

**CERTIFIED
ESTIMATING
PROFESSIONAL
CERTIFICATION
STUDY GUIDE
2nd Edition**

CEEP



Certified Estimating Professional (CEP) Certification Study Guide

Second Edition

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CEP Certification Study Guide

Second Edition

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By

AACE International

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Preface

The AACE International *Certified Estimating Professional (CEP) Certification Study Guide* has been developed to accomplish two purposes. First, it is intended to aid aspiring certification candidates by summarizing the fields of recommended study necessary to prepare for the certification examination. Second, the intent is to assemble and summarize various topics considered essential knowledge for a Certified Estimating Professional (CEP), as outlined in the AACE International Recommended Practice (RP) 46R-11, *Required Skills & Knowledge of Project Cost Estimating* and included in the current edition of the AACE International *Skills and Knowledge of Cost Engineering*.

Terms and phrases incorporated in the *CEP Certification Study Guide* are generic to the profession and listed in RP 10S-90, *Cost Engineering Terminology*. The terms and phrases used in industry and technical software may not always agree precisely with your understanding, therefore consult RP 10S-90 for the standard definition. The goal of the AACE International Education Board is to continually improve this publication, making it a living document that will be revised as needed to support the CEP exam while maintaining the recognized strengths described above. All are encouraged to offer comments and suggestions for improvements in future editions. Please forward comments to the Education Board at AACE International.

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Introduction to the CEP Certification Study Guide

This certification study guide structures the study of recommended reference materials, so that prospective certificants gain the knowledge essential to earn the Certified Estimating Professional (CEP) credential. The CEP Competency Model was developed by the CEP Task Force to support the design of the examination. This Competency Model was later written into Recommended Practice RP 46R-11, *Required Skills and Knowledge of Project Cost Estimating*. The Table of Contents of this study guide mirrors the skills as they are defined in the Recommended Practice.

As a guide to study, this publication does not provide detailed, fundamental education in cost estimating. Those seeking the CEP credential should already know the basics. One expects, however, that even seasoned professionals do not routinely apply all estimating knowledge and skills on a frequent basis. Recent study of seldom-used knowledge and techniques in the months before sitting for the certification examination is prudent. This *CEP Certification Study Guide* enables efficient and effective preparation for the CEP examination.

Each section in this *CEP Certification Study Guide* is addressed with content organized as follows:

- Introduction
- Learning Objectives
- Reference Study Materials
- Terms to Know
- Key Points for Review
- Summary
- Sample Questions
- Sample Question Answers

This certification study guide primarily uses process industry and building construction projects as the basis for presenting the knowledge, skills, and abilities required of competent cost estimators.

CEP Certification Requirements

The prospective Certified Estimating Professional (CEP) should know all requirements for earning the credential. This study guide is designed for the most efficient use of time to improve one's knowledge, skills, and abilities to thresholds that industry consensus deems essential for a proficient cost estimator.

For the most current information regarding the eligibility requirements, applications, and payment for this specialty certification, visit the AACE website at www.aacei.org under the Certification section.

Preparing for the Examination

Generally speaking, a candidate's education and professional experience are the primary sources that prepare the individual for the examination; however, there are additional ways to prepare for the examination:

- Use the *CEP Certification Study Guide* as an outline for study.
- Study the reference materials identified in this manual.
- Learn the estimating terms found in AACE International Recommended Practice 10S-90, *Cost Engineering Terminology*.
- Access relevant distance learning opportunities through the AACE International website.
- Attend the CEP Certification Review Seminar conducted at the AACE International Annual Meeting.
- Attend CEP Review Courses by local AACE Sections.

Use the AACE Website

The AACE website provides many resources that can help you prepare for the examination. All of the referenced materials are available on the website, many at no cost. In addition there are Professional Practice Guides (PPGs), webinars, and other remote learning opportunities available. The Virtual Library can help you locate hundreds of papers and magazine articles for almost any cost estimating subject you wish to research. In addition you can find information about section meetings or seminars in your area. Meeting and talking with other estimators is a great resource to broaden your estimating knowledge.

Passing the Examination

To become a Certified Estimating Professional, an overall passing score must be achieved, as determined by the Certification Board.

If a candidate has special needs, such as accessibility or handicapped considerations, they must be made known to AACE International when submitting the CEP certification exam application.

If the candidate has questions unanswered by the general information that has been published about the examination, they should contact the AACE International, Certification Manager.

Special attention should be given to Certification Requirements. For the latest information and application forms, please visit AACE International's website at www.aacei.org or contact AACE International Headquarters at either 804-296-8444.

Maintaining the CEP

The Cost Estimating Professional certification is valid for three years. At the end of that period you may renew your certification by professional credits or re-examination. The most popular choice for re-certification is the professional credit plan. The details for this may be found at <http://www.aacei.org>. This plan requires 15 earned credits over the three-year period. Three credits can be earned each year just by being employed in the Cost Estimating profession. Up to one credit per year can be earned by attending local section meetings. If you are not near a location where meetings are held, check with the section to see if they offer on-line meeting attendance. An additional two credits per year can be earned by becoming an active officer in your local section. There are many other ways to earn professional credits that are all identified in the Recertification Application Handbook noted above.

CEP Certification Examination Structure

Introduction

A review of the structure and content of the CEP certification examination is useful for prospective

applicants. This study guide provides direction for preparing to meet those requirements.

Examination Basis

AACE International's Certified Estimating Professional (CEP) certification program is designed to establish credentials for those individuals working in the cost estimating field. This certification program will give professionals a means to validate their skills and knowledge. CEP certification will distinguish you as a Certified Estimating Professional who has the knowledge and skills that impact the bottom line.

CEP Exam Format

The examination is delivered through computer-based testing (CBT) and consists of multiple-choice questions and a written exercise. The topics covered in the examination are the principles and knowledge of cost estimating as delineated in RP 46R-11, *Required Skills and Knowledge of Project Cost Estimating*.

Recognizing there are many industries and fields within the profession -- engineering, construction, manufacturing, process facilities, mining, utilities, transportation, aerospace, environmental, and government — one can expect some questions from any of those settings.

For the latest information regarding the CEP exam format, visit the AACE website under the Certification Section.

Understanding and Using the Sample Questions Provided in the CEP Study Guide

The *CEP Certification Study Guide* includes many sample questions with answers. These questions should be answered so you know which areas might need additional preparation on your part. The questions are found at the end of each section.

The questions found in the *CEP Certification Study Guide* have been developed specifically for those preparing for the examination and are similar in content and context to the actual exam questions. All of the questions on the CEP Certification Examination, except the writing requirement, are multiple-choice questions. Each has four possible answers with one correct solution, similar to the sample questions in this Certification Study Guide.

Questions in this study guide are in the following formats:

- Simple multiple-choice questions, similar to what you might find on the CEP Certification Examination. It is important to recognize that more than one answer to a question may appear to be correct; the correct answer is the one that is most correct.
- Complex multiple-choice problems. The intent of this question set is to enable the student to prepare for the complex-question section of the examination. A complex question sample is found in Appendix A with some limited examples in some of the other sections.

It is recommended that you use a copy of RP 10S-90, *Cost Engineering Terminology* while working with this guide. Anytime you encounter a term you don't fully understand you should look up the definition. It is recommended that you spend time reviewing RP 10S-90 to help you understand the relationships between estimators and other disciplines of Cost Engineering. There will be questions on the examination regarding the interfaces between estimators and other disciplines.

Introduction to the Cost Estimating Competency Model

The Competency Model for Estimating is described in Recommended Practice 46R-11, *Required Skills and Knowledge of Project Cost Estimating*. This is a subset of Recommended Practice 11R-88, *Required Skills and Knowledge of Cost Engineering* which was developed from the Total Cost Management Framework which defines the complete body of knowledge of the fields within Cost Engineering. A professional estimator should understand not only the field of estimating, but how estimating interacts with the other cost engineering disciplines such as scheduling, cost control, engineering economics, etc. Understanding those relationships will help the estimator produce a better estimate that will facilitate the project through its complete life cycle.

The CEP study guide was organized using the recommended practice for estimating as an outline. As part of the preparation for the examination, the candidate should read and understand the RP. The chapters in the CEP study guide are listed below:

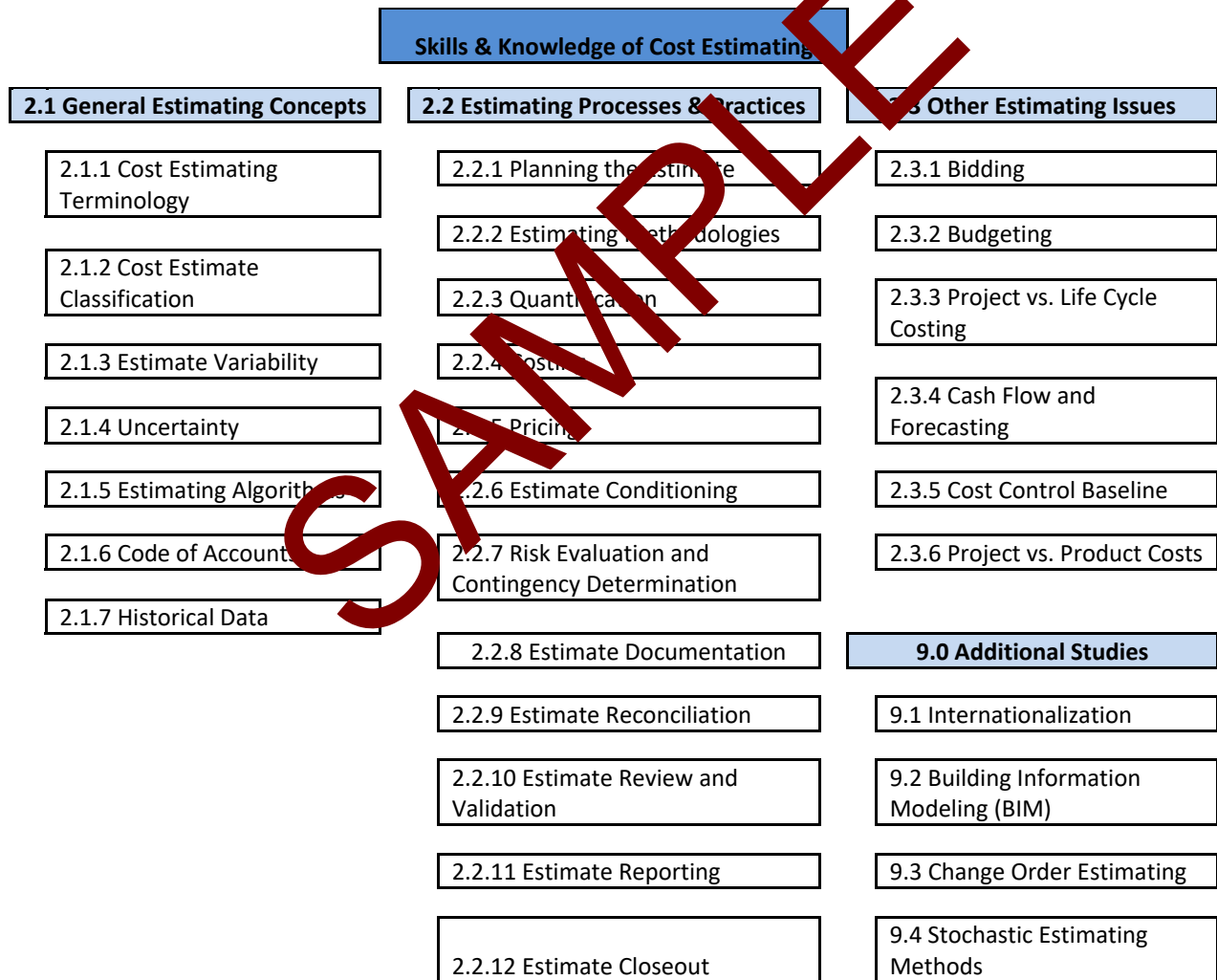


Figure 1—Cost Estimating Competency Model

Test Your CEP Knowledge

As a good gauge of CEP knowledge, the candidate is encouraged to answer the following pre-study questions. Answers should be recorded, and when studies are complete, the candidate will answer the same questions again. A close comparison of the results, before and after study, will show the knowledge gained by using this study guide and references, and what gaps may remain prior to sitting for the exam.

1. What is estimating?
2. What is the role of the cost estimator?
3. What is budgeting?
4. What is quantification?
5. What are the different classes of estimates?
6. What is the difference between costing and pricing?
7. What are the different types of parametric methodologies?
8. What are codes of accounts and their use?
9. What is Building Information Modeling (BIM)?
10. What are the fundamental considerations for internationalization?
11. What is the difference between accuracy and contingency?
12. What are cost estimating relationships (CER's)?
13. What are location factors?
14. What are life cycle costs?
15. What are the differences between direct and indirect costs?
16. What is the difference between a Hour Factor and a Lang Factor?
17. What is the difference between a work package and an assembly?
18. What are the keys to cost and scheduling integration?
19. What are some of the challenges for change order estimating?
20. What is the difference between a composite and an average crew rate?
21. What are the differences between bare rates and burdened rates?
22. What is the difference between a material unit price and material price?
23. What is the difference between unbalancing and front end loading?
24. What are the different types of work breakdown structures (WBS) and use?
25. What is the difference between labor productivity and a labor productivity factor?
26. How does change order estimating differ from project estimating?
27. What is the importance of project cash flow?

Chapter 1.0 - Supporting Skills and Knowledge

To become a competent professional cost estimator requires a strong understanding of the skills and knowledge that are used to practice the profession. Competent cost estimators routinely integrate their knowledge of elements of cost, analysis, and other enabling knowledge throughout all of their estimating activities.

AACE Recommended Practice 10S-90, *Cost Engineering Terminology*, defines the term, “project cost estimator” as follows:

“Project cost estimators predict the cost of a project for a defined scope, to be completed at a defined location and point of time in the future. Cost estimators assist in the economic evaluation of potential projects by supporting the development of project budgets, project resource requirements, and value engineering. They also support project control by providing input to the cost control baseline. Estimators collect and analyze data on all of the factors that can affect project cost, such as: materials, equipment, labor, location, duration of the project, and other project requirements.”

As seen in the definition, the project cost estimate is integrated with the effort of other cost engineering disciplines. A project cost estimate becomes the basis for the budget used in project cost control. A project cost estimate is required for economic evaluation of a project. The resources of the estimate may be used for resource analysis in the project schedule. As part of supporting skills and knowledge, it is therefore necessary that the professional project cost estimator understand how the estimate may be used by other cost engineering disciplines.

Thus, the definition of a cost estimator relates to the duties that are performed by the professional estimating practitioner (See Figure 1.0).

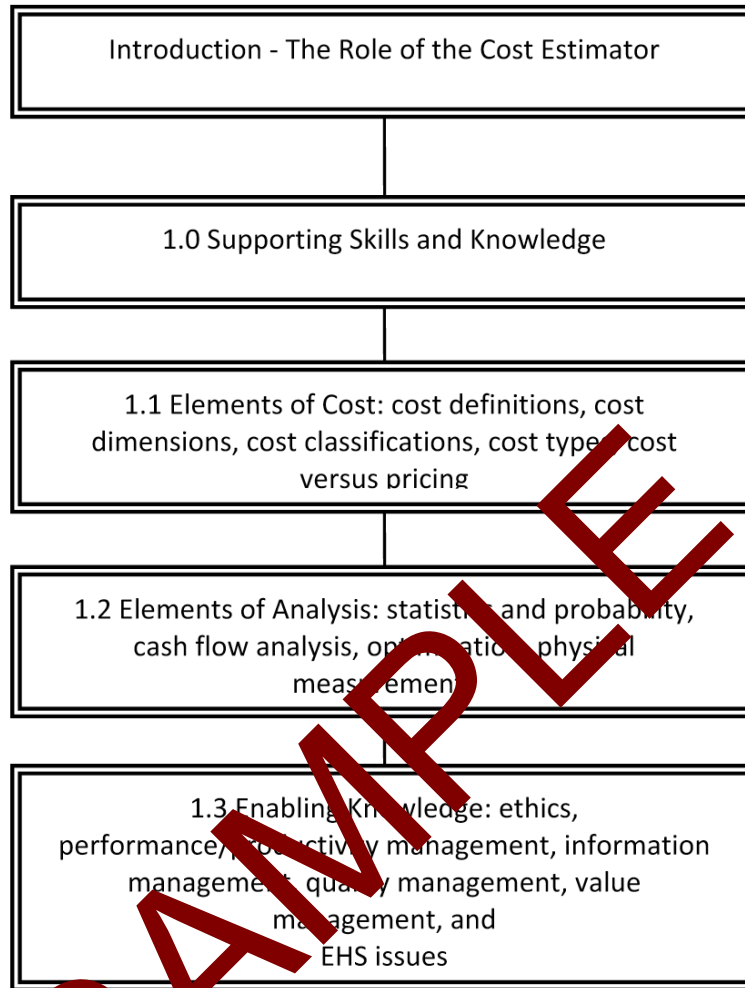


Figure 1.0—Breakdown of Chapter Topics

Introduction: The Role of the Cost Estimator

According to AACE International Recommended Practice 10S-90, *Cost Engineering Terminology, Cost Estimating* is:

“The predictive process used to quantify, cost, and price the resources required by the scope of an investment option, activity, or project. Cost estimating is a process used to predict uncertain future costs. In that regard, a goal of cost estimating is to minimize the uncertainty of the estimate given the level and quality of scope definition. The outcome of cost estimating ideally includes both an expected cost and a probabilistic cost distribution. As a predictive process, historical reference cost data (where applicable) improve the reliability of cost estimating. Cost estimating, by providing the basis for budgets, also shares a goal with cost control of maximizing the probability of the actual cost outcome being the same as predicted.”

You will see as your study of cost estimating advances, the process of developing an estimate varies depending on the stage of scope development for the project/product. But regardless of the current progress of development or the appropriate estimating methodology chosen, at least the following three common steps are involved.

Step One: Quantification—Whether using a stochastic estimating approach or a more definitive approach, the elements of scope must first be quantified in order to assign costs.

Step Two: Costing—Once the scope has been translated into measurable items with quantities, costs can be assigned to those items.

Step Three: Pricing—Once the estimated items are costed, it is time to price the estimate, entailing making judgments concerning the anticipated economic environment, competitive situation, allowance for overhead and profit, and other factors to shape the estimate to meet the needs of the parties involved. Often, once the estimate has been priced, it will still need to be conditioned or adapted to specific conditions applicable to the project or product being estimated.

Learning Objectives

- Understand the role of a cost estimator.
- Understand the required skills, knowledge, and abilities of cost estimators.
- Understand how the project estimate supports other cost engineering disciplines.
- Understand how other cost engineering disciplines support the project estimate.

Terms to Know

- Cost Estimate
- Cost Estimator
- Quantification
- Costing
- Pricing
- Scope Definition

Key Points for Review

- Project cost estimators predict the cost of a project for a defined scope, to be completed at a defined location and a point in time.
- Cost estimators assist in the economic evaluation of potential projects by supporting the development of project budgets, project resource requirements, and value engineering.
- Cost estimators support project control by providing input to the cost control baseline.
- Cost estimators collect and analyze data on all of the factors that can affect project costs such as materials, equipment, labor, location, duration of the project, and other project requirements.
- Methods used by estimators vary.
- Project Cost Estimators are most often office-based, but may visit the construction site or manufacturing floor at times to witness production.
- There is often considerable pressure on estimators as they face deadlines for delivery of estimates.
- Job entry requirements vary by industry, but often require either a bachelor's degree in a related field or actual experience in industry.
- Required skills and knowledge for estimators often include ability in mathematics, probability, and statistics, having an analytical aptitude, and good attention to detail. Strong interpersonal skills, especially those in communication and presentation are important.

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Section 1.1 Elements of Cost

Introduction

Cost, in project control and accounting, is the amount measured in money, cash expended or liability incurred, in consideration of goods and/or services received. From a total cost management perspective, cost may include any investment of resources in strategic assets including time, monetary, human, and physical resources.

Elements of cost include engineering, design, labor, material, equipment, and any other costs necessary for delivering the scope of work at an agreed-upon price. Aggregating these costs to determine a total cost is necessary to determine pricing to cover other costs associated with being able to perform the work, and, in most cases, provide a reasonable profit.

Cost estimating is often intertwined with corporate accounting. This is particularly true with the treatment of expenditures for property records and resulting tax treatment. Expenditures by a company will fall into either the category of “capital” or “operation and maintenance (O&M)”. Where this is required it is important that the cost estimator work with the accounting department to make the determination. Generally a capital expenditure is for new equipment or facility or a significant repair or replacement of that facility. It will have more than a one-year life. O&M expenditures are generally repairs to existing equipment or facilities that represent much less than the value of the items which are being repaired. These determinations can be very complex and company specific so input from the accounting department is important.

Two other cost elements that fall within the accounting treatment in a company are demolition and salvage. At the end of the life of a project the equipment or facility is often removed. The cost of removing it is demolition cost. Any parts that are sold for scrap or use by others are considered salvage value.

Costs within an estimate are often categorized into direct and indirect costs.

- Direct costs are costs of completing works that are directly attributable to its performance and are necessary for its completion.
 - In construction, the cost of installed equipment, material, labor and supervision directly or immediately involved in the physical construction of the permanent facility.
 - In manufacturing, service, and other non-construction industries: the portion of operating costs that is readily assignable to a specific product or process area.
- Indirect costs are costs not directly attributable to the completion of an activity, which are typically allocated or spread across all activities on a predetermined basis.
 - In construction, (field) indirects are costs which do not become a final part of the installation, but which are required for the orderly completion of the installation and may include, but are not limited to, field administration, direct supervision, capital tolls, startup costs, contractor’s fees, insurance, taxes, etc.
 - In manufacturing, costs not directly assignable to the end product or process, such as overhead and general purpose labor, or costs of outside operations, such as

transportation and distribution. Indirect manufacturing costs sometimes include insurance, property taxes, maintenance, depreciation, packaging, warehousing, and loading.

There is another element of cost that helps to define the accuracy of an estimate. During the development of a project there can often be a continuous effort to purchase the elements to be installed or the effort to install them. A convenient way to convey this is to assign a field in the estimate to identify if the element has been estimated, quoted or purchased. Summarizing by these items helps to identify the potential risk remaining in the estimate.

Cost elements can be categorized into groupings, such as work breakdown structures, in order to better organize, present, and analyze the estimate. A more detailed presentation of different types of categories is covered in this study guide in *Section 2.1.6 Code of Accounts* and *Section 1.2 Elements of Analysis*.

Learning Objectives

- Describe the various elements of cost and the role they play in comprising total cost.
- Understand the different types of cost and how they are treated differently in the estimate.
- Describe the process of “rolling up” cost elements into higher groupings.
- Identify the characteristics that separate direct from indirect costs.
- Understand the importance of identifying capital versus O&M costs.

Terms to Know

- Assembly
- Capital/O&M Cost
- Code of Accounts
- Cost Category
- Cost Element
- Demolition Cost
- Direct Cost
- Fixed Cost
- Variable Cost
- Equipment Costs
- Indirect Cost
- Labor Costs
- Material Costs
- Salvage Value
- Subcontractor Costs
- Suppliers
- Work Breakdown Structure (WBS)

Key Points for Review

- What are the characteristics that distinguish direct versus indirect costs?
- How do cost estimate classifications help organize and present the estimate?
- What are the characteristics of fixed versus variable costs?

- How can elements of cost be summarized?

Summary

- The elements of cost include the material, labor, equipment, and other miscellaneous items necessary to perform the prescribed work.
- Estimate classifications assist all parties in gaining a mutual understanding of the basis of the estimate.
- Cost elements may be “rolled up” to higher levels of detail.

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Check on Learning

1. The difference between a cost element and a cost category is best explained by:
 - A. Cost elements are a grouping of detailed line items
 - B. Cost categories are subdivided by assemblies
 - C. Cost elements are a subdivision of a cost category
 - D. Cost categories are a subdivision of an assembly

2. Which of the following is *not* an element of the cost of a project?
 - A. Material
 - B. Freight
 - C. Material waste
 - D. Esteem value

3. Which of the following is an indirect cost of a concrete wall?
 - A. Material
 - B. Forming labor
 - C. Supervisory labor
 - D. Labor fringe benefits and taxes

4. Variable costs in the manufacture of a product differ from fixed costs in that they _____.
 - A. Can also be termed, "indirect costs"
 - B. Increase/decrease in proportion to the quantity of product produced
 - C. Cannot be readily estimated
 - D. Have unit costs that are variable

5. Unit cost refers to
 - A. The cost of one unit where "unit" refers to a dwelling unit such as an apartment
 - B. The cost of a given unit of a product or service
 - C. The cost of labor, materials, equipment, and overhead, "united"
 - D. The cost of one "unit" of labor

6. In a manufacturing environment, variable costs are ...
 - A. Those costs that vary with the value of local currency
 - B. Labor costs that can vary with the productivity and efficiency of the specific workers assigned to complete the task
 - C. Those costs that are a function of production and those processing costs that vary with plant output
 - D. Those costs that vary with location

7. The term "unit hours" refers to ...
- A. Work hours per unit of production
 - B. Hours "on the clock"
 - C. Crew hours expended toward completion of a direct item of work
 - D. Overtime spent in completion of an item of work

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Solutions

1. C Cost elements are a subdivision of a cost category
2. D Esteem value
3. C Supervisory labor
4. B Increase/decrease in proportion to the quantity of product produced
5. B The cost of a given unit of a product or service
6. C Those costs that are a function of production and those processing costs that vary with plant output
7. A Work hours per unit of production

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Section 1.2 Elements of Analysis

Introduction

Statistics and probability are a fundamental basis for analysis of projects and costs in that there are patterns and consistencies that to a certain level can be predicted to have a particular influence on a cost estimate. The learning-curve function and Pareto's Law are two examples.

Economic and financial analysis is a separate process that generally takes a broader view of the project, but can also be used on a case-by-case basis to help determine a project's viability. Optimization is a process to determine the most favorable combination of design and/or resources to achieve the most value for the work scope. Appropriate metrics or benchmarks, based on physical measurements, can be collected to provide feedback on current cost estimates, as well as be archived for historical purposes.

Learning Objectives

- Explain how statistics and probability are used to facilitate analysis of projects.
- Understand how elements of cost may be optimized.
- Develop techniques for using metrics and benchmarks to evaluate current status of projects, documenting historical parameters for use on future projects.

Terms to Know

- Analysis
- Baseline
- Certainty
- Contingency
- Cost Estimating Relationship (CER)
- Database
- Decision Analysis
- Deviation
- Learning-Curve Function
- Life-Cycle Costing
- Most Likely Value
- Pareto's Law
- Profitability Analysis
- Risk Analysis
- Standard Deviation
- Value Engineering
- Variance

Key Points for Review

- Understand the use of statistics and probabilities to provide insight and direction in analyzing estimates.

- Be familiar with Pareto 80/20 Rule and how to prioritize the time available to maximize the use of that time.
- Understand how the learning curve affects estimates.

Summary

- Statistics, probability, and other analytical tools turn the raw data of databases into data usable in the process of estimating.
- Proper analysis of data is essential in order to prepare an estimate that is sensitive to the context of the project in terms of scope, time, and place.
- Analysis estimates can be used to select the best alternative.

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Check on Learning

The following table shows the data selected from all seven company projects. This table is used for questions 1.a through 1.e

Project	Crew hours / cubic yard	Cubic yards placed
1	0.375	1,200
2	0.680	426
3	0.420	391
4	0.481	288
5	0.555	61
6	0.621	55
7	0.587	126

1.a Calculate the average production rate experienced on these projects.

- A. 0.531 crew hours / cubic yard
- B. 0.620 crew hours / cubic yard
- C. 0.533 crew hours / cubic yard
- D. 0.465 crew hours / cubic yard

1.b If the total yards placed per project are as shown in the following table, calculate the weighted average production rate experienced on these projects.

- A. 636.8 crew hours / cubic yard
- B. 0.531 crew hours / cubic yard
- C. 0.465 crew hours / cubic yard
- D. 0.0015 crew hours / cubic yard

1.c What does calculating the standard deviation of production rates (0.102) tell us about the data?

- A. It provides a test of whether the average is a valid number to use in calculations
- B. It provides a measure of the variation of the rates
- C. That the production rate decreases as the quantity increases
- D. That there is no correlation between production rate and quantity

1.d Another way of expressing the accuracy of the production rates is _____.

- A. 0.465 ± 0.102
- B. 0.429 to 0.633
- C. To increase the number of digits
- D. To increase the accuracy of timesheets on projects

1.e If one establishes a standard that one only uses production rate data that lies plus or minus one sigma of the mean, which (if any) data point(s) should be excluded?

- A. 0.429, 0.633
 - B. One should exclude the highest and lowest values
 - C. 0.375, 0.680, 0.420
 - D. 0.621, 0.680
2. What does using methods of statistical analysis accomplish for the estimator in this instance?
- A. It allows the estimator to judge that he or she should use the mean cost in the estimate.
 - B. It provides a 3-sigma range of costs to use in the estimate
 - C. It gives the estimator a sense of the variation of data in the cost database and assists him or her in judging the cost to be used in the estimate.
 - D. It is of no particular value in determining the cost to be used in the estimate.
3. An estimator is responsible for reviewing the team's estimate. Pareto's Law can be a useful tool in that ...
- A. By carefully selecting the items, the team can review 80% of the cost of the estimate by checking 20% of the items.
 - B. The team can be certain that the estimate is 80% accurate.
 - C. Any 20% of the items reviewed will represent 80% of the cost of the estimate.
 - D. Approximately 80% of the overrun will occur in 20% of the items in the estimate.

SAMPLE

Solutions

1.a A 0.531 crew hours/cubic yard

Commentary: The average production rate is calculated simply, as follows:

Project	Crew hours/cubic yard
1	0.375
2	0.680
3	0.420
4	0.481
5	0.555
6	0.621
7	<u>0.587</u>
Sum	3.719

Average = sum / # of occurrences = 3.719 / 7 = 0.531 crew hours / cubic yard.

1.b C 0.465 crew hours / cubic yard

Commentary: One can calculate the weighted average production rate as follows:

Project	Cubic yards placed	Crew hours/cubic yard	Total crew hours
1	1200	0.375	450
2	420	0.680	289.68
3	391	0.420	164.22
4	288	0.481	138.528
5	61	0.555	38.855
6	55	0.621	34.155
7	126	0.587	73.962
Sums	2547		1184.400

The weighted average is calculated by 1,184.4 / 2,547 = 0.465 crew hours / cubic yard.

1.c B It provides a measure of the variation of the rates.

Commentary: Please note that calculation of the standard deviation of a population is different than the calculation of a sampling of a population. It is noted that the table is “all seven of the company projects” and therefore is a full population. Had this been a sampling of several company projects the standard deviation would have been 0.110

1.d B 0.428 to 0.634

Commentary: This is the range defined by the mean minus the standard deviation to the mean plus the standard deviation.

1.e C 0.375, 0.680, 0.420

Commentary: One sigma is one standard deviation and so the range in question 1.4 identifies the limits of the range. 0.375, 0.680, 0.420 lie outside the range and so under the defined standard, should be eliminated.

2. C It gives the estimator a sense of the variation of data in the cost database and assists him or her in judging the value to be used in the estimate
3. A By carefully selecting the items, the team can review 80% of the cost of the estimate by checking 20% of the items

SAMPLE