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Approach to Overhead Variance Analysis

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Even most experienced cost accountants disagree on their definitions of overhead variances. Here the authors suggest a general approach which can be used to reach the necessary differentiation and precision for all individual variances —

AN APPROACH TO OVERHEAD VARIANCE ANALYSIS

by Russell F. Peppet and Richard B. Troxel
Peat, Marwick, Mitchell & Co.

STANDARD cost accounting literature offers little agreement or uniformity as to the definition of overhead variances. Some authors espouse a two-variance system; others champion three variances; still other analysts insist on four variances. The formulas invariably seem precise at first glance. On closer scrutiny, all appear to be quite different. Even the names of the variances change from one piece of literature to the next. Because of the maze of nomenclature and formulas, the authors have found even trained accountants sometimes bewildered. What exactly is the connection between all the formulas? Should there be two, three, or more variances? Is there no one *best* way?

Most new concepts in accounting literature are in reality restatements or clarifications of previously stated ideas. This article is no exception. However, clarification is itself often a worthwhile pursuit, and this discussion is presented in the belief that it offers a simple and straightforward approach to the complex issue of overhead variance analysis.

A Graphic approach

Let's begin with a simple example:

Attainable Capacity	2,000 hrs.
Variable Overhead	$0.60 per hr.
Fixed Overhead	$800 or $0.40 per hr. at capacity

These data are graphically presented in Exhibit 1 on page 40. This exhibit illustrates that even if we spend at the predetermined budget rate, we will have, nevertheless, an unfavorable variance—we will be underabsorbed—by the difference between total budgeted overhead cost (both fixed and variable) and the applied overhead at all volumes below 2,000 hours. This variance occurs, therefore, when the plant is operated at less than capacity and is commonly and logically identified as the idle capacity variance.

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In Exhibit 2 on page 40 we add the following conditions to the example:

Actual Hours	1,700 hrs.
Actual Overhead	$2,150

If we assume that we apply $1,700 of overhead to production (1,700 hours × $1 per hour), we have a total variance of $450. Line A'B' is evidently an unfavorable spending variance of $330 created because actual expenses exceeded the budgeted overhead by that amount. As demonstrated in Exhibit 2, line B'E' ($120) is an unfavorable idle capacity variance. This is more precisely calculated as the idle hours (300) times the fixed rate (.40), as will be illustrated later.

Two variances

At this point, therefore, we have developed two basic variances generated according to these definitions:

1. The spending variance occurs because actual overhead expense differs from the budgeted overhead expense.
2. The idle capacity variance occurs because budgeted overhead expense differs from the overhead expense that would be applied at actual hours.

Behavior of variances

Observe also in Exhibit 2 the behavioral characteristics of these variances. As the actual hours move toward capacity (as the hours approach 2,000) at a rate equal to or greater than the increase in the actual dollar amount, the spending variance decreases as more budgeted overhead is attributed to the higher hours.[1] Simi-

In any standard cost system, each variance must be independent as to the reasons for its existence. If variances are "lumped together," management cannot clearly gain appreciation of the causes of the variances and subsequently work toward their elimination.

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[1] To facilitate the presentation, the example assumes actual cost to be the same at all volume levels. While this is obviously unrealistic, the method of computing the spending variance is accurate regardless of the slope of the actual cost line.

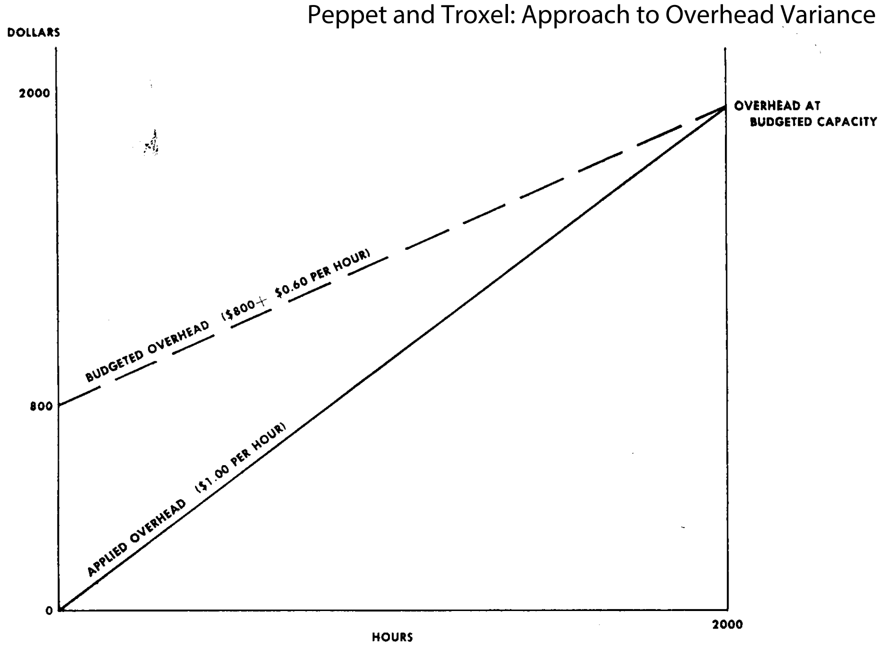

EXHIBIT 1

Overhead Variance
Single-Variance Analysis

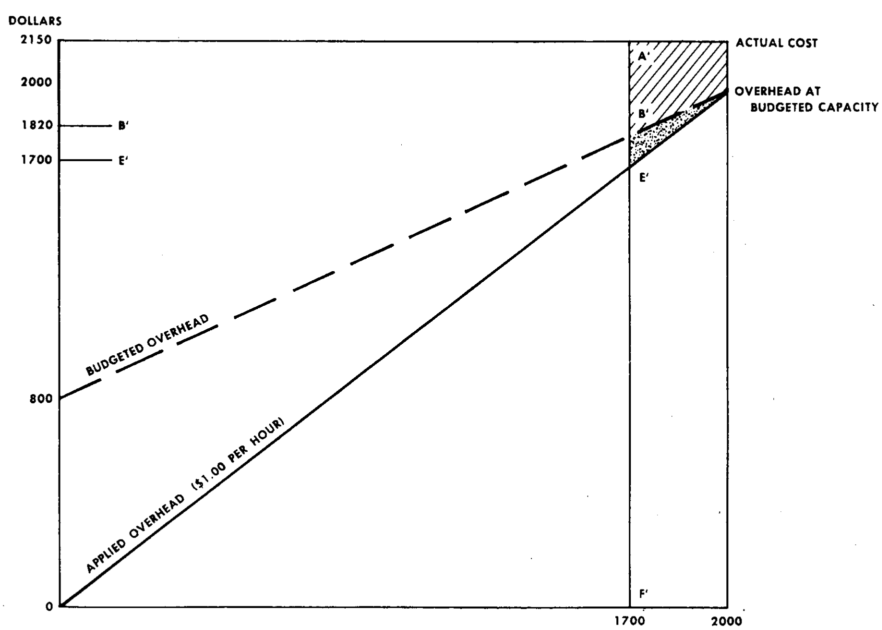

EXHIBIT 2

Overhead Variance
Two-Variance Analysis

larly, as the basis for overhead application (in this case, actual hours) moves toward 2,000, the idle capacity variance decreases as more of capacity is utilized.

Let us add one more set of assumptions to the example we have been using.

Standard Hours	1,300 hrs.
Applied Overhead	$1,300

As shown in Exhibit 3 on page 41, the spending variance (line AB or A′B′) is unchanged. This is consistent with definition 1 stated previously. Spending variance is the difference between actual dollars and the budgeted overhead based on actual hours. It is unrelated to applied overhead.

Also, idle capacity is unaffected. As defined in definition 2, idle capacity is determined by the applications rate times actual hours. Exhibit 3 illustrates this variance (DE or B′E′) by a line DB′ parallel to EE′. In other words, the idle capacity can be reduced only if actual hours increase. It is not affected by the efficiency of operations.

New variances created

However, efficiency measurement does create a new set of variances. As line AF (standard hours) moves away from actual hours—that is, as efficiency decreases—the line BD grows larger. This variance can be conveniently split into its variable and fixed portions by the budgeted overhead line so that BC represents the amount of variable dollars not charged to production ($0.60 × 400 lost hours or $240) and CD represents the fixed dollars not charged ($0.40 × 400 lost hours or $160).

The causes and effect of these efficiency variances are readily apparent in the diagram. As line AF moves toward A′F′—as efficiency increases—these variances decrease but idle capacity and spending remain constant.

Various names have been assigned to these variances; for our purposes we will designate the variable portion (BC) as the efficiency variance and the fixed portion (CD) as the effectiveness variance.

Let us complete our definitions:

3. The efficiency variance is the product of the standard variable rate times the difference in hours between actual and standard, where standard hours is the basis for overhead application.

4. The effectiveness variance is computed in the same manner using the standard fixed rate.[2]

Distinction between variances

It is sometimes argued that the spending variance should be calculated from the standard hour allowance, but as Exhibit 3 demonstrates, this approach incorrectly combines variances from two different causes. The difference between the variable allowance based on standard hours and the same allowance based on actual hours is, in fact, the increased variable overhead required because of inefficiency. It should be classified as an "efficiency variance" along with the more common "labor efficiency variance." A department can only be said to be "over" or "under" spent when measured against the actual hour allowance.

'Effectiveness' variance

The fourth variance, "effectiveness," is extremely important to segregate since it designates the amount of idle capacity being consumed by inefficiency. It is possible that business which could be marginally profitable is not taken because the plant is believed to be "full" when actually increased performance would provide additional capacity.

An algebraic solution

The reader who has followed this presentation up to now has mastered the four-variance method of overhead variance analysis. The more common three-variance method utilizes the same approach except that it combines the efficiency and effectiveness variances into one total.

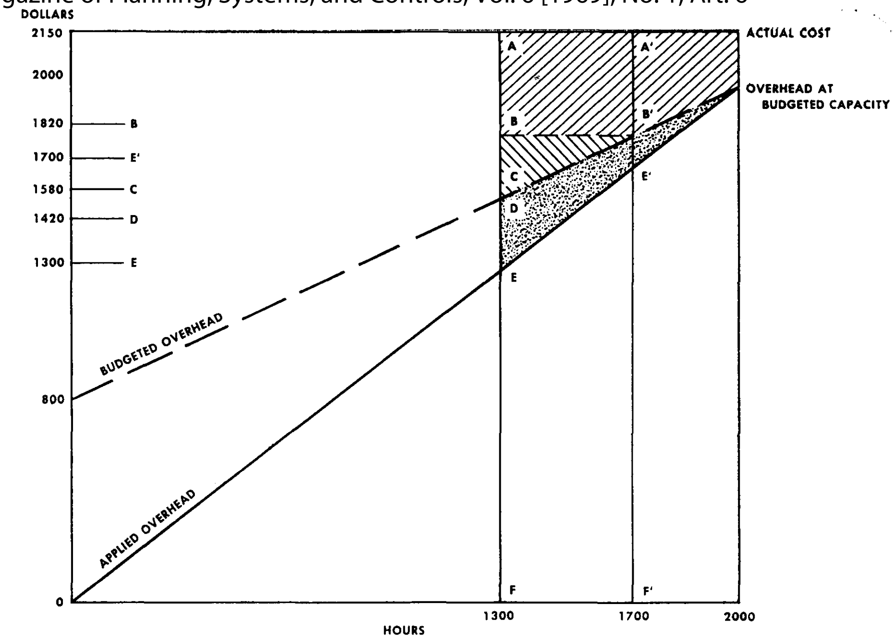

EXHIBIT 3

Overhead Variance
Four-Variance Analysis

Based upon the previous graphical presentation, a generalized algebraic expression of overhead variances can be derived. The following symbols will be used (these symbols are not related to those used in the preceding exhibits):

Attainable Capacity	C	
Actual Hours	A	
Standard Hours	S	
Budgeted Variable Dollars Per Hour	v	(total budgeted variable dollars ÷ C)
Budgeted Fixed Dollars Per Hour	f	(total budgeted fixed dollars ÷ C)
Actual Variable Expense	V	
Actual Fixed Expense	F	

We can state these general expressions:

(1) Applied Overhead =
Sv (Variable Expense Applied) + Sf (Fixed Expense Applied)

(2) Budget Allowance =
Cf (Total Fixed Dollars) + Av (Variable Expense Allowed)

(3) Overhead Variance =
[V + F] (Total Actual Dollars) − [Sv + Sf] (Applied Overhead (1))

Substituting the data from Exhibit 3, equation (3) becomes:

(3) Overhead Variance =
$$\$2{,}150 - [(1{,}300 \times .60) + (1{,}300 \times .40)]$$
$$= \$2{,}150 - [780 + 520]$$
$$= \$\ 850$$
or an amount equivalent to line AE in Exhibit 3.

Equation (3), while self-evident and simply derived, is the source of all overhead variance analysis techniques. By adding and subtracting

[2] For a thorough discussion of this variance, see Keith Shwayder, "A Note on a Contribution Margin Approach to the Analysis of Capacity Utilization," *The Accounting Review*, Vol. XLIII, No. 1, January, 1968, pp. 101-104.

The graphical technique is easily grasped by nonfinancial executives

the budget allowance (2) we can derive:

(4) Overhead Variance =
[(V + F) − (Cf + Av)]
Spending variance or line AB
+
[(Cf + Av) − (Sv + Sf)]
Volume variance or line BE

This could be used as a two-variance analysis. A three-variance analysis and a better solution would be:

(5) Overhead Variance =
[(V + F) − (Cf + Av)]
Spending variance or line AB
+
[(v + f) (A − S)]
Combined efficiency variance or line BD
+
[f(C − A)]
Idle capacity variance or line DE

This is obtained by adding and subtracting Af to the volume variance equation and rearranging. The best solution[3] is the four-variance analysis:

(6) Overhead Variance =
[(V + F) − (Cf + Av)]
Spending variance or line AB
+
[v(A − S)]
Efficiency variance or line BC
+
[f(A − S)]
Effectiveness variance or line CD
+
[f(C − A)]
Idle capacity variance or line DE

This is the four-variance solution shown in Exhibit 3, obtained by splitting the combined efficiency variance equation.

[3] If actual costs are segregated between variable and fixed, it is possible (and useful) to further break the spending variance into variable spending variance (V-Av) and fixed spending variance (F-Cf).

In any standard cost system, each variance must be independent as to the reasons for its existence. If variances are "lumped together," management cannot clearly gain appreciation of the causes of the variances and subsequently work toward their elimination.

The results of four different variance solutions to the example problem are tabulated in Exhibit 4 on this page. While each is quite different, they all clearly emanate from the basic four-variance solution.

Conclusion

The subject of overhead variance analysis has received much attention over the years. A large portion of this work has been scholarly and well done;[4] some has only added to an aura of complexity and confusion. Uniformity in definitions is lacking; a two-variance solution by one author may be different from that of another (for an example of this, see Exhibit 4).

As we hope we have demonstrated, overhead variance analysis can be reduced to easily expressed terms. On various occasions we have found that the graphical technique is easily grasped by nonfinancial executives, and the reader also may find such a presentation helpful in such circumstances.

The generalized algebraic solution can, we believe, be modified so as to apply to any overhead variance problem and as such is useful in computer programing applications.

We believe the generalized approach can assist in clarifying the complex issues of overhead variance analysis.

[4] The reader is particularly directed to Ching-wen Kwang and Albert Slavin, "The Simple Mathematics of Variance Analysis," *The Accounting Review*, Vol. XXXVII, No. 3, July, 1962, pp. 415-432.

EXHIBIT 4

SOLUTIONS

	NUMBER OF VARIANCES				
	Four	Three	Two*	or	Two**
Spending	$330 AB	$330 AB	$330 AB	}	$570 AC
Efficiency	240 BC }	400 BD			
Effectiveness	160 CD }		520 BE	}	280 CE
Idle Capacity	120 DE	120 DE			
	$850	$850	$850		$850

*Computed by a technique suggested by some authors. See, for example, Richard L. Smith, *Management Through Accounting,* Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1962, page 404.

**Calculated through an alternative two-variance method described by other authors. For example, see Cecil Gillespie, *Cost Accounting and Control,* Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1957, pp. 494-495.