schedule
I-8	Environmental Mitigation	Studies indicate that the area is heavily saturated with de-icing chemicals as well as agricultural fertilization and pesticide residuals.	LIKELY	SIGNIFICANT	HIGH	$1,600,000	LIKELY	SIGNIFICANT	HIGH	24	UNIFORM		Environmental Compliance Specialist	Construction Cost	Cost & Schedule
I-9	HTRW	A small portion of the project is located within the limits of an Army Chemical Depot undergoing BRAC.	UNLIKELY	MARGINAL	LOW	$400,000	UNLIKELY	SIGNIFICANT	MODERATE	18	UNIFORM		Environmental Compliance Specialist	Construction Cost	Schedule
I-10	Permits	Substantial permitting delays may occur if there are significant environmental mitigation/HTRW issues, or political opposition.	LIKELY	NEGLIGIBLE	LOW	$150,000	LIKELY	MARGINAL	MODERATE	17	TRIANGULAR	I-14, E-4	Planning/Regulatory	PED/Lands & Damages	Schedule
I-11	Environmental Windows	Project site is a natural habitat for various species of threatened wildlife that spawn during Spring months. No excavation is permitted from April 15 - June 30.	VERY LIKELY	SIGNIFICANT	HIGH	$3,500,000	VERY LIKELY	SIGNIFICANT	HIGH	30	TRIANGULAR	E-2	Project Manager/Planner	Construction Cost	Cost & Schedule
I-12	Sufficient Planning Schedule	Project is a fast-track project, although complicated. Concerns exist on obtaining appropriate schedule and funding for sufficient review and effort by specialized team members and contractors	LIKELY	MARGINAL	MODERATE	$300,000	LIKELY	SIGNIFICANT	HIGH	14	TRIANGULAR		Project Manager/Planner	Construction Cost	Cost & Schedule
I-13	Adequate Technical Staff	Due to fast-tracking, portions of design and planning effort are split between Gov't and AE specialists. Concern remains that the integration of staff may create delays.	LIKELY	NEGLIGIBLE	LOW	$200,000	LIKELY	MARGINAL	MODERATE	7	TRIANGULAR		Project Manager/Planner	PED	Schedule

I-14	Site Access	Site access is limited due to clearances required from U.S. Army installation, and local farmers remaining on property. Also, no excavation (or boring) is permitted April 15 - June 30.	VERY LIKELY	MARGINAL	MODERATE	$500,000	VERY LIKELY	NEGLIGIBLE	LOW	2	TRIANGULAR	I-10	Project Manager/Planner	Construction Cost	Cost
I-15	Special Equipment Fabrication	There are only two known manufacturers of the specialized filtration and pumping stations required on site, and neither are domestic.	UNLIKELY	NEGLIGIBLE	LOW	$1,900,000	UNLIKELY	NEGLIGIBLE	LOW	7	TRIANGULAR	I-4	Cost Engineering	Construction Cost	
I-16	Potential savings due to innovation, streamlining, and gains in efficiency	Value Engineering has already been incorporated into the project. VE remains on the pumping plant.	LIKELY	MARGINAL	MODERATE	($2,500,000)	LIKELY	NEGLIGIBLE	LOW	11	UNIFORM	I-2	Value Engineering Team	Productivity	Cost
I-17	Acquisition Plan	The estimate was based on full and open competition, with minimal tiering of contractor subs. The Acq Plan has not been finalized, therefore there is a potential for additional tiering of the contracts.	LIKELY	SIGNIFICANT	HIGH	$7,500,000	LIKELY	MARGINAL	MODERATE	16	TRIANGULAR	E-3	Acquisition Strategy Board	Construction Cost	Cost & Schedule
I-XX	Other Potentials														
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
E-1	Weather	Work will be done on the river, unpredictable, scour protection is more vulnerable	LIKELY	NEGLIGIBLE	LOW	$175,000	LIKELY	MARGINAL	MODERATE	6	TRIANGULAR		N/A	Labor/ Production Rates	Schedule
E-2	Environmental Policy Changes	There are external environmental policy changes that can change the construction work windows.	LIKELY	SIGNIFICANT	HIGH	$1,400,000	LIKELY	SIGNIFICANT	HIGH	10	TRIANGULAR	I-11	Project Manager/Planner	Construction Cost	Cost & Schedule
E-3	Bidding Climate – Saturated Local Market	$3 Billion construction will be going on in downtown Pittsburgh over the next 5 years.	LIKELY	MARGINAL	MODERATE	$2,000,000	LIKELY	NEGLIGIBLE	LOW	4	UNIFORM	I-16	Acquisition Professional	Construction Cost	Cost
E-4	Political Support/Opposition	Project is highly visible and controversial. Delays due to political ramifications are possible and could critically delay or terminate the work.	LIKELY	SIGNIFICANT	HIGH	$6,400,000	LIKELY	SIGNIFICANT	HIGH	28	UNIFORM	I-10	Project Manager/Planner	Project Cost	Cost & Schedule
E-5	Sufficient Incremental Funding	Budget constraints could limit or delay funding, creating potential sequencing delays and issues, considering the environmental window constraints.	VERY LIKELY	SIGNIFICANT	HIGH	$4,600,000	VERY LIKELY	SIGNIFICANT	HIGH	27	TRIANGULAR		Project Manager/Planner	Project Cost	Cost & Schedule
E-XX	Other Potentials														

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.

A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.

7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Figure 6-2. Sample Risk Register

6.2.4.1 Following the Pareto Principle, 80 percent of the cost of a project is contained in 20 percent of the estimated work elements. The object is to focus on the uncertainty associated with the so-called 20 percent “critical” elements. Variables such as internal project and external project influences should be considered. Internal variables that carry differing degrees of confidence that can significantly impact cost and schedule might be items such as real estate, mitigation, scope definition, quantities, productivity, labor, specific materials or equipment, location, and access. Scope has been identified as the largest impact to cost and schedule growth. Examples of external influences might be contract acquisition strategy and bidding climate, bid competition, assurance of project funding, weather, etc.

6.2.4.2 Upon determination of what items are considered potential risks, the cost engineer then completes the most likely cost estimate, which becomes the base cost represented within the TPCS before application of contingency and escalation. The cost engineer then studies the market to determine whether the perceived risks are real and significant to the successful execution of the project.

6.2.4.3 Upon completion of the market studies, conclusions can then be made related to the significance of the risks. The cost engineer then completes the risk register(s), addressing both cost and schedule impacts. The cost engineer evaluates the most likely estimate and related risk parameters, determining the best or most optimistic potential, the most likely potential, and the worst-case potential. Caution should be exercised to ensure the best case and worst case are not taken to an extreme, because those extremes can skew the risk potential.

6.2.4.4 Upon completion and understanding of the impacts for the significant items, the cost engineer is then ready to prepare the data for a software application and analysis. It is recommended that the risk be captured and reported at the 80 percent confidence level. Quite often, the first software application will result in contingency value that does not seem credible. The cost engineer should re-evaluate and question the risk potentials, studying possible duplication, item correlations, or unreal best or worst-case items. There are occurrences where the entire PDT must meet again to discuss the results, but often, the cost engineer can resolve concerns by working with key individuals of the PDT.

6.2.4.5 A high contingency can mean several things. It can reflect lack of clear scope. It may mean that the “most likely” estimate is actually low or too optimistic. It can also imply a flawed risk analysis. Conversely, if a low contingency result is obtained where scope is still poorly defined, further risk study is in order.

6.2.4.6 A cost and schedule risk analysis will identify the contingency that must be added to a project to cover cost and schedule growth potential. It should be noted that the use of risk analysis will not reduce the uncertainties associated with the project cost estimate or solve the problems of cost variance due to insufficient investigations or design data. This process more readily identifies elements of the project where additional design or study effort may reduce the uncertainties and provide a more reliable cost estimate.

6.3 Contingency.

6.3.1 Contingency is to cover unknowns, unforeseen uncertainties, and/or unanticipated conditions that are not possible to adequately evaluate or determine from the data on hand at the time the cost estimate is prepared. Contingencies relate to the uncertainties of the current known and defined project scope and are not a prediction of future project scope or schedule changes.

6.3.2 The goal in contingency development is to determine a confidence value by means of a percentage in potential cost and schedule growth. The contingency value reflects the level or degree of project development. Typically, the less defined a project, the higher the contingency value. Scope definition and estimate quality have a significant bearing on confidence, risks, and resulting contingency development. The more defined a scope and the better developed the estimate will result in a lower contingency. Consideration must be given to the details available at each stage of planning, design, or construction for which a cost estimate is being prepared.

6.3.3 For a preliminary estimate at feasibility level, the contingency may be a result of a formal risk analysis. When performing the analysis, the estimate should not contain a contingency, because the risk analysis is developing that amount. Upon completion of the estimate, sufficient contingencies should be considered at the lowest MCACES title or detail level where the risks or uncertainties have been identified. Contingencies may vary throughout the cost estimate and could have a significant impact on overall costs being high when the lack of investigation data or design detail is associated with critical/high cost elements. The cost estimate narrative should discuss the reasons for the applied estimate contingency rate and assignment.

6.3.4 Forward pricing in an estimate to adjust current prices to reflect the cost expected at the actual purchase date, e.g., long construction period, should not be included as a contingency, but should be clearly and separately defined in each estimate. Labor wage increases throughout long construction periods shall be included and clearly documented in the estimate and not considered contingency.

6.3.5 Contingency allocations are specifically related to the project uncertainties and should not be reduced without appropriate supporting justification. The decision to reduce these uncertainties and improve the cost estimate through additional investigations or studies, or to proceed with the higher cost estimate, is a management decision.

6.4 Cost Escalation.

6.4.1 Civil Works Construction Cost Index System (CWCCIS), Engineer Manual (EM) 1110-2-1304, provides historical and forecasted cost indexes for use in price indexing and escalation to account for inflation. The indexes presented in the manual are specifically designed for civil works construction, and are specific for each of the major civil works features. Only indexes for construction costs have been developed. The indexes are also used to escalate or inflate various project cost features to current or future price levels respectively.

6.4.2 Each cost engineer providing support to planning studies must be familiar with cost estimates prepared on a constant dollar basis (escalation) and an inflated dollar basis (inflation) described in the Planning Guidance Notebook (ER 1105-2-100). Reporting civil works project costs and guidance for preparing the TPCS sheet (presented in appendix B).

6.4.3 Construction cost estimates, when finalized, must reflect the total estimated cost during the entire duration of construction. Cost escalation due to inflation must be identified as a separate element within the cost estimate. This allows the cost engineer the ability to easily adjust the estimate to reflect construction schedule changes.

6.4.4 For projects with construction cost estimates more than two years old without an update in pricing, special consideration is required. In these situations, it is the responsibility of the cost engineer to perform an appropriate analysis to ensure that the construction estimate is based on the current design and schedule. The construction cost estimates for major or unique and Congress-approved projects will be updated and re-priced using current labor and material rates.

6.4.5 For projects with construction estimates less than two years old, it is acceptable to use the CWCCIS cost indexes to update the construction estimate and other project cost elements. This decision should be based on the judgment and experience of the cost engineer.

6.4.6 Schedule Development for Total Project Schedule

6.4.6.1 The project schedule is used to forecast when project tasks or activities will begin, the duration of each task, and its relationship to other tasks. Knowing how each task or activity is funded will illustrate when the costs are expected to occur and when the funding is needed. When referring to CWCCIS and the TPCS, it becomes very apparent that escalation is dependent upon the project schedule. In order to confidently compute the escalation that is reflected within the TPCS, a project schedule must be developed that represents all feature levels, engineering, and design as well as construction efforts. The cost engineer is responsible to develop the schedule for the construction elements and tasks. There are several software programs available to accomplish this.

6.4.6.2 It is recommended that, as a minimum, schedule development includes the main tasks or activities; the main cost and schedule drivers that can affect duration. While the cost engineer may choose to resource load the schedule for both cost and time, the minimum schedule should reflect the logic and construction flow of critical and near critical path elements and durations. Those durations should reflect the estimate task productivities. Often times, the schedule will indicate logic flaws within the estimate related to critical and near-critical tasks, concurrent activities, sequential activities, work windows and restrictions, need for crew adjustments, and/or overtime. The schedule may result in a need to change the estimate logic. This is critical, because the objective is to estimate an escalation value commensurate with the project requirements and restrictions.

6.4.7 Price Level/Escalation Adjustment

6.4.7.1 All cost estimate elements will be priced to a common calendar date base (month and year). This date is referred to as the effective price level date. Once the cost estimate has been prepared to the effective price level date, the estimate may require cost adjustment to accommodate economic analyses, budgeting and financial analyses, the construction schedule, or the project schedule. Therefore, the cost engineer should calculate escalation as separately identifiable elements, and the calculation methodology should be clearly defined and indicated. See CWCCIS, EM 1110-2-1304, for specific guidance and the TPCS found in appendix B.

6.4.7.2 As the project scope progresses to a feasibility level and as indicated in ER 1110-2-1150, project schedules are required to support escalation calculations as well as planning project management activities. The project schedules are extremely helpful in considering the estimate logic related to critical path, near critical path, and concurrent activities as well as potential need for overtime, multiple crews, and shifts to perform the work.

CHAPTER 7

Independent Government Estimates

7.1 General.

7.1.1 The IGE for construction is the formal, approved cost estimate prepared and submitted to support contract award. This estimate is required for all contracts of $100,000 or more (FAR 36.203). The IGE is used to determine the reasonableness of competitive bids or proposals received in connection with formally advertised construction contracts, regardless of the acquisition strategy or contract type. The IGE typically consists of a Government Estimate of Contract Cost, Details and Analysis of Construction Contract Costs, and Support to the Estimate. Each part is shown in figure 7-1. Sample Government estimate sheets are illustrated in appendix E. Security and control of the Government estimate is described in paragraph 7.7.4.1.

7.1.2 The IGE normally consists of a title page, signature page, and price or bid schedule. Supporting documents that are publicly available as parts of the solicitation (such as plans, specifications, and project descriptions) are not part of the IGE. The IGE shall be approved, dated, and signed by the District Commander or approved designee.

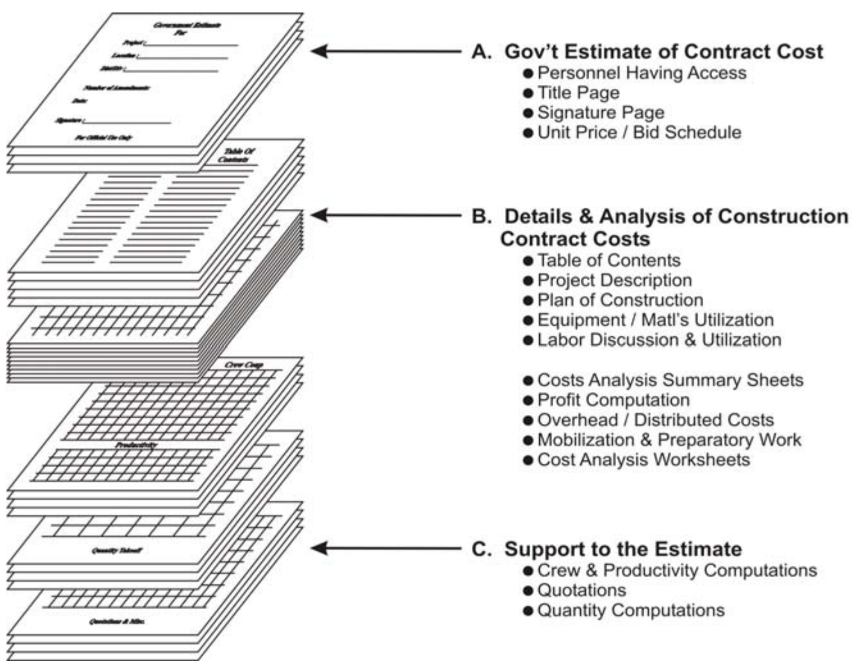


Figure 7-1. Example Composition of an Independent Government Estimate

7.2 Contract Cost. The IGE is the portion of the cost estimate to be submitted as required by procurement regulations. It includes the title page, signature page, and bid/price schedule.

7.2.1 Title Page. The title page should include the name and location of the project, the office responsible for the project design, the cost engineer responsible for preparation of the cost estimate, and the date and price level of the cost estimate.

7.2.2 Signature Page. The signature page should contain the names and signatures of those individuals responsible for the preparation, review, submittal, and approval of the cost estimate. It is necessary that the sheet contain the total amount of the estimated costs. The number of amendments included in the estimate should appear on the same page so that there will be no question as to the approved amount.

7.2.3 Pricing Schedule. The bid/price schedule required by the solicitation documents must be completed as part of the IGE. As part of the design team, the cost engineer should be involved in the development of the bid/price schedule. The format of the bid/price schedule must be anticipated in planning and design estimates. When the bid/price schedule is finalized for procurement, it must show unit prices, quantities, extension of unit prices, lump sum items, and total costs. Rounding off is not permitted on the bid/price schedule between the unit price and extension. Any rounding adjustments must be performed in the bid schedule. Instructions found within the contract solicitation bid documents also pertain to the IGE.

7.3 Details and Analysis of Construction Contract Costs. This part of the estimate of construction cost consists primarily of those sheets with notes, which describe the scope tasks and costing. It also contains discussions, considerations, and developed construction plan. The types of items normally included are as follows:

7.3.1 Table of Contents. The table of contents should reflect the estimate structure and CWWBS. For IGEs, the table of contents should reflect the bid schedule at the highest level, estimate structure at the lower levels, reflecting the CWWBS.

7.3.2 Project Narrative. The project narrative provides general details of the project scope and supporting cost databases. The narrative shall present discussion of the major construction features and elements. The narrative shall also define the critical assumptions and basis of costs that were made during the preparation of the cost estimate. It describes the project requirements and construction methodology that must be performed in sufficient detail to give a clear understanding of the scope of work. It also describes project details including length, width, height and shape of primary features, special problems that will be encountered in performing the work, site conditions affecting the work, reasons for selection of major plant and equipment, method and time for mobilization and demobilization of all equipment, and the reasons for unusually high or low unit prices. Each estimate will include a statement, which relates both the development of design, as appropriate, and date of effective pricing. Other factors to be considered in the project narrative include:

7.3.2.1 Construction schedule, use of overtime, construction windows, phasing, acquisition plan, and subcontracting.

7.3.2.2 Project related details including site access; borrow areas; construction methodology; unusual conditions (soil, water, or weather); unique techniques of construction; equipment/labor availability and distance traveled; environmental concerns; and effective dates and sources for labor, equipment, and material pricing.

7.3.3 Construction Schedule

7.3.3.1 The cost engineer may prepare a construction schedule to support the cost estimate that is consistent with the schedule for completion of the project. It may be in the form of a bar chart or network analysis system. It must identify the sequence and duration of the tasks upon which the cost estimate is developed. The schedule must be prepared in sufficient detail to adequately develop the required labor, equipment, crew sizes, and production rates required for each of the identified construction tasks.

7.3.3.2 Schedules are helpful in determining estimate logic, sequencing, phasing, and concurrent activities as well as critical path elements. The schedule should be compared to the contract schedule requirements when determining which portions of the work may require overtime and/or multiple work crews and crew sizes.

7.3.4 Equipment and Materials Utilization. On those projects involving considerable heavy construction equipment, it is necessary to sufficiently plan the equipment usage against the work schedule to identify the actual number of cranes, dozers, etc., and allow for proper mobilization to assure that demand for the equipment is not over- or understated. For equipment selected from EP 1110-1-8, indicate the region and date of the equipment schedule used for pricing the equipment. Materials, which require long lead time and can become critical to the construction schedule, should be noted, planned, and adequately considered. Certain heavy equipment choices must consider load and size restrictions on structures such as dams, highways, bridges, overhead obstructions, etc.

7.3.5 Labor Discussion and Utilization. The estimate should clearly state the sources for the various labor classifications and rates and include tabulation by crafts of the various composite wage rates used. When extensive overtime beyond the normal workday is used in the estimate, an explanation should be included.

7.4 Support to the Estimate.

7.4.1 This part of the estimate consists of all the support and backup documentation. The various categories of support documentation contained in this part include:

7.4.1.1 Cost Analysis Summary Sheets. The automated or manually prepared summary sheets for direct, indirect, and owner costs are used to summarize cost components for each bid item and by the appropriate CWWBS. Distribution of overhead and profit is shown on this sheet.

7.4.1.2 Mobilization, Preparatory Work, and Demobilization. These costs should be itemized and costed separately. These costs may be combined at the summary level with overhead if these costs are not paid as a separate bid item. This item may be shown as a lump sum on the bid schedule.

7.4.1.3 Profit Computation Sheet. Profit is not to be included in any construction IGE for work to be performed by private contract (33 United States Code 624) so that the 25 percent fair and reasonable award measure can be made in accordance with PL 95-269. This applies to any basic contract for construction, as well as task orders since they are considered separate contracts. Should profit be requested by the contracting officer for negotiation purposes, the weighted guideline (paragraph 5.3.3.1) profit calculation method will be used to compute the profit and will be part of the cost estimate backup, but it shall not be included within the 25 percent award comparison.

7.4.1.4 Overhead Costs. The itemization and calculations of overhead costs, both job site and home office, should be accomplished in accordance with chapter 5.

7.4.1.5 Bond Costs. Bond costs should be calculated in accordance with paragraph 5.4. Distribution is made to bid items similar to or as part of overhead costs distribution.

7.4.1.6 Automated Detail Sheets. The completed direct costs should be organized in the proper sequence by the appropriate CWWBS for each bid item.

7.4.1.7 Production Rates. The automated or manually prepared details are used to express production rate analysis of crews. See chapter 4 for further discussion.

7.4.1.8 Crew, Labor, and Equipment Rates. These automated or manually prepared details are used to express the crew composition and associated rates for labor and equipment costs. The information contained on these sheets provides the backup support for the task unit labor and equipment costs shown.

7.4.1.9 Quantity Computations. The quantity takeoff computations for the tasks estimated should be organized by task for the bid items and kept as backup. The takeoff should reference the drawing and clearly explain the computation.

7.4.1.10 Quotations. Quotations should be collected and compiled by task or bid item into an organized reference. When quotations were not obtained for significant material and supply items, the basis for the cost used should be fully described. Quotations should be considered proprietary information and should be kept confidential to protect the information entrusted to the cost engineer. Quotations should consider whether markups and delivery have been included.

7.5 Miscellaneous Support Data.

7.5.1 Include all other information pertinent to the estimate such as drawings and sketches, which were used as the basis of the cost estimate. Drawings may include a project map showing the location of the work with respect to principal cities, roads, railways, and waterways. A site map may show the location of the work, borrow, quarry, spoil areas, and existing work access roads. Any existing facilities usable by the contractor should be included as well as a general plan and elevation or profile of the work with typical sections and a construction layout.

7.5.2 Supporting documents that are publicly available as parts of the solicitation, such as plans, specifications, and project description, or that contain no cost information, such as sketches, soil boring, and material classifications, are not part of the IGE or Government estimate backup.

7.6 Estimate and Schedule Quality Review.

7.6.1 Before IGE approval and submission by cost engineering, the cost engineer shall ensure an adequate DQC review (chapter 9) has been provided, and the estimate adjusted accordingly.

7.7 Revision to Independent Government Estimate. Prior to award, the IGE may be changed or revised as a result of errors, omissions, or additional information. Approval authority for revision to the estimate remains the original estimate-approving official. Each office shall assure that appropriate justification is attached to the revised cost estimate. Estimates may be revised by supplementary sheets or by actually changing the contents of the original estimate pages. The method used will be determined by the nature of the revision and the format of the estimate. Whichever the method, all revisions to the estimate must be clearly indicated, dated, justified, and approved. A new signature sheet relating both the previously approved total and revised total will be reapproved. A copy of each estimate that has been approved should be included in a file along with the details and circumstances reflecting the revisions.

7.7.1 Access to Independent Government Estimates. Access to the IGE and its contents will be limited to personnel whose duties require knowledge of the subject. When an A-E is contracted to prepare an estimate, the A-E submittal should include a list of personnel that have had access to the total estimate amount. It is recommended that all personnel sign a confidentiality agreement. Government cost engineers preparing or reviewing the final IGE may also sign the same or a similar list. A list similar to figure E-1 (appendix E) may be filed with the IGE.

7.7.2 Marking the Records "For Official Use Only." The marking of records at the time of their creation provides notice of FOUO content and facilitates review when a record is requested under the Freedom of Information Act (FOIA). The responsible cost engineer will ensure that the FOUO marking is applied in accordance with Army Regulation 25-55, The Department of the Army Freedom of Information Act, to all pertinent documents, computer files, compact discs, printouts, and other documents prepared manually or electronically for incorporation into the IGE.

7.7.3 Disclosure of Records

7.7.3.1 The IGE and Government estimate backup data, prepared for construction contracts, are sensitive procurement information and should in many cases be withheld under FOIA. Ordinarily, after contract award, only the title page, signature page, and price schedule are disclosed outside the Government. The Government estimate backup data should not be released since it contains sensitive, detailed cost data (e.g., contractor quotes, crews, and productivity) that are proprietary or might compromise claim litigation and cost estimates for future similar procurement.

7.7.3.2 Fair market price determinations, under the Small Business Program, FAR 19.202.6, will be treated as IGEs for purposes of this guidance.

7.7.3.3 Supporting documents that are publicly available as part of the solicitation, such as plans, specifications and project description, or documents that do not contain cost information, such as sketches, soil borings and material classifications, are not part of the IGE or Government estimate backup.

7.7.4 Bid Protests and Litigation

7.7.4.1 During bid protests and litigation, if appropriate and to the extent possible, USACE Office of Counsel should have the IGE and/or the Government estimate backup data placed under a "protective order." At that time, security of the IGE becomes even more critical and any cost information and release should go through the Office of Counsel. There are valid reasons for not releasing the Government backup data supporting the IGE to the contractors and can be considered one of the exemptions under the FOIA. In the case of a bid protest, there is a possibility that the contract could be re-advertised or converted to a negotiated procurement. Release of the Government backup data would provide bidders with the detailed cost data that supports the IGE. If, however, the apparent low bidder protests the reasonableness of the IGE, the USACE command may choose to provide the IGE and Government estimate backup data, to the protestor only, upon receipt of complete details of the protestor's estimate.

7.7.4.2 For this potential, it is imperative that the estimate be well developed and defensible with adequate information to support the basis of the estimate through discussion and notes supporting estimate assumptions and methodology.

7.7.5 Release Under Freedom of Information Act. IGE and Government estimate backup data are intra-agency memoranda, which may be withheld under FOIA Exemption 5, "confidential commercial information" and "deliberative process" privileges. Proper use of Exemption 5, however, requires a showing that release of information will harm the Government's interests. Therefore, requests for the IGE and Government estimate backup data will be reviewed on a case-by-case basis, based on the following guidance, to determine whether release will harm the interests of the Government.

7.7.5.1 In reviewing requests, the FOIA officer will seek the assistance of the cost engineer. If the FOIA officer determines that release will harm the interests of the Government, the information will be withheld.

7.7.5.2 When sealed bidding is used, neither the IGE nor the Government estimate backup data should be released prior to bid opening. See FAR 36-203(c), 36.204. It is well established that release of IGE and Government estimate backup data before contract award would harm the interests of the Government. The FAR and legal reference is FAR 36.203, Federal Open Market Committee v. Merrill, 443 U.S. 340 (1979), Morrison-Knudson v. Department of the Army, 595 F. Supp. 352 (D.D.C. 1984), aff'd 762 F.2d 138 (D.C. Cir 1985).

7.7.5.3 The IGE will normally be released when bids are opened. In some instances, however, the IGE will not be released at that time, such as when all bids received are non-responsive and a re-procurement is envisioned.

7.7.5.4 In negotiated procurement for construction under FAR Parts 15 and 36, the IGE should not be released prior to contract award, except that Government negotiators may disclose portions of the IGE in negotiating a fair and reasonable price, see FAR 36-203(c).

7.7.5.5 The Government estimate backup data should not be released. Release of Government estimate backup data after contract award and before completion of a construction contract may also result in harm to the Government. The Government estimate backup data is used to develop cost estimates for modifications and claims. Release of the backup data prior to contract completion provides the contractor with the details of the Government's position and would allow the contractor to develop a biased price proposal or support a claim. This could harm the Government's ability to negotiate a fair and reasonable price for the modification or claim, putting the Government at a serious commercial disadvantage. Moreover, knowledge of the construction methods contemplated by the Government might reduce the contractor's incentive to discover less expensive methods. This could also reduce the contractor's incentive to locate and charge out materials at a lower cost, or to achieve project goals using less labor and equipment. See Quarles v. Department of the Navy, 983 F.2d 390, (D.C. Cir 1990) and Taylor Woodrow International, Ltd. V. Department of the Navy, No. 88-429R, (W.D. Wash. Apr. 6, 1989).

7.7.5.6 Generally, after contract completion (and after all claims have been resolved), the Government estimate backup data may be released. Situations where the information should not be released include frequently recurring contracts and multiple-phased projects where a series of similar contracts are awarded in sequence. In those cases, each IGE is based upon the same backup data and the same analysis of how to perform the work.

CHAPTER 8

Independent Government Estimates for Contract Modifications

8.1 General. The cost engineering office is currently not responsible to prepare construction modification estimates, but may do so upon request from the construction office. The district cost engineer has several important tasks to perform prior to actually preparing the estimate. The cost engineer will review the contract modification package to thoroughly understand the scope of changes, dispute, or other issues related to cost and time impacts. A contract modification and its estimate must address both cost and time, since both will be negotiated. Some of the major activities to be considered in preparing the estimate in addition to labor, material, equipment, and construction techniques include the following discussions.

8.2 Reviewing Documents. The cost engineer will review documents received and become thoroughly familiar with the scope and requirements of the changed work. The review should entail comparison, analysis, and discussions with the designer or field office to ensure common understanding of the scope of work. The cost engineer must assure that the proposed modification is clearly defined with regard to specified work requirements, proposed measurement, and payment.

8.3 Determine Status of Construction. The cost engineer will determine the status of construction and the effect the changed work will have on the construction schedule. This will require obtaining progress reports, schedules, and discussions with the field office responsible for the construction. For major or complex changes, a visit to the construction site is required.

8.4 Contractor's Existing Methods. The cost engineer should be fully aware of the contractor's existing methods, capabilities, and rates of accomplishment. The estimate should not arbitrarily include methods and capabilities different from the method in which the contractor is performing the ongoing work. The cost engineer should base the change on existing contractor operations for similar work. When work is anticipated to be subcontracted, the estimate should be prepared to include subcontractor costs.

8.5 Current Labor and Equipment Rates. Current labor and equipment rates for the workforce must be obtained for ongoing work. These rates are usually available from labor reports or from the contractor upon request. Suppliers for materials should be contacted for quotes. The price, which the contractor is expected to pay, should be the basis for estimating material costs. A list of equipment on the job should be obtained and equipment rates determined in accordance with EP 1110-1-8.

8.6 Scope of Work Coordination. The cost engineer should become familiar with the scope of work through the contracting officer’s designated representative and with the contractor prior to preparation of the IGE. This discussion will assist both the Government and contractor in reaching a mutually acceptable scope of work to eliminate unnecessary effort for both parties during negotiations. After initial scope discussions, the scope of work documents may require revision for accuracy and clarity to support estimates and negotiations.

8.7 Preparation of Cost Estimates and Negotiation. The estimate can be prepared after all the information has been collected and analyzed, and the cost engineer decides upon the format to present the change. The format should distinguish between added work and deleted contract work. The estimate should denote both cost and time impacts. It is important to have a prior agreement and discussion as previously indicated with the contractor. Generally, successful negotiations depend on agreement in scope of work and accurate quantity takeoff and a detailed estimate supported by accurate cost data for all elements.

8.7.1 Additional Work. For additional work, items and format should be priced similar to a new contract as performed by the known contractor. All new work should be priced at the rates anticipated to be in effect at the time the work will be performed.

8.7.2 Changed Work. For changed work, a separate quantity takeoff for each item directly affected will be required for both before and after the change. Each item should be priced at the rates that would be in effect at the scheduled time of accomplishment. Typically, each item of changed original work is priced, and each comparable item of revised work is priced at the applicable rates. The net cost (or credit) would be obtained by subtracting the total of the original work from the total of the revised work. It is important that the cost engineer maintains a comparable scope of work for both estimates. When an item of work will be performed as originally specified, except for a revision in quantity, the net quantity may be estimated directly for that item.

8.7.3 Deleted Work. For deleted work, the item and format should be priced similar to a new procurement as performed by the current contractor. Rates in effect at the time the work would have occurred should be utilized. In addition to the direct cost of the work, overhead, profit, and bond costs should be included for credit on the deleted work.

8.7.4 Impact Related Costs. Often times, a modification can affect other portions of the contract that are not easily discernable when reviewing the modification scope. Impacts related to cost and schedule, if applicable, should be clearly described and included as part of each cost estimate. Remobilization, schedules, efficiencies, and productivities are prime examples of impact related costs. Further discussion is in paragraph 8.11.

8.8 Detail of Estimate. The cost estimate for a modification should be prepared in as much detail as required to clearly cost the change for negotiations. In many instances, even more detail is required to negotiate the lowest reasonable price. The estimate should, however, be modified to reflect a negotiated procurement in lieu of an advertised procurement. It should include a general summary sheet relating the major categories of cost of the modification, both for increases and decreases. Revised construction drawings and specifications are included in the modification supporting documents. When the cost engineer prepares the estimate, the effort should be the same as the contractor acting prudently under the given conditions. The results will generally provide an accurate estimate, which can be used as a firm basis for negotiation. The IGE should not rely on past generalized rates and settlements unless actually appropriate to the specific modification under consideration.

8.9 Basis of Estimate. The estimate should be based on the data actually collected and experienced from the project. Time motion studies are important, and periodic field visits and log records can provide this data. Previous modifications can also provide valuable data. Valuable cost data is often available from past audit reports on other modifications. With the assistance of the auditor, many costs can be readily obtained and may be directly applicable to the present modification. The cost engineer must exercise judgment in the use of audit information from a specific report that may not be released to Government personnel or other contractors.

8.10 Estimate Preparation. In addition to the preparation of an accurate cost estimate, it must be prepared in a timely manner. Procurement requirements stress the importance of settlement prior to commencing the work. As construction time progresses, the Government is at greater risk for further contractor impacts which can increase cost and time. Therefore, the cost engineer should immediately proceed to obtain the necessary data for the modification and notify the appropriate authorities of the earliest date that the estimate can be completed. It is generally understood that the larger and more complex the change, the longer the time requirement for the initial preparation of an accurate cost estimate.

8.11 Impact Cost and Schedule.

8.11.1 When a modification is initiated, the settlement of that modification includes not only the cost and time change of the work directly affected but also the cost and time impact on the unchanged work. It is very important to accurately estimate the impact portion of a modification. The scope of impact may be broad and susceptible to a large variety of situations. The following discussion will provide guidance and understanding of impact cost considerations.

8.11.2 Generally, the greatest portion of impact costs results from acceleration and/or delays due to changes. When delays due to a change can be minimized, impact costs are reduced. Impact costs are normally determined on a case-by-case basis for each particular situation. The determinations have been based on interpretation of the

Contract General Provision Clauses and on Board of Contract Appeals and court decisions.

8.11.3 The contractor generally presents impact costs as part of the proposal. The existing construction schedule furnished by the contractor must be analyzed to determine the actual construction and the extent of the impact at the time of the change. The modification work must be superimposed upon the original schedule in such a position to determine and minimize the delay. The revised plan must then be thoroughly reviewed relative to the existing job plan. This comparative review should indicate those areas, which have been affected by the modification.

8.11.4 Once the extent of impact has been determined, each cost claimed must be classified as either factual or judgmental. The factual costs are those which are fixed and established and can be determined directly from records. These include rental agreements, wage rate agreements, and purchase orders. Once the item has been determined valid as a factual impact, the item cost may be directly calculated. The amount of cost change is stated on the certified document or can be determined from the scheduled time change of the construction progress plan. Judgmental costs are dependent on variable factors such as performance, efficiency, or methodology and cannot be stated factually prior to actual accomplishment. These costs must be negotiated and based upon experienced judgments. In actual practice, most factual costs are based to varying degrees upon judgment.

8.11.5 Estimating Impact Costs and Schedules. The estimate of impact should be prepared for each activity affecting the change. In some cases, the impact items are typically so interrelated that it is often best to develop a detailed plan for accomplishing the remaining work. Each item in this plan would be estimated at the productivity and rate in effect at the time the work is to be accomplished. The same items of work under the original plan would also be estimated at the productivity and rate in effect at the originally scheduled time. The comparison of these two estimates yields the cost of impact. Impact costs determined to be valid must be estimated by the most accurate method available and included in the modification.

8.11.6 Impact Factors. The following impact factors or conditions play a recurring role in determining impact costs and schedules. Each modification must be evaluated separately and impacts considered specifically for the implications of the particular change. Impacts should only be included by detailed itemization and only after having been found to be valid.

8.11.6.1 Impact costs considered factual include escalation of material and labor wage rates, and change in equipment rates.

8.11.6.2 Impact costs and schedules considered judgmental include change of efficiency resulting from rescheduling; loss of labor efficiency resulting from long hours;

loss of efficiency caused by disruption of the orderly existing processes and procedures; inefficiency from tearing out completed work and the associated lowering of morale; loss of efficiency during rescheduling of manpower; inefficiency incurred from re-submittal of shop drawings, sample materials, etc.; and additional costs resulting from inability to transfer manpower expertise to other work; and change in management for the revised work.

8.11.6.3 Impact costs and schedules considered factual but based on judgmental decisions include increase from extending the storage period for materials and equipment; increase from extending the contract for labor cost and subsistence; increase from a longer period of equipment rentals and/or use; increase from a longer period of using overhead personnel, materials, and utilities; and increase from a longer period of providing overhead and project office services.

8.12 Cost Engineering Support.

8.12.1 Before participating as part of a negotiating team, the cost engineer must become thoroughly familiar with negotiating requirements and techniques. The expertise and support of the cost engineer can be very beneficial in major and complex changes.

8.12.2 The cost engineer should review the contractor's proposal. Many of the costs that are presented in the contractor's proposal breakdown must be reviewed for allowability. Of those costs found allowable, each item must further be reviewed for applicability for that portion relevant to the particular change. The auditor has primary responsibility for this determination and should advise the negotiation team accordingly. For those cases where the auditor is not directly involved, the negotiation team must base their decisions on regulatory guidance and the best expertise available. In accomplishing the review of the proposal, the cost engineer should remain constantly aware of the contractor's profit motivation. The Government must consider all reasonable costs anticipated to be incurred by the contractor.

8.13 Estimate Revisions. Revision of the IGE may be necessary as a result of an error, changed conditions, or additional information. Approval authority for revisions to the estimate remains the responsibility of the contracting officer or authorized original estimate-approving official. When the IGE is changed during or subsequent to conferences or negotiations, the details of the basis for the revision or changes in price shall be fully explained and documented in the price negotiation memorandum. A copy of each estimate that has been approved should be included in the official modification file along with the details and circumstances causing the revisions.

CHAPTER 9

Technical Reviews

9.1 General. To improve the quality of the cost estimates, there are various levels of review as discussed within this chapter. Certain reviews are mandatory and are directed by headquarters (refer to ER 1110-2-1150 and ER 1110-2-1302). The reviews cover the products from "top to bottom" to ensure quality and confidence has been maintained.

9.2 District Quality Control Review.

9.2.1 The DQC review (also known as a peer review) is an internal peer review by a technical element within a district as a quality control measure. It consists of a formal procedure or set of procedures intended to ensure that the developed product adheres to a defined set of quality criteria or meets the requirements of the client, customer, and regulations. A DQC is similar to, but not identical with, QA. QA is often times defined as a procedure or set of procedures intended to ensure that a product or service under development (before work is complete, as opposed to afterwards) meets specified requirements. QA is sometimes expressed together with QC as a single expression, QC/QA. A sample quality review checklist is provided in appendix F.

9.2.2 Within the estimate processes, the cost engineering office is required to prepare the products in accordance to the regulations, most specifically to ER 1110-2-1150 and ER 1110-2-1302 for each phase of the estimate. The cost engineering office shall provide a formal review process performed by a senior lead estimator to ensure the products meet cost estimating requirements. In these cases, it may relate to various design phases with respect to scope, quantities, estimates, schedules, escalation, and contingencies.

9.2.3 While much focus is placed on the quality of the IGEs, other estimates are equally and possibly more important. It is highly advisable that all critical estimates, schedules, and the resulting TPCS receive a quality review by a senior estimator within a formal process. When cost estimates are subject to an ATR or independent cost review, the quality responsibility remains within the estimating office that produced the estimate. The earlier estimates used for budgeting, programming, and congressional authorization and funding are very important management tools that should not be overlooked, underutilized, or unsupported by the PDT.

9.3 Agency Technical Review.

9.3.1 It has become more commonplace for upper management to require an ATR (formerly known as an independent technical review). An ATR is an independent technical review, which is a critical examination by a qualified person or technical team outside the submitting district that is not involved in the day-to-day technical work that supports a decision document. The review products normally include all documents, including the TPC. Documents include scoping information, plans and specifications, reports, quantities, estimates, schedules, risk analyses, and record of DQC. For the cost data, the ATR may include the TPC or specific portions of the TPC. The ATR can be performed at any stage of product development, even during construction as a measure of quality, confidence, and reliability.

9.3.2 HQUSACE mandates that the National Planning Centers of Expertise coordinate with the Cost Engineering Center of Expertise (CX) at the Walla Walla District for ATR of cost estimates, construction schedules, and contingencies included in all decision documents requiring Congressional authorization. The Cost Engineering CX will assign the reviewer(s) to the review teams and will utilize the USACE personnel and/or private sector to assure highly qualified persons are available to conduct these reviews. This approach will provide consistency in business practices and in the use of cost engineering tools. The Cost Engineering CX also developed a technical review checklist (appendix F) to assist the Cost Estimator on the PDT and the ATR team to ensure that the critical project planning, design, and engineering data are made available prior to preparation of the TPC estimate (appendix B of ER 1110-2-1302). This checklist is intended to serve as guidance, is considered a living document, and can be changed to better serve the product under review.

9.3.3 An ATR during the reconnaissance phase shall concentrate on evaluation of the overall project plans, on the initial cost estimates, and on the PMP. Reviewers shall also evaluate the schedule, budget, and work plan proposed in the PMP for the feasibility phase (refer to ER 1110-2-1150).

9.3.4 An ATR for the feasibility phase, as a minimum, must verify that the level of engineering is sufficient to substantiate both the screening level comparative cost estimates and the BCE with contingencies to support selection of the recommended plan and to establish the baseline schedule and cost estimate with contingencies.

9.3.5 Senior estimators, preferably USACE regional technical experts, shall be used for ATRs. A-Es shall use senior experienced cost engineers or estimators, who are certified by a professional estimating organization, to conduct their product ATRs. The ATR process requires a formalized comment and resolution process.

9.3.6 In order to receive a certification, the ATR process requires a formalized comment and resolution process. It is important that the reviewer be given the opportunity to formally place the comments, consider comment responses, back check the revised products, and close out all comments as having been resolved. For the TPC, the certification shall document the final acceptance date, the accepted cost, and schedule to ensure the integrity of what product has been certified and to what value.

9.4 Independent External Peer Review. Like the ATR, an IEPR may be required by upper management. An IEPR is an independent review of the technical efficacy of a decision document by a review organization external to USACE. The term “external” implies non-USACE or non-governmental review. An IEPR is conducted on projects that meet mandatory or discretionary triggers outlined in Engineer Circular 1105-2-410, Review of Decision Documents. Similar to the ATR process, a formalized comment resolution process must take place and may fall under scrutiny through FOIA. Often times, the IEPR occurs at the same time as an ATR. IEPR coordination is critical regarding timeliness and funding, because the IEPR commonly requires a contractual process to fund the IEPR.

APPENDIX A

References

Public Law 74-403
Davis-Bacon Act, http://www.dol.gov/esa/regs/statutes/whd/dbra.htm

Public Law 95-269 (91 Stat. 218-219)
Pertains to preparation of construction cost estimates as though the Government were a prudent and well-equipped contractor.

Public Law 99-662 (H.R.6)
The Water Resources Development Act of 1986.

Title 33 United States Code Section 622 and 624
Section 624 provides that projects for river and harbor improvement shall be performed by private contract if the contract price is less than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or less than 25 percent in excess of a fair and reasonable estimated cost of a well-equipped contractor doing the work.

Federal Acquisition Regulation (FAR), Subparts 14, 15, and 36
http://www.acquisition.gov/far/

Defense Federal Acquisition Regulation Supplment (DFARS)
http://www.acq.osd.mil/dpap/dars/dfarspgi/current/index.html

Engineer Federal Acquisition Regulation Supplement (EFARS)
http://www.hq.usace.army.mil/cepr/efars.htm.

Army Regulation (AR) 25-55
Department of Army Freedom of Information Act Program,
http://www.army.mil/usapa/epubs/pdf/r25_55.pdf

Army Field Manual 5-434
Earthmoving Operations

Engineer Regulation (ER) 5-1-11
U. S. Army Corps of Engineers Business Process
http://www.usace.army.mil/inet/usace-docs/eng-regs/er5-1-11/toc.htm

ER 1110-1-12
Quality Management
http://www.usace.army.mil/publications/eng-regs/er1110-1-12/toc.htm

ER 1110-1-1300
Cost Engineering Policy and General Requirements
http://www.usace.army.mil/inet/usace-docs/eng-regs/er1110-1-1300/toc.htm

ER 1105-2-100
Planning Guidance Notebook
http://www.usace.army.mil/publications/eng-regs/er1105-2-100/toc.htm

ER 1110-2-1150
Engineering and Design for Civil Works Projects
http://www.usace.army.mil/inet/usace-docs/eng-regs/er1110-2-1150/toc.htm

ER 1110-2-1302
Civil Works Cost Engineering
http://www.usace.army.mil/inet/usace-docs/eng-regs/er1110-2-1302/toc.htm

ER 1110-2-8159
Life Cycle Design and Performance and Civil Works Missions and Evaluation Procedures
http://www.usace.army.mil/publications/eng-regs/er1110-2-8159/toc.htm

ER 1130-2-520
Navigation and Dredging Operations and Maintenance Policies
http://www.usace.army.mil/publications/eng-regs/er1130-2-520/toc.htm

Engineer Manual 1110-2-1304
Civil Works Construction Cost Index System (CWCCIS)
http://www.usace.army.mil/publications/eng-manuals

Engineer Pamphlet 1110-1-8
Construction Equipment Ownership and Operating Expense Schedule
http://www.nww.usace.army.mil/cost/ep.asp

Construction Specifications Institute
http://www.csinet.org/s_csi/index.asp

APPENDIX B

Total Project Cost Summary

B-1. General.

a. A Total Project Cost Summary (TPCS) is required for all civil works cost estimates submitted for approval at all levels within the U.S. Army Corps of Engineers (Corps). Figure B-1 illustrates the TPCS process. Figures B-2 and B-3 are examples based upon feasibility estimate reporting requirements in Engineer Regulation (ER) 1105-2-100, Planning Guidance Notebook. "Two project cost estimates shall be displayed in the feasibility report; one based on constant dollars and one based on projected inflation rates." The basis for this second estimate is the project schedule. It is developed on an inflated dollar basis and represents the fully funded project cost.

b. This inflated total project cost is information for the non-Federal sponsor's financial analysis. The primary purpose of the financial analysis itself is to ensure that the non-Federal sponsor has a reasonable plan for meeting its financial commitment. Financial analysis is not normally a function of cost engineering.

c. A TPCS shall be prepared at each significant milestone throughout project development. Whenever the construction cost estimate is greater than 2 years old, the estimate shall be updated and a new TPCS prepared. For authorized projects, the estimate and TPCS shall be updated annually.

d. The TPCS is a signature document for the appropriate district managerial approvals. ER 1105-2-100 states that project cost estimates will be prepared by or reviewed by the cost engineering office in the district and the chief of that office will sign the estimate. Real estate estimates included in the project cost are reviewed, approved, and signed by the chief or designee of the real estate office. Figure B-2 lists other review/approval signatures that may be a district requirement.

e. Preparing a TPCS during the reconnaissance phase is recommended, because it is the first document that will show the estimated total project cost at the anticipated authorizing budget year and forecast the total project cost inflated through construction based on the known scope and schedule.

f. The sample TPCS (figure B-2) is in a spreadsheet format beginning with the total project cost summary followed by total contract cost summary sheets (figure B-3). One contract summary sample is shown whereas the data shown in the project summary sheet represents multiple contracts for this sample project. The summary is a rollup of all contracts.

g. Each form consists of three primary data columns. For reporting purposes, round project costs to the nearest thousand dollars. By definition, total project cost reflects all related costs to the project in the form of all feature level accounts, escalation, and contingency.

B-2. Current Total Project Cost.

a. The first primary column is the current total project cost including the Microcomputer Aided Cost Engineering System construction estimate, estimates for lands and damages, feasibility studies, planning, engineering and design, and construction management. All are identified by their applicable Civil Works Work Breakdown Structure / work category code / feature code. A contingency for each item is shown. The effective price level date for costs in this primary column is the date when the estimates were prepared. This is typically the preparation date of the construction estimate.

b. For lengthy projects having construction contracts with extended construction periods and multiple cost elements scheduled over a period of years, the cost engineer must assure that the estimates include escalation for inflation when funding is obligated at the beginning of an extended period. Refer to Engineer Manual 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS). The best example is a fixed price contract where the funds are obligated at the beginning of the contact.

c. Without firm cost estimates and schedules, neither the Federal government nor the non-Federal sponsors can make prudent financial and budgetary decisions.

B-3. Program/Budget Year Total Project Cost.

a. The second primary column is the total project cost at the price level for the authorization year/budget year/program year. This total project cost estimate based on constant dollars is the one used for authorization purposes and is the total project cost used to determine subsequent Section 902 cost limits (appendix G of ER 1105-2-100), which is one of the cost estimates to be displayed in the feasibility report.

b. The total cost of each contract and/or element in the project is indexed to the scheduled budget/program year. The dollar amounts are computed on a constant dollar basis using the appropriate cost indices. Refer to CWCCIS. Typically, the price level date is 1 October (of the program year). The basic formula is as follows:

$$\frac{\textbf{Cost Index}\ \text{(Budget/Program Year)}}{\textbf{Cost Index}\ \text{(Current Preparation Date)}} \times \textbf{Current Cost}\ \text{(Extended duration activities Include escalation for inflation)} = \textbf{Budget/Program Year Cost}$$

c. Current total project cost and program/budget year total project cost presented in the first two columns on the TPCS, respectively, are suitable for economic analysis, because each are developed on a constant dollar basis. Costs and benefits are to be compared on the same price level.

B-4. Inflated Total Project Cost.

a. The third primary column of the TPCS is the total project cost estimate inflated through project completion, which is the second cost estimate to be displayed in the feasibility report. For financial analysis, an inflated dollar basis is to be used for the sponsor's information. Reasonably accurate and complete cost estimates and schedules are necessary for the Federal Government and the non-Federal sponsors to make prudent financial and budgetary decisions.

b. The project schedule is used to forecast when project elements will begin and the duration of each element. Knowing how each activity/element is funded and the duration will illustrate when the costs are expected to occur.

c. When the activity/element is scheduled over an extended period and the estimate includes escalation to account for inflation over the duration of the activity/element, the date used to select the CWCCIS index must be the beginning of the activity/element.

$$\frac{\textbf{Cost Index}\ \text{(Beginning Date)}}{\textbf{Cost Index}\ \text{(Current Preparation Date)}} \times \textbf{Current Cost}\ \text{(including escalation for inflation)} = \textbf{Inflated Cost}$$

d. For construction contracts and other project elements having a relatively short duration, choosing an index coinciding with the midpoint of the duration may be adequate to escalate the costs for inflation. Also, activities/elements that are primarily level of effort, where costs are relatively consistent throughout the duration, a date at the midpoint of the duration is usually adequate to select the CWCCIS index to inflate the activity/element cost.

$$\frac{\textbf{Cost Index}\ \text{(Duration midpoint Date)}}{\textbf{Cost Index}\ \text{(Current Preparation Date)}} \times \textbf{Current Cost} = \textbf{Inflated Cost}$$

e. Sunk costs, construction and activities completed, are reported in this primary column. Reconnaissance study costs are 100 percent Federal cost prior to project authorization and should not be included as a sunk cost.

f. Not printed (for reporting purposes) with the contract summary sheet are additional spreadsheet cells containing the costs indices used in the constant dollar and inflated dollar calculations. On the far left of figure B-3, the CWCCIS cost index for each line item is shown. The project schedule is used to determine the applicable index for each line item.

g. The costs of water resources studies and projects developed by the Corps are shared between Federal and non-Federal entities as defined in laws and administrative provisions. The Water Resources Development Act of 1986, established new cost sharing rules for all studies and projects conducted by the Corps. The cost sharing provisions of the Water Resources Development Act of 1986 place greater financial responsibilities on non-Federal sponsors of Corps projects. The amount of non-Federal share varies depending upon the project purpose and the general and specific laws that apply to each project.

h. The total project cost inflated through construction is divided into Federal cost and non-Federal cost. The non-Federal cost is for the sponsor’s information and financial analysis.

i. The cost engineer must coordinate with the project manager to determine the appropriate cost sharing percentages applicable to the project. To illustrate, the cost of feasibility studies is shared equally (50/50) and the remaining project cost may be shared 25 percent non-Federal cost and 75 percent Federal cost. Guidance on cost sharing for each civil works mission and authority is presented in ER 1105-2-100.

B-5. Section 902 Project Cost Limit.

a. When appropriate for authorized projects spanning several years, the TPCS is updated annually and the Section 902 project cost limit is computed and presented on the updated TPCS.

b. The maximum project cost limit imposed by Section 902 is a numerical value specified by law, which must be computed in a legally supportable manner. It is not an estimate of the current cost of the project. The construction component of the authorized cost will be updated to account for historical inflation using the CWCCIS. The real estate component of the authorized cost will be updated to account for historical inflation based on changes to the Consumer Price Index. ER 1105-2-100, appendix G, paragraph G-15a., provides detailed guidance on the calculations necessary to determine the numerical value.

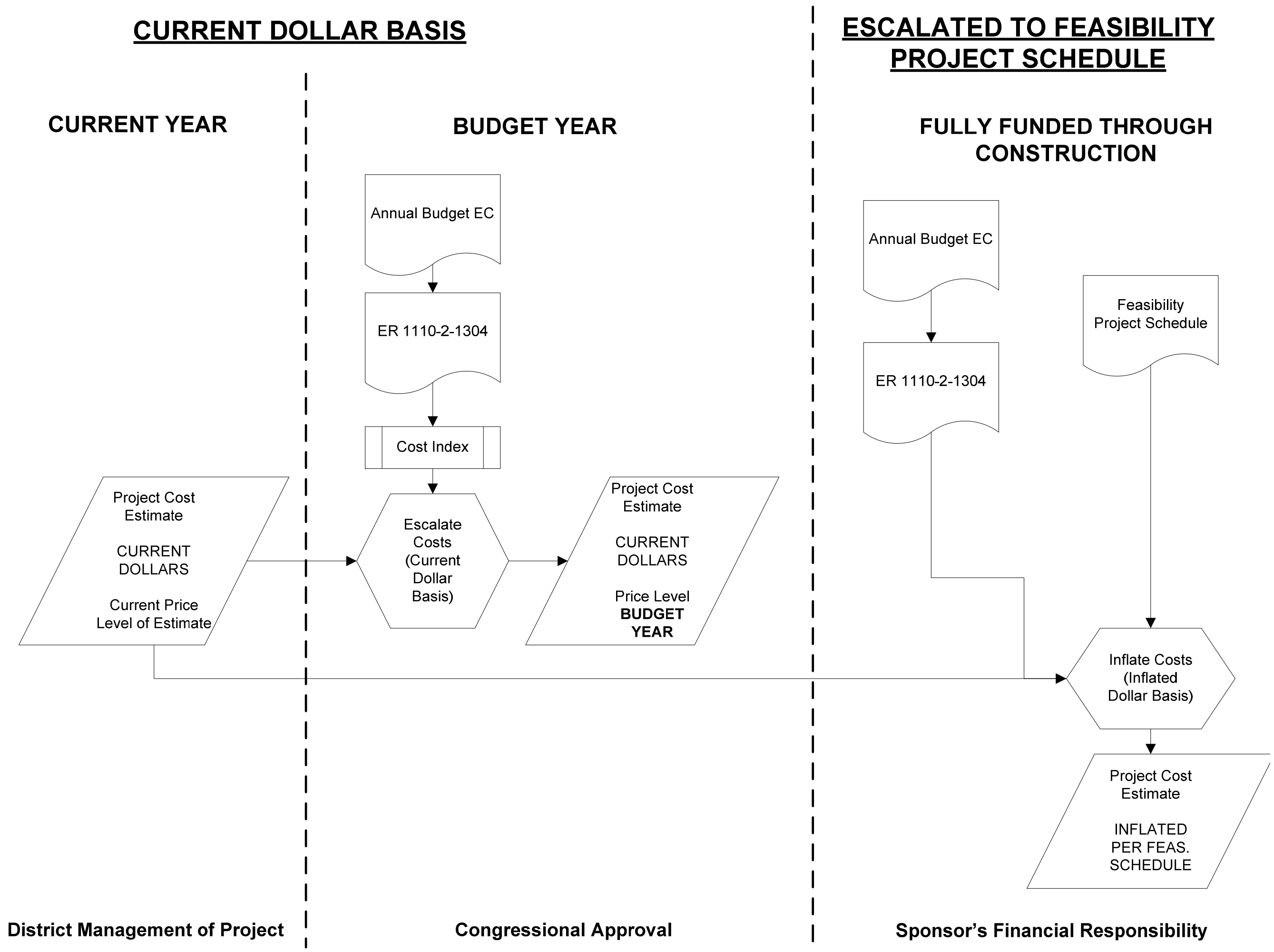


Figure B-1. TPCS Flowchart

****** TOTAL PROJECT COST SUMMARY ******

PAGE 1 OF __

PROJECT: ____________________ DISTRICT: ____________________
LOCATION: ____________________ P.O.C.: ____________________

		CURRENT MCACES ESTIMATE PREPARED: SEE EACH FOLLOWING SHEETS.				AUTHORIZ./BUDGET YEAR: 2008 EFFECT. PRICING LEVEL: 1 OCT 2007				FULLY FUNDED ESTIMATI		
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	SPENT THRU FY 07 ($K)	COST ($K)	CNTG ($K)	FULL ($K)
04	DAMS	73,726	17,886	24%	91,612	74,572	18,091	92,663	62,989	79,793	19,396	162,178
06	FISH & WILDLIFE FACILITIES	4,885	1,735	36%	6,620	4,962	1,761	6,723		6,114	2,169	8,283
	TOTAL CONSTRUCTION COSTS ===>	78,611	19,621	25%	98,232	79,534	19,852	99,386	62,989	85,907	21,565	170,461
01	LANDS AND DAMAGES								500			500
21	RECONNAISSANCE STUDIES											
22	FEASIBILITY STUDIES											
30	PLANNING, ENGINEERING & DESIGN	3,078	880	29%	3,958	3,117	888	4,005		3,401	979	4,380
31	CONSTRUCTION MANAGEMENT	10,269	2,540	25%	12,809	10,386	2,564	12,950		11,197	2,778	13,975
	TOTAL PROJECT COSTS ========>	91,958	23,041	25%	114,999	93,037	23,304	116,341	63,489	100,505	25,322	189,316

TOTAL FEDERAL COSTS ==============>	**180,415**
TOTAL NON-FEDERAL COSTS ==========>	8,900
THE MAXIMUM PROJECT COST IS =======>	189,316
THIS TPCS REFLECTS A PROJECT COST CHANGE OF	**68,405**
THE 902 COST LIMIT IS =============>	120,911
	110%

____________________ CHIEF, COST ENGINEERING, ____________

____________________ PROJECT MANAGER, ____________________

____________________ CHIEF, REAL ESTATE ____________________

____________________ CHIEF, PLANNING

____________________ CHIEF, ENGINEERING

____________________ CHIEF, OPERATIONS

____________________ CHIEF, CONSTRUCTION

____________________ CHIEF, CONTRACTING

____________________ CHIEF, PM-PB

NOTE: Valid only when completely signed.

hh902limit tps 15Aug2007 Gareths File

Printed: 8/22/2007

Figure B-2. Total Project Cost Summary

**** TOTAL CONTRACT COST SUMMARY ****

PAGE 5 OF 10

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE 60% DESIGN DATED: JULY 2006

CWCCIS EM 1110-2-13-4, Page 3, April 2001

PROJECT: ____________________
LOCATION: ____________________

DISTRICT: ____________________
P.O.C.: ____________ CHIEF, COST ENGINEERING

Mid Point of Constr.	CWISS #			ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: 2007(Apr - Jun) COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: 2008 EFFECT. PRICING LEVEL: 1 OCT 2007 OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED ESTIMATE FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
2007Q3	658.64	2007(Apr - Jun)	ESTIMATE PREPARED DATE															
2008Q1	666.19	2007(Oct - Dec)	BUDGETING'S EFFECTIVE PRICING LEVEL DATE: 1 OCT 2007															
2008Q4	678.50	2008(Jul - Sep)	CONSTR MID POINT DATE	04	DAMS FISH PASSAGE RESTORATION FACILITY SUPPORT BUILDINGS - SITEWORK, ADMINISTRATIVE (3,329 SF) AND MAINTENANCE (4,935 SF) BUILDINGS	2,142	536	25%	2,678	1.1%	2,167	542	2,709	2008Q4	1.8%	2,207	552	2,759
					TOTAL CONSTRUCTION COSTS ===>	2,142	536	25%	2,678		2,167	542	2,709			2,207	552	2,759
2008Q1	666.19	2007(Oct - Dec)	Not used.	01	LANDS AND DAMAGES													
2008Q1	666.19	2007(Oct - Dec)	Not used.	22	FEASIBILITY STUDIES (Environmental Documents)													
				30	PLANNING, ENGINEERING & DESIGN													
2008Q1	666.19	2007(Oct - Dec)	DESIGN MID POINT DATE	2.5%	Project Management	54	14	25%	68	1.1%	55	14	69	2008Q1		55	14	69
2008Q1	666.19	2007(Oct - Dec)	DESIGN MID POINT DATE		Planning & Environmental Compliance													
2008Q1	666.19	2007(Oct - Dec)	DESIGN MID POINT DATE	2.6%	Engineering & Design	57	14	25%	71	1.1%	58	14	72	2008Q1		58	14	72
2008Q1	666.19	2007(Oct - Dec)	DESIGN MID POINT DATE		Engineering Tech Review & VE													
2008Q1	666.19	2007(Oct - Dec)	DESIGN MID POINT DATE		Contracting & Reprographics													
2008Q1	666.19	2007(Oct - Dec)	DESIGN MID POINT DATE		Project Operation:													
				31	CONSTRUCTION MANAGEMENT													
2008Q4	678.50	2008(Jul - Sep)	CONSTR MID POINT DATE	7.0%	Construction Management	149	38	25%	187	1.1%	151	38	189	2008Q4	1.8%	154	39	193
2008Q4	678.50	2008(Jul - Sep)	CONSTR MID POINT DATE	3.0%	Engineering During Construction	64	17	25%	81	1.1%	65	17	82	2008Q4	1.8%	66	17	83
2008Q4	678.50	2008(Jul - Sep)	CONSTR MID POINT DATE		Planning During Construction													
2008Q4	678.50	2008(Jul - Sep)	CONSTR MID POINT DATE		Project Operation:													
2008Q4	678.50	2008(Jul - Sep)	CONSTR MID POINT DATE	2.5%	Project Management	53	14	25%	67	1.1%	54	14	68	2008Q4	1.8%	55	14	69
					TOTAL COSTS ==================>	2,519	633	25%	3,152		2,550	639	3,189			2,595	650	3,245

Note: The above Percentage is a percentage of (30 or 31 Amount Total) divided by Total Construction costs. (Required for Reviewing 30 & 31 accounts amounts)

Figure B-3. Total Contract Cost Summary

APPENDIX C

Tri-Service Automated Cost Engineering Systems

C-1 General.

a. This appendix provides information on the Tri-Service Automated Cost Engineering Systems (TRACES), which is the umbrella linking all automated cost engineering systems and their associated databases. The Tri-Service Committee on cost engineering is the proponent for all the major components of TRACES. The assigned responsible agency for TRACES is the U.S. Army Engineering and Support Center, Automated Systems Branch, TRACES group, Huntsville, Alabama (https://www.hnd.usace.army.mil/TRACES/). The assigned responsible agency serves as the focal point for support usage of these software programs by providing operation, maintenance, and "Hot-Line" telephone support.

b. Detailed guidance on the use of each system can be found in the appropriate system user manual for each software program. The appropriate policy guidance on the use of automation in developing cost estimates is provided in the specific agency cost engineering regulations.

c. The entire system seeks to provide a user-friendly cost engineering platform in a standard environment that will provide the cost engineer the tools to prepare, review, and maintain all types of cost estimates. Software for scheduling construction projects is also linkable to TRACES. Figure C-1 depicts the major components of TRACES.

C-2 Use of Automated Systems. The use of cost engineering automated systems enhances the efficiency, accuracy, and credibility of project cost estimates. Automation assists in the standardization of estimating procedures and provides estimates that are easily reviewed, revised, and adapted to new projects or situations. Standardization assists in collection and analysis of historical costs that can be used to develop budget estimates for cost comparison purposes, for reporting and tracking of project cost data, and for the building of parametric models.

a. Software Updates and New Systems. Automation continues to develop at a rapid pace. Minor upgrades may occur annually and major system changes every 2 or 3 years. Major new systems may be fielded at any time. Cost engineers should ensure that they are using the latest available software versions.

b. Limitations of Automation. Automation is a tool, and even the best cost automated system is not a replacement for good estimator judgment. The cost engineer should always be knowledgeable of the system's capabilities and limitations in relation to a project. The cost engineer must be especially careful in using models, parametrics, average unit rates and prices, cost books, and in adopting existing estimates to new projects. The automated information sources, especially in critical and major cost areas, should be further studied for reasonableness as related to the specific project under development. Estimate output should be checked for reasonableness. Assumptions and methodology should be verified and documented.

C-3 Major Automated Systems and Modules. TRACES includes the following major systems/modules: a detailed quantity takeoff, cost engineering system referred to as Microcomputer Aided Cost Engineering System (MCACES); a parametric system for the preparation of less than fully detailed design estimates for military construction projects referred to as Parametric Cost Engineering System (PACES); a historical cost analysis generator (HAG) to collect, store, and analyze historical cost data for facilities and site work; a location area cost factor (ACF) system to adjust average historical facility costs to a specific project location; a Cost Engineering Dredge Estimating Program (CEDEP); a life cycle cost (LCC) module for analysis of system design alternatives; a parametric system for preparation of Hazardous, Toxic, and Radioactive Waste (HTRW); budgetary estimates called Remedial Action Cost Estimating Requirements (RACER); a scheduling interface (SI) module; and risk analysis systems.

a. Microcomputer Aided Cost Engineering System. MCACES is a multi-user software program for the preparation of detailed construction cost estimates for military, civil works, and HTRW programs. The system also includes a project database and supporting databases. The supporting databases include Cost Book, crews, assemblies, labor rates, equipment ownership schedule costs, and models. All databases work in conjunction with each other to produce a detailed cost estimate. The databases are described in the MCACES user manual.

b. Parametric Cost Engineering System. PACES is a parametric cost estimating system, which is used primarily for development of programming or budgetary cost estimates in support of Military Construction Programs such as military facilities, family Housing, medical, and operation and maintenance projects. PACES is a comprehensive program incorporating cost models for new construction, alteration, and renovation. The system uses a parametric methodology adjusting cost models for estimating project costs. The cost models are based on generic engineering solutions for building and site work projects, technologies, and processes. The generic engineering solutions were derived from historical project information, government laboratories, construction management agencies, vendors, contractors, and engineering analysis. PACES provides the capability to prepare cost estimates of military projects based on past designs on less than fully detailed design information. It uses the appropriate Work Breakdown Structure (WBS), a database of models and assemblies from historic projects, and a series of detailed linking algorithms used to develop a cost estimate. If desired, the estimate can be transferred to MCACES or SUCCESS™ for task-by-task analysis of the cost estimate. PACES is the U.S. Air Force's primary tool for preparing programming estimates.

c. Historical Cost Analysis Generator Software/Module. HAG is a stand-alone software/module, which is used to collect and display historical cost data from awarded projects. HAG uses the standard WBS structure to track historical bid costs by type, location, size, and time and has the capability of automatically normalizing and adjusting awarded costs. The HAG system also provides a vehicle to retrieve selected statistical cost information from the historical cost database for use in the preparation of programming or budgetary cost estimates.

d. Area Cost Factor Program. The ACF program calculates the area cost factor index for each specific location based on material, labor, and equipment index and matrix factors. At a given installation, the combination of local labor, material, and equipment costs has the largest impact on total construction cost. Therefore, a comparison of the local labor, material, and equipment project costs for typical military construction at different cities would give a comparison of relative construction costs. A market basket of 10 labor crafts, 20 materials and 4 pieces of construction equipment, and 7 matrix factors for each location are used in the calculation of the ACF index.

e. Cost Engineering Dredge Estimating Program.

(1) The CEDEP is a stand-alone program used for the preparation of pipeline, hopper, and mechanical dredge estimates. Two support data files are also provided within CEDEP. The CHECKRATE support program also included in the CEDEP is a computerized version of the Dredge Ownership and Operating Rate Worksheet, chapter 4 of Engineer Pamphlet 1110-1-8, *Construction Equipment Ownership and Operating Expense Schedule*.

(2) CEDEP is a comprehensive software package that allows the user to prepare estimates for dredging. Three separate Microsoft Excel® templates are available. Clamshell CEDEP, which is used to create estimates using mechanical type dredge, Hopper CEDEP, which is used to create estimates using hopper dredge plant, and Pipeline CEDEP, which is used to create estimates using cutter head type dredge.

f. Life Cycle Cost Module. The LCC module is a stand-alone program designed primarily to conduct LCC analyses among competing design alternatives for a given project providing a record of the results. The program comes with an extensive maintenance and repair (M&R) database tailored for U.S. Army buildings. Estimates of construction/acquisition costs can be transferred electronically into the LCC module from any MCACES Gold project estimate. The most prominent capabilities are: (1) to conduct LCC analyses in accordance with the provisions of statutes, regulations, and requirements; (2) to calculate the present worth of individual building or facility components; and (3) to compare M&R costs for building components in the M&R database.

g. Remedial Action Cost Estimating Requirements System. RACER is a parametric cost estimating system, which is used primarily for development of programming or budgetary cost estimates for environmental projects. The RACER system provides engineers, managers, estimators, and technical support personnel an easy-to-use tool to quickly develop budget estimates for environmental projects when little or no design information is available to develop a detailed cost estimate. The system is a comprehensive program incorporating cost models for studies (PA/SI, RI/FS and RFI/CMS), remedial design, remedial action, operations and maintenance, long term monitoring, and site work and utilities. The system uses a parametric methodology for estimating costs. The cost models are based on generic engineering solutions for environmental projects, technologies, and processes.

h. Scheduling Interface Module. The SI module is a stand-alone program that provides project scheduling capabilities for MCACES or SUCCESS™ cost estimates. The SI module produces a pure logic sequencing of project activities for scheduling purposes. The module also allows export of this data to various scheduling software packages for the development of more detailed scheduling functions. The scheduling data produced by the SI module is stored with the MCACES/SUCCESS™ estimate (Project Database) and can be saved as a master template or as a model for future use by other projects.

i. Risk Analysis Systems

(1) Crystal Ball® Software. For civil works, 2007 Headquarters U.S. Army Corps of Engineers guidance requires utilization of a Monte Carlo theory, i.e., statistical-based risk software known as Crystal Ball® to study risks for contingency development. This replaces previous software programs for civil works estimates. This requirement is “for all decision documents requiring Congressional authorization for projects exceeding $40 million.” This guidance statement refers to the total project cost, normally established at the feasibility stage; however, during any critical period of the project, a risk analysis may be prudent to highlight areas of concern that may be “mitigated” to lessen risk to cost and schedule. The advantage of the risk analysis process is that it includes all major project delivery team members with respect to all costs and features related to the total project cost. This risk analysis process provides a forum for discussion whereby the members meet to discuss risk potentials that may adversely impact the project. Moreover, those meetings may also highlight opportunities that the team finds advantageous for the project. Value engineering studies may also be an outcome of these meetings.

(2) COSTRISK. The Risk Analysis Systems (CostRisk) software program provides the capability to assess risk and uncertainty associated with any Military, Civil Works, or HTRW project cost estimate at any time during the project life cycle period. This process of “probability based” estimating can be used to revise estimates based on “confidence levels” and can assist in the evaluation of project contingency funds. The CostRisk software is designed to work with TRACES parametric cost estimating programs (PACES and RACER). In addition to these interfaces, CostRisk is capable of performing a cost risk analysis on any cost estimate that is developed in Microsoft Excel®. CostRisk performs cost risk analysis on the construction cost estimates using Monte Carlo simulation techniques as the basis of its calculations.

j. Other Systems. The need to integrate cost estimating tools with agency specific program/project management systems has led to the development of several cost estimating tools and modules. Some of these tools are stand-alone programs designed primarily for a specific requirement and for use by base/installation personnel, which include PC-Cost, Department of Defense Form 1391 (for Army users); SUCCESS, PCEM, Department of Defense Form 1391 + Project Cost (for Navy users).

C-4 Databases and Files Used by TRACES Systems/Modules.

a. Cost Book Database. The Cost Book database, also referred to as the Unit Price Book (UPB) supporting the MCACES, is a collection of common construction detail line item tasks used in developing project estimates for military, civil works, and HTRW programs. The Cost Book is organized in accordance with the Construction Specification Institute numbering system. These material costs can be modified to reflect localized costs for other locations. Each task listed provides unit costs for labor, equipment, and materials. Localized Cost Books can be developed by modifying the key rates in the national Cost Book.

b. Models Database. This database contains groupings of assemblies for a whole facility or site work entity. Linkage between assemblies and assemblies to tasks are by WBS or as exists in a historic estimate. Linkage algorithms are provided to the cost engineer for project-specific estimate refinement. At the heart of the detail pricing is the Cost Book task costs. Using models can reduce the time for estimate preparation but relies heavily on past designs using default linkages.

c. Assemblies Database. The assemblies database stores common groupings of related work tasks, each representing a composite cost required to create a larger piece of a project rather than a single task. The individual cost items within each assembly are either extracted from the Cost Book or from the labor and equipment databases. The database is broken down according to the WBS. Each assembly includes parameter worksheets, requiring only input of parameters appropriate for the specific job. Using assemblies can greatly reduce the amount of data entry required to build a project.

d. Other Databases. Other TRACES databases include the crews' database, labor rates database, and equipment rates database.

e. Work Breakdown Structure Data File. This data file provides a separate hierarchical work breakdown master structure for use as a template in formatting cost estimates for civil works, military, and HTRW projects.

f. Civil Works Construction Cost Index System. The Civil Works Construction Cost Index System (Engineer Manual 1110-2-1304) will be used to update unit prices and various project cost features to current price levels. Inflation factors published in Civil Works Construction Cost Index System for use in predicting future costs are based on those factors developed by the Office of Management and Budget. The factors are published by Headquarters U.S. Army Corps of Engineers, Programs Division, in the Engineer Circular for the Annual Program and Budget Request for Civil Works Activities.

g. Area Cost Factor Index. The ACF index is used in adjusting estimated costs to a specific geographical area. The factors reflect the average surveyed difference for each location in direct costs between that location and the national average location.

h. Historical Cost Analysis System. The Historical Cost Analysis System is a stand-alone system to store historical cost data for HTRW remedial action projects. Project costs are stored in the program using a Historical Cost Analysis System-developed category code and the Remedial Action WBS. The user may search the database by using the query function and specifying the type of media, type of contaminant, and type of technology. The search can also be narrowed by additional criterion such as contract types, geographic location, award date, HTRW Remedial Action WBS, etc. Project cost can be printed or exported to other programs.

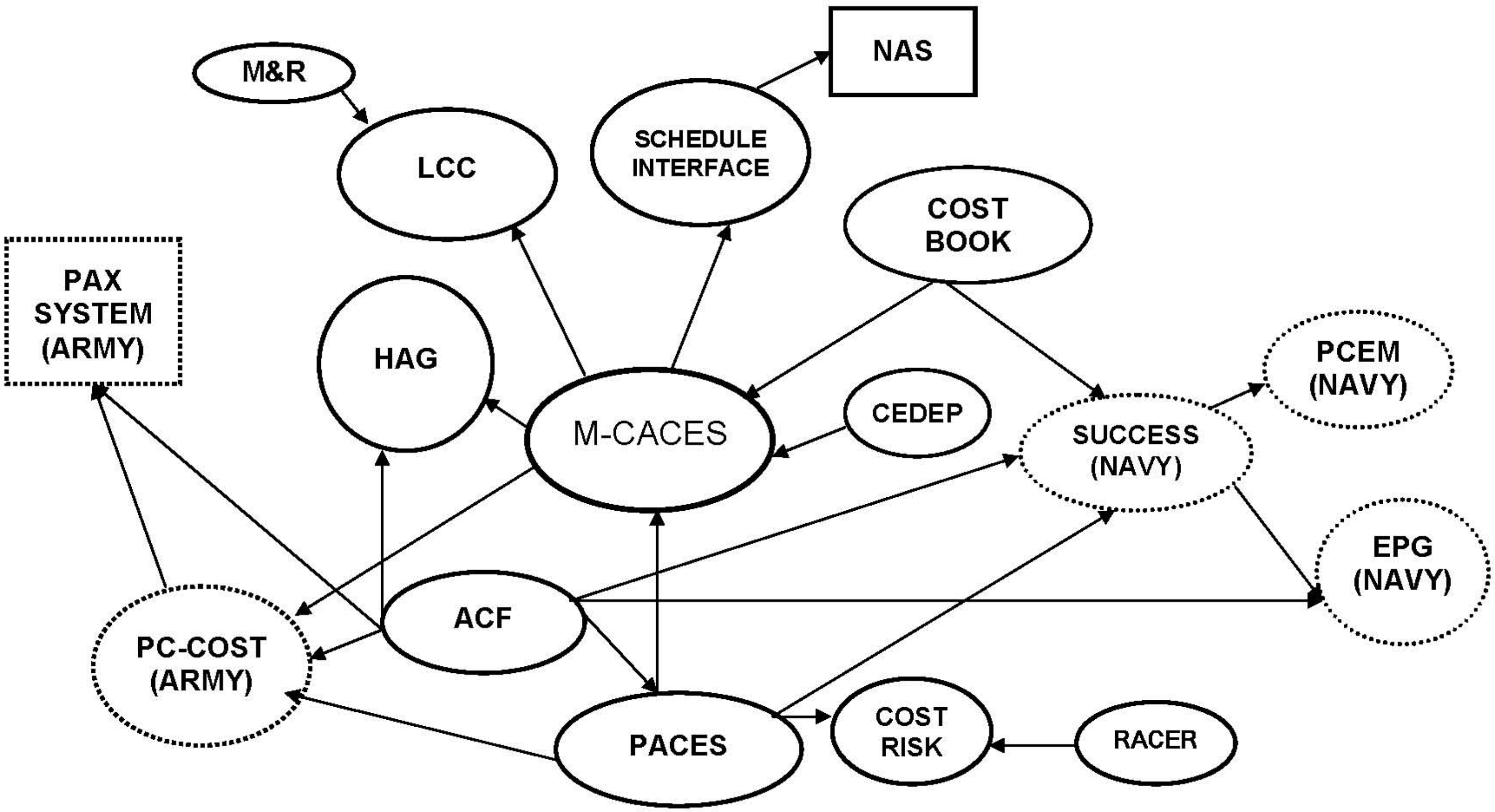


Figure C-1. Tri-Service Automation Cost Engineering Systems

APPENDIX D

Preparation of Dredge Cost Estimates

D-1 Preparation of Dredge Cost Estimates. This appendix provides guidance for estimating the dredging portion of a project. Each cost engineer should be aware of various techniques that have proven to produce the most accurate results for specific projects. It is highly recommended that proper training be taken for estimating dredging projects. The methodology for cost estimating of pipeline, hopper, and mechanical dredging should be part of the course training.

D-2 Associated Work Items. Associated work items, such as clearing and grubbing, dike or weir construction, disposal area operation and maintenance, drilling and blasting, and environmental protection, are not included and should be estimated separately in accordance with other parts of this manual.

D-3 Software Program.

a. Estimates may be prepared in accordance with the software program, entitled Cost Engineering Dredge Estimating Programs (CEDEP), and will contain narrative documenting reasons for decisions and selections made by the cost engineer. Figure D-1, Dredge Prism, indicates project dimensions and quantity of material considerations to determine pay items.

b. Software distribution is restricted, because CEDEP is considered proprietary to the Government and should not be distributed to architect engineers or to contractors.

D-4 Definitions.

a. Allowable Downtime. "Allowable downtime" is "non-effective working time" (see non-effective working time).

b. Allowable Over Depth Not Dredged. "Allowable over depth not dredged" is the volume of "allowable over depth volume" that is estimated and will not be dredged.

c. Allowable Over Depth Volume. "Allowable over depth volume" is the volume of material between the required pay prism and the maximum pay prism.

d. Cost Engineering Dredge Estimating Programs. CEDEP is the acronym for the three four Cost Engineering Dredge Estimating Programs that operate on microcomputers. The three four software programs developed are Pipeline Rock Dredge, Pipeline CEDEP; Mechanical CEDEP; and Hopper CEDEP. The software programs are available at http://www.nww.usace.army.mil/cost/cedepframe.htm.

e. Dredging Time. "Dredging time" is "operating time" plus "allowable downtime."

f. Effective Working Time. "Effective working time" is time during the dredging operation when actual production is taking place, such as material moving through the pipeline. "Effective working time" is chargeable to the cost of work.

g. Gross Production Cost. "Gross production cost" is the cost of dredging the gross volume. It is determined by multiplying the total monthly cost by the dredging time in months and adding the fixed and indirect costs.

h. Gross Volume. "Gross volume" is the "net pay volume" plus the "non-pay volume."

i. Lost Time. "Lost time" is downtime, which is not operational, normally due to a lack of required crew, major repairs and alterations, drydocking, cessation, and collisions. "Lost time" is not chargeable to the cost of work.

j. Maximum Pay Volume. "Maximum pay volume" is the sum of the "required volume" and the "allowable over depth volume."

k. Net Pay Volume. "Net pay volume" is the "maximum pay volume" minus the "allowable over depth not dredged."

l. Non-Allowable Downtime. "Non-allowable downtime" is "lost time" (see "lost time").

m. Non-Effective Working Time. "Non-effective working time" is time during the dredging operation when the dredge is operational but no production is taking place, such as making changes to pipelines, cleaning trash from the suction head, minor operating repairs, and moving between locations. "Non effective working time" is chargeable to the cost of work.

n. Non-Pay Volume. "Non-pay volume" based on excavation measurement is the volume of material estimated to be removed from outside the maximum pay prism. "Non-pay volume" based on fill measurement is the volume of material that results in overfill and/or washes away.

o. Operating Time. "Operating time" is the "effective working time" (see "effective working time").

p. Percentage of Effective Working Time. (See "time efficiency.")

q. Required Volume. "Required volume" based on excavation measurement is the volume of material to be removed from within the required pay prism. "Required volume" based on fill measurement is the volume of material to be placed within the pay prism.

r. Time Efficiency. "Time efficiency" is the ratio of the "operating time" to the "dredging time," and is expressed as a percentage. Also known as "percentage of effective working time" (% of EWT).

D-5 Development of Dredging Estimate. The methods of development of dredging estimates are as follows:

a. Historical Information. The simplest and most reliable approach for estimating production for all types of dredges is to rely upon dredging records for the same or similar type work performed by the same or at least a similar dredge. The dredging records include the daily dredging reports. If project conditions have changed, for example, a different horsepower or haul distance, historical production information must be adjusted and documented for use in the estimate. Using such adjustments is a valid method for obtaining production rates when historical data is not available. Some valuable sources of historical dredging data include daily reports of operations, operations personnel, other districts, and regional dredge teams. Cost and pricing data may be obtained from audits and contract modifications. Adjustments should be made to this data reflecting current pricing levels.

b. Similar Projects. Information may be obtained from similar projects with similar characteristics to prepare a dredging estimate.

c. Regional Dredge Teams. The use of regional dredge teams is recommended. Members of regional dredge teams can be contacted for guidance on production rates, effective times, cost data, or other pertinent information.

d. Combining Methods. A combination of the methods, as previously described, may be used at the discretion and judgment of the cost engineer.

e. Computer Programs. When historical data is not available, CEDEP may be used to compute a production rate, or the production rate may be computed using recognized commercially generated programs or industry-generated programs. The cost engineer should include in the estimate a complete statement of the source of computer program used in the estimate.

D-6 Project Overview. The cost engineer should review the known project conditions and scope of work for the following items and determine which items are judgmental and which are factual at the time the estimate is prepared.

a. Location of Work. This information is necessary to make a determination of availability of historical data, plant availability, mobilization distances, disposal areas, and restraints placed on the various types of dredge operations.

b. Type of Material to be Dredged. Information may be obtained from geotechnical investigations, expert opinion, and historical data of specific site or adjoining areas, site visits, or similar projects with similar characteristics.

c. Placement Area. Information should be obtained on location, size, type, regulatory, and permit requirements.

d. Project Dimensions. Project dimensions may include such items as length, width, depth, and channel alignment.

e. Site Restrictions. This may include such items as waterway usage, vessel traffic, as well as time, weather, noise, and environmental restraints. Many areas are subject to restricted dredging seasons. To minimize environmental impacts creating scheduling conflicts, higher costs may occur and must be considered and documented in the cost estimate.

D-7 Selection of Equipment. An economical dredge shall be selected. Dredge type and size depends mainly on availability, job duration, type of material, and exposure to the elements, disposal area restraints, environmental restraints, and production requirements. The narrative will include the rationale used by the cost engineer for equipment selection.

a. Pipeline Dredging. The term "pipeline" refers to the discharge method through onboard pumps. The common types are cutterhead, suction, and dustpan dredges, which refer to the intake method. Pipeline dredges are sized by the inside diameter of the dredge discharge flange, and they are effective in dredging densely packed materials. Although they are best suited for low-traffic areas and sheltered waterways such as rivers, bays, harbors, and canals, some pipeline dredges are equipped to operate in calm to moderate seas offshore. Pipeline dredges lend themselves well to shore disposal operations.

b. Hopper Dredging. Hopper dredges are sized or classed by their hopper capacity. However, a particular size dredge is actually limited by its weight carrying capacity and the environmental restrictions of the project. Hopper dredges operate in cycles, and they normally cover the length of the total dredging area, deepening it gradually. They are the most efficient type dredge for excavating loose, unconsolidated material and are used mainly in exposed harbors and shipping channels where traffic and operating conditions rule out the use of stationary dredges.

c. Mechanical Dredging. Mechanical dredges include bucket, bucket-ladder, clamshell, and dragline dredges. Transportation of the dredged material is made by additional plant, tug and barge, or scow. Mechanical dredges are classified by bucket size and are best adapted for dredging fine-grained material. They are the most efficient dredge for working near bridges, docks, wharfs, piers, or breakwater structures.

d. Specialty Dredging. Some dredging projects have unusual conditions or unique project requirements that cannot readily utilize standard dredge plant. There are a variety of specialized dredge plant, which must be considered under these circumstances. For example, when dealing with rock dredging, special equipment may be required. In addition, adjustments to production and maintenance may have to be considered.

D-8 Production. In calculating production rates for dredging, effective time is commonly used. Lost time due to major repairs and alteration, cessation, and collisions is not used in dredging time calculations. Whenever possible, the production rate used in CEDEP should be based on historical data. When historical data is not available, the sequence described in this appendix shall be used.

a. Pipeline Dredging.

(1) Production is determined by the pumping rate and the effective time.

(2) Pumping rate is affected by items such as water depth, density of material, distance discharged, available horsepower, bank height, wave climate, disposal area restraints, environmental restraints, and dredge configuration, such as spud carriage, ladder pump, degassers, and Hoffa valve.

(3) The effective time is affected by items such as weather, handling pipeline, moving swing wires, minor operating repairs, vessel traffic, repositioning the dredge, and surveys.

b. Hopper Dredging.

(1) Hopper dredge production is best evaluated in terms of its cycle components and the effective time.

(2) The hopper dredge cycle consists of excavation time, transport time, and disposal time. Excavation time per load may be limited to pumping to overflow only, due to environmental concerns, or may be continued beyond overflow to obtain an economic or a maximum load. Transport time may be affected by items such as ship traffic, weather, distance, and tides. Disposal consists of either gravity dumping or pumping out the material. The time required to gravity dump the material in open water depends on the type of material and the dredge. If the material is pumped out, the time

becomes a function of pump size, discharge diameter, and pipeline length, similar to a pipeline dredge. The volume per load depends on the hopper size, the dredge's load carrying capability, type and characteristics of material, distance to the placement area, and environmental concerns.

(3) The effective time is affected by items such as vessel traffic, minor operating repairs, and refueling.

c. Mechanical Dredging.

(1) To determine mechanical dredge production, the cost engineer must calculate both a dredge excavation cycle time and a haul cycle time. Effective time is considered separately for each cycle. The longer of these two cycle times determines the production rate. When the haul cycle time is longer than the dredge excavation time, the dredge is sitting idle while waiting on scows. Normally, when this occurs, the number of scows required is increased to achieve the most efficient cost.

(2) The dredge excavation cycle consists of excavating the material and loading scows. This cycle is affected by items such as bucket size, type of material, operator efficiency, and size of dredge. Effective time is affected by items such as weather, vessel traffic, repositioning of dredge, and minor operating repairs.

(3) The haul cycle consists of transport time and disposal time. This cycle is affected by the size, type, and number of scows available, as well as the size, type, and number of towing vessels available. Effective time is affected by items such as weather, vessel traffic, and minor operating repairs.

d. Specialty Dredging. The cost engineer will have to investigate in detail the method, equipment, and expected production on a case-by-case basis.

D-9 Monthly Costs. The monthly costs for all types of dredges are based on labor, equipment, and other monthly costs.

a. Labor. Labor costs consist of wages, fringe benefits, taxes, and insurance. Labor consists of personnel necessary for the operation of the dredge, attendant plant and equipment with required supervision, and shore personnel used for the dredging work.

b. Equipment Costs. Equipment costs consist of ownership costs and operating costs. Costs for dredge plant will be based on historical data. In the absence of valid historical data, the CEDEP will be the basis for cost of dredge plant. Other equipment costs shall be obtained from Engineer Pamphlet 1110-1-8, Equipment Ownership Schedule.

c. Other Costs. Indirect costs are to be determined by the cost engineer. In addition, such things as surveys, environmental monitoring, and navigation aids may need to be included.

D-10 Fixed Costs

The fixed costs for all types of dredges are project specific. They are one-time costs for the project that are not included elsewhere.

D-11 Pay Items

a. Mobilization and Demobilization. The cost estimate for this item consists of the following:

(1) Preparing Dredge and Attendant Plant for Transfer. Costs incurred may consist of such items as preparing laid-up equipment for use, re-inspection, and stocking equipment and supplies.

(2) Mobilization Transfer Costs. This item includes the cost to move all plant and equipment and the return of the tug or towing vessels(s).

(3) Preparing Plant for Work. This item includes preparation costs that are incurred to setup the equipment to start work, assemble, and place discharge line and boosters.

(4) Construction Support Site. Establishing a work yard at or near the project site may be necessary and is a part of mobilization cost.

(5) Demobilize Plant. This item includes preparing the dredge and attendant plant for transfer.

(6) Demobilization Transfer Costs. This item is similar to mobilization transfer costs. Mobilization and demobilization distances may not necessarily be the same. Reasons for using different distances must be documented.

(7) Prepare Plant for Lay-up. This item includes all costs to secure machinery and equipment for storage.

(8) Indirect Costs. Indirect costs must be included in the mobilization and demobilization pay item. They should be the same as those used for the dredging pay item.

b. Dredging. Pay for unit price contracts may be based on volume, area, time, scow or bin measure, or lump sum as described in Engineer Regulation 1130-2-520.

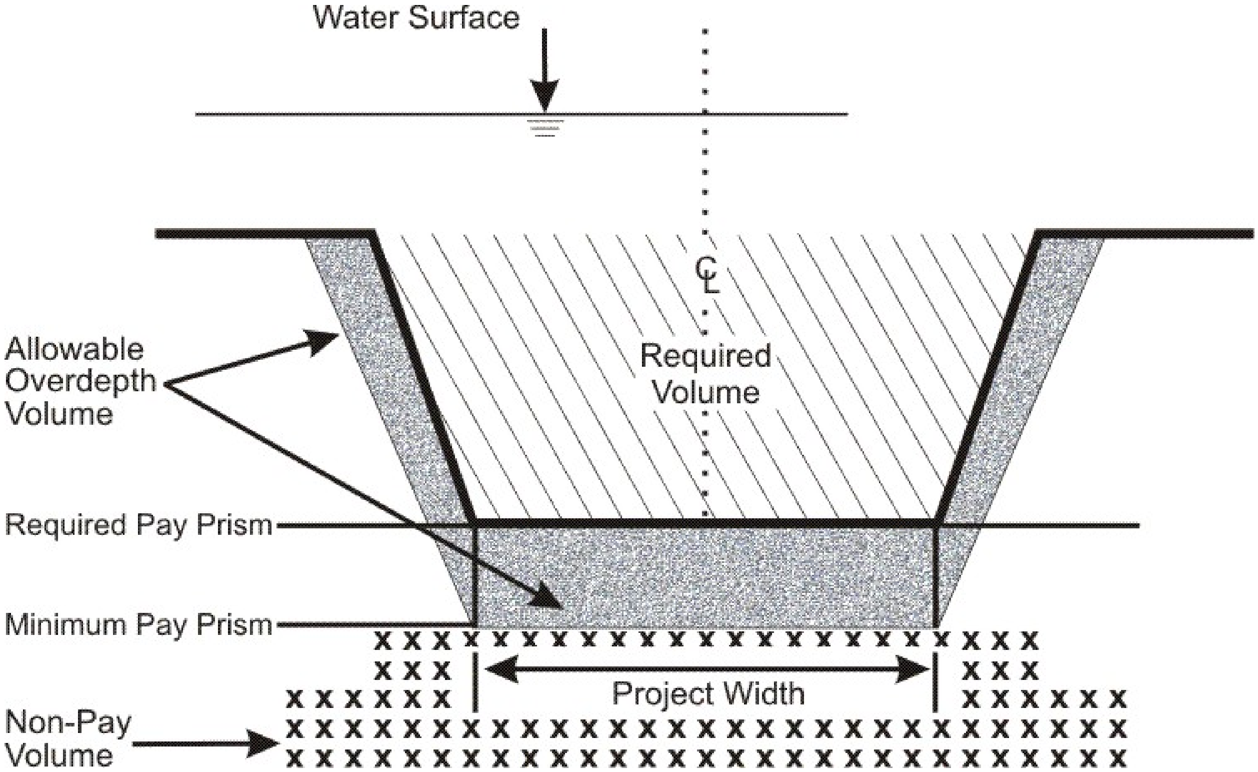
To determine the unit cost of dredging, divide the gross production cost by the number of pay units.

(1) Pipeline dredge gross production costs consist of costs associated with dredging time and are not separated by elements of work.

(2) Hopper dredge and mechanical dredge gross production costs consist of costs associated with excavation time, transportation time, and disposal time.

(3) Specialty dredging gross production costs will be determined on a case-by-case basis.

c. Total Dredging Costs. Total dredging cost includes mobilization and demobilization cost plus dredging cost as previously discussed.



Maximum pay volume = Required volume + Allowable over depth volume
Net pay volume = Maximum Pay Volume – Allowable over depth not dredged
Gross Volume = Net pay volume + non-pay volume

Figure D-1. Dredging Pay Prism

APPENDIX E

Sample Estimate Sheets and Forms

E-1. General. This appendix contains samples of the standard estimating forms that can be used to present construction cost estimates. It is recommend that a project narrative present the general information of the major features and assumptions of the project.

E-2. Preparing Forms. Estimates developed using these forms may be prepared in an electronic format or pencil format. For uniformity in form completion, the following general guidance is provided:

a. Each original sheet should be in reproducible quality.

b. Once the estimate has been completed, checked, and approved, the desired number of copies should be reproduced from the original.

c. For architect-engineer prepared estimates, the original should be forwarded with the final submittal.

d. Originals should normally be retained by the cost engineering office preparing the estimate.

e. A cover sheet with the “For Official Use Only” marking should be initialed by both the preparer and the reviewer.

E-3. Form Standardization. The following figures are intended as samples that record and convey estimating efforts used in developing cost estimates. Although no forms are mandatory for use in estimates, it is recommended that the cost engineer consider using forms to express unit price and extended prices calculations.

CONTROL RECORD FOR GOVERNMENT ESTIMATE

Date Received:	Date of Document:	No. of Copies:	Copy No.:

From: Engineering Division

SUBJECT
:

Number & Description of
Enclosures:

GOVERNMENT ESTIMATE

INTRA-OFFICE ROUTING DATA

Division or Branch	Date	Division or Branch	Date

NAME OF ALL PERSONS HANDLING THE ATTACHED DOCUMENT
OR WHO HAVE BEEN INFORMED OF ITS CONTENT

Name	Date	Name	Date

Figure E-1. Example Control Record for Independent Government Estimates

GOVERNMENT ESTIMATE FORM

Furnishing all plant, labor, materials, and equipment and performing all work for

in strict accordance with the specifications schedules, drawings, and amendments.

See attached Price Schedule for Items.

The project manager has budgeted adequate funds to cover estimated price of this project as contained in this Government Estimate.

SUBMITTED: ______________________________ ____________
Dated:

REVIEWED AND CONCUR: ______________________________ ____________
Chief Cost Engineer Dated:

APPROVED: ______________________________ ____________
Chief Engineer Dated:

PROTECTIVE MARKINGS ARE CANCELED AFTER THIS ESTIMATE HAS BEEN PUBLICLY OPENED, READ, AND RECORDED.

____________ ______________________________ ____________
Date Canceled Signature Division

(NOTE: Completed signature page and all pages of the Government Estimate should be marked "FOR OFFICIAL USE ONLY.")

Figure E-2. Example Signature Page for Independent Government Estimate

IFB No. XXX______ - _____ - X -

PRICING SCHEDULE

FY ________ Contingency Communications Element Facility and Vehicle Maintenance Facility

CLIN	Contract Line Item No. (Description of bid item)	UOM	UNIT PRICE	QTY	TOTAL PRICE
0001	All work for the Contingency Communications	LS	1,000,000.00	1	$ 1,000,000.00
0002	All work for the Vehicle Maintenance Facility.	LS	600,000.00	1	$ 600,000.00
0003	All work for the decorative screening contained in the contingency Communications Element Facility project.	LS	100,000.00	1	$ 100,000.00
0004	Site Preparation	SM	$ 5.00	10,000	$ 50,000 .00
TOTAL AMOUNT OF CLIN ITEMS 0001 THROUGH 000					$ 1,750,000.00

(Additives/deductives will also be shown on the price schedule)

NOTES TO BIDDERS (May vary according to the type of project, military, civil or HTRW)

1. The low bidder for purpose of award will be determined on the basis of the bidder offering the lowest total of Contract Line Items Numbers (CLIN) 0001 through 0004.

2. The bidders are required to bid on all items or their bid will be rejected.

3. Bidders are reminded that they must bid on the issued plans and specifications, as amended. Any deviations, conditions or attachment made by the bidder himself thereto may render the bid non-responsive and be cause for its rejection.

4. Any bid, which is materially unbalanced as to prices for each Contract Line Item Number, may be rejected. An unbalanced bid is one, which is based on prices significantly less than cost for some work and prices, which are significantly overstated for other work.

Figure E-3. Example Price Schedule

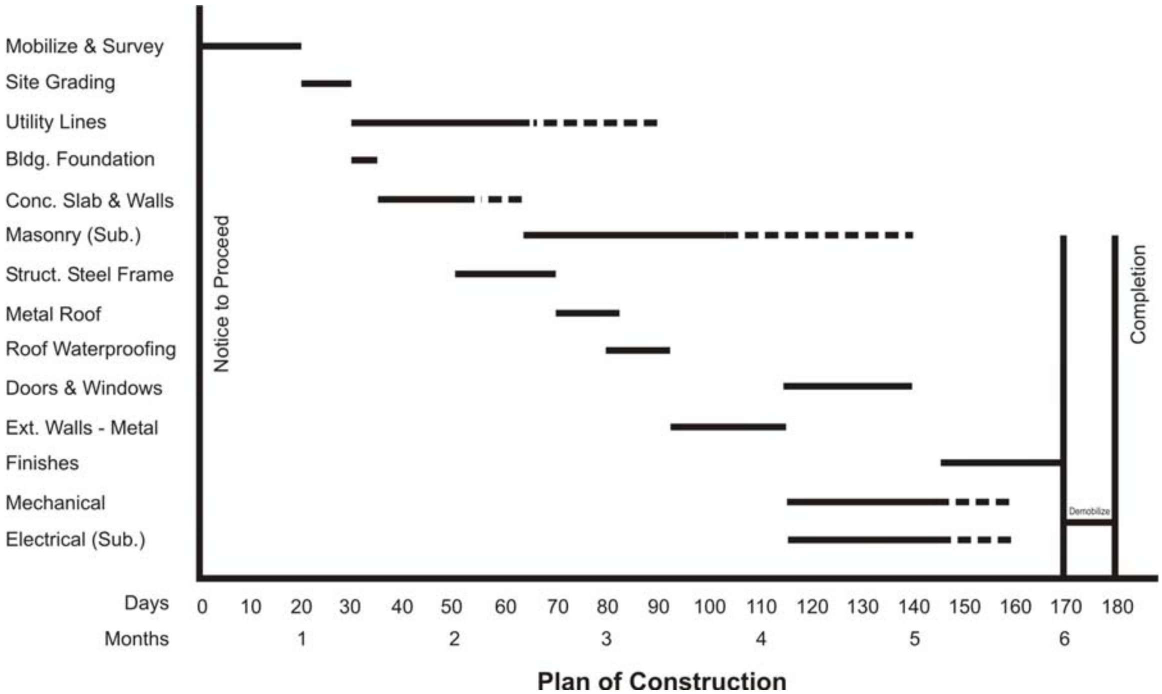


Figure E-4. Example Simplified Construction Schedule

SHEET OF

TELEPHONE QUOTATION SHEET			CSI NUMBER:
FIRM QUOTING		RFP/CONTRACT NO	
ADDRESS:			PROJECT:
City	State	Zip Code	
Country			LOCATION:
PHONE:			
PERSON QUOTING:			ESTIMATOR:
DATE: 9/27/05	TOTAL QUANTITY QUOTED:		AMOUNT:
ITEM QUOTED DESCRIPTION:			
INSTALLED: ☐ YES ☐ NO INCLUDE SALES TAX: ☐ YES ☐ NO PER PLANS/SPECIFICATIONS: ☐ YES ☐ NO			
EXPLAIN EXCEPTIONS:			
FREIGHT INCLUDED TO: ☐ FAS PORT ☐ FOB FACTORY ☐ FOB JOB ☐ OTHER			
	TOTAL QUOTATION		
WEIGHT	EXPORT PACKING		
VOLUME	US INLAND FREIGHT		
QUOTE VALID FOR DAYS	**TOTAL MATERIAL COST**		
REMARKS:			

Figure E-5. Example Telephone Quotation Sheet

REASONABLE CONTRACT ESTIMATE *(ER 1110-2-1302)*				Sheet 1 of 1	
PROJECT CONSTRUCT PUMP PLANT A				INVITATION NO. DACW97-01-0001	
ITEM NO.	**DESCRIPTION**	**ESTIMATED QUANTITY**	**UNIT**	**UNIT PRICE**	**ESTIMATED AMOUNT**
1	MOBILZATION/DEMOBLIZATION (WBS 13.01)	1	JOB	L.S.	$ 19,700.00
2	PUMPING PLANT A (WBS 13.00)	1	JOB	L.S.	$ 893,800.00
		Total			$ 913,500.00
	APPROVED:				
	CHIEF, COST ENGINEERING SECTION				
	Date				
	EFFECTIVE PRICE DATE				

ENG FORM 1738-R, MAR 94 EDITION OF APR 67 IS OBSOLETE Print Form (Proponent: CECW-ED)

Figure E-6. Example Reasonable Contract Estimate

REASONABLE CONTRACT ESTIMATE DETAIL SUMMARY SHEET														Sheet 1 of 1	
PROJECT CONSTRUCT PUMP PLANT A															
BID ITEM													ADJUSTED		
NO	DESIGNATION	Qty	UNIT	EQUIPMENT	MOBILIZATION AND DEMOBILIZATION	LABOR	MATERIALS	SUPPLIES	SUBTOTAL	32% DISTRIBUTED COSTS	TOTAL COSTS	UNIT COSTS	UNIT COSTS	AMOUNT	NO
1	(WBS 13.01) MOB/DEMOB	1	JOB	$7,850		$3,270		$3,800	$14,920	$4,774	$19,694	L.S.	L.S.	$19,700	
1	(WBS13.00) PUMP PLANT A	1	JOB	$101,586		$146,731	$408,385	$20,419	$677,121	$216,679	$893,800	L.S.	L.S.	$893,800	
TOTALS				$109,436		$150,001	$408,385	$24,219	$692,041	$221,453	$913,494	L.S.	L.S.	$913,500	

Print Form

Figure E-7. Example Reasonable Contract Estimate Detail Summary Sheet

REASONABLE CONTRACT ESTIMATE WORKSHEET SUMMARY					SHEET 1 OF 1	
PROJECT CONSTRUCT PUMPING PLANT						
SUBJECT BI 02. (WBS 13.00) PUMP PLANT A					QUANTITY 1-JOB	
SUBITEM	EQUIPMENT	LABOR	MATERIALS	SUPPLIES	SUBTOTAL	REF. PG.
.01(WBS 13.03) CARE & DIVERSION OF WATER	$35,200.00	$7,800.00	$900.00	$1,000.00	$44,900.00	4
.02 (WBS 13.10) EARTHWORK FOR STRUCTURE	$45,100.00	$6,200.00	$0.00	$490.00	$51,790.00	7
.03 (WBS 13.74) SUBSTRUCTURE.	$3,806.00	$51,581.00	$26,785.00	$12,809.00	$94,981.00	11
.04 (WBS 13.75) SUPERSTRUCTURE	$780.00	$35,600.00	$65,100.00	$1,300.00	$102,780.00	15
.05 (WBS 13.76) MACHINERY & APPT.	$12,800.00	$28,300.00	$265,000.00	$4,320.00	$310,420.00	18
.06 (WBS 13.77) GATES & VALVES	$2,200.00	$12,400.00	$38,100.00	$400.00	$53,100.00	22
.07 (13.78) AUXILIARY EQUIPMENT	$500.00	$1,200.00	$8,400.00	$100.00	$10,200.00	24
.08 (WBS 13.98) ASSOCIATES ITEMS	$1,200.00	$3,650.00	$4,100.00	$0.00	$8,950.00	26
NOTE: BID ITEM 01 & SUBITEMS 02.01 THROUGH 02.08 HAVE DETAILED COSTS DEVELOPED SIMILIAR						
TO THOSE SHOWN ON ITEM 02.03. THE DETAILED ESTIMATING SHEETS AND BACKUP SHEETS ARE						
EXCLUDED FROM THIS EXAMPLE TO MINIMIZE PRINTING.						
TOTALS	$101,588.00	$146,731.00	$408,385.00	$20,419.00	$677,121.00	

ENG FORM 1740-R, MAR 94 ***(ER 11100-2-1302)*** **EDITION OF AUG 69 IS OBSOLETE.** Print Form

Figure E-8. Example Reasonable Contract Estimate Worksheet Summary

REASONABLE CONTRACT ESTIMATE WORKSHEET *(ER 1110-2-1302)*		SHEET 1 of 1
PROJECT CONSTRUCT PUMP PLANT A		
SUBJECT BI 02.03 (WBS 13.74) SUBSTRUCTURE	QUANTITY 165 M3	
	SHIFTS PER DAY 1	HOURS PER SHIFT 10
PLAN OF OPERATIONS		
USE READY-MIX SUPPLIER FOR 20.7 MPA CONCRETE		
1. PLACE CONCRETE – 164M3 @ 7.5M3/HR = SAY 22 HRS		
USE: HYD S.P. CRANE – 30T C 7522000		
CONCRETE BUCKET – 2 CY B30Z1055		
AIR COMPRESSOR – 250CFM A15Z0140		
CONCRETE VIB – 2.5 IN AIR C65XX001		
LAB 4/M		
5 LABORERS		
1 CARPENTER		
2. FINISH WORK -		
FLOAT 2 CEMENT FIN – 293M2/16.3M2/HR = SAY 18 HRS		
STEEL TROWEL –109M2/7.3M2/HR = SAY 15 HRS		
USE 1 CEMENT FIN		
1 EA. POWER TROWEL		
3. INSTALL WATER STOP – 8"		
1 CARP @ 2M/HR = 53/2 = SAY 27 MHRS		
4. CURE CONCRETE -		
USE 2 LABORERS – 4 HR/DAY X 14 DAYS = 56 HOURS		

ENG FORM 1741-R, MAR 94 **EDITION OF NOV 81 IS OBSOLETE.** Print Form

Figure E-9. Example Reasonable Contract Estimate Worksheet

REASONABLE CONTRACT ESTIMATE WORKSHEET *(ER 1110-2-1302)*		SHEET 1 of 1
PROJECT CONSTRUCT PUMP PLANT A		
SUBJECT	QUANTITY 165 M3	
BI 02.03 (WBS 13.74) SUBSTRUCTURE	SHIFTS PER DAY 1	HOURS PER SHIFT 10
PLAN OF OPERATIONS		
5. USE SUBCONTRACT QUOTE FOR RESTEEL 7.4MT		
6. FORMING - USE 1 CARP 4/M + 4 CARP		
A: BLDG WALL FORMS – 2 USES – 315M2/2 = 158M2		
Bldg @ 3.9M2/CREW HR = 40.5 CREW HRS		
B: SET & STRIP		
WALLS @ 3.9M2/CREW HRS – 314M2/3.9 = 80.5 HRS		
SLAB EDGE @ 7M2 /CREW HRS 53/7 = 7.6 HRS		
ELEVATOR SLAB @ 3M2/CREW HRS =109/3 = 36.3 HRS		
SET/REMOVE SHORINIG @ 2M2/HR = 109/2 = 54.5 HOURS		
TOTAL CREW HRS, BLDG/SET/STRIP = 219.4		
SAY 220 HRS		
C: FORM LUMBER -		
SLAB @ 30BF/M2 = 30 (53) = 1590 BF		
WALL @ 358F/M2 = 35 (153) = 5530 BF		
ELEV SLAB @ 40BF/M2 =(109) = 4360 BF		
TOTAL 11,480 BF		

ENG FORM 1741-R, MAR 94 **EDITION OF NOV 81 IS OBSOLETE.** Print Form

Figure E-10. Example Reasonable Contract Estimate Worksheet

REASONABLE CONTRACT ESTIMATE WORKSHEET *(ER 1110-2-1302)*					SHEET 10 OF 29
SUBJECT ITEM 02.03 SUBSTRUCTURE CONCRETE (WBS 13.74)					QUANTITY 165M3
EQUIPMENT					
UNIT OF EQUPMENT	SIZE	NO.	HOURS*	RATE	AMOUNT
1. PLACE CONCRETE					
HYD S.P. R.T. CRANE –C75Z2000	30T	1	22.00	$42.61	$937.42
CONCRETE BUCKET – B30Z1055	2CY	1	22.00	$0.56	$12.32
AIR COMPRESSOR – A15Z0140	250CFM	1	22.00	$8.66	$190.52
CONCRETE VIBRATOR – C65XX001	2.5*	2	22.00	$0.85	$37.40
AIR HOSE – 100LF-A20Z0430	1.5*	2	22.00	$0.56	$24.64
2. FINISH CONCRETE					
STEEL POWER TROWELL - C25Z1560	46*	1	15.00	$1.63	$24.45
EQUIPMENT RATES TAKEN FROM EP-1110-1-8					
VOL #8, AUG 95, RATES HAVE BEEN ADJUSTED FOR					
50 HR WORK WEEK					
***NOTE: USE WORKING HOURS**				*SUBTOTAL*	$1,226.75
	SMALL TOOLS 5.0 % OF LABOR				$2,579.00
				TOTAL EQUIPMENT COSTS	$3,805.75

LABOR					
OPERATIONS	CRAFT	NO.	HOURS*	RATE	AMOUNT
1. PLACE CONCRETE	4/M X- LABOR	1	22.00	$32.56	$716.32
	X-LABOR	5	22.00	$29.51	$3,246.00
	X-CARPENTER	1	22.00	$35.76	$786.71
	X-EQOPRMED	1	22.00	$38.15	$839.30
2. FINISH CONCRETE					
FLOAT	X-CEMTFINR	2	18	$33.63	$1,210.68
STEEL TROWELL	X-CEMTFINR	1	15	$33.63	$504.45
3. INSTALL WATER STOP	X-CARPENTER	1	27	$35.76	$965.52
4. CURE CONCRETE	X-LABOR	2	56	$29.51	$3,305.12
6. FORMWORK	4/M X-CARPENTER	4	220	$38.81	$8,538.20
	X-CARPENTER	4	220	$35.76	$31,486.80
				TOTAL LABOR COSTS	$51,581.20

ENG FORM 1741a-R, MAR 94 **EDITION OF NOV 81 IS OBSOLETE.** Print Form

Figure E-11. Example Reasonable Contract Estimate Worksheet

REASONABLE CONTRACT ESTIMATE WORKSHEET *(ER 1110-2-1302)*				SHEET 11 OF 29
SUBJECT ITEM 02.03 SUBSTRUCTURE CONCRETE (WBS 13.74)			QUANTITY 165 M3	
MATERIALS				
DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
READY MIX CONCRETE 20.7 MPA (INCLUDES WASTE)	M3	175	$78.60	$13,755.00
WATER STOP 9" PVC X 3/8" THK	M	53	$11.75	$622.75
22.00				
SUBTOTAL : $14,378				
SALES TAX: 6%				$863.00
RESTEEL SUBCONTRACTOR	MT	74	$1,560.00	$11,544.00
TOTAL MATERIALS COST				$26,784.75
SUPPLIES				
DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT
CURING SUPPLIES	M2	476	$0.50	$238.00
FORM PLYWOOD ½"	M2	56	$78.60	$392.00
FORM PLYWOOD ¾"	M2	267	$10.00	$2,670.00
FORM LUMBER	MBF	12	$375.00	$4,500.00
FORMS TIES & OIL	M2	476	$9.00	$4,284.00
SUBTOTAL : $12,084				
SALES TAX 6%				$725.00
TOTAL SUPPLIES COST				$12,809.00
SUMMARY FOR TRANSFER TO ENG FORM 1739-R OR 1740-R				
EQUIPMENT				$3,806.00
LABOR				$51,581.00
MATERIALS				$26,785.00
SUPPLIES				$12,809.00
TOTAL				$94,981.00
REMARKS: (Indicate by asterisk (*) prices on items which are based on quotation from manufacturers or suppliers)			**DATE** 9/22/05	PREPARED BY J. SMITH CHECKED BY J. DOE

ENG FORM 1741b-R, MAR 94 **EDITION OF NOV 81 IS OBSOLETE.** Print Form

Figure E-12. Example Reasonable Contract Estimate Worksheet

REASONABLE CONTRACT ESTIMATE WORKSHEET					SHEET 12 OF 29
SUBJECT ITEM 02.03 SUBSTRUCTURE CONCRETE (WBS 13.74)					QUANTITY 165 M3
EQUPMENT					
UNIT OF EQUIPMENT	SIZE	NO.	HOURS*	RATE	AMOUNT
HYD S.P. R.T. CRANE – C752000	30	1	22	$42.81	$937.42
CONCRETE BUCKET – B30Z1055	2CY	1	22	$0.56	$12.32
AIR COMPRESSOR – A15Z0140	250CFM	1	22	$8.66	$190.52
CONCRETE VIBRATOR – C65XX001	2.5"	2	22	$0.85	$37.40
AIR HOSE – 100LF – A20Z0430	1.5"	2	22	$0.56	$24.64
STEEL POWER TROWEL – C25Z156	46"	1	15	$1.63	$24.45
(*NOTE: USE WORKING HOURS)	SUBTOTAL				$1,226.75
	MOBILIZATION AND DEMOBILIZATION				
	SMALL TOOLS 5.0 % OF LABOR				$2,579.00
	TOTAL EQUIPMENT COSTS				$3,805.75
LABOR — OPERATIONS	CRAFT	NO.	HOURS*	RATE	AMOUNT
1. PLACE CONCRETE	4/M X-LABOR	1	22	$32.56	$716.32
	X-LABOR	5	22	$29.51	$3,246.10
	X-CARPENTER	1	22	$35.76	$786.71
	X-EQOPRMED	1	22	$38.15	$839.30
2. FINISH CONCRETE	X-CEMFINR	1	51	$33.63	$1,715.13
3. INST WATER STOP	X-CARPENTER	1	27	$35.76	$965.52
TOTAL LABOR COSTS					$7,303.56
MATERIALS — DESCRIPTION	UNIT	QUANTITY		PRICE	AMOUNT
READY MIX CONCRETE – 20.7 MPA	M3	175		$78.60	$13,755.00
WATER STOP 9" X 3/8 THK	M	53		$11.75	$622.75
SUBTOTAL: $14,378					
SALES TAX 6%		1		$863.00	$863.00
RESTEEL SUBCONTRACTOR	MT	7.4		$1,560.00	$11,544.00
TOTAL MATERIALS COST					$26,784.75
SUPPLIES — DESCRIPTION	UNIT	QUANTITY		PRICE	AMOUNT
CURING FORM TIES & OIL	M2	476		$10.07	$4,793.32
PLYWOOD ½ IN	M2	56		$7.42	$415.52
PLYWOOD ¾ IN	M2	267		$10.60	$2,830.20
FORM LUMBER	MBF	12		$397.50	$4,770.00
TOTAL SUPPLIES COST					$12,809.04
TOTAL FOR TRANSFER TO ENG FORM 1739-R OR 1740-R					$94,981.00
REMARKS: (Indicate by asterisk (*) prices on items which are based on quotation from manufacturers or suppliers)	DATE 9/22/05				PREPARED BY J. SMITH CHECKED BY J. DOE

ENG FORM 1741c-R, MAR 94 **EDITION OF NOV 81 IS OBSOLETE.** *(ER 1110-2-1302)* Print Form

Figure E-13. Example Reasonable Contract Estimate Worksheet

WAGE RATE CALCULATIONS			EFFECTIVE PERIOD OCT 97 – SEP 98
PROJECT CONSTRUCT PUMP PLANT			OPERATIONAL SHIFTS 1/10-5 DAY WEEK
LOCATION RT. BANK, RM 12, SPRUCE RIVER	ESTIMATOR J. SMITH		CHECKED BY J. DOE

LABOR COST

CRAFT DESCRIPTION	BASIC HOURLY WAGE RATE	OVERTIME		SUBTOTAL (B+D)	TAXES & INS		SUBTOTAL (e + g)	FRINGE BENEFITS	TRAVEL OR SUBSIST	TOTAL HOURLY COSTS (h + i + j)
		% OF (b)	AMT		% OF (e)	AMT				
a	b	c	d	e	f	g	h	i	j	k
X-CARPENTER 4/M	20.49	10	2.05	22.54	38.7	8.72	31.26	5.55	2	38.81
X-CARPENTER	18.49	10	1.85	20.34	38.7	7.87	28.21	5.55	2	35.76
X-LABOR 4/M	16.47	10	1.65	18.12	38.7	7.01	25.13	4.43	3	32.56
X-LABOR	14.47	10	1.45	15.92	38.7	6.16	22.08	4.43	3	29.51
X-EQOPRMED	18.97	10	1.90	20.87	29.7	6.20	27.07	6.08	5	38.15
X-EQOPOIL	14.80	10	1.48	16.28	29.7	4.84	21.12	6.08	5	32.20
X-CEMTFINR	17.91	10	1.79	19.70	29.7	5.85	25.55	5.08	3	33.63

Print Form

Figure E-14. Example Wage Rate Calculations

ESTIMATE DETAIL SUMMARY SHEET											
PROJECT WAREHOUSE BUILDING				ESTIMATOR J. SMITH					SHEET 1 OF 1		
LOCATION FORT HUNTSVILLE, AL				CHECKED BY J. DOE					DATE PREPARED 19 MAY 1997		
BID ITEM				SUB CONTRACT COST	PRIME CONTRACT COST	TOTAL DIRECT COST	OVERHEAD	SUB-TOTAL	PROFIT	TOTAL COST	
No.	Description	Quantity	Unit Meas								
1	WAREHOUSE BUILDING	JOB	L.S.	$335,781	$619,361	$955,142	$186,253	$1,141,395	$80,468	$1,221,863	
2	SITE WORK	JOB	L.S.		$294,636	$294,636	$57,454	$352,090	$24,822	$376,912	
			TOTAL	$335,781	$913,997	$1,249,788	$243,707	$1,493,485	$105,290	$1,598,775	

Print Form

Figure E-15. Example Estimate Detail Summary Sheet

CONSTRUCTION COST ESTIMATE WORKSHEET	DATE PREPARED 10 MAY 1997	SHEET 1 OF 1
PROJECT WAREHOUSE BUILDING		
LOCATION FORT HUNTSVILLE, AL		
PLAN NO.	ESTIMATOR J. SMITH	CHECKED BY J. DOE
SITE WORK		

QUANTITY TAKE-OFF CALCULATIONS SHOULD BE PREPARED IN A MANNER THAT IS CONSISTENT WITH THE DISTRICT'S ESTABLISHED PROCEDURES

Print Form

Figure E-16. Example Construction Cost Estimate Worksheet

CREW AND PRODUCTIVITY REPORT					DATE PREPARED 10 May 1997	
PROJECT WAREHOUSE BUILDING			PREPARED BY J. SMITH		CREW REF NO. B-25	
LOCATION FORT HUNTSVILLE, AL			CHECKED BY J. DOE			

CREW COMPOSITION

WORK TYPE	WORK SCHEDULE	SPECIAL INFORMATION
PLACE CONCRETE	1-10 HR; 5 DAYS/WEEK	

CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST	
		HOURLY* RATE ($/HR)	TOTAL FOR CREW ($/HR)	HOURLY* RATE ($/HR)	TOTAL FOR CREW ($/HR)
HYD. SPCRANE 30T C757200	1			$42.61	$42.61
CONC BKT, 2 CY, B3071055	1			$0.56	$0.56
CONC VIB, 2 ½ " A, C65XX00	1			$0.35	$0.35
AIR COMP, 250 CFM, A1570140	1			$8.66	$8.66
AIR HOSE 1 ½" X 100', A2070480	2			$0.56	$1.12
X-EAOPR MED	1	$38.15	$38.15		
X-LABOR 4/M	1	$32.56	$32.56		
X-LABOR	4	$29.51	$118.04		
X-CEMTFNR	1	$33.63	$33.63		
TOTAL MANHOURS	7	LABOR COST	$222.38	EQUIPMENT COST	$53.80

CREW PRODUCTIVITY

WORK TASK	PRODUCTIVITY RATE (UNIT/HR)	LABOR		EQUIPMENT $/UNIT	COMMENTS
		MH/UNIT	$/UNIT		
PLACE CONCRETE	7.5M3/HR	0.93	$29.65	$7.17	

EQUIP RATES HAVE BEEN ADJ FOR 50 HR WORK WEEK AND RATES TAKEN FROM EP 1110-1-8, VOL 3. LABOR RATES TAKEN FROM DAVIS BACON ACT AGREEMENT GENERAL DECISION NUMBER

* INCLUDING FRINGE BENEFITS

Print Form

Figure E-17. Example Crew and Productivity Worksheet

COST ESTIMATE ANALYSIS

INVITIATION/CONTRACT NO. DACA85-B-97-B-0001

EFFECTIVE PRICING DATE AUGUST 1997

DATE PREPARED 10 May 1997

PROJECT WAREHOUSE BUILDING

CODE (Check one) ☐ A ☐ B ☐ C ☐ OTHER

DRAWING NO.

SHEET 1 OF 1 SHEETS

LOCATION FORT HUNTSVILLE, AL

ESTIMATOR J. SMITH

CHECKED BY J. DOE

TASK DESCRIPTION	QUANTITY		LABOR				EQUIPMENT		MATERIAL		TOTAL	SHIPPING	
	NO. OF UNITS	UNIT MEAS	MH/ UNIT	TOTAL HRS	UNIT PRICE	COST	UNIT PRICE	COST	UNIT PRICE	COST		UNIT WT	TOTAL WT
01 STANDARD FDN													
03110-1113 WALL FTG FORMS	52	M2	0.75	39	$23.34	$1,214.00	$0.43	$23.00	$6.67	$347.00	$1,584.00		22
03210-1003 FTG RESTEEL	6390	KG	0.014	89	$0.52	$3,302.00	$0.00	$19.00	$0.46	$2,921.00	$6,242.00		
03311 – 1123 FTG CONCRETE	80	M3	0.52	42	$15.50	$1,240.00	$0.54	$43.00	$65.80	$5,264.00	$6,547.00		
02221 – 3401 COMPACT BACKFILL	35.76	M3	0.92	32	$9.64	$337.00	$0.32	$11.00			$348.00		
TOTALS				426		$13,474.00		$359.00		$10,288.00	$24,120.00		
03 SLAB ON GRADE													
03110-1662 BLOCKOUT FORMS	20	M2	2.26	45	$69.54	$1,390.00	$1.40	$28.00	$9.80	$196.00	$1,614.00		
03210-1003 RESTEEL	8482	KG	0.014	119	$0.52	$4,411.00	$0.00	$26.00	$0.46	$3,902.00	$8,339.00		
03311-1164 CONCRETE SLAB	245	M3	0.35	86	$10.62	$2,602.00	$0.37	$91.00	$65.83	$16,129.00	$18,822.00		
07111 – 5002 POLY VAPOR BARRIER	1300	M2	0.029	38	$0.95	$1,235.00	$0.01	$13.00	$0.20	$260.00	$1,508.00		
TOTAL THIS SHEET													

DAFORM 5418-R, Apr 85

Print Form

Figure E-18. Example Cost Estimate Analysis (DA Form 5418-R)

APPENDIX F

Sample Quality Review Checklist

Reviewed by: _____ Organization: _____		Review Date:	
		Rev. Date:	
Estimate Type and Phase:			
FOR:			
PROJECT:			
WORK REQUEST NUMBER		WORK REQUEST DATE	

SCOPE OF WORK / PROJECT DESCRIPTION

Provide brief description of project scope, major components, and complexities.

REGULATION AND GUIDANCE

Engineer Regulation (ER) 1105-2-100, Planning Guidance Notebook.
ER 1110-2-1150, Engineering and Design for Civil Works Projects.
ER 1110-1-1300, Cost Engineering Policy and General Requirements.
ER 1110-2-1302, Civil Works Cost Engineering.
Engineer Manual (EM) 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS).
Engineer Technical Letter 1110-2-573 Construction Cost Estimating Guide for Civil Works
Engineering and Construction Bulletin No. 2006-5, 12 June 2006, Microcomputer Aided Cost Engineering System (MCACES).
Corps of Engineers Directorate of Civil Works Planning and Policy (CECW-P) Memorandum for Peer Review Process, 30 March 2007
Engineering and Construction Bulletin No. 2007-17, 10 September 2007, Risk Analysis.

LIST OF DOCUMENTS REVIEWED

Yes ☐ No ☐ Main report
Yes ☐ No ☐ Cost appendix
Yes ☐ No ☐ Engineering appendix
Yes ☐ No ☐ Scoping documents
Yes ☐ No ☐ Estimates of recommended plan in electronic format for MCACES MII and Corps of Engineers Dredge Estimating Program (CEDEP)
Yes ☐ No ☐ Total project cost sheet – all feature accounts
Yes ☐ No ☐ Total project schedule – all feature accounts
Yes ☐ No ☐ Risk analysis for projects (required for project >$40 million)
Yes ☐ No ☐ Labor funding to provide review

REVIEW ITEMS AND COMMENTS

[Note to reviewer: copy and paste these comments to DrChecks or other document submitted to the customer.]

Cost Summary

$	RECOMMENDED PLAN CONSTRUCTION ESTIMATE (EXCLUDING CONTINGENCY)
%	PERCENT CONTINGENCY
$	TOTAL RECOMMEND PLAN CONSTRUCTION COST
	PRICE LEVEL DATE OF THE RECOMMENDED PLAN CONSTRUCTION COST
$	TOTAL PROJECT COST (CONSTANT DOLLARS)
	PRICE LEVEL DATE OF THE TOTAL PROJECT COST (CONSTANT DOLLARS)
$	TOTAL PROJECT COST INFLATED THROUGH THE PROJECT SCHEDULE

<u>REPORT CONTENT COMMENTS</u>

(Comments with the corresponding line reference numbered 1.XX)

<u>COMPARATIVE COST ESTIMATES COMMENTS</u>

(Comments with the corresponding line reference numbered 1.3XX)

<u>RECOMMENDED PLAN CONSTRUCTION COST ESTIMATE REVIEW COMMENTS</u>

(Comments with the corresponding line reference numbered 2.XX through 6.XX)

<u>CONSTRUCTION AND PROJECT SCHEDULE REVIEW COMMENTS</u>

(Comments with the corresponding line reference numbered 7.XX)

<u>TOTAL PROJECT COST SUMMARY REVIEW COMMENTS</u>

(Comments with the corresponding line reference numbered 8.XX through 10.XX)

COST ENGINEERING FEASIBILITY AGENCY TECHNICAL REVIEW CHECKLIST

INSTRUCTIONS: Check items that are approved by the technical review as “Y” for yes or “N” for no. Check “N/P” for items not provided, “N/A” for lines that do not pertain to the level of estimate being reviewed. Fill out "Comment Review Form" or "DrChecks" with the corresponding line reference number. Indicate whether the comments have been submitted in DrChecks.

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**1.00**	**Basic Information for Reviewer – SCOPE AND FORM**
☐	☐	☐	☐	**1.10**	**Draft Report Document, General**
☐	☐	☐	☐	**1.101**	Is the complete report document provided for this cost review? As a minimum, this should include the main body of the report, the engineering appendix, all cost tables or appendixes, and the project schedule. .
☐	☐	☐	☐	**1.102**	Is the detailed construction cost estimate provided in electronic format? Current software is MCACES MII or CEDEP.
☐	☐	☐	☐	**1.103**	Does the executive summary clearly present the “Total Project Cost” (TPC) inflated through the project schedule? The TPC at the time the project is authorized by Congress becomes the Baseline Cost Estimate (BCE). The BCE is subject to cost limits of Section 902 Water Resources Development Act of 1986. (ER 1105-2-100)
☐	☐	☐	☐	**1.104**	
☐	☐	☐	☐	**1.20**	**Draft Report Document, Cost Estimate Report Section**
☐	☐	☐	☐	**1.201**	Does the report include separate sections summarizing the development of screening comparative estimates, the construction cost estimate for the recommended plan, and the TPC (BCE)?
☐	☐	☐	☐	**1.202**	Does the cost estimate report section summarize and describe the basis and development of the comparative estimates, such as describing the method of construction, assumptions used in developing the estimate, and the technical/design data available? (ER 1110-2-1302, 3.a.)
☐	☐	☐	☐	**1.203**	Does the cost estimate report section clearly indicate, summarize, and describe development of the recommended plan construction cost estimate?
☐	☐	☐	☐	**1.204**	Does the cost estimate report section summarize the uncertainties associated with major cost items in the recommended plan estimate? (ER 1105-2-100, appendix E)
☐	☐	☐	☐	**1.205**	Does the cost estimate report section summarize the cost risk and resulting contingency development for the recommended plan construction cost estimate?
☐	☐	☐	☐	**1.206**	Does the report describe the development of the recommended plan construction schedule and where applicable, development of multiple

Y	N	N/P	N/A		Categories/Questions
					construction contract schedules?
☐	☐	☐	☐	**1.207**	Does the cost estimate report section summarize and describe the basis and development of TPC. For example, the source and basis of; the feasibility report cost (Feature 22), engineering and design (E&D) (Feature 30), construction management (Feature 31), other pertinent feature costs, the price level of the constant dollar estimates (preparation date and program year date), and basis of cost indexes for inflating the project costs (inflated dollar basis) through the project schedule?
☐	☐	☐	☐	**1.208**	
☐	☐	☐	☐	**1.30**	**Comparative Construction Cost Estimates**
☐	☐	☐	☐	**1.301**	Is the technical/design data, method of construction, and assumptions used for developing the comparative estimates included and described? (ER 1110-2-1302)
☐	☐	☐	☐	**1.302**	Are all comparative cost estimates at the same price level?
☐	☐	☐	☐	**1.303**	Is the TPC of each comparative estimate accurately used in the economic analysis comparisons, such as costs and benefits at the same price level? (ER 1105-2-100)
☐	☐	☐	☐	**1.304**	
☐	☐	☐	☐	**1.40**	**Recommended Plan - Construction Cost Estimate**
☐	☐	☐	☐	**1.401**	Does it appear that the scope of the recommended plan has been adequately captured and presented in the construction estimate? If not, provide specific examples.
☐	☐	☐	☐	**1.402**	Is the construction cost estimate prepared using current estimating tools in MCACES (Currently MII and CEDEP)?. Engineering and Construction Bulletin, 12 June 2006, MCACES.
☐	☐	☐	☐	**1.403**	Are construction cost estimates at current price levels for the recommended plan?
☐	☐	☐	☐	**1.404**	Has the estimate been previously reviewed and checked? Date: ______ (ER 1110-1-1300)
☐	☐	☐	☐	**1.405**	Has estimate been approved by Chief, Cost Engineering Branch/Section? (ER 1110-1-1300)
☐	☐	☐	☐	**1.406**	
☐	☐	☐	☐	**1.50**	**Construction Schedule(s)**
☐	☐	☐	☐	**1.501**	Is the construction schedule(s) based upon the scope of design and details in the cost estimate for the recommended plan?
☐	☐	☐	☐	**1.502**	

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**1.60**	**Project Schedule – Baseline Project Schedule**
☐	☐	☐	☐	**1.601**	Has a total baseline project schedule been provided indicating pre-construction and post-construction award activities for all Features?
☐	☐	☐	☐	**1.602**	Are the construction schedules clearly presented in the project schedule?
☐	☐	☐	☐	**1.603**	
☐	☐	☐	☐	**1.70**	**Total Project Cost Summary - Baseline Cost Estimate**
☐	☐	☐	☐	**1.701**	Are the costs for lands and damages, all construction features, planning, E&D, and construction management, and all project management included in the TPC?
☐	☐	☐	☐	**1.702**	Are appropriate contingencies included and supported with sound basis?
☐	☐	☐	☐	**1.703**	Are two TPC estimates displayed in the feasibility report; one based on constant dollars and one based on projected inflation rates? (ER 1105-2-100, ER 1105-2-100, 4.3., and ER 1110-2-1302)
☐	☐	☐	☐	**1.704**	Is each contract and/or element of the recommended plan escalated for inflation according to the baseline project schedule?
☐	☐	☐	☐	**1.705**	Are the Federal and non-Federal cost share percentages shown and total costs separated accordingly?
☐	☐	☐	☐	**1.706**	Is the non-Federal sponsor's obligations clearly shown?
☐	☐	☐	☐	**1.707**	
☐	☐	☐	☐	**1.80**	**Engineering Appendix**
☐	☐	☐	☐	**1.801**	Does the design package clearly meet the requirements of ER 1110-2-1150, E&D for Civil Works Projects – Feasibility Stage (Section 13 – Engineering During Feasibility Stage)? http://www.usace.army.mil/publications/eng-regs/cecw.htm
☐	☐	☐	☐	**1.802**	**Scope is extremely important as it affects cost, schedule, and contingency**. Has the scope been adequately captured and presented at the prescribed level in accordance with ER 1110-2-1150?
☐	☐	☐	☐	**1.803**	Does reviewer have a clear definition of scope? **Provide general comment regarding your confidence in the scope quality provided.** - - -
☐	☐	☐	☐	**1.804**	Does the package meet the requirements within ER 1105-2-100, Exhibit G of the Planning Guidance Notebook?
☐	☐	☐	☐	**1.805**	

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**2.00**	**Project Description (General Construction Details and Narrative) in the Construction Cost Estimate Project Notes**
☐	☐	☐	☐	**2.100**	**Basis of Cost Estimate Notes**
☐	☐	☐	☐	**2.101**	Do the project notes present a clear understanding and definition of scope?
☐	☐	☐	☐	**2.102**	Is the scope in the project notes consistent with the scope of the recommended plan?
☐	☐	☐	☐	**2.103**	Do the project notes identify documents used as the basis for this estimate?
☐	☐	☐	☐	**2.104**	Are the major project features identified?
☐	☐	☐	☐	**2.105**	Do the project notes identify Federal and non-Federal cost sharing requirements?
☐	☐	☐	☐	**2.106**	Do the notes address significant volatile cost items in the project scope?
☐	☐	☐	☐	**2.107**	Do the project notes describe the process used to establish contingencies, such as a risk analysis, process, concerns?
☐	☐	☐	☐	**2.108**	Do the project notes clarify major assumptions such as acquisition strategy, expected bid competition, prime and subcontractor assignments, major cost quotes, major construction processes, construction phasing and/or sequencing?
☐	☐	☐	☐	**2.109**	
☐	☐	☐	☐	**2.20**	**Basis of Construction Schedule Notes**
☐	☐	☐	☐	**2.201**	Is the construction schedule consistent with the baseline project schedule?
☐	☐	☐	☐	**2.202**	Are dates for completion given, milestone dates set?
☐	☐	☐	☐	**2.203**	Are construction windows or limitations considered and documented?
☐	☐	☐	☐	**2.204**	Do the notes identify inflation points (beginning or midpoint of construction) consistent with the project schedule?
☐	☐	☐	☐	**2.205**	Do the notes address number of crews, shift work, and overtime?
☐	☐	☐	☐	**2.206**	
☐	☐	☐	☐	**2.30**	**Construction Estimate Notes**
☐	☐	☐	☐	**2.301**	Are general assumptions noted in the project notes and are they reasonable?
☐	☐	☐	☐	**2.302**	Is site access considered and presented in the notes?
☐	☐	☐	☐	**2.303**	Are borrow areas needed and identified?
☐	☐	☐	☐	**2.304**	Are unusual conditions (soil, water and water diversion, hazardous materials, weather) considered and documented in the estimate notes?
☐	☐	☐	☐	**2.305**	Are unique construction techniques considered and documented?
☐	☐	☐	☐	**2.306**	Do the notes address equipment availability and distance traveled?
☐	☐	☐	☐	**2.307**	Do the notes address labor availability and distance traveled?

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**2.308**	Do the notes address material availability and distance traveled?
☐	☐	☐	☐	**2.309**	Are environmental concerns during construction documented in the notes?
☐	☐	☐	☐	**2.310**	Is there an Acquisition Plan? (When and what method of acquisition)
☐	☐	☐	☐	**2.311**	Is there a subcontracting plan and subcontract crafts identified?
☐	☐	☐	☐	**2.312**	Are effective dates for pricing labor, equipment, and material given?
☐	☐	☐	☐	**2.313**	Are estimate supporting databases listed, current and up-to-date for the location?
☐	☐	☐	☐	**2.314**	
☐	☐	☐	☐	**2.4D**	**Dredging Estimate Notes**
☐	☐	☐	☐	**2.4D1**	Do the project notes include a narrative presenting the rationale used by the cost engineer for dredging equipment selection?
☐	☐	☐	☐	**2.4D2**	Do the project notes describe the basis for production rates?
☐	☐	☐	☐	**2.4D3**	Do the notes adequately address containment and disposal areas?
☐	☐	☐	☐	**2.4D4**	
☐	☐	☐	☐	**2.40**	**Question, at this point do you, the reviewer, have a good understanding of the project?**
☐	☐	☐	☐	**3.00**	**General Estimate Layout - Title Structure (Work Breakdown Structure)**
☐	☐	☐	☐	**3.01**	Is the estimate in proper Work Breakdown Structure (WBS) format in accordance with all guidelines?
☐	☐	☐	☐	**3.02**	Does the WBS adequately reflect all project scope?
☐	☐	☐	☐	**3.03**	Are the title structure and the descriptions adequate to determine what was being estimated?
☐	☐	☐	☐	**3.04**	Were good unit title task costs/assemblies developed to depict a complete estimate?
☐	☐	☐	☐	**3.05**	Were good unit title task costs/assemblies developed to demonstrate reasonable costs and unit prices?
☐	☐	☐	☐	**3.06**	Were good unit title task costs/assemblies developed to support the development of a reasonable construction schedule?
☐	☐	☐	☐	**3.07**	
☐	☐	☐	☐	**4.00**	**Construction Estimate Details – Unit Price Book Items Used to Develop Assemblies**
☐	☐	☐	☐	**4.10**	**General Details**
☐	☐	☐	☐	**4.101**	Is the estimate detail traceable back to the scope package?
☐	☐	☐	☐	**4.102**	Does the estimate separate and include all major items scoped in the recommended plan?
☐	☐	☐	☐	**4.103**	Does the estimate detail the assumptions made for development of the detailed cost items?

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**4.104**	Do quantities appear reasonable and consistent with the recommended plan?
☐	☐	☐	☐	**4.105**	Are note fields used to briefly explain the detail costs?
☐	☐	☐	☐	**4.106**	Does the estimate organize and present a logical sequence of work?
☐	☐	☐	☐	**4.107**	Are critical quantities and costs identified in the estimate details?
☐	☐	☐	☐	**4.108**	Does the estimate contain specific detail to make judgment on whether costs are reasonable?
☐	☐	☐	☐	**4.109**	
☐	☐	☐	☐	**4.20**	**Labor and Equipment**
☐	☐	☐	☐	**4.201**	Are the actual labor rates reasonable? Check specific rates.
☐	☐	☐	☐	**4.202**	Do the labor rates reflect current market and locale such as rural or metro availability?
☐	☐	☐	☐	**4.203**	Review the estimate settings for overtime and any other modifiers. Is any overtime used judiciously for critical-path elements?
☐	☐	☐	☐	**4.204**	Are the actual equipment rates reasonable? Check specific rates.
☐	☐	☐	☐	**4.205**	Does crew makeup appear reasonable?
☐	☐	☐	☐	**4.206**	Are crew production rates reasonable?
☐	☐	☐	☐	**4.207**	Were equipment fuels updated to current rates?
☐	☐	☐	☐	**4.208**	Does the estimate clearly indicate that the costs for dredge plant are based on historical data or CEDEP?
☐	☐	☐	☐	**4.209**	
☐	☐	☐	☐	**4.30**	**Materials**
☐	☐	☐	☐	**4.301**	Are appropriate allowances applied to items where loss due to handling, placement, cutting, transportation, contamination, etc.?
☐	☐	☐	☐	**4.302**	Does earthwork items make distinction and reasonable assumptions for bank cubic yards, loose cubic yards, and embankment cubic yards?
☐	☐	☐	☐	**4.303**	Are critical or volatile materials and quantities identified at the detail level?
☐	☐	☐	☐	**4.304**	Are major material quotes identified with quote source documentation?
☐	☐	☐	☐	**4.305**	Does the estimate clarify/include transport costs?
☐	☐	☐	☐	**4.306**	
☐	☐	☐	☐	**4.40**	**Mobilization - Preparatory Work, Demobilization – Cleanup**
☐	☐	☐	☐	**4.401**	Are mobilization and demobilization costs detailed?
☐	☐	☐	☐	**4.402**	Does the total mobilization and demobilization cost appear reasonable?
☐	☐	☐	☐	**4.403**	
☐	☐	☐	☐	**4.4D1**	Dredge work: does the estimate include preparation of dredge attendant plant for transfer, the cost to move all plant and equipment return of tug or towing vessel, and preparation of the plant to start

Y	N	N/P	N/A		Categories/Questions
					work?
☐	☐	☐	☐	**4.4D2**	Dredge Work: Does the estimate clearly include a construction support site?
☐	☐	☐	☐	**4.4D3**	Dredge Work: Does the estimate present the reasons for using a different distance for demobilization?
☐	☐	☐	☐	**4.4D4**	Dredge Work: Does the estimate include all costs to secure machinery and equipment for storage?
☐	☐	☐	☐	**4.4D5**	Dredge Work: Does the estimate clearly include indirect costs in the mobilization and demobilization pay item?
☐	☐	☐	☐	**4.4D6**	
☐	☐	☐	☐	**4.50**	**Miscellaneous Estimate Details**
☐	☐	☐	☐	**4.501**	Are volatile cost items identified? Check major items that affect cost.
☐	☐	☐	☐	**4.502**	Do major cost items reflect a reasonable unit of measure to ascertain a unit cost?
☐	☐	☐	☐	**4.503**	Do major unit prices appear reasonable for the locale? (Concrete, steel, earthwork, fabrication, etc.)
☐	☐	☐	☐	**4.504**	Are major construction concerns considered such as site access, care and diversion of water, etc.
☐	☐	☐	☐	**4.505**	Are any costs developed for Hazardous, Toxic, and Radioactive Waste concerns?
☐	☐	☐	☐	**4.506**	
☐	☐	☐	☐	**4.5D1**	Dredge Work: Where applicable, are pipeline dredging gross production costs consist of costs associated with dredging time, not by element of work?
☐	☐	☐	☐	**4.5D2**	Dredge Work: Where applicable, are hopper and mechanical dredge gross production costs based on excavation time, transport time, and disposal time?
☐	☐	☐	☐	**4.5D3**	
☐	☐	☐	☐	**4.60**	**Subcontracting**
☐	☐	☐	☐	**4.601**	Are subcontractor assignments and markups reasonable?
☐	☐	☐	☐	**4.602**	Does the estimate identify subcontract quotes (dependent on type of estimate)?
☐	☐	☐	☐	**4.603**	Has an appropriate consideration been made in addressing multi-tier subcontracting for specialty items?
☐	☐	☐	☐	**4.604**	
☐	☐	☐	☐	**5.00**	**Construction Cost Summary, Including Indirect and Markups**
☐	☐	☐	☐	**5.01**	Are appropriate taxes included or excluded as may be required?
☐	☐	☐	☐	**5.02**	Is the field office overhead reasonable for this project?
☐	☐	☐	☐	**5.03**	Does the home office overhead look reasonable for this type of work?

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**5.04**	Is profit reasonable and was the weighted guideline method used to calculate it?
☐	☐	☐	☐	**5.05**	Does bond seem reasonable?
☐	☐	☐	☐	**5.06**	Are all costs at the same price level?
☐	☐	☐	☐	**5.07**	
☐	☐	☐	☐	**6.00**	**Risk Analysis and Contingency (required over $40 million)**
☐	☐	☐	☐	**6.10**	**Risk Analysis**
☐	☐	☐	☐	**6.101**	Does the estimate include a discussion of the uncertainties associated with each major cost item? (ER 1105-2-100, appendix E)
☐	☐	☐	☐	**6.102**	Was a risk analysis completed and documented using accepted software?
☐	☐	☐	☐	**6.103**	Was the analysis supported by market research?
☐	☐	☐	☐	**6.104**	Did the project delivery team provide input for the risk analysis?
☐	☐	☐	☐	**6.105**	Are key variables identified and considered?
☐	☐	☐	☐	**6.106**	Is scope quality and detail addressed?
☐	☐	☐	☐	**6.107**	Are key design elements considered within the study?
☐	☐	☐	☐	**6.108**	Is volatile pricing considered?
☐	☐	☐	☐	**6.109**	Is material availability and transport considered?
☐	☐	☐	☐	**6.110**	Is unique construction considered?
☐	☐	☐	☐	**6.111**	Is schedule (restrictive or permissive) considered?
☐	☐	☐	☐	**6.112**	Are there any other key variables requiring consideration?
☐	☐	☐	☐	**6.113**	Does risk consider acquisition strategy?
☐	☐	☐	☐	**6.114**	Does the analysis consider potential savings such as value engineering and alternatives?
☐	☐	☐	☐	**6.115**	Are the contingency allowances a result of a risk analysis?
☐	☐	☐	☐	**6.116**	
☐	☐	☐	☐	**6.20**	**Contingency**
☐	☐	☐	☐	**6.201**	Do the applied contingency rates appear reasonable for each major cost item?
☐	☐	☐	☐	**6.202**	Does the overall contingency rate appear reasonable?
☐	☐	☐	☐	**6.203**	Does the contingency reflect a confidence value near 80 percent?
☐	☐	☐	☐	**6.204**	
☐	☐	☐	☐	**7.00**	**Schedules**
☐	☐	☐	☐	**7.10**	**Construction Schedule**
☐	☐	☐	☐	**7.101**	Are construction schedules clearly presented in the feasibility report?
☐	☐	☐	☐	**7.102**	Does the schedule identify critical aspects of the construction?

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**7.103**	Are key milestones depicted?
☐	☐	☐	☐	**7.104**	Does the construction schedule reflect reasonable logic of activities?
☐	☐	☐	☐	**7.105**	Does the construction schedule indicate a likely critical path?
☐	☐	☐	☐	**7.106**	Are all activities tied?
☐	☐	☐	☐	**7.107**	Does the construction schedule consider crew sizes, numbers of crews, related productivity?
☐	☐	☐	☐	**7.108**	Do construction schedules make distinction between single shift and double shift?
☐	☐	☐	☐	**7.109**	Does the estimate and risk analysis reflect the schedule (i.e., overtime usage, numbers of crews, numbers of shifts, critical delivery aspects, concurrent activities, etc.)?
☐	☐	☐	☐	**7.110**	Do construction schedules depict critical or time-sensitive orders or procurements?
☐	☐	☐	☐	**7.111**	
☐	☐	☐	☐	**7.20**	**Project Schedule**
☐	☐	☐	☐	**7.201**	Does the project schedule include all activities for Total Project such as planning, E&D, advertising and award, construction, and closeout and turnover to sponsor?
☐	☐	☐	☐	**7.202**	Does the project schedule clearly present dates to determine inflation based on escalation indexes, i.e., the activity beginning date or the activity midpoint?
☐	☐	☐	☐	**7.203**	
☐	☐	☐	☐	**8.00**	**Total Project Cost Summary in Current Dollars**
☐	☐	☐	☐	**8.01**	Is there a proper TPC worksheet?
☐	☐	☐	☐	**8.02**	Is the price level date shown and is it consistent with the estimate preparation date?
☐	☐	☐	☐	**8.03**	Are all the project-related Civil Works WBS Features shown in the TPC Summary?
☐	☐	☐	☐	**8.04**	Do the Lands and Damages cost (01 Feature) provided by Real Estate Division include contingencies?
☐	☐	☐	☐	**8.05**	Are Relocations (02 Feature) accurately separated and shown?
☐	☐	☐	☐	**8.06**	Are costs for Cultural Resources (18 Feature) included?
☐	☐	☐	☐	**8.07**	Is the basis of the Cultural Resources costs noted?
☐	☐	☐	☐	**8.08**	Are the feasibility study costs (22 Feature) shown and included in the TPC?
☐	☐	☐	☐	**8.09**	Is the basis of the feasibility study costs noted?
☐	☐	☐	☐	**8.10**	Is the basis of the 30 and 31 feature costs noted?
☐	☐	☐	☐	**8.11**	Does the E&D clearly include costs for project management, planning and engineering, E&D, independent technical review and value engineering, contracting, reprographics, engineering during construction, planning during construction, project operation?

Y	N	N/P	N/A		Categories/Questions
☐	☐	☐	☐	**8.12**	Are reasonable percentages used to develop costs for E&D (30 Feature)?
☐	☐	☐	☐	**8.13**	Are reasonable percentages used to develop costs for Construction Management (31 Feature)?
☐	☐	☐	☐	**8.14**	Are contingencies separately shown for each Feature?
☐	☐	☐	☐	**8.15**	
☐	☐	☐	☐	**9.00**	**Total Project Cost Inflated (using escalation indexes) go the Project Schedule**
☐	☐	☐	☐	**9.01**	Is the contingency allowance consistent with the TPC in current dollars?
☐	☐	☐	☐	**9.02**	Are the work breakdown codes (Feature Codes) shown in the inflated TPC Summary?
☐	☐	☐	☐	**9.03**	Are all features and elements inflated through the project schedule?
☐	☐	☐	☐	**9.04**	Are the escalation dates shown for each inflated feature?
☐	☐	☐	☐	**9.05**	Are the escalation dates consistent with the project schedule?
☐	☐	☐	☐	**9.06**	Are inflated TPCs based on price indexes from the current CWCCIS, EM 1110-2-1304?
☐	☐	☐	☐	**9.07**	Are inflation percentage rates shown for each feature?
☐	☐	☐	☐	**9.08**	Are inflation percentages calculated correctly?
☐	☐	☐	☐	**9.09**	If Lands and Damages are inflated, is the escalation for inflation based on the Consumer Price Index?
☐	☐	☐	☐	**9.10**	Does the inflated TPC include any escalation beyond CWCCIS guidance based on market research?
☐	☐	☐	☐	**9.11**	Does the feasibility report present the basis and rationale for inflating the project cost using something other than CWCCIS guidance?
☐	☐	☐	☐	**9.12**	
☐	☐	☐	☐	**10.00**	**Federal and Non-Federal Costs**
☐	☐	☐	☐	**10.01**	Are the Federal and non-Federal cost share percentages shown?
☐	☐	☐	☐	**10.02**	Is the feasibility report cost share clearly shown?
☐	☐	☐	☐	**10.03**	Is the project cost share percent consistent with the feasibility cost sharing agreement?
☐	☐	☐	☐	**10.04**	If applicable, is the cost/value of non-Federal in-kind services shown?
☐	☐	☐	☐	**10.05**	Are cost shares calculated correctly?
☐	☐	☐	☐	**10.06**	

APPENDIX G

Cost and Schedule Risk Analysis

G-1. Risk Analysis Overview.

a. Cost risk analysis is the process of determining the probability of cost and schedule overruns and assigning a studied growth potential presented as a contingency percentage or value. The analysis is a formal process that includes involvement of the project delivery team (PDT) utilizing nationally recognized software based on the Monte Carlo principles.

b. A risk analysis should be provided on the total project cost, including all work breakdown structure features of the project, but excluding escalation and contingency. Too often, risk focuses on just the construction activities, which can result in critical risk elements remaining unidentified. Through early determination of potential project risks, management can then focus efforts in those areas for potential risk mitigation, resulting in cost and schedule savings. A formal risk analysis should be accomplished as a joint analysis between the cost engineer and the other PDT members that have specific knowledge and expertise on all possible project risks for all features, both internal and external project risks.

c. Beginning a Cost and Schedule Risk Analysis (Process Box 0). As part of the PDT, the project manager (PM) shall establish a risk analysis member/facilitator, their funding, and delivery schedule. The task of the PDT risk analysis facilitator is to lead the PDT in risk assessment and then produce a Cost and Schedule Risk Analysis (CSRA). In short, the CSRA begins with assembling members of the PDT to brainstorm the project's risk elements. PDT members who have the responsibility of either defining scope or the development of data would participate in the brainstorming session. Members are likely to include the PM, risk facilitator, and personnel from real estate, relocations, environmental, design, contracting, construction, scheduling, and estimating. The initial objectives are to develop:

(1) Cost risk register addressing all project features, internal and external risks.

(2) The "Most Likely" base cost estimate.

(3) The "best case" and "worst case" estimates.

(4) Cost risk assessment model using Crystal Ball.

(5) Schedule risk register addressing all features.

(6) Schedule risk assessment model using Crystal Ball.

d. All project features must be addressed within the risk analysis study to ensure total project risk has been captured. Communication is the key since the cost engineer has based the construction estimate on certain assumptions. While the cost engineer is responsible for the construction estimate, it is highly recommended that the estimate used for the risk analysis include all project costs and all feature costs. Those estimates should exclude any contingency and escalation, since those are determined after the risk analysis is complete.

e. Risk elements are any aspect of the project that could cause the cost and/or schedule to vary from the estimator's "Most Likely" cost estimate and schedule (the "Most Likely" estimate is the one presented as the base cost and base schedule). The brainstorming sessions typically last 1 day or less, during which the team identifies risk elements, their likelihood, and their potential impacts. The PDT considers internal risks within the project but also external influences. The outcome of the initial brainstorming session is a preliminary risk register(s) that displays the PDT's perceived risks and impacts to cost and schedule.

f. After the brainstorming session, the cost engineer will require several days to develop low (best case) and high (worst case) cost and schedule estimates based upon the risk elements identified by the PDT. Additional time may be required to perform local market studies on key commodities such as fuel, material cost, and labor. The studies identify the actual significance of the risk items and whether further risk study is warranted. At that time, the cost engineer can complete the risk register(s) with the identified risk items and their significance to the subsequent risk analysis. The market studies may reveal a change of impact significance and criticality related to the identified risk. The PDT risk analysis member will need several days to customize the risk model based on the data available for the CSRA. During that period, the cost engineer will assign distribution curves depicting the best, "Most Likely", and worst case for each high-risk item within the register(s). Once the CSRA model has been developed, ran, and the results analyzed, a quality check is made to assure the results are logic-based on model assumptions.

g. A typical CSRA requires 10-15 days to perform. Internal labor varies, but in general, 80-120 hours are required for the risk analysis PDT member, plus additional costs for the cost engineer and remaining PDT members who have provided support to the risk development effort. On significantly large and complex projects, labor could be as great as 1,000 hours where significant market analyses are required prior to the CSRA.

G-2. Cost and Schedule Risk Process.

a. Figure G-1 illustrates the steps involved in conducting a CSRA.

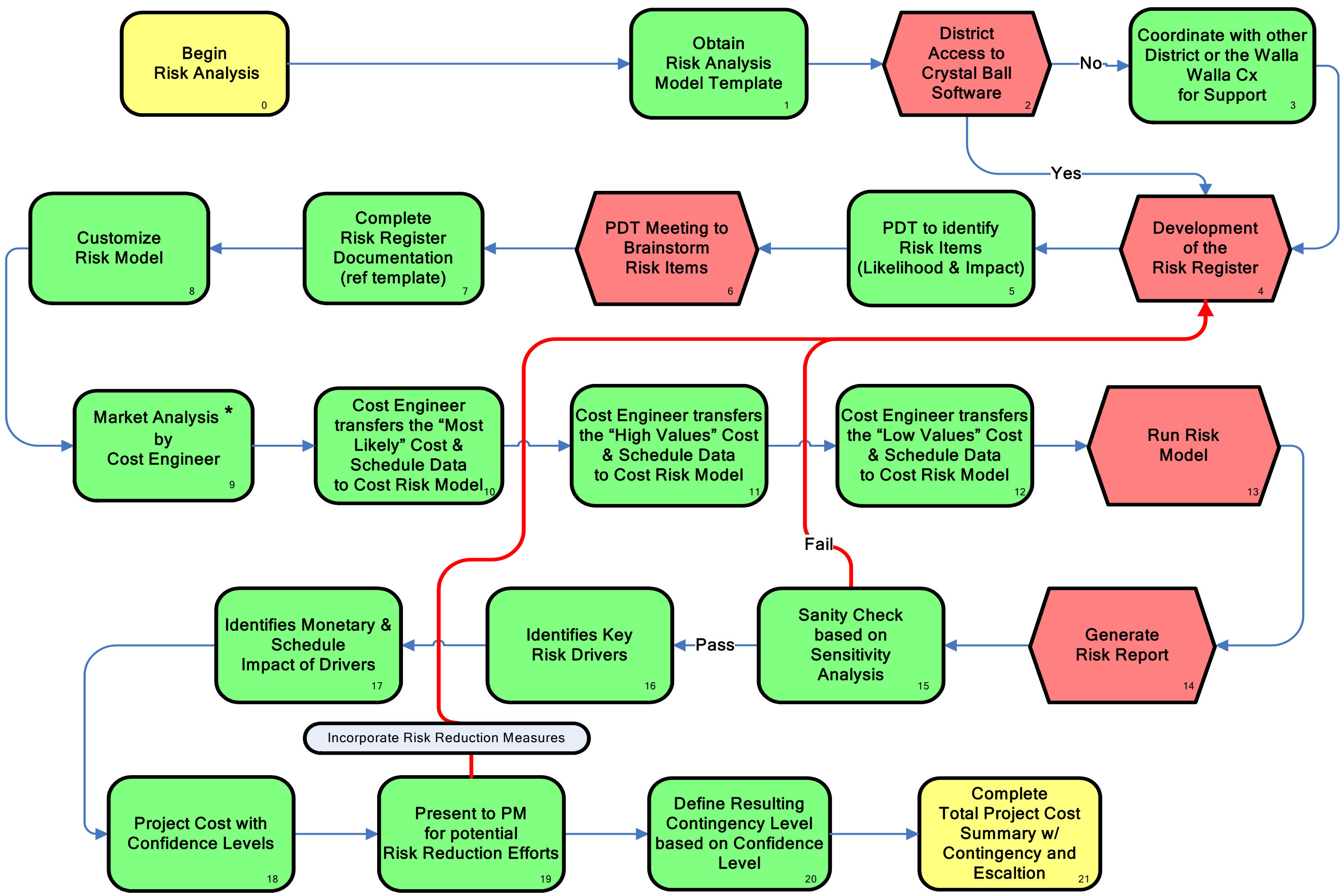


Figure G-1. Cost and Schedule Risk Process

b. Obtain CSRA Template (Process Box 1). A U.S. Army Corps of Engineers standard draft template for CSRA is available for download from the Walla Walla District, Cost Engineering Branch Center of Expertise (CX) web page at http://www.nww.usace.army.mil/html/offices/ed/cb/cepage.htm.

c. District Access to Crystal Ball Software (Process Box 2 and 3). The CSRA template requires Crystal Ball software in order to conduct a risk analysis. This software can be obtained through coordination with another district, architect-engineer cost firm, or the Walla Walla Cost Engineering CX to support you on the CSRA.

G-3. Development of Risk Register (Process Box 4). The first worksheet of the CSRA template, is the risk register (a sample risk register is shown in figure G-2 and addresses both cost and schedule risks). The risk register is a structured approach to communicate potential risk of the program or project and to assign risk potentials.

a. Project Delivery Team to Identify Risk Items (Process Box 5 and 6). The first step in building the risk register is for the cost engineer to identify to the PDT the basis of the cost estimate and schedule. The PDT would brainstorm and identify risks items that could potentially cause a variance to the cost estimate or schedule. Drivers, which should be discussed as a minimum, are bidding climate, saturated local market, volatile real estate values, scope definition, evolving design changes, weather, schedule constraints, labor availability/pricing, equipment availability/pricing, material availability/pricing, fuel prices, productivity, potential savings due to innovation, streamlining, acquisition strategy, and gains in efficiency.

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Risk Level

Likelihood of Occurrence

	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	Discussion and Concerns	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/ POC	Affected Project Component	Project Implications
			Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)					
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
I-1	Scope Definition	Scope is fairly well defined for standard civil works features. The pumping plant requires considerable design and approximates 20% of the cost.	LIKELY	SIGNIFICANT	HIGH	$1,200,000	LIKELY	SIGNIFICANT	HIGH	8	UNIFORM	I-2	Project Manager/Planner	Construction Cost	Cost & Schedule
I-2	Scope Growth / Reduction	Scope is fairly well defined for standard civil works features. The pumping plant has potential of VE savings through better data and VE.	LIKELY	MARGINAL	MODERATE	($275,000)	LIKELY	MARGINAL	MODERATE	10	UNIFORM	I-1, I-16	Project Manager/Planner	Construction Cost	Cost & Schedule
I-3	Labor Availability/Pricing	$3 Billion construction will be occurring in locale over the next 5 years.	LIKELY	SIGNIFICANT	HIGH	$3,000,000	LIKELY	MARGINAL	MODERATE	9	TRIANGULAR		Project Manager/Planner	Labor/ Production Rates	Cost & Schedule
I-4	Equipment Availability/Pricing	Large cranes required, but available. Pump plant equipment long lead time.	UNLIKELY	NEGLIGIBLE	LOW	$900,000	UNLIKELY	MARGINAL	LOW	6	TRIANGULAR	I-15	Cost Engineering	Equipment/ Production Rates	
I-5	Material Availability/Pricing	Needed aggregates in short supply locally. This affects concrete, rip rap, base course and asphalt	VERY LIKELY	SIGNIFICANT	HIGH	$2,300,000	VERY LIKELY	MARGINAL	MODERATE	4	TRIANGULAR		Cost Engineering	Material Costs	Cost & Schedule
I-6	Fuel Prices	$2.65 per gallon was used in the Oct 06 MCACES, increases will effect equipment and delivery or materials	VERY LIKELY	SIGNIFICANT	HIGH	$1,750,000	VERY LIKELY	NEGLIGIBLE	LOW	0	TRIANGULAR		Cost Engineering	Equipment	Cost
I-7	Utility Relocations	Location is rural. However, several unmarked and abandoned farm related utilities are prevalent at this location.	LIKELY	MARGINAL	MODERATE	$870,000	LIKELY	MARGINAL	MODERATE	3	TRIANGULAR		Civil Design	Construction Cost	Cost & Schedule
I-8	Environmental Mitigation	Studies indicate that the area is heavily saturated with de-icing chemicals as well as agricultural fertilization and pesticide residuals.	LIKELY	SIGNIFICANT	HIGH	$1,600,000	LIKELY	SIGNIFICANT	HIGH	24	UNIFORM		Environmental Compliance Specialist	Construction Cost	Cost & Schedule
I-9	HTRW	A small portion of the project is located within the limits of an Army Chemical Depot undergoing BRAC.	UNLIKELY	MARGINAL	LOW	$400,000	UNLIKELY	SIGNIFICANT	MODERATE	18	UNIFORM		Environmental Compliance Specialist	Construction Cost	Schedule
I-10	Permits	Substantial permitting delays may occur if there are significant environmental mitigation/HTRW issues, or political opposition.	LIKELY	NEGLIGIBLE	LOW	$150,000	LIKELY	MARGINAL	MODERATE	17	TRIANGULAR	I-14, E-4	Planning/Regulatory	PED/Lands & Damages	Schedule
I-11	Environmental Windows	Project site is a natural habitat for various species of threatened wildlife that spawn during Spring months. No excavation is permitted from April 15 - June 30.	VERY LIKELY	SIGNIFICANT	HIGH	$3,500,000	VERY LIKELY	SIGNIFICANT	HIGH	30	TRIANGULAR	E-2	Project Manager/Planner	Construction Cost	Cost & Schedule
I-12	Sufficient Planning Schedule	Project is a fast-track project, although complicated. Concerns exist on obtaining appropriate schedule and funding for sufficient review and effort by specialized team members and contractors	LIKELY	MARGINAL	MODERATE	$300,000	LIKELY	SIGNIFICANT	HIGH	14	TRIANGULAR		Project Manager/Planner	Construction Cost	Cost & Schedule
I-13	Adequate Technical Staff	Due to fast-tracking, portions of design and planning effort are split between Gov't and AE specialists. Concern remains that the integration of staff may create delays.	LIKELY	NEGLIGIBLE	LOW	$200,000	LIKELY	MARGINAL	MODERATE	7	TRIANGULAR		Project Manager/Planner	PED	Schedule

I-14	Site Access	Site access is limited due to clearances required from U.S. Army installation, and local farmers remaining on property. Also, no excavation (or boring) is permitted April 15 - June 30.	VERY LIKELY	MARGINAL	MODERATE	$500,000	VERY LIKELY	NEGLIGIBLE	LOW	2	TRIANGULAR	I-10	Project Manager/Planner	Construction Cost	Cost
I-15	Special Equipment Fabrication	There are only two known manufacturers of the specialized filtration and pumping stations required on site, and neither are domestic.	UNLIKELY	NEGLIGIBLE	LOW	$1,900,000	UNLIKELY	NEGLIGIBLE	LOW	7	TRIANGULAR	I-4	Cost Engineering	Construction Cost	
I-16	Potential savings due to innovation, streamlining, and gains in efficiency	Value Engineering has already been incorporated into the project. VE remains on the pumping plant.	LIKELY	MARGINAL	MODERATE	($2,500,000)	LIKELY	NEGLIGIBLE	LOW	11	UNIFORM	I-2	Value Engineering Team	Productivity	Cost
I-17	Acquisition Plan	The estimate was based on full and open competition, with minimal tiering of contractor subs. The Acq Plan has not been finalized, therefore there is a potential for additional tiering of the contracts.	LIKELY	SIGNIFICANT	HIGH	$7,500,000	LIKELY	MARGINAL	MODERATE	16	TRIANGULAR	E-3	Acquisition Strategy Board	Construction Cost	Cost & Schedule
I-XX	Other Potentials														
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
E-1	Weather	Work will be done on the river, unpredictable, scour protection is more vulnerable	LIKELY	NEGLIGIBLE	LOW	$175,000	LIKELY	MARGINAL	MODERATE	6	TRIANGULAR		N/A	Labor/ Production Rates	Schedule
E-2	Environmental Policy Changes	There are external environmental policy changes that can change the construction work windows.	LIKELY	SIGNIFICANT	HIGH	$1,400,000	LIKELY	SIGNIFICANT	HIGH	10	TRIANGULAR	I-11	Project Manager/Planner	Construction Cost	Cost & Schedule
E-3	Bidding Climate – Saturated Local Market	$3 Billion construction will be going on in downtown Pittsburgh over the next 5 years.	LIKELY	MARGINAL	MODERATE	$2,000,000	LIKELY	NEGLIGIBLE	LOW	4	UNIFORM	I-16	Acquisition Professional	Construction Cost	Cost
E-4	Political Support/Opposition	Project is highly visible and controversial. Delays due to political ramifications are possible and could critically delay or terminate the work.	LIKELY	SIGNIFICANT	HIGH	$6,400,000	LIKELY	SIGNIFICANT	HIGH	28	UNIFORM	I-10	Project Manager/Planner	Project Cost	Cost & Schedule
E-5	Sufficient Incremental Funding	Budget constraints could limit or delay funding, creating potential sequencing delays and issues, considering the environmental window constraints.	VERY LIKELY	SIGNIFICANT	HIGH	$4,600,000	VERY LIKELY	SIGNIFICANT	HIGH	27	TRIANGULAR		Project Manager/Planner	Project Cost	Cost & Schedule
E-XX	Other Potentials														

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.

A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.

7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Figure G-2. Example of a Risk Register

b. Complete Risk Register Documentation (Process Box 7).

(1) Once the risk events have been identified, the PDT will then assign a likelihood and potential impact to each event within a preliminary risk register. This draft risk register will identify the high cost and schedule concerns. It should also identify potential savings related to cost and schedule. This will allow the risk model to place emphasis on the events that result in the greatest potential impacts, positive and negative. The team will provide the PDT cost engineer the information required to calculate impacts of the identified driver or event. The PDT cost engineer will likely need to consult the market as well as historical data as a basis for determining certain impact potentials.

(2) Once the risk item impacts have been determined for cost and schedule, a final risk register can be completed, demonstrating the significant or high-risk items that warrant inclusion within the risk model. The final risk register is commonly completed by the cost engineer that has performed the estimate and studied the cost impacts through research. Note that during this period of study, the impact significance can change as a result of further cost and schedule study of the identified impacts.

(3) After the initial PDT brainstorming session, it is common that the "Most Likely" estimate may need revision based upon the issues learned during those discussions. To adequately address risk associated with potential design or original assumption changes, the PDT shall provide enough information for the cost engineer to develop a reasonable "Most Likely" cost estimate and schedule to reflect these potential changes. This initial process, more than any other, demonstrates that the CSRA process is a team tasking. The risk model is only as good as the data provided.

G-4. <u>Customize Risk Model (Process Box 8)</u>.

a. Having now completed the first worksheet (the Risk Register) of the CSRA template, the second worksheet (the Risk Model) will need to be customized for the CSRA currently being developed. The risk model will include one row for every identified risk item to be included in the study within an Excel spreadsheet format. This can be accomplished in a variety of ways such as utilizing the "Most Likely" estimate work breakdown structure OR by reflecting the actual risk register. The risk model must encompass the full scope, cost and schedule of the project with all features and at an adequate detail level that clearly reflects the cost and schedule variances of the specific risk(s). The risk model must address the low (best case) estimate, the "Most Likely" estimate, and the high (worst case) estimate for those individual items that are deemed significant risks. When developing the best and worst cases, the extremes should not be included, because they can skew the results unreasonably. For this reason, the best and worst cases are commonly presented as bounded by 20 percent (best case 20 percent, worst case 80 percent). It is highly recommended that the best and worst cases are developed from the “Most Likely” estimate. In that way, any other estimates and variances reflect the same work breakdown structure OR risk register format for comparison purposes. In order to develop a traceable document, the risk model should reflect the “Most Likely” estimate, but be traceable back to the risk register.

b. The level of detail of these items, and hence the number of risk items established for further study, should be determined by the PDT risk analysis member working together with the cost engineer. Typically, risk that potentially affects the overall estimate by 1 percent or more would be addressed in the risk model. A standard number of critical risk items under study would approximate 8-12 variables. This could be just the high risk items, but may also include the moderate risks if those risks are still a considerable cost or schedule impact.

c. Market Analysis by Cost Engineer (Process Box 9). To establish the best and worst-case estimates, the cost engineer will need to perform a market analysis for the local area on the critical risk items. This would include information such as labor market, construction market, fuel cost, material cost, bidding climate, and competition. Some of this effort can begin prior to customizing the risk model, as the market conditions may uncover other risks. Various tools are used for this study, sources such as:

- Historical bid data.
- Internet research.
- Engineering news record.
- Construction records.
- Engineering and planning.
- Real estate.

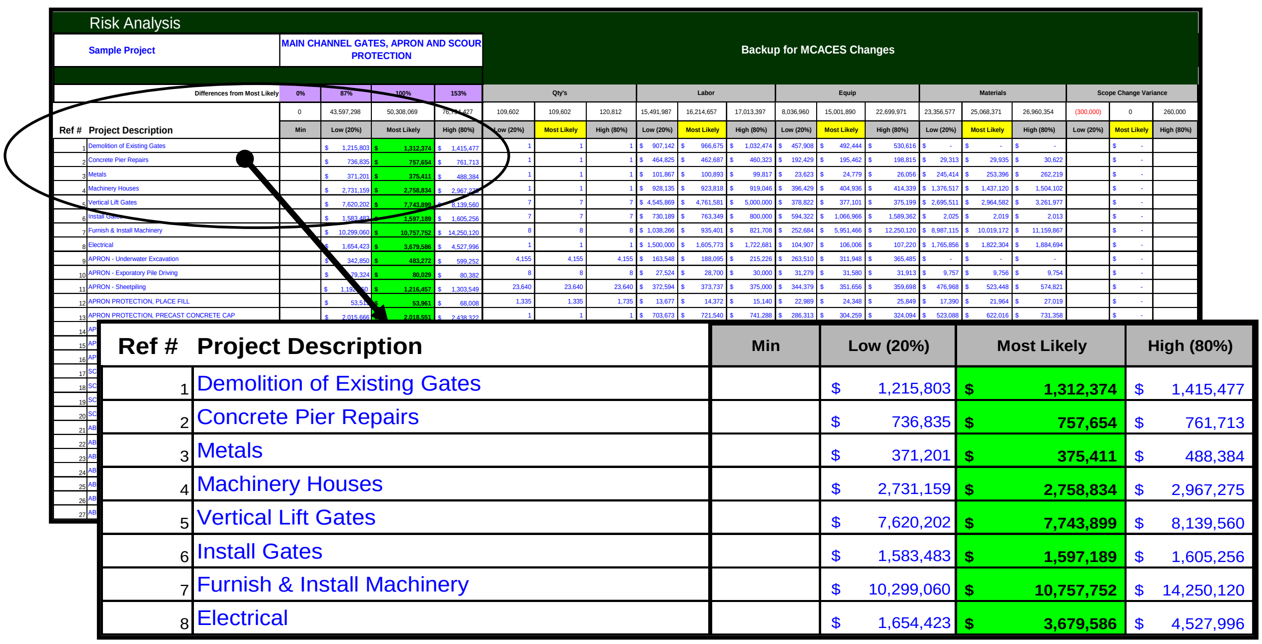
This process could start at anytime prior to running the risk model. Typically, the cost engineer may have already sought current data for the estimate development. For the risk analysis, additional data would be required such as the range of values including highs and lows.

d. Transfer the “Most Likely[1]” Cost and Schedule Data to the Risk Model (Process Box 10). The cost engineer will transfer data from the escalation and contingency-free cost estimate to the risk model’s “Most Likely” column (figure G-3). The “Most Likely” estimate is the estimate represented within the Total Project Cost Summary as presented within appendix B. The level of detail to be run in the model will vary on a project-by-project basis, and the cost engineer will be required to communicate with the PDT risk analysis member to establish the level of detail.

[1] “Most likely” is the cost developed by the cost engineer based on current project data and assumptions.

e. Transfer the "High Values" Cost and Schedule Data to Cost Risk Model (Process Box 11). The cost engineer will be required to develop the "High Cost" estimate based on the information from the risk register. It is important to have clear communications with the PDT risk analysis member to define what the high estimate should reflect. The software program allows the user to customize the model for what the "High" estimate constitutes. In figure G-3, the high estimate was based on cost that reflects an 80 percent chance of covering the item. The cost model requires this input to define the distribution (figure G-3).

f. Transfer the "Low Values" Cost and Schedule Data to Cost Risk Model (Process Box 12). The cost engineer will be required to develop the "Low Cost" estimate based on the information from the risk register. It is also important to have clear communications with the PDT risk analysis member to define what the low estimate should reflect. The software program allows the user to customize the model for what the "Low" estimate constitutes. In figure G-3, the low estimate was based on cost that reflects a 20 percent chance of covering the item. The cost model requires this input to help define the distribution (figure G-3).



Ref #	Project Description	Min	Low (20%)	Most Likely	High (80%)
1	Demolition of Existing Gates		$ 1,215,803	$ 1,312,374	$ 1,415,477
2	Concrete Pier Repairs		$ 736,835	$ 757,654	$ 761,713
3	Metals		$ 371,201	$ 375,411	$ 488,384
4	Machinery Houses		$ 2,731,159	$ 2,758,834	$ 2,967,275
5	Vertical Lift Gates		$ 7,620,202	$ 7,743,899	$ 8,139,560
6	Install Gates		$ 1,583,483	$ 1,597,189	$ 1,605,256
7	Furnish & Install Machinery		$ 10,299,060	$ 10,757,752	$ 14,250,120
8	Electrical		$ 1,654,423	$ 3,679,586	$ 4,527,996

Figure G-3. Example of Cost Model Input

g. The next step would be to assign, what are called in Crystal Ball, "assumptions" to each risk item. Assumptions are simply probability distributions, e.g., triangular, uniform, binomial, or Bernoulli. The distributions most commonly used in CSRAs are triangle and uniform, but the distribution should be tailored to best represent the determined variance potential. The distribution reflects the best, "Most Likely", and worst-case parameters; thus, a triangular distribution is typically established. It is strongly suggested that someone who has been trained in performing a CSRA customize the risk model. Note that the study includes both a cost and a schedule risk run. Both are treated in a best, “Most Likely”, and worst-case scenario. The results can be displayed as a percentage or as a cost in dollars or schedule by months. The schedule growth can then be converted into a risk escalation and presented as part of the contingency.

h. Schedule Risk Analysis (Process Box 10, 11, and 12). A schedule risk analysis uses statistical techniques to predict the level of confidence in meeting a program’s completion date. This analysis focuses not only on critical path activities but also on activities near the critical path, since they can potentially affect program status. Like a cost estimate risk and uncertainty analysis, a schedule risk analysis relies on Monte Carlo simulation to randomly vary activity durations according to their probability distributions to develop a level of confidence in the overall integrated schedule. This analysis can provide valuable insight into “what-if” drills and quantify the impact of program changes.

(1) To develop a schedule risk analysis, probability distributions for each activity’s duration along and near the critical path must be established. (The critical path based on the schedule network identifies the specific tasks that will lead to the entire program slipping if not completed on time.) Typically, three-point estimates are used to develop the probability distributions for the duration of workflow activities, including best, “Most Likely”, and worst-case estimates.

(2) After the distributions are developed, the Monte Carlo simulation is run, and the resulting cumulative confidence diagrams display the probability associated with the range of program completion dates. If the analysis is to be credible, the program must have a good schedule network that clearly identifies the critical path that is based on a minimum number of date constraints.

(3) The risk analysis should also identify which tasks during the simulation most often ended up on the critical path, so that near–critical path activities can also be closely monitored and managed.

(4) One of the most important reasons for performing a schedule risk analysis is that the overall program schedule will always be greater than the sum of the durations for lower-level activities. This is because of schedule uncertainty, which can cause activities to lengthen. When they do, other activities can be affected by network schedule linkages. Lengthening of schedule would cause escalation increases to the estimate.

(5) Such uncertainty is typically brought on by:

- A large number of activities and tasks.
- Independent parallel tasks that have near the same completion date.
- Interdependence of two or more tasks.
- Work packages lasting longer than 3 months.
- Planning packages longer than 6 months.
- Reflection of a great deal of lag time in the schedule.

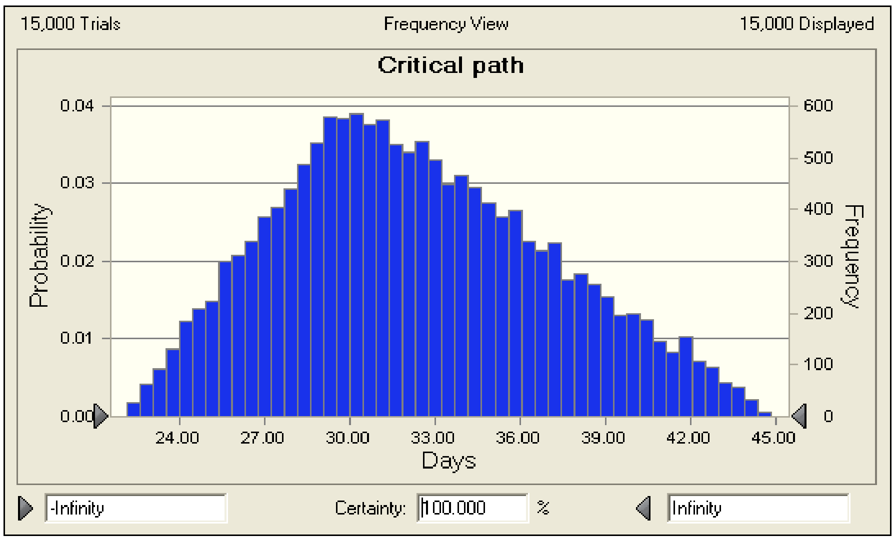


Figure G-4 Example of Critical Path Distribution

(6) Since each activity has an uncertain duration, it makes sense that the duration of the overall program schedule will also be uncertain. Therefore, unless a statistical simulation is run, the sum of "Most Likely" duration distributions will tend to underestimate the overall program critical path duration. Accordingly, because critical path activity durations are uncertain, the probability distribution of the program's total duration must be determined statistically, by adding the individual probability distributions of critical path activities.

(7) To capture the uncertainty for each critical path activity distribution, various estimates must be collected. They should be formulated by a consensus of knowledgeable technical experts and coordinated with the same people who manage the program's risk mitigation watch list. Once the distributions have been established, the Monte Carlo simulation uses random numbers to select specific durations from each critical path activity probability distribution and calculates a new critical path. The Monte Carlo simulation continues this random selection thousands of times, creating a new

program duration estimate and critical path each time. The resulting frequency distribution displays the range of program completion dates along with the probabilities that these dates will occur, as seen in figure G-4.

(8) The program schedule should satisfy the 11-point schedule assessment listed below. Questions that should be answered during a schedule risk assessment include:

- Does the schedule reflect all work to be completed?
- Are the program critical dates used to plan the schedule?
- Are the activities sequenced logically?
- Are activity interdependencies identified and logical?
- If there are constraints, lags, and lead times, what documentation is available to justify the amounts?
- How realistic are the schedule activity duration estimates?
- How were resource estimates developed for each activity and will the resources be available when needed?
- How accurate is the critical path and was it developed with scheduling software?
- How reasonable are float estimates?
- Can the schedule determine current status and provide reasonable completion date forecasts?
- What level of confidence is associated with the program schedule completion date?

(9) Other rules of thumb that can mitigate schedule risk include:

- Longer activities should be broken down to show critical handoffs. For example, if a task is 4 months long but a critical handoff is expected halfway through, the task should be broken down into separate 2-month tasks that logically link the handoff between tasks.
- Work packages should be no longer than 2 months so that work can be planned within two reporting periods.
- Lag should represent only the passing of time and should never be used to replace a task.

- Resources should be scheduled to reflect constraints, such as availability of staff or equipment.

- Constraints should be minimized, not to exceed 5 percent, because they impose a movement restriction on tasks and can cause false dates in a schedule.

- Total “float” that is more than 5 percent of the total program schedule may indicate that the network schedule is not yet mature.

G-5. Run Model, Interpret Data, and Apply Results.

a. Run Risk Model (Process Box 13). Once the model has been setup and populated with data, the PDT risk analysis member will run the risk model using the Crystal Ball software.

b. Generate Risk Report (Process Box 14). After running the risk model, there are several information reports that can be generated to help communicate the areas of cost and schedule risk on the project, and their potential impacts to the project cost development. These reports will enable management to better understand the critical risks that should be closely monitored and managed since they will reflect potential cost and schedule growth.

c. Sanity Check Based on Sensitivity Analysis (Process Box 15). An important step in the CSRA process is to check to assure the outcome fits a logical result from the data. During the data generation stage, the cost engineer has “Most Likely” had to make assumptions while generating model data. After running the risk model, the results are available to analyze, and a sanity check of the results is required. The risk result should be commensurate with the PDT confidence, a reflection of the scope development, the estimate quality, and the perceived risk impacts. A sanity check may require the team to review previous assumptions for accuracy or engage in risk reduction efforts; keep in mind that the CSRA process typically requires several passes. There is potential that the same or similar risks overly influence the outcome, thereby, unreasonably magnifying a risk. An example might be contract acquisition strategy that drives bidding competition. If both are measured separately, an undue exaggeration of risk can result. Other risks can have a similar correlation whereby, if one risk increases, the other must follow. An example might be aggregate, cement, asphalt, and concrete. Care must be given to consider and minimize these potentials. Note: This is not a step to artificially reduce the results. The PM and team must show great resolve to accurately define the risk and potential impacts of the project or to enact risk reduction measures through various means, such as more accurate information or assurance of sound acquisition strategies.

d. Identify Key Risk Drivers and Their Impact (Process Box 16 & 17). The PDT risk analysis member will be able to generate reports that identify key risk drivers and respective impacts to the project. This will allow management the ability to focus efforts on risk reduction measures for the project. These reports are called, “tornado charts.” A tornado chart is a visual attempt to sort risks in the project (figure G-5).

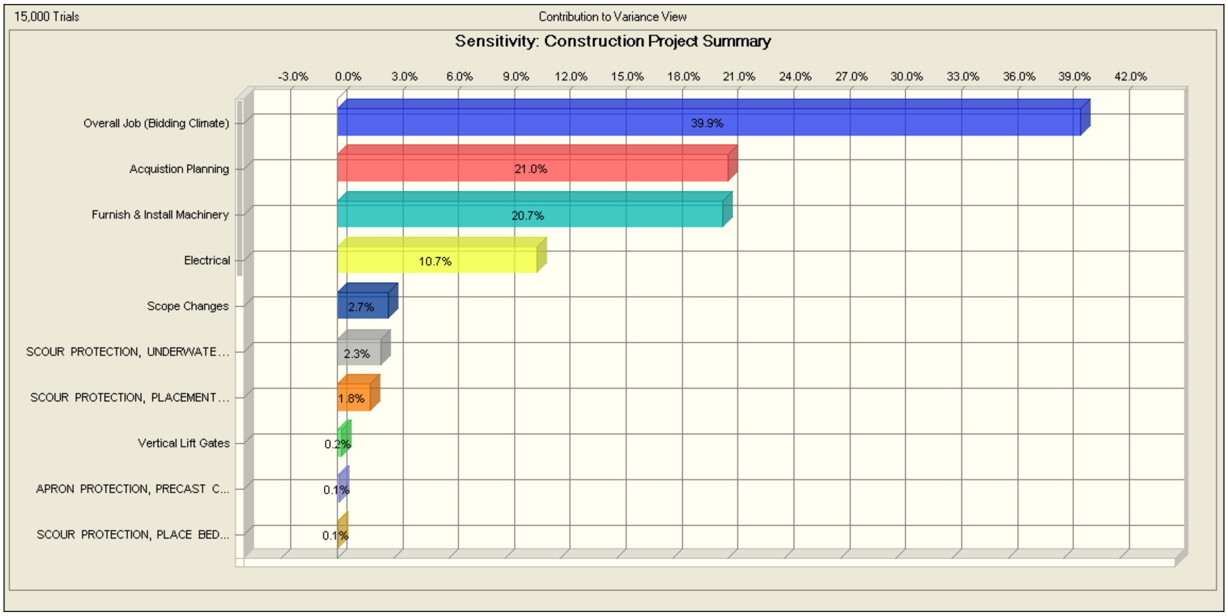


Figure G-4. Example of Sensitivity (Tornado) Chart

e. Project Cost with Confidence levels (Process Box 18). The next step is to generate a table that depicts the project cost with corresponding confidence levels. This data is generated from the risk model (figure G-6).

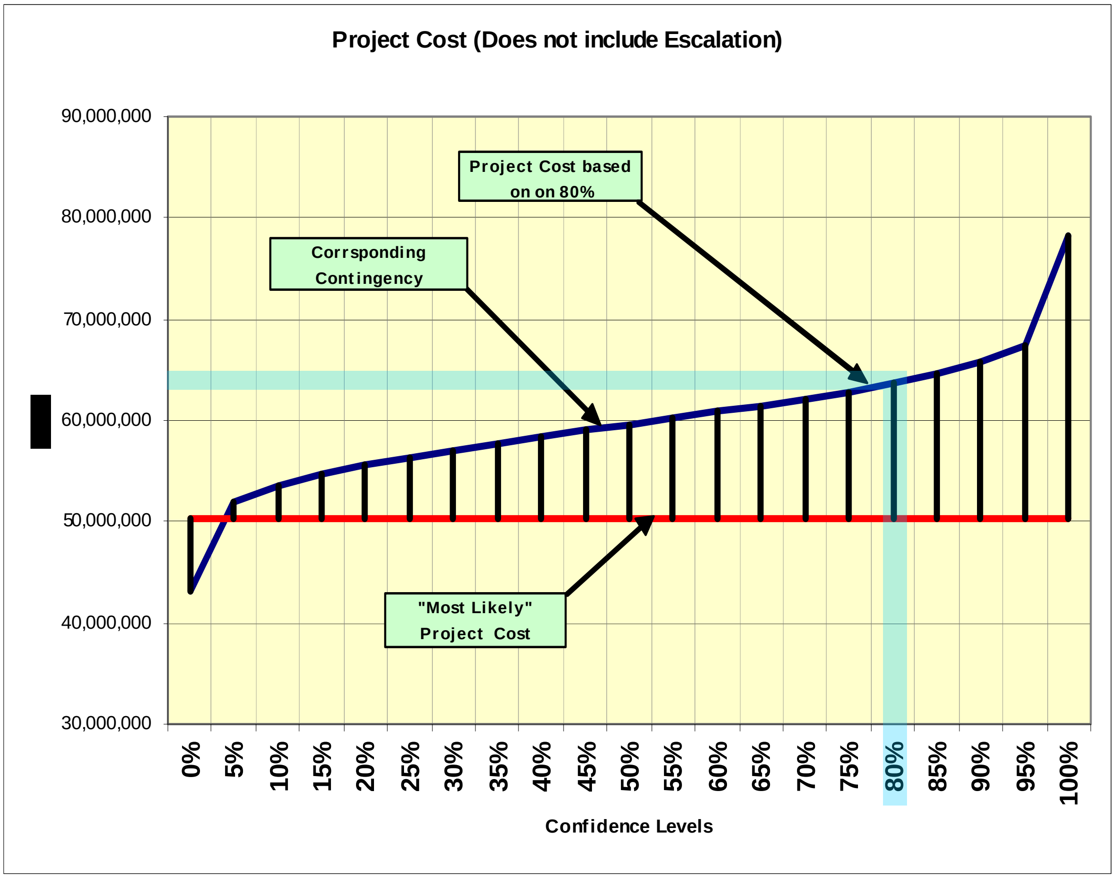


Figure G-5. Project Cost versus Confidence Levels

f. Present to Project Manager for Potential Management Risk Reduction Efforts (Process Box 19). An important outcome of the CSRA is the communication of high-risk areas, which have a high potential to affect the project cost and/or schedule. When considerable uncertainties are identified, a CSRA can establish the areas of high cost uncertainty and the probability that the estimated project cost will or will not be exceeded. This gives the management team another and effective tool in assisting the decision making process associated with project planning and design. It is highly recommended that this information is made through a report that indicates the processes used, the PDT members included, methodology such as software tools, market research, historical data. The report should present the risk register, indicate the major concerns, and the various tables and charts supporting the calculated contingencies. It is also recommended that this report be placed within the Cost Engineering Appendix of the main project report such as a Decision Document at feasibility level.

g. Define Resulting Contingency Levels (Process Box 20). The next step is to determine what confidence level and associated contingency to report. This is a management decision. The PM will be responsible to direct what confidence level will be used for final contingency development. Typically, an 80 percent confidence level is used. However, factors such as how much risk reduction the PDT will be able to generate will factor into this decision. A sample of a contingency analysis table is provided in figure G-7. It is not necessary to carry the values to the nearest dollar.

Contingency Analysis		
Most Likely Cost Estimate		$ 50,308,069
Confidence Level	**Value**	**Contingency**
0%	43,155,265	-14%
5%	51,821,453	3%
10%	53,502,697	6%
15%	54,686,375	9%
20%	55,611,609	11%
25%	56,380,494	12%
30%	57,058,654	13%
35%	57,715,962	15%
40%	58,371,325	16%
45%	58,979,742	17%
50%	59,584,456	18%
55%	60,179,500	20%
60%	60,823,452	21%
65%	61,468,369	22%
70%	62,132,732	24%
75%	62,851,176	25%
80%	**63,650,172**	**27%**
85%	64,564,879	28%
90%	65,751,019	31%
95%	67,449,189	34%
100%	78,119,072	55%

Figure G-6. Example of Contingency Analysis Table

h. Complete Total Project Cost Summary with Contingency (Process Box 21). The last step is to generate the Total Project Cost Summary that identifies base cost by feature, project, and construction management costs; contingency cost; and escalation cost. An example of a total project cost sheet is provided in figure G-8. The confidence level is decided upon and provided to the cost member through the PM. The contingency rate is used from the contingency analysis table. Total project cost, including contingency, may differ slightly from the contingency analysis table, since the contingency rate applied is usually rounded. In addition, small changes to the estimate would not require that a complete new risk analysis be run, since the contingency rate is used and should be relative to cost. If significant changes are made to the construction cost estimate or schedule, then a new risk analysis may be required.

Effective Price Level: 15-Jan-01

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)
06	**Fish and Wildlife Facilities**	50,308,069	13,342,103	27%	63,650,172
	CONSTRUCTION ESTIMATE TOTALS:	50,308,069	13,342,103		**63,650,172**

PROJECT: Example Project, XXXXX
LOCATION: West Coast

DISTRICT: Walla Walla
POC: Coug Smith, Chief, Cost Engineering

PREPARED: 16-Aug-07

This Estimate reflects the scope and schedule in feasibility report; Enter the report or document this estimate is based upon.

Estimate Prepared: 14-Aug-07
Effective Price Level: 15-Jan-01

Program Year (Budget EC): 2007
Effective Price Level Date: 1 OCT 07

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST ESTIMATE: Spent Thru: ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
06	**Fish and Wildlife Facilities**	50,308,069	13,342,103	27%	63,650,172	3.2%	51,917,847	13,769,029	65,686,876	-	10.8%	55,741,819	14,783,177	70,524,996
	CONSTRUCTION ESTIMATE TOTALS:	50,308,069	13,342,103		**63,650,172**		51,917,847	13,769,029	65,686,876	**0**		55,741,819	14,783,177	70,524,996
01	LANDS AND DAMAGES	-	-	-	-		-	-	-	-		-	-	-
21	RECONNAISSANCE STUDIES									**100,000**				100,000
22	FEASIBILITY STUDIES	50	13	26%	63		52	13	65	-		52	14	66
30	PLANNING, ENGINEERING & DESIGN	13,331,639	3,332,910	25%	16,664,549		13,758,231	3,439,556	17,197,787	-		14,306,681	3,576,672	17,883,353
31	CONSTRUCTION MANAGEMENT	7,294,670	1,823,668	25%	9,118,338		7,528,088	1,882,022	9,410,110	-		8,082,564	2,020,642	10,103,206
	PROJECT COST TOTALS:	70,934,428	18,498,694	26%	**89,433,122**		73,204,218	19,090,620	92,294,838	100,000		78,131,116	20,380,505	**98,611,621**

ESTIMATED FEDERAL COST: **98,611,621**
ESTIMATED NON-FEDERAL COST: -
ESTIMATED TOTAL PROJECT COST: **98,611,621**

______________ CHIEF, COST ENGINEERING
______________ Project Management, {Enter PM Name}
______________ CHIEF, REAL ESTATE
______________ CHIEF, PLANNING
______________ CHIEF, ENGINEERING
______________ CHIEF, OPERATIONS
______________ CHIEF, CONSTRUCTION
______________ CHIEF, CONTRACTING
______________ CHIEF, PM-PB
______________ CHIEF, DPM

Figure G-7. Example of Total Project Cost Sheet

G-6. Risk Register Checklist. Use the checklist of risk items for consideration when performing a risk analysis. Of critical importance is consideration of all feature codes as presented within the civil works breakdown structure.

FEATURE CODE	DESCRIPTION
01	Lands and Damages
02	Relocations
03	Reservoirs
04	Dams
05	Locks
06	Fish and Wildlife Facilities
07	Power Plant
08	Roads, Railroads, and Bridges
09	Channels and Canals

10	Breakwaters and Seawalls
11	Levees and Floodwalls
12	Navigation Ports and Harbors
13	Pumping Plants
14	Recreation Facilities
15	Floodway Control-Diversion Structure
16	Bank Stabilization
17	Beach Replenishment
18	Cultural Resource Preservation
19	Buildings, Grounds, and Utilities
20	Permanent Operation Equipment
30	Planning, Engineering and Design
31	Construction Management

a. Engineering and Construction Management Risk Document Checklist. Risk management reports vary depending on the size, nature, and phase of the project. The following are examples of risk management documents and reports that may be useful:

- Risk management plan.
- Risk information form.
- Risk assessment report.
- Risk handling priority list.
- Risk handling plan of action.
- Aggregated risk list.
- Risk monitoring documentation:
    - Project metrics.
    - Technical reports.
    - Earned value reports.
    - Watch list.
    - Schedule performance report.
    - Critical risk processes reports.

b. The following items are a composite of several checklists from various agencies. They have been tailored to better address the more common U.S. Army Corps of Engineers civil works project risks. The list, though not all encompassing, provides a valuable tool meant to serve as an aid in PDT discussions of potential risk items for a specific project.

CHECKLIST OF POTENTIAL RISK ITEMS:

Organizational and Project Management Risks

- ❑ Project purpose and objectives are poorly defined
- ❑ Project scope definition is poor or incomplete
- ❑ Project schedule in question
- ❑ No control over staff priorities
- ❑ Project competing with other projects, funding, and resources
- ❑ Functional and technical labor units not available or overloaded
- ❑ Losing critical staff at crucial point of the project
- ❑ Inexperienced or inadequate staff assigned
- ❑ Product development by several sources or entities (virtual or remote efforts)
- ❑ Coordination/communication difficulties
- ❑ Communication breakdown with project team
- ❑ Insufficient time to plan
- ❑ Timely response to critical decisions by project manager and/or management
- ❑ Architect-engineer and Construction Consultant or contractor delays
- ❑ Pressure to deliver project on an accelerated schedule
- ❑ Unanticipated project manager workload
- ❑ Internal red tape causes delay getting approvals, decisions
- ❑ Unplanned work that must be accommodated
- ❑ Local agency/regulator issues
- ❑ Priorities change on existing program

Contract Acquisition Risks

- ❑ Undefined acquisition strategy
- ❑ Lack of acquisition planning support/involvement
- ❑ Preference to Small Business Development and 8(a) contracts
- ❑ Acquisition planning to accommodate funding stream or anticipated strategy
- ❑ Numerous separate contracts
- ❑ Acquisition strategy decreasing competition
- ❑ Acquisition strategy results in higher scope risk (Design Build)

Technical Risks

- ❑ Design development stage, incomplete, or preliminary
- ❑ Confidence in scope, investigations, design, and critical quantities:
  - Geotechnical
  - Civil
  - Structural
  - Mechanical
  - Electrical
  - Architectural
  - Environmental

Controls
Other Specialized Disciplines

- ❑ Design confidence in products by others
- ❑ Consultant design not up to department standards
- ❑ Inaccurate or risky design assumptions on technical issues
- ❑ Innovative designs, highly complex, first of a kind, or prototypes
- ❑ Incomplete studies (geotech, hydrology and hydraulic, structural, HTRW, etc.)
- ❑ Surveys late and/or surveys in question
- ❑ Sufficiency/availability of as-built data/base map data
- ❑ Borrow/fill sources identified/secured
- ❑ Sufficiency/condition of borrow/fill sites
- ❑ Right-of-way analysis in question
- ❑ Lacking critical subsurface information for under-water/in-water work
- ❑ Hazardous waste concerns
- ❑ Need for design exceptions or waivers
- ❑ Dredge estimate scope, quantities, and equipment:
  Correct dredge equipment decisions
  Consideration for adequate pumping for long pipeline runs
  Adequate disposal facilities in size and number

Lands and Damages

- ❑ Real Estate plan defined
- ❑ Status of real estate/easement acquisition
- ❑ Objections to right-of-way appraisal take more time and/or money
- ❑ Ancillary owner rights, ownerships in question
- ❑ Freeway agreements
- ❑ Railroad involvement
- ❑ Relocations identified
- ❑ Records/as-built availability/inaccuracies
- ❑ Known and unknown utility impacts
- ❑ Relocations may not happen in time
- ❑ Environmental mitigation needs identified
- ❑ Vagrancy, loitering issues
- ❑ Quality of lands and damages estimates as “Most Likely” case
- ❑ Hidden estimate/schedule contingencies

Regulatory and Environmental Risks

- ❑ Established requirements for initial project studies and potential impacts
- ❑ Environmental and Water quality issues
- ❑ Conforming to the state implementation plan for air quality
- ❑ Historic/cultural site, endangered species, or wetlands present
- ❑ Project in an area of high sensitivity for paleontology
- ❑ Project in an area of high sensitivity for cultural artifacts

- ❑ Numerous exclusion zones in project area/vicinity
- ❑ Hazardous waste preliminary site investigation required
- ❑ Status of critical environmental and regulatory studies
- ❑ Status of permits
- ❑ Lack of specialized staff (biology, anthropology, archeology, etc.)
- ❑ Reviewing agency requires higher-level review than assumed
- ❑ Permits or agency actions delayed or take longer than expected
- ❑ Reviewing agency requires higher-level review than assumed
- ❑ Potential for critical regulation changes
- ❑ New permits or new information required
- ❑ Project in the coastal zone
- ❑ Project on a scenic highway, state, or national park
- ❑ Negative community impacts expected
- ❑ Pressure to compress the study and permitting activities

Construction Risks

- ❑ Accelerated contract schedule
- ❑ Inefficient contractor
- ❑ Subcontractor capabilities
- ❑ Conflicts with other contracts
- ❑ Innovative project construction
- ❑ Timely delivery of critical Government-furnished equipment
- ❑ Permits, licenses, and submittal approvals
- ❑ Permit and environmental work windows
- ❑ Environmental restrictions (equipment use, exhaust, and paint fumes)
- ❑ Site access/restrictions (highways, bridges, dams, water, overhead/underground utilities)
- ❑ Adequate staging areas
- ❑ Rural/remote locale
- ❑ Inadequate skilled trades available for labor force
- ❑ Inadequate housing/utilities to support labor force
- ❑ Special equipment and equipment availability
- ❑ Material availability and delivery
- ❑ Productivity of critical work items
- ❑ Critical fabrication and delivery
- ❑ Unknown utilities
- ❑ Survey information
- ❑ Limited transportation/haul routes available
- ❑ Transportation/haul routes constricted or unusable during periods of time
- ❑ Unusual transportation haul distances
- ❑ Regulatory/operational work windows or outage periods
- ❑ Restricted schedule, accelerated schedule impacts
- ❑ In-water work

- ❑ Control and diversion of water
- ❑ Differing site conditions
- ❑ Unidentified hazardous waste
- ❑ Historic change order or modification growth
- ❑ Consideration for standard weather impact
- ❑ Adequacy of construction schedule depicting durations, sequencing, phasing, and production rates

Estimate and Schedule Risks

- ❑ Estimate captures scope for all project features
- ❑ Estimate developed for current scope and design level
- ❑ Estimates developed in Microcomputer Aided Cost Engineering System MII and/or Cost Engineering Dredge Estimating Program
- ❑ Estimate quality related to lesser designed features
- ❑ Estimate(s) quality when developed by others
- ❑ Estimate confidence in large and critical quantities
- ❑ Estimate include waste/dropoff quantities
- ❑ Estimate reflects local market for labor and subsistence
- ❑ Estimate reasonableness of crews and productivities
- ❑ Estimate reflects local material costs and delivery
- ❑ Parametric estimates for unit prices adequate for critical items
- ❑ Consideration and local quotes for special equipment (cranes, barges, tugs, and diving)
- ❑ Prime and subcontractor structure matches likely acquisition strategy
- ❑ Adequate schedule depicting all project features
- ❑ Schedule matches preconstruction engineering and design plan
- ❑ Schedule portrays critical construction features, matching estimate productivity
- ❑ Schedule depicts logical construction sequencing, phasing, and parallel activities
- ❑ Estimate and schedule reflecting “Most Likely” occurrence
- ❑ Overall confidence in estimate and schedule

External Risks

- ❑ Adequacy of project funding (incremental or full funding)
- ❑ Priorities change on existing program
- ❑ Local communities pose objections
- ❑ Loss of public trust/goodwill
- ❑ Political factors change at local, state, or federal
- ❑ Stakeholders request late changes
- ❑ New stakeholders emerge and demand new work
- ❑ Influential stakeholders request additional needs to serve other purposes
- ❑ Political opposition/threat of lawsuits
- ❑ Stakeholders choose time and/or cost over quality
- ❑ Market conditions and bidding competition

- ❑ Unexpected escalation on key materials
- ❑ Labor disruptions
- ❑ Acts of God (seismic events: volcanic activity, earthquakes, tsunamis; or severe weather: freezing, flooding or hurricane)

APPENDIX H

Sample Checklist for Cost Estimate Preparation or Reviewer Checklist

H-1. It is highly advisable that all critical estimates, schedules, and Total Project Cost Summaries receive a quality review by a senior estimator within a formal process. An independent technical review or independent cost review is often requested, but the main quality responsibility lies within the estimating shop that produced the estimate. While much focus is placed on the quality of the bid estimates, other estimates are equally and possibly more important. The earlier estimates used for budgeting, programming, and congressional authorization and funding are very important management tools that should not be overlooked, underutilized, or unsupported.

H-2. During the review process, certain items may indicate the need for further resolution by specific project delivery team members. Many times, these items relate to project scope, schedule, site access, contract acquisition, market conditions, value engineering, risk, etc.

H-3. The estimate product should comply with applicable cost engineering guidance:

a. Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works Projects.

b. ER 1110-1-1300, Cost Engineering Policy and General Requirements.

c. ER 1110-2-1302, Civil Works Cost Engineering.

d. ER 1130-2-520, Navigation and Dredging Operations and Maintenance Policies.

H-4. The following is a checklist for preparing construction baseline estimates.

- ❑ Prepare cost estimates, schedules, and risk analyses using agency approved software, as appropriate, and structured using the appropriate Work Breakdown Structure for civil works.
- ❑ Confirm the estimates level of development and quality as related to the respective engineering regulations. For civil works estimates, ER 1110-2-1150 and 1110-2-1302 are crucial to a successful review.
- ❑ Confirm whether a project schedule, risk analysis, and a Total Project Cost Summary are required products based on engineering regulations. If so, they should also be reviewed. The escalation and contingency are critical items within the Total Project Cost Summary.

- ❑ Ensure the estimate has been developed under a likely contract acquisition strategy that may have a bearing on the costs. Examples include a competitive Information for Bid, Small Disadvantaged Business set-aside, Design-Build, limited competition, etc.
- ❑ Prepare narrative with statement summarizing purpose of estimate, brief statement and description of the project, type of contract acquisition, level of project scope, and major estimate assumptions.
- ❑ Identify the stage of the estimate (reconnaissance, feasibility, predesign, 30 percent, 60 percent, 90 percent, 100 percent, and bid).
- ❑ Clearly identify and define assumptions and identify significant features upon which the cost estimate is based. Identify special issues, concerns, and technologies.
- ❑ Identify significant findings and concerns during preparation. Coordinate those concerns with the respective project delivery team member, seeking resolution.
- ❑ Develop notes throughout the estimate, particularly to identify sequencing of construction activities and crew productions, and include in the agency-approved estimating software notes reference.
- ❑ Consider the quantity takeoffs and their application to the estimate. Ensure an adequate process has been used to address material waste, losses, soil factors, metal dropoff, etc.
- ❑ Separate subcontract work from prime contract work.
- ❑ Identify separate markups for subcontractors and prime contractor.
- ❑ Identify sources of unit prices and vendor or subcontractor quotes. Identify what is included within those prices and quotes.
- ❑ Consider unit prices and quotes for reasonableness.
- ❑ Include design contingencies and construction contingencies in the cost estimate, if appropriate.
- ❑ Include cost growth (escalation) from the date of the estimate to the midpoint of construction and/or operation. Identify source of index used for escalation, e.g., Civil Works Construction Cost Index System. Determine how the escalation was developed as related to the estimate's productivity rates and project schedule.
- ❑ Total Project Cost includes all Federal and authorized non-Federal costs. Refer to the civil works work breakdown structure to ensure all cost items have been captured. Ensure the project delivery team provides costs for land and damages, engineering and design, construction management, and construction features are coordinated with the Civil Works Breakdown Structure. The cost estimate becomes fully funded when inflation is added to the estimate. An estimate for profit is included in the reconnaissance and feasibility phases to ensure costs represent the total cost of the project; however, profit is not included in the Government estimate for authorized civil

work contracts for award. Profit is included in construction contracts for modifications and change orders.

- ❑ Minimize use of lump sum pricing. If used, the lump sum description must indicate in detail what is included in the price and whether or not it is based on a quotation.
- ❑ Use prevailing current location-specific wage rates in the estimate. Consider market rates for labor to ensure there is reasonable competition ongoing in the area where the construction is being performed and/or may be competing with the domestic projects being constructed.
- ❑ Check derived unit costs with historical data when available. Override Cost Book labor and/or material unit prices as required, to fit project-specific conditions.
- ❑ Complex or major features of a project should include a detailed breakdown for labor, equipment, and material.
- ❑ Calculate in detail the job office overhead as applicable. Preliminary estimates may need only a percentage markup.
- ❑ Calculate home office overhead as a percentage of total contract cost.
- ❑ Include bond costs, sales tax, and gross receipts taxes as applicable.
- ❑ Include all applicable costs for permits, insurances, licenses, taxes, and fees.
- ❑ Calculate prime and subcontractor profit by weighted guidelines method.
- ❑ Ensure the estimate has adequately captured the escalation and contingencies based on studies from schedules and risk analyses where applicable. A Total Project Cost Summary should capture all escalations and contingencies of all features, their respective durations, and risk.
- ❑ Provide cost engineer point of contact and telephone number.
- ❑ Prepare a formal review document that denotes the items reviewed, items of concern, senior reviewer’s name, and date of formal review.

APPENDIX I

Protests or Litigation Concerning the Independent Government Estimate

I-1. Bid Protests.

a. In accordance with 33 United States Code 622 and 624, no civil works construction contracts shall be awarded if the contract price exceeds the independent Government estimate (IGE) prepared in accordance with Engineer Federal Acquisition Regulation Supplement 36.203.100 by more than 25 percent. This limitation does not apply to service and supply contracts, change orders, or contract modifications.

b. There are two major situations when the cost engineer may become involved in litigation concerning the IGE: a bid protest when bids are opened or a proposed change order/modification is not accepted by a contractor, and the contractor pursues the dispute.

c. The procedure to process the issues are the same for all types of projects or contracts associated with civil works programs. When either of the above occurs, the cost engineer has a major role in reviewing the IGE and evaluating the Government's position. That role must fall under the directorship of the contracting officer and office of counsel; however, the cost engineer retains the technical expertise and ownership related to the cost estimate. It cannot be over-emphasized that the IGE must be defensible for its basis of cost and assumptions.

d. Bid Protests Affecting the Independent Government Estimate

(1) During the bidding process and upon receipt of bids, if all bids are sufficiently higher than the IGE, any one of the proposers/offerors can protest the unreasonableness of the IGE by stating it contains errors or omissions as being too low and not fair and reasonable. A major concern occurs for a bid opening in civil works, as the contract cannot be awarded to the low bidder if the low bid exceeds the IGE by 25 percent. In such a case, a bid protest will delay all further contractual action to award until either the bid protester withdraws the protest, the IGE is revised, or a determination is made through the judicial process.

(2) For special cost engineering dredging problems or concerns, the use of the Corps' regional dredge teams is recommended. These teams are composed of cost engineering and construction-operations personnel most experienced in dredging and established for the East Coast, West Coast, Gulf Coast, the Great Lakes, and Mississippi River and tributaries. The appropriate team is convened at the request of the district engineer. The chairperson of the regional dredge teams is appointed by Headquarters U.S. Army Corps of Engineers and is responsible to ensure that the teams are maintained with competent cost engineering and construction-operations

personnel and that requests for assistance are promptly fulfilled. The regional dredge teams are designed to provide assistance to all districts in the evaluation of bid protests, mistakes in bids, or other unique issues that may be required to validate the estimate for the Government. Further, the teams are available to support districts that seldom do large dredging contracts and, therefore, may have little expertise or historical cost data that is needed to prepare accurate planning estimates and/or Government estimates for contract award. The teams' role in all cases is to act in an advisory capacity with the requesting district having the responsibility and authority to make all final decisions. The regional dredge teams are represented in geographical areas and the office of the chairperson of each team is located in North Atlantic Division; Seattle District; New Orleans District, and Detroit District.

e. Review of the Independent Government Estimate. The cost engineer should review the estimate to be sure that it does not contain mistakes. This evaluation must be completed as soon as possible to provide timely advice to the District staff to preclude delay in award. If the IGE is revised, and the revised estimate brings an offeror's price within the range of a fair and reasonable price, award will be made provided funds are available. The revised estimate requires the same approval authority as the original IGE.

f. Protest Resolution

(1) When the IGE is reviewed and has been determined to be fair and reasonable for the intended scope of work, unless the protester withdraws the bid protest, the usual procedure will require a contracting officer’s decision (COD) in the form of a (letter) memorandum of denial of the protest unless the protestor withdraws the bid protest.

(2) Meetings may be held with the apparent low bidder or contractor prior to issuance of the COD memorandum to ensure that both the Government and the protestor have the opportunity to review the project and agree to the scope of work as specified by the plans and specifications. Meetings will also allow discussion whether there are unusual conditions or circumstances that may affect or complicate the work. If a meeting reveals an error or omission in the IGE, it may be revised as previously discussed.

(3) The protest/dispute may take several months to resolve. The Government's position may be reviewed and evaluated at the appropriate agency office, as well as by the General Accounting Office, a court, or a board of contract appeals. During each of these reviews, questions will arise, and the cost engineer will be called on to support the estimate. The cost engineer(s) responsible for preparing the IGE is most familiar with the estimate and should be prepared to assist counsel, contracting, and other staff to

resolve the issue and be prepared to testify in court and certify the validity of the estimate.

I-2. Contract Modifications/Change Orders.

a. Scope and Cost Development

(1) During ongoing construction, the cost engineer may be required to prepare cost estimates for major or complex changes, design change orders, extensive quantity overrun bid items or even assisting in evaluating claims occurring during construction whereby an IGE is required.

(2) Prior to the cost engineer finalizing the IGE, it is important to meet with the designated contracting officer's representative and the contractor to agree on the scope of work concerning change orders for ongoing construction (cost and time negotiations are not allowed at this time). Discussions may include scope changes and impacts affecting both cost and schedule. The cost engineer will prepare the cost estimate as detailed in chapter 4 of Engineer Technical Letter 1110-2-573.

b. Modification Disputes

(1) On occasion, disputes arise between the Government and the contractor, primarily due to a wide variance between the value of work estimated by the contractor versus the IGE. When a dispute arises, meetings are necessary in an attempt to resolve the difference between the contractor and the Government. Even when the scope may be in general agreement, the cost or time may be in dispute. If resolution cannot be reached, the contracting officer and office of counsel begin to play a major role in the dispute settlement.

(2) The contracting officer may issue a unilateral modification establishing the cost and time, and the modification may result in litigation. The procedure upon encountering an impasse generally results in the Government issuing a COD, and the process is the same as previously discussed for a bid protest.

c. Revised Independent Government Estimate

(1) It is possible that not all of the facts of a claim, change, or major overrun of quantities have been provided or verified by the cost engineer. In those cases where the cost engineer was unable to meet with the contractor, and additional facts are discovered by other means, the cost engineer may revise the IGE as appropriate, provided an original IGE was prepared. The revised IGE requires the same approval authority as the original IGE. Upon revising the IGE and mutual agreement by the contractor and Government, a modification is processed.

(2) When the IGE is changed during or subsequent to conferences or negotiation, the basis for the revision or changes in price shall be fully explained and documented in the price negotiation memorandum. Judgment in making this type of decision should be based on the circumstances of a particular issue, not all encompassing, and recommendations should be made to the contracting officer. For major differences in cost, disputes, or claims that are not resolved, a revised IGE is recommended, supported by a technical and cost analysis of the dispute in litigation.

I-3. Technical and Cost Analysis by Cost Engineer.

a. In the case of bid protests or disputes regarding cost differences between the IGE and the contractor(s), the cost engineer may be required to prepare a technical and cost analysis evaluation for documentation in the contract file. Major factors in the analysis include:

(1) The technical analysis will consist of an in-depth, point-by-point response to all issues raised on the cost estimate by the protestor or contractor.

(2) The cost analysis will consist of a review of the IGE, including all backup and supporting data, and assumptions made which support the estimate.

b. Additional information concerning factors to be considered in the technical and cost analysis is presented in chapter 3. Reference is made to Federal Acquisition Regulation (FAR) sub-part 15.608 for proposal evaluation.

I-4. Mistake in Bids. After the opening of bids, contracting officers shall examine all bids for mistakes. In cases of apparent mistakes and in cases where the contracting officer has reason to believe that a mistake may have been made, the contracting officer shall request from the bidder a verification of the bid, calling attention to the suspected mistake. The contracting officer before award may correct any clerical mistake apparent on its face in the bid, i.e., obvious misplacement of a decimal point, after first receiving verification of the bid intended.

a. Before Award in Sealed Bidding. For other mistakes disclosed before award in sealed bidding, the bidder must provide clear and convincing evidence to establish both the existence of the mistake and the bid actually intended. The contracting officer must make a determination as to the circumstances to verify the mistake; to allow the bidder to withdraw the bid; or make a determination that the bid be neither withdrawn nor corrected. The cost engineer may be part of the team of specialists to provide an analysis and a recommendation to the contracting officer. For the cost engineer, the evaluation could be the verification of a quantity as related to a unit price bid item or determination of a fair and reasonable cost for a service or product. The cost engineer may refer to FAR part 14 for the appropriate definitions, discussions, and overview of the acquisition requirements pertaining to sealed bidding.

b. Before Award in Negotiated Procurement

(1) The process for determination of a mistake in bid when the solicitation of a project is contracted by negotiated procurement is similar to the procedure as for sealed bidding. Additional tools are available to the Government to amend a solicitation before award as compared to sealed bidding. Clarification may be used to communicate with an offeror for the sole purpose of eliminating minor irregularities, informalities, or apparent clerical mistakes in the proposal. In negotiated procurement, discussions mean any oral or written communications between the Government and an offeror that involves information essential to determine the acceptability of a proposal or provides the offeror an opportunity to revise or modify its proposal. When, either before or after receipt of proposals, the Government changes, relaxes, increases, or otherwise modifies its requirements, the contracting officer shall issue a written amendment to the solicitation.

(2) In the event evaluation factors are selected to evaluate proposals, price, or cost to the Government, those evaluation factors shall be included in every source selection. If a mistake in a proposal is suspected, the contracting officer shall advise the offeror or otherwise identifying the area of the proposal where the suspected mistake is and request verification. If the offeror verifies its proposal, award may be made. If an offeror alleges a mistake in its proposal, the contracting officer shall advise the offeror that it may withdraw the proposal or seek correction by submitting clear and convincing evidence and a determination is made by agency. The cost engineer may also be involved in providing support to the contracting officer if any mistake concerns scope, quantity, or prices in the IGE. The cost engineer may refer to FAR part 15 for the appropriate definitions, discussions, and overview of the acquisition requirements pertaining to negotiated procurement. In the event negotiations are conducted with offerors in the competitive field, the cost engineer should be a member of the negotiation team.

APPENDIX J

Job Office Overhead Template

ADMINISTRATION JOB OFFICE

Descriptions

Includes all field administrating, accounting, purchasing, inventory, and security personnel and expenses. Also, consider subsistence and travel, offices, vehicles, supplies, and miscellaneous items to run the field office. Subsistence amounts may vary depending upon seniority and job classification.

Some Cost Groupings

- Field Office Administration Personnel
- Field Office Building and Supplies
- Inventory and Purchasing Personnel
- Field Office Security Personnel
- Field Office Subsistence and Travel
- Security Fencing
- Field Office Utility Installation and Removal
- Field Office Utility Usage Fees

WAREHOUSE AND MATERIALS HANDLING

Descriptions

Includes all field warehouses, stockyards, personnel, and equipment to handle, receive, unload, store, and transport materials around the project site. Also, consider subsistence and travel, vehicles, supplies, and miscellaneous cost items.

Some Cost Groupings

- Warehouse Personnel
- Warehouse Building and Grounds
- Material Handling Equipment and Operators
- Warehouse Subsistence and Travel
- Warehouse Utility Installation and Removal
- Warehouse Utility Usage Fees

ENGINEERING AND SURVEYING

Descriptions

Includes all engineering, drafting, submittals, scheduling, surveying, and change order personnel. Also, consider subsistence and travel, vehicles, miscellaneous computer expenses, shop drawings, submittals and Critical Path Method schedules, operation and maintenance manuals, and miscellaneous cost items.

Note: Personnel costs and supplies may cover submittal development and required contract document costs.

Some Cost Groupings

Field Engineering Personnel
Scheduling and Change Order Personnel
Field Surveying
Field Eng Subsistence and Travel

QUALITY CONTROL (QC) AND TESTING

Descriptions

Includes personnel, vehicles, equipment, and supplies to produce all QC reports, QC inspections, and all other contract quality requirements. Also, consider subsistence and travel, vehicles, supplies and miscellaneous cost items.

Note: Personnel costs and supplies may cover submittal development and required contract document costs.

Some Cost Groupings

QC Management
QC Laboratory and Equipment
QC Subsistence and Travel
Offsite Testing
Project Monitoring
QC Utility Installation
QC Utility Usage Fees
Weld Testing

SAFETY, TRAFFIC CONTROL, FIRST AID, FIRE

Descriptions

Includes all personnel, supplies, and vehicles needed for safety, traffic control, first aid, safety training, and fire prevention. Also, consider subsistence and travel, vehicles, supplies and miscellaneous cost items.

Note: Personnel costs and supplies may cover submittal and required contract document costs.

Some Cost Groupings

Safety Management
Field First Aid

Field Hazardous, Toxic, and Radioactive Waste Safety Equipment and Clothing
Site Spill Containment
Safety Training
Personnel Safety Supplies
Field Fire Protection
Safety Subsistence and Travel
Traffic Control: Vehicles, Flaggers, Signage, Barricades, and Devices

SANITATION FACILITIES AND TEMPORARY BUILDINGS

Descriptions

Includes all sanitation facilities miscellaneous, buildings, yards, and building costs not otherwise classified. This grouping does not include all project utilities costs.

Some Cost Groupings

Sanitation Facilities
Temporary Buildings
Equipment and Tool Sheds
Lighting

GENERAL EQUIPMENT EXPENSES

Descriptions

Includes equipment not required by specific work items. Also, consider testing and rental of equipment when not charged to a specific bid item or items of work. Inspection fees and permits are included in mobilization and demobilization items.

Some Cost Groupings

Hook Services
Crane Testing
Miscellaneous Vehicles and Equipment

PROJECT UTILITIES SITE AND CLEANUP

Descriptions

Includes all project costs not otherwise classified.

Some Cost Groupings

Site Cleanup
Miscellaneous Project Expenses
Site Utility Usage Fees
Site Utility Installation / Hookup Fees
Lighting

WINTERIZE PROJECT

Descriptions

Includes all items needed for a winter shutdown of the project or for construction activities during the winter months.

Some Cost Groupings

Winterize Project
Earthwork during cold periods
Facilities and utilities

CAMP FACILITIES AND WORKER SUBSISTENCE AND TRAVEL

Descriptions

Includes costs to operate a camp to support construction workers. If no camp is furnished and subsistence is not included in the workers hourly wage, show the number of subsistence days and daily cost. However, it is preferred to include subsistence with the hourly wage. Also, consider kitchens, camp vehicles, supplies, and miscellaneous items.

Some Cost Groupings

Camp Facilities
Camp Operations
Camp Supplies
Camp Worker Subsistence and Travel
Camp Utility Installation
Camp Utility Usage Fees

INSURANCE, INTEREST, PERMITS, AND FEES

Descriptions

Includes insurance cost, permits, and fees required by the contract. Business and occupation taxes, tribal Employment Rights Office (TERO) taxes, and bid bond cost are not included in the job office overhead (JOOH) but are included in other indirect cost markups.

Some Cost Groupings

Insurance Costs
Money Costs
Project Permits

MOBILIZATION AND PREPARATORY WORK (Optional)

Descriptions

Includes all items needed for the contractors' mobilization and site preparatory work.

Also, consider trucks, trailers, pilot cars, inspection fees, highway permits, loading, unloading, equipment standby and setup, and surveys.

USE ONLY if the project does NOT have a mobilization bid item.

Some Cost Groupings

- Mobilization and Equipment Setup
- Preparatory Work
- Plant Setup and Testing

DEMOBILIZATION WORK (Optional)

Descriptions

Includes all items needed for contractors' demobilization from the project site and halfway to another project. Also, consider trucks, trailers, pilot cars, inspection fees, highway permits, loading, unloading, equipment standby, and take down.

USE ONLY if the project does NOT have a demobilization bid item.

Some Cost Groupings

- Demobilization of Equipment
- Shutdown Programs
- Plant Shutdown and Removal

GOVERNMENT INSPECTION COSTS (In Alaska only)

Descriptions

Includes all items needed to keep Government Inspectors on site excluding salary.

Some Cost Groupings

- Inspector’s Accommodations and Travel costs

GLOSSARY

Terms and Abbreviations

ACF	Area Cost Factor
A-E	Architect-Engineer
AR	Army Regulation
ATR	Agency Technical Review
BCE	Baseline Cost Estimate
CEDEP	Cost Engineering Dredge Estimating Program
COD	Contractor Officer's Decision
CSRA	Cost and Schedule Risk Analysis
CWWBS	Civil Works Work Breakdown Structure
CWCCIS	Civil Works Construction Cost Index System
CX	Cost Engineering Center of Expertise at the Walla Walla District
DFARS	Defense Federal Acquisition Regulation Supplement
DQC	District Quality Control
E&D	Engineering and Design
EFARS	Engineer Federal Acquisition Regulation Supplement
EM	Engineer Manual
EP	Engineer Pamphlet
ER	Engineer Regulation
ETL	Engineer Technical Letter
EWT	effective working time
FAR	Federal Acquisition Regulation
FOB	Free on Board
FOIA	Freedom of Information Act
FOUO	For Official Use Only
FULLY FUNDED	This term is used to indicate that the costs presented include allowances for cost growth due to inflation through project completion. Certain estimates by definition include cost growth and are considered fully funded.
G&A	General and Administrative or General Home Office Overhead
GRR	General Revaluation Report
HAG	Historical Analysis Generator
HOOH	Home Office Overhead
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HTRW	Hazardous, Toxic, and Radioactive Waste
IEPR	Independent External Peer Review
IGE	Independent Government Estimate
JOOH	Job Office Overhead
LRR	Limited Revaluation Report

LCC	Life Cycle Cost
MCACES	Microcomputer Aided Cost Engineering System
MSC	Major Subordinate Command
NED	National Economic Development
PACES	Parametric Cost Estimating System
PDT	Project Delivery Team
PL	Public Law
PM	Project Manager
PMP	Project Management Plan
QA	Quality Assurance
QC	Quality Control
RACER	Remedial Action Cost Engineering and Requirements system
SAA	Surety Association of America
SI	Scheduling Interface
SUCCESS™	Cost Estimating Software Program
TPC	Total Project Cost
TPCS	Total Project Cost Summary
TRACES	Tri-Service Cost Engineering Systems
UPB	Unit Price Book
USACE	U. S. Army Corps of Engineers