Earned Value Professional Certification Study Guide

3rd Edition

A Product of the Education Board of AACE® International

AACE® INTERNATIONAL

The Authority for Total Cost Management®

AACE® International

Earned Value Professional (EVP) Certification Study Guide

Third Edition

Edited by:
Sean T. Regan, CCP CEP FAACE

2015

Earned Value Professional
(EVP)
Certification Study Guide

Printed by CreateSpace

1265 Suncrest Towne Centre
Morgantown, WV 26505-1[illegible]76 USA
Phone: +1 (304) 2[illegible]8444
Fax: +1 (304) [illegible]91-57[illegible]3
E-mail: info@aacei.org
Web: w[illegible]w.aace[illegible].org

ISBN-13: 97[illegible]-15[illegible]2315960
ISBN-10: 1[illegible]02315963

A Special Publication
of
AACE® International–The Authority for Total Cost Management

Earned Value Professional (EVP) Certification Study Guide

2015

A continuing project of the AACE International Education Board
With collaboration from the
AACE Certification Board and AACE Technical Board

Acknowledgments

The 2013/2014 AACE International Education Board is grateful to the following individuals and companies who have assisted in the development of the **EVP Certification Study Guide**, *Third Edition*:

Editor: Sean T. Regan, CCP CEP FAACE

Authors:
Marlene M. Hyde, CCP EVP
Ray Stratton, EVP
Dr. Paul Giammalvo, CCP
Chris Boyd, CCP CEP
Elena Rybina
Sean T. Regan, CCP CEP FAACE MRICS

Reviewers:
Larry Dysert, CCP CEP DRMP
Tony Woodrich, CCP
Robert Loop, EVP PSP
Scott Sanford

2013/2014 Education Board Members:

Peter W. Griesmyer (Chair) FAACE
Chris A. Boyd, CCP CEP
Dr. John O. Evans, III PSP
Donald F. McDonald, Jr. PE CCP PSP FAACE
Dr. Don Mah, P.Eng
Sunu M. Pillai, CCP EVP PSP
Rohit Singh, P.Eng. CCP
Marlene M. Hyde, CCP EVP
Dr. Baabak Ashuri, CCP
Ann Marie Cox, EVP (Co-Chair)
Mark T. Hyden, PE CCP FAACE
Clive D. Francis, CCP FAACE
Dr. Mark Hastak, PE CCP
Marina G. Sominsky, PSP
Sean T. Regan, CCP CEP FAACE MRICS
James G. Zack, Jr. CFCC FAACE FRICS
Carole Ann Venters CCP EVP

AACE International and the Education Board would like to give special thanks to Jacobs Engineering, Administrative Controls Management, Inc. (ACM), PMSOFT Group of Companies, Management Technologies, and LGM International, LLC, for the time and support they provided to the writers and editors of this document. Without their support and the dedication of their writers, reviewers and editor, the timeframe in which this document was written could not have been met.

2012/2013 Education Board Members:

Peter W. Griesmyer (Chair) FAACE
Michael B. Pritchett, CCP CEP FAACE (Co-Chair)
Ann Marie Cox, EVP
Clive D. Francis, CCP FAACE
Dr. Mark Hastak, PE CCP
Bryan Payne, PE CCP CFCC
Sean T. Regan, CCP CEP FAACE MRICS
Chris A. Boyd, CCP CEP
Dr. John O. Evans, III PSP
Prof. John (Jeff) Hannon, CEP
Donald F. McDonald, Jr. PE CCP PSP FAACE
Sunu M. Pillai, CCP EVP PSP
James G. Zack, CFCC FAACE FRICS

Table of Contents

List of Figures

List of Tables

Design, editing, formatting, proofing
of this **Earned Value Professional (EVP) Certification Study Guide**
coordinated by the AACE International Headquarters Publications Department

Charity A. Golden, MBA CIA, Executive Director
John Hines, Manager, Education
Penny Whoolery, Manager, Certification
Marvin D. Gelhausen, Managing Editor
Noah Kinderknecht, Art Director

Preface

AACE International developed the "Earned Value Professional (EVP) Certification Study Guide" for two reasons. First it is to aid professionals studying for AACE International's (AACE) specialty certification in earned value management (EVM). Second, to assemble and summarize various topics considered essential for earned value management professionals' knowledge, as outlined in AACE International's Recommended Practice 11R-88, "*Required Skills and Knowledge of Cost Engineering.*"

The "Earned Value Professional Certification Study Guide" (study guide) serves the needs of EV professionals who are preparing to take the AACE International Earned Value Professional (EVP) certification examination. It is organized in a concise and easy-to-follow format and covers the major skills and knowledge used by a EV professional.

The information contained in the study guide parallels the related topics of the "Skills and Knowledge of Cost Engineering" and the "Certified Cost Professional (CCP®) Certification Study Guide." These publications can be combined for a course of study in both cost engineering and earned value management, which include sample problems related to the subject matter.

Most terms and phrases incorporated in the study guide are generic to the profession; where applicable, however, professionals should understand the definitions provided in AACE International's Recommended Practice 10S-90, *Cost Engineering Terminology,* and the terms found in the glossary of this study guide. The terms and phrases used in industry and software may not conform to the readers' understanding, so consult the EVP glossary found in Appendix A.

The goal of the AACE International Education Board is continually to improve this publication, making it a living document that will be revised as needed to support the EVP exam, while maintaining its strengths. AACE's Education Board encourages everyone to offer comments and suggestions for improvements to future editions; please forward comments to the AACE International Education Board at: education@aacei.org.

Please see **Introduction to the EVP Certification Study Guide** on page 9

Introduction to the EVP Certification Study Guide

This is a study guide for the Earned Value Professional (EVP) certification examination sponsored by AACE International, the Authority for Total Cost Management.

The following systematic approach was used to develop this guide:

1. Review basic Earned Value Management (EVM) concepts.
2. Establish the terminology used in EVM in a way that is consistent with the ANSI/EIA 748 C, September 2013 standard and AACE Recommended Practice 10S-90, *Cost Engineering Terminology*, which has been adopted by ANSI.
3. Review the EVM process.
4. Review methods for monitoring a project by using EVM.
5. Review methods of reporting, executing, and forecasting project performance using EVM.
6. Ensure consistency with AACE International's Total Cost Management (TCM) Framework, as shown in figure 1.

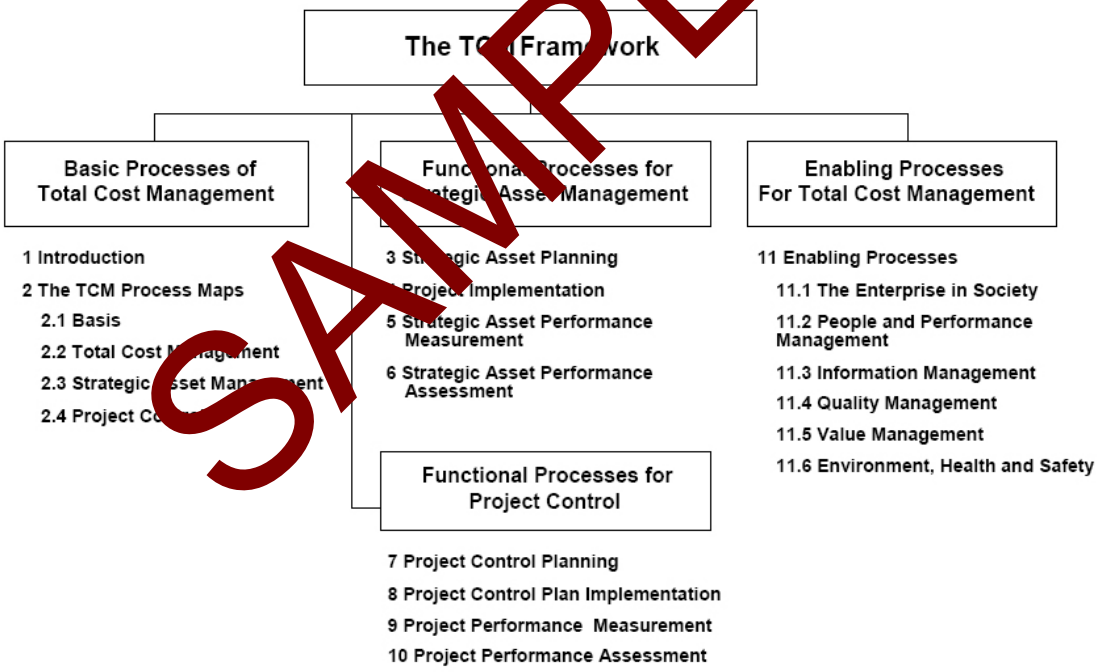

Figure 1—Outline Structure of AACE International's TCM Framework

As shown in figure 1, EVM comprises a critical part of the functional processes for project control. EVM is a specific methodology that includes planning, performance measurement and assessment steps. EVM contains many elements of the project controls process, as described in the AACE publication, **Total Cost Management Framework**, *Part III. Project Control Process*. While the TCM Framework process is not limited to EVM methods, it is consistent with them. This is illustrated by the *TCM Process Map for Project Performance Measurement* (from the TCM Framework, *Section 9.2, Progress and Performance Measurement*), shown in this study guide as figure 2. It includes general measurement steps that apply to EVM, as well as the process map. A the *TCM Process Map for* Project Performance Assessment (TCM Framework, *Section 10.1*) shown in figure 3,, as well as a *TCM Process Map for Change Management* (TCM Framework, Section 10.3) shown in figure 4, that includes general project assessment steps applicable to EVM. It should be noted that there are a number of other areas within TCM that are applicable in EVM (for example, but not limited to: TCM Framework, *Section 8.1 – Project Control Plan Implementation*, and *Section 9.1 – Project Cost Accounting*).

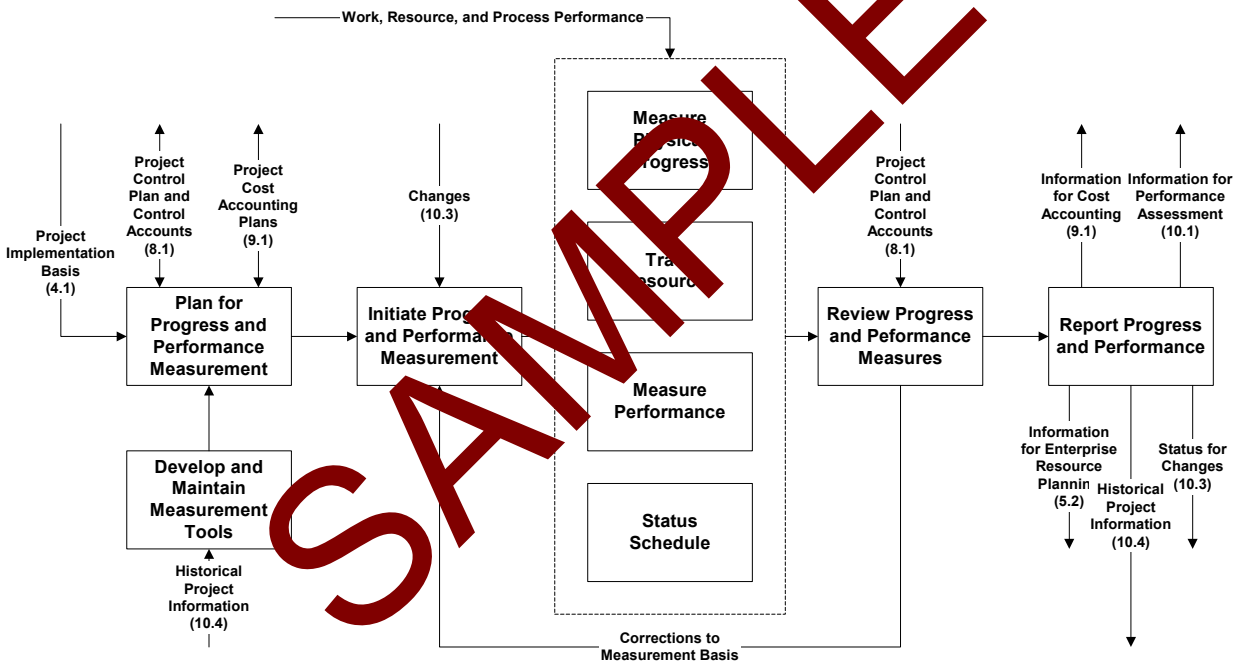

Figure 2—The TCM Process Map for Project Performance Measurement

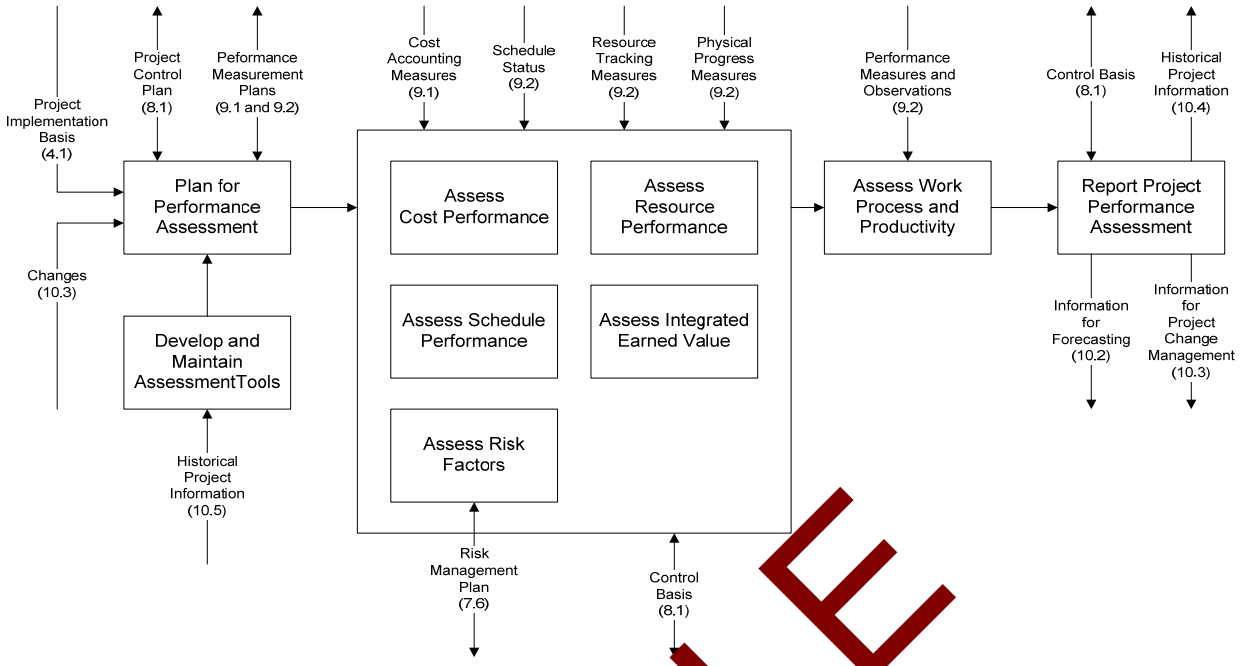

Figure 3—Process Map for Project Performance Assessment

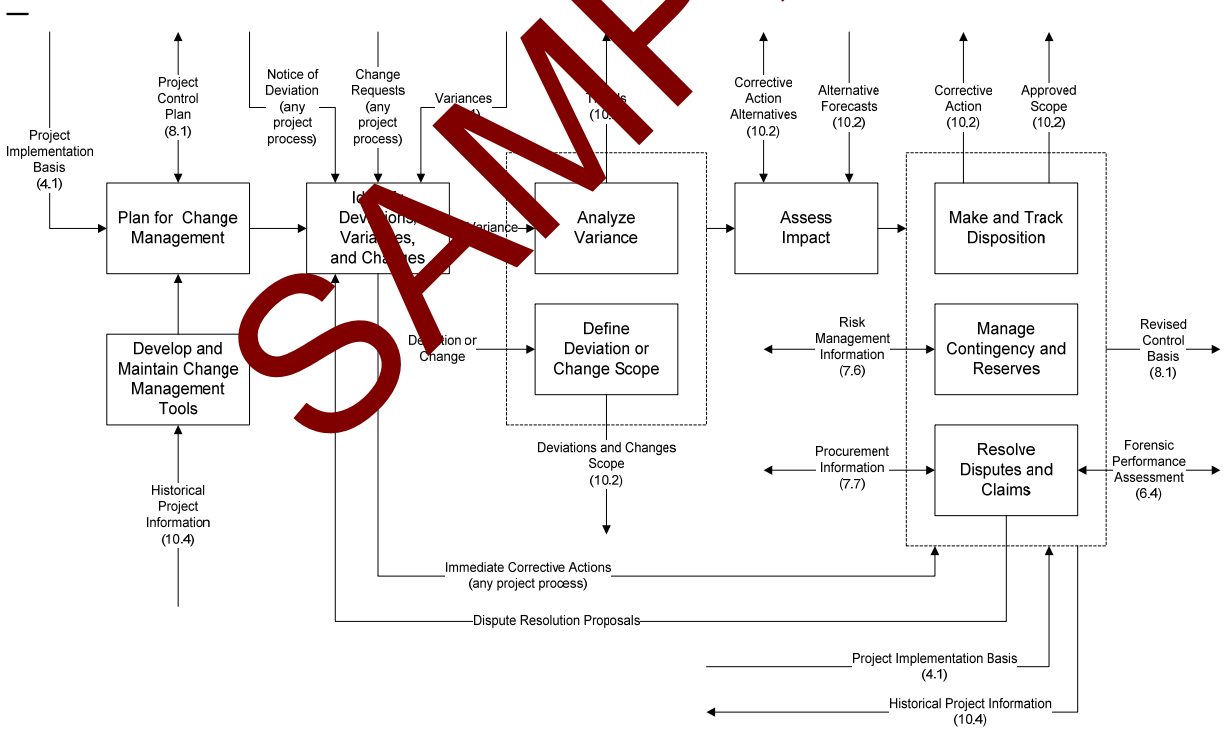

Figure 4—Process Map for Change Management

The overall learning objectives of this *Study Guide* are:

- Understand the basis of EVM within the TCM Framework process.
- Know the evolution of EVM.
- Describe what is essential to plan and implement an earned value management system (EVMS).
- Understand and be able to execute the measurement and tracking of EV as a basis of project management. And,
- Provide the basis for AACE International's EVP Certification within the TCM Framework of figure 2.

References

These are the references providing the basis of knowledge outlined in this guide (Please visit www.aacei.org for the most current version of the referenced AACE Recommended Practices (RP) as the RPs are periodically updated):

1. **AACE International Recommended Practice (RP) 10S-90**, *Cost Engineering Terminology*. (2014).
2. **AACE International Recommended Practice (RP) 11R-88**, *Required Skills and Knowledge of Cost Engineering*. (2013).
3. **AACE International Recommended Practice (RP) 14R-90**, *Responsibility and Required Skills for a Planning and Scheduling Professional*. (2006).
4. **AACE International Recommended Practice (RP) 23R-02**, *Planning and Scheduling Identification of Activities*. (2007).
5. **AACE International Recommended Practice (RP) 24R-03**, *Planning and Scheduling, Developing Activity Logic*. (2004).
6. **AACE International Recommended Practice (RP) 52R-06**, *Time Impact Analysis—As Applied in Construction*. (2006).
7. **AACE International Recommended Practice (RP) 75R-13**, *Schedule and Cost Reserves within the Framework of ANSI EIA-748*. (2013).
8. **AACE International Recommended Practice (RP) 81R-13**, *Required Skills and Knowledge of Earned Value Management*. (2014).
9. **AACE International Recommended Practice (RP) 83R-13**, *Organizational Breakdown Structure and Responsibility Matrix*. (2014).
10. American National Standards Institute/Electronic Industries Alliance Standard (ANSI/EIA) 748 C; September 2013, *Earned Value Management Systems*.
11. Amos, S. (Ed.). **Skills & Knowledge of Cost Engineering**, 5th Edition. (See especially Section 4, *Progress and Cost Control*). (2004).
12. Bramble, B. and M. Callahan. **Construction Delay Claims**, 3rd Edition, (2007).
13. Budd, Charles, and Charles Budd, **A Practical Guide to Earned Value Project Management**, 1st Edition (2010).
14. Crawford, T. (Ed.). **AACE International Professional Practice Guide (PPG) No. 4**, *Planning and Scheduling*, 2nd Edition, (2006).
15. Fleming, Q. and J. Koppelman. **Earned Value Project Management**, 3rd Edition, (2005).
16. Government Accounting Office (GAO), **Cost Estimating and Assessment Guide**, GAO-09-3SP (2009).
17. Glavinich, T. **Construction Planning and Scheduling Manual**, 2nd Edition, (2004).
18. Haugan, G. **Project Planning and Scheduling**, (2001).
19. Hollman, J. (Ed.). **Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management**, AACE International, (2006).
20. Humphreys and Associates. **Project Management Using Earned Value**, (2002).
21. Kemps, Robert R. **Fundamentals of Project Performance Measurement**, 5th Edition, (2007).
22. Kerzner, H. **Project Management: A Systems Approach to Planning, Scheduling and Controlling**, 9th Edition, (2005).
23. Marshall, R. (Ed.). **AACE International Professional Practice Guide (PPG) No. 5**, *Earned Value*, 2nd Edition, (2007).

24. National Defense Industrial Association (NDIA) Program Management Systems Committee (PMSC). **Earned Value Management Systems Intent Guide**. http://management.energy.gov/documents/NDIA_PMSC_EVMS_IntentGuide_Nov_2006.pdf
25. O'Brien, J. and F. Plotnick. **CPM in Construction Management**, 6th Edition (2005).
26. Regan, S., **EVMS System Manual**, 1st Edition (2012)
27. Pritchett, M. (Ed.). **CCP Certification Study Guide**, 1st Edition. (See especially Section 4, *Progress and Cost Control*.) AACE International, (2014).
28. Wickwire, J., T. Driscoll, and S. Hurlbut. **Construction Scheduling: Preparation, Liability and Claims**, 2nd Edition, (2007).

This **EVP Certification Study Guide** assumes a basic knowledge of EVM on the part of the candidate. The study guide addresses EVM knowledge and skills that are non-industry specific.

This manual guides the student to learn the basic terminology and processes for the earned value management process. However, an individual's company or industry may dictate or emphasize other methods or means as part of the EVM process of a project or program implementation.

The *study guide* is organized according to the EVP body of knowledge and this body of knowledge is described at the beginning of each individual section. The recommended examination preparation should include review of many of the references listed above. The candidate must also draw knowledge from personal EVM experience.

Origin of Earned Value Management

The Earned Value Management System, or EVMS, is not a new concept. In fact, according to Lt. Gen. (USAF) Hans H. (Whitey) Driessnack, it was derived from the factory floor in the late 1800's. Planned, earned, and actual standards were the terminologies used then:

"*The earned value concept came to us right off the factory floor, from the industrial engineers who were comparing their planned standards with the earned standards and the actual costs. We simply applied this same concept to our one-time only, non-recurring developmental tasks*." [Driessnack, 1990].

In the 1950s, "cost variance" was defined by industrial engineers as the difference between the actual costs expended as compared to the earned standards achieved. This is an early indication of the correct application of modern earned value analysis methods.

PERT/Cost, Late 1950s-Early 1960s

The earned value concept evolved over time in major phases. Much of the material below is taken from Quentin Fleming in his book, Earned Value Project Management, 2nd Edition [Project Management Institute, 2000].

The scheduling methodologies that underlie today's earned value systems derived from two types of schedule logic networks:

- *Activity-on-Node (AON) Network* also referred to the *Arrow Diagramming Method* (ADM).
- *Precedence Diagram Method* (PDM) *Network*.

The *Program Evaluation and Review Technique* (PERT) was developed by the US Navy in 1958, to manage the Polaris Missile Program. Its objective was to simulate the schedule risk of the missile Research & Development program work using a flow diagram technique that, in turn, lent itself readily to scheduling and network analysis. However, its complexity made it unpopular and limited its applicability as a tool for general scheduling. The scheduling methodology called *Critical Path Method* (CPM) was developed at about the same time by a DuPont engineer using the *Activity-on-Arrow* (AOA) method for network development, and it became a more readily accepted basis for scheduling. While not identical, procedures for both techniques were similar and leveraged the computational capabilities provided by electronic computers.

According to Fleming, "Most of the networks today that are called PERT are actually *Precedence Diagram Method* (PDM) networks, not true PERT networks." The importance of PERT to earned value, however, lies in the implementation of the PERT/cost models in industry. With the implementation of PERT in 1962, eleven reporting formats were required, one of those being a "cost of work report," which required the measurement and comparison of "value of work performed" versus the "actual costs." This was a beginning of the modern earned value technique as a project management tool as we know it today.

Cost/Schedule Control Systems Criteria (C/SCSC): 1967 to 1996

The development of the C/SCSC was led by the US Air Force, which endeavored to determine if contractors involved in the development of systems could do so while observing certain simple management criteria. According to Driessnack, an interview of an individual who was actually

involved in the development of this system revealed that these criteria covered the following questions:

- Does the contractor break down the work into short span packages that can be budgeted, scheduled, and evaluated?
- Does the contractor have a system for accumulating costs?
- Does the contractor measure performance on these work packages? And,
- Does the contractor report status and variances to their own internal management?

When initially implemented, the US Department of Defense (DoD) imposed 35 criteria on any contractor desiring to perform work on cost reimbursable or cost incentive contracts, over a certain funding threshold. This system was adopted by many governmental agencies.

According to Fleming, although generally beneficial in its ultimate effect, the C/SCSC had mixed results. Although much valuable project data was gained, the system grew ever more bureaucratic and difficult for contractors to implement and maintain on projects. Many of the more detailed aspects of system implementation were resisted by contractors. In fact, it was not adopted by private industry for a number of reasons. Much of the rejection of the C/SCSC was based on the need to understand a new set of terminologies that were not intuitive to many project managers, such as using the term *Budgeted Cost for Work Scheduled* (BCWS) instead of the word "planned"; *Budgeted Cost for Work Performed* (BCWP) instead of "earned;" and *Actual Cost of Work Performed* (ACWP) instead of "spent." Additional frustration was experienced by practitioners in the field through the adoption of other confusing terms within the system that, they believed, served to only cloud the simpler project issue of cost over-runs and schedule delays.

EVMS (ANSI/EIA 748): 1996 to Present

Feedback from practitioners and the refusal of private industry to adopt the C/SCSC led the US government to revise it and develop a simpler system that would be accepted by the private sector.

This demonstrated conclusively that EVM mattered to secretary-level leadership. In the 1990s, many U.S. Government regulations were eliminated or streamlined. However, EVM not only survived the acquisition reform movement, but became strongly associated with the acquisition reform movement itself. Most notably, from 1995 to 1996, ownership of EVM criteria (reduced to 32) was transferred to industry by adoption of ANSI EIA 748-A standard [7].

The National Defense Industrial Association (NDIA) led this effort, reducing the number of system performance criteria from 35 to 32. The result of NDIA's work was called the "*Earned Value Management System*" (EVMS), which was adopted by the Department of Defense in December 1996, and incorporated into *DoD Instruction 5000.2R*. Wider application of this system outside the realm of the DoD was the goal of its 32 guidelines being reflected in American National Standard Institute/Electronic Industry Association (ANSI/EIA) 748 Guide that was issued in 1998. The ANSI/EIA 748 B Guide was published in July 2007 and C issued September 2013.

With a return to a simpler, more intuitive approach as represented by EVMS, private industry adoption of EVM techniques grew in recognition of it being a "best-practice methodology." The passage of the Sarbanes-Oxley (SOX) Act in 2002, which intended to more effectively detect fraud in corporate operations, has further strengthened the standing of the EVM method as a robust means to ensure that project execution proceeds in a transparent.

EVP Certification Examination Structure

Introduction

Certification as an Earned Value Professional (EVP) requires passage of a written examination in addition to other experience criteria as set forth by AACE International. This study guide provides information for preparing to take the EVP examination, however it is recommended that the latest version of ANSI-748 be studied as it is the basis for the examination.

Examination Basis

The purpose of any professional certification or licensing program is to provide a mechanism to formally and objectively evaluate and publicly recognize the capabilities of an individual in a defined skill area. Certification as an Earned Value Professional (EVP) recognizes certificate holders who have demonstrated their expertise in Earned Value Management (EVM). Specifically, EVM includes the following:

- organizing;
- planning, scheduling and budgeting;
- accounting considerations;
- analysis and management reports; and,
- revisions and data maintenance.

These EVM components provide the basis for the AACE International certification examination. The examination tests for proficiency across these areas.

To define EVM more specifically in terms of expected skills and knowledge, AACE International has published several Earned Value Recommended Practices (RP). Please refer to the RPs for additional technical background which will be useful during the examination. In addition, other references include the ANSI-748, the National Defense Industrial Association (NDIA) Intent Guide dated 2014, and the Recommended Practices for the basis for the EVP examination. Other helpful documents include the GAO Cost Estimating and Assessment Guide dated March 2009 and the GAO Scheduling Guide dated 2013; the DOD EVM Guide; the PASEG Planning and Scheduling Excellence Guide. In recognition of this, the examination addresses the following.

- minimum knowledge covered by the basic skills documents; and
- advanced knowledge based upon EVM experience.

A professional project controls engineer specializing in EVM is expected to keep abreast of these advances and demonstrate this awareness in the examination.

Computer-Based Examination Schedule

Computer-based examinations are offered year-round in over 500 locations around the world. When you're ready to take the examination, submit your application to AACE Headquarter along with payment. Once you're approved for the examination, contact the Kryterion office to schedule the location and date that you want to take the examination. The exam must be taken within a specified period of time after approval.

Examination Format

The examination consists of four parts

- **MULTIPLE CHOICE EXAMS**: The exam is delivered through computer based testing (CBT)* and is comprised of multiple-choice and compound, scenario questions.

- **MEMO ASSIGNMENT**: The memo assignment will allow the candidate to choose from an onscreen list of suggested scenarios and will require the candidate to demonstrate professional writing skills and a general knowledge around an estimating competency. The memo will be written in the text box provided onscreen and should demonstrate a candidate's ability to organize thought and communicate effectively. The memo will need to be addressed properly, include a purpose statement, describe the potential impact of any described problem or issue, propose a clear actionable solution with supporting rationale and include a closing statement. In addition to demonstrating technical knowledge, successful candidates will be recognized for applying appropriate Enabling Knowledge. See also Appendix C for additional and more comprehensive guidance notes

The exam is closed book. Candidates are permitted to bring any simple or calculator, including programmable calculators, to use during the exam.

The examination is not based upon use or knowledge of specific software, but rather embodies the knowledge and experience of a DRM practitioner using such tools. All materials provided during the examination, including work paper, must be turned in upon completion of the examination.

Recognizing that there are many industries and fields within the profession—engineering, construction, manufacturing, process facilities, mining, utilities, transportation, aerospace, environment and government—candidates can expect questions from any of these practices. The exam takes into account the fact that no one can be expected to be conversant in all practice areas through its multiple-option format and extensive use of questions of general applicability.

EVP candidates are expected to have fairly broad skills, knowledge, and experiences in cost engineering in addition to specific EVM skills and knowledge. While it is not required, candidates will benefit from first passing the CCP examination because of the exams' shared skills and knowledge of total cost management (TCM) and cost engineering in general and economic analysis in particular. However, passing the EVPP is not a substitute for nor does it indicate achievement of the CCP. EVM professionals cannot provide effective support to decision makers and project leaders without understanding the context of the relevant asset and project management process.

Earned Value Management goes beyond the CCP with respect to skills and knowledge of EVM process steps (as shown in figures 3 and 4) and incorporated methods such as decision analysis, risk analysis, and contingency analysis. These methods require strong quantitative skills and knowledge, particularly in the areas of probability, statistics, and modeling. Finally, communication skills are vital to making sure earned value skills are identified and understood, particularly among stakeholders, decision makers, and managers who have strong expectations and biases. Before investing in the effort and expense required for taking the exam, candidates should review objectively their understanding, skill, and experience of this diverse body of knowledge.

Chapter 1.0—Organization

Introduction

Organizing the work is the initial task for planning any project or task. Organization entails defining the project or task scope of work and the groups or individuals that will be responsible for the various execution phases of any task or project. The organizational elements of a *Program* or *Project Management Office* (PMO) consist of, at a minimum, the *Work Breakdown Structure* (WBS), *Organizational Breakdown Structure* (OBS), *Work Authorization* (WA) process and documents, and a *Responsibility Assignment Matrix* (RAM).

The OBS reflects the company's organization as integrated with a particular PMO to support a specific project. Many organizations operate as a matrix organization and others may use an *Integrated Product Team* (IPT) approach. A PMO is usually established to be responsible for the business and technical management of the project.

Terms to Know

- *Program* or *Project Management Office* (PMO);
- *Work Breakdown Structure* (WBS);
- *Organization Breakdown Structure* (OBS);
- *Work Authorization* (WA);
- *Work Authorization Document* (WAD);
- *Responsibility Assignment Matrix* (RAM);
- *Integrated Product Team* (IPT);
- *Budgeted Cost for Work Scheduled* (BCWS); also referred to as *Planned Value* (PV);
- *Budgeted Cost for Work Performed* (BCWP); also referred to as *Earned Value* (EV);
- *Actual Cost of Work Performed* (ACWP); also referred to as *Actual Cost* (AC);
- *Budget at Completion* (BAC), and,
- *Estimate at Completion* (EAC).

Key Points for Review

Organization is the key in developing a system for execution and management of a project supported by an EVMS.

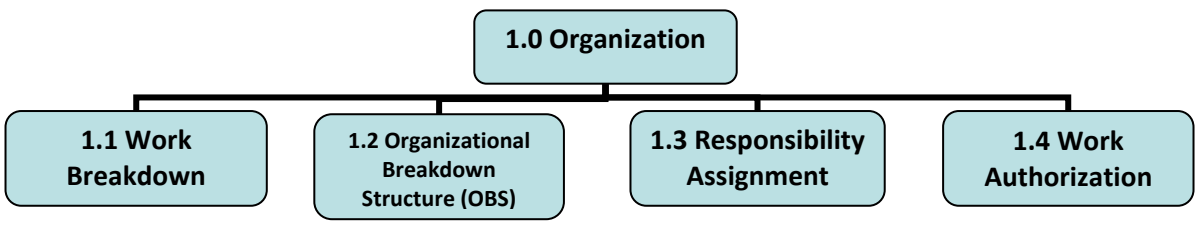

Figure 1.0 —EVP Body of Knowledge Diagram for Organization

Section 1.1 Work Breakdown Structure (WBS)

Introduction

The *Work Breakdown Structure* is the fundamental building block of an earned value management system. It is the "What" of the EVM system. The WBS provides the framework by which all project effort is organized so it can be scheduled, budgeted, authorized, measured, and reported. The WBS is an organized, hierarchical decomposition of project scope that serves as the backbone for the planning and management of the project. The WBS contains all of the work scope required by the contract, called the *Statement of Work* (SOW). It may also be referred to as *the Statement of Objectives (SOO)* or other government document.

The WBS is developed by decomposing the program into its various deliverables and services. It should be based on deliverables rather than on functions. Each deliverable is continually decomposed until all tasks necessary to complete the project are identified *and assigned to a specific party or team, and all resources essential to accomplish the tasks are assigned* in detail to the tasks. The deliverable-orientation of the structure allows for effort to be estimated for the identified tasks, the effort to be translated into an estimated cost, and the estimated costs to be rolled-up to sub-deliverables of the program. This, in turn, allows for the balancing of scope to budget that is crucial for a successful earned value management program.

The *WBS Dictionary, a separate document from the WBS* provides definitions of each WBS element and is a cross reference between WBS elements and the corresponding project statement of work, mission statement, or other customer documents that define the scope of work. It is essential that the cross reference be checked for completeness against the SOW and that no work included in the *WBS Dictionary* is in excess of the SOW scope. The latter is necessary to ensure that no work is being performed that is outside of the contractual requirements. It also is used to validate the opposite that all of the SOW has been planned within the WBS structure. The WBS Dictionary that defines the WBS elements must be unique to the project or program. Typically, the WBS Dictionary should include the number, title, definition of the scope, any deliverables under that WBS element, and the organization responsible for performing the work. See example shown in figure 1.1 for a sample WBS.

Each WBS element should be identified in a numeric (or alpha or alphanumeric combination) hierarchy such that each element is associated with a unique identifier that also identifies the level at which the element exists. Often numeric indenture levels are separated by periods. Normally, the customer defines the top two or three levels of the contract WBS (CWBS) and the contractor further defines the WBS to the lowest managerially significant level depending on the complexity of the project. The WBS must go down to at least the level required for management control, however it may be extended below this to the work package or even to activities/milestones/or charge numbers.

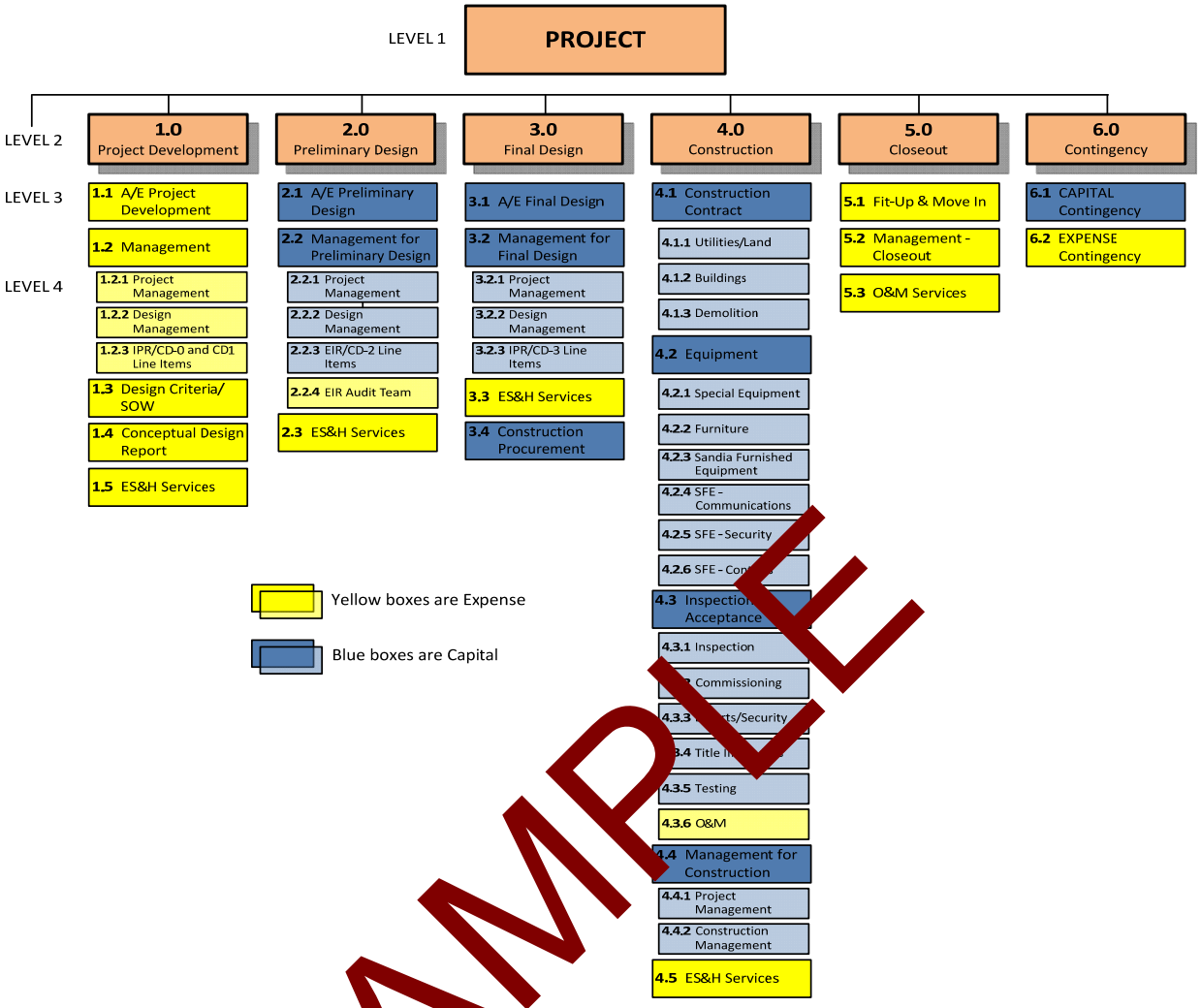

Figure 1.1—Sample WBS

Terms to Know

- *Work Breakdown Structure* (WBS);
- *Statement of Work* (SOW);
- *WBS Dictionary*;
- *WBS number*; and,
- *WBS level.*

Key Points for Review

1. Know why the WBS should never over or under-represent the full project scope.
2. Know how the WBS graphically displays products and services.
3. Know the relationship between the WBS and SOW. And,
4. Know how to develop the *WBS Dictionary*.

Please see **Sample Questions for Section 1.1** on page 23

Sample Questions for Section 1.1:

1. Which of the following is not a component of the *Work Breakdown Structure*?

   A. Scope
   B. Deliverables
   C. Numeric designator
   D. WBS Dictionary

2. The WBS numeric designator 01.02.023.01.502.06 typically represents what level of the WBS hierarchy?

   A. 4
   B. 5
   C. 6
   D. 7

3. Which of the following statements about the WBS is not true?

   A. A project consists of the sum of all the WBS elements.
   B. Any element that is not contained in the WBS is not part of the project.
   C. Any work that cannot be identified in the WBS requires an approved change order.
   D. The WBS contains functional elements such as engineering and manufacturing.

4. A WBS:

   A. Is derived from the project schedule network logic diagram.
   B. Is derived from the conceptual cost estimate for the project.
   C. Always has five hierarchical levels.
   D. Is the structure by which the project scope is decomposed into manageable components.

Solutions to Sample Questions for Section 1.1:

1. D The WBS Dictionary is not part of the WBS, but is a separate document.

2. C Six levels, as identified by the break, which is normally a period.

3. D A WBS is the "What." The WBS should be based on deliverables, not on functions. Functions are the "Who" and belong in the *Organizational Breakdown Structure* (OBS).

4. D The WBS divides the project into manageable scopes of work, which are assigned to responsible parties with necessary management authority.

