Project Management Institute

# *Practice Standard for Earned Value Management*

Practice Standard for Earned Value Management
ISBN: 1-930699-42-5

Published by: Project Management Institute, Inc.
Four Campus Boulevard
Newtown Square, Pennsylvania 19073-3299 USA.
Phone: 610-356-4600 / Internet: www.pmi.org

Cover and interior design: Automated Graphic Systems, Inc.



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# Preface

The *Practice Standard for Earned Value Management (EVM)* has been developed as a supplement to *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. The *Practice Standard for EVM* is designed to provide readers who are familiar with the *PMBOK® Guide* with a fundamental understanding of the principles of EVM and its role in facilitating effective project management.

The *Practice Standard for EVM* assumes that the reader has a basic working knowledge of Project Management Process Groups, Knowledge Areas, and other key concepts such as work breakdown structures (WBS) and critical path method (CPM) scheduling, as outlined in the *PMBOK® Guide*. If that is not the case, it is recommended that the reader undertake a review of the *PMBOK® Guide* before reading the *Practice Standard for EVM.*

The *Practice Standard for EVM* is organized as follows:

**Introduction.** A brief overview of EVM, highlighting the key management questions EVM can help answer and exploring where EVM fits into the project management universe.

**Basic Elements of Earned Value Management.** This section discusses the three cornerstones of EVM: **Planned Value (PV), Earned Value (EV)**, and **Actual Cost (AC)**. It examines how these three data points are determined and how they relate to one another.

**EVM Performance Analysis and Forecasting.** This section describes variances, indices, and forecasts that can be developed using **Planned Value (PV), Earned Value (EV)**, and **Actual Cost (AC)**. The chapter also examines how these variances, indices, and forecasts can be used to answer essential management questions.

**Guidance for the Use of Key EVM Practices.** This section outlines basic EVM practices in their project management context and shows how EVM practices facilitate project planning and control for better management of project cost and schedule performance.

**Glossary.** This section provides concise definitions of key terms used throughout this Practice Standard. Most of these terms also appear in the *PMBOK® Guide*—Third Edition's glossary. Note, however, that many of the *PMBOK® Guide's* definitions are broader and more inclusive, since they apply beyond the scope of the *Practice Standard for Earned Value Management*.

**Appendices.** These offer additional sources of EVM concepts and methods for further study and information related to the development of the Practice Standard.

Chapter 1

# Introduction

## 1.1 THE ROLE OF EARNED VALUE MANAGEMENT

Feedback is critical to the success of any project. Timely and targeted feedback can enable project managers to identify problems early and make adjustments that can keep a project on time and on budget.

Earned Value Management (EVM) has proven itself to be one of the most effective performance measurement and feedback tools for managing projects. It enables managers to close the loop in the plan-do-check-act management cycle.

EVM has been called ''management with the lights on'' because it can help clearly and objectively illuminate where a project is and where it is going—as compared to where it was supposed to be and where it was supposed to be going. EVM uses the fundamental principle that patterns and trends in the past can be good predictors of the future.

EVM provides organizations with the methodology needed to integrate the management of project scope, schedule, and cost. EVM can play a crucial role in answering management questions that are critical to the success of every project, such as:

- Are we ahead of or behind schedule?
- How efficiently are we using our time?
- When is the project likely to be completed?
- Are we currently under or over our budget?
- How efficiently are we using our resources?
- What is the remaining work likely to cost?
- What is the entire project likely to cost?
- How much will we be under or over budget at the end?

If the application of EVM to a project reveals that the project is behind schedule or over budget, the project manager can use the EVM methodology to help identify:

- Where problems are occurring
- Whether the problems are critical or not
- What it will take to get the project back on track.

## 1.2 EVM AND THE PROJECT MANAGEMENT PROCESS

The effective use of EVM requires that it is used on projects where the principles of good project management, as outlined in *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide*), are being applied. To establish a basic foundation for understanding EVM's role in effective project management, it is important that we examine the relationship between EVM and the *PMBOK® Guide's* Project Management Process Groups and Knowledge Areas.

Project management is primarily a matter of planning, executing, and controlling work. Figure 1-1 indicates the areas of project management to which EVM is fundamentally most applicable.

| Knowledge Areas | Process Groups | | | | |
|---|---|---|---|---|---|
| | Initiating | Planning | Executing | Controlling | Closing |
| Integration | | X | X | X | |
| Scope | | X | | X | |
| Time | | X | | X | |
| Cost | | X | | X | |
| Quality | | | | | |
| Human Resources | | | | | |
| Communications | | X | X | X | |
| Risk | | X | | X | |
| Procurement | | X | | X | |

X — One or more project management processes for which EVM is fundamentally applicable

One or more project management processes for which EVM is of little significance

No project management process is mapped here

**Figure 1-1.** EVM and Project Management

Project planning is mostly a matter of determining:

- What work must be done (scope) and in what pieces (work breakdown structure)
- Who is going to perform and manage the work (responsibility assignment matrix)
- When the work is going to be done (schedule)
- How much labor, materials, and related resources the work is going to require (cost).

Project execution is primarily a matter of doing the planned work and keeping workers and managers informed.

Project control focuses mostly on monitoring and reporting the execution of project management plans related to scope, schedule, and cost, along with quality and risk. In other words, project control is a process for keeping work performance and results within a tolerable range of the work plan.

As a performance management methodology, EVM adds some critical practices to the project management process. These practices occur primarily in the areas of project planning and control, and are related to the goal of measuring, analyzing, forecasting, and reporting cost and schedule performance data for evaluation and action by workers, managers, and other key stakeholders. See Figure 1-2.

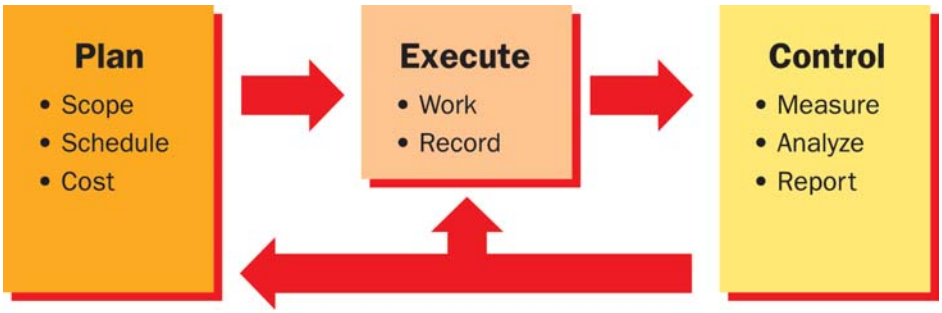



**Figure 1-2.** EVM and the Basic PM Process

During the project planning process, EVM requires the establishment of a performance measurement baseline (PMB). This requirement amplifies the importance of project planning principles, especially those related to scope, schedule, and cost. EVM elevates the need for project work to be executable and manageable, and for the workers and managers to be held responsible and accountable for the project's performance.

Project work needs to be broken down—using a work breakdown structure—into executable tasks and manageable elements often called control accounts. Either an individual or a team needs to manage each of the work elements. All of the work needs to be assigned to the workforce for execution using an organization breakdown structure (OBS). See Figure 1-3 and Box 1-1.

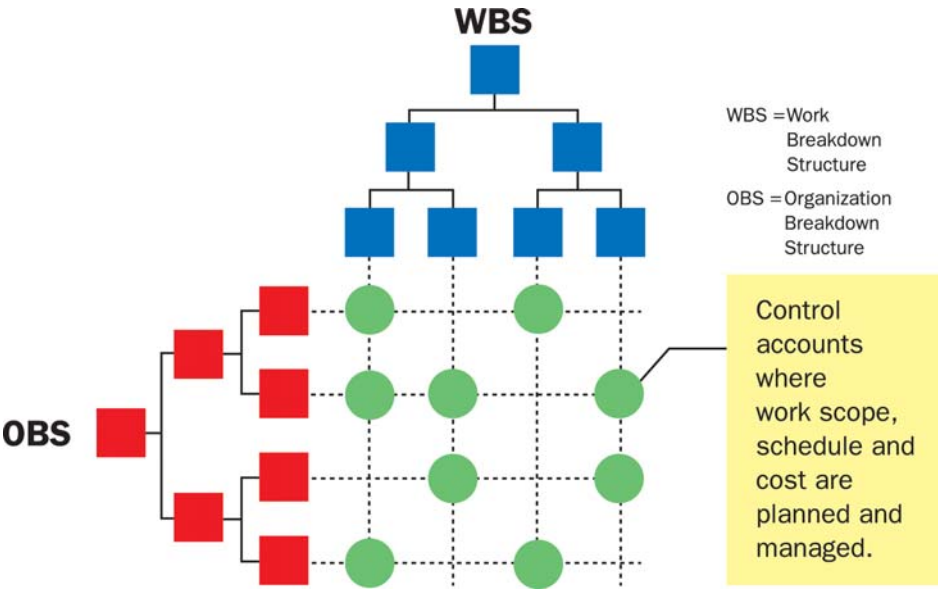



**Figure 1-3.** Control Account Matrix

Project work needs to be logically scheduled and resourced in a work plan; the work scope, schedule, and cost need to be integrated and recorded in a time-phased budget known as a performance measurement baseline (PMB). Figure 1-4 illustrates a hypothetical work plan with a Gantt (bar) chart, to which earned value measurement

**Box 1-1: Scaling EVM to Fit Varying Situations**

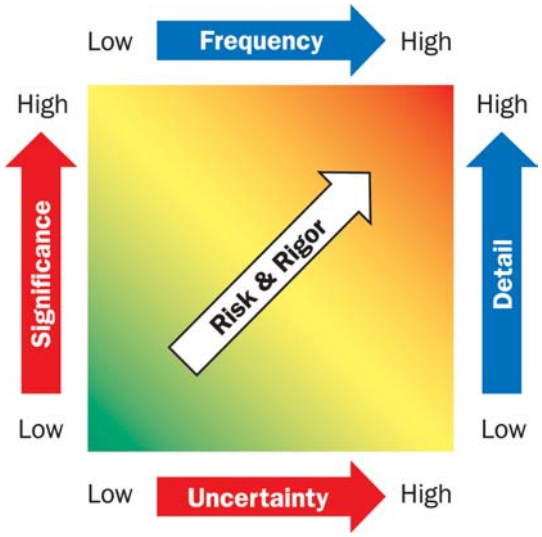
EVM, as well as project management, needs to be tailored to fit the specific project situation to be effective and efficient. Project situations vary along two fundamental dimensions, the **significance** and the **uncertainty** of the project:

Significance has to do with the impact of project success or failure, and uncertainty has to do with the likelihood of success or failure. Factors that affect significance include financial, political, and environmental considerations, while factors that contribute to project uncertainty include its size, complexity, and duration. These and other uncertainty factors can interact with the project management maturity of the performing organization to amplify or dampen their effects.

As project significance and uncertainty increase, the rigor with which EVM is applied also needs to increase. There are two basic dimensions to EVM rigor, the **granularity** and the **frequency** of the measurement of project performance:

Granularity refers to the level of detail to which the project work scope is broken down using a WBS. Frequency is the time interval at which project performance is assessed, analyzed, and reported, ranging from daily to monthly or longer. EVM implementation can be scaled along the dimensions of granularity and frequency to achieve the degree of rigor required by the significance and the uncertainty of the project. The figure below shows a notional model of the "risk-rigor" relationship.

**EVM Rigor as a Function of Project Risk**




techniques (described in Chapter 2) have been added. Figure 1-5 displays the PMB for the hypothetical work plan (also described in Chapter 2).

In the planning process, the means for assessing physical work progress and assigning budgetary earned value also needs to be established. In addition to routine project management planning, earned value measurement techniques are selected and applied for each work task, based on scope, schedule, and cost considerations.

In the project execution process, EVM requires the recording of resource utilization (i.e., labor, materials, and the like) for the work performed within each of the work elements included in the project management plan. In other words, actual costs need to be captured in such a way that permits their comparison with the performance measurement baseline.

| Task | Budget | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 6 | | | | | | | | | | |
| 1 | 12 | | | | | | | | | | | | |
| | | | 8 | 12 | 16 | 12 | | | | | | | |
| 2 | 48 | | | | | | | | | | | | |
| | | | | | | 7 | 21 | | | | | | |
| 3 | 28 | | | | | | | | | | | | |
| | | | | | | | | 18 | | | | | |
| 4 | 18 | | | | | | | | | | | | |
| | | | | | | | | 4 | 8 | 10 | 6 | | |
| 5 | 28 | | | | | | | | | | | | |
| | | | | | | | | | | | | 8 | 8 |
| 6 | 16 | | | | | | | | | | | | |
| Σ | 150 | 6 | 14 | 12 | 16 | 19 | 21 | 22 | 8 | 10 | 6 | 8 | 8 |
| CUM | - | 6 | 20 | 32 | 48 | 67 | 88 | 110 | 118 | 128 | 134 | 142 | 150 |

**Figure 1-4.** Work Plan—Gantt (Bar) Chart

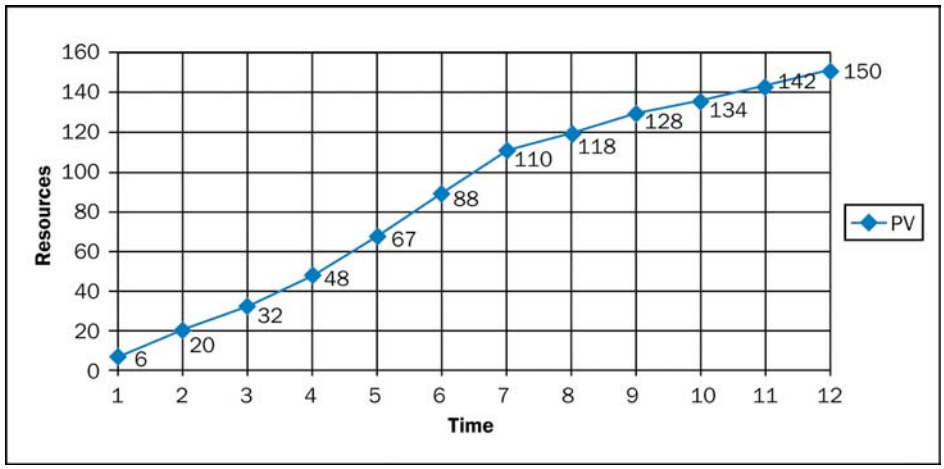



**Figure 1-5.** Performance Measurement Baseline (PMB)

In the project control process, EVM requires that physical work progress be assessed and budgetary earned value be credited (using the selected earned value measurement techniques), as prescribed in the project management plan. With this earned value data, the planned value data from the performance measurement baseline, and the actual cost data from the project cost tracking system, the project team can perform EVM analysis at the control account and other levels of the project work breakdown structure, and report the EVM results as needed.

In summary, EVM strategically augments good project management to facilitate the planning and control of cost and schedule performance. The key practices of EVM include:

- Establish a performance measurement baseline (PMB)
  - Decompose work scope to a manageable level
  - Assign unambiguous management responsibility
  - Develop a time-phased budget for each work task
  - Select EV measurement techniques for all tasks
  - Maintain integrity of PMB throughout the project.

- Measure and analyze performance against the baseline
  - Record resource usage during project execution
  - Objectively measure the physical work progress
  - Credit EV according to EV techniques
  - Analyze and forecast cost/schedule performance
  - Report performance problems and/or take action.

Chapter 2 provides a detailed explanation of the three basic elements of EVM: **Planned Value, Earned Value,** and **Actual Cost**.

Chapter 2

# Basic Elements of Earned Value Management

As indicated in Chapter 1, Earned Value Management (EVM) relies on three key data points:

- **Planned Value**
- **Earned Value**
- **Actual Cost**

This chapter describes each of these data points and discusses how they are derived. Throughout this chapter and the next, Project EZ is presented as an example to help explain these data points and other essential elements of EVM. Project EZ is a hypothetical project that could represent any type of project: for example, the building of a house, development of a new software program, or production of an airplane. The fundamentals of EVM are the same, regardless of the type or size of project to which they are being applied.

## 2.1 DESCRIPTIONS OF THE BASIC EVM ELEMENTS

### Planned Value

**Planned Value** (**PV**) describes how far along project work is supposed to be at any given point in the project schedule. It is a numeric reflection of the budgeted work that is scheduled to be performed, and it is the established baseline (also known as the performance measurement baseline, or PMB) against which the actual progress of the project is measured. Once established, this baseline may only change to reflect cost and schedule changes necessitated by changes in the scope of work. Also known as the **Budgeted Cost of Work Scheduled (BCWS)**, Planned Value is usually charted showing the cumulative resources budgeted across the project schedule. Figure 2-1 shows the **Planned Value S-Curve** for Project EZ.

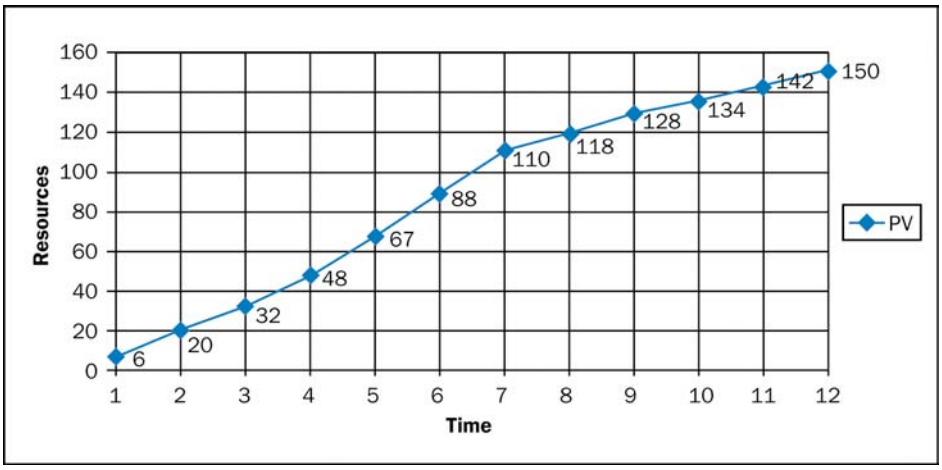



**Figure 2-1.** Cumulative Planned Value for Project EZ

### Earned Value

**Earned Value (EV)** is a snapshot of work progress at a given point in time. Also known as the **Budgeted Cost of Work Performed (BCWP)**, it reflects the amount of work that has actually been accomplished to date (or in a given time period), expressed as the planned value for that work. Figure 2-2 shows the Earned Value for Project EZ at the four-month mark, and indicates that less work than planned has been accomplished.

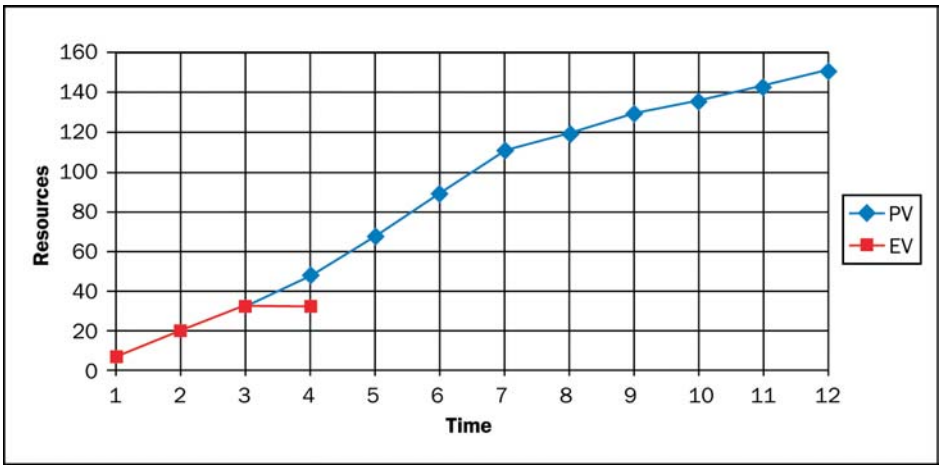



**Figure 2-2.** Cumulative Planned Value and Earned Value for Project EZ

### Actual Cost

**Actual Cost (AC),** also known as the **Actual Cost of Work Performed (ACWP)**, is an indication of the level of resources that have been expended to achieve the actual work performed to date (or in a given time period). Figure 2-3 shows the Actual Cost for Project EZ at the four-month mark, and indicates that the organization has spent less than it planned to spend to achieve the work performed to date.

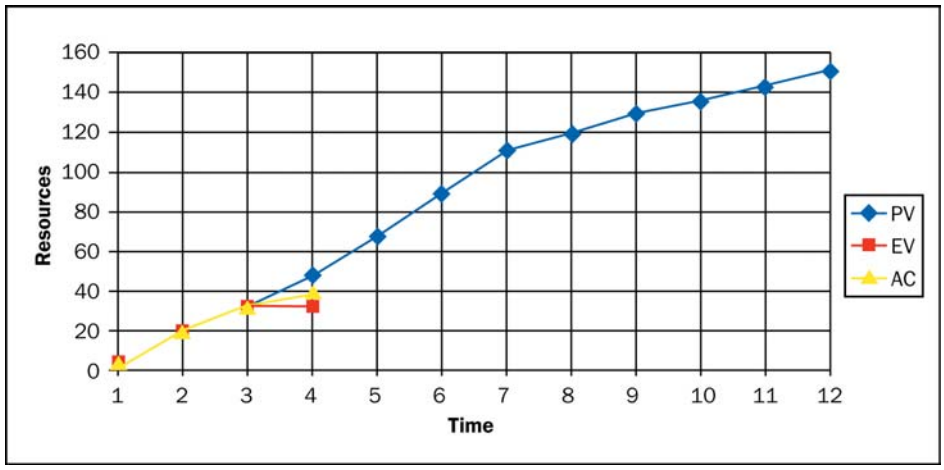



**Figure 2-3.** Cumulative Planned Value, Earned Value and Actual Cost for Project EZ

## 2.2 DERIVATIONS OF THE BASIC EVM ELEMENTS

### Planned Value

The work plan for Project EZ, shown in Figure 2-4 is the basis for the Planned Value and the performance measurement baseline for the project (see Figure 2-1). This work plan establishes a time-phased budget for each task in the project. For example, Task 2 has a budget of 48 resource units, which are phased over a four-month period. The plan for Task 2 calls for varying increments of Planned Value to be earned in each month of the task. As the planned work is accomplished, its budgeted cost becomes Earned Value.

Tasks may be planned and measured in whatever resource units are most suitable to the work, including labor hours, material quantities, and the monetary equivalent of these resources. As discussed in the next section, however, performance management works best when the physical progress of work is objectively planned and measured. The techniques used in EVM to achieve this goal are Earned Value measurement techniques (sometimes called earning and crediting methods).

#### *Earned Value Measurement Techniques*

Earned Value is a measure of work performed. Techniques for measuring work performed are selected during project planning and are the basis for performance measurement during project execution and control. Earned Value (EV) techniques should be selected based on key attributes of the work, primarily 1) the duration of the effort and 2) the tangibility of its product.

The performance of separate and distinct work effort that is related to the completion of specific and tangible end products or services, and which can be directly planned and measured, is called **discrete effort**. In comparison, effort applied to project work that is not readily divisible into discrete efforts for that work, but which is related in direct proportion to measurable discrete work efforts, is called **apportioned effort**, and support-type activity that does not produce definitive end products is referred to as **level of effort**.

| Task | Budget | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 6 | | | | | | | | | | |
| 1 | 12 | | | | | | | | | | | | |
| | | | 8 | 12 | 16 | 12 | | | | | | | |
| 2 | 48 | | | | | | | | | | | | |
| | | | | | | 7 | 21 | | | | | | |
| 3 | 28 | | | | | | | | | | | | |
| | | | | | | | | 18 | | | | | |
| 4 | 18 | | | | | | | | | | | | |
| | | | | | | | | 4 | 8 | 10 | 6 | | |
| 5 | 28 | | | | | | | | | | | | |
| | | | | | | | | | | | | 8 | 8 |
| 6 | 16 | | | | | | | | | | | | |
| ∑ | 150 | 6 | 14 | 12 | 16 | 19 | 21 | 22 | 8 | 10 | 6 | 8 | 8 |
| CUM | - | 6 | 20 | 32 | 48 | 67 | 88 | 110 | 118 | 128 | 134 | 142 | 150 |
| PV | 150 | 6 | 14 | 12 | 16 | 19 | 21 | 22 | 8 | 10 | 6 | 8 | 8 |
| CUM | | 6 | 20 | 32 | 48 | 67 | 88 | 110 | 118 | 128 | 134 | 142 | 150 |

**Figure 2-4.** Work Plan for Project EZ

Work performance is measured periodically, such as weekly or monthly. The EV technique selected for measuring the performance of discrete effort will depend on its duration and the number of measurement periods it spans. Discrete efforts that span one to two periods are often measured with **fixed formula** techniques, where a fixed percentage of work performance is credited at the start of the work and the remaining percentage is credited at the completion of the work. Discrete efforts of longer duration (greater than two periods) are measured with other techniques, including those known as **weighted milestone** and **percent complete**.

The above guidelines for selecting EV measurement techniques are outlined in Figure 2-5, and some of the most common techniques are described in the paragraphs that follow.

| Product of Work | Duration of Work Effort | |
|---|---|---|
| | 1-2 Measurement Periods | >2 Measurement Periods |
| Tangible | *Fixed Formula* | *Weighted Milestone*<br>*Percent Complete* |
| Intangible | *Apportioned Effort*<br>*Level of Effort* | |

**Figure 2-5.** Earned Value Measurement Techniques

### Fixed Formula

A typical example of fixed formula is the 50/50 technique. With this method, 50 percent of the work is credited as complete for the measurement period in which the work begins, regardless of how much work has actually been accomplished. The remaining 50 percent is credited when the work is completed. Other variations of the fixed formula method include 25/75 and 0/100. Fixed formula techniques are most effectively used on small, short-duration tasks.

In Figure 2-4, the 50/50 technique has been selected to determine Earned Value for Tasks 1 and 6 of Project EZ. The 25/75 technique has been selected to determine Earned Value for Task 3 of Project EZ, and 0/100 has been selected for Task 4.

### Weighted Milestone

The weighted milestone technique divides the work to be completed into segments, each ending with an observable milestone; it then assigns a value to the achievement of each milestone. The weighted milestone technique is more suitable for longer duration tasks having intermediate, tangible outcomes. In Figure 2-4, the weighted milestone technique has been used for Tasks 2 and 5 of Project EZ.

### Percent Complete

The percent complete technique is among the simplest and easiest, but can be the most subjective of the Earned Value measurement techniques if there are no objective indicators to back it up. This is the case when, at each measurement period, the responsible worker or manager makes an estimate of the percentage of the work complete. These estimates are usually for the cumulative progress made against the plan for each task. However, if there are objective indicators that can be used to arrive at the percent complete (for example, number of units of product completed divided by the total number of units to be completed), then this can be a more useful technique.

### Apportioned Effort

If a task has a direct, supportive relationship to another task that has its own Earned Value, the value for the support task may be determined based on (or apportioned to) the Earned Value of the reference base activity. Examples of proportional tasks include quality assurance and inspection activities.

For instance, in Figure 2-4, Task 2 of Project EZ might have a quality assurance function associated with it. Using the apportioned effort technique, the project manager might determine that the Planned Value for the quality assurance task is 10 percent of the value of the main task. The total apportioned Planned Value for the quality assurance effort related to Task 2, therefore, would be 4.8 or 10 percent of 48 (which is the Planned Value for Task 2). Earned Value for each measurement period would be assigned for the quality assurance component in direct proportion to the Earned Value assigned for Task 2.

### Level of Effort

Some project activities do not produce tangible outcomes that can be measured objectively. Examples include project management and operating a project technical library. These activities consume project resources and should be included in EVM planning and measurement. In these cases, the level of effort (LOE) technique is used

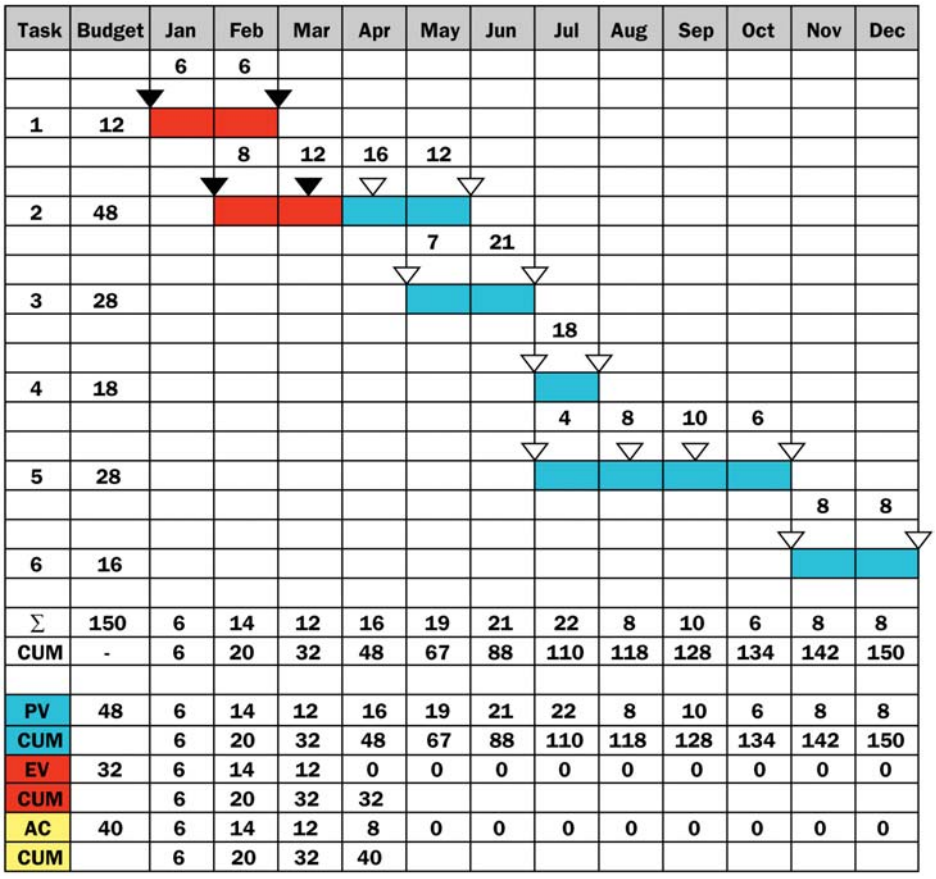
for determining Earned Value. A Planned Value is assigned to each LOE task for each measurement period. This Planned Value is automatically credited as the Earned Value at the end of the measurement period.

LOE should be used only when the task does not lend itself to a technique that actually measures physical work progress. LOE tasks have no schedule variance and bias the project data toward an on-schedule condition. They also can reflect misleading cost variances if they are not executed with the human resources on whom the cost estimates and planned values in the performance measurement baseline are based.

### Earned Value

While value is planned and measured using the Earned Value techniques outlined above, value is earned by accomplishing the planned work. Earned Value is credited when progress is demonstrated in accordance with the Earned Value technique selected for the planned work. For discrete work, observable evidence of a tangible product or progress is required.

The status of Project EZ after four months is presented in Figure 2-6. This progress report indicates that all of the work planned for Task 1 has been accomplished. This discrete work was planned and measured using the 50/50 EV technique. The work was credited with an Earned Value of 6 by demonstrating physical and objective



| Task | Budget | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 6 | | | | | | | | | | |
| 1 | 12 | | | | | | | | | | | | |
| | | | 8 | 12 | 16 | 12 | | | | | | | |
| 2 | 48 | | | | | | | | | | | | |
| | | | | | | 7 | 21 | | | | | | |
| 3 | 28 | | | | | | | | | | | | |
| | | | | | | | | 18 | | | | | |
| 4 | 18 | | | | | | | | | | | | |
| | | | | | | | | 4 | 8 | 10 | 6 | | |
| 5 | 28 | | | | | | | | | | | | |
| | | | | | | | | | | | | 8 | 8 |
| 6 | 16 | | | | | | | | | | | | |
| ∑ | 150 | 6 | 14 | 12 | 16 | 19 | 21 | 22 | 8 | 10 | 6 | 8 | 8 |
| CUM | - | 6 | 20 | 32 | 48 | 67 | 88 | 110 | 118 | 128 | 134 | 142 | 150 |
| PV | 48 | 6 | 14 | 12 | 16 | 19 | 21 | 22 | 8 | 10 | 6 | 8 | 8 |
| CUM | | 6 | 20 | 32 | 48 | 67 | 88 | 110 | 118 | 128 | 134 | 142 | 150 |
| EV | 32 | 6 | 14 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CUM | | 6 | 20 | 32 | 32 | | | | | | | | |
| AC | 40 | 6 | 14 | 12 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CUM | | 6 | 20 | 32 | 40 | | | | | | | | |

**Figure 2-6.** Work Plan and Status for Project EZ (As of April 30)

evidence that the task began in January, and it earned the remaining value of 6 in February by demonstrating completion of the work in the same manner.

Task 2 of Project EZ is discrete work that was planned and measured using the weighted or valued milestone measurement technique. The progress report in Figure 2-6 shows that some of the work planned for completion by the end of April has not been accomplished. Two of the three scheduled milestones for Task 2 (those in February through April) have been reached, but the third milestone has not, and the Planned Value for that intermediate product has not been credited. To receive the Earned Value for the first two milestones required observable evidence of those tangible outcomes.

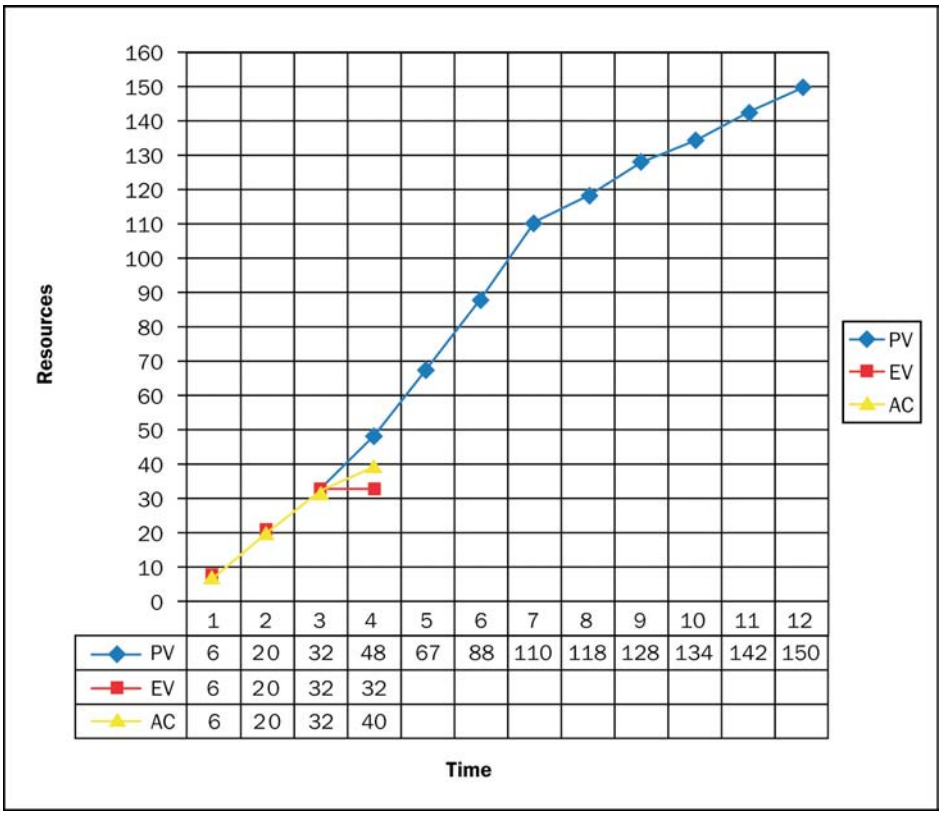
### Actual Cost

To determine Actual Cost, an organization needs to have in place a system for tracking costs over time and by project component. The sophistication and complexity of this system will vary by organization and project, but, at a minimum, some type of cost tracking system must be in place that can tie costs to the plan and to the way Earned Value is credited.

The status of Project EZ in Figure 2-6 shows that, although no Earned Value was credited for Task 2 in April, some costs were reflected for that month, which put the task and the project over budget at the end of April, as the Actual Cost exceeded the Earned Value (see also Figure 2-3).

## 2.3 PUTTING IT ALL TOGETHER

Once Planned Value, Earned Value, and Actual Cost have been determined, a manager can use these data points to analyze where a project is and forecast where it is headed. Chapter 3 looks at EVM analysis and forecasting techniques using the Planned Value, Earned Value, and Actual Cost for Project EZ after four months, as shown in Figure 2-7.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV | 6 | 20 | 32 | 48 | 67 | 88 | 110 | 118 | 128 | 134 | 142 | 150 |
| EV | 6 | 20 | 32 | 32 | | | | | | | | |
| AC | 6 | 20 | 32 | 40 | | | | | | | | |

**Figure 2-7.** Cumulative Planned Value, Earned Value, and Actual Cost for Project EZ (As of April 30)

Chapter 3

# EVM Performance Analysis and Forecasting

Chapter 2 introduced the three cornerstones of Earned Value Management (EVM):

- **Planned Value**
- **Earned Value**
- **Actual Cost**

This chapter examines how the data points of **Planned Value (PV), Earned Value (EV)**, and **Actual Cost (AC)** can be used to analyze the current status of a project and forecast its likely future. EVM looks at project performance for the current period and at cumulative performance to date. EVM is described and illustrated here in terms of cumulative data, using the Project EZ data displayed in Figure 2-7.

This chapter introduces a fourth data point, **Budget at Completion (BAC)**, which is the final data point on the performance measurement baseline (PMB). Budget at Completion represents the total Planned Value for the project. For Project EZ, the BAC is 150.

In this chapter, we will examine:

- **Variances:** Schedule Variance (SV); Cost Variance (CV); and Variance at Completion (VAC)
- **Indices:** Schedule Performance Index (SPI); Cost Performance Index (CPI); and To-Complete Performance Index (TCPI)
- **Forecasts:** Time Estimate at Completion ($EAC_t$); Estimate at Completion (EAC); and Estimate to Complete (ETC)

Figure 3-1 shows the relationships among the basic EVM performance measures.

These variances, indices, and forecasts can be used to answer the key project management questions raised in Chapter 1. Figure 3-2 shows the relationship between those project management questions and the EVM performance measures.

Figure 3-3 shows what EVM performance measures indicate about a project in regard to its planned work schedule and resource budget.

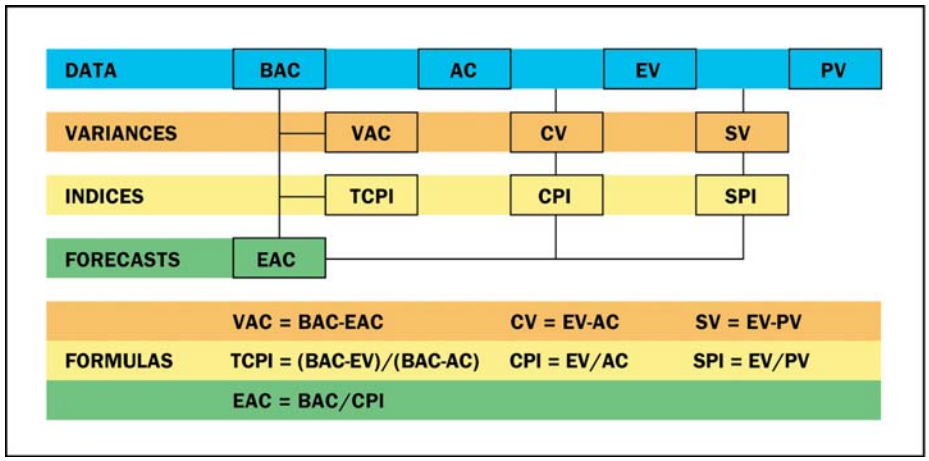



**Figure 3-1.** EVM Performance Measures

| Project Management Question | EVM Performance Measures |
|---|---|
| ***How are we doing time-wise?*** | **Schedule Analysis & Forecasting** |
| *- Are we ahead or behind schedule?* | - Schedule Variance (SV) |
| *- How efficiently are we using time?* | - Schedule Performance Index (SPI) |
| *- When are we likely to finish work?* | - Time Estimate at Completion (EACt) |
| ***How are we doing cost-wise?*** | **Cost Analysis & Forecasting** |
| *- Are we under or over our budget?* | - Cost Variance (CV) |
| *- How efficiently are we using our resources?* | - Cost Performance Index (CPI) |
| *- How efficiently must we use our remaining resources?* | - To-Complete Performance Index (TCPI) |
| *- What is the project likely to cost?* | - Estimate at Completion (EAC) |
| *- Will we be under or over budget?* | - Variance at Completion (VAC) |
| *- What will the remaining work cost?* | - Estimate to Complete (ETC) |

**Figure 3-2.** EVM and Basic Project Management Questions

| Performance Measures | | Schedule | | |
|---|---|---|---|---|
| | | SV > 0 & SPI > 1.0 | SV = 0 & SPI = 1.0 | SV < 0 & SPI < 1.0 |
| Cost | CV > 0 & CPI > 1.0 | Ahead of Schedule Under Budget | On Schedule Under Budget | Behind Schedule Under Budget |
| | CV = 0 & CPI = 1.0 | Ahead of Schedule On Budget | On Schedule On Budget | Behind Schedule On Budget |
| | CV < 0 & CPI < 1.0 | Ahead of Schedule Over Budget | On Schedule Over Budget | Behind Schedule Over Budget |

**Figure 3-3.** Interpretations of Basic EVM Performance Measures

## 3.1 SCHEDULE ANALYSIS AND FORECASTING *(How are we doing timewise?)*

### Schedule Variance *(Are we ahead or behind schedule?)*

The **Schedule Variance** (**SV**) determines whether a project is ahead of or behind schedule. It is calculated by subtracting the **Planned Value** (**PV**) from the **Earned Value** (**EV**). A positive value indicates a favorable condition and a negative value indicates an unfavorable condition. For Project EZ:

$$\mathbf{SV = EV - PV} = 32 - 48 = -16 \text{ \{unfavorable\}}$$

The Schedule Variance can be expressed as a percentage by dividing the **Schedule Variance** (**SV**) by the **Planned Value** (**PV**):

$$\mathbf{SV\% = SV / PV} = -16 / 48 = -33\% \text{ \{unfavorable\}}$$

In other words, the project is 33 percent behind schedule, meaning that 33 percent of the planned work has not been accomplished (see Box 3-1).

### Schedule Performance Index *(How efficiently are we using time?)*

The **Schedule Performance Index** (**SPI**) indicates how efficiently the project team is using its time. **SPI** is calculated by dividing the **Earned Value** (**EV**) by the **Planned Value** (**PV**). For Project EZ:

$$\mathbf{SPI = EV / PV} = 32 / 48 = 0.67 \text{ \{unfavorable\}}$$

This Schedule Performance Index indicates that—on average—for each 8-hour day worked on the project, only 5 hours and 20 minutes worth of the planned work is being performed; that is, work is being accomplished at 67 percent efficiency.

### Time Estimate at Completion *(When are we likely to finish work?)*

Using the **Schedule Performance Index** (**SPI**) and the average **Planned Value** (**PV**) per unit of time, the project team can generate a rough estimate of when the project will be completed, if current trends continue, compared to when it was originally supposed to be completed (see Box 3-1). For Project EZ:

$$\mathbf{EAC_t = (BAC/SPI)/(BAC/months)} = (150/0.6667)/(150/12) = 18 \text{ months}$$

The originally estimated completion time for the project was 12 months, so the project manager now knows that if work continues at the current rate the project will take six months longer than originally planned. It is important to note that this method generates a fairly rough estimate and must always be compared with the status reflected by a time-based schedule method such as critical path method. It is possible that an earned value analysis could show no schedule variance and yet the project is still behind schedule; for example, when tasks that are planned to be completed in the future are performed ahead of tasks on the critical path.

**Box 3-1: Time-Based Schedule Measures – An Emerging EVM Practice**

In the current practice of EVM, schedule variance and schedule performance are both measures of work scope, not time. The work is represented by its budgeted cost as recorded in the performance measurement baseline. The EVM schedule variance is the difference between work performed and work scheduled, and the schedule performance index is the ratio of work performed to work scheduled. For Project EZ, these measures indicate that work is not being accomplished as quickly or as efficiently as planned:

**SV = EV - PV = 32 - 48 = -16** **SPI = EV / PV = 32 / 48 = 0.67**

If the work were to continue at this rate, then all of the work of Project EZ would take 18 months to accomplish instead of the 12 months planned (12 / 0.6667 = 18).

These SV and SPI measures are useful indicators and predictors of performance and results. But, because they are based on work and not time, they can behave in ways that are not normally expected of schedule indicators and predictors. The problem can be illustrated with Project EZ: Whether all of the work is completed as planned at 12 months or at 18 months as predicted by the four-month SPI of 0.67, it will be completed eventually and at that time the work-based schedule variance and performance index will indicate perfect performance. For when the work is completed: EV = PV, and so SV = 0 and SPI = 1.0. This is fine if the work is being accomplished according to plan, but problematic if it is not. If Project EZ does take 18 months, SV will nonetheless equal 0 and SPI equal 1.0, when it's clear that Project EZ is 6 months late and averaged only 67% efficiency.

There is an emerging practice in EVM, which uses time-based measures of schedule variance and schedule performance as an alternative or supplement to the traditional work-based measures. This new method avoids the problems of the work-based method illustrated above. Whereas the traditional work-based method compares work performed and work scheduled at or to a point in time, the time-based method compares the actual time with the planned time for the work performed. In the case of Project EZ, the work performed after four months (AT = 4) had a planned time of three months (PT = 3) [refer to Figures 2-6 and 2-7]. In a manner that parallels the use of AC and EV in traditional EVM, practitioners are beginning to use actual time (AT) and planned time (PT) to compute SV and SPI:

**SV(t) = PT - AT = 3 - 4 = - 1 month** **SPI(t) = PT / AT = 3 / 4 = 0.75**

While the work- and time-based methods provide comparable results at the four-month point in Project EZ, look at the difference at project completion after 18 months:

**SV(t) = PT - AT = 12 - 18 = - 6 months** **SPI(t) = PT / AT = 12 / 18 = 0.67**

**SV($) = EV - PV = 150 - 150 = 0** **SPI($) = EV / PV = 150 / 150 = 1.0**

## 3.2 COST ANALYSIS AND FORECASTING *(How are we doing costwise?)*

### Cost Variance *(Are we under or over our budget?)*

A project's **Cost Variance** (**CV**) shows whether a project is under or over budget. This measure is determined by subtracting the **Actual Cost** (**AC**) from the **Earned Value** (**EV**). The **CV** for the Project EZ example shows:

$$\mathbf{CV = EV - AC = 32 - 40 = -8\ \{unfavorable\}}$$

This number can be expressed as a percentage by dividing the **Cost Variance** (**CV**) by the **Earned Value** (**EV**).

$$\mathbf{CV\% = CV / EV = -8 / 32 = -25\%\ \{unfavorable\}}$$

In other words, to date, the project is 25 percent over budget for the work performed.

### Cost Performance Index *(How efficiently are we using our resources?)*

**Earned Value** and **Actual Cost** can also be used to calculate the cumulative **Cost Performance Index** (**CPI**), which is one of the clearest indicators of the cumulative cost efficiency of a project. **CPI** gauges how efficiently the team is using its resources. It is determined by dividing the **Earned Value** (**EV**) by the **Actual Cost** (**AC**). In regards to Project EZ, the **CPI** is:

$$\mathbf{CPI = EV / AC} = 32 / 40 = 0.80 = 0.80 \text{ \{unfavorable\}}$$

Translated into dollars, this means that Project EZ has a cost efficiency that provides US $0.80 worth of work for every project dollar spent to date.

### To-Complete Performance Index *(How efficiently must we use our remaining resources?)*

Another very useful index is the **To-Complete Performance Index** (**TCPI**), which helps the team determine the efficiency that must be achieved on the remaining work for a project to meet a specified endpoint, such as the **Budget at Completion** (**BAC**) or the team's revised **Estimate at Completion** (**EAC**) (see the following discussions of EAC and ETC). The **TCPI** for achieving the **BAC** is calculated by dividing the *work remaining* by the *budget remaining* as follows:

$$\mathbf{TCPI = (BAC - EV) / (BAC - AC)} = (150 - 32) / (150 - 40) = 1.07$$

This means that for Project EZ to achieve the **BAC**, performance must improve from a **CPI** of 0.80 to a **TCPI** of 1.07 for performance of the remaining work.

### Estimate at Completion *(What is the project likely to cost?)*

The calculated **Estimate at Completion** (**EAC**) projects for the team the final cost of the project if current performance trends continue. One common method for calculating the **EAC** is to divide the **Budget at Completion** (**BAC**) by the cumulative **Cost Performance Index** (**CPI**). For Project EZ, this is:

$$\mathbf{EAC = BAC / CPI} = 150 / 0.80 = 187.50$$

This forecasting formula assumes that the cumulative performance reflected in the **CPI** is likely to continue for the duration of the project. Other formulas used to forecast cost at completion with earned value data are outlined in Box 3-2. Estimates based on project team and management analysis of remaining work are discussed in the following section on **Estimate to Complete** (**ETC**).

### Variance at Completion *(Will we be under or over budget?)*

With the **EAC** figure in hand, the manager can now compute the cost **Variance at Completion** (**VAC**), which shows the team whether the project will finish under or over budget, by subtracting the **EAC** from the **BAC**. For Project EZ, this is:

$$\mathbf{VAC = BAC - EAC} = 150 - 187.50 = -37.50$$

In other words, if current trends continue, the project will cost an additional 37.50 units worth of resources than originally planned. This can be expressed as a percentage by dividing **VAC** by **BAC**.

$$\mathbf{VAC\%} = \mathbf{VAC} / \mathbf{BAC} = -37.50 / 150 = -25\%$$

### Estimate to Complete *(What will the remaining work cost?)*

There are two ways to develop the **Estimate to Complete** (**ETC**), which shows what the remaining work will cost. One way is a *management* **ETC** developed by workers and/or managers based on an analysis of the remaining work. The management **ETC** can be added to the **Actual Cost** (**AC**) to derive the management **Estimate at Completion** (**EAC**) of the total cost of the project at completion.

$$\mathbf{EAC} = \mathbf{AC} + \mathbf{ETC} = 40 + ? = ?$$

As a check on these management estimates, organizations can use a *calculated* **ETC** based on the efficiency-to-date measured by the **CPI**. The calculated **ETC** can be used to determine the calculated **Estimate at Completion** (**EAC**), which the team can compare with the management **EAC**. For Project EZ, the **ETC** and **EAC** are calculated as follows:

$$\mathbf{ETC} = (\mathbf{BAC} - \mathbf{EV}) / \mathbf{CPI} = (150 - 32) / 0.80 = 147.50$$

$$\mathbf{EAC} = \mathbf{AC} + \mathbf{ETC} = 40 + 147.50 = 187.50$$

Note that this **EAC** formula is equivalent to the following (see Box 3-2):

$$\mathbf{EAC} = \mathbf{AC} + [(\mathbf{BAC} - \mathbf{EV}) / \mathbf{CPI}] = \mathbf{BAC} / \mathbf{CPI}$$

## 3.3 MANAGEMENT BY EXCEPTION

EVM provides an organization with the capability of practicing ''management-by-exception'' on its projects. This practice contributes greatly to the efficiency and effectiveness of project management, by allowing managers and others to focus on project execution and invoke control actions only when and where they are needed. EVM performance measures, used in conjunction with the project work breakdown structure (WBS), provide the objective data needed to practice ''management-by-exception.''

Using EVM, an organization can establish acceptable levels of performance for a project and its work tasks. Variance percentages and efficiency indices are most often used. For instance, an organization may consider a Cost Variance (CV) of plus or minus 10 percent to be an acceptable range of variance from the project management plan. In this case, no management action would be taken except when and where a CV falls outside of this acceptable range. While a negative variance is potentially problematic, a positive variance may represent an opportunity.

Because EVM occurs first at the task level, where the scope, schedule, and cost of work are planned and controlled, ''management-by-exception'' also starts at this level. Managers use EVM performance measures to determine whether action thresholds have been reached for their tasks and control accounts. And with the use of a work

**Box 3-2: Alternative Calculations of Estimate at Completion (EAC)**

The hallmark of EVM measures is that they provide objective information used to "check" a project as part of the plan-do-check-act management cycle. EVM measures serve as a check of progress against plans using ***Earned Value*** and its derivative variances and indices (e.g., SV, CV, SPI, and CPI). Among the checks is the comparison of the project BAC with the EAC calculated using the CPI cost efficiency measure: ***EAC = BAC / CPI.*** In addition to checking original project estimates, like the BAC, efficiency measures also are used to check revised project estimates, especially estimates of cost at completion, like the manager's EAC.

Forecasting with EVM measures should take project performance patterns and trends into account. The simple EAC calculation noted above assumes that the cumulative CPI adequately reflects past performance that will continue to the end of the project. There may be reasons to conclude otherwise and therefore to use an alternative calculation. One consideration is schedule performance. If the project is under-performing in this regard, there may be reason to include the SPI in the forecasting calculation on the assumption that additional costs will be incurred in an attempt to recover and get the project back on schedule.

Another forecasting consideration is the trend exhibited in cost performance. An examination of periodic cost performance may show better or worse performance in recent periods, suggesting that a CPI capturing the recent trend may be a better predictor of future performance. In this case, for example, the average performance for the last three periods could be used in the calculation instead of the cumulative CPI. All calculations of EAC are estimates of the cost to do the work remaining on the project, plus the ***Actual Cost***. The remaining work is the total planned work minus the work performed, which is captured in the expression: ***BAC - EV.***

Here is a sample of the most common alternative ways of calculating the EAC:

| Assumption | Example Formula |
|---|---|
| Future cost performance will be the same as all past cost performance | $EAC = AC + [(BAC - EV) / CPI] = BAC / CPI$ |
| Future cost performance will be the same as the last three measurement periods (i, j, k) | $EAC = AC + [(BAC - EV) / ((EV_i + EV_j + EV_k) / (AC_i + AC_j + AC_k))]$ |
| Future cost performance will be influenced additionally by past schedule performance | $EAC = AC + [(BAC - EV) / (CPI \times SPI)]$ |
| Future cost performance will be influenced jointly in some proportion by both indices | $EAC = AC + [(BAC - EV) / (.8\ CPI + .2\ SPI)]$ |

breakdown structure, which ties the tasks and control accounts of a project together, EVM and ''management-by-exception'' can be used at any level of the project (specified in the WBS).

While variance and efficiency thresholds are commonly used in EVM, trends in the performance measures for a project can help a project manager decipher or anticipate a potential performance problem. For instance, a cumulative Cost Performance Index (CPI) that is within an acceptable range, but has been trending down toward the efficiency threshold for several measurement periods, may be cause for some concern and prompt an examination of the underlying cause of the trend. If the trend is seen at the project level, a WBS will enable the manager to ''drill down'' to lower levels to see what underlies the trend.

Graphs of variance and efficiency data are helpful tools in performing this kind of Earned Value analysis. Plotting the CV percentage or the CPI over time, for example, will indicate their values and show their trends. Computer software, especially some

developed specifically for project management and EVM, is capable of producing such graphs. Box 3-3 outlines other basic kinds of performance management and reporting displays that are frequently used in EVM. Appendix E provides additional sources of information on EVM concepts, methods, and practices.

**Box 3-3: Performance Reporting**

Earned Value Management (EVM) can provide a great deal of useful information to key stakeholders about a project. However, the level and type of information needed about a project may vary greatly from one stakeholder to another. The client, owner, or upper management may simply need a top-line report that indicates whether the project is on time and within budget. By contrast, the project manager will need much more detail that will allow him or her to make any necessary adjustments to the project.

A number of different methods have evolved for presenting EVM data. These methods are designed to address these diverse stakeholder needs. Several of these methods may be used on a given project to meet the needs of different stakeholder audiences. The most commonly used methods include:

- S-curves
- Tables
- Bar Charts

**S-Curves**
S-Curves have been used throughout this Practice Standard to illustrate the cumulative performance metrics of Earned Value Management. The typical EVM S-Curve is displayed on an X-Y axis with Time across the bottom and Resources up the side. An example is Figure 2-7, which shows the ***Planned Value, Earned Value*** and ***Actual Cost*** lines for Project EZ. This type of display can be very effective for providing a quick look at the overall performance of a task, a control account, or a project.

**Tables**
A tabular format can be an effective method for displaying the EVM results by project component. For instance, the individual components of a project could be listed down one side with various EVM calculations going across: ***Planned Value, Earned Value, Actual Cost, Cost Variance, Schedule Variance, Cost Performance Index, Schedule Performance Index, T o-Complete Performance Index, Budget at Completion, Estimate at Completion***, and ***Variance at Completion***. A table format provides the project manager and other top-level stakeholders with a complete, concise picture of what is happening with each major component of the project. It can be used as a logical follow-on to an S-Curve to provide more detail on where the project is at a given point in time.

**Bar Charts**
Bar charts can be a useful tool for comparing data such as ***Planned Value*** to ***Earned Value*** as demonstrated in Figure 2-6.

Chapter 4

# Guidance for the Use of Key EVM Practices

Earned Value Management (EVM) strategically augments good project management with key practices that facilitate the planning and control of cost and schedule performance. This chapter outlines guiding principles for using these key EVM practices, which were introduced in Chapter 1. The following outline shows the interdependence of the fundamental practices of EVM and project management.

- Establish a performance measurement baseline (PMB)
  - Decompose work scope to a manageable level
  - Assign unambiguous management responsibility
  - Develop a time-phased budget for each work task
  - Select EV measurement techniques for all tasks
  - Maintain integrity of PMB throughout the project.

- Measure and analyze performance against the baseline
  - Record resource usage during project execution
  - Objectively measure the physical work progress
  - Credit earned value according to EV techniques
  - Analyze and forecast cost/schedule performance
  - Report performance problems and/or take action.

## 4.1 ESTABLISH A PERFORMANCE MEASUREMENT BASELINE

### Decompose Work Scope to a Manageable Level

All project work must be executed, and effective and efficient execution requires planning and control. Most work scopes are broken down for optimal planning, execution, and control. EVM requires that scope, schedule, and resources (i.e., cost) be managed as integrated parts of project work. This integration occurs at the task or activity level where physical work is performed. Work scope (tasks or activities) to which EVM is applied is grouped into control accounts for integrated management.

### Assign Unambiguous Management Responsibility

All project work must be managed; its execution must be planned and controlled. Integrated management of work scope, schedule, and cost requires that a single individual or product delivery team be held responsible and accountable for the work grouped in each control account. An individual or team can be responsible for more than one control account, but each control account must be managed by only one control account manager or team.

### Develop Time-Phased Budget for Each Work Task

The full scope of work for each task or activity must be scheduled and resourced. This results in a time-phased budget, which integrates the scope, schedule, and cost for the work (task or activity). In EVM, these time-phased budgets are the Planned Value (PV) for the work, and represent its performance measurement baseline (PMB). The vertical integration of a work breakdown structure (WBS) facilitates aggregation of these time-phased budgets to higher levels including the control account, the project, and levels in between.

### Select Earned Value Measurement Techniques for All Tasks

In EVM, the progress of all work must be measured. Measuring the amount of work scope completed is planned at the task level in conjunction with the performance measurement baseline. An EV technique is selected for each task based on the temporal and physical qualities of the work. Objective measurement of physical progress on tasks with tangible outcomes is superior to all other measurements. Subjective assessments of progress are considered inferior. Tasks that can be completed in one progress-reporting period require only one measurement and are preferred. Tasks that span several reporting periods should be measured objectively with milestones representing intermediate, tangible outcomes.

### Maintain Integrity of Performance Measurement Baseline throughout the Project

The four key practices above are interdependent and should be undertaken in concert to establish a realistic and durable performance measurement baseline. Once the baseline is established, its integrity as an integrated measurement tool—relating scope, schedule, and cost—should be strictly maintained. There are two basic reasons to change the performance measurement baseline: 1) If the work scope is changed, then the estimated cost and possibly the schedule will change, and all of these changes need to be reflected in a revised baseline. 2) If poor performance in the past is rendering the baseline worthless as a tool for measuring present performance, then a revised baseline may be justified.

## 4.2 MEASURE AND ANALYZE PERFORMANCE AGAINST THE BASELINE

### Record Resource Usage During Project Execution

In EVM, the costs associated with the performance of work scope must be recorded on a regular basis. Costs should be measured at the level at which work scope, schedule,

and cost are integrated in the time-phased budgets of the performance measurement baseline. The lower the level of cost measurement, the higher the level of rigor at which cost performance can be managed. If resource usage can be recorded only at a higher level of work scope, the vertical integration afforded by the project work breakdown structure will facilitate cost performance management at that higher level. While monetary costs are the common denominator for resources used on most projects (and are therefore preferred), some projects—and some tasks within a project—may find the use of labor hours or material quantities to be adequate or preferable.

### Objectively Measure the Physical Work Progress

EVM strives to objectively measure the physical progress of work. The more this technique achieves this goal, the better it performs its role of performance management and the more it contributes to effective project management. Projects vary a lot in regard to the physical qualities of their work. For example, most construction projects consist largely of tangible products, which can be readily and directly measured. Many research projects, however, yield only intangible outcomes until their final product emerges at the end. Although objective measures of physical progress are vastly preferred, some measure of work scope accomplishment, including a subjective assessment of progress, is better than none at all.

### Credit Earned Value According to Earned Value Techniques

Physical work progress on tasks is credited in terms of predetermined techniques that are selected during project planning and are included in the performance measurement plans for the tasks. Adherence to the measurement plans during project execution assures that assessments of work progress yield earned values that can be compared with the planned values and the actual costs for the task. It also assures that earned values are credited in the same measurement units used to establish planned values and record actual costs (labor hours, material quantities, or their monetary value).

### Analyze and Forecast Cost/Schedule Performance

Cost and schedule performance should be measured and analyzed as feasible with regularity and intensity consistent with project management need including the magnitude of performance risk. Analysis should be progressive and should follow the principle of management by exception. Variance thresholds should be established in the planning phase and should be used to guide the examination of performance. Tasks whose performance falls within the prescribed tolerance range should not require additional scrutiny. However, when performance data at higher levels of the work breakdown structure are reviewed, caution should be exercised because compensating good performance can mask poor performance at lower levels. The function of EVM forecasts is to compare their objective values with management estimates offered by project delivery team members.

### Report Performance Problems and/or Take Action

The goal of EVM is better cost and schedule performance in the accomplishment of work scope. But performance is not simply a function of execution; it depends also on the quality of planning and control. EVM data do not reveal the causes of performance.

Project managers and others must decide where the problems lie and what actions to take or recommend. Poor execution may call for recovery, while poor planning may call for replanning. It is critical that EVM provide the best possible feedback to those who must make the decisions and take the actions. Simple metrics alone may not be enough, especially if decisions and actions appear to be warranted. Patterns and trends in periodic and cumulative data should be displayed in tables and graphs for review, and explanations and interpretations should be provided by the managers having that information and insight.

Appendix A

# Guidelines for a Project Management Institute Practice Standard

- Each practice standard provides guidelines on the mechanics (e.g., basics, fundamentals, step-by-step usage guide, how it operates) of some significant process (inputs, tools and techniques, or outputs) that is relevant to a project manager.
- A practice standard does not necessarily mirror the life-cycle phases of many projects. However, an individual practice standard may be applicable to the completion of one or more phases within a project.
- A practice standard does not necessarily mirror the Knowledge Areas within *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, although an individual practice standard will provide sufficient detail and background for one or more of the inputs, tools and techniques, and/or outputs. Therefore, practice standards are not required to use the name of any Knowledge Area.
- Each practice standard should include information on *what* the significant process is and does, *why* it is significant, *when* it should be performed and, if necessary for further clarification, *who* should perform it.
- Each practice standard should include information that is accepted and applicable for most projects most of the time within the project management community. Processes that are generally restricted or applicable to one industry, country, or companion profession (i.e., an application area) may be included as an appendix for informational purpose, rather than as part of the practice standard. With strong support and evidence, an application area-specific process may be considered as an *extension* of a practice standard, in the same manner as extensions to the *PMBOK® Guide* are considered.
- Each practice standard will benefit from the inclusion of examples and templates in the appendices. It is best when such examples or templates include a discussion of their strengths and weaknesses. To put such a discussion in its appropriate context, the standard may include a background discussion. The examples and templates featured should be aligned with the relevant information that appears in the standard or other appendices.

- All practice standards will be written in the same general style and format, in accordance with PMI's preferred style manual.
- Each practice standard project will assess the need to align with or reference other practice standards.
- Each practice standard will be consistent with the current edition of the *PMBOK® Guide*.
- Each practice standard is intended to be more prescriptive than the current edition of the *PMBOK® Guide*.

Appendix B

# Evolution of PMI's Practice Standard For EVM

Recognizing the need for global guidance on Earned Value Management beyond that included in *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, the Project Management Institute (PMI) initiated its second practice standard project in 2001 and invited the PMI College of Performance Management (PMI-CPM) to assume a leadership role. PMI-CPM accepted the invitation and agreed to contribute both knowledge and financial resources to help make the project a success. It was agreed that the PMI-CPM Vice President of Professional Development, Dr. John Singley, PMP, would serve as Project Manager of PMI's *Practice Standard for Earned Value Management*.

During the first year of the project, a project charter was developed, team members were recruited, and a preliminary draft of the *Practice Standard For Earned Value Management* was prepared. The project team was comprised of about 30 PMI members, most of whom were PMI-CPM members. During that year, the team held several meetings and working sessions, and by the end of the first six months, the team had developed an outline of the Practice Standard. Small writing teams were formed and given the charge of preparing the first draft. By the end of the year, a preliminary draft of the Practice Standard was distributed to the whole team for review. A team meeting was held to gather and discuss recommendations.

Although the outline for the Practice Standard aligned it with the *PMBOK® Guide* and focused its content on those essentials of Earned Value that contribute to good project management, it was the opinion of most team members reviewing the preliminary draft that it went beyond the guidance provided by the outline and lacked the desired focus on essentials. The President of PMI-CPM, Mr. Wayne Abba, agreeing with the team's assessment of the preliminary draft, presented a compelling recommendation to return to the intent of the outline and align the Practice Standard with the *PMBOK® Guide*. The assembled team members agreed with this objective, but expressed varying opinions about the ways to achieve Mr. Abba's recommendation.

The Project Manager decided on a course of action: The two writing teams were asked to finish any remaining work on their drafts (without making any major revisions), and submit them to the Project Manager for editing. With the help of an independent, professional editor, the project team attempted—during the summer and fall of 2002—to reshape and revise the preliminary draft of the Practice Standard.

The results of this effort were not satisfactory; the edited Practice Standard appeared to mimic the structure and content of the *PMBOK® Guide*. It became apparent that a different approach was required.

At about this same time, the Practice Standard project team began to grow significantly, adding many new members who wanted to contribute to the development of the Practice Standard. (By February 2003, the end of the second year of the project, the team had grown to about 80 members; during the course of the project's third year, team membership peaked at about 145 individuals.) On the recommendation of the PMI Standards Program Manager, Mr. Steve Fahrenkrog, the Project Manager of the Practice Standard prepared an article for the March 2003 issue of *PMI Today*. This article reaffirmed PMI's vision for the Practice Standard and renewed the project team's commitment to realizing this vision.

To meet the challenge of writing a standard containing universal guidance for a global community of project management practitioners, a new and different approach was adopted: the Project Manager hired a ghost writer to prepare a series of drafts that the more than 100 members on the project team would each review. Capitalizing on the expert knowledge captured in the earlier drafts of the Practice Standard, the writer composed a rough draft and distributed it—in June 2003—to the project team for review. Comments and recommendations were collected from the project team's members. The writer revised the draft Practice Standard to reflect accepted recommendations; the Project Manager distributed this revised draft—in August 2003—to the project team for review. This process was repeated four times. The third draft, completed in October 2003, was submitted to the PMI Standards Program Team.

The third draft of the Practice Standard was revised by the writer to incorporate recommendations of the PMI Standards Program Team, as well as recommendations from the Practice Standard Project Team (which, as noted earlier, had expanded to include about 145 members). Throughout the entire review-revise process, a concerted effort was made to stand by the vision for the Practice Standard and to focus on providing universal guidance for a global audience. In early January 2004, the Project Manager submitted to PMI for publication as an exposure draft, a fourth, 30-page-long draft of the new Practice Standard. In February 2004, PMI posted the new draft Practice Standard on its Web site for a 60-day period of review by the project management community. PMI invited reviewers to submit their recommendations.

The exposure process, which included special invitations to independent Earned Value Management experts (who had not participated in the Practice Standard project), yielded 280 recommendations. Four small project teams were formed to help with the process of adjudicating the recommendations. During the summer and fall of 2004, the Standard's Project Manager and writer used accepted recommendations to revise the exposure draft into the final draft of the Practice Standard. In October 2004, the Project Manager submitted the final draft to PMI for publication.

From the beginning of the project to its end, PMI has recognized its challenge of developing the *Practice Standard for Earned Value Management* to provide project management practitioners with a better focus on the essentials of Earned Value Management that apply to most projects most of the time. The best-known practice of Earned Value Management matured over a period of 30 years in the United States and allied countries through its application on large defense systems contracts. Most of the literature on Earned Value Management and most of its professionally active community is grounded in that experience. Guidance for the practice of Earned Value Management, written and followed by that community, is comprehensive project management guidance with Earned Value seamlessly incorporated. PMI's challenge

in writing this Practice Standard has been to transcend that experience, extract the essence of Earned Value, and align it with the *PMBOK® Guide*, so that it applies to most projects most of the time. PMI believes that it has been successful, and it hopes that you agree.

Appendix C

# Contributors and Reviewers of the Practice Standard for Earned Value Management

## C.1 PRACTICE STANDARD FOR EARNED VALUE MANAGEMENT PROJECT CORE TEAM

The following individuals served as members and were contributors of text or concepts, and as Co-Leaders within the Project Core Team (PCT):
John Singley, PhD, PMP, Project Manager
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## C.2 PRACTICE STANDARD FOR EARNED VALUE MANAGEMENT PROJECT CONTRIBUTORS

In addition to those listed above, the following *Practice Standard for Earned Value Management* Project Team Members were contributors of text or concepts, or provided recommendations on drafts of the *Practice Standard for Earned Value Management*:

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## C.3 PRACTICE STANDARD FOR EARNED VALUE MANAGEMENT PROJECT TEAM MEMBERS

In addition to those listed above, the following *Practice Standard for Earned Value Management* Project Team Members performed reviews of drafts of the *Practice Standard for Earned Value Management*:

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## C.4 FINAL EXPOSURE DRAFT REVIEWERS AND CONTRIBUTORS

In addition to team members, the following individuals provided recommendations for improving the Exposure Draft of the *Practice Standard for Earned Value Management*:

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## C.5 PMI PROJECT MANAGEMENT STANDARDS PROGRAM MEMBER ADVISORY GROUP

The following individuals served as members of the PMI Standards Program Member Advisory Group during development of the *Practice Standard for Earned Value Management*:
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## C.6 PRODUCTION STAFF

Special mention is due to the following employees of PMI:
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Steven L. Fahrenkrog, PMP—Director, Knowledge Delivery
Kristin L. Wright—Standards Project Specialist
Richard E. Schwartz—Product Editor
Barbara Walsh—Publications Planner
Dan Goldfischer—Editor-in-Chief

Appendix D

# Additional Sources of Information

This standard focuses on the fundamentals of Earned Value Management that can be applied to most projects most of the time. It does not address specifics that apply only to particular situations, such as government contracts—with the budgeting, accounting, and reporting requirements common to these contracts. This standard also avoids describing concepts, methods, and practices that are commonly considered to be central to project management, such as scoping and scheduling—except when these vary to enable the use of Earned Value Management. Readers are encouraged to pursue the subject of Earned Value Management beyond the fundamentals presented in this standard. To facilitate and encourage further study, PMI offers its readers the following basic guide to additional sources.

### Publications

To learn about project management in general, PMI recommends:

- Project Management Institute. (2004). *A guide to the project management body of knowledg*e (3rd ed.). Newtown Square, PA: Project Management Institute.

To acquire details on the subject of the work breakdown structure, PMI suggests:

- Project Management Institute. (2002). *PMI practice standard for work breakdown structures*. Newtown Square, PA: Project Management Institute.

PMI commissioned reviews of the following books on Earned Value, which appear in Appendix E:

- Fleming, Q. W., & Koppelman, J. M. (2000). *Earned value project management* (2nd ed.) Upper Darby, PA: Project Management Institute.
- Humphreys & Associates, Inc. (2002). *Project management using earned value.*
- Kemps, R. R. (2000). *Fundamentals of project performance measurement.*
- Lambert, L. R., & Lambert, E. (2000). *Project management: The commonsense approach*. Columbus, OH: LCG Publishing.

Other available standards and guides include:

- American National Standards Institute/Electronic Industries Alliance. (1998). *Earned value management systems*. Arlington, VA: Electronic Industries Alliance. (ANSI-EIA-748-98)
- Earned Value Management Committee, Council of Standards Australia. (2003). *Project performance measurement using earned value*. Sydney: Standards Australia International, LTD. (AS4817)
- The Association for Project Management. (2002). *Earned value management APM guideline for the UK*. Buckinghamshire, UK: The Association for Project Management.


An extensive bibliography on Earned Value is available at this Web site:

- http://www.suu.edu/faculty/christensend/ev-bib.html

### Organizations

The following organizations are recommended sources of information:

- The Project Management Institute (PMI)
  http://www.pmi.org/info/default.asp
- The PMI College of Performance Management
  http://www.pmi-cpm.org/
- The PMI College of Scheduling
  http://www.pmicos.org/

### Education and Training

For opportunities in this area, consult the organizations above and the PMI R.E.P. Program:

- http://www.pmi.org/info/PDC REPOverviewFile.asp?nav=0406

Appendix E

# Reviews of Selected Books on EVM

The following information lists PMI-commissioned reviews of books on Earned Value Management (EVM):

- Fleming, Q. W., & Koppelman, J. M. (2000). *Earned value project management* (2nd ed.). Upper Darby, PA: Project Management Institute.
- Humphreys & Associates, Inc. (2002). *Project management using earned value*. Orange, CA: Humphreys & Associates, Inc.
- Kemps, R. R. (2000). *Fundamentals of project performance measurement.* Orange, CA: Humphreys & Associates, Inc.
- Lambert, L. R., & Lambert, E. (2000). *Project management: The commonsense approach.* Columbus, OH: LCG Publishing.

***Earned Value Project Management, Second Edition***

by Quentin W. Fleming and Joel M. Koppelman

Project Management Institute, 2000, ISBN: 1-880410-27-3, paperback, 224 pp.

Reviewed by Kenneth H. Rose, PMP, Book Review Editor, *Project Management Journal*

Earned Value Management is a simple, powerful technique for measuring project performance and projecting final results that is often overlooked or even avoided by project managers. It is required on many government contracts; but its historically arcane and ponderous terminology has made it almost an anathema in commercial contexts. In their updated second edition of *Earned Value Project Management*, Quentin W. Fleming and Joel M. Koppelman address the benefits of Earned Value Management in a way intended to simplify application processes and make it accessible to the masses.

The book begins with an illuminating *Once upon a time. . .* story about a project manager facing a challenging task. The scenario will seem familiar to many readers. So much so, in fact, that readers will find it hard to miss the beneficial role of Earned Value Management in achieving project goals. This opening approach — different from a dry recitation of facts and figures — does much to bring readers on board and provides a performance-based reason for careful study of what follows.

Thankfully, this book is not yet another listing of almost identical formulas and acronyms to be memorized by obedient readers. First, the gobbledygook acronyms of times past have been replaced by the more contemporary and user-friendly terms of planned value, earned value, and actual cost. (Though in some places, the authors use both old and new terminology, probably as a means of transition for experienced readers.) These authors seem to strive for establishing a common understanding and disclosing concepts and goals, an approach that allows the formulas they discuss to clearly take shape in the reader's mind.

The authors make a strong case for the need for Earned Value Management by describing a commonly used evaluation device, the spending plan. A typical spending plan compares budget to actual expenditures, but does not offer a clue about the actual work that was accomplished as compared to what should have been accomplished. This is the essence of Earned Value Management: a three-way comparison showing work to be done (in terms of expected cost), actual work completed (in terms of expected cost), and actual work completed (in terms of actual cost). These three data elements allow a project manager to determine variances in both schedule and cost and to make reasonable estimates of schedule and cost at completion.

Fleming and Koppelman offer ten basic benefits of employing Earned Value Management. They then use these as a foundation for developing a simplified form and approach that may be integrated with other, traditional tools. They show that a work breakdown structure (WBS) is essential for defining tasks and managing scope. This leads naturally to planning and scheduling, also essential for effective application of the technique. A third step, estimating and allocating resources, allows completion of detailed control accounts (formerly known as cost accounts), which are a distinguishing mark of an Earned Value Management system. This information forms the foundation of the project baseline, against which all future performance will be measured.

Quantifying subsequent work in baseline dollars and then calculating the cost of that work allows a project manager to gauge progress against planned schedule and planned cost. This information is far more meaningful and valuable than that found in a typical spending plan. The authors describe eight different methods for measuring performance using earned value methods. Control account plans are an essential element in Earned Value Management and the authors provide as examples specific information related to high technology, architectural, and software projects.

This book brims with practical guidance and advice. For example, the authors state that cost performance tends to remain stable after 15–20 percent of the project is complete. They show that the schedule performance index (SPI) is important during early project phases, less important closer to completion. They also note that CPI should be watched more closely than SPI because negative positions are more difficult to correct; cost overruns can be improved, but usually not fully recovered. The authors also address the forecasting of final costs and schedule results, doing so in a discussion on the three critical factors that influence project performance outcomes.

While Earned Value Management may be essential—or even required—for large cost-reimbursement contracts, its full and formal requirements are not necessary in smaller or firm-fixed price agreements where its benefits should not go untapped. The book closes with 10 basic steps for applying Earned Value Management in just about any project environment.

*Earned Value Project Management* does not, by the authors' own declaration, offer anything really new. Rather, it examines an existing technique and transforms it into something more user-friendly—something more useful to those who need it. It is a basic resource—perhaps even the best currently available—that will benefit all project management professionals.

***Project Management Using Earned Value***

Humphreys & Associates, Inc.

Humphreys & Associates, Inc., 2002, ISBN: 0970861400, hardcover, 926 pp.

Reviewed by Kenneth H. Rose, PMP, Book Review Editor, *Project Management Journal*

Earned Value Management is a subject that often receives stand-alone treatment in either a brief book or a separate chapter in a larger text. Humphreys & Associates, a project and program management consulting firm in Orange, CA, USA, takes a different approach in their massive *Project Management Using Earned Value*. The book provides a comprehensive, whole-cloth view of project management with earned value woven into the fabric, showing how earned value is an integrated part of good project management, not an appliqué to be pasted on when needed or convenient.

''Massive'' is an understatement. The book is formidable: 8.5×11-inch format, almost 2 inches thick, and weighing in at 6 pounds. It is more suited to library shelves than the desks or briefcases of busy project managers. But its cumbersome size shrinks to irrelevance when readers first open it and discover its immense value.

The book is designed as an instructional aid, probably more for hands-on seminars than formal academic settings. Text is written in a direct, speak-to-the-reader style that makes complex topics comfortable and easy to understand. Each chapter ends with a series of review questions and a parallel series of true-false questions. Both are useful. The former allows exploration and tests deep understanding; the latter emphasizes single points of information that should be assimilated and retained. Solutions appear at the end of the book in a section that provides brief discussion of the review questions and correct information for the ''false'' questions.

The book's 39 chapters are divided into five parts. Part 1 comprises five chapters that introduce the concept of earned value and describe the WBS and its role as the foundation of Earned Value Management; it also links risk, organizational responsibilities, and work teams. Readers will immediately see that this is not a descriptive text that aims to tell them about earned value. It is an immersion text that enables readers to experience earned value through a rich collection of case studies.

The individual case studies—44 in all—are not toy scenarios created to fit the text, but rather real-world examples from consulting experience. The documents and data will have a familiar feel to many readers as they arise from general practice, not from an individual author's personal view. Case studies are challenging and sometimes complex. The publisher offers complete solutions on its Web site, providing individual PDF files and a zip file of the collected set that may be downloaded as readers choose.

Part 1 introduces a flowchart of a 15-step process for earned value project management. The chart reappears throughout the book as a graphic guide to readers that shows where they are in the process as they progress through the technical information. Each of the five parts ends with a quiz of variable length that reinforces learning. Answers to quiz questions are also provided in the back of the book.

Comprising 15 chapters, part 2, ''Scheduling,'' is the longest in the book. The overall length reflects the critical role of scheduling in project planning. The number of chapters reflects the publisher's wise design that focuses on the chapter as the basic unit of organization for major teaching points. Readers will encounter bite-size elements that are easily taken in and logically linked to each other. Textbook discussions on scheduling often get cut short—several pages of explanation, a couple of diagrams, and then on to the next topic. Not so here. Readers march through almost 300 pages of progressive concepts and case studies that address not only the usual basics, but also the practical procedures that make things work.

Part 3 presents the estimating process in eight chapters. Readers will not miss the importance of this critical step to Earned Value Management. A realistic estimate is the foundation of successful Earned Value Management—the data element that, when added to the equation, makes sense of traditional comparisons of budgeted to actual costs. The case studies are particularly useful in clarifying what otherwise might be ''smoke-and-mirrors'' in an often theoretical discussion.

Earned value methods are the focus of part 4. The discussion begins with the usual disclosure of the shortcomings of the budget-actuals approach. A following, simple example of building a brick wall makes clear the superiority of the earned value approach. This is where most books stop, leaving the reader to figure out exactly what to do next. But here, it is only the beginning. Readers move through the minefields of measuring accomplishments, establishing performance measurement baselines, collecting actual cost data, analyzing data, and taking corrective actions. Safely through, readers will feel confident that they can determine when and how to apply Earned Value Management in their projects. To guide readers in the final step of application, part 5 addresses implementation as a single chapter and case study.

Project management is not easy. Success depends on many factors, including realistic schedules, accurate cost estimates, and well understood risks. In addition, success depends on effectively measuring work progress. *Project Management Using Earned Value* provides the means to acquire this ability and apply it in the project world.

### *Fundamentals of Project Performance Measurement, Fourth Edition*

By Robert R. Kemps, updated by Gary C. Humphreys

Humphreys & Associates, Inc., 2004, ISBN: 0912495219, hardcover, 129 pp.

Reviewed by Kenneth H. Rose, PMP, Book Review Editor, *Project Management Journal*

Earned Value Management is not the center of the universe. Though it may seem so from all the hype in project management literature, it is just a part—albeit an important one—of a larger whole. Robert R. Kemps makes this clear in *Fundamentals of Project Performance Measurement*, first published in 1996 and now it its fourth updated edition.

What Kemps makes clear is that measuring project performance is a complex task involving many interrelated and progressive steps. Earned Value Management is a powerful, essential element, but it is not an end in itself. Other books discuss earned value in glorious detail. Kemps weaves it into a broader discussion that focuses on concepts rather than formulas. It is earned value without the onerous acronyms.

Kemps begins by describing performance measurement as a method for comparing actual performance to a baseline plan. He shows the typical chart that compares actual costs to the approved budget and points out the inherent shortsightedness of this view. This is one of the rare occasions where he uses the terms and acronyms for budgeted cost of work scheduled, budgeted cost of work performed, and actual cost of work performed. Having established, in a traditional way, the need for a different method of measurement, Kemps proceeds in a nontraditional way, eschewing the how-to formulas in favor of a better understanding of what to do and why.

Understanding the full scope of the project is the first step toward effective performance measurement. Kemps describes the work breakdown structure as a means of defining project work and, once completed, a framework for integrating management subsystems and accumulating performance information. Linking this to an organiza-

tional breakdown structure is an essential step — and one that must be carefully performed — that produces control accounts, the basic level of work measurement.

At this point in the book, readers will probably have noticed another standout feature of Kemps approach: the ease with which the information may be taken in. Kemps lays out a step-by-step journey in brief chapters that address a single subject. In addition, his writing style is simple and direct. Satisfied readers may well wonder why all books are not written this way.

Moving forward with scheduling and budgeting, Kemps emphasizes the importance of vertical and horizontal *traceability*; that is, the linkage of scheduled tasks from top to bottom and from beginning to end. In the budgeting discussion, readers should note the definition of *management reserve*. This term seems not to have a universal meaning in project management literature. Readers should be aware of the way Kemps uses it.

While establishing the project baseline is a difficult and time-consuming task, it is also a critical step in gaining a realistic view of what lies ahead. Kemps cautions readers about external budgeting decisions made without regard to their effect on individual projects: these often lead to much grief in schedule slippage and cost overruns.

Although detailed planning produces work packages (a defined task or set of tasks that have a completed product or end result), the author points out that this not always that simple. Work packages may encompass a variety of time spans. Some work, such as general project management, may not be amenable to packaging. Such work must be captured by either separate level-of-effort accounting or apportioning to affected work packages.

''The key to performance measurement is the objective assessment of work in progress,'' (p. 43) says the author in the beginning of his discussion on earned value. He describes the difficulties associated with measuring work of different kinds and different durations, of reinforcing the role of control accounts, work packages, accounting systems, and data collection in achieving meaning measures.

Chapter 11, ''Estimating Cost at Completion,'' stands out as being centrally important. Kemps emphasizes that cost estimates must not be structured to fit some predetermined, politically saleable number. Now, earned value arises as a comprehensive method for measuring progress. The author also points out that the numbers resulting from earned value analysis are not sacrosanct. Rather, they should be used as a sanity check within wider consideration of other types of estimates.

Since projects are not carved in stone when initial planning is complete, Kemps reminds readers that change—both internally and externally generated—is inevitable. Changes, he explains, must be managed and baselines must be adjusted to avoid downstream surprises, adding that maintaining the baseline is probably the most difficult aspect of performance measurement. Kemps suggests that measuring performance against a goal rather than a total authorized budget may be a more practical approach, if the customer agrees.

Kemps addresses the matter of external reporting in some detail. His view that work breakdown structures generally expand at a one-to-six rate is a helpful heuristic in determining the level of reporting. A level too low may result in so much variance analysis and so much time required for explanations that the process encumbers rather than enables management. Kemps suggests reports in column format, different from the S-curves usually encountered in project management literature. He also suggests a baseline report that will disclose any *rubber baseline* problems—those baseline adjustments that result from using future funds to solve current problems.

The author also discusses the more usual S-curve reports, but ties in two others: one for showing cost and schedule variance trends, and one for showing actual versus

projected performance. Kemps wraps things up in a final chapter that reviews the U.S. Department of Defense's Earned Value Management Systems Guidelines.

*Fundamentals of Project Performance Measurement* delivers exactly what its title describes. It is not a collection of acronyms and formulas. It is a logically progressive presentation of concepts and offers a general approach. Before applying specific earned value techniques, readers should understand what these techniques are all about. This book is the place to start.

### *Project Management: The CommonSense Approach: Using Earned Value to Balance the Triple Constraint*

By Lee R. Lambert and Erin Lambert

LCG Publishing, 2000, ISBN: 0962639788, paperback, 136 pp.

Reviewed by Kenneth H. Rose, PMP, Book Review Editor, *Project Management Journal*

For many, Earned Value Management can be a matter of great mystery. New concepts and obscure formulas tumble together in an avalanche of acronyms. Lee and Erin Lambert have brought a welcome degree of clarity and simplicity to this topic in their brief book *Project Management: The CommonSense Approach*.

This dandy little book is appropriately subtitled*, Using Earned Value to Balance the Triple Constraint*. Simple and direct, brief and to the point, the book takes readers right to the heart of Earned Value Management. It shows readers how a few simple calculations can disclose project actual status and overcome the inaccuracies or exaggerations of a more subjective approach.

While the calculations may be simple, the foundation is not. Successful application of Earned Value Management depends on careful planning and controlled implementation, all based on complete understanding of the concepts. The authors give considerable attention to the necessary foundation before providing the formulas.

This highly readable book follows a bullet point format with information in concise statements that readers may easily grasp. Cartoons, sprinkled liberally throughout the text, illuminate key points and provide a bit of levity to what otherwise could be a deadly dull subject. A recurring cartoon character heralds the delivery of ''Common Sense''—short, pithy paragraphs that present basic truths to be remembered and applied.

Readers learn early that Earned Value Management begins with project planning. It cannot be tagged on to a project midstream; it must be an integral part of requirements definition, planning, and data gathering. Readers also learn the key role played by control accounts, something the authors reinforce throughout the text.

But control accounts do not stand alone. Work packages are the discrete, well defined work elements that are the basis for measurement and the source of essential data. The book includes a couple of clear graphics that display the relationships and roles of work packages and control accounts.

In the early part of the book, the authors wisely chose to introduce the concepts and define the terms in general language without the appearance of the associated formulas. This approach allows readers to get the concepts before they have to deal with the math.

Work authorization and flow is a critical factor in managing control accounts, but it is an end-of-line process. The authors show the whole picture, starting right at the top, so that readers will understand the larger context of Earned Value Management. One of the first points of ''Common Sense'' gently warns readers to adopt good

planning and accurate progress measuring techniques. Other, more subjective techniques will not release the full potential of Earned Value Management. A discussion of budgets and cost accumulation completes the review of essential elements.

Performance measurement is the thorny subject in any earned value implementation. This is where the smoke and mirrors usually appear. The book describes several different methods for determining work completion status. Some are simple, some complex. The authors suggest an innovative approach that may be applied to projects with a high research component, bringing the benefits of Earned Value Management to an area where it has been historically ignored.

Data from performance measurement lead to variances—differences between what was planned and what was done. This is the focus of Earned Value Management. The authors give examples and explain a variety of conditions that may be of interest or concern to project managers. Another ''Common Sense'' point comes in to advise readers to evaluate earned value data in the context of the project network diagram. Schedule variances off the critical path may indicate a proper use of float, not a performance problem.

Finally, the formulas appear. Because of all the preparation, they come in as a natural next step, not a new source of anxiety and confusion. Readers may well wonder what all the fuss was about. At this point, it all seems pretty straightforward. One last bit of ''Common Sense'' reminds readers that materials accounting can be a source of disconnect in Earned Value Management. The authors provide several options for materials accounting that will meet various project situations.

In closing the book, the authors make the point that training is essential and that it should be applied near the time of use and consider actual project data if possible. They also provide an extensive discussion on selecting project software that may be something of a *non sequitur* but still generally useful. Of certain value is the appendix of guidelines for applying Earned Value Management. It gives readers a practical framework for using what they have learned.

*Earned Value Management: The CommonSense Approach* may not be the most impressive looking book on the shelf. It won't win any prizes for weight or number of pages. It offers something more important. Its brevity and unique approach provide a degree of value matched by few others. If you are just starting Earned Value Management, start here. If you are midstream in implementation, read this book, digest its contents, and you may find some simple solutions to problems that have been blocking your way.

# References

Project Management Institute. (2004). *A guide to the project management body of knowledge* (3rd ed.). Newtown Square, PA: Project Management Institute.

# Glossary

**Actual Cost (AC).** Total costs actually incurred and recorded in accomplishing work performed during a given time period. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Actual Cost of Work Performed (ACWP).** See Actual Cost (AC).

**Apportioned Effort (AE).** Effort applied to project work that is not readily divisible into discrete efforts for that work, but which is related in direct proportion to measurable discrete work efforts. Contrast with Discrete Effort.

**Budget at Completion (BAC).** The sum of all the budgets established for the work to be performed on the project. The total planned value for the project. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Budgeted Cost of Work Performed (BCWP).** See Earned Value (EV).

**Budgeted Cost of Work Scheduled (BCWS).** See Planned Value (PV).

**Control Account.** A management control point where scope, budget (resource plans), actual cost, and schedule are integrated and compared to earned value for performance measurement. Control accounts are placed at selected management points (specific components at selected levels) of the work breakdown structure. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Cost Performance Index (CPI).** A measure of cost efficiency on a project. It is the ratio of earned value (EV) to actual costs (AC). CPI = EV divided by AC. A value equal to or greater than one indicates a favorable condition and a value less than one indicates an unfavorable condition.

**Cost Variance (CV).** A measure of cost performance on a project. It is the algebraic difference between earned value (EV) and actual cost (AC). CV = EV minus AC. A positive value indicates a favorable condition and a negative value indicates an unfavorable condition.

**Discrete Effort.** Work effort that is separate, distinct, and related to the completion of specific end products or services, and that can be directly planned and measured. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Earned Value (EV).** The value of work performed expressed in terms of the budget assigned to that work. Also referred to as the Budgeted Cost of Work Performed (BCWP). (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Earned Value Technique (EVT).** A technique or method for measuring the performance of work, and used to establish the performance measurement baseline (PMB). (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Estimate at Completion (EAC).** The expected total cost of completing project work. EAC is equal to the actual cost (AC) plus the estimate to complete (ETC) for all of the remaining work. The EAC may be calculated based on performance to date or estimated by the project team based on other factors. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Estimate to Complete (ETC).** The estimated cost of completing the remaining work. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Level of Effort (LOE).** Support-type activity (e.g., seller or customer liaison, project cost accounting, project management), which does not produce definitive end products. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Management by Exception.** A management technique that emphasizes attention to performance behavior that falls outside of some predetermined range of normal or expected outcomes. This technique is characterized by containment and conservatism.

**Organizational Breakdown Structure (OBS).** A hierarchically organized depiction of the project organization arranged so as to relate the work to the performing organizational units. (Sometimes OBS is written as Organization Breakdown Structure with the same definition.) (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Performance Measurement Baseline (PMB).** An approved, integrated scope-schedule-cost plan for the project work against which project execution is compared to measure and manage performance. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Physical Work Progress.** The amount of work physically completed on the project or task. This may be different from the amount of effort or money expended on the project or task. Predetermined techniques of claiming physical work progress that were selected during project planning are used to credit Earned Value when work is partially complete at the time of progress reporting.

**Planned Value (PV).** The authorized budget assigned to the scheduled work to be accomplished. Also referred to as the budgeted cost of work scheduled (BCWS). (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Responsibility Assignment Matrix (RAM).** A structure that relates the project organizational breakdown structure to the work breakdown structure to help ensure that each component of the project's scope of work is assigned to a responsible person/team.

**Schedule Performance Index (SPI).** A measure of schedule efficiency on a project. It is the ratio of earned value (EV) to planned value (PV). The SPI = EV divided by PV. An SPI equal to or greater than one indicates a favorable condition and a value of less than one indicates an unfavorable condition.

**Schedule Variance (SV).** A measure of schedule performance on a project. It is the algebraic difference between the earned value (EV) and the planned value (PV). SV = EV minus PV. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.

**S-Curve.** Graphic display of cumulative costs, labor hours, percentage of work, or other quantities, plotted against time. Used to depict Planned Value, Earned Value, and Actual Cost of project work. (Note: The *PMBOK® Guide* definition for this term is broader and more inclusive in that it applies beyond the scope of the *Practice Standard for Earned Value Management*.)

**Time-Phase Budget.** A project budget that identifies how much money or labor is to be expended on each task for each time period (e.g., month) in the project schedule (see Planned Value).

**To-Complete Performance Index (TCPI).** The calculated projection of cost performance that must be achieved on remaining work to meet a specified goal, such as the BAC or the management EAC. For example: To-Complete Performance Index = (remaining work) / (budget remaining) = (BAC − EV) / (BAC − AC).

**Variance at Completion (VAC).** The difference between the total budget assigned to a project (BAC) and the total cost estimate at completion (EAC). Variance at Completion = Budget at Completion − Estimate at Completion. It represents the amount of expected overrun or underrun.

**Variance Threshold.** A predetermined range of normal outcomes that is determined during the planning process and sets the boundaries within which the team practices management by exception.

# Index by Keyword