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UNIFIED FACILITIES CRITERIA (UFC)

CONSTRUCTION COST ESTIMATING

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UNIFIED FACILITIES CRITERIA (UFC)

CONSTRUCTION COST ESTIMATING

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 3-740-05, dated 8 November 2010.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

Costs estimates are to be prepared as though the Government were a prudent and well-equipped contractor estimating the project. Therefore, the total construction costs, which a prudent, experienced contractor would expect to incur, are to be included in the cost estimate. This philosophy prevails throughout the entire project cycle -- from programming through completion of construction.

1-2 REISSUES AND CANCELS.

This UFC reissues and cancels UFC 3-740-05, 8 November 2010.

1-3 PURPOSE AND SCOPE.

This document establishes uniform guidance to describe methods, procedures, and formats for the preparation of cost estimates and associated analyses (price/cost). This guidance applies where services have common requirements, however, for instances where there are differences, use the policies and procedures of the cognizant design agency.

This document addresses the various phases of cost estimating from the initial start of design through modification cost estimates during construction. UFC 3-730-01 - PROGRAMMING COST ESTIMATES FOR MILITARY CONSTRUCTION provides guidance for cost estimating during the initial planning, programming, and budget review phases. The term construction includes remedial action environmental projects, dredging and other construction type work often implemented as service contracts. For the purposes of this document, the term cost engineer applies to qualified individuals, whether employed by the Government or under contract to the Government, who are routinely engaged in the preparation or review of cost estimates.

1-4 APPLICABILITY.

This UFC applies to Military Construction (MILCON) and Military Operations and Maintenance (O&M) projects. “Construction” is defined as construction, alteration, or repair (including dredging, excavating, and painting) of buildings, structures, or other real property. See FAR 2.101.

1-5 GLOSSARY.

APPENDIX C contains acronyms.

1-6 REFERENCES.

APPENDIX D contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

The samples and data referenced in this UFC are found under "Related Materials" accompanying this UFC on the (WBDG) Web site: https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05.

CHAPTER 2 GENERAL

2-1 COST ESTIMATING PHILOSOPHY.

Per Government Accountability Office (GAO-20-195G), the four key elements of a reliable cost estimate are (1) Comprehensive; (2) Well Documented; (3) Credible and (4) Accurate. Therefore, all costs, which a prudent, experienced contractor would expect to incur, are to be included in the cost estimate. Each cost estimate is to be developed as accurately as possible, in as much detail as can be assumed, and be based upon the best information available. This objective is to be maintained during the programming, design, and construction phases of the project. Cost estimating in the Federal government does not intend to be the low bidder but to represent a fair and reasonable cost of a prudent, well equipped contractor.

2-2 RESPONSIBILITY FOR PREPARATION, REVIEW AND PRESENTATION.

2-2.1 General.

Preparation and review of cost estimates through project completion is the responsibility of an independent centralized Cost Engineering Office within the design agency. The Cost Engineering Office will provide independence and consistency with training, software, and cost estimating practices. In concert with this responsibility, the cost engineer must be accountable for the comprehensiveness, documentation, credibility and accuracy completeness, quality, accuracy and the reasonableness of the cost estimate. The project manager (PM) will disclose to the cost engineer the intended recipient(s) of the cost estimate and the reason the cost estimate is being produced.

2-2.2 Preparation.

Cost estimates may be prepared in-house or by contract. When it is necessary to contract services for the preparation of cost estimates, such services will be provided by competent firms experienced in cost engineering. Other specific needs, submittals, and requirements are to be provided to insure a complete understanding of the cost engineering requirements. These supplementary requirements are to be included as part of a comprehensive contract scope of work.

2-2.3 Review.

Cost estimates, whether prepared in-house or by contract, will be given an independent review by government cost engineers as prescribed by the cognizant agency review procedures. The cost estimate is to be reviewed for the purpose of confirming the validity of the assumptions and the logic used in estimating the cost of construction tasks. The review is to include a check of the quantities, unit prices, arithmetic, and include a comparison to any other available historical data. It is important that the reviewer develops and completes a review checklist to assure that important considerations have not been overlooked (see sample checklist provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05). The review checklist may be customized based on the nature of the work and the design stage. Cost estimates are not to be released until receiving review and approval.

2-2.4 Presentation to Management.

A cost estimate is not considered complete until management, as defined by the cognizant agency, has approved it. Refer to the cognizant agency for specific requirements. Because many cost estimates are developed to support a budget request or make a decision between competing alternatives, it is vital that management is presented with information on how the cost estimate was developed, including risks associated with the underlying assumptions, data, and methods. Therefore, the cost estimator presents management with enough detail to easily defend the cost estimate by showing how it is complete and high in quality. The information in a cost estimate presentation succinctly illustrates the main cost drivers and the final cost estimate, and is to match the information in the cost estimate documentation.

2-3 TEAM INVOLVEMENT.

Cost engineers are important members of the project delivery team (PDT). The cost engineer is expected to have a clear understanding of those responsibilities and areas where contributions can be made. It is imperative that the team concept be enhanced and supported by each member. As such, the cost engineer is encouraged to lead in cost issues and provide ideas for cost control and sharing measures. The cost engineering team will develop a cost estimating plan. The plan will state who is on the cost engineering team and the schedule for completion dates of the cost engineering products at each design stage.

2-4 PROGRAM SPECIFIC REQUIREMENTS.

In the MILCON and O&M programs, cost estimates are prepared throughout the planning, design, and construction phases of a construction project. These cost estimates may be categorized as follows: Programming & Budgetary, Current Working Estimate (CWE), and Independent Government Estimate (IGE).

2-4.1 Programming and Budgetary Estimates.

In the planning phase, the cost estimate is called a programming estimate and is prepared on a Department of Defense form, DD Form 1391. Develop this programming estimate based on preliminary construction scope or mission requirements. Refer to UFC 3-730-01 for criteria and standards for development and preparation of programming cost estimates for constructing military facilities.

2-4.2 Current Working Estimates.

Current working estimates for projects may be categorized as 15%, 35%, 50%, 65%, 95%, or 100% stages of design as examples. For Design-Bid-Build (DBB) projects the CWE’s are refined more during their respective phases, in order to match the increased definition of the design criteria and project requirements. CWE’s for Design-Build (DB) projects are based upon RFP performance and prescriptive specifications. A technical baseline document will be developed by the design team at the earliest possible design phase to define the project. The technical baseline document describes the acquisition strategy, the work breakdown structure, and how the project will perform its purpose.

2-4.3 Independent Government Estimate.

The last stage of development is the IGE. For DBB projects the IGE is based on the Ready to Advertise (RTA) set of the plans and specifications and contract amendments. The RTA set of plans and specification is typically considered the corrected final incorporating all back checked review comments. For DB projects the IGE is based upon the final RFP performance and prescriptive specifications and contract amendments. The IGE is the cost estimate that is provided for procurement.

2-4.4 Independent Cost Estimate.

An Independent Cost Estimate (ICE), is conducted by an organization independent of the cognizant design agency, it is based on the same construction scope used for the cost estimate. ICEs are used primarily to validate cost estimates and are reconciled with them. Because the team performing the ICE is independent, the ICE provides an unbiased test of whether the cost estimate is reasonable. The ICE is also used to identify risks related to budget shortfalls or excesses.

2-5 LIFE CYCLE COST (LCC) STUDY SUPPORT.

Quality management policy requires LCC studies to be performed to evaluate system alternatives. The alternative analyses are the responsibility of the design team. Cost engineering provides the cost estimating input for the LCC analyses. As preparation to such responsibility, the cost engineer is to be familiar with the LCC procedures.

2-6 COST ESTIMATE FORMAT STRUCTURE.

It is important that the format of the cost estimate be as consistent as possible. UNIFORMAT II (ASTM Standard E1557-09) has been established for this purpose: This is a hierarchical presentation of the scope of work. It provides a common, ordered hierarchy framework for summarizing information and for quantitative reporting to customers and management. The purpose of this format is to: (1) provide an organized manner of collecting project cost data in a standard format for cost reporting and cost tracking; (2) provide a checklist for categorizing costs; and (3) provide a basis to maintain historical cost data in a standard format.

2-7 WORK BREAKDOWN STRUCTURE (WBS).

2-7.1 Military Construction Program.

The MILCON process is formally structured to comply with the DOD's Planning, Programming, Budgeting, and Execution (PPBE) process for resource allocation.

The common elements of the MILCON program are as follows:

- Planning and Programming: All effort of technical and functional activities associated with identifying the requirement, prioritizing, justification, and requesting funds for a project.
- Program Management: The business and administrative of planning, organizing, coordinating, tracking and controlling the overall program objectives as they apply to a specific program.
- Design and Construction: Develop plans, specifications, cost estimate, solicit bidders, execute the contract and construct the project. This UFC is focused on the design and construction component.
- Delivery: Provide final product to the owner/stakeholder.

2-7.2 Facility Construction WBS.

The goal of this work breakdown structure (WBS) is to establish a standardized classification of building elements and related sitework. These elements are major components to most facilities and perform a given function, regardless of the design specification, construction method, or materials used. Using the WBS ensures consistency in project management, data collection, and economic evaluation of projects over time and from project to project.

UNIFORMAT II (ASTM International E1557-09) provides a common framework for preparing cost estimates, developing models, and collecting cost data for Department of Defense (DOD) military construction projects. It is to be used for categorizing facility costs and associated supporting facility costs for conventional military construction projects. This WBS is comprised of a collection of six building related elemental system classifications, and a collection of one sitework elemental building classification system. Each system is organized in a hierarchical structure with multiple sub-elements. Detail items or assemblies can be entered at an appropriate level within the hierarchy. An example of the UNIFORMAT II WBS structure is shown to Level 4 below:

Level 1 – Major Group Elements
Example: A - SUBSTRUCTURE
- Level 2 – Group Elements
  Example: A10 - Foundations
  - Level 3 – Individual Elements
    Example: A1010 – Standard Foundations
    - Example Level 4 Elements from Appendix X1.1 of E1557-09
      Example: A101001 – Wall Foundations

Table A-1 in Appendix A lists the UNIFORMAT II elements to Level 3.

2-7.2.1 Measure.

A unit of measure is associated with each level of the WBS and must be followed in every cost estimate to facilitate the estimating review process. This will allow cost estimates to be compared to other similar project cost estimates.

2-7.2.2 Numbering Structure.

The complete hierarchical structure is defined in ASTM Standard E1557-09. An example is shown in Appendix A, Table A-1.

2-8 DEGREE OF DETAIL.

2-8.1 Construction Tasks.

Cost estimates within the scope of this manual will be prepared on the basis of 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 cost estimate. Each task is then defined and priced as accurately as possible. Tasks are seldom spelled out in the contract documents, but are necessary for evaluating the requirements and developing their cost.

2-8.2 Analyzing Construction Tasks.

When analyzing construction tasks in a cost estimate, the cost engineer identifies the tasks that account for the major costs in the cost estimate. These tasks can be identified by applying the Pareto Principle (80/20 rule), which states that approximately 80% of the project cost is contained in 20% of the items. Because these significant items account for most of the project cost, they receive prime emphasis and effort in both preparation and review.

2-8.3 At the Most Detailed Level.

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 are to be as complete and accurate as possible to lend credibility to the cost estimate and aid in later review and analysis. An example of a detailed manually prepared cost estimate is provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05. Whenever a significant amount of design assumptions are necessary such as in design-build process, the cost engineer leverages cost data from previous similarly designed projects or use parametric estimating models.

2-9 RELIABILITY.

GAO uses the term “reliable” to describe the standard in quality for cost estimating. A reliable cost estimate is defined as well documented, comprehensive, accurate, and credible.

Accuracy and completeness are critical factors in cost estimates. An accurate and complete cost estimate establishes accountability with the cost engineer and enables management to place greater confidence in the cost estimate. Given the probabilistic nature of cost estimating, a point estimate does not provide the best picture of the accuracy of the estimate. That requires accounting for the amount of variation inherent in the cost estimate. A given point estimate is one cost estimate in a range of cost estimates. A more complete understanding of accuracy, therefore, is provided by indicating where a given point estimate falls in a range of possible cost estimates.

2-10 ROUNDING FIGURES.

For preliminary or alternative cost estimates, when design details are limited, the cost estimate may be rounded based on the experience of the cost engineer, whereby the end cost is not significantly affected.

Rounding the total cost of military construction projects to the nearest thousand dollars for design estimates and Independent Government Estimates (IGE) is acceptable for reporting purposes.

2-11 SAFEGUARDING COST ESTIMATES.

Although not required by regulations, cost estimates based on less than completed design must be handled in a discretionary manner. Access to each cost estimate and its contents will be limited to those persons whose duties require knowledge of the cost estimate. Cost estimates prepared by A-E's will also be similarly handled. Architect-Engineer (A-E) contracts must provide a letter of transmittal that includes the following statement: "To the best of my knowledge the confidential nature of this cost estimate has been maintained." for each cost estimate submitted to the Government. This statement must be signed, dated, and maintained until the official markings have been removed. Any request by the public for information and pricing in the cost estimate will not be provided until coordination, verification of data, and approvals have been given by the commander or designated authority. Procedures for safeguarding the cost estimate are to be in accordance with the design agency's requirements.

2-12 SECURITY AND DISCLOSURE OF INDEPENDENT GOVERNMENT ESTIMATE.

2-12.1 Contents of the Independent Government Estimate.

The Independent Government Estimate (IGE) normally consists of a title page, signature page, and 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. IGEs for contract awards and contract modifications are treated the same.

2-12.2 Access to the Independent Government Estimate.

Access to the IGE and its contents will be limited to personnel whose duties require they have knowledge of the subject. When an A-E is responsible for preparing any such IGE, the A-E submittal includes a list of individual's names that have had access to the total amount of the IGE. Government personnel also sign the same or a similar list. A list similar to the "Sample Control Record for IGE", provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 is filed with the IGE.

2-12.3 Marking the Independent Government Estimate.

The IGE will be marked in accordance with DODINST 5200.48 and cognizant design agency requirement. The IGE will ensure that the protective marking "Controlled Unclassified Information" (CUI) is properly applied to pertinent documents, computer files, compact discs (CDs), printouts, and other documents prepared manually or electronically for incorporation into the IGE.

2-12.4 Disclosure Outside of the Government.

After contract award, ordinarily, only the title page, signature page, and bid schedule are disclosed outside the Government. The IGE back-up data is not released since it contains sensitive cost data (e.g., contractor quotes, crews and productivity) that are proprietary or might compromise cost estimates for future similar procurement.

2-12.5 Bid Protests and Litigation.

During bid protests and litigation, if appropriate and to the extent possible, Counsel should have the IGE and the IGE back-up data placed under a “protective order.” There are valid reasons for not releasing the IGE back-up data supporting the IGE to the contractors. 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 IGE back-up data would provide bidders with the detailed cost data that supports the IGE. If, however, the apparent low bidder protests the details of the IGE, the Command may provide the IGE and IGE back-up data, to the protestor only, upon receipt of complete details of the protestor’s cost estimate. If the protest is not sustained and the proposal is re-advertised, bidders are entitled to have the same information as the protestor.

2-13 RELEASE OF INDEPENDENT GOVERNMENT ESTIMATES UNDER THE FREEDOM OF INFORMATION ACT (FOIA).

The IGE and IGE back-up data, prepared for construction contracts and modifications, are sensitive procurement information and in many cases are withheld under the FOIA.

2-13.1 Definitions.

- The IGE consists of a title page, signature page, and bid schedule.
- The IGE back-up data is the detailed cost data, which includes production and crew development methodology, labor, equipment and crew back-up files, subcontractor quotes and other data identified on agency approved cost estimating software as detail sheets.
- Fair market price determinations, under the Small Business Program, Federal Acquisition Regulations (FAR) 19.202-6, will be treated as the IGE for purposes of this guidance.
- Supporting documents that are publicly available as part of the solicitation, such as plans, specifications and project description, or that contains no

cost information, such as sketches, soil borings and material classifications, are not part of the IGE or back-up data.

2-13.2 Requests for Independent Government Estimates and Back-Up Data.

IGE's and IGE back-up 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 IGE and back-up 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. 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.

2-13.2.1 Sealed Bid Procurement.

When sealed bidding is used, neither the IGE nor the IGE back-up data is to be released prior to bid opening. See FAR 36.203(c), 36.204. It is well established that release of IGE's and back-up data before contract award would harm the interests of the Government. Refer to 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).

2-13.2.2 Post Bid.

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 bids received are non-responsive and a re-procurement is envisioned.

2-13.2.3 Negotiated Procurement.

In negotiated procurement for construction under FAR Parts 15 and 36, the IGE will 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).

2-13.2.4 Back-Up Data.

The IGE back-up data will not be released. Release of IGE back-up data after contract award and before completion of a construction contract may also result in harm to the Government. The IGE back-up 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. 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). Taylor Woodrow International, Ltd. V. Department of the Navy, No. 88-429R, (W.D. Wash. Apr 6, 1989).

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CHAPTER 3 BASICS FOR PREPARATION OF COST ESTIMATES

3-1 GENERAL.

This chapter establishes uniform guidance to be used prior to cost estimate preparation. In the normal sequence of events toward the preparation of any cost estimate, it is of utmost importance to understand basic fundamental principles and responsibilities. Cost estimates consist of:

- Descriptions of work elements to be accomplished (tasks).
- A quantity of work required for each task.
- A cost for each task quantity.

A unit cost for each task is developed to increase the accuracy of the estimating procedure and to provide a reference comparison to historic experience. Lump sum cost estimating when used at the task level must be fully documented to show the intent and extent of the item.

3-2 PLANNING THE WORK.

The cost engineer must thoroughly understand the construction scope of work and the biddability, constructability, operability, environmental, sustainability (BCOES) aspects of the project being estimated. The cost engineer must review available resources including design analysis, drawings, and specifications. The cost engineer must also consider construction sequences, durations, and site conditions 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 difficult site conditions, major maintenance and repair projects, and alteration/addition projects. The construction sequence must be developed as soon as possible and used to provide a checklist of construction requirements throughout the cost estimating process. The overall format of major cost elements in a cost estimate must be compatible with current standards, management needs, the anticipated bidding schedule, and the appropriate WBS.

3-3 QUANTITIES.

The quantity “take-off” is an important part of the cost estimate. It must be as accurate as possible, and be based on available engineering and design data.

- After the scope has been analyzed and broken down into the construction tasks, each task must be quantified prior to pricing. Equal emphasis is placed on both accurate quantity calculation and accurate pricing. Quantities are to be shown in standard units of measure and consistent with design units. Assistance for preparing “take-off's” 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.

- 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. Project notes will be added at the appropriate level in the cost estimate to explain the basis for the quantity calculations, to clearly show contingencies, and to note quantities determined by cost engineering judgment that will be reconciled upon design refinement.
- For Design-Build contracts the cost engineer is provided a proof of concept (pilot project design, which demonstrates that a design concept is feasible) from the design team in which reasonable quantities and scope can be derived to establish the baseline cost estimate. The proof of concept addresses the RFP requirements so that the project delivery team can verify the scope can be built within budget.

3-4 TYPES OF COSTS.

Various types of cost elements must be evaluated in detail.

- Direct costs are those costs, which can be attributed to a single task of construction work. These costs are usually associated with a construction labor crew performing a task using specific equipment and materials for the task. Labor foreman cost is normally considered a direct cost. Subcontracted costs are considered as direct costs to the prime contractor in cost estimates.
- Indirect costs are those costs which cannot be attributed to a single task of construction work. These costs could include but are not limited to mobilization, demobilization, supervision, overhead, profit, and bond. Indirect costs are also referred to as distributed costs. When a percentage factor is used, an engineer's cost estimate is developed to verify the adequacy of the percentage factor used. For example, thru the use of an estimated construction schedule, the superintendents, quality control manager, safety officer, and trailers monthly costs multiplied by the number of required months from the schedule is compared to the resultant of the percentage factor used for JOOH to verify if the percentage used is in the right order of magnitude.
- Cost estimates based on detailed design will be developed from separate direct cost pricing of labor, material, construction equipment, and supplies. Applicable indirect costs will be added to reflect the total construction cost. Other costs, including escalation, design contingencies, design-build design costs, building commissioning, sustainment, construction contingencies, construction supervision, inspections and overhead (SIOH), and Operation and Maintenance (O&M) Manuals, may be added to the cost estimate to determine the total project cost as required by program specific requirements. These costs are often applied as multipliers at various levels in the cost estimate and distributed across the

items within that level. In some cases, there may be specific tasks costs developed for such items. For Design/Construction Contingency and DB Design Costs a cost estimate is developed to verify the adequacy of the percentage factor used.

3-5 COST SOURCES.

Typically, there are various cost sources available to the cost engineer. In obtaining costs from any source, experience and ability to relate data in hand to a specific circumstance is important. The following discussion is provided on commonly used sources and source development.

3-5.1 Cost Book

The Cost Book is the common name for the Tri-Services construction direct costs database. It contains repetitive construction tasks with direct cost pricing (labor, equipment, material) based on a typical crew and production rate for new construction. Some Cost Book line items may include quotes for work that is fully provided and installed by subcontractor. Quotes for work fully priced by subcontractor must be clearly identified. Each office is encouraged to use this cost source and to refine the project database to more accurately reflect local costs at the project site (i.e., obtain quotes, adjust productivity, assess crew makeup).

3-5.2 Historical Data.

Historical costs from past similar work are excellent pricing sources when adequate details have been saved and adjustment to project specifics can be defined. Portions of other cost estimates having similar work can be retrieved and repriced to the current project rates. Automated historical databases are discussed in Appendix B. Historical data is consistently gathered, organized for ease of access, and analyzed for trends. MILCON historical data is utilized to develop the guidance unit costs provided in Chapter 2 of UFC 3-701-01.

3-5.3 Parametric Database.

A parametric database of predefined assemblies for buildings and sitework has been developed and is discussed in Appendix B.

3-5.4 Development of Specific Tasks.

When Cost Book items do not meet project needs, specific new cost tasks may need to be developed. Such development requires experience. Descriptions developed must adequately define the scope and material requirement for each task. Unit cost for each task is developed as a direct cost with separate costing for the labor, equipment, and material components. Notes, which explain key factors in the pricing and methodology, 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 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/unit.
- Equipment unit cost - This cost is derived similar to labor unit cost. Hourly equipment rates are obtained from the appropriate regional manual, entitled, Construction Equipment Ownership and Operating Expense Schedule (herein referenced as, Equipment Ownership Schedule), Engineer Pamphlet (EP) 1110-1-8 or developed according to the methodology as described in this pamphlet.
- Material unit cost - This cost is developed using vendor quotes, historical costs, commercial pricing sources, or component calculations. The price is to include delivery to the project site.
- Commercial unit cost books - These common sources are 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.

3-6 COSTS AND PRICING.

The cost for each task is developed by summing the direct cost elements for materials, labor, and equipment. The indirect costs and other markups associated with each task or work item are identified and are considered separately for the specific project.

3-6.1 Minor Direct Costs.

The direct cost on construction tasks of minor overall cost significance and of a repetitive nature can normally be priced from any of those sources discussed above.

3-6.2 Historical Pricing.

When using historical pricing, adjustments must be made for project location, work methodology, quantity of work, and escalation to current price level, and other dissimilarities, which affect prices.

3-6.3 Lump Sum Items.

Use of lump sum items is discouraged. If lump sum items are used in the cost estimate, they must have backup cost data relating to their tasks and source of the data.

3-6.4 Detailed Backup of Cost.

As a general rule-of-thumb, it is highly recommended that when a task extended direct cost is 5 percent or more of the total direct cost, a detailed backup for the cost is prepared or vendor quotations obtained as pricing support to the cost estimate. Use of the Pareto Principle should be considered.

3-6.5 Predetermined Bid Items.

Applying a similar rule-of-thumb, in some instances, unit price bid items for IGEs may be based on suitable experienced bid prices or historical cost data, i.e., predetermined bid item does not exceed 5 percent or more of the estimated total cost a detailed backup for the cost is prepared as pricing support to the IGE. For cost estimates prepared during preliminary or planning phases, where design is limited or not available, predetermined unit prices adjusted to current pricing level may be used by the cost engineer. Use of predetermined prices are to consider any necessary adjustments in prime contractor's profit or distributed costs appropriate to the contract requirements. The cost engineer must use extreme care and sound judgment when using predetermined unit costs. The basis for the unit costs is to be well documented and included in the supporting data of the cost estimate. Where a bid item consists mostly of equipment and labor costs, with very little materials and supplies, it is advisable to develop the cost as indicated above, even though the item may fall under this rule-of-thumb.

3-7 COST ESTIMATE FORMAT AND SUPPORTING DOCUMENTATION.

Cost estimates are generally composed of contract costs and other allowable project costs authorized by directives or regulations. The overall format of the cost estimate must be in accordance with the appropriate WBS as described in Chapter 2. The cost engineer is to be aware of the documentation necessary to support the cost estimate submission requirements specified for each phase of project development. Support documentation such as project narrative, bid schedule, estimated construction schedule, backup data, and drawings and sketches are further discussed in Chapter 4.

3-8 MILITARY CONSTRUCTION PROGRAM SPECIFIC REQUIREMENTS.

In addition to costs described in this chapter, the cost estimate for Military Construction projects are to include other costs authorized by directive to be charged to construction as funded cost. These costs include installation costs or installed equipment in place to be furnished by the using service or other agency, and the cost of Government-Furnished Materials (GFM) or Government-Furnished Equipment (GFE) purchased with construction funds and furnished to the contractor without reimbursement.

3-9 UPDATING COST ESTIMATE.

At each project development milestone including solicitation amendments, the cost estimate must be updated with current costs so that it is always relevant and current. The continual updating of the cost estimate as the project matures not only results in a more accurate cost, but also gives opportunities to incorporate lessons learned. Future cost estimates can benefit from the new knowledge. For example, cost or schedule variances resulting from incorrect assumptions are thoroughly documented so as not to repeat those mistakes on future cost estimates. Finally, actual cost is collected and archived in the Historical Analysis Generator Second Generation (HAG/HII) historical database for use in supporting new cost estimates.

CHAPTER 4 COMPOSITION OF INDEPENDENT GOVERNMENT ESTIMATES

4-1 GENERAL.

Well-documented cost estimates are considered a best practice for high-quality cost estimates for several reasons.

- First, thorough documentation is essential for validating and defending a cost estimate. That is, a well-documented cost estimate can present a convincing argument of a cost estimate's validity and can help answer decision-makers' and oversight groups' probing questions.
- Second, documenting the cost estimate in detail, step by step, provides enough information so that someone unfamiliar with the program could easily recreate or update it.
- Third, good documentation helps with analyzing changes in program costs and contributes to the collection of cost and technical data that can be used to support future cost estimates.
- Finally, a well-documented cost estimate is essential, if an independent review or audit is performed, to ensure that it is valid and reliable. It also supports reconciling differences with an independent cost estimate, if performed, by improving understanding of the cost elements and their differences so that decision-makers can be better informed.

Documentation provides total recall of the cost estimate's detail so that it can be replicated by someone other than those who prepared it. It also serves as a reference to support future cost estimates. Documenting the cost estimate makes available a written justification showing how it was developed and aiding in updating it as key assumptions change and more information becomes available.

The IGE is the final approved cost estimate submitted to the Contracting Officer to support contract award. Each Agency may have its own requirements and procedures. The presentation format for this type of IGE generally is: Independent Government Estimate of Construction Cost, Basis of Estimate (BOE), IGE back-up data, and miscellaneous support data. Sample IGE sheets are provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05. Security and control of the IGE is described in Chapter 2.

4-2 INDEPENDENT GOVERNMENT ESTIMATE OF CONSTRUCTION COST.

The Independent Government Estimate (IGE) of Construction Cost is to be submitted as required by procurement regulations. It includes the protective cover page, title page, signature page, and bid schedule.

4-2.1 CUI Cover Page.

The IGE must include a CUI cover page per section 2-8.3.

4-2.2 Title Page.

The title page must include the name and location of the project, the office responsible for the project design, the cost engineer responsible for preparation of the IGE, and the submittal date.

4-2.3 Signature Page.

The signature page contains the names and signatures of those individuals responsible for the preparation, review, submittal, and approval of the IGE. It is necessary that the signature page contain the total amount of the estimated costs so that there will be no question as to the approved total amount. The number of amendments included in the IGE appears on the same page so that there will be no question whether the IGE accounts for all amendments.

4-2.4 Bid Schedule.

The bid schedule required by the solicitation documents must be completed as part of the IGE. As part of the design team, the cost engineer is involved in the development of the bid schedule. The format of the bid schedule must be anticipated and discussed as early in the planning process as possible. It is important that the bid schedule includes meaningful scopes of work elements structured to aid in evaluation and historical data collection. When the bid 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 schedule between the unit price and extension. Refer to Price Schedule (https://www.wbdg.org/ffc/navy-navfac/project-information-form-specifications-cover-sheet/price-schedule) for the minimum bid schedule items.

4-3 BASIS OF ESTIMATE (BOE).

Two important criteria are to be kept in mind when generating high-quality cost estimate documentation. First, document the cost estimating process, data sources, and methods. Second, present the results of the estimating process in a format that makes it easy to prepare reports and briefings to upper management and stakeholders.

Cost estimators document the steps used to develop the cost estimate. As a best practice, the cost estimate documentation addresses how the cost estimate satisfies the guidance used to govern the creation, maintenance, structure, and status of the cost estimate. It contains discussions, considerations, and the developed construction plan.

4-3.1 Cover Page and Table of Contents.

This page denotes the project name, date, milestone, names of the cost estimators and the organization they belong to.

4-3.2 Executive Summary.

This section provides at the minimum the following information:

- Summarizes clearly and concisely the cost estimate results, with enough information about cost drivers and high-risk areas for management to make informed decisions
- Identifies critical ground rules and assumptions
- Identifies data sources and methods used to develop major WBS cost elements and reasons for each approach
- Discusses independent cost estimate (ICE), if performed, results and differences and explains whether the point estimate can be considered reasonable
- Discusses the results of a sensitivity analysis, the level of uncertainty associated with the point estimate, and any contingency recommendations

4-3.3 Cost Estimate Purpose.

This section provides the cost estimates purpose, need, and submittal. If the cost estimate needed to be revised, note and identify the purpose of the revision.

4-3.4 Construction Scope and Assumptions.

The construction scope description provides detail to give a clear understanding of the scope of work. The construction scope description defines the assumptions made during the preparation of the cost estimate. It describes the project requirements 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 equipment, and the reasons for unusually high or low unit prices. Each cost estimate will include a statement, which relates both the development of design, as appropriate, and date of effective pricing.

The construction scope description defines the assumptions made during the preparation of the cost estimate. Assumptions represent a set of judgments about past, present or future conditions postulated as true in the absence of positive proof. It is important that assumptions developed by the cost estimator are based on input from the technical team.

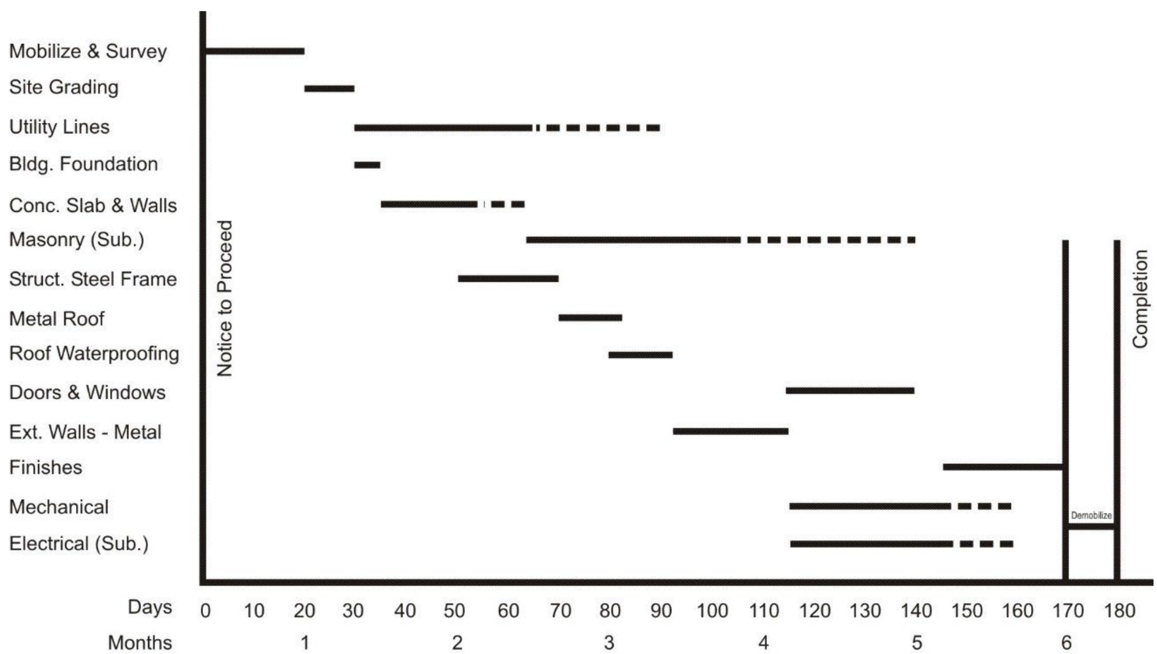
Other factors to be considered in the construction scope description include:

- Construction schedule, use of overtime, construction windows, phasing, acquisition plan and subcontracting.
- 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, contingencies by feature or sub feature, if appropriate, and effective dates and sources for labor, equipment and material pricing.

4-3.5 Estimated Construction Schedule.

The cost engineer prepares 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 (see Figure 4-1 for an example). It must identify the sequence and duration of the tasks upon which the cost estimate is developed. The schedule considers holidays, non-workdays, and weather days as supplied in the specifications. 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. In addition, it will support the development of the duration of the job office overhead. The construction schedule is reviewed by the project delivery team.

Figure 4-1 Construction Schedule Example



4-3.6 Sensitivity Analysis.

- Describe the effect of changing key cost drivers and assumptions independently
- Identify the major cost drivers that to be closely monitored

4-3.7 Risk and Uncertainty Analysis.

- Discuss sources of risk and uncertainty, including critical assumptions, associated with the cost estimate as developed by the CSRA
- Document the effect of uncertainty associated with the point estimate is quantified with probability distributions, and the resulting S-curve; the

method for quantifying uncertainty is discussed and backed up by supporting data

- Discuss risk distributions and correlation between WBS elements
- Describe the basis for contingency and how it was calculated.

4-3.8 Equipment and Materials Utilization.

On those projects involving considerable heavy construction equipment, it is necessary to sufficiently plan the equipment usage against the construction work schedule to identify the actual number of cranes, dozers, and allow for proper mobilization to assure that demand for the equipment is not over or understated. Equipment references are to be provided which indicate the region and date of the equipment library used for pricing the equipment. Materials, which require long lead-time and can become critical to the construction schedule are to be noted, planned, and adequately considered.

4-3.9 Labor Discussion and Utilization.

The cost estimate clearly states 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 cost estimate, an explanation is to be included.

4-4 INDEPENDENT GOVERNMENT ESTIMATE BACKUP DATA.

This part of the IGE consists of the support and backup documentation. The various categories of support documentation contained in this part are:

- Cost estimate 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 Work Breakdown Structure. Distribution of overhead and profit is shown on this sheet.
- Mobilization, preparatory work, and demobilization. These costs are to be itemized and costed separately. These costs may be combined at summary level with overhead if these costs are not paid as a separate bid item.
- Profit computation sheet. When profit is included, the weighted guidelines will be used to compute the profit and will be part of the cost estimate backup.
- Overhead costs. The itemization and calculations of overhead costs, both job site and home office, are to be accomplished in accordance with Chapter 10.
- Bond costs. Bond costs are to be calculated in accordance with Chapter 12. Distribution is made to bid items similar to or as part of overhead costs distribution.

- Automated detail sheets. The completed direct costs are to be organized in the proper sequence by the appropriate Work Breakdown Structure for each bid item.
- Production rates. The automated or manually prepared details are used to express production rate analysis of crews. See Chapter 6 for further discussion.
- Crew, labor, 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.
- Quantity computations. The quantity takeoff computations for the tasks estimated, are organized by task for the bid items and kept as backup. The takeoff references the drawing and clearly explain the computation.
- Quotations. Quotations are to 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 is fully described. Quotations are considered proprietary information and kept confidential to protect the information entrusted to the cost engineer.

Projects outside continental United States (OCONUS) are to include International Balance of Payment (IBOP) analysis under normal or revised procedures. Cost estimates will not include the IBOP statement but the documentation will be retained at the cognizant design agency office. The projects will be evaluated for IBOP impact in accordance with DODI 7060.2, Federal Acquisition Regulation (FAR) 25-300 and Defense Federal Acquisition Regulation Supplement (DFARS) 225.75. Countries exempt from IBOP analysis are listed in DFARS 225.872-1.

4-5 MISCELLANEOUS SUPPORT DATA.

Include other information pertinent to the cost estimate such as drawings, sketches, and a listing of similar projects that may be relevant for comparison, 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 showing the location of the work, borrow, quarry, and spoil areas, and existing work access roads; any existing facilities usable by the contractor; a general plan and elevation, or profile of the work with typical sections; and a construction layout.

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 back-up.

4-6 REQUIREMENTS FOR REVISION TO INDEPENDENT GOVERNMENT ESTIMATE.

The IGE may be changed or revised as a result of errors, differing conditions or additional information. Approval authority for revision to the IGE remains the responsibility of the Contracting Officer or authorized original IGE-approving official. Each office assures that appropriate justification is attached to the revised IGE. Any revision to the IGE must be clearly indicated, dated, justified, and approved. A copy of each IGE that has been approved is included in a file along with the details and circumstances reflecting the revisions.

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CHAPTER 5 LABOR

5-1 GENERAL.

5-1.1 Direct Labor Costs.

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.

5-1.2 Indirect Labor Costs.

Indirect labor costs are wages and labor cost additives paid to contractor personnel whose effort cannot be attributed to a specific construction task. Personnel such as superintendents, engineers, clerks, and site cleanup laborers are usually included as indirect labor costs (overhead).

5-2 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 are to 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.

5-3 WAGE RATES.

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 cost estimate. The computation will be prepared on the "Wage Rate Calculations" for provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 or similar local forms, or cognizant design agency approved cost estimating software.

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 sam.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 consults 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, or the work is in a remote area, or it is well known that rates higher than the set rate scale will be paid, these higher wage rates are 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 is adjusted to include travel time or night differential where these are a customary requirement.

For projects in locations not contiguous to the United States and its territories the wage rates are to reflect the prevailing wages being paid for construction labor in the host nation. These are to be fully burdened wage rates, including fringes, insurance and taxes.

5-3.1 Long Duration Projects.

For a long duration project, where future wage rates (i.e., Union Agreements) are known and used, care must be taken to avoid duplication by not applying an escalation rate to such costs.

5-4 OVERTIME AND SHIFT DIFFERENTIAL.

The cost engineer is to 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 are to 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 is normally avoided due to lower labor efficiency and the requirement to include equipment maintenance.

5-4.1 Overtime.

Overtime is to 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 subsistence costs are not. Figure 5-1 shows an example of overtime calculation for 40 hours regular time, plus 8 hours overtime at time and one half:

Figure 5-1 Overtime Calculation

OVERTIME CALCULATION EXAMPLE	
48 hours at Straight Time	= 48.00 hours
8 hours at ½ Time	= 4.0 hours paid
Equivalent Straight Time	=52.00 hours
(52 hours paid/48 hours worked = 1.0833) - 1 x 100% = 8.33%	
Note: Refer to the Related Material on WBDG.org for example estimate sheets for method of application	

5-4.2 Shift Operations.

Many construction projects utilize multiple shift operations. When estimating direct labor costs for multiple shift operations, the cost engineer estimates 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 construction schedule. Differential shift premiums may need to be added to the hourly rate.

5-4.3 Tabulation of Overtime Percentages.

A tabulation of overtime percentages for most conditions is provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05. The percentage also includes an allowance for the direct work loss of multiple shift or shift differential, where applicable.

5-5 TAXES AND INSURANCE.

5-5.1 Rates.

Rates for taxes and insurance are to be verified prior to computation.

5-5.2 Workman's Compensation.

Workman's compensation and employer's liability insurance costs applicable for the state in which the work is performed are to 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 every craft employed by the contractor.

5-5.3 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 every project. Insurance rates can be obtained from the state unemployment office, commercial publications, or the Bureau of Labor Statistics.

5-5.4 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.

5-5.5 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. Figure 5-2 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.

Figure 5-2 Total Taxes and Insurance Percentage

TOTAL TAXES AND INSURANCE PERCENTAGE	
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. Refer to the Related Material on WBDG.org for example estimate sheets for method of application	

5-6 FRINGE BENEFITS AND TRAVEL/SUBSISTENCE.

5-6.1 Fringe Benefits.

Fringe benefits may include health and welfare, pension, 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.

Figure 5-3 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.

Figure 5-3 Fringe Benefits

FRINGE BENEFITS EXAMPLE	
Health and Welfare	$0.70/hr
Pension	$0.75/hr
Apprentice Training (N/A in this case)	$0.00/hr
Total Fringe Benefits	$1.45/hr

5-6.2 Travel and Subsistence.

Travel and subsistence (per diem) costs are normally expressed as a daily or weekly cost. Travel and subsistence may 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 provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 for methodology.

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

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CHAPTER 6 LABOR PRODUCTIVITY

6-1 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 crew members 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.

6-1 PRODUCTIVITY ADJUSTMENT CONSIDERATIONS.

6-1.1 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, site specific security requirements, 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 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.

6-1.2 Complexity of the Variable.

The complexity of the variables affecting productivity makes it difficult to estimate a production rate. Therefore, production rates are 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.

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CHAPTER 7 CONSTRUCTION EQUIPMENT AND PLANT

7-1 GENERAL.

Construction plant and equipment 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.

7-2 SELECTION OF EQUIPMENT.

An important consideration in the preparation of a cost estimate is the selection of the proper equipment to perform the required tasks. The cost engineer is to 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; mobility and availability of equipment; suitability of equipment for other uses; equipment capabilities; number of shifts; distances material must be moved; steepness and direction of grades; weather conditions; hauling restrictions; standby time; and mobilization and demobilization costs.

The cost engineer preparing the cost estimate must be familiar with construction equipment and job-site conditions. The selected equipment conforms to contract requirements and be suitable for the materials to be handled and conditions that will exist on the project.

7-3 ESTIMATING METHODOLOGY.

The "crew concept" discussed in Chapter 5 for cost estimates requiring detailed estimating of labor, materials, and equipment 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 is prorated between both crews.

7-4 PRODUCTION RATE.

After determining the type of equipment to be employed, the cost engineer selects the specific equipment size which 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 Micro Computer-Aided Cost Engineering System 2nd Generation

(MCACES/MII)/historical equipment models and assemblies, adjusted for project conditions.

7-5 MOBILIZATION AND DEMOBILIZATION.

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. Labor, equipment, and supply costs required to mobilize the equipment are to 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 are 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. 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 is to be included in the demobilization cost. Transportation rates should be obtained periodically from qualified firms normally engaged in that type work.

Mobilization and demobilization costs for plant are 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 that are distributed throughout work accomplishment.

7-6 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE COST RATES.

The EP 1110-1-8 Construction Equipment Ownership and Operating Expense (includes 12 volumes) determines the hourly rates for equipment ownership and operating expense by region. These regional rates are incorporated into the Cost Book and are to be used in the preparation of cost estimates for owned equipment. These volumes have been developed for different geographic regions in the United States, and the appropriate volume is to be used based upon project location. Rented and leased equipment is also discussed in the EP and is appropriate for inclusion in the cost estimate at competitive rates if judgment determines this to be a reasonable approach.

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

7-7 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 are 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., is to be included in the cost estimate as part of the cost of these materials or supplies manufactured or produced at the site.

7-8 SMALL TOOLS.

The cost of small power and hand tools and miscellaneous non-capitalized equipment and supplies are 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. Unit prices based on historical data already include a small tools allowance. The small tool cost will be considered as part of equipment cost. Such allowance is typically 2 percent of direct labor cost. The cost engineer must ensure that this cost is not duplicated in the overhead rate percentages. The crews in the Cost Book do not contain a small tools allowance.

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CHAPTER 8 MATERIALS AND SUPPLIES

8-1 GENERAL.

Materials and supplies are defined below, and for the purpose of cost estimating, both can be considered materials unless they need to be separated because of different tax rates.

8-1.1 Materials.

Those items which are physically incorporated into and become part of the permanent structure.

8-1.2 Supplies.

Those items which are used in construction but do not become physically incorporated into the project such as concrete forms.

8-2 SOURCES OF PRICING DATA.

8-2.1 General.

Prices for materials and supplies may be obtained from pricing services, the Cost Book, 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 is to be taken when using this type of cost data to make proper allowances for quantity discounts, escalation, and other factors affecting contractor cost.

8-2.2 Quotes from Manufacturers and Suppliers.

Quotes are to be obtained for significant materials and installed equipment and for specialized or not readily available items. Use the Pareto Principle to determine the number of quotes required. Quotations may be received either in writing, electronically, or by telephone. 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 is to 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 cost estimate. Quotes are kept proprietary to preserve the confidentiality entrusted. A sample telephone quotation data sheet similar to that provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 is utilized for recording quoted information. The cost engineer is to 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.

8-3 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. The preferred methodology used by the cost engineer is not to charge labor on the excess quantity. In either case, a note statement is required in the cost estimate explaining the methodology used.

8-4 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, is not to be included as a contingency, but clearly and separately defined in each cost estimate. Adjust current pricing to future pricing using program specific escalation factors. Computations of adjustments are to be clear and maintained as cost estimate backup support. The cost engineer is to ensure that this cost is not duplicated in the escalation to midpoint of construction percentages.

8-5 FREIGHT.

The cost engineer checks 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/Freight on Board (FOB) refers to the point to which the seller will deliver goods without additional charge to the buyer.

8-5.1 FOB Factory or Warehouse.

If the materials or supplies are FOB factory or warehouse, freight costs to the construction site are to be added to the cost of the materials or supplies.

8-5.2 Unloading and Transporting the 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 is to be included in the cost estimate.

8-5.3 Large Quantity in Bulk.

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

8-6 HANDLING AND STORAGE.

The contractor is usually required to off-load, handle and stockpile, or warehouse materials on site. These costs are to be included in the cost 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 are considered as an indirect cost and be included in the job-site overhead cost.

8-7 TAXES.

When applicable, state and local taxes (i.e., sales, excise) are to be added to the materials or supplies cost. In some states, material incorporated into Federal construction is exempt, but supplies are not. Care is to be taken, therefore, that the sales tax rate is applied as required. The cost engineer is to 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.

8-8 MATERIALS OR SUPPLIES MANUFACTURED OR PRODUCED AT THE SITE.

If it is likely the contractor will manufacture or produce materials or supplies at the project site, a separate cost estimate component (i.e., batch plant) is to be developed for this work. This cost estimate includes a detailed equipment, labor, materials, and supplies estimate, and concludes with a unit cost of material or supply delivered to the stockpile, storage yard, or other end point.

8-9 GOVERNMENT-FURNISHED MATERIALS (GFM) OR EQUIPMENT (GFE).

On some projects, the Government may provide some of the project materials. Government-furnished materials and equipment are to be estimated in the same manner as other materials, except that the purchase price is not included. The cost estimate includes 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 total project cost.

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CHAPTER 9 SUBCONTRACTED WORK

9-1 GENERAL.

In construction, specialty work such as plumbing, heating, electrical, roofing, plastering, and tile work 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 cost estimate is prepared as practically and as realistically as possible, subcontract costs become a necessary consideration.

9-1.1 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 cost estimate. The appropriate subcontractor overhead and profit costs are to be applied to subcontractor direct cost items in addition to the appropriate prime contractor overhead and profit.

9-1.2 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, set-up, and charges for overhead and profit. Particular attention is given to large items such as turbines, generators, and incinerators. The total subcontract cost is considered a direct cost to the prime contractor.

9-1.3 Construction Contractual Methods.

The cost engineer should be aware of the type of contractual method for which the solicitation is being issued. Limited competition contractual procurement methods may result in multiple compounded levels of subcontracted work, e.g., compounded subcontractors' markups passed on to the prime contractor. Some examples of limited contractual procurement methods are 8-A Sole Source RFP, MATOC sole source task order, POCA sole source task order, etc. The prime contractor is required per the contract to perform a minimum amount of work, but the remaining work may be performed by subcontractors. If possible, particular attention is to be given to the workload capacity and workforce capability of the prime contractor. If the prime contractor already is at full capacity in performing other work, or their own workforce resources are at maximum usage, then the prime contractor will likely subcontract to the maximum extent allowable. Also, the same scenario would occur for the subcontractors if they are at their maximum capacities.

9-2 USE OF QUOTATIONS.

Potential prime contractors are not to be utilized for quotes. The cost engineer may utilize quotes for the expected subcontracted work when reviewed and verified as reasonable. In lieu of a quotation, each task of the subcontract is priced as a direct cost with an appropriate rate of subcontractor's overhead and profit added.

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CHAPTER 10 OVERHEAD COSTS

10-1 GENERAL.

Overhead costs are those costs, which cannot be attributed to a single task of construction work. Costs, which can be applied to a particular item of work is to be considered a direct cost to that item and are not to be included in overhead costs. The overhead costs are customarily divided into two categories:

- General home office overhead (HOOH) commonly referred to as General and Administrative (G&A) costs.
- Job office overhead (JOOH) also referred to as General Conditions or Field Office Overhead (FOOH).

10-1.1 Duplication of Overhead Costs.

The cost engineer must be sure that overhead costs are not duplicated between the two categories (JOOH/HOOH). 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 (CSI) 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.

Beyond ensuring there is no duplication of costs, the General Requirements Section of the contract specifications can also impact specific adjustments to costs, such as number of project offices, utility requirements/coverage’s, contractor quality control matrices, allowances or restrictions against multiple roles for a single supervisory role, etc.

10-1.2 Previously Determined Overhead Rates.

The application of a previously determined overhead rate may be used for early design stages, but it is not an accurate or reliable method of forecasting costs. Overhead will vary from project to project and may even vary from month to month within any given project. Job overhead items for the prime contractor are estimated in detail for projects at final design requiring a cost estimate. Detailing of overhead costs for subcontract work is recommended when the impact of these costs is significant.

10-2 GENERAL HOME OFFICE OVERHEAD (G&A/HOOH).

Home office overhead expenses are those incurred by the contractor in the overall management of the business. Since they are not incurred for any one specific project, they must be apportioned to all the projects. Many expenses such as interest and entertainment are not allowable. Construction equipment depreciation is included in the EP 1110-1-8, Construction Equipment and Operating Expense Ownership Schedule cost rates and are not 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.

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. 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 cost estimates. When more specific data is not available, the cost engineer may include empirical rates. Empirical G&A rates typically range from three percent for large contractors to ten percent for small contractors. 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 home office overhead are:

- Main office building, furniture, equipment.
- Management and office staff, salary and expense.
- Utilities.
- General communications and travel.
- Supplies.
- Corporate vehicles.
- General business insurance.
- Taxes.

10-3 JOB OFFICE OVERHEAD.

Job overhead costs are those costs at the project site, which occur specifically as a result of that particular project. Some examples of job overhead costs are:

- Job supervision and office personnel.
- Engineering and shop drawings/surveys.
- Site security.
- Temporary facilities, project office.
- Temporary material storage.
- Temporary utilities.
- Preparatory work and laboratory testing.
- Transportation vehicles.
- Supplies and maintenance facilities.

- Temporary protection and Occupational Safety and Health Administration (OSHA) requirements.
- Telephone and communications.
- Permits and licenses.
- Insurance (project coverage).
- Schedules & reports.
- Quality control.
- Cleanup.
- Taxes.
- Fuel.
- Support Equipment utilized for general use on site
- Operation and maintenance of temporary job-site facilities.
- Project specific travel
- Relocation of key personnel

10-3.1 Mobilization and Preparatory Work.

The costs of mobilization and preparatory work, including the setup and removal of construction facilities and equipment are part of overhead costs unless there is a specific bid item. For large projects, the cost for each part of this initial work is to be estimated on a labor, materials, and equipment basis. For smaller projects, these costs may be estimated based on experience.

10-4 DURATION OF OVERHEAD ITEMS.

After the overhead items have been listed, a cost must be determined for each. Each item is to be evaluated separately. Some items such as erection of the project office may occur only once in the project. The cost engineer utilizes the construction schedule (see paragraph 4-3.5) in estimating requirements based on duration. Costs reflective of each particular item during the scheduled period are to be applied.

10-5 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 contractors bid data and audits. Some contractors will informally discuss and furnish information for overhead items and audit reports of previous similar projects. Other sources include previously negotiated modifications and review of organizational charts of construction firms for staffing and overhead costs evaluation. Overhead salaries are to include an allowance for payroll taxes and fringes such as Federal Insurance Contributions Act (FICA), health benefits, and vacation.

10-6 DISTRIBUTION OF OVERHEAD.

The prime contractor's overhead costs, which have been costed in an organized format, are to be summed and distributed proportionally to the Contract Line Item (CLIN) items. A proportional distribution is commonly made by percentage ratio of total direct costs to those direct costs in each item. When options, additive, or split-bid items are included, only those job office overhead costs, which relate directly to the work, are to be distributed to those items.

Job office overhead costs which the contractor will incur regardless of whether the item is optional, additive, or split is 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 cost estimates are to clearly demonstrate the procedures and cost principles applied.

For modifications that extend the baseline contract duration, the estimated job office overhead requirements are to be itemized and costed to reflect the actual net change in cost of overhead, that is, costs before and after the modification work. As a refinement to distribution, the cost engineer may reasonably and justifiably reduce the prime job office overhead distribution on subcontract work items. The balance of the total prime job office overhead are then distributed as discussed above to the remaining prime items of work.

CHAPTER 11 PROFIT

11-1 GENERAL.

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.

11-2 WEIGHTED GUIDELINES METHOD.

Profit and weighted guideline methods determining profit are discussed in the FAR and its supplements. There are various types of weighted guideline methods for determining profit according to DFARS 215.404-4. The proper weighted guideline method to use will depend on the type of contractual acquisition action and the supplemental regulations that apply to the contracting activity. Reference FAR Sub-part 15.404-4 concerning the use of profit when price is based on a negotiated firm fixed price construction contracts. The use of the weighted guideline method when price is negotiated will be per the cognizant design agency guidance. The determination of profit, as appropriate for each procurement action, may be determined and submitted on the sample worksheet identified as Figure 11-1 which applies to the weighted guidelines alternate structured approach DFARS 215.404-4 (b)(1)(C) “Alternate Structured Approach”. Explanation of the factors to be used in calculating profit, are described below, and provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05.

11-2.1 Weighted Guidelines Method.

The weighted guidelines method yields a reasonable profit value and are to be used to determine profit for contracts that include profit. This methodology is also be used wherever a detailed direct costing method is used for preparing cost estimates. A rate of profit may be used based on historical experience for early stage cost estimates prepared for programming, budgeting, reconnaissance, or concept design.

11-2.2 Weighted Guideline Factors for the Alternate Structured Approach.

Based on the circumstances of each procurement action, each of the factors listed in the “Guidelines for Weighted Factors Profit Determination” at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05. will be weighted from 0.03 to 0.12 as discussed in the following text. 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 is 0.03; as the degree of risk increases, the weighting is 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 is 0.12 and is 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 cost 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 work is performed by the contractor's own forces.

11-2.3 Separate Profit Calculation.

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

Figure 11-1 Profit Computation Sheet using the Alternate Structure Approach

PROFIT COMPUTATION SHEET

Project:	Estimated By:
Contract No:	Checked By:
Change Order No:	Date: XX/XX/XX

Profit Objective For: (Prime Contractor, Subcontractor)

Factor	Rate (%)		Weight (0.03-0.12)		Value
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.

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CHAPTER 12 SURETY BONDS

12-1 GENERAL.

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, these three parties are as follows:

Three Party	Under a General Contract	Under a Subcontract
The Principal	Contractor	Subcontractor
The Obligee	Government	Contractor
The Surety	Surety	Surety

12-2 PURPOSE OF BONDS.

The purpose of surety bonds varies with the type of bond.

12-2.1 Bid Bonds or Bid Guarantee.

Bid bonds or bid guarantee provides 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.

12-2.2 Payment Bonds.

Payment bonds protect subcontractors, suppliers, and laborers against nonpayment by the prime contractor.

12-2.3 Performance Bonds.

Performance bonds ensure 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 guaranty 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.

12-3 AMOUNT OF REQUIRED SURETY BONDS.

The amount included in the cost estimate is based on the contract requirements, the bond rules, premium rates, and, if known, the actual contractor bond cost. Performance and payment bonds are required for construction contracts of $150,000 or more (FAR 28.102-1). Payment bonds are required for construction contract values from $35,000 to $150,000 or some form of payment guarantee (FAR 28.101-1 and 28.101-2).

Performance bonds may not be required for construction contract values of less than $150,000. The cost of performance bonds, payment bonds, and other types of bonds determined to be appropriate by the cost engineer are allowable costs.

12-4 RULES GOVERNING THE APPLICATION OF BOND RATES.

Bonds are classified as Class A, Class B, or Class A-1, depending on the type of construction to be performed. If the contract is susceptible to two classifications, normally the higher rate is applicable. Bond rates tables are provide at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05.

12-4.1 Separate Contracts.

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's providing certain materials.

12-4.2 Subcontracts.

Subcontracts take the same classifications and rates as general contracts.

12-4.3 Non-Deviating States Exceeding 12 Months Stipulated Time.

For states in conformance (non-deviating) with the Surety Association of America (SAA) rates (Bond Rates Table) 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.

12-4.4 Non-Deviating States Exceeding 24 Months Stipulated Time.

For states in conformance (non-deviating) with the SAA rates (Bond Rates Table) 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.

12-4.5 Deviating States Exceeding Stipulated Time.

For states not conforming (deviating) with the SAA rates where the construction time exceeds the bond stipulated time of 12 months, add ½ 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.

12-4.6 Consent of the Surety 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.

12-4.7 Consent of the Surety 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's cost.

12-5 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.

The development of costs for surety bonds is to be in accordance with the design agency requirements.

12-5.1 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.

12-5.2 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.

12-5.3 Types and Classes of Bonds.

Contract Bonds Rate Classifications tables provided on https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 shows the various types and classes of bonds.

12-5.4 Calculation of Bond Premium Cost.

Figure12-1 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 20 months. From the Contract Bond Rates Classification tables, excavation is found in Class B. Referring to the Class B rate schedule in the Bond Rates table, 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:

Figure 12-1 Bond Premium Calculation

BOND PREMIUM CALCULATION					
Estimated Bond Amount x Rate = Premium					
First	$100,000	@	$25.00/M	=	$2,500
Next	$400,000	@	$15.00/M	=	$6,000
Next	$2,000,000	@	$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 mos x 1% x $28,500)		=	$2,280		
TOTAL PREMIUM		=	$30,780		

CHAPTER 13 OTHER COSTS

13-1 GENERAL.

This chapter provides guidance regarding other costs not specifically identified in previous chapters, but costs that must be included in the preparation of detailed project cost estimates.

13-2 CONTRACTOR COMPETITION AND MARKET ANALYSIS.

Each IGE for procurement will reflect the fair and reasonable cost for performing the scope specified. Although contractor bids will reflect the anticipated competitiveness, the IGE must remain the "yardstick" against which cost reasonableness is judged.

During development of the design-stage, market competitiveness may be considered for funding and design alternatives. When competition is included in the cost estimate, it must be clearly defined and documented in the BOE.

13-3 OTHER PROJECT COSTS.

13-3.1 Design Costs

Design costs for Design Build projects may not be included in the cost estimate for all agencies. Refer to cognizant design agency guidance for clarity.

13-3.1.1 SIOH.

An allowance or cost calculation for construction management is normally included in each Budgetary estimate. Budgetary estimates must include SIOH, a factor expressed as a percentage applied to the total of the construction contract including construction contingency. The rate of SIOH and its application is further discussed in the specific program regulation. The current cognizant design agency's authorized SIOH percentage for the continental United States (CONUS) and outside the continental United States (OCONUS) must be used.

13-3.1.2 Other Project Costs.

In order for a total project cost estimate to be prepared, other project costs identified in project requirements and per cognizant design agency guidance need to be estimated. These costs, such as as-built drawing preparation, O&M manual preparation, need to be identified and included as determined by the PM and specific program requirements.

13-4 COST ESCALATION.

Cost estimates, when finalized, must reflect cost escalation due to inflation. This cost escalation must be identified as a separate element within the cost estimate. This allows the cost engineer the ability to easily adjust the cost estimate to reflect schedule changes. The usual method of applying cost escalation is to use the midpoint of construction as the end date of the escalation.

13-4.1 Military Programs.

The Selling Price Index (SPI) will be used for bringing cost estimates from a historical date to the current date. The forecasted SPI is provided by Table 4.2 of UFC 3-701-01. Refer to cognizant design agency guidance for clarity.

13-5 CONTINGENCIES.

Contingencies are used to cover unknowns, unforeseen uncertainties, and unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared, but must be represented by a sufficient cost to cover the identified risks. Contingencies relate to a known and defined construction scope and are not a prediction of future construction scope or schedule changes. Contingency allocations are specifically related to the project uncertainties and are not to be reduced without appropriate supporting justification. Contingencies are normally separated into two elements - design contingencies and construction contingencies.

13-5.1 Design Contingencies.

Design contingencies are assigned to cover construction cost increases due to design incompleteness, detail changes, alternative design changes, and associated costing inaccuracy. Design contingencies are used to cover known costs that are not yet well-defined (or defined at all) in the design. Design contingencies will normally decrease, as design information becomes known. The magnitude of design contingency is determined by the level of technical complexity of the project for which the cost estimate is being prepared. Cost Engineers use experience and reliable data in order to make assumptions that will cover those costs until they are defined appropriately in the design documents.

13-5.2 Construction Contingencies.

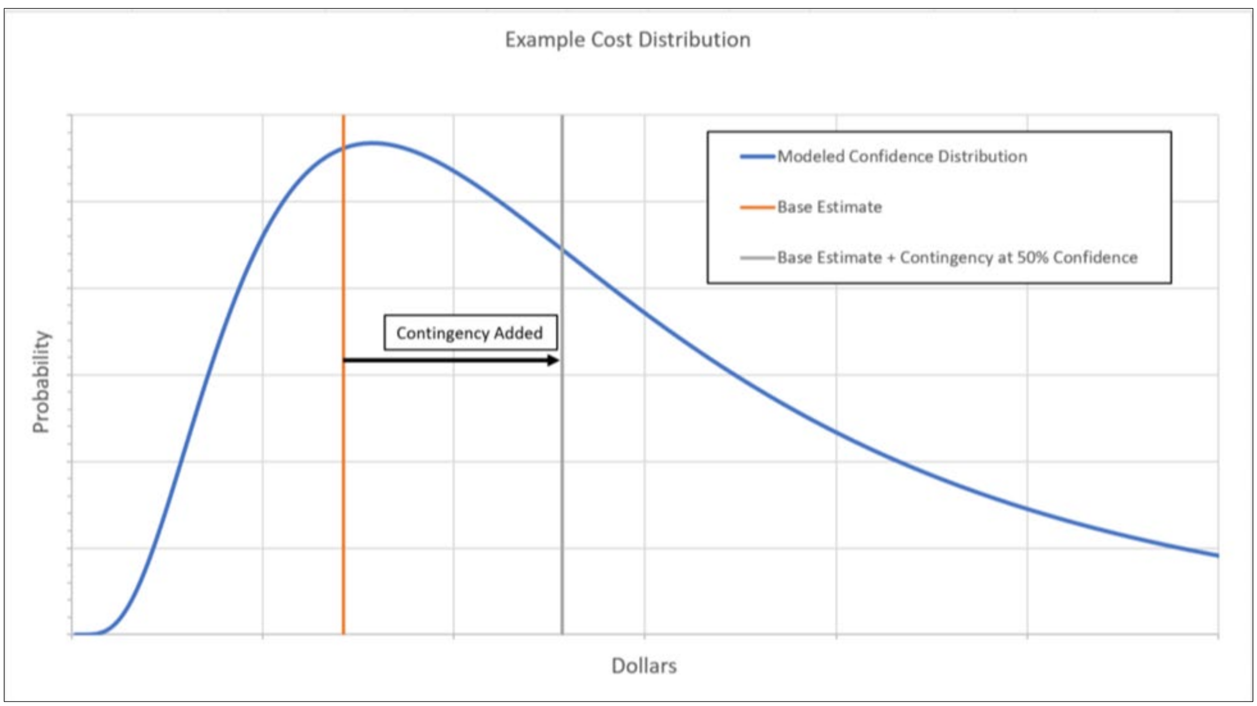
Construction contingencies are a reserve for construction cost increases due to adverse or unexpected conditions such as unforeseeable relocations; foundation conditions; utility lines in unknown locations; quantity overruns; or other unforeseen problems beyond interpretation at the time of or after contract award. Construction Contingency percentages for military projects may be applied in accordance with cognizant agency requirements.

CHAPTER 14 COST AND SCHEDULE RISK ANALYSIS

14-1 GENERAL.

Construction projects face uncertainties from design through construction that need to be addressed through risk management measures. Because the project scope definition is developed in an iterative fashion over time, the development of the associated cost and schedule for a project are based on iterative improvements in project scope definition. This iterative process drives the need for determining the appropriate contingency required at each cost and schedule estimate milestone for the uncertainties. The base estimate will reflect the anticipated value and the contingency will cover uncertainties for a total project cost and schedule or as defined by the cognizant agency procedures. The cost estimate can best be understood in the context of a range of possible cost (Figure 14-1). The contingency due to risks and unknowns will typically be highest at concept design and typically reduce over time as the scope matures and construction is completed. These considerations will minimize the likelihood that a project will experience funding-related issues. The iterative development of project scope definition gives rise to risks and opportunities that need to be managed.

Figure 14-1 Range of Cost



Cost and Schedule Risk Analysis (CSRA) is the process by which cost and schedule risks/opportunities are identified, documented, qualified, quantified and managed. Monte Carlo simulation is employed to determine the contingency needed to achieve any level of confidence. The output of the CSRA process includes a risk register and contingency models that provides a defensible contingency value.

The CSRA process was developed by the US Army Corps of Engineers in 2007 with the help of AACE and follows the best practices from range estimating techniques with adaptation to general DOD principles of cost estimating. Do not use “expected value” type modeling for construction risks.

The CSRA process provides many benefits, including:

- Communicating as a team regarding scope, status, cost, schedule and risk concerns
- Understanding the potential risks and opportunities that could impact the project
- Establishing contingencies supported by project team involvement and studies
- Defining and targeting high risk areas for management and risk reduction
- Realizing cost and schedule opportunities similar to the value engineering process
- Increasing the probability of successful completion of the project
- Understanding where the base estimate fall within possible ranges
- Informing decision makers by providing the context in which to consider a base estimate

The risk management process is incorporated as a risk management plan, (RMP) and included within the project management plan (PMP). The four main building blocks of the risk management process include:

- Risk Identification
- Risk Assessment
- Risk Response
- Risk Documentation

14-1.1 CSRA Stages.

CSRA is a dynamic, ongoing effort that can be useful at any given stage of project development and execution.

14-1.1.1 Budgeting.

The early stages of project development often focus on systemic risks. AACE Recommended Practice (RP) 10S-90 describes these types of risks as those that are artifacts of such things as an organization’s project system, strategy, or culture. Systemic risk are often understood well by the project team and even by some of the project’s stakeholders. Project specific risks must be considered at this level where available.

14-1.1.2 Design.

When the project team begins developing the project technical documents. Many if not most of the systemic risks will likely be mitigated or eliminated. At this stage systemic risks will typically give way to project-specific risks – those specific events, actions and other conditions associated with the project's scope (as per AACE RP 10S-90).

14-1.1.3 Construction.

The DOD Construction Agent (DCA) may choose to continue the use of the CSRA, developed in support of the IGE, as an in-house tool to assist the government's construction managers in tracking the project. This is not to be confused with the Contractor's own risk management tools. Any CSRA information developed in support of the IGE must not be disclosed to those without a need to know.

14-1.2 Terminology and Definitions.

It is helpful to consider the use of terminology in the context of the CSRA process. AACE RP 10S-90, Cost Engineering Terminology provides useful concepts for defining risks as used in this context:

- Allowance: A quantity of resources added to cost or schedule estimate to cover known but undefined requirements for specific items to be included in the cost or schedule.

- Confidence Interval: The probability that a specified range along the continuum of possible values will include the actual value of the quantity of resources being estimated.

- Confidence Level: The probability that the actual value of the quantity of resources being estimated is equal to or less than a specified point along the continuum of possible values.

- Contingency: A quantity of resources to be added to cost or schedule estimate to achieve a specified confidence level.

- Estimate: A prediction of the quantity of resources (material, labor, costs, time) required to achieve an agreed upon scope of work, at an agreed upon location, within an agreed upon period of performance. Note that cost and schedule are a type of estimate in this context.

- Risk: Any uncertain event that could affect a project objective or business goal such as cost, schedule or scope.

- Uncertainty: The total range of events that may arise and produce risks. These events are neither 0% nor 100% likely to occur. Risks may be favorable (opportunities) or unfavorable (threats). Considered collectively, Uncertainty = threats + opportunities.

14-2 RESPONSIBLITIES.

The CSRA requires the active participation of the project team. As members of the project team, the Cost Engineer and Risk Analyst play key roles in facilitating the process and in preparing the risk register, developing and running the risk models, and analyzing the results. However, the necessary familiarity with and detailed knowledge of the project resides with the PM and other project team members. In addition, the PM and other members project team also are in the best position not only to identify and qualitatively assess the risks, but they are also in a position to be able to provide potential risk mitigation measures.

14-2.1 Project Team.

The project team assists in identifying risk likelihood and their potential impacts to cost and schedule. The project team includes stakeholders that have knowledge of the project and critical responsibility for development and management of the total project. Project team members typically include representatives from but not limited to:

- Project and planning management
- Contracting and acquisition
- Real estate and relocations
- Environmental
- Technical design
- Cost estimators and schedulers
- Risk analyst
- Construction
- Operations
- Host installation public works personnel
- Sponsors
- Project End User

14-2.2 Project Manager (PM).

The PM is responsible for leading the project. Since CSRA is instrumental for successful project completion, the PM’s engagement is critical in the following tasks:

- Developing a PMP that addresses risk management, the CSRA requirements and its execution.
- Supporting the CSRA process related to budgeting, scheduling, and team formulation to accomplish the CSRA.
- Participation in the identification of risk mitigation measures.

- Monitoring and managing recognized risk events that may impact successful execution of the budget and schedule.
- Evaluating the need for follow-on CSRAs.
- Validate that the CSRA results are appropriately captured in the project cost and schedule estimate.

14-2.3 Cost Engineer/Risk Analyst.

The experienced cost engineer or seasoned risk analyst will perform key roles in the CSRA process. One individual may be responsible for both functions or if multiple individuals are involved then effective coordination is required.

A cost engineer is typically assigned the role as the risk analyst and many times serves as the CSRA meeting facilitator to lead the project team through the CSRA process i.e., project team discussions to develop the initial risk register and establish the resulting CSRA conclusions. A confident facilitator, knowledgeable with the type of project work, is needed to actively engage and encourage communication amongst the project team.

The cost engineer/risk analyst is tasked to lead the CSRA and report the results. Typically, a risk analyst is responsible for developing and running the CSRA models to develop project contingencies. Additional responsibilities include:

- Sharing the contents, assumptions, and accepted risks of the base estimate.
- Updating the cost estimate as information is gathered from the project team.
- Sharing the contents and assumptions of the schedule.
- Updating the schedule as information is gathered from the project team.
- Record/document team comments and determinations in the risk register.
- Leading the market analysis to quantitatively bracket the variances with regards to cost and schedule.
- Facilitating the identification of risk events.
- Facilitating the qualitative assessment of risk levels.
- Create, run, document and summarize cost and schedule risk models.
- Collaborating with the PM the results of the CSRA.
- Incorporate the contingency results from CSRA model into the total project cost and schedule.

14-3 SUPPORTING DOCUMENTATION.

Applicable documents recommended for the CSRA process and deliverables include*:

- Current project scope
- Quality base cost estimate excluding contingency
- Quality Basis of Estimate
- Quality base schedule estimate correlating with the project scope and base cost estimate
- Agency specific guidance
- Risk presentation to educate the project team
- Risk checklist presenting typical risks considered
- Risk register
- Cost and schedule risk templates/models
- A table of recommended risk mitigation measures for the project
- Report of the process, outcome, and recommendations

14-3.1 Tri-Service CSRA Template.

The Tri-Service CSRA template is located at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 and is to be used for MILCONs that require a CSRA. The CSRA Template is to be used unless otherwise approved by the cognizant design agency. The template includes several tabs that are summarized below:

- Tab A-Quick Instructions: Provides instructions on how to use the template.
- Tab B-Meeting Agenda: Provides a sample agenda for the initial risk discussion.
- Tab C-Risk Checklist (MILCON): Provides a sample risk checklist for common risk events related to MILCON projects. The checklist is not all-inclusive and risks are to be added as necessary.
- Tab D-Project Data: Input project details and scope of work.
- Tab E-Cost & Schedule Summary: Input base cost and schedule estimate.
- Tab F-Meeting Attendance: Input list of attendees from initial risk discussion.
- Tab G-Assumptions: Provides a summary of the risk range assumption development for qualitatively analyzing the risks.

- Tab H-Risk Register-Model: List identified risks associated with the project. Provide qualitative and quantitative analysis and run the model.
- Tab I-Project Contingency: Provides a summary of the model contingency results for cost and schedule.
- Tab J-Sensitivity Chart: Provides a summary of the risks sensitivity analysis.
- Tab K-Dashboard Template: Provides a summary of the model contingency results and a table to itemize risks used in the model and identify suggested risk reduction measures.

14-4 CSRA PROCESS.

CSRA uses risk identification processes common in the industry. It is a formally documented process of the project team's efforts, considerations, and concerns. The CSRA process combines two powerful risk-management tools, a well-developed risk register and an integrated cost/schedule risk analysis model.

The CSRA identifies risks including but not limited to variances in the base estimate, then qualitatively assesses the risk. It then quantifies the risks related to the project cost and schedule. This is accomplished through collaborative meetings. The results are expressed in terms of cost and schedule contingency amounts, which are measured in both dollars and time. It also expresses the level of confidence in the ability to successfully execute the project.

CSRA is an ongoing and iterative process. Risks are to be considered from budgeting to construction, maintaining a broad view of risks and opportunities avoids leaving many of them unidentified and unmanaged. As the project evolves, new risks may be identified and previously identified risks may be accepted into the project scope and cost and schedule estimate, mitigated or retired. The CSRA must reflect the latest project scope and base estimate. CSRA could be continued through design, procurement and post award. The CSRA should be updated at each submittal.

The outcome of the CSRA includes:

- A risk register including current and historical known risks, team discussions regarding those risks, and recommended actions necessary to manage, eliminate, reduce or plan for known risk events and opportunities. This is best accomplished through the use of a risk breakdown structure that categorizes risks consistently.
- A well-documented, tailored project cost contingency at various confidence levels.
- A well-documented tailored project schedule contingency at various confidence levels.
- Common understanding of the project and the scope.

14-4.1 CSRA Determination.

The Monte Carlo CSRA is recommended for projects that are large, complex, of long duration, or critical funding constraints. Regulations, policy and guidance play a large role in establishing mandatory CSRAs. The PM must follow their agency requirements, but also consider whether other project milestones warrant a CSRA update based on scope, cost, schedule, and risk changes. This is a critical step in quality project management processes. The PM may directly consult leadership, but generally the regulations and intent are fairly clear.

14-4.2 Preparation.

The cost and schedule estimate based on the current project scope are prepared to support the CSRA process as the base estimate and base schedule. The total project scope must be reflected within the two products. During the early stages of the project, the base estimate may not be available at the beginning of the CSRA process, but the risk identification may be started and later quantified once cost and schedule estimate are available. Care is to be taken when design contingency is applied within the base estimate and if the CSRA includes risks focused on incomplete design scope to avoid overstating contingency. A best practice would be to include design contingency at the system level within the base estimate and model the variation with the CSRA.

The PM typically establishes the project team. The project team is comprised of experienced members and project stake holders with knowledge of the project scope and criteria, potential risks, opportunities, and unknowns.

In preparation for the initial risk discussions that prepare the first risk register (the document used to support the CSRA), it is recommended that the Risk Analyst distribute to the project team a list of potential risks that are commonly encountered for MILCON projects. A sample risk checklist is available as part of the CSRA template. The sample risk checklist is not intended to be exhaustive but serve to stimulate the team in the brainstorming of each project's specific applicable risks. The project team is encouraged to examine lessons learned for inclusion in the risk checklist. After reviewing the checklist, the project team members will be better prepared to present their risk concerns at the brainstorming meeting where the risks are discussed and captured within the initial risk register.

14-4.3 Initial Risk Discussion.

The project team brainstorming session is the first step in developing the risk register that serves as the basis for the CSRA. In order to prepare the initial risk register supporting the CSRA, the following coordination steps are recommended.

14-4.3.1 Project Team Coordination and Assembly.

The PM coordinates the brainstorming session with the project team. This is the first meeting where the project team attempts to collectively capture the total project risks and place them into the risk register.

14-4.3.2 CSRA Presentation.

It is recommended that the designated facilitator begin with a CSRA presentation in order to explain the process and expected outcomes with the project team. A confident facilitator, knowledgeable with the type of work, is needed to actively engage and encourage discussion and communication among the project team members.

14-4.4 Project Scope and Cost Presentation.

Next, it is highly recommended that the PM or technical design lead and the lead cost engineer for the project present the project scope and related cost and schedule. The presentation includes the major construction features and assumptions in the design, base estimate, and schedule. Oftentimes it is discovered that the base estimate and assumptions do not match current understood scoping and construction elements. As a rule, well-defined scope is the critical element that then establishes the current cost and schedule estimate. Less defined scoping documents will generally lead to the development of more severe risks and higher contingency values. As scope is improved and more confident designs are developed, contingencies normally decrease. Risk analysis cannot overcome significant omissions or errors in scope of the project. If something significant is missing, the CSRA model may not provide an adequate contingency. It is also recommended that the risk analyst discuss the parameters related to likelihood of occurrence, cost impact ranges, and schedule impact ranges to better aide in risk identification.

14-4.5 Brainstorming Session.

The brainstorming session is the opportunity for the project team to qualitatively define the risk concerns, as well as potential opportunities. It is highly recommended that the brainstorming session include the major project team members because the dialogue between the members typically results in scope clarification or change, findings of new risks, and possible revision of the cost and schedule estimate. The potential variances to the base estimate that are identified in the brainstorming session are the basis for further study and modeling in the analysis. This stage is considered the qualitative stage that lacks the studies to establish cost and schedule impacts or variances. This period is more speculative, pre-study.

To guide the project team through the discussions, refer to the risk checklist for ideas. As previously mentioned, this list is not intended to be exhaustive. Each project team member is provided an opportunity to address their concerns. As concerns are discussed, the facilitator or risk analyst begins developing the initial risk register that supports the CSRA, capturing the project teams concerns and discussions. Like a value engineering study, any concern is valid, considered, and captured within the risk register—even lower risks, because they serve as record of discussion. This session can result in revised cost and schedule estimate.

Generally, the project team must address the key risks listed below:

- Potential scope growth

- Acquisition strategy
- Construction elements
- Design quantities
- Special fabrication and equipment
- Market/bidding conditions
- Escalation
- Cost estimate assumptions
- Schedule estimate assumptions
- External Risk
- Assumed Funding Strategy (MILCON, O&M, Other Appropriations)
- Design Confidence
- Project Management Plan (Pre & Post Design)
- Potential for unknown-unknown risks (risks unforeseen by the team that have an unknown likelihood of occurrence)
- Change management approach of the agency. Managing customer requested changes beyond the scope.
- Potential mitigation efforts for identified risks

14-4.6 Completing the Initial Risk Register.

A well-developed risk register captures the identified risks along with a qualitative risk assessment (in a range from “low risk” to “high risk”) that combines their probability of occurrence and their range of impact on project cost and schedule. It serves to document the risks considered throughout the design development (and potentially beyond), including mitigation measures.

Within the model, the risk register (Tab H) will serve as the basis for the CSRA model. When referring to the risk register, the project team focuses on the following fields:

- REF – Risk ID (typically numerical)
- Risk Type – Technical, External, etc. (drop down list)
- Risk/Opportunity – Event (simple clear title)
- Risk Event Description (clearly written specific concerns)
- PDT Discussion on Impact and Likelihood (decision justifying chosen risk levels)
- Project Cost: Likelihood, Impact, and Risk Level as a result.
- Project Schedule: Likelihood, Impact, and Risk Level as a result.
- Responsibility/POC

- Suggested Risk Reduction Measures

The project team attempts to capture concerns for project features, even if the risk level is considered low. The register serves as an archive of discussions and there is potential that those low-level risks may become higher following market studies, improved information being made available, or through time during the risk management and risk mitigation processes.

Within the risk register, the project team's concerns and discussions must be adequately and clearly captured because the logic presented in those discussions must support the "likelihood" and "impact" decisions reflected within the risk register. While this product is the initial risk register, it has already captured the project team's greater concerns. The project team can begin using this data to prepare for project risk management. The cost estimator/risk analyst is to send out a copy of the initial risk register to the project team to make sure their comments are adequately captured from the brainstorming session.

14-4.7 Modeling and Output.

The next steps in the CSRA process are to review the base estimate and schedule, conduct market research, develop and run the models, and analyze the model output. These steps are detailed in subsequent sections.

14-5 COST AND SCHEDULE ESTIMATE INDEPENDENT REVIEW AND ADJUSTEMENT.

The CSRA can begin before the cost and schedule estimate have received an adequate review, whether it is by QC check, agency technical review, or by external agencies. This may be a reasonable approach if the PM is keenly interested in quantifying the potential impacts from the established risk events. However, if later reviews determine that sufficient changes in the cost and schedule estimate are needed, the base estimate and CSRA may have to be adjusted prior to finalization of the analysis.

Once the initial risk register is complete, the PM and cost engineer, responsible for the cost and schedule estimate, must consider whether the base estimate truly represent the most likely project scope. Often times, project team discussions will present scope changes or processes that may impact the current cost and schedule estimate. There could be a different construction approach. There could be items such as revised productivity or crew makeup. Important assumptions and quantities may not yet be confident.

Other project team members may choose to revise their portions of the featured costs and schedules that reside within their area of responsibility. The cost engineer is responsible for the costs and schedules. Other project team members are responsible for the cost and schedule estimate of their project areas/efforts, such as project management, contract acquisition, design studies, construction management, etc. The PM must confirm from the project team whether these areas must be further developed or improved to reflect the most likely base estimate that serve as the basis for the market studies and the CSRA product.

14-6 MARKET ANALYSIS.

Once the initial risk register is completed and the project team is confident that the cost and schedule reflect the base estimate conditions, the initial risk register is ready for the risk analyst to begin the market analysis. Risks qualitatively determined to be medium to high will be moved forward for quantitative analysis. This classification is made using a likelihood vs impact matrix. It is recommended to carefully review the qualitative assessment of each risk to ensure that it is accurately characterized as only the moderate and high risks will move forward for Monte Carlo analysis in the risk model. Any risks misclassified are to be corrected in the risk register.

The market analysis supports the quantitative portion of the CSRA, establishing estimate values or ranges in cost and schedule impacts. It is intended to validate the presumed risk levels within the initial risk register for both cost and schedule. The market analysis will help establish the "most optimistic" (or "low variance"), and the "worst case" (also referred to as the "high variance"). These two data points or values will be used within the risk model to evaluate the range of costs and schedule from the base estimate. A key concept is that potential variances from the base estimate and schedule are studied. Risks that can be tied directly to base estimate and schedule are defined as the "likely" value as zero and model low, and high variance accordingly. For risks that do not have a direct link to the base estimate, define the three values (low variance, likely, high variance) according to market analysis.

The study and quantification of risks may require project team interviews, historical data research, internet searches, etc. Issues may include items such as real estate fluctuations, land acquisition and easements, construction productivity concerns, fuel pricing, construction modifications, specialized equipment and material availability, local labor resources and rates, potential scope growth, bidding competition, effects resulting from the acquisition strategy, economic trends, etc.

14-7 FINALIZING THE RISK REGISTER.

This section describes the completion of the risk register for the current submittal. A logical flow must occur between risk events, concerns, discussions, and reasoning for the chosen likelihood and impact values that result in the risk level of low-moderate-high.

To finalize the risk register, market analysis may result in revising the risk register as needed. Refinement may reveal similar risk events that could be duplicates or double-counted as a risk impact. It may result in adding risk/opportunity events not previously captured. It may result in revising the "likelihood" and "impact" values to support a revised risk level that reflects the research findings. If the likelihood and impact values is revised, the project team concerns and discussions may have to be reevaluated to ensure that they logically support the revised risk register. The final risk register must reflect the correct final risk classification of low, medium, or high based on the revised "likelihood" and "impact".

The market analysis will enable the risk analyst to complete the risk model fields:

- Cost Impacts
- Cost Variations (low variance, likely, and high variance)
- Schedule Impacts
- Schedule Variations (low, likeliest and high)
- Correlation of Risks to One Another
- Cost Impacts due to Schedule Variations

The model focuses on certain risk register categories and the market analysis values related to low, likeliest, and high. The entire risk register can be included in the model; however, it can be cumbersome when producing paper documents and reports. The key risk register fields required to be completed are:

- REF (Risk number)
- Risk Type
- Risk/Opportunity Event
- Risk Event Description
- Likelihood-Impact-Risk level (Cost and Schedule)
- Variance Distribution (Cost and Schedule)
- Risk Correlation to Other(s)
- Suggested Risk Reduction Measures
- Cost and Schedule Variances (Low, likeliest, high)

14-7.1 Cost Impacts and Distribution.

The market analysis will help establish the input probability distribution parameters (low, likeliest and high values). These parameters may be used within the risk model to determine the input probability distribution. The impacts can be indicated in dollars or percent.

14-7.2 Schedule Impacts and Distribution.

The market analysis will help establish the input probability distribution parameters (low, likeliest and high values). These parameters may be used within the risk model to determine the input probability distribution. The impacts can be indicated in months or percent. Additionally in investigating the schedule risks often these risks will imply an additional cost may be incurred due to the schedule risk. In the recommended standard template there is to be a separate group of columns to include/model any specific risks due to schedule. This technique allows the cost due to schedule risks to be modeled. These risks sum into the overall cost risk forecast in the template. In general, most schedule risks will have some cost risk such as but not limited to time related cost impacts such as extended Field Office Overhead, support crews, and special monitoring. Often this cost risk is below the threshold for modeling and is evaluated case by case.

14-7.3 Correlations.

Many times risk events have a correlation or relationship to one another. A positive correlation occurs when one risk goes higher and the other must also go higher. A negative or adverse correlation occurs when one risk increases and the other risk must decrease. To complete the risk register, note the assumed correlations and include in the model development. When preparing the model, it is highly recommended to review correlations before running the risk model because they may significantly alter the output. Many times assumed correlations are actually restatements of the same risk and are best combined into one variable.

14-7.4 Risk Register Quality Control Check.

Upon completion of the market analysis, the cost engineer/risk analyst completes the risk register, confident that the:

- Project team risk/opportunity events are adequately captured/conveyed
- Project team discussions support the “likelihood” and “impact” decisions especially after updating cost or schedule impacts from modeling because it could change your impact rating.
- Market analysis supports the risk level assigned
- Current cost and schedule estimate serve as the base estimate for the CSRA
- Correlations and event duplication are minimized and addressed
- Market analysis adequately defines the cost and schedule variations

14-8 COST AND SCHEDULE RISK MODEL DEVELOPMENT.

The integrated cost/schedule risk model is developed by the cost engineer or risk analyst experienced with the CSRA process. The model includes the key risk drivers and a Monte Carlo computer simulation tool is utilized to produce the probability distribution of likely cost and schedule variances. These then become the basis for developing contingencies required to provide a given level of confidence. Cost and schedule processes are separated since each requires a separate analysis - though the results of each may impact each other. On larger projects, the CSRA process may require additional members to study the initial risk register, evaluate the concerns captured within the brainstorming session(s), perform market analysis of those risk events, and validate whether the project team’s risk level assignments are accurate.

14-8.1 Risk Model Template.

The risk model utilizes the risk register as its basis within the spreadsheet format. The cost engineer/risk analyst and the project team must determine the best modeling method that provides adequate model output for the project. The result is a customized model specifically related to the project. The final product must present contingencies in the desired format for the total project cost and schedule. For example, CSRAs can be performed on each contract (assuming several contracts), on assumed funding cycles, on each project feature, or on the total project. The use of the standard risk model template is recommended as it provides a common platform for development, review, analysis and future data collection efforts.

14-8.1.1 Establishing the Risk Events for Study.

The CSRA process relies on the Pareto Principle that in construction projects 20% of the risks will cause 80% of the impacts. This is akin to the "Few Risk Items" approach outlined in the current DOD Joint Cost Schedule Risk and Uncertainty Handbook. Practice has shown that risk events evaluated as having lower than a moderate level of risk have a negligible impact on CSRA results and are therefore not considered to be materially beneficial to the process.

It is recommended that moderate and high-risk events be further studied and included in the model. Large and complicated projects may have considerably more identified risks meeting the threshold for modeling. Identified risks are examined to make certain of their overall risk rating. Often events may be qualitatively assessed in error by the team and a small effort of further study could indicate it is overall a low risk (not modeled) or a moderate to high risk (included in the model). If the risk analysis later determines a risk was either not identified or was not qualitatively assessed correctly by the team it is added/noted in the risk register and the proper classification entered to ensure the model and the risk register match.

The risk register depicts only the risk events under study; however, the cost engineer/risk analyst documents identified risk events within the model, simply indicating that the risk is not modeled and is not assigned a variance distribution.

14-8.1.2 Incorporating Market Analysis into Model.

Once the determination of which risk events will be incorporated into the model has been completed, the market analysis findings can be added. Values are then input into the model to support the variance distribution. When assigning the distributions, the likeliest value must be a hard value with no equations or links to other data. Remember that the likeliest value is generally be zero indicating that the base estimate value is the likeliest value for this model. If the likeliest value is nonzero this can indicate that the base estimate may be deficient in the costing/duration of this variable. It is recommended to correct deficiencies in the base estimate prior to modeling the project.

14-8.1.3 Establishing Variance Distribution.

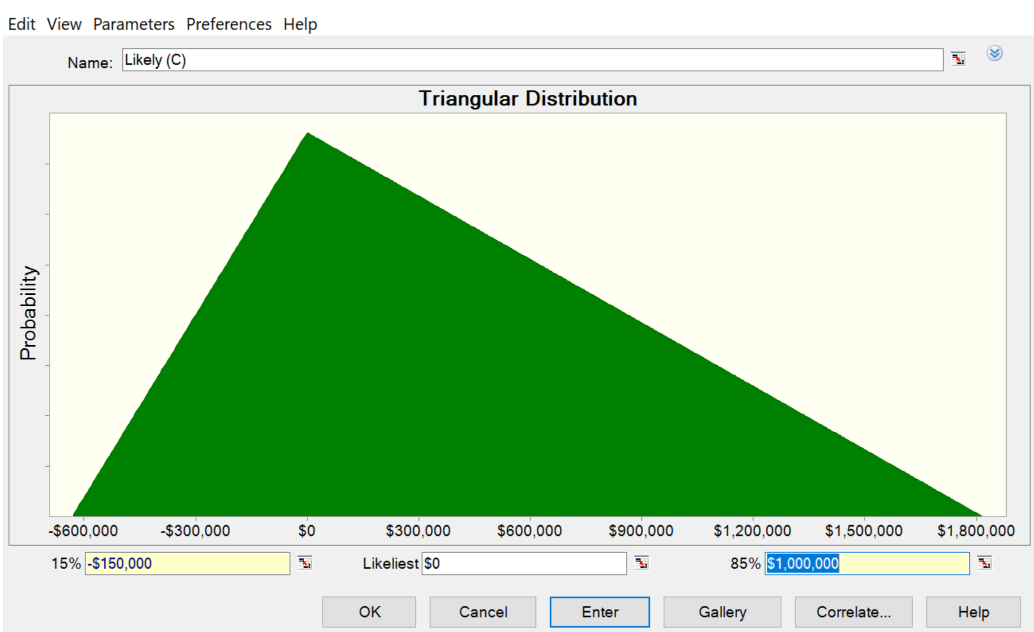
The variance distribution within the model must only address those risk events under study. The value in the base estimate establishes what is most likely to occur and the risk study is based on how the cost/duration within the estimate could vary. Most risks in the model will have zero for the likeliest value.

Within the model, the distribution gallery provides more than 20 diagrams or distribution choices that can represent the market analysis data related to low, likeliest and high value. The most commonly utilized distributions are the triangular and the uniform distributions. Other distributions may better address certain risks where better data exists and considered more appropriate. This is very rarely the case.

When modeling assumptions (risks) within the model, for each assumption (risk event), the cost engineer/risk analyst must properly name the risk event, enter the low, likeliest (usually zero), and high values and address any correlations, both positive and negative, between the respective risk events.

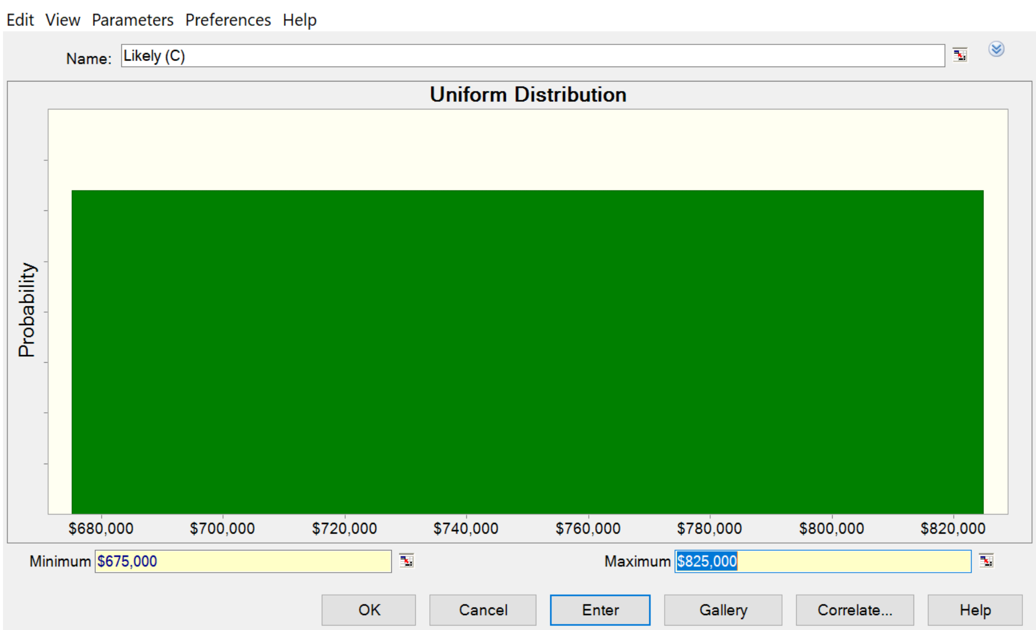
The triangular distribution (Figure 14-2) is commonly used for construction. The cost or schedule estimate generally will have likeliest value and the ranges of low and high values that are determined by market analysis. This distribution is recommended for the risk events that impact specific areas or details of the cost or schedule estimate. It is recommended to set the default parameters to low, likeliest (typically 0), and high value. It is also recommended and a GAO best practice that the low value be set to the 15^{th} percentile and the high value be set at the 85th percentile when utilizing the triangular distribution. Lessons learned indicate that often the teams are too optimistic in the high value and underestimate the high value of the risk. There is research that shows that even the most experienced subject matter experts' opinion on the impact rarely if ever exceeds the 85th percentile.

Figure 14-2 Example of Triangular Distribution



The uniform distribution (Figure 14-3) is used when any value between the low and high value is equally likely to occur. In these instances, only two points are needed, the low and high value. A second variable of Probability of Occurrence could be added to the equation for events with discrete causal effect such as a storm or overtopping event. Caution must be exercised to use this approach to ensure the modeling is correct. Often a triangular distribution may be more appropriate.

Figure 14-3 Example of Uniform Distribution



14-8.1.4 Forecast.

The input risk distributions are used by the model to develop the forecast. The cost engineer/risk analyst needs to understand what the summation of the assumption represents. Simply summing the assumption cells and creating a forecast on a formula cell will yield the variance of the model. The creation of confidence tables and charts are not an automatic function but instead are created using the outputs of the forecast cell.

The cost engineer/risk analyst must set the model parameters related to desired reports, decision variables, defining the forecast, establishing precisions, etc. Once the model includes the risk events under study, distribution variances have been assigned, duplications and correlations have been addressed, and the base estimate captured, the cost engineer/risk analyst is ready for the initial model run.

14-8.1.5 Model Execution and Evaluation.

By this time, the cost engineer/risk analyst has a feel for the quality of the scope, base estimate, and market analysis. It will be of value when reviewing the initial output data. The cost engineer/risk analyst evaluates the initial reports, reviewing areas of potential conflict or inaccuracy. Even if the contingency values appear reasonable, a QC check must still be performed.

Generally, several iterations will be performed as the model is studied for logic, assumptions, and values. Through several iterations, the model is corrected and improved; however, care must be taken to ensure the model is not arbitrarily adjusted to present preferred results. Ultimately, the final product and report must reflect logic and pass the scrutiny of independent review.

14-8.1.6 Model Results Quality Control (QC).

A QC is required to validate reasonableness after the initial model/first trial has been run. Contingency calculations may seem too low or too high, based on the cost engineer/risk analyst's knowledge of the scope and cost and schedule estimate quality. If the contingency data falls significantly outside the anticipated range, there may be errors within the model, the base estimate, or market analysis. Within the sensitivity chart (Figure 14-5), the order of high-risk events may seem unlikely or out of expected order.

Common mistakes include:

- Poor project scoping. Risk analysis cannot overcome significant omissions or errors in scope of the project. If something significant is missing, the CSRA may not provide an adequate contingency.

- Base estimate is too optimistic or too conservative. A conservative base estimate could result in the outcome of negative contingency or an optimistic base estimate could result in the base estimate falling below zero percentage of occurrence.

- Double counting of risks - There may be similar risk events that are listed separately within the risk register, thereby measuring the risk twice. This is especially common on schedule risks since some activities may be on the same critical path and one risk event could help mitigate another.

- Omissions of risks- There may be critical risks absent from the modeling, especially external risks.

- Risk Mitigation measures assumed to be 100% effective prior to execution and or no consideration for second and third order effects of mitigation. The second and even third level effects of risk mitigation could be more severe than the original perceived risk.

The initial output may cause a change in the risk discussions on the risk register. The discussions are to be clear and explain the logic for the chosen likelihood and impact values.

Failure to update the project CWE with the correct risk percentage or amount to show the project's overall total cost correctly will have an impact on the fixed rate costs such as SIOH that grow linearly with the construction cost.

14-8.1.7 Risk Model Output.

There are numerous model outputs that are helpful in presenting data as well as supporting the CSRA report. While not all are portrayed in this document, the more common figures used to support the final report are presented in the following paragraphs. This data is obtained from the output after the risk simulation is run.

14-8.1.7.1 Sensitivity Chart.

The sensitivity chart (Figure 14-4 and Figure 14-5) ranks risk events by way of variability. It is similar to a tornado chart, but a tornado chart does not include any effects of modeling and simply shows the absolute value of the ranges of the modeled variables from highest to lowest. These charts can be very misleading as to the true contribution of contingency to the project. The risks with the largest ranges of cost or schedule typically show up at the top of the chart. This may or may not indicate their actual contribution to project contingency. High cost or time impacts with small ranges of variance can contribute substantially to the overall contingency but may not show up on the sensitivity chart. For example consider the following two risk events:

Risk 1. A risk with a low of -$4M(savings), a likely of $0, and a high of $4M (cost increase has a variance of $8M).

Risk 2. It is determined that most likely an event of $5M is missing from the base estimate, and it is added to the risk analysis with a low of $5M, a likely of $5M, and a high value of $6M.

From a sensitivity analysis point, Risk 1 has an $8M range and will show higher than Risk 2 ($1M range) on the sensitivity chart. Understanding and analysis of the model is required to determine the truly critical risk drivers that need to be addressed. It is recommended to compare the sensitivity results to a sorting of the risks based on the likely and high-risk values for comparison to identify additional critical risks beyond the sensitivity analysis. This is often referred to as a "Pareto ranking." Sensitivity analysis alone is not adequate for the ranking of risks in priority and the cost engineer/risk analyst must examine the risks, effects of modeling, and communicate the key risk drivers within the analysis.

Figure 14-4 Sensitivity Chart for Cost

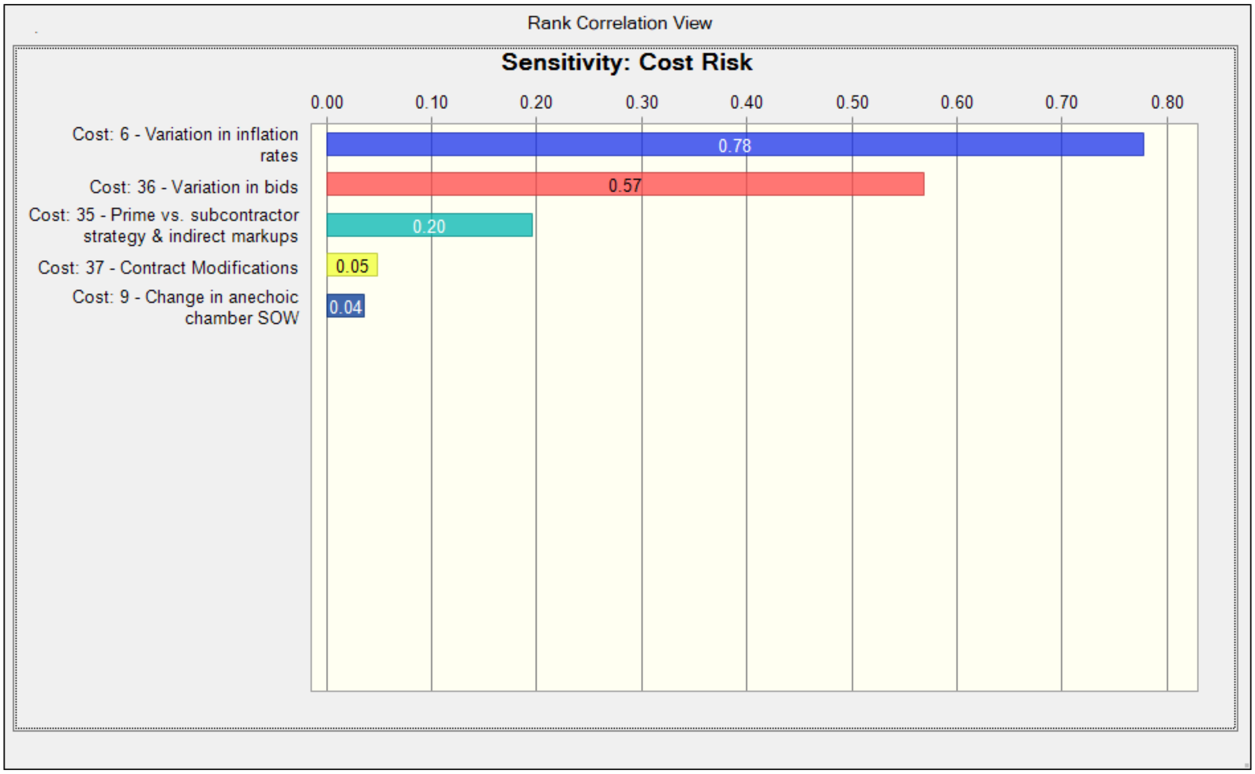
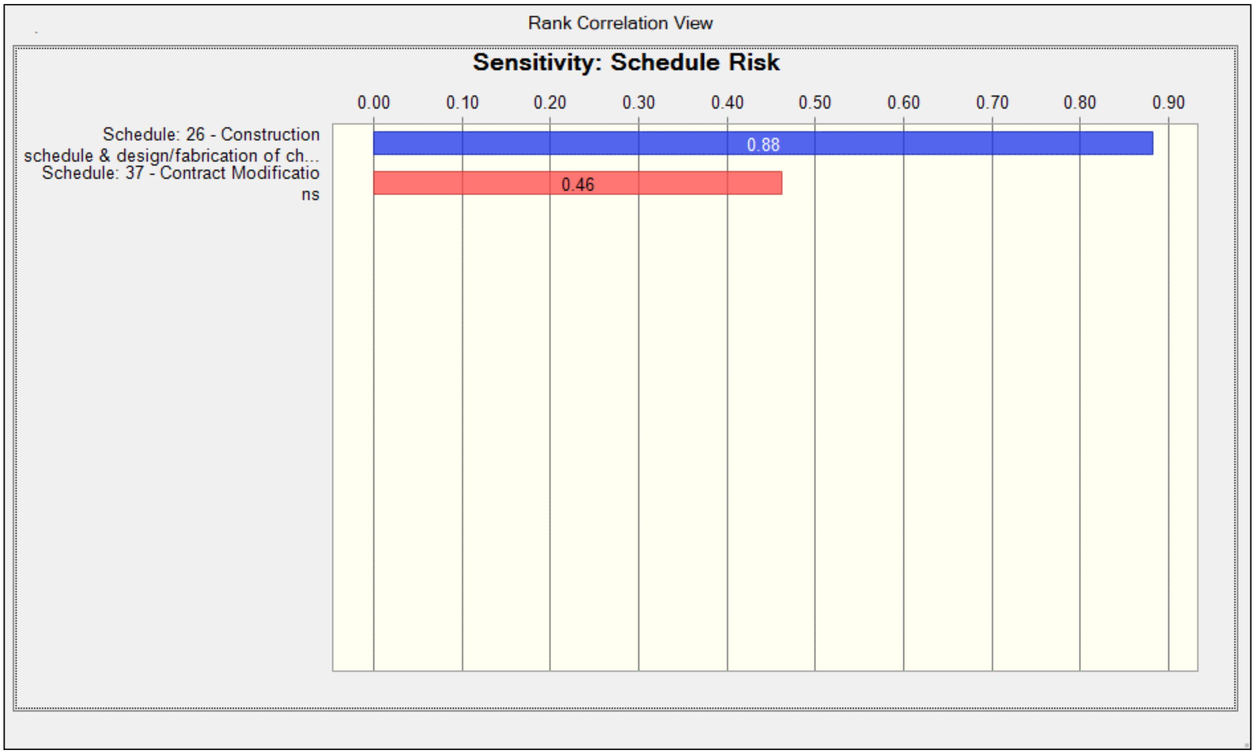


Figure 14-5 Sensitivity Chart for Schedule



14-8.1.7.2 Contingency Analysis.

A contingency analysis is measured against the base estimate and schedule in dollars and months. The model output creates tables and figures summarizing the cost and schedule values with associated confidence level for successful project execution. It can be presented in tabular form and graphically as a confidence curve. Each agency is left to decide what confidence level they will use. It is recommended that the project contingencies be presented with confidence levels and associated contingencies in 5-10 percent confidence increments from 0-100%. Events to consider in the confidence level chosen could be life safety, project complexity, national priority, project status, and likelihood of mitigating risks. In any case, the chosen value is justified within the CSRA and main reports.

Tables 14-1, 14-2 and 14-3, and Figures 14-6 and 14-7 are an example of the final CSRA outputs.

Table 14-1 Contingency Analysis Output for Cost

Base Estimate ->	$30,889,900	
Confidence Level	Contingency Value	Contingency
0%	-4,942,384	-16%
10%	617,798	2%
20%	1,853,394	6%
30%	2,780,091	9%
40%	3,706,788	12%
50%	**4,633,485**	**15%**
60%	5,560,182	18%
70%	6,486,879	21%
80%	7,722,475	25%
90%	9,266,970	30%
100%	15,444,950	50%

Figure 14-6 Cost Contingency Analysis

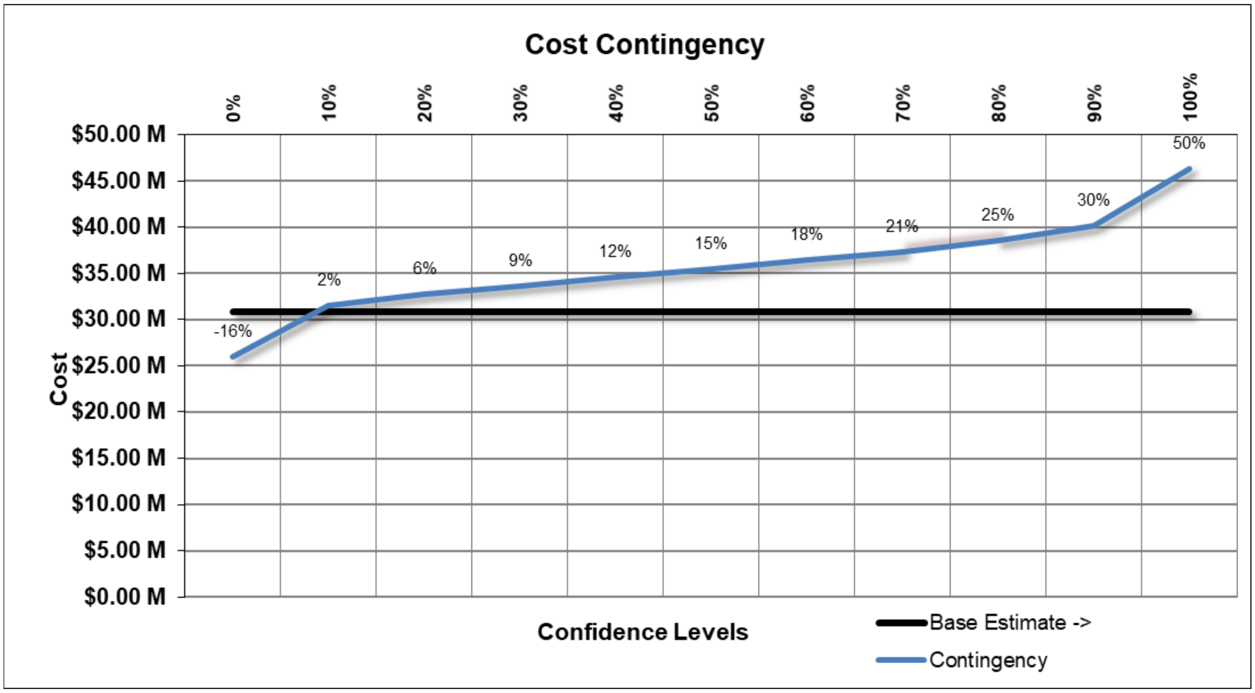


Table 14-2 Contingency Analysis Output for Schedule

Base Schedule Duration ->	53.0 Months	
Confidence Level	**Contingency Value**	**Contingency**
0%	0.5 Months	1%
10%	1.1 Months	2%
20%	1.6 Months	3%
30%	2.1 Months	4%
40%	2.6 Months	5%
50%	**2.6 Months**	**5%**
60%	3.2 Months	6%
70%	3.7 Months	7%
80%	4.2 Months	8%
90%	4.8 Months	9%
100%	6.9 Months	13%

Figure 14-7 Schedule Contingency Analysis

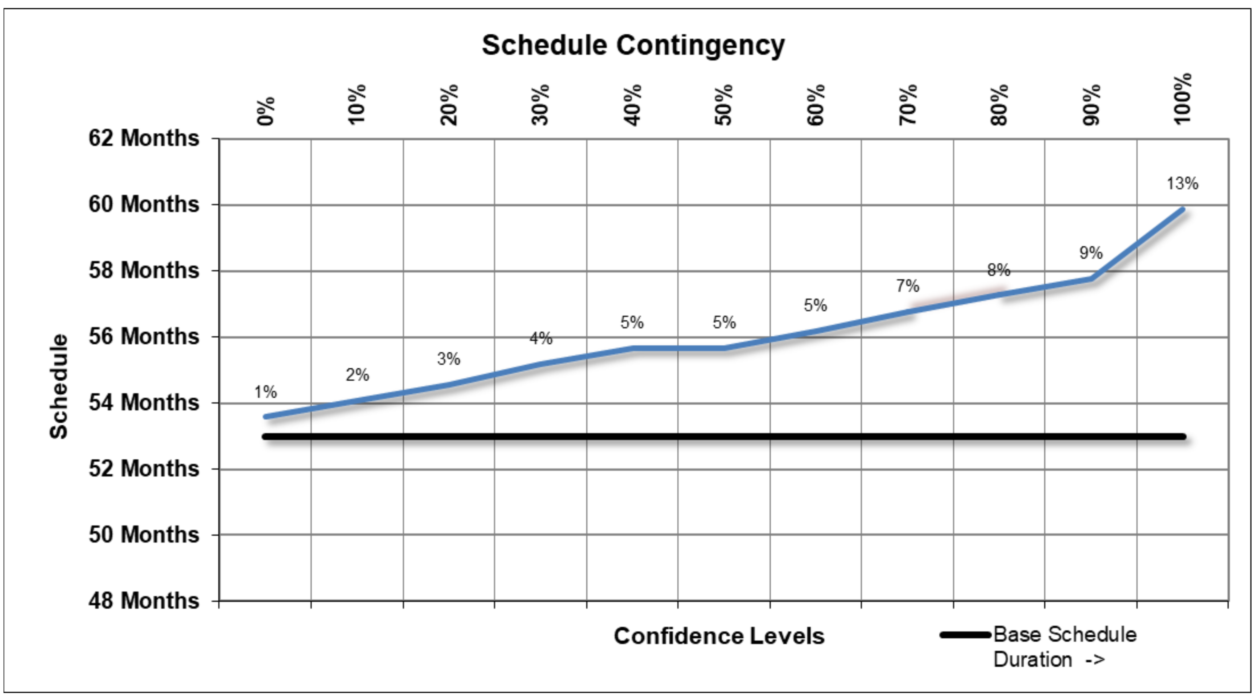


Table 14-3 Contingency Analysis Output for Cost and Schedule

Contingency on Base Estimate	50% Confidence Project Cost	
Base Estimate ->	$30,889,900	
Estimate Contingency ->	$4,633,485	15%
Base Estimate w/ Contingency (50% Confidence) ->	$35,523,385	

Contingency on Base Schedule	50% Confidence Project Schedule	
Base Schedule Start Date ->	October 1, 2021	
Base Schedule Finish Date ->	March 1, 2026	
Base Schedule Duration ->	53.0 Months	
Schedule Contingency Duration ->	2.6 Months	5%
Base Schedule w/ Contingency (50% Confidence) ->	55.6 Months	
Base Finish Date w/ Contingency (50% Confidence) ->	May 22, 2026	

14-9 CSRA DELIVERABLES.

Finally, the CSRA results are included within a report (A sample CSRA report is available on https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05). The CSRA report can be added to the cost report or it can remain a standalone report. The report is a result focused document and not include common methodology/process related discussion on CSRA. These deliverables are to be updated at each submittal as required by the inclusion of CSRA.

Include the following:

- Title page with project name, date, and author
- Executive Summary with the following points: project scope, key assumptions, major findings, observations and risk reduction recommendations.
- Tab K- Dashboard Template from CSRA model
- CSRA Model Excel file

CHAPTER 15 SENSITIVITY ANALYSIS

15-1 GENERAL.

As a best practice, a sensitivity analysis should be included in cost estimates because it examines the effects of changing cost estimate inputs, or parameters, and underlying assumptions. Sensitivity analysis involves recalculating the cost estimate with different quantitative values for selected inputs to compare the results with the original cost estimate. If a small change in the value of a factor yields a large change in the overall cost estimate, the results are considered sensitive to that factor.

Typically performed on high-cost and high-risk elements, sensitivity analysis examines how the cost estimate is affected by a change in a parameter or assumption. For example, it might evaluate how the point estimate varies with different assumptions about system reliability values, or how costs vary in response to system weight growth.

15-2 PROCESS STEPS.

For sensitivity analysis to reveal how the cost estimate is affected by a change in a single parameter or assumption, the cost estimator must examine the effect of changing one factor at a time while holding all others constant. This allows for an understanding of which factor most affects the cost estimate. By examining each factor independently, the cost estimator can evaluate the results to discover which parameters or assumptions most influence the cost estimate.

A valid sensitivity analysis typically has five steps:

1. Identify assumptions and parameters, including key cost drivers, as factors for sensitivity testing
2. Re-estimate the total cost of the program by varying one of these factors between two set amounts
3. Document the results
4. Repeat steps 2 and 3 until factors identified in step 1 have been tested independently
5. Evaluate the results to determine which factors affect the cost estimate most and document the results

15-3 IDENTIFY FACTORS.

The first step of a sensitivity analysis requires analysts to identify the factors to be varied. The sources of variation are to be well documented and traceable. Simply varying factors by a subjective plus or minus percentage is not useful and does not constitute a valid sensitivity analysis.

Uncertainty about the values of some, if not most, of the technical parameters is common early in a program’s design and development. Many assumptions made at the start of a program turn out to be inaccurate. Therefore, once the point estimate has been developed, it is important to determine how sensitive the total cost estimate is to changes in the factors. Some factors that are often varied in a sensitivity analysis are:

- Variations in specific material pricing
- Labor Rates of specific trade
- Escalation rates

In a sensitivity analysis, the cost estimator includes the factors that are most likely to change, such as an assumption that was made for lack of knowledge or one that is outside the project team's control.

Another method for identifying parameters is to examine artifacts from related analyses, such as cost and schedule risk analysis. One such artifact is a tornado chart, a special type of bar chart that shows which parameters have the greatest effect—positive or negative—on the overall point estimate.

Determining which parameters are key cost drivers can be done in several ways. One way to determine key cost drivers is to calculate the proportion of each cost element to the total cost. Those input variables affecting the highest proportion cost elements are varied in a sensitivity analysis. However, analysts may want to consider the parameters contributing to high-risk cost elements as well, even if they are not cost drivers, because these elements may become schedule drivers.

15-4 LIMITATIONS.

A sensitivity analysis reveals critical factors that most affect the cost estimate results and can sometimes yield surprises. Therefore, the value of sensitivity analysis to decision-makers lies in the additional information and understanding it brings.

However, sensitivity analysis does not yield a comprehensive sense of the overall possible range of the cost estimate. Rather, it examines only the effect of changing one factor at a time. In some cases, a sensitivity analysis can be conducted to examine the effect of multiple factors changing in relation to a specific scenario. But the risk of several factors varying simultaneously and the effect on the overall point estimate should be understood. Whether the analysis is performed on only one cost driver or several within a single scenario, sensitivity analysis tries to isolate the effects of changing one variable at a time, while risk and uncertainty analysis examines the effects of many variables changing at once.

CHAPTER 16 COMPETED PROCUREMENTS

16-1 GENERAL.

FAR 36.203 requires an IGE for contracts in excess of the Simplified Acquisition Threshold.

16-2 DIRECTIVES.

Those responsible for the preparation of IGEs for contracts should be thoroughly familiar with the requirements set forth in FAR, DFARS, their supplements, and per guidance of the cognizant design agency. The acronyms for the Federal Acquisition Regulations are listed in the Glossary.

16-3 SEALED BID ABSTRACTS.

A bid/proposal abstract are prepared on invitation for bid (IFB) procurements. The bid/proposal abstract is simply a table comparing each bidders/proposers pricing vs the IGE. An analysis is performed on the bid/proposal abstracts by the cost engineer.

16-4 PRICE ANALYSIS.

The cost engineer who prepared the IGE should be a member of the Price Evaluation Team (PET) for RFP's. A price analysis is to be developed by the PET on RFP competed procurements. The price analysis will compare the bottom line cost of each offer with the market average and IGE to provide the PET's evaluation of reasonableness. The PET notes in the price evaluation any unbalanced contract line item numbers (CLIN's) that may be considered detrimental to the government.

16-5 COST ANALYSIS.

The cost engineer who prepared the IGE should perform the cost analysis for RFP's. The cost analysis includes a technical reviewer who was part of the scoping team. A cost analysis is developed on non-competed procurements as well as on cost reimbursable procurements. For firm fixed price non-competed contracts, the cost analysis will compare individual aspects of the proposal to the IGE including labor, equipment, materials, and other markups and costs to evaluate reasonableness. For cost reimbursable projects, a cost realism analysis will determine the probable cost for each proposal given the proposal technical approach and the elemental costs of labor, material, equipment, and other markups and costs.

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CHAPTER 17 CONTRACT MODIFICATIONS AND OTHER NEGOTIATED PROCUREMENTS

17-1 GENERAL.

FAR Subpart 36.203 requires an IGE for modifications in excess of the Simplified Acquisition Threshold. IGEs are required for unilateral modifications. For contract modifications, the amount refers to the sum of the absolute value of increases and decreases. For example, if the SAT is $250,000 a modification containing an increase of $160,000 and decrease of $145,000 has an absolute value of $305,000, and therefore an IGE will be required.

17-2 DIRECTIVES.

Those responsible for the preparation of IGEs for contract modifications should be thoroughly familiar with the requirements set forth in FAR, DFARS, their supplements, and per guidance of the cognizant design agency. The acronyms for the Federal Acquisition Regulations are listed in the Glossary.

17-3 NEGOTIATED PROCUREMENTS AND CONTRACT MODIFICATIONS.

The cost engineer has several important tasks to perform prior to actually preparing the IGE. Some of the major activities to be considered in preparing the IGE are technical and cost analysis in addition to labor, material, equipment and construction techniques include:

17-3.1 Review of Available Documents.

Reviewing available documents and becoming thoroughly familiar with the scope and requirements of the changed work. This will perhaps entail a 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 or procurement action is clearly defined with regard to specified work requirements, proposed measurement, and payment.

17-3.2 Determine Status of Construction.

Determining the status of construction and how the changed work will impact the construction schedule. This will require obtaining progress reports, schedules, and discussion with the field office responsible for the construction. For major or complex changes, a visit to the construction site is required.

17-3.3 Contractor’s Existing Methods, Capabilities and Rates.

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

17-3.4 Current Labor and Equipment Rates.

The cost engineer must obtain current labor and equipment rates for the work force and work actually ongoing. These rates are usually available from labor reports or from the contractor upon request. Suppliers for materials are not to be contacted for quotes. The price, which the contractor is expected to pay, is the basis for estimating material costs. A list of equipment on the job is to be obtained and equipment rates determined in accordance with EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule for owned equipment. If rental equipment is being used onsite, contact the equipment supplier for current rental rates.

17-4 PREPARATION OF COST ESTIMATES FOR NEGOTIATION.

The cost estimate can be prepared after the information has been collected and analyzed, and the cost engineer decides upon the format to present the change. 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 take-off and a detailed cost estimate supported by accurate cost data for each element. General guidance for the calculation of direct costs is as follows:

17-4.1 Additional Work.

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

17-4.2 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 is to be priced at the rates, which 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 maintain a comparable scope of work for both cost 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.

17-4.3 Deleted Work.

For deleted work, the item and format is priced similar to a new procurement as performed by the current contractor. Current labor, equipment, and material rates at the time of the modification are to be used instead of rates used in the contractor's original bid/proposal or original IGE. In addition to the direct cost of the work, overhead, profit, and bond costs are included for credit on the deleted work.

17-4.4 Impact Related Costs.

Impact related costs, if applicable, are clearly described and included as a part of each cost estimate.

17-4.5 Detail of Cost Estimate.

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

17-5 COST CONSIDERATIONS.

The cost 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, which may not be released.

17-6 TIMELINESS OF PREPARATION.

Timeliness of the cost estimate for modification is as important as its accuracy. Procurement requirements stress the importance of settlement prior to commencing the work. 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 cost 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.

17-7 IMPACT COSTS.

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. The impact portion of a modification is very important to be estimated accurately. 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.

17-7.1 Acceleration or Delay.

Generally, the greatest portion of impact costs results from acceleration 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 Clauses and on Board of Contract Appeals and court decisions.

17-7.2 Comparative Review.

Impact costs are generally presented by the contractor 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 indicates those areas, which have been affected by the modification.

17-7.3 Factual or Judgmental Costs.

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 those, which are dependent on variable factors such as performance, efficiency, or methodology and cannot be stated factually prior to actual accomplishment. These must be negotiated and based upon experienced judgments. In actual practice, most factual costs are based to varying degrees upon judgment.

17-7.4 Cost of Impact.

The cost estimate of impact is to 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 cost 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.

17-7.5 Impact Factors or Conditions.

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

17-7.5.1 Factual.

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

17-7.5.2 Judgmental.

Impact costs considered judgmental include change of efficiency resulting from rescheduling; loss of labor efficiency resulting from longer work 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, and sample materials; additional costs resulting from inability to transfer manpower expertise to other work; and change in management for the revised work.

17-7.5.3 Factual Based on Judgmental.

Impact costs considered factual but are based on judgmental decisions including 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 or use; increase from a longer period of utilizing overhead personnel, materials, and utilities; and increase from a longer period of providing overhead and project office services.

17-8 SUPPORT FOR THE NEGOTIATIONS.

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.

17-8.1 Review for Allowability.

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.

17-8.2 Settlement of Disputed Work Items.

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 IGE to lay open upon the negotiation table. During negotiations the IGE including backup support is considered CUI and protected accordingly.

17-8.3 Technical Evaluation.

A technical analysis, as performed by the technical team, is the evaluation of the contractor's proposal for scope differences from the IGE. The technical evaluation also may include questions asked during negotiations. This performed prior to negotiations will help expedite the negotiation process.

17-8.4 Teaming with Negotiator.

The cost engineer should be on the negotiation team. As a team member working with the negotiator, coordinate with the contractor to agree on scope of work and format prior to preparation of the IGE and submittal of the contractor's proposal. This discussion will assist both the Government and contractor in reaching a mutually accepted scope of work to eliminate unnecessary effort for both parties during negotiations.

17-8.5 Cost Analysis.

A cost analysis is the evaluation of the contractor's proposal for cost reasonableness which is typically determined after negotiations. The cost analysis must address the cost elements within the proposal, not just the bottom line cost. This is performed prior to award of the contract or modification.

17-8.6 Revision of the Independent Government Estimate.

Revision of the IGE may be necessary as a result of an error, changed conditions, or additional information. Approval authority for revisions to the IGE remains the responsibility of the Contracting Officer or authorized original IGE-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 must be fully explained and documented in the price negotiation memorandum. A copy of each IGE that has been approved is included in the official modification file along with the details and circumstances causing the revisions.

CHAPTER 18 LITIGATION CONCERNING THE INDEPENDENT GOVERNMENT ESTIMATE

18-1 GENERAL.

There are two major situations in which the cost engineer may become involved in litigation concerning the IGE. These situations include:

- A bid protest when bids are opened;
- A proposed change order/modification is not accepted by a contractor and the contractor pursues the dispute.

The procedure to process the issues are the same for the many types of projects or contracts associated to military programs. When either of the above occurs, the cost engineer has a major role in reviewing the IGE and evaluating the Government's position.

18-1.1 Bid/Proposals.

During the bidding process, and upon receipt of bids/proposals, if bids/proposals are significantly higher than the IGE, the Contracting Officer should verify the reasonableness of the IGE. The cost engineer is a key resource for assisting the Contracting Officer in determining reasonableness. The allowed award percentage above the IGE must be in accordance with the design agency regulations.

18-1.2 Contract Modifications/Change Orders.

During the on-going construction, changes will occur; including over-runs of quantities, and disagreements may occur between the contractor and the Government. If a dispute does arise, it generally concerns a disagreement between what the government considers a fair and reasonable cost as compared to the proposal offered by the contractor. In the event, an agreement can’t be reached between the contractor and the Government, a dispute, or claim may result.

18-2 PREPARATION OF TECHNICAL AND COST ANALYSIS BY COST ENGINEER.

The cost engineer should prepare a technical and cost analysis evaluation for documentation of the contract file. Additional information concerning factors to be considered in the technical and cost analysis is presented in Chapter 17. Reference is made to FAR sub-part 15.404 for proposal evaluation.

18-3 REVIEW OF THE INDEPENDENT GOVERNMENT ESTIMATE.

18-3.1 Bid Protests.

If there is a bid protest concerning the reasonableness of the IGE, i.e., a bidder is claiming the IGE is too low, the cost engineer conducts a review of the IGE for missing scope, site conditions, quantities, market conditions, etc.

18-3.1.1 Independent Government Estimate Evaluation.

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

18-3.1.2 Fair and Reasonable Determination.

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 Officers Decision (COD) in the form of a (letter) memorandum of denial of the protest unless the protestor withdraws the bid protest.

18-3.1.3 Meetings.

Meetings may be held with the apparent low bidder or contractor prior to issuance of the COD memoranda 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.

18-3.1.4 Resolution Assistance.

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 IGE. The cost engineer(s) responsible for preparing the IGE are most familiar with the IGE, as such, 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 IGE.

18-3.2 Contract Modifications/Change Orders.

The cost engineer may also be required to prepare cost estimates for major or complex changes; or design change orders for on-going construction projects; major or extensive quantity overrun bid items; or even assisting in evaluating claims occurring during construction whereby an IGE is required.

18-3.2.1 Independent Government Estimate Agreement.

Prior to the cost engineer finalizing the IGE, it is important to meet with the contractor to agree on the scope of work concerning change orders for on-going construction. The cost engineer will prepare the IGE as detailed in Chapter 17. On occasion, disputes arise between the Government and the contractor, primarily due to a very wide variance between the value of work estimated by the contractor and the IGE being on the low side. When a dispute arises, meetings are necessary in an attempt to resolve the difference in cost between the contractor and the Government. Even when the scope may be in general agreement, the cost may be in dispute. The Contracting Officer may issue a unilateral modification establishing the cost 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.

18-3.2.2 Independent Government Estimate Revision.

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.

18-3.2.3 Revision Documentation.

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

18-4 SECURITY AND DISCLOSURE OF INDEPENDENT GOVERNMENT ESTIMATES.

Security and disclosure of the revised IGE must be handled in the same manner as the original IGE. Procedures for handling the IGE are described in Chapter 2.

18-5 MISTAKE IN BIDS.

After the opening of bids, contracting officers examine 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 requests from the bidder a verification of the bid, calling attention to the suspected mistake. Any clerical mistake, apparent on its face in the bid, i.e., obvious misplacement of a decimal point, may be corrected by the contracting officer before award, after first receiving verification of the bid intended.

18-5.1 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.

18-5.2 Before Award in Negotiated Procurement.

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 issues a written amendment to the solicitation. In the event evaluation factors are selected to evaluate proposals, price or cost to the Government is included as an evaluation factor in every source selection. If a mistake in a proposal is suspected, the contracting officer advises 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 advises 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 offeror’s in the competitive field, the cost engineer should be a member of the negotiation team.

CHAPTER 19 STANDARD COST ESTIMATING FORMS

19-1 GENERAL.

This chapter contains a discussion of the standard cost estimating forms with a brief explanation of their use in presenting manually prepared cost estimates. A Basis of Estimate is to be provided for each cost estimate prepared using these forms. Refer to Chapter 4-3 for factors to be considered when preparing the BOE.

19-1.1 Completed Examples.

Completed examples of these forms are provided in this chapter. Cost 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 given:

Each original sheet is to be in reproducible quality.

- Once the cost estimate has been completed, checked, and approved, the desired number of copies is reproduced from the original.
- For Architect-Engineer prepared cost estimates, the original is included with the final submittal.
- Originals are normally retained by the cost engineering office preparing the cost estimate.
- A cover sheet is to be initialed by both the preparer and the reviewer.

19-2 FORMS.

Although no forms are mandatory for use in preparing early cost estimates, it is recommended that the cost engineer consider using forms expressing unit price and extended price in columns. The following standard cost estimating forms may be used in preparing detailed cost estimates for military projects. Sample forms for use in development of cost estimates are provided at https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-3-740-05 and are discussed in paragraphs 19-2.1 through 19-2.5.

19-2.1 Cost Estimate Detail Summary Sheet.

Cost Estimate Detail Summary Sheet is used to summarize project costs, to relate the method of distribution of overhead and profit to the various bid items, and to determine the overall price for each bid item. For unit price bid items, calculations, results, and rounding may be shown on the line following the total bid item price calculation. Rounding of Lump Sum bid items may also be shown similarly. The total cost, or adjusted cost, is transferred to the bidding schedule.

19-2.2 Cost Estimate Analysis.

Cost Estimate Analysis is used to itemize and quantify work tasks and to calculate the direct cost for each task. The form follows, column by column, the format shown in the

Cost Book. It is also intended as the direct cost summary sheet for each bid item. Items of significant cost are related to other detailed backup sheets with analysis or quotations.

19-2.3 Cost Estimate Worksheet.

Cost Estimate Worksheet is used for miscellaneous cost items. Common uses include quantity takeoff, description and discussion pages, and price quotations.

19-2.4 Crew and Productivity Worksheet.

Crew and Productivity Worksheet is used to develop a crew analysis and task unit cost for labor and equipment. This is necessary for significant and unusual construction tasks. The "CREW REF NO" can be completed similar to the crew names described in the Cost Book.

19-2.5 Wage Rate Calculations.

Wage Rate Calculations, is used to calculate hourly cost for laborers.

APPENDIX A BEST PRACTICES

A-1 WORK BREAKDOWN STRUCTURE.

The information contained in this appendix is to aid in the presentation of cost estimates for military programs. The structure outlined in this appendix is described in Chapter 2.

A-1.1 Uniformat II.

Military Construction Uniformat II Structure, see Table A-1.

Table A-1 Uniformat II Structure

PRIMARY FACILITIES				
Section A	Substructure			
	A10	Foundation		
		A1010	Standard Foundations	
		A1020	Special Foundations	
		A1030	Slab On Grade	
	A20	Basement Construction		
		A2010	Basement Excavation	
		A2020	Basement Walls	
Section B	Shell			
	B10	Superstructure		
		B1010	Floor Construction	
		B1020	Roof Construction	
	B20	Exterior Closure		
		B2010	Exterior Walls	
		B2020	Exterior Windows	
		B2030	Exterior Doors	
	B30	Roofing		
		B3010	Roof Coverings	
		B3020	Roof Openings	
Section C	Interiors			
	C10	Interior Construction		
		C1010	Partitions	
		C1020	Interior Doors	
		C1030	Fittings	
	C20	Stairs		
		C2010	Stair Construction	
		C2020	Stair Finishes	
	C30	Interior Finishes		
		C3010	Wall Finishes	
		C3020	Floor Finishes	
		C3030	Ceiling Finishes	

Section D	Services		
	D10	Conveying	
		D1010	Elevators & Lifts
		D1020	Escalators and Moving Walks
		D1090	Other Conveying Systems
	D20	Plumbing	
		D2010	Plumbing Fixtures
		D2020	Domestic Water Distribution
		D2030	Sanitary Waste
		D2040	Rain Water Discharge
		D2090	Other Plumbing Systems
	D30	HVAC	
		D3010	Energy Supply
		D3020	Heat Generating Systems
		D3030	Cooling Generating Systems
		D3040	Distribution Systems
		D3050	Terminal and Package Units
		D3060	Controls & Instrumentation
		D3070	Systems Testing & Balancing
		D3090	Other HVAC Systems & Equipment
	D40	Fire Protection Services	
		D4010	Sprinklers
		D4020	Standpipes
		D4030	Fire Protection Specialties
		D4090	Other Fire Protection Systems
	D50 Electrical		
		D5010	Electrical Service & Distribution
		D5020	Lighting and Branch Wiring
		D5030	Communication & Security
		D5090	Other Electrical Systems
Section E	Equipment and Services		
	E10	Equipment	
		E1010	Commercial Equipment
		E1020	Institutional Equipment
		E1030	Vehicular Equipment
		E1090	Other Equipment
	E20	Furnishing	
		E2010	Fixed Furnishings
		E2020	Movable Furnishings

	Section F	Special Construction & Demolition		
		F10	Special Construction	
			F1010	Special Structures
			F1020	Integrated Construction
			F1030	Special Construction Systems
			F1040	Special Facilities
			F1050	Special Controls and Instrumentation
		F20	Selective Building Demolition	
			F2010	Building Elements Demolition
			F2020	Hazardous Components Abatement
SUPPORTING FACILITIES				
	Section G	Building Sitework		
		G10	Site Preparations	
			G1010	Site Clearing
			G1020	Site Demolition and Relocations
			G1030	Site Earthwork
			G1040	Hazardous Waste Remediation
		G20	Site Improvements	
			G2010	Roadways
			G2020	Parking Lots
			G2030	Pedestrian Paving
			G2040	Site Development
			G2050	Landscaping
		G30	Site Mechanical Utilities	
			G3010	Water Supply
			G3020	Sanitary Sewer
			G3030	Storm Sewer
			G3040	Heating Distribution
			G3050	Cooling Distribution
			G3060	Fuel Distribution
			G3090	Other Site Mechanical Utilities
		G40	Site Electrical Utilities	
			G4010	Electrical Distribution
			G4020	Site Lighting
			G4030	Site Communication & Security
			G4090	Other Site Electrical Utilities
		G90	Other Site Construction	
			G9010	Service and Pedestrian Tunnels
			G9090	Other Site Systems & Equipment

General Requirements *
Field Overhead *
Quality Control *
Design Build Fee *

Note: These item (*) are not part of the Uniformat II Structure, but are required in order to produce a complete cost estimate with markups.

APPENDIX B AUTOMATION

B-1 PURPOSE.

This appendix provides general information on using this automation and an overview of existing systems. 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.

B-2 USE OF COST ENGINEERING 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 cost estimating procedures and provides cost 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.

B-2.1 Software Updates and New Systems.

Automation continues to develop at a rapid pace. Minor upgrades may occur annually and major system changes can occur every two or three years. Major new systems may be fielded at any time. Cost engineers should insure that they are using the latest available version of the software.

B-2.2 Limitations on the Use of Automation.

Automation is just a tool and cannot take the place of professional cost engineering knowledge or 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 using models and in adapting existing cost estimates to new projects to insure that there are neither duplications nor omissions in the cost estimate. Output is to be checked for reasonableness and assumptions and methodology verified and documented. The best cost automated system is not a replacement for good cost engineering judgment.

B-2.3 Automation Proponent.

The Tri-Service Committee on Cost Engineering is the proponent for all the major components of the Tri-Service Cost Engineering Systems (TRACES).

B-3 OVERVIEW OF TRI-SERVICE AUTOMATED COST ENGINEERING SYSTEMS (TRACES).

TRACES is the umbrella linking automated cost engineering systems and their associated databases. 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 types of cost estimates.

TRACES includes the following major systems/modules: a detailed quantity take-off cost engineering system (MCACES/MII); a parametric systems for the preparation of less than fully detailed design cost estimates for military construction projects Parametric Cost Engineering System (PACES); a historical cost analysis generator (HAG/HII) to collect, store, and analyze historical cost data for facilities, and site work; a location cost factors system to adjust average historical facility cost to a specific project location (ACF) ; a dredge cost engineering system (CEDEP); a life-cycle cost (LCC) module (ECONPACK) for analysis of system design alternatives; a parametric system for preparation of Formerly Used Defense Sites (FUDS)/Cost to Complete (CTC) estimates (RACER); a scheduling software program (i.e., Microsoft Project, P2, Primavera); and risk analysis software (i.e., Oracle Crystal Ball).

B-3.1 Other Systems.

Other systems/modules which are specific to each Service's requirement include: PC-Cost, DD Form 1391 for Army users. EPG Electronic Project Generator to develop DD Form 1391 for NAVFAC users.

B-3.2 Micro Computer-Aided Cost Engineering System 2nd Generation (MCACES/MII).

MCACES/MII is a multi-user software program used 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. Databases work in conjunction with each other to produce a detailed cost estimate. The databases are described in the MCACES/MII user's manual.

B-3.3 Parametric Cost Engineering System (PACES).

PACES is a parametric cost estimating system which is used primarily for development of programming or budgetary cost estimates in support of MILCON Program such as military facilities, family Housing, medical, and operation and maintenance projects. The 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. The cost estimate can then be transferred to

MCACES/MII for task-by-task analysis of the cost estimate. PACES is the Air Force's primary tool for preparing programming estimates.

B-3.4 Historical (Cost) Analysis Generator (HAG/HII).

HAG/HII is a stand-alone software/module which is used to collect and display historical cost data from awarded projects. HAG/HII 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/HII 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 estimates.

B-3.5 Area Cost Factor (ACF).

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 (LME) costs has the largest impact on total construction cost. Therefore, a comparison of the local LME project costs for typical military construction at different cities would give a comparison of relative construction costs. A market basket of 8 labor crafts, 18 materials and 4 pieces of construction equipment, and seven matrix factors for each location are used in the calculation of the ACF index.

B-3.6 Life Cycle Cost (LCC) Module.

The LCC module called ECONPACK is a stand-alone program designed primarily to conduct life-cycle cost (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 Army buildings. The most prominent capabilities are: (a) to conduct LCC analyses in accordance with the provisions of statutes, regulations, and requirements; (b) to calculate the present worth of individual building or facility components; and (c) to compare M&R costs for building components in the M&R database.

B-3.7 Oracle Crystal Ball.

The Oracle Crystal Ball 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 cost and schedule estimates based on "confidence levels," and can assist in the evaluation of project contingency funds. The Oracle Crystal Ball software performs cost and schedule risk analyses on cost and schedule estimates using Monte Carlo simulation techniques as the basis of its calculations.

B-3.8 Other TRACES System/Module.

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 models. Some of these tools are stand-alone programs designed primarily for a specific requirement and for use by base/installation personnel.

B-3.8.1 PC-Cost.

PC-Cost is a comprehensive software package that allows the user to prepare and submit programming or budgetary cost estimates based on the Department of Defense Facilities Pricing Guide and Army specific HAG/HII data. PC-Cost also allows the user to create an cost estimate from an existing detailed or parametric cost estimate, download a DD Form 1391 cost estimate for revisions (for Army users of PAX System), or create a new DD Form 1391 estimate from a template. PC-Cost also provides a mechanism for a user interface access capability with MCACES/MII and PACES.

B-3.8.2 DD Form 1391 Estimate Generator.

The DD Form 1391 Estimate Generator is one of the modules within the Army's DD 1391 Processor. It is an interactive computer program which assists users in preparing the programming cost estimate shown on the DD Form 1391, Military Construction Project Data. (The DD Form 1391 is used by DOD agencies to justify the need of a military project and serves as a funding request for the Authorization and Appropriation of Military Construction funds by Congress.) The cost estimate generator of the DD Form 1391 Processor has capabilities for automatic computation of area cost factor adjustments, size factor adjustments, and automatic escalation computation. It uses the cost data from the DOD Facilities Pricing Guide and HAG/HII to generate costs of facilities.

B-3.8.3 Electronic Project Generator (EPG).

EPG, the Electronic Project Generator, is a web-based software system that supports the development, review, and approval of Navy MILCON and SRM projects. It is the paperless vehicle by which DD 1391 supported projects are entered into the NAVFAC planning, programming, and budgeting process.

B-4 OVERVIEW OF TRACES DATABASES AND FILES.

Databases and files used by the TRACES modules are as follows:

B-4.1 Cost Book Database.

The Cost Book database is a collection of common construction detail line item tasks used in developing project cost estimates for military, civil works, and HTRW programs. The Cost Book is organized in accordance with the Construction Specification Institute (CSI) 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-4.2 Models Database.

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

B-4.3 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 that you input the parameters appropriate for your specific job. Using assemblies can greatly reduce the amount of data entry required to build a project.

B-4.4 Other Databases.

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

B-4.5 Work Breakdown Structure (WBS).

This data file provides a separate hierarchical work breakdown master structure for use as a template in formatting cost estimates for military projects.

B-4.6 Cost Escalation Index.

The cost escalation index provides a historic and projected cost index for cost escalation adjustment due to inflationary factors.

B-4.7 Area Cost Factor (ACF) 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.

B-4.8 Department of Defense Facilities Pricing Guide.

This guide is published yearly as an update to UFC 3-701-01. The guide provides unit cost factors intended for macro-level analysis and planning in tools such as the Sustainment Cost Factors which are generally not suitable for individual facilities or projects. The guide also provides unit cost data and related adjustment factors for selected DoD facility types and is intended for use in developing project-level cost estimates and preparing MILCON project documentation (DD Forms 1391 cost estimate).

B-4.9 Army Facilities Pricing Guide ($/SF).

This index is a listing of facility unit costs normalized to a geographical location factor of 1.00. Unit prices reflect costs forecast on the basis of an assumed midpoint of construction date. This guide is published via PAX Newsletter.

B-5 ASSIGNED AGENCY.

The Assigned Responsible Agency (ARA) for TRACES is the U.S. Army Engineering and Support Center, Automated Systems Branch, TRACES group, Huntsville, Alabama. The ARA serves as the focal point for support usage of these software programs by providing operation, maintenance, and "Hot-Line" telephone support.

APPENDIX C GLOSSARY

C-1 ACRONYMS.

ACF	Area Cost Factor
ACO	Administrative Contracting Officer
A-E	Architect-Engineer
AFARS	Army Federal Acquisition Regulation Supplement
AFCEC	Air Force Civil Engineer Center
AR	Army Regulation
ARA	Assigned Responsible Agency
ASA(CW)	Assistant Secretary of the Army (Civil Works)
ASTM	American Standards for Testing and Material
AT/FP	Anti-Terrorism/Force Protection
BIA	Bilateral Infrastructure Agreement
BOE	Basis of Estimate
CACES	Computer Aided Cost Engineering System
CD	Compact Disc
CE	Cost Engineer
CLIN	Contract Line Item Numbers
COD	Contracting Officers Decision
CONUS	Continental United States
CSI	Construction Specification Institute
CSRA	Cost and Schedule Risk Analysis
CTC	Cost to Complete
CUI	Controlled Unclassified Information
CWE	Current Working Estimate
DB	Design Build

DBB	Design Bid Build
DCA	DOD Construction Agent
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	Department of Defense
DODINST	DOD Instruction
EP	Engineer Pamphlet
EPG	Electronic Project Generator
ER	Engineer Regulation
FAR	Federal Acquisition Regulations
FICA	Federal Insurance Contributions Act
FOB	Free/Freight on Board
FOIA	Freedom of Information Act
FOOH	Field Office Overhead
FUDS	Formerly Used Defense Sites
G&A	General and Administrative
GAO	Government Accountability Office
GFE	Government-Furnished Equipment
GFM	Government-Furnished Materials
HTRW	Hazardous, Toxic and Radioactive Waste
HAG/HII	Historical Analysis Generator Second Generation
HOOH	Home Office Overhead
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
ICE	Independent Cost Estimate
IFB	Invitation for Bid (Sealed Bidding)
IGE	Independent Government Estimate

JOOH	Job Office Overhead
LCC	Life Cycle Cost
MATOC	Multiple Award Task Order Contract
MCACES/MII	Micro Computer-Aided Cost Engineering System 2nd Generation
MILCON	Military Construction
NAVFAC	Naval Facilities Engineering Systems Command
O&M	Operations and Maintenance
OCONUS	Outside the Continental United States
OSHA	Occupational Safety and Health Administration
PACES	Parametric Cost Engineering System
PAX	Programming Administration Execution
PDT	Project Delivery Team
PET	Price Evaluation Team
PL	Public Law
PM	Project Manager
PMP	Project Management Plan
POC	Point of Contact
POCA	Performance Oriented Construction Activities
QC	Quality Control
RA	Risk Analyst
RFP	Request for Proposal
RMP	Risk Management Plan
RP	Recommended Practice
RTA	Ready to Advertise
SAA	Surety Association of America
SAT	Simplified Acquisition Threshold

SIOH	Supervision, Inspections and Overhead
SOFA	Status of Forces Agreements
SPI	Selling Price Index
TRACES	Tri-Service Cost Engineering Systems
UAI	USACE Acquisition Instruction
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
U.S.	United States
VE	Value Engineering
WBS	Work Breakdown Structure

APPENDIX D REFERENCES

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (NAVFAC)

Price Schedule
https://www.wbdg.org/ffc/navy-navfac/project-information-form-specifications-cover-sheet/price-schedule

PUBLIC LAW

PL No. 74-403 *Davis Bacon Act*

U.S. ARMY CORPS OF ENGINEERS

EP 1110-1-8 *Construction Equipment Ownership and Operating Expense Schedule*
https://www.publications.usace.army.mil/USACE-Publications/Engineer-Pamphlets/?udt_43545_param_page=2

U.S. DEPARTMENT OF DEFENSE

DoDINST 5200.48, *Controlled Unclassified Information (CUI)*
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/520048p.PDF

U.S. GOVERNMENT ACCOUNTABILITY OFFICE

GAO-20-195G *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*
https://www.gao.gov/products/GAO-20-195G

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 3-701-01 *DoD Facilities Pricing Guide*

UFC 3-730-01 *Programming Cost Estimates for Military Construction*

ASSOCIATION FOR THE ADVANCEMENT OF COST ENGINEERING INTERNATIONAL (AACE)

AACE International Recommended Practice No. 10S-90, *Cost Engineering Terminology*

ASTM INTERNATIONAL

E1557-09 *Standard Classification for Building Elements and Related Sitework – UNIFORMAT II*