

AACE
INTERNATIONAL
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PRACTICE

86R-14

**VARIANCE ANALYSIS AND
REPORTING**

SAMPLE

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VARIANCE ANALYSIS AND REPORTING

TCM Framework: 9.1 – Project Cost Accounting

9.2 – Progress and Performance Measurement

10.1 – Project Performance Assessment

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Note: As AAACE International Recommended Practices evolve over time, please refer to www.aaacei.org for the latest revisions.

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Disclaimer: The opinions expressed by the authors and contributors to this recommended practice are their own and do not necessarily reflect those of their employers, unless otherwise stated.

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October 19, 2015

INTRODUCTION

This RP is intended to provide guidance for planning, performing, managing, and controlling the variance analysis process. Earned value management (EVM) practitioners would consider this guidance to be advisable for analyzing earned value (EV) metrics and addressing any potential influences to project execution. The target audience for this RP is anyone with a need to understand how to prepare an EV variance analysis and perform a root cause analysis.

As with all AACE International recommended practices, this document is not intended to be a standard, but provides further clarification of recommended EVM practices as they apply to planning, implementation, and reporting a variance analysis.

This RP is aligned with the *Total Cost Management Framework*, as well as the *American National Standards Institute (ANSI) Electronics Industries Alliance (EIA) - 748 Earned Value Management Systems (EVMS)* guidelines (Guidelines 22-26). This document also provides further explanation of the intent and application of variance analysis and reporting that is not contained in the *ANSI/EIA-748 Standard*^[1] and the *National Defense Industries Association (NDIA) Earned Value Management Systems Interim Guide*^[2].

RECOMMENDED PRACTICE

Variance analysis is an essential practice in industry and government sectors for all types of projects regardless of geographic location. The information that follows in some cases transcends EV and may be applicable in other project environments where variance analysis is needed.

Introduction to Variance Analysis

Variance analysis is an important earned value practice that is used for management decision-making on projects world-wide. No plan is perfect, which is why variances are expected on every project. Cost variance is calculated as the earned value minus the actual cost incurred while schedule variance is calculated as earned value minus the planned value. Both cost variance and schedule variance should be calculated on a period and a cumulative basis. Although earned value is considered a management by exception practice a project with a zero variance should also be considered suspect since it may have miscalculated earned value or elements that are masking variances or that have manipulated elements.

Variance analysis can be used as a tool that allows the project team to forecast more realistically, based on the project's demonstrated history with productivity rates, communication between subcontractors, ability to meet milestones, design quality and other project factors. In fact when calculating the estimate at completion (EAC) for the project, the trends and variances to cost and schedule should be reviewed as a primary basis. This retrospective project analysis allows more accurate forecasting of the expected final cost and completion date.

Variance analysis is based upon the management by exception principle with defined variance thresholds, which can be by cost variance or a percentage variance to alert the project team to potential areas of concern. Setting the thresholds for tracking VARs is important and can vary depending on the phase of the project. This variance threshold set by the project team is used to determine what variances and what levels of the work breakdown structure (WBS) require analysis. A written variance analysis report (VAR) should be prepared to explain the

reasons for the variance and any corrective actions required to mitigate or correct the variance(s).

For example, a variance may be considered acceptable within plus or minus 10% or \$50,000, while anything over or under that threshold requires producing a VAR. Some projects or programs may use a “stoplight” approach where, for example, plus or minus 5% is “green” which requires no action or explanation; while plus or minus 5% to 20% is “yellow” requiring that a VAR be written, while anything over plus or minus 20% is a “red” which triggers a potential stop to the project or a reevaluation by higher levels of management. The “red” variance is typically based on a cumulative rather than a monthly calculation so projects are not halted for non-critical period variances. Variance thresholds are usually set at different levels for current period and cumulative to-date data, because the larger cumulative numbers result in more stable performance index percentages where a smaller threshold is appropriate. The same smaller threshold philosophy is also usually applied to variance at completion (VAC) thresholds. Threshold values are based upon individual project and program requirements.

The VAR can be a useful document to the entire project team when it is correctly analyzed and the necessary follow-up actions are taken. The VAR contains:

- Information on the root causes of the variance.
- Identification of any corrective actions or mitigation actions required.
- Identification of changes to the budget at completion (BAC), estimate at completion (EAC) or estimate to completion (ETC).
- Documentation of any management actions.

Creating a useful and acceptable VAR requires input from many stakeholders, which can include the design engineers; project engineers; construction team; safety, health, and environmental engineers; procurement; the client; and others depending on the type of project.

Basic Terms and Formulas for Variance Analysis

Basic earned value terms and formulas are being presented since they are prerequisite to the understanding and discussion of variance analysis. The following terms are basic to EV:

EV Term	Interpretation based on 10S-90
Planned value (PV) or budgeted cost of work scheduled (BCWS)	Measure of the amount of money budgeted to complete the scheduled work as of the data date.
Earned value (EV) or budgeted cost of work performed (BCWP)	Measure of the value of work performed so far.
Actual cost (AC) or actual cost of work performed (ACWP)	A measure of the actual cost of the work performed as of a data date.
Budget at completion (BAC)	The summation of time phased costs at any work breakdown structure (WBS) level.
Estimate at completion (EAC)	An estimate of the total cost an activity or group of activities will accumulate upon final completion.
Variance at completion (VAC)	The schedule or budget at completion less the estimate at completion.

Cost Variance (CV) = EV - AC (Eq 1)

A positive variance means the actual costs are less than the value of work accomplished, while a negative number means the actual costs were higher than expected for the value of the work accomplished. Costs can be either direct costs such as labor, materials and equipment or indirect costs.

Cost Performance Index (CPI) = EV/AC (Eq 2)

The cost performance index (CPI) is another way to look at this information. The CPI identifies project performance relative to an index value of 1.00; a result above 1.00 is positive, meaning that the earned value is

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higher than actual costs.

$$\text{Schedule Variance (SV)} = \text{EV} - \text{PV} \quad (\text{Eq 3})$$

A positive variance means the earned value of the work accomplished is more than what was planned.

$$\text{Schedule Performance Index (SPI)} = \text{EV}/\text{PV} \quad (\text{Eq 4})$$

The schedule performance index (SPI) is another way to look at this information. The SPI identifies project performance relative to an index value of 1.00; a result above 1.00 is positive, meaning that the earned value is higher than planned value. In order to understand the context and implication of the metric, one needs to actually review the schedule. EV schedule metrics are only an indicator.

Additional schedule analysis may be needed to determine if a schedule variance is indicative of actual schedule performance. For example, a project could be accomplishing a significant amount of low non-critical work but be behind schedule on critical path work effort. In that case, the SV or SPI could look favorable, yet the project is not accomplishing critical path work and therefore slipping the project completion date.

$$\text{Variance at Completion (VAC)} = \text{BAC} - \text{EAC} \quad (\text{Eq 5})$$

A positive variance is good and indicates that the forecast is less than the current budget. While positive results are typically a favorable indicator, caution should be taken and any positive value should be reviewed too. Sometimes an overly favorable variance is also indicative of an issue.

All of these measures can be calculated for the overall project and/or at the level of a given work package or control account.

For a complete description of estimate at completion (EAC) and methods for calculate EAC, please refer to Recommended Practice 80R-13, *Estimate at Completion*.

Variance Analysis Process

Variance analysis is an integral part of the EVM process, which is a closed loop system depicted in *Figure 1 - EV Cycle and RP Focus Areas*. The two steps which are covered in this RP (shown in red) are:

- 1) Analyze deviations or variances; define the root cause of the variances and their impacts on the project.
- 2) Develop corrective action(s) or mitigate the impact of the situation on the remaining work.

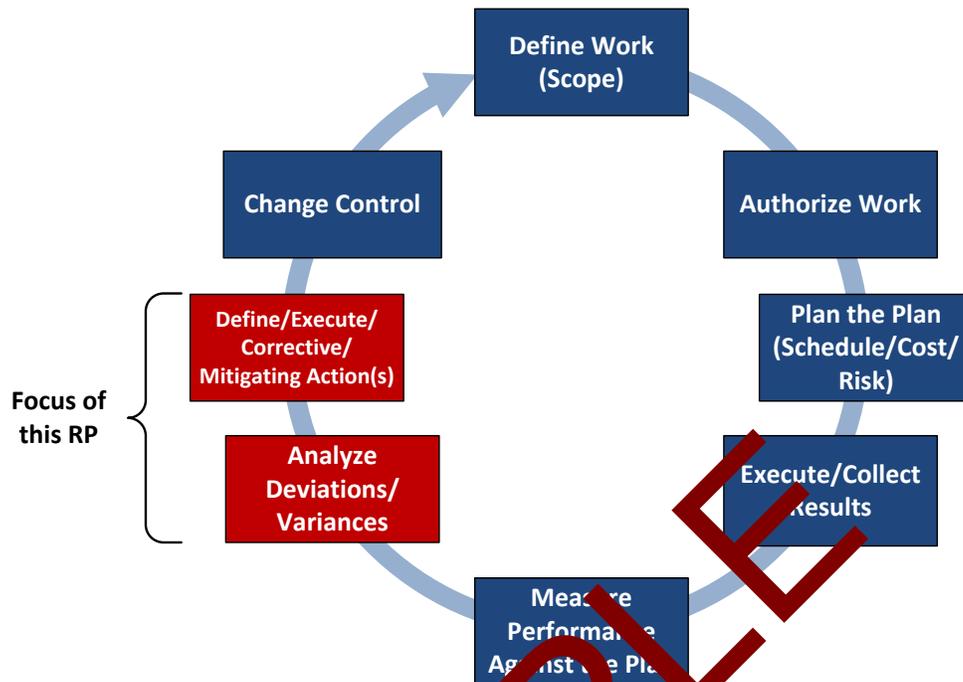


Figure 1 – EV Cycle and RP Focus Areas

Analyzing Variance Analysis Reports

Typical steps in preparing a VAR include, but are not limited to, the items noted in Table 1 below.

Step	Step Definition
1.	Collecting technical, schedule and cost data
2.	Validating the information
3.	Stating the problem
4.	Determine the cause of the problem (root cause)
5.	Address the technical, schedule, cost impacts to other work scope elements in the project
6.	Develop a corrective action plan (CAP) to mitigate, eliminate or offset the problem
7.	Analyze impacts to the estimate to complete (ETC) and the estimate at completion (EAC)
8.	Implement and track the corrective action
9.	Monitor and revise the corrective action, as necessary

Table 1 - Steps in Analyzing a Variance Analysis Report

The first step in analyzing a VAR is to understand the information provided in the following sample report. Using Figure 2 – Example of a Typical VAR Report and Key Sections shown below, each part of the VAR will be described. A VAR typically contains three main sections: header information (item 1), the tabular EV data (item 2) and the narrative section (item 3). The header section includes the name of the account, either the control account (CA), work package (WP) or other unique identifier. In the sample VAR, the identifier is the CA, the period that the data is derived from is shown (Apr12 in the example.) Owners of the data (people and organizations) are identified. The project manager is Mr. Smith and the systems analyst is Ms. Doe in this example. The VAR is often an output of the cost system, a spreadsheet, or third party software. The tabular data on a VAR, shows the basic EV calculations. This information can be current period and/or cumulative and at complete data and is derived from