CHAPTER 9

Standard Costing: A Functional-Based Control Approach

AFTER STUDYING THIS CHAPTER, YOU SHOULD BE ABLE TO:

1. Describe how unit input standards are developed, and explain why standard costing systems are adopted.
2. Explain the purpose of a standard cost sheet.
3. Compute and journalize the direct materials and direct labor variances, and explain how they are used for control.
4. Compute overhead variances three different ways, and explain overhead accounting.
5. Calculate mix and yield variances for direct materials and direct labor.

Budgets help managers in planning and, at the same time, set standards that are used to control and evaluate managerial performance. In Chapter 8, we saw how budgets can be classified as static or flexible. Static budgets are not very useful for assessing efficiency; their main value is to assess whether or not the targeted level of activity is achieved and, thus, provide some insight concerning managerial effectiveness. On the other hand, flexible budgets evaluate efficiency by comparing the actual costs and actual revenues with the corresponding budgeted amounts for the *same* level of activity. These flexible budget variances generate important feedback for managers but fail to reveal whether the sources of the variances are attributable to input prices, input quantities, or both.

OBJECTIVE 1

Describe how unit input standards are developed, and explain why standard costing systems are adopted.

Developing Unit Input Standards

Although flexible budget variances provide significant information for control, developing standards for input prices and input quantities allows a more detailed understanding of the sources of these variances. **Price standards** specify how much should be paid for the quantity of the input to be used. **Quantity standards** specify how much of the input should be used per unit of output. The **unit standard cost** is defined as the product of these two standards: Standard price × Standard quantity ($SP \times SQ$).

For example, an ice cream company may decide that 25 ounces of yogurt should be used for every quart of frozen yogurt produced (the quantity standard) and that the price of the yogurt should be $0.02 per ounce (the price standard). The standard cost of the yogurt per quart of frozen yogurt is then $0.50 ($0.02 × 25). The standard cost of yogurt per quart can be used to predict what the total cost of yogurt should be as the activity level varies; it thus becomes a flexible budget formula. If 20,000 quarts of frozen yogurt are produced, the total expected cost of yogurt is $10,000 ($0.50 × 20,000); if 30,000 quarts are produced, the total expected cost of yogurt is $15,000 ($0.50 × 30,000). Standard costs, therefore, facilitate budgeting, but the input price and quantity standards will also allow us to obtain a more detailed analysis of the flexible budget variance.

Establishing Standards

Developing standards requires significant input from a variety of sources. Historical experience, engineering studies, and input from operating personnel are three potential sources of quantitative standards. Historical experience should be used with caution because relying on input-output relationships from the past may perpetuate operating inefficiencies. Engineers and operating personnel can provide valuable insights concerning efficient levels of input quantities. Similar comments can be made about input price standards. Price standards are the joint responsibility of operations, purchasing, personnel, and accounting. Operations determines the quality of the inputs required; personnel and purchasing have the responsibility to acquire the input quality requested at the lowest price. Market forces, trade unions, and other external forces limit the range of choices for price standards. In setting price standards, purchasing must consider discounts, freight, and quality; personnel, on the other hand, must consider payroll taxes, fringe benefits, and qualifications. Accounting is responsible for recording price standards and for preparing reports that compare actual performance to the standard.

Standards are often classified as either *ideal* or *currently attainable*. **Ideal standards** are standards that demand maximum efficiency and can be achieved only if everything operates perfectly. No machine breakdowns, slack, or lack of skill (even momentarily) are allowed. **Currently attainable standards** can be achieved under efficient operating conditions. Allowance is made for normal breakdowns, interruptions, less than perfect skill, and so on. These standards are demanding but achievable. One cautionary observation about standards should be made. If standards are too tight and never achievable, workers become frustrated, and performance levels decline. However, challenging but achievable standards can lead to higher performance levels—particularly when the individuals subject to the standards have participated in their creation.

Kaizen Standards

Another type of standard known as a *kaizen* standard is also possible. **Kaizen standards** are continuous improvement standards. Kaizen standards reflect a planned improvement and are a type of currently attainable standard. Kaizen standards by their very nature have a cost reduction focus and because of their emphasis on continuous improvement are constantly changing. (They are dynamic standards.) Kaizen standards are discussed in detail in Chapter 12. This chapter focuses on the more traditional standard cost system.

Standards and Activity-Based Costing

Standards also play an important role in activity-based systems. An activity's cost is determined by the amount of resources consumed by each activity. To avoid measuring the amount of resource consumption on an ongoing basis for literally hundreds of activities, standard consumption patterns are identified based on historical experience. The purpose of standards in this case is to facilitate cost assignments. Control is not an issue. Standards used in this sense were discussed in Chapter 4. Activity-based systems also use standards for control, where control is specifically defined as cost reduction. Activities are classified as either those that add value or those that do not. For each activity, the ideal output is identified and then efforts are made to reduce activity production to this ideal level. This activity-based approach to control is described in Chapter 12.

Usage of Standard Costing Systems

Standard costing systems are widely used. For example, according to one survey, 74 percent of the respondents were using a standard costing system, with the usage emphasis being placed on planning and control.[1] Several reasons for adopting a standard costing system can be mentioned: managing costs, improving planning and control, facilitating decision making, and facilitating product costing.

Cost Management

Standard costing allows managers to manage costs by establishing standards that reflect efficient operating conditions. Standards also help managers understand what needs to be done to improve current and future performance. Furthermore, for firms concerned with continuous improvement, kaizen standards are useful aids in achieving significant cost reductions.

Planning and Control

Standard costing systems enhance planning and control and improve performance measurement. Unit standards are a fundamental requirement for a flexible budgeting system, which is a key feature of a meaningful planning and control system. Budgetary control systems compare actual costs with budgeted costs by computing variances, the difference between the actual and planned costs for the actual level of activity. By developing unit price and quantity standards, an overall variance can be decomposed into a *price variance* and a *usage* or *efficiency variance*. By performing this decomposition, a manager has more information. For example, a manager can tell whether the variance is attributable to discrepancies between planned prices and actual prices, to discrepancies between planned usage and actual usage, or to both. Thus, in principle, the use of efficiency variances enhances operational control. Additionally, by breaking out the price variance, over which managers have little control, the system provides an improved measure of managerial efficiency.

Decision Making and Product Costing

Standard costing systems also facilitate decision making and product costing. For example, standard costing systems provide readily available unit cost information that can be used for pricing decisions. This is particularly useful for companies that engage in extensive bidding and for companies that are paid on a cost-plus basis. Standard product costs are determined using quantity and price standards for direct materials, direct labor, and overhead. In contrast, a normal costing system predetermines overhead costs for the purpose of product costing but assigns direct materials and direct labor to products by using actual costs. An actual costing system assigns the actual costs of all three manufacturing inputs to products. Exhibit 9-1 summarizes these three cost assignment approaches.

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1. Norwood Whittle, "Older and Wiser," *Management Accounting* (July/August 2000): 34–36.

COST MANAGEMENT **Technology in Action**

Smith Dairy is a family-owned producer of milk and milk products that operates in Ohio, Indiana, and Kentucky. A fleet of delivery trucks delivers its products throughout its sales region. Distribution cost is the second highest cost in a dairy, exceeded only by production cost. Thus, operating standards are set for such things as truck speed, shifting patterns, idling time, braking intensity, temperature in transit, Department of Transportation (DOT) log compliance, and unloading rates. Low unloading rates and excessive amounts of speed, shifting, idling time, and braking can significantly increase delivery costs. Furthermore, incorrect temperatures can ruin a load of goods.

To better monitor and improve compliance with delivery performance standards, Smith installed onboard computers in each of its delivery trucks. These computers monitor and report on speed, shifting, and temperature in transit; they record hard braking (when speed drops more than eight miles per second); and they have reduced idle time and lowered fuel costs. The computer record also legally replaces the DOT logs that drivers formerly completed manually (saving about $100,000 per year). The system has also improved driver safety by capturing how vehicles are operated on a real-time basis.

Source: Jack Mans, "High-Tech Cost Management," *Dairy Foods* (March 2000): 51–53.

EXHIBIT 9-1 Cost Assignment Approaches

	Manufacturing Costs		
	Direct Materials	**Direct Labor**	**Overhead**
Actual costing system	Actual	Actual	Actual
Normal costing system	Actual	Actual	Budgeted
Standard costing system	Standard	Standard	Standard

Standard costing also simplifies product costing for firms in process industries. For example, if a process-costing system uses standard costing to assign product costs, there is no need to compute a unit cost for each equivalent unit-cost category. A standard unit cost would exist for direct materials, transferred-in materials, and conversion costs categories.[2] Usually, a standard process-costing system will follow the equivalent-unit calculation of the FIFO approach. That is, *current* equivalent units of work are calculated. By calculating current equivalent units of work, current actual production costs can be compared with standard costs (costs allowed for current production) for control purposes.

OBJECTIVE 2

Explain the purpose of a standard cost sheet.

Standard Cost Sheets

Standard costing systems can be used in both manufacturing and service organizations. Both products and services use inputs such as direct materials, direct labor, and overhead. Standard costing simply establishes price and quantity standards for these inputs and is oblivious as to whether the inputs are associated with tangible or intangible products. To illustrate standard costing for a service setting, consider standard costing in a hospital. Hospital costing systems often use a homogeneous work unit called a **relative value unit (RVU)**. An RVU measures the relative amount of time required to perform

2. If you have not read the chapter on process costing (Chapter 6), the discussion on the merits of standard costing will not be as meaningful. However, the point being made is still relevant. Standard costing can produce useful computational savings.

a procedure. Although the exact time to perform a particular test is not revealed, the relative time for performing two or more distinct tests has been computed. Thus, a test with an RVU of three will take three times as long to perform as a test with an RVU of one. Historical standards can be computed by dividing the variable direct labor costs of a hospital department by the number of RVUs performed by that department. This standard direct labor cost per RVU can then be multiplied by the RVUs of a given procedure to obtain the standard direct labor cost for that procedure.[3]

As indicated, standard costs are developed for direct materials, direct labor, and overhead used in producing a product or service. Using these costs, the **standard cost per unit** is computed. The **standard cost sheet** provides the detail underlying the standard unit cost. To illustrate, let us develop a standard cost sheet for a quart of deluxe strawberry frozen yogurt, produced by Helado Company. (Helado sells its frozen yogurt only at specialty shops.) The production of the strawberry frozen yogurt begins by creating two different mixtures. The first mixture consists of milk and gelatin. These two ingredients are mixed, heated, and then cooled. The second mixture consists of yogurt, whipped cream, and crushed strawberries. The two mixtures are blended and mixed well. This final mixture is then poured into a one-quart container and frozen. The process is automated. Direct labor is used to operate the equipment and inspect the product for consistency and flavor. The standard cost sheet is given in Exhibit 9-2.

EXHIBIT 9-2 Standard Cost Sheet for Deluxe Strawberry Frozen Yogurt

Description	Standard Price		Standard Usage		Standard Cost	Subtotal
Direct materials:						
Yogurt	$0.020	×	25 oz.	=	$0.50	
Strawberries	0.010	×	10 oz.	=	0.10	
Milk	0.015	×	8 oz.	=	0.12	
Whipped cream	0.025	×	4 oz.	=	0.10	
Gelatin	0.010	×	1 oz.	=	0.01	
Container	0.030	×	1	=	0.03	
Total direct materials						$0.86
Direct labor:						
Machine operators	8.00	×	0.01 hr.	=	$0.08	
Total direct labor						0.08
Overhead:						
Variable overhead	6.00	×	0.01 hr.	=	$0.06	
Fixed overhead	20.00	×	0.01 hr.	=	0.20	
Total overhead						0.26
Total standard unit cost						$1.20

Five materials are used to produce the deluxe strawberry frozen yogurt: yogurt, strawberries, milk, whipped cream, and gelatin. The container in which the yogurt is placed is also classified as a direct material. Direct labor consists of machine operators (who also inspect). Variable overhead is made up of three costs: gas (used in cooking),

3. For an entertaining and interesting description of how historical labor standards can be developed in a hospital setting, see Richard D. McDermott, Kevin D. Stocks, and Joan Ogden, *Code Blue* (Syracuse, Utah: Traemus Books, 2000), pp. 212–221.

electricity (used to operate the equipment), and water (used for cleaning); it is applied using direct labor hours. Fixed overhead is also applied using direct labor hours and consists of salaries, depreciation, taxes, and insurance. Notice that 37 ounces of liquids (yogurt, milk, and whipped cream) are used to produce a quart of frozen yogurt. This extra input is needed for two reasons. First, some liquid is lost through evaporation. Second, Helado wants slightly more than 32 ounces of frozen yogurt placed in each container to ensure customer satisfaction.

Exhibit 9-2 also reveals other important insights. The standard usage for variable and fixed overhead is tied to the direct labor standards. For variable overhead, the rate is \$6.00 per direct labor hour. Since one quart of frozen yogurt uses 0.01 direct labor hour, the variable overhead cost assigned to a quart is \$0.06 (\$6.00 × 0.01). For fixed overhead, the rate is \$20 per direct labor hour, making the fixed overhead cost per quart \$0.20 (\$20 × 0.01). Using direct labor hours as the only driver to assign overhead reveals that Helado uses a functional-based cost accounting system.

The standard cost sheet also reveals the quantity of each input that should be used to produce one unit of output. The unit quantity standards can be used to compute the total amount of inputs allowed for the actual output. This computation is an essential component in computing efficiency variances. A manager should be able to compute the **standard quantity of materials allowed** (SQ) and the **standard hours allowed** (SH) for the actual output. This computation must be done for every class of direct material and for every class of direct labor. Assume, for example, that 20,000 quarts of deluxe strawberry frozen yogurt are produced during the first week of April. How much yogurt should have been used for the actual output of 20,000 quarts? The unit quantity standard is 25 ounces of yogurt per quart (see Exhibit 9-2). For 20,000 quarts, the standard quantity of yogurt allowed is computed as follows:

$$\begin{aligned} SQ &= \text{Unit quantity standard} \times \text{Actual output} \\ &= 25 \times 20{,}000 \\ &= 500{,}000 \text{ ounces} \end{aligned}$$

The computation of standard direct labor hours allowed can also be illustrated. From Exhibit 9-2, we see that the unit quantity standard is 0.01 hour per quart produced. Thus, if 20,000 quarts are produced, the standard hours allowed are computed as follows:

$$\begin{aligned} SH &= \text{Unit quantity standard} \times \text{Actual output} \\ &= 0.01 \times 20{,}000 \\ &= 200 \text{ direct labor hours} \end{aligned}$$

OBJECTIVE 3

Compute and journalize the direct materials and direct labor variances, and explain how they are used for control.

Variance Analysis and Accounting: Direct Materials and Direct Labor

A flexible budget can be used to identify the direct material or direct labor input costs that should have been incurred for the actual level of activity. This planned cost is obtained by multiplying the amount of input allowed for the actual output by the standard unit price. Letting *SP* be the standard unit price of an input and *SQ* the standard quantity of inputs allowed for the actual output, the planned or budgeted input cost is $SP \times SQ$. The actual input cost is $AP \times AQ$, where *AP* is the actual price per unit of the input, and *AQ* is the actual quantity of input used. The **total budget variance** is simply the difference between the actual cost of the input and its planned cost:

$$\text{Total budget variance} = (AP \times AQ) - (SP \times SQ)$$

The total budget variance measures the difference between the actual cost of direct materials and direct labor and their budgeted costs for the actual level of activity. To illustrate, consider these selected data for Helado Company for the first week of May.

To keep the example simple, only one direct material (yogurt) is used. A complete analysis for the company would include all categories of direct materials.

Actual production: 30,000 quarts
Actual yogurt usage: 780,000 ounces (no beginning or ending yogurt inventory)
Actual price paid per ounce of yogurt: $0.025
Actual direct labor hours: 325 hours
Actual wage rate: $8.20 per hour

Using the above actual data and the unit standards from Exhibit 9-2, a performance report for the first week of May is developed and illustrated in Exhibit 9-3. The report provides total budget variances for yogurt and direct labor. The total input variances can be divided into price and usage variances, providing more control information to the manager. We will first look at the price and usage variances for direct materials and then we will examine them for direct labor.

EXHIBIT 9-3 Performance Report: Total Budget Variances

	Actual Costs	Budgeted Costs*	Total Budget Variance**
Yogurt	$19,500	$15,000	$4,500 U
Direct labor	2,665	2,400	265 U

*The standard quantities for direct materials and direct labor are computed as follows, using unit quantity standards from Exhibit 9-2: Yogurt: 25 × 30,000 = 750,000 ounces; Direct labor: 0.01 × 30,000 = 300 hours. Multiplying these standard quantities by the unit standard prices given in Exhibit 9-2 produces the budgeted amounts appearing in this column.
**U signifies an unfavorable variance (the actual costs are greater than the planned costs).

Calculating Direct Materials Price and Usage Variances

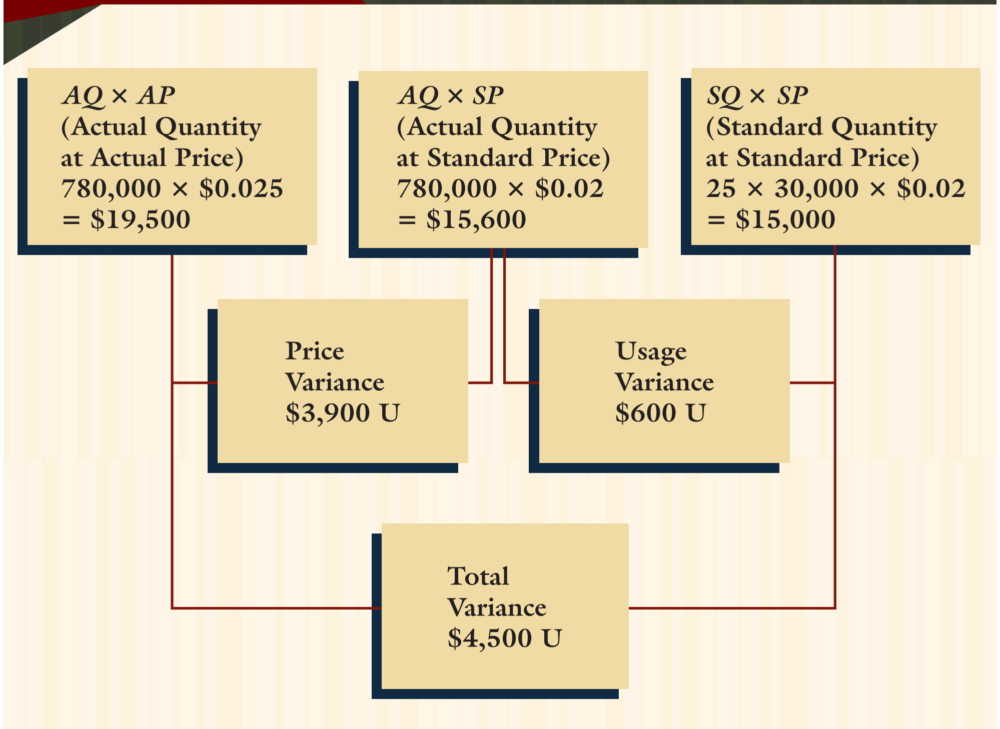
The total budget variance can be broken down into price and usage variances. **Price (rate) variance** is the difference between the actual and standard unit prices of an input multiplied by the actual quantity of inputs. **Usage (efficiency) variance** is the difference between the actual and standard quantity of inputs multiplied by the standard unit price of the input. An **unfavorable (U) variance** occurs whenever actual prices or usage of inputs are greater than standard prices or usage. When the opposite occurs, a **favorable (F) variance** is obtained. A graphical, 3-pronged approach illustrating how the direct materials price and usage variances are calculated is shown in Exhibit 9-4 (for the Helado Company example). Only the price and usage variances for yogurt are shown.

Using Formulas to Compute Direct Materials Price and Usage Variances

The direct materials price and usage variances can be calculated using variance formulas. Some find this approach easier. The **direct materials price variance (MPV)** measures the difference between what should have been paid for direct materials and what was actually paid. A simple formula for computing this variance is:

$$MPV = (AP \times AQ) - (SP \times AQ)$$

EXHIBIT 9-4 **Price and Usage Variances: Direct Materials**



Notice that the right side of the three-pronged diagram is simply the amount of direct materials allowed per unit × the units produced × the standard price.

or, factoring, we have:

$$MPV = (AP - SP)AQ$$

where

$$\begin{aligned} AP &= \text{Actual price per unit} \\ SP &= \text{Standard price per unit} \\ AQ &= \text{Actual quantity of direct material used} \end{aligned}$$

Helado Company purchased and used 780,000 ounces of yogurt for the first week of May. The purchase price was $0.025 per ounce. Thus, *AP* is $0.025, *AQ* is 780,000 ounces, and *SP* (from Exhibit 9-2) is $0.02. Using this information, the direct materials price variance is computed as follows (see Exhibit 9-4 to compare the graphical, 3-pronged approach with the formula approach):

$$\begin{aligned} MPV &= (AP - SP)AQ \\ &= (\$0.025 - \$0.020)780{,}000 \\ &= \$0.005 \times 780{,}000 \\ &= \$3{,}900 \text{ U} \end{aligned}$$

The **direct materials usage variance (MUV)** measures the difference between the direct materials actually used and the direct materials that should have been used for the actual output. The formula for computing this variance is:

$$MUV = (SP \times AQ) - (SP \times SQ)$$

or, factoring, we have:

$$MUV = (AQ - SQ)SP$$

where

AQ = Actual quantity of direct materials used
SQ = Standard quantity of direct materials allowed for the actual output
SP = Standard price per unit

Helado Company used 780,000 ounces of yogurt to produce 30,000 quarts of the deluxe strawberry frozen yogurt. Therefore, AQ is 780,000. From Exhibit 9-2, we see that SP is \$0.02 per ounce of yogurt. Although standard direct materials allowed (SQ) has already been computed in Exhibit 9-3, the details underlying the computation need to be reviewed. Recall that SQ is the product of the unit quantity standard and the actual units produced. From Exhibit 9-2, the unit standard is 25 ounces of yogurt for every quart of yogurt. Thus, SQ is $25 \times 30{,}000$, or 750,000 ounces. The direct materials usage variance is computed as follows (see Exhibit 9-4 to compare the formula approach with the 3-pronged approach):

$$\begin{aligned} MUV &= (AQ - SQ)SP \\ &= (780{,}000 - 750{,}000)\$0.02 \\ &= \$600 \text{ U} \end{aligned}$$

Timing of the Price Variance Computation

The direct materials price variance can be computed at one of two points: (1) when the direct materials are issued for use in production or (2) when they are purchased. Computing the price variance at the point of purchase is preferable. It is better to have information on variances earlier rather than later. The more timely the information, the more likely proper managerial action can be taken. Old information is often useless information. Direct materials may sit in inventory for weeks or months before they are needed in production. By the time the direct materials price variance is computed, signaling a problem, it may be too late to take corrective action. Or, even if corrective action is still possible, the delay may cost the company thousands of dollars.

If the direct materials price variance is computed at the point of purchase, then AQ needs to be redefined as the actual quantity of direct materials *purchased*, rather than actual direct materials used. Since the direct materials purchased may differ from the direct materials used, the overall direct materials budget variance is not necessarily the sum of the direct materials price variance and the direct materials usage variance. When the direct materials purchased are all used in production for the period in which the variances are calculated, the two variances will equal the total budget variance. If this is not the case, then the only way to compute each direct materials variance is by using the formula approach. The 3-pronged approach will not work.

Timing of the Computation of the Direct Materials Usage Variance

The direct materials usage variance should be computed as direct materials are issued for production. To facilitate this process, many companies use three forms: a standard bill of materials, color-coded excessive usage forms, and color-coded returned-materials forms. The **standard bill of materials** identifies the quantity of direct materials that should be used to produce a predetermined quantity of output. A standard bill of materials for Helado Company is illustrated in Exhibit 9-5.

The standard bill of materials acts as a materials requisition form. The production manager presents this form to the materials manager and receives the standard quantity allowed for the indicated output. If the production manager has to requisition more direct materials later, the excessive usage form is used. This form, different in color from the standard bill of materials, provides immediate feedback to the production manager that excess direct materials are being used. If, on the other hand, fewer direct materials are used than the standard requires, the production manager can return the leftover direct materials, along with the returned-materials form. This form also provides immediate feedback.

EXHIBIT 9-5 Standard Bill of Materials

Product: Quarts of Deluxe Strawberry Frozen Yogurt		Output: 30,000 Quarts
Direct Material	**Unit Standard**	**Total Requirements**
Yogurt	25 oz.	750,000 oz.
Strawberries	10 oz.	300,000 oz.
Milk	8 oz.	240,000 oz.
Whipped cream	4 oz.	120,000 oz.
Gelatin	1 oz.	30,000 oz.
Containers	1 container	30,000 containers

Accounting for Direct Materials Price and Usage Variances

As a general rule, in a *standard costing system*, *all inventories are carried at standard*. Actual costs are never entered into an inventory account. Following this general rule means that the direct materials price variance is computed at the point of purchase. In recording variances, unfavorable variances are always debits, and favorable variances are always credits. The general form of the journal entry associated with the purchase of direct materials for a standard costing system follows. This entry assumes an unfavorable *MPV* and that *AQ* is defined as direct materials purchased.

Materials	$(SP \times AQ)$	
Direct Materials Price Variance	$(AP - SP)AQ$	
Accounts Payable		$AP \times AQ$

For the Helado Company example, the entry pertaining to the acquisition of yogurt would be:

Materials	15,600	
Direct Materials Price Variance	3,900	
Accounts Payable		19,500

The direct materials usage variance is recognized when direct materials are issued. The standard cost of the direct materials issued is assigned to Work in Process. The general form for the entry to record the issuance and usage of direct materials, assuming an unfavorable *MUV*, is as follows:

Work in Process	$SQ \times SP$	
Direct Materials Usage Variance	$(AQ - SQ)SP$	
Materials		$AQ \times SP$

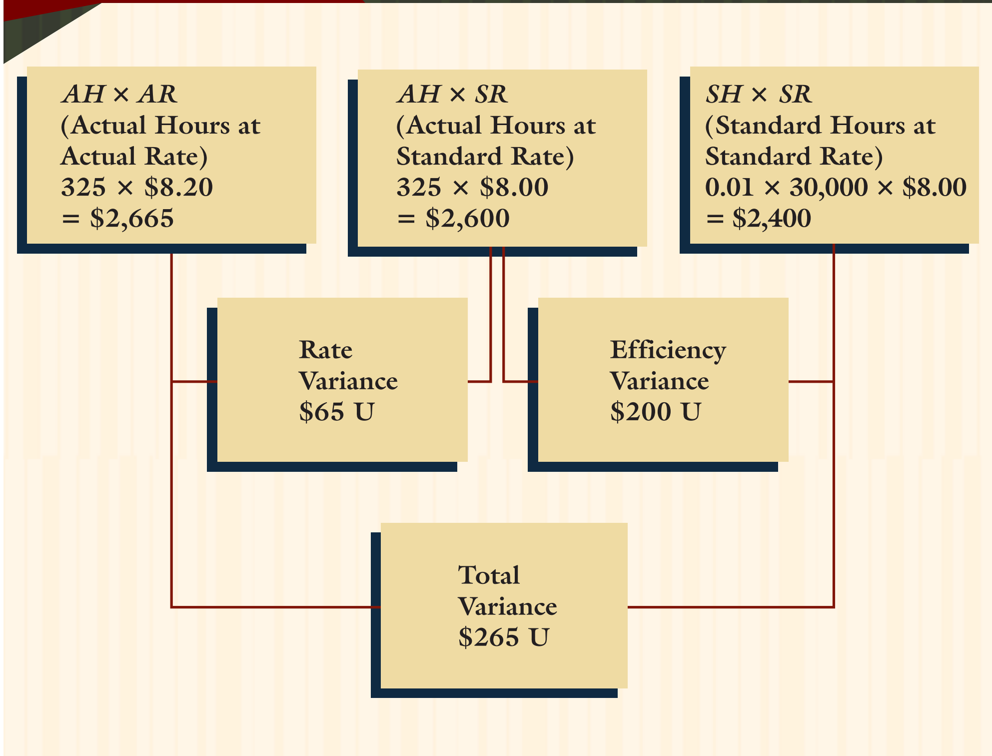
The entry to record Helado's usage of yogurt during the first week of May is as follows:

Work in Process	15,000	
Direct Materials Usage Variance	600	
Materials		15,600

Calculating Direct Labor Variances

The rate (price) and efficiency (usage) variances for direct labor can be calculated using either the graphical, 3-pronged approach or a formula approach. The 3-pronged calculation is illustrated in Exhibit 9-6 for direct labor at the Helado Company plant. The calculation using formulas is discussed next.

EXHIBIT 9-6 Rate and Efficiency Variances: Direct Labor



Note: As shown in the third prong, the standard hours allowed are computed by multiplying the unit standard by the units produced.

Direct Labor Rate and Efficiency Variances: Formula Approach

The **direct labor rate variance (LRV)** computes the difference between what was paid to direct laborers and what should have been paid:

$$LRV = (AR \times AH) - (SR \times AH)$$

or, factoring, we have:

$$LRV = (AR - SR)AH$$

where

$$\begin{aligned} AR &= \text{Actual hourly wage rate} \\ SR &= \text{Standard hourly wage rate} \\ AH &= \text{Actual direct labor hours used} \end{aligned}$$

Direct labor activity for Helado Company's machine operators will be used to illustrate the computation of the direct labor rate variance. We know that 325 hours were used during the first week in May. The actual hourly wage paid for machine operation was \$8.20. From Exhibit 9-2, the standard wage rate is \$8.00. Thus, *AH* is 325, *AR* is \$8.20, and *SR* is \$8.00. The direct labor rate variance is computed as follows:

$$\begin{aligned} \text{LRV} &= (AR - SR)AH \\ &= (\$8.20 - \$8.00)325 \\ &= \$0.20 \times 325 \\ &= \$65\ \text{U} \end{aligned}$$

The **direct labor efficiency variance (LEV)** measures the difference between the direct labor hours that were actually used and the direct labor hours that should have been used:

$$LEV = (AH \times SR) - (SH \times SR)$$

or, factoring, we have:

$$LEV = (AH - SH)SR$$

where

AH = Actual direct labor hours used
SH = Standard direct labor hours that should have been used
SR = Standard hourly wage rate

Helado Company used 325 direct labor hours while producing 30,000 quarts of yogurt. From Exhibit 9-2, 0.01 hour per quart at a cost of \$8.00 per hour should have been used. The standard hours allowed are 300 ($0.01 \times 30{,}000$). Thus, AH is 325, SH is 300, and SR is \$8.00. The direct labor efficiency variance is computed as follows:

$$\begin{aligned} \text{LEV} &= (AH - SH)SR \\ &= (325 - 300)\$8.00 \\ &= 25 \times \$8.00 \\ &= \$200\text{ U} \end{aligned}$$

Accounting for the Direct Labor Rate and Efficiency Variances

The journal entry to record the direct labor rate and efficiency variance is made simultaneously. The general form of this journal entry follows. (It assumes a favorable direct labor rate variance and an unfavorable direct labor efficiency variance.)

Work in Process	$SH \times SR$	
Direct Labor Efficiency Variance	$(AH - SH)SR$	
Direct Labor Rate Variance		$(AR - SR)AH$
Wages Payable		$AH \times AR$

Notice that only standard hours and standard rates are used to assign direct labor costs to Work in Process. Actual prices and quantities are not used. This emphasizes the principle that all inventories are carried at standard.

The journal entry for Helado's use of direct labor during the first week of May follows. Since both variances are unfavorable, the variance accounts are debited:

Work in Process	2,400	
Direct Labor Rate Variance	65	
Direct Labor Efficiency Variance	200	
Wages Payable		2,665

Investigating Direct Materials and Labor Variances

Rarely will actual performance exactly meet the established standards, nor does management expect it to do so. Random variations around the standard are expected. Because of this, management should have in mind an acceptable range of performance. When variances are within this range, they are assumed to be caused by random factors. When a variance falls outside this range, the deviation is likely to be caused by nonrandom factors, either factors that managers can control or factors they cannot control. In the noncontrollable case, managers need to revise the standard. For the controllable case, an investigation should be undertaken only if the anticipated benefits are greater than the expected costs. In making this assessment, a manager must consider whether a variance will recur. If so, the process may be permanently out of control, meaning that periodic savings may be achieved if corrective action is taken. For example, consider Helado's unfavorable materials usage variance. Assume that investigation reveals that the unfavorable direct variance was the result of rejecting a 1,200-quart batch because of poor consistency and flavor. Some settings in the mixing process had been mistakenly altered, resulting in a faulty mix of ingredients. The setting was corrected, and no further problems were noticed.

Because it is difficult to assess the costs and benefits of variance analysis on a case-by-case basis, many firms adopt the general guideline of investigating variances only if they fall outside an acceptable range. The acceptable range is the standard, plus or minus an allowable deviation. The top and bottom measures of the allowable range are called the **control limits**. The *upper control limit* is the standard plus the allowable deviation, and the *lower control limit* is the standard minus the allowable deviation. Current practice sets the control limits subjectively: based on past experience, intuition, and judgment, management determines the allowable deviation from standard.[4]

The control limits are usually expressed both as a percentage of the standard and as an absolute dollar amount. For example, the allowable deviation may be expressed as the lesser of 10 percent of the standard amount or $10,000. In other words, management will not accept a deviation of more than $10,000 even if that deviation is less than 10 percent of the standard. Alternatively, even if the dollar amount is less than $10,000, an investigation is required if the deviation is more than 10 percent of the standard amount. Formal statistical procedures can also be used to set the control limits. In this way, less subjectivity is involved and a manager can assess the likelihood of the variance being caused by random factors. The use of such formal procedures has gained little acceptance.

Responsibility for the Direct Materials Variances

The responsibility for controlling the direct materials price variance is usually the purchasing agent's. Admittedly, the price of direct materials is largely beyond his or her control; however, the price variance can be influenced by such factors as quality, quantity discounts, distance of the source from the plant, and so on. These factors are often under the control of the agent. The production manager is generally responsible for direct materials usage. Minimizing scrap, waste, and rework are all ways in which the manager can ensure that the standard is met. However, at times, the cause of the variance is attributable to others outside the production area. For example, the purchase of lower-quality direct materials may produce bad output. In this case, responsibility would be assigned to purchasing rather than production.

Using the price variance to evaluate the performance of purchasing has some limitations. Emphasis on meeting or beating the standard can produce some undesirable outcomes. For example, if the purchasing agent feels pressured to produce favorable variances, he or she may purchase direct materials of a lower quality than desired or acquire too much inventory in order to take advantage of quantity discounts. As with the price variance, applying the usage variance to evaluate performance can lead to undesirable behavior. For example, a production manager feeling pressure to produce a favorable variance might allow a defective unit to be transferred to finished goods. While this avoids the problem of wasted direct materials, it may create customer-relations problems once a customer gets stuck with the bad product.

Responsibility for the Direct Labor Variances

Direct labor rates are largely determined by such external forces as labor markets and union contracts. When direct labor rate variances occur, they often do so because an av-

4. Bruce R. Gaumnitz and Felix P. Kollaritsch, "Manufacturing Variances: Current Practices and Trends," *Journal of Cost Management* (Spring 1991): 58–64. In this article, the authors report that about 45–47 percent of firms use dollar or percentage control limits. Most of the remaining use judgment rather than any formal identification of limits.

erage wage rate is used for the rate standard or because more skilled and more highly paid laborers are used for less skilled tasks. Wage rates for a particular direct labor activity often differ among workers because of differing levels of seniority. Rather than selecting direct labor rate standards reflecting those different levels, an average wage rate is often chosen. As the seniority mix changes, the average rate changes. This will give rise to a direct labor rate variance; it also calls for a new standard to reflect the new seniority mix. Controllability is not assignable for this cause of a direct labor rate variance.

However, the *use* of direct labor is controllable by the production manager. The use of more skilled workers to perform less skilled tasks (or vice versa) is a decision that a production manager consciously makes. For this reason, responsibility for the direct labor rate variance is generally assigned to the individuals who decide how direct labor will be used. The same is true of the direct labor efficiency variance. However, as is true of all variances, once the cause is discovered, responsibility may be assigned elsewhere. For example, frequent breakdowns of machinery may cause interruptions and nonproductive use of direct labor. But the responsibility for these breakdowns may be faulty maintenance. If so, the maintenance manager should be charged with the unfavorable direct labor efficiency variance.

Production managers may be tempted to engage in dysfunctional behavior if too much emphasis is placed on the direct labor variances. For example, to avoid losing hours and using additional hours because of possible rework, a production manager could deliberately transfer defective units to finished goods.

Disposition of Direct Materials and Direct Labor Variances

Most companies dispose of variances at the end of the year by either closing them to Cost of Goods Sold or prorating them among Work in Process, Cost of Goods Sold, and Finished Goods. If the variances are immaterial, then the most expedient disposition is simply to assign them to Cost of Goods Sold. To illustrate, assume that the variances we have computed for the first week in May are the year-end variances (for Helado Company). Assuming the variances are immaterial, the following entry would be made to dispose of them:

Cost of Goods Sold	4,765	
Direct Materials Price Variance		3,900
Direct Materials Usage Variance		600
Direct Labor Rate Variance		65
Direct Labor Efficiency Variance		200

If the variances are judged to be material, then the proration option is usually exercised. This option is driven by GAAP requirements that inventories and cost of goods sold be reported at actual costs. Yet, if variances are measures of inefficiency, it seems difficult to justify carrying costs of inefficiency as assets. It seems more logical to write off the costs of inefficiency as a cost of the period. With this conceptual qualification, we will illustrate one method of proration, using Helado's May variances as year-end variances. We will assume that direct materials and direct labor are added uniformly throughout the process; thus, the direct materials and direct labor variances can be assigned in proportion to the total prime costs in each of the three inventory accounts. Assume that the standard prime costs (before allocation of the direct materials and direct labor variances) are as follows (these are assumed values):

	Prime Costs	*Percentage of Total*
Work in Process	$ 0	0%
Finished Goods	3,480	20
Cost of Goods Sold	13,920	80
Total	$17,400	100%

Using these percentages, the materials and labor variances would be assigned as follows:

Finished Goods: $0.2 \times \$4{,}765 = \$953$
Cost of Goods Sold: $0.8 \times \$4{,}765 = \$3{,}812$

The journal entry to close out the variance accounts is as follows:

Finished Goods	953	
Cost of Goods Sold	3,812	
Direct Materials Price Variance		3,900
Direct Materials Usage Variance		600
Direct Labor Rate Variance		65
Direct Labor Efficiency Variance		200

Other proration variations are possible. For example, direct materials variances could be assigned in proportion to the total direct materials cost in each account, and the direct labor variances could be assigned in proportion to the total direct labor costs. Some even argue that finer assignments of the variances may be needed. The direct materials price variance, for example, could be assigned to the MUV account, the materials inventory account, work in process, finished goods, and the cost of goods sold account (with the other variances assigned only to the usual three inventory accounts).

Variance Analysis: Overhead Costs

OBJECTIVE 4

Compute overhead variances three different ways, and explain overhead accounting.

For direct materials and direct labor, total variances are broken down into price and efficiency variances. The total overhead variance—the difference between applied and actual overhead—is also broken down into component variances. The number of component variances computed depends on the method of variance analysis used. We will emphasize the 4-variance method: two variances for variable overhead and two variances for fixed overhead. We first divide overhead into categories: variable and fixed. Next, we look at component variances for each category. The total variable overhead variance is divided into two components: the variable overhead spending variance and the variable overhead efficiency variance. Similarly, the total fixed overhead variance is divided into two components: the fixed overhead spending variance and the fixed overhead volume variance. Although the 4-variance method provides the most detail, it also requires a company to identify the actual variable and fixed costs as well as budgeted rates and costs. For companies that wish to avoid the need to track actual variable and fixed costs, the 2-variance and 3-variance methods can be used. These methods also will be briefly reviewed.

In analyzing overhead variances, a traditional approach is assumed. Standard overhead rates are computed in basically the same way that was described in Chapter 4. Traditional overhead rate computations rely on unit-level drivers such as direct labor hours and machine hours. The overhead analysis in this chapter assumes that direct labor hours is the only driver used to assign overhead costs to products. Thus, when we speak of variable and fixed overhead, we are assuming that it is fixed or variable with respect to direct labor hours, a unit-level driver. In Chapter 12, variance analysis is extended to a more general setting where both unit- and nonunit-level drivers are allowed.

Four-Variance Method: The Two Variable Overhead Variances

To illustrate the variable overhead variances, we will examine activity for Helado Company during the month of May. The following data were gathered for this time period:

Variable overhead rate (standard)	$6.00 per direct labor hour[a]
Actual variable overhead costs	$7,540
Actual hours worked	1,300
Quarts of deluxe strawberry frozen yogurt produced	120,000
Hours allowed for production	1,200[b]
Applied variable overhead	$7,200[c]

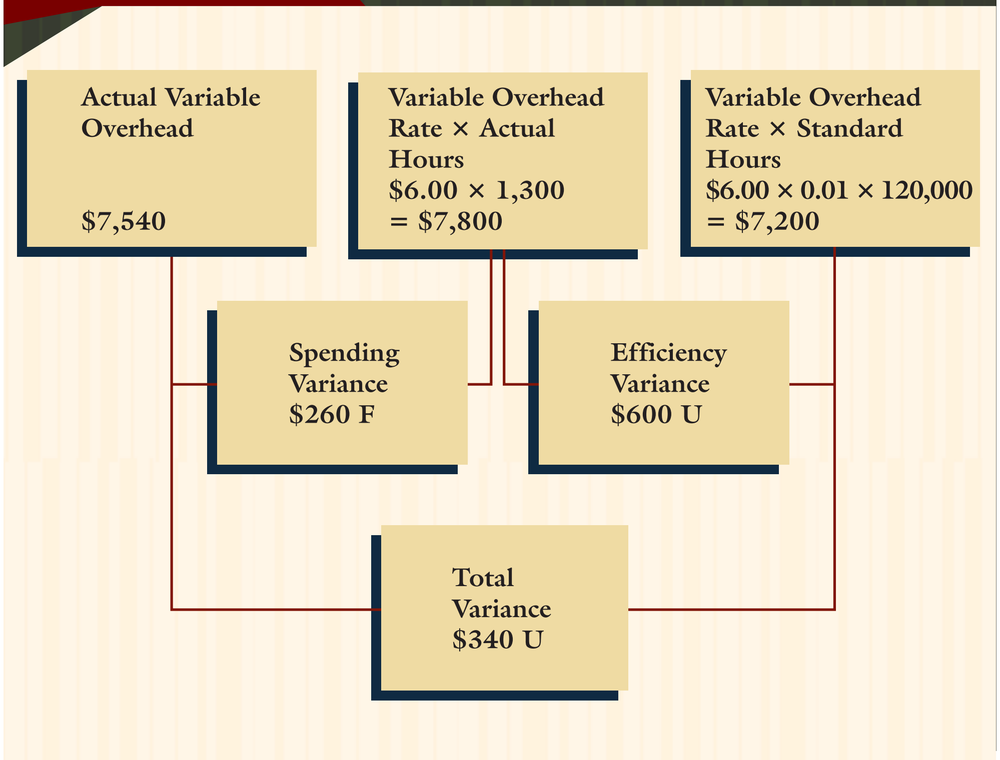
[a]Budgeted variable overhead/Standard hours allowed for practical volume.
[b]0.01 × 120,000 (See Exhibit 9-2 for unit standards and prices.)
[c]$6.00 × 1,200 (Overhead is applied using standard hours allowed.)

The total variable overhead variance is the difference between the actual and the applied variable overhead. For our example, the total variable overhead variance is computed as follows:

$$\begin{aligned}\text{Total variance} &= \$7{,}540 - \$7{,}200 \\ &= \$340\text{ U}\end{aligned}$$

A graphical, 3-pronged approach for dividing this total variance into spending and efficiency variances is illustrated in Exhibit 9-7.

EXHIBIT 9-7 Variance Overhead Analysis



Variable Overhead Spending Variance

The **variable overhead spending variance** measures the aggregate effect of differences in the actual variable overhead rate ($AVOR$) and the standard variable overhead rate ($SVOR$). The actual variable overhead rate is simply actual variable overhead divided by actual hours. For our example, this rate is \$5.80 (\$7,540/1,300 hrs.). The formula for computing the variable overhead spending variance is as follows:

$$
\begin{aligned}
\text{Variable overhead spending variance} &= (AVOR \times AH) - (SVOR \times AH) \\
&= (AVOR - SVOR)AH \\
&= (\$5.80 - \$6.00)1{,}300 \\
&= \$260\ \text{F}
\end{aligned}
$$

The variable overhead spending variance is similar to the price variances of direct materials and direct labor, although there are some conceptual differences. Variable overhead is not a homogeneous input—it is made up of a large number of individual items such as indirect materials, indirect labor, electricity, maintenance, and so on. The standard variable overhead rate represents the weighted cost per direct labor hour that should be incurred for all variable overhead items. The difference between what should have been spent per hour and what actually was spent per hour is a type of price variance.

A variable overhead spending variance can arise because prices for individual variable overhead items have increased or decreased. Assume, for the moment, that the price changes of individual overhead items are the only cause of the spending variance. If the spending variance is unfavorable, then price increases for individual variable overhead items are the cause; if the spending variance is favorable, then price decreases are dominating.

If the only source of the variable overhead spending variance were price changes, then it would be completely analogous to the price variances of direct materials and direct labor. Unfortunately, the spending variance also is affected by how efficiently overhead is used. Waste or inefficiency in the use of variable overhead increases the actual variable overhead cost. This increased cost, in turn, is reflected in an increased actual variable overhead rate. Thus, even if the actual prices of the individual overhead items were equal to the budgeted or standard prices, an unfavorable variable overhead spending variance could still take place. Similarly, efficiency can decrease the actual variable overhead cost and decrease the actual variable overhead rate. Efficient use of variable overhead items contributes to a favorable spending variance. If the waste effect dominates, then the net contribution will be unfavorable; if efficiency dominates, then the net contribution is favorable. Thus, the variable overhead spending variance is the result of both price and efficiency.

Many variable overhead items are affected by several responsibility centers. For example, utilities are a joint cost. Assigning the cost to a specific area of responsibility requires that cost be traced—not allocated—to the area. To the extent that consumption of variable overhead can be traced to a responsibility center, responsibility can be assigned. Consumption of indirect materials is an example of a traceable variable overhead cost.

Controllability is a prerequisite for assigning responsibility. Price changes of variable overhead items are essentially beyond the control of supervisors. If price changes are small (as they often are), the spending variance is primarily a matter of the efficient use of overhead in production, which is controllable by production supervisors. Accordingly, responsibility for the variable overhead spending variance is generally assigned to production departments.

The \$260 favorable spending variance simply reveals that, in the aggregate, Helado Company spent less on variable overhead than expected. Even if the variance was insignificant, it reveals nothing about how well costs of individual variable overhead items were controlled. Control of variable overhead requires line-by-line analysis for each individual item. Exhibit 9-8 presents a performance report that supplies the line-by-line information essential for proper control of variable overhead. Assuming that Helado investigates any item that deviates more than 10 percent from budget, the cost of gas would be the only item that would be investigated. The investigation reveals that the utility company lowered the price of natural gas as a result of a state regulatory hear-

EXHIBIT 9-8 **Variable Overhead Spending Variance by Item**

Helado Company
Performance Report
For the Month Ended May 31, 2007

	Cost Formula[a]	Actual Costs	Budget[b]	Spending Variance
Natural gas	$3.80	$4,400	$4,940	$540 F
Electricity	2.00	2,840	2,600	240 U
Water	0.20	300	260	40 U
Total	$6.00	$7,540	$7,800	$260 F

[a]Per direct labor hour.
[b]The budget allowance is computed using the cost formula and an activity level of 1,300 actual direct labor hours.

ing. The reduction is expected to be permanent. In this case, the cause of the favorable variance is beyond the control of the company. The correct response is to revise the budget formula to reflect the decreased cost of natural gas.

Variable Overhead Efficiency Variance

Variable overhead is assumed to vary as the production volume changes. Thus, variable overhead changes in proportion to changes in the direct labor hours used. The **variable overhead efficiency variance** measures the change in variable overhead consumption that occurs because of efficient (or inefficient) use of direct labor. The efficiency variance is computed using the following formula:

$$\begin{aligned}\text{Variable overhead efficiency variance} &= (AH - SH)SVOR \\ &= (1{,}300 - 1{,}200)\$6.00 \\ &= \$600\text{ U}\end{aligned}$$

The variable overhead efficiency variance is directly related to the direct labor efficiency or usage variance. If variable overhead is truly driven by direct labor hours, then like the direct labor usage variance, the variable overhead efficiency variance is caused by efficient or inefficient use of direct labor. If more (or fewer) direct labor hours are used than the standard calls for, then the total variable overhead cost will increase (or decrease). The validity of the measure depends on the validity of the relationship between variable overhead costs and direct labor hours. In other words, do variable overhead costs *really* change in proportion to changes in direct labor hours? If so, responsibility for the variable overhead efficiency variance should be assigned to the individual who has responsibility for the use of direct labor: the production manager.

The reasons for the unfavorable variable overhead efficiency variance are generally the same as those offered for the unfavorable labor usage variance. For example, some of the variance can be explained by the fact that overtime hours were used during the first week to make up for a bad batch of yogurt. The remaining deficiency was caused by the use of new employees who took longer to carry out tasks because of their lack of experience.

More information concerning the effect of direct labor usage on variable overhead is available in a line-by-line analysis of individual variable overhead items. This can be accomplished by comparing the budget allowance for the actual hours used with the budget allowance for the standard hours allowed for each item. A performance report that makes this comparison for all variable overhead costs is shown in Exhibit 9-9. From Exhibit 9-9, we can see that the cost of natural gas is affected most by inefficient use of direct labor. For example, the extra time required to make up for a bad batch would increase gas consumption. Similarly, inexperienced laborers may heat the mix of gelatin and milk longer than is really needed, thus using more gas.

EXHIBIT 9-9 Variable Overhead Spending and Efficiency Variances by Item

Helado Company
Performance Report
For the Month Ended May 31, 2007

Cost	Cost Formula[a]	Actual Costs	Budget for Actual Hours	Spending Variance[b]	Budget for Standard Hours	Efficiency Variance[c]
Natural gas	$3.80	$4,400	$4,940	$540 F	$4,560	$380 U
Electricity	2.00	2,840	2,600	240 U	2,400	200 U
Water	0.20	300	260	40 U	240	20 U
Total	$6.00	$7,540	$7,800	$260 F	$7,200	$600 U

[a] Per direct labor hour.
[b] Spending variance = Actual costs − Budget for actual hours.
[c] Efficiency variance = Budget for actual hours − Budget for standard hours.

The column labeled *Budget for Standard Hours* gives the amount that should have been spent on variable overhead for the actual output. The total of all items in this column is the applied variable overhead, the amount assigned to production in a standard costing system. Note that in a standard costing system, variable overhead is applied using the hours allowed for the actual output (*SH*), while in normal costing, variable overhead is applied using actual hours. Although not shown in Exhibit 9-9, the difference between actual costs and this column is the total variable overhead variance (underapplied by $340). Thus, the underapplied variable overhead variance is the sum of the spending and efficiency variances.

Four-Variance Analysis: The Two Fixed Overhead Variances

We will again use the Helado Company example to illustrate the computation of the fixed overhead variances. The data needed for the calculation are as follows:

	Budgeted/Planned Items (May)
Budgeted fixed overhead	$20,000
Expected activity	1,000 direct labor hours[a]
Standard fixed overhead rate	$20[b]

[a] Hours allowed to produce 100,000 quarts of frozen yogurt (0.01 × 100,000).
[b] $20,000/1,000.

	Actual Results
Actual production	120,000 quarts
Actual fixed overhead cost	\$20,500
Standard hours allowed for actual production	1,200[a]

[a]0.01 × 120,000.

The total fixed overhead variance is the difference between actual fixed overhead and applied fixed overhead, when applied fixed overhead is obtained by multiplying the standard fixed overhead rate by the standard hours allowed for the actual output. Thus, the applied fixed overhead is calculated as follows:

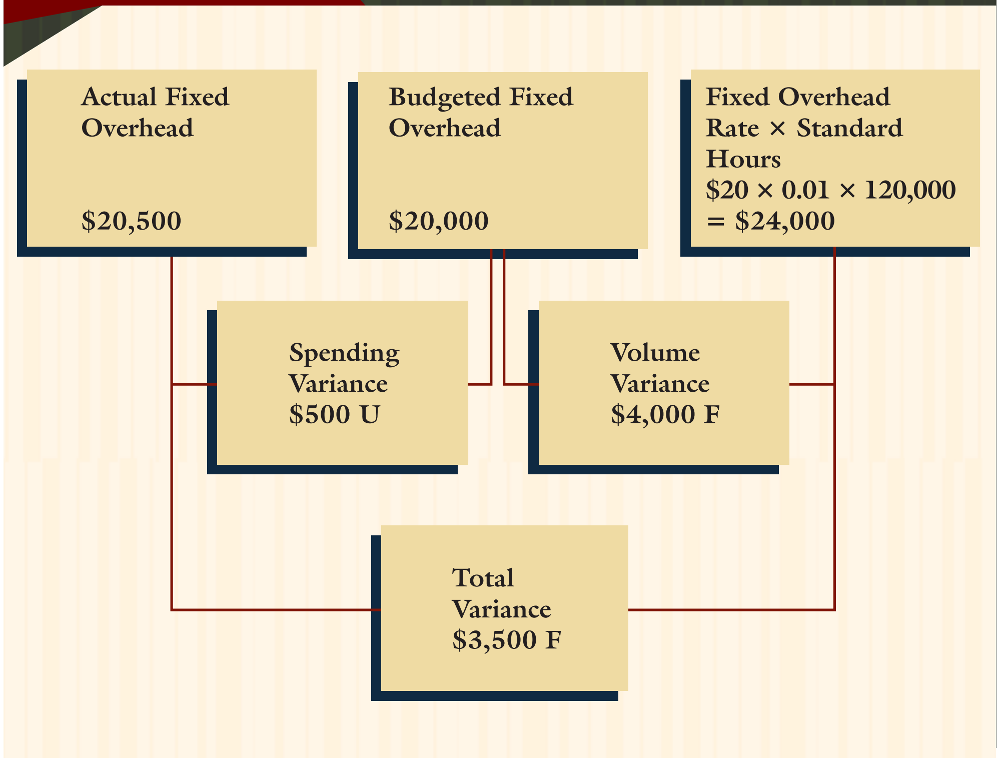
$$\begin{aligned}\text{Applied fixed overhead} &= \text{Standard fixed overhead rate} \times \text{Standard hours}\\ &= \$20 \times 1{,}200\\ &= \$24{,}000\end{aligned}$$

The total fixed overhead variance is the difference between the actual fixed overhead and the applied fixed overhead:

$$\begin{aligned}\text{Total fixed overhead variance} &= \$20{,}500 - \$24{,}000\\ &= \$3{,}500 \text{ Overapplied}\end{aligned}$$

To help managers understand why fixed overhead was overapplied by \$3,500, the total variance can be broken down into two variances: the fixed overhead spending variance and the fixed overhead volume variance. The calculations of the two variances are illustrated graphically in Exhibit 9-10.

EXHIBIT 9-10 **Fixed Overhead Variances**



The Fixed Overhead Spending Variance

The **fixed overhead spending variance** is defined as the difference between the actual fixed overhead and the budgeted fixed overhead. The spending variance is favorable because less was spent on fixed overhead items than was budgeted. The formula for computing the fixed overhead variance follows ($AFOH$ = Actual fixed overhead and $BFOH$ = Budgeted fixed overhead):

$$\begin{aligned}\text{Fixed overhead spending variance} &= AFOH - BFOH \\ &= \$20{,}500 - \$20{,}000 \\ &= \$500\ \text{U}\end{aligned}$$

Fixed overhead is made up of a number of individual items such as salaries, depreciation, taxes, and insurance. Many fixed overhead items—long-run investments, for instance—are not subject to change in the short run; consequently, fixed overhead costs are often beyond the immediate control of management. Since many fixed overhead costs are affected primarily by long-run decisions, not by changes in production levels, the budget variance is usually small. For example, depreciation, salaries, taxes, and insurance costs are not likely to be much different than planned.

Because fixed overhead is made up of many individual items, a line-by-line comparison of budgeted costs with actual costs provides more information concerning the causes of the spending variance. Exhibit 9-11 provides such a report. The report reveals that the fixed overhead spending variance is essentially in line with expectations. The fixed overhead spending variances, both on a line-item basis and in the aggregate, are relatively small (all less than 10 percent of the budgeted costs).

EXHIBIT 9-11

Helado Company
Performance Report
For the Month Ended May 31, 2007

Fixed Overhead Items	Actual Cost	Budgeted Cost	Variance
Depreciation	$ 5,000	$ 5,000	$ —
Salaries	13,400	13,000	400 U
Taxes	1,100	1,050	50 U
Insurance	1,000	950	50 U
Total	$20,500	$20,000	$500 U

Fixed Overhead Volume Variance

The **fixed overhead volume variance** is the difference between budgeted fixed overhead and applied fixed overhead. The volume variance measures the effect of the actual output departing from the output used at the beginning of the period to compute the predetermined standard fixed overhead rate. To see this, let $SH(D)$ represent the standard hours allowed for the denominator volume (the volume used at the beginning of the period to compute the predetermined fixed overhead rate). The standard fixed overhead rate is computed in the following way:

$$\text{Standard fixed overhead rate} = \text{Budgeted fixed overhead}/SH(D)$$

From this equation, we know that the budgeted fixed overhead can be computed by multiplying the standard fixed overhead rate by the denominator hours.

$$\text{Budgeted fixed overhead} = \text{Standard fixed overhead rate} \times SH(D)$$

From Exhibit 9-10, we know that the volume variance can be computed as follows:

$$\begin{aligned}\text{Volume variance} &= \text{Budgeted fixed overhead} - \text{Applied fixed overhead}\\ &= [\text{Standard fixed overhead rate} \times SH(D)] - (\text{Standard fixed overhead rate} \times SH)\\ &= \text{Standard fixed overhead rate} \times [SH(D) - SH]\\ &= \$20(1{,}000 - 1{,}200)\\ &= \$4{,}000\ \text{F}\end{aligned}$$

Thus, for a volume variance to occur, the denominator hours, $SH(D)$, must differ from the standard hours allowed for the actual volume, SH. Assume Helado expected to produce 100,000 quarts of frozen yogurt in May, using 1,000 direct labor hours. The actual outcome was 120,000 quarts produced, using 1,200 standard hours. Therefore, more was produced than expected, and a favorable volume variance arises.

But what is the meaning of this variance? The variance occurs because the actual output differs from the denominator output volume. At the beginning of the month, if management had expected 120,000 quarts with 1,200 standard hours as the denominator volume, the volume variance would not have existed. In this view, the volume variance is seen as prediction error—a measure of the inability of management to select the correct volume over which to spread fixed overhead.

If, however, the denominator volume represented the amount that management believed *could* be produced and sold, the volume variance conveys more significant information. If the actual volume is more than the denominator volume, the volume variance signals that a gain has occurred (relative to expectations). That gain is not equivalent, however, to the dollar value of the volume variance. The gain is equal to the increase in contribution margin on the extra units produced and sold. However, the volume variance is positively correlated with the gain. Suppose that the contribution margin per standard direct labor hour is \$50. By producing 120,000 quarts of frozen yogurt instead of 100,000 quarts, the company gained sales of 20,000 quarts. This is equivalent to 200 hours ($0.01 \times 20{,}000$). At \$50 per hour, the gain is \$10,000 (\$50 $\times$ 200). The favorable volume variance of \$4,000 signals this gain but understates it. In this sense, the volume variance is a measure of this year's *planned* utilization of capacity.

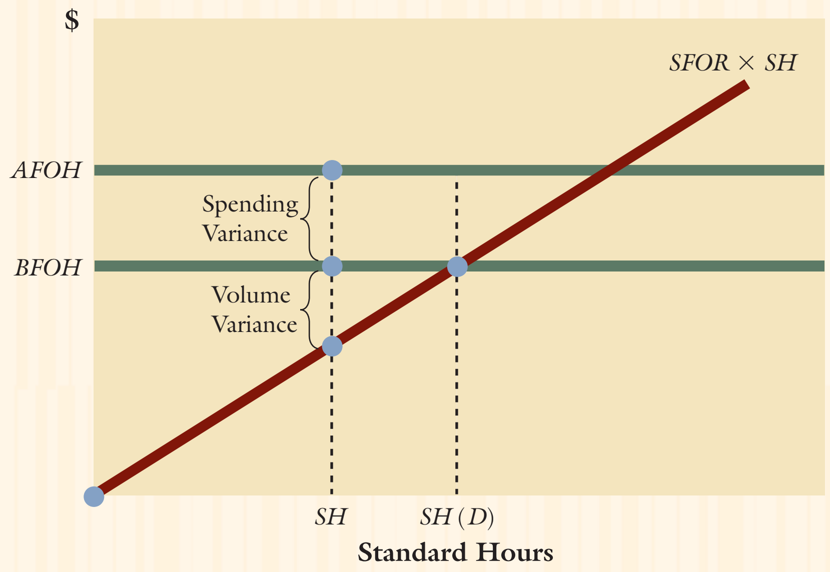
On the other hand, if *practical capacity* is used as the denominator volume, then the volume variance is a direct measure of capacity utilization. Practical capacity measures the most that can be produced under efficient operating conditions (and, thus, represents the productive capacity the firm has acquired). The difference between available hours of production and actual hours is a measure of underutilization, and when multiplied by the standard fixed overhead rate, the volume variance becomes a measure of the cost of underutilization of capacity. This is similar in concept to the activity capacity utilization measure described in Chapter 3. The principal difference is that the fixed overhead rate used to measure the cost of unused capacity contains more than the cost of acquiring the productive capacity. Fixed overhead is made up of many costs incurred for reasons other than obtaining productive capacity (e.g., the salaries of the plant supervisor, janitors, and industrial engineers).

Assuming that volume variance measures capacity utilization implies that the general responsibility for this variance should be assigned to the production department. At times, however, investigation into the reasons for a significant volume variance may reveal the cause to be factors beyond the control of production. In this instance, specific responsibility may be assigned elsewhere. For example, if purchasing acquires a direct material of lower quality than usual, significant rework time may result, causing lower production and an unfavorable volume variance. In this case, responsibility for the variance rests with purchasing, not production.

Graphical Representation of Fixed Overhead Variances

Exhibit 9-12, on the following page, provides a graph that illustrates the fixed overhead variances. The graph is structured so that the actual fixed overhead is greater than

EXHIBIT 9-12 Graph of Fixed Overhead Variances



the budgeted fixed overhead. Notice that applying fixed overhead by multiplying the fixed overhead rate by the standard hours allowed for production has the effect of converting fixed overhead into a unit-level variable cost ($SFOR \times SH$ is represented by a line coming out of the origin, with slope *SFOR*, where *SFOR* is the standard fixed overhead rate). Converting a fixed cost into a variable cost contributes significantly to the creation of the volume variance (as well as to the total fixed overhead variance). Notice also that the volume variance has a lot to do with how well we estimate *SH* (the hours allowed for actual production). If $SH = SH(D)$, there is no volume variance. (This is where the applied line intersects with the *BFOH* line.) Notice also how the total variance breaks down into the spending and volume variances.

Accounting for Overhead Variances

Overhead is applied to production by debiting Work in Process and crediting variable and fixed overhead control accounts. The amount assigned is simply the respective overhead rates multiplied by the standard hours allowed for actual production. The actual overhead is accumulated on the debit side of the overhead control accounts. Periodically (e.g., monthly), overhead variance reports are prepared. At the end of the year, the applied variable and fixed overhead costs and the actual fixed overhead costs are closed out and the variances isolated. The overhead variances are then disposed of by closing them to Cost of Goods Sold if they are not material or by prorating them among Work in Process, Finished Goods, and Cost of Goods Sold if they are material. We will use the May transactions for Helado Company to illustrate the process that would occur at the end of the year. Essentially, we are assuming that the May transactions reflect an entire year for illustrative purposes.

To assign overhead to production, we have the following entry:

Work in Process	31,200	
Variable Overhead Control		7,200
Fixed Overhead Control		24,000

To recognize the incurrence of actual overhead, the following entry is needed:

Variable Overhead Control	7,540	
Fixed Overhead Control	20,500	
Miscellaneous Accounts		28,040

To recognize the variances, the following entry is needed:

Fixed Overhead Control	3,500	
Variable Overhead Efficiency Variance	600	
Fixed Overhead Spending Variance	500	
Variable Overhead Control		340
Variable Overhead Spending Variance		260
Fixed Overhead Volume Variance		4,000

Finally, to close out the variances to Cost of Goods Sold, we would have the following entries. (Entries assume that variances are immaterial.)

Fixed Overhead Volume Variance	4,000	
Variable Overhead Spending Variance	260	
Cost of Goods Sold		4,260
Cost of Goods Sold	1,100	
Variable Overhead Efficiency Variance		600
Fixed Overhead Spending Variance		500

Two- and Three-Variance Analyses

The 2- and 3-variance analyses do not require knowledge of actual variable and actual fixed overhead. These methods provide less detail and, thus, less information. We will simply present the method of computation for the two forms of analysis. The 4-variance method is recommended over these two approaches. The May data for Helado Company will be used to illustrate the two methods with the assumption that only the total actual overhead is known: $28,040.

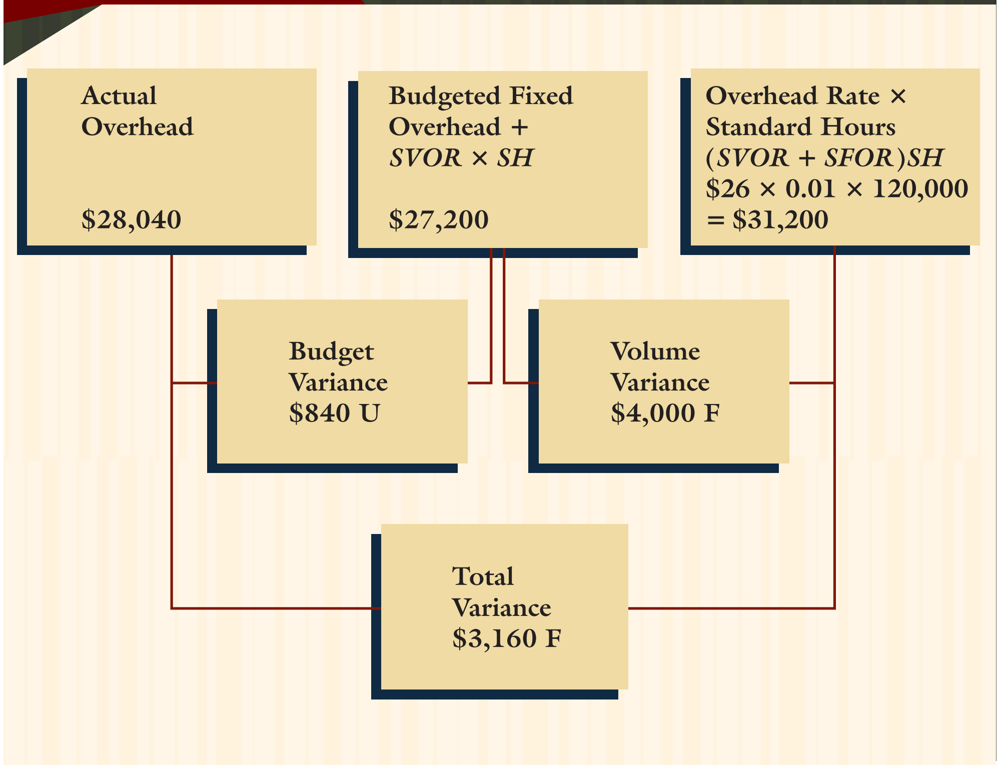
Two-Variance Analysis

The 2-variance analysis is shown in Exhibit 9-13 on the following page. (*SVOR* designates the standard variable overhead rate.) Several points should be made relative to the 4-variance analysis appearing in Exhibits 9-7 and 9-10. First, the total variance is the sum of the total fixed and variable overhead variances. Second, the volume variance is the same as that of the 4-variance method. Notice that in the computation of the volume variance, the applied variable overhead term, $SVOR \times SH$, is common to the middle and right prongs of the diagram. Thus, when the right number is subtracted from the left number, we are left with the $BFOH - SFOR \times SH$ term, which is the fixed overhead volume variance. Third, the budget variance is the sum of the spending and efficiency variances of the 4-variance method ($260 F + $500 U + $600 U = $840 U). As indicated, the 2-variance method sacrifices a lot of information.

Three-Variance Analysis

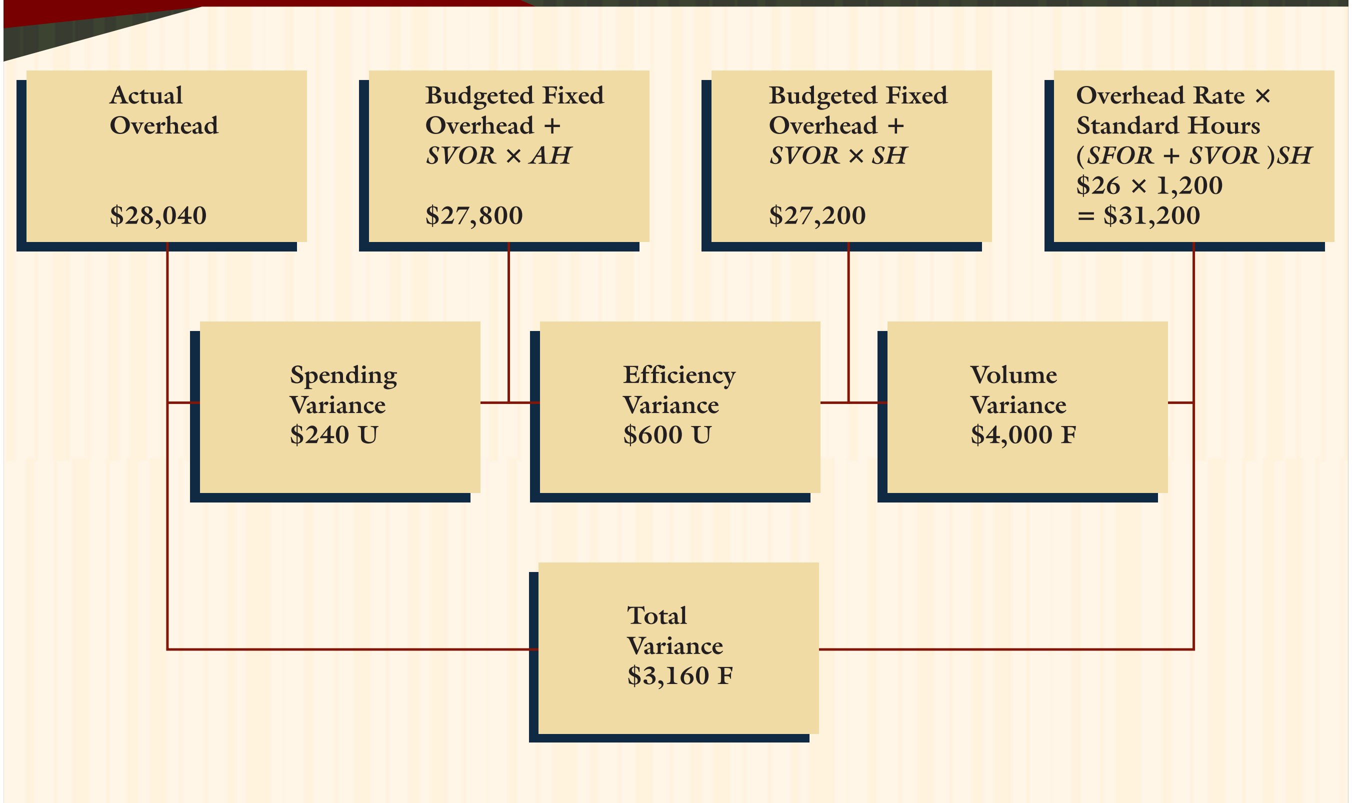
The 3-variance analysis is shown in Exhibit 9-14 on the following page. Again, some observations can be made about this method relative to the 4-variance method. First, the total variance is again the sum of the total variable and fixed overhead variances. Second, the spending variance is the sum of the variable and fixed overhead spending variances. The variable overhead efficiency and the fixed overhead volume variances are the same. The 3-variance method also illustrates that the budget variance of the 2-variance method breaks down into spending and efficiency variances.

EXHIBIT 9-13 Two-Variance Analysis: Helado Company



Note: SFOR = Standard fixed overhead rate
SVOR = Standard variable overhead rate

EXHIBIT 9-14 Three-Variance Analysis: Helado Company



OBJECTIVE 5

Calculate mix and yield variances for direct materials and direct labor.

Mix and Yield Variances: Materials and Labor

For some production processes, it may be possible to substitute one direct material input for another or one type of direct labor for another. Usually, a standard mix specification identifies the proportion of each direct material and the proportion of each type of direct labor that should be used for producing the product. For example, in producing an orange-pineapple fruit drink, the standard direct materials mix may call for 30 percent pineapple and 70 percent orange, and the standard direct labor mix may call for 33 percent of fruit preparation labor and 67 percent of fruit processing labor. Clearly, within reason, it is possible to make input substitutions. Substituting direct materials or direct labor, however, may produce *mix* and *yield* variances. A **mix variance** is created whenever the actual mix of inputs differs from the standard mix. A **yield variance** occurs whenever the actual yield (output) differs from the standard yield. For direct materials, the sum of the mix and yield variances equals the direct materials usage variance; for direct labor, the sum is the direct labor efficiency variance.

Direct Materials Mix and Yield Variances

To illustrate direct materials mix and yield variances, let us look at Malcom Nut Company. Malcom produces a variety of mixed nuts. One type of mixed nuts uses peanuts and almonds. Malcom developed the following standard mix for producing 120 pounds of mixed nuts. (Almonds and peanuts are purchased in the shell and processed.)

Standard Mix Information: Direct Materials

Direct Material	*Mix*	*Mix Proportion*	*SP*	*Standard Cost*
Peanuts	128 lbs.	0.80	$0.50	$64
Almonds	32	0.20	1.00	32
Total	160 lbs.			$96

Yield 120 lbs.
Yield ratio: 0.75 (120/160)
Standard cost of yield (*SPy*): $0.80 per pound ($96/120 pounds of yield)

Now suppose that Malcom processes a batch of 1,600 pounds and produces the following actual results:

Direct Material	*Actual Mix*	*Percentages**
Peanuts	1,120 lbs.	70%
Almonds	480	30
Total	1,600 lbs.	100%
Yield	1,300 lbs.	81.3%

*Uses 1,600 lbs. as the base.

Direct Materials Mix Variance

The mix variance is the difference in the standard cost of the actual mix of inputs used and the standard cost of the mix of inputs that should have been used. Let *SM* be the quantity of each input that should have been used given the total actual input quantity. This quantity is computed as follows for each direct material input:

$$SM = \text{Standard mix proportion} \times \text{Total actual input quantity}$$

For example, the standard mix proportion for peanuts is 0.80. Thus, if 1,600 pounds of actual input were used, then the mix standard calls for the following amount of peanuts:[5]

$$SM(\text{peanuts}) = 0.80 \times 1{,}600 = 1{,}280 \text{ pounds}$$

A similar computation produces $SM = 320$ pounds for almonds ($0.20 \times 1{,}600$).

Given SM, the mix variance is computed as follows:

$$\text{Mix variance} = \sum (AQi - SMi)SPi \qquad (9.1)$$

The formula can be applied most easily using the following approach:

Direct Material	*AQ*	*SM*	*AQ − SM*	*SP*	*(AQ − SM)SP*
Peanuts	1,120	1,280	(160)	\$0.50	\$ (80)
Almonds	480	320	160	1.00	160
Mix variance					\$ 80 U

Notice that the mix variance is unfavorable. This occurs because more almonds are used than are called for in the standard mix, and almonds are a more expensive input. If the mix variance is material, then an investigation should be undertaken to determine the cause of the variance so that corrective action can be taken.

Direct Materials Yield Variance

Using the standard mix information and the actual results, the yield variance is computed by the following formula:

$$\text{Yield variance} = (\text{Standard yield} - \text{Actual yield})SPy \qquad (9.2)$$

where

$$\text{Standard yield} = \text{Yield ratio} \times \text{Total actual inputs}$$

Thus, for the actual input of 1,600 pounds, the standard yield is 1,200 pounds ($0.75 \times 1{,}600$). The yield variance is computed as follows:

$$\begin{aligned}\text{Yield variance} &= (1{,}200 - 1{,}300)\$0.80 \\ &= \$80 \text{ F}\end{aligned}$$

The yield variance is favorable because the actual yield is greater than the standard yield. Direct material yield variance should be investigated to find the root causes. Corrective action to restore the process to the standards may be required or it may lead to a change in standards if the joint effect of the mix and yield variances is favorable.

Direct Labor Mix and Yield Variances

The direct labor mix and yield variances are computed in the same way as the direct materials mix and yield variances. Specifically, Equations 9.1 and 9.2 apply to direct labor in the same way with the notation defined appropriately for direct labor. For example, AQ, in Equation 9.1, is interpreted as AH, the actual hours used, and SP as the stan-

5. The standard mix amounts are not the standard quantities allowed for actual output. The total standard quantity allowed is computed by dividing the actual yield by the standard yield ratio. The total standard input allowed is then multiplied by the standard mix ratios to compute the quantity of each direct material input that should have been used of the actual output. Alternatively, the unit direct material standards can be developed by dividing the standard input mix quantity by the standard yield. Multiplying the unit standards by the actual yield will also produce SQ for each input.

dard price of labor. With this understanding, the computation of mix and yield variances will be illustrated using the Malcom Nut Company example. Suppose that Malcom has two types of direct labor, shelling labor and mixing labor. Malcom has developed the following standard mix for direct labor. (Yield, of course, is measured in pounds of output and corresponds to the same batch size used for the direct materials standards.)

Standard Mix Information: Direct Labor

Direct Labor Type	*Mix*	*Mix Proportion*	*SP*	*Standard Cost*
Shelling	3 hrs.	0.60	$ 8.00	$24
Mixing	2	0.40	15.00	30
Total	5 hrs.			$54

Yield 120 lbs.
Yield ratio: 24 = (120/5), or 2,400%
Standard cost of yield (*SPy*): $0.45 per pound ($54/120 pounds of yield)

As discussed earlier, suppose that Malcom processes 1,600 pounds of nuts and produces the following actual results:

Direct Labor Type	*Actual*	*Mix Percentages**
Shelling	20 hrs.	40%
Mixing	30	60
Total	50 hrs.	100%
Yield	1,300 lbs.	2,600%

*Uses 50 hours as the base.

Direct Labor Mix Variance

The standard mix proportion for shelling labor is 0.60. Thus, if 50 hours of actual input were used, then the mix standard calls for the following amount of shelling labor:

$$\begin{aligned} SM(\text{shelling}) &= 0.60 \times 50 \\ &= 30 \text{ hours} \end{aligned}$$

A similar computation produces SM = 20 hours for mixing labor (0.40 × 50).

Given SM, the direct labor mix variance is computed as follows (using Equation 9.1):

Direct Labor Type	*AH*	*SM*	*AH − SM*	*SP*	*(AH − SM)SP*
Shelling	20	30	(10)	$ 8.00	$ (80)
Mixing	30	20	10	15.00	150
Direct labor mix variance					$ 70 U

Notice that the direct labor mix variance is unfavorable. This occurs because more mixing labor was used than was called for in the standard mix, and mixing labor is more expensive than shelling labor.

Direct Labor Yield Variance

Using the standard mix information and the actual results, the direct labor yield variance is computed as follows:

$$\begin{aligned} \text{Direct labor yield variance} &= (\text{Standard yield} - \text{Actual yield})SPy \\ &= [(24 \times 50) - 1{,}300]\$0.45 \\ &= (1{,}200 - 1{,}300)\$0.45 \\ &= \$45 \text{ F} \end{aligned}$$

The direct labor yield variance is favorable because the actual yield is greater than the standard yield.

SUMMARY

A standard costing system budgets quantities and costs on a unit basis. These unit budgets are for direct labor, direct materials, and overhead. Standard costs, therefore, are the amount that should be expended to produce a product or service. Standards are set using historical experience, engineering studies, and input from operating personnel, marketing, and accounting. Currently attainable standards are those that can be achieved under efficient operating conditions. Ideal standards are those achievable under maximum efficiency—under ideal operating conditions. Standard costing systems are adopted to improve planning and control and to facilitate product costing. By comparing actual outcomes with standards and breaking the variance into price and quantity components, detailed feedback is provided to managers. This information allows managers to exercise a greater degree of cost control than is typically found in a normal or actual costing system. Decisions such as bidding are also made easier when a standard costing system is in place.

The standard cost sheet provides the detail for the computation of the standard cost per unit. It shows the standard costs for direct materials, direct labor, variable overhead, and fixed overhead. It also reveals the quantity of each input that should be used to produce one unit of output. Using these unit quantity standards, the standard quantity of direct materials allowed and the standard hours allowed can be computed for the actual output. These computations play an important role in variance analysis.

REVIEW PROBLEM AND SOLUTION

MATERIALS, LABOR, AND OVERHEAD VARIANCES

Bertgon Manufacturing has the following standard cost sheet for one of its products:

Direct materials (6 ft. @ \$5)	\$30
Direct labor (1.5 hrs. @ \$10)	15
Fixed overhead (1.5 hrs. @ \$2*)	3
Variable overhead (1.5 hrs. @ \$4*)	6
Standard unit cost	\$54

*Rate based on expected activity of 17,000 hours.

During the most recent year, the following actual results were recorded:

Production	12,000 units
Fixed overhead	\$33,000
Variable overhead	\$69,000
Direct materials (71,750 ft. purchased)	\$361,620
Direct labor (17,900 hrs.)	\$182,580

Required:

Compute the following variances:
1. Direct materials price and usage variances.
2. Direct labor rate and efficiency variances.

3. Variable overhead spending and efficiency variances.
4. Fixed overhead spending and volume variances.

SOLUTION

1. Direct materials variances:

$AQ \times AP$ (Actual Quantity at Actual Price)	$AQ \times SP$ (Actual Quantity at Standard Price)	$SQ \times SP$ (Standard Quantity at Standard Price)
71,750 × \$5.04 = \$361,620	71,750 × \$5.00 = \$358,750	6 × 12,000 × \$5.00 = \$360,000

Price Variance \$2,870 U

Usage Variance \$1,250 U

Or, using formulas:

$$
\begin{aligned}
MPV &= (AP - SP)AQ \\
&= (\$5.04 - \$5.00)71{,}750 \\
&= \$2{,}870 \text{ U}
\end{aligned}
$$

$$
\begin{aligned}
MUV &= (AQ - SQ)SP \\
&= (71{,}750 - 72{,}000)\$5.00 \\
&= \$1{,}250 \text{ F}
\end{aligned}
$$

2. Direct labor variances:

$AH \times AR$ (Actual Hours at Actual Rate)	$AH \times SR$ (Actual Hours at Standard Rate)	$SH \times SR$ (Standard Hours at Standard Rate)
17,900 × \$10.20 = \$182,580	17,900 × \$10.00 = \$179,000	1.5 × 12,000 × \$10.00 = \$180,000

Rate Variance \$3,580 U

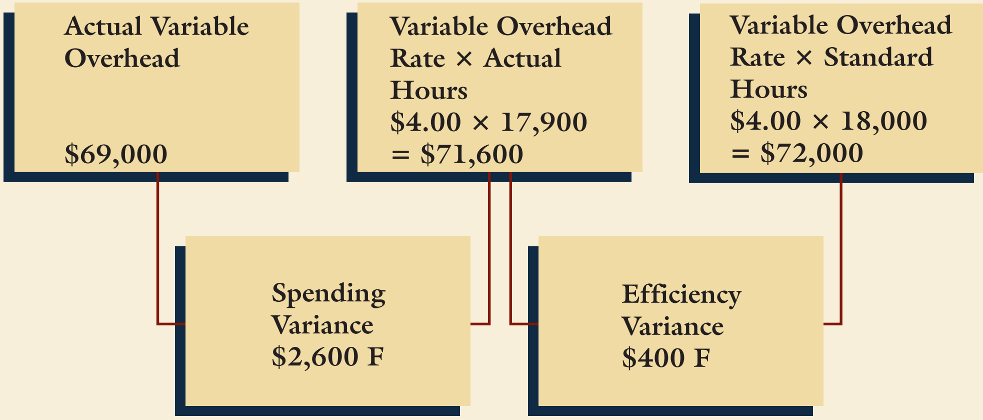
Efficiency Variance \$1,000 U

Or, using formulas:

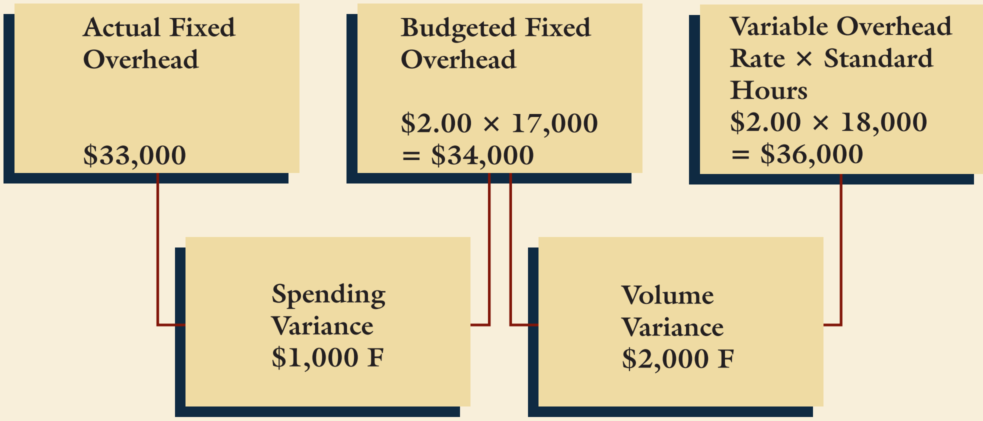
$$
\begin{aligned}
LRV &= (AR - SR)AH \\
&= (\$10.20 - \$10.00)17{,}900 \\
&= \$3{,}580 \text{ U}
\end{aligned}
$$

$$
\begin{aligned}
LEV &= (AH - SH)SR \\
&= (17{,}900 - 18{,}000)\$10.00 \\
&= \$1{,}000 \text{ F}
\end{aligned}
$$

3. Variable overhead variances:



4. Fixed overhead variances:



KEY TERMS

Control limits 394
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QUESTIONS FOR WRITING AND DISCUSSION

1. Discuss the difference between budgets and standard costs.
2. What is the quantity decision? The pricing decision?
3. Why is historical experience often a poor basis for establishing standards?
4. What are ideal standards? Currently attainable standards? Of the two, which is usually adopted? Why?
5. How does standard costing improve the control function?
6. The budget variance for variable production costs is broken down into quantity and price variances. Explain why the quantity variance is more useful for control purposes than the price variance.
7. Explain why the direct materials price variance is often computed at the point of purchase rather than at the point of issuance.
8. The direct materials usage variance is always the responsibility of the production supervisor. Do you agree or disagree? Why?
9. The direct labor rate variance is never controllable. Do you agree or disagree? Why?
10. Suggest some possible causes of an unfavorable direct labor efficiency variance.
11. Explain why the variable overhead spending variance is not a pure price variance.
12. What is the cause of an unfavorable volume variance? Does the volume variance convey any meaningful information to managers?
13. What are control limits, and how are they set?
14. Explain how the 2-, 3-, and 4-variance overhead analyses are related.
15. Explain what mix and yield variances are.

EXERCISES

9-1 SETTING STANDARDS, ETHICAL BEHAVIOR

LO1, LO2

CMA

Quincy Farms is a producer of items made from farm products that are distributed to supermarkets. For many years, Quincy's products have had strong regional sales on the basis of brand recognition. However, other companies have been marketing similar products in the area, and price competition has become increasingly important. Doug Gilbert, the company's controller, is planning to implement a standard costing system for Quincy and has gathered considerable information from his coworkers on production and direct materials requirements for Quincy's products. Doug believes that the use of standard costing will allow Quincy to improve cost control and make better operating decisions.

Quincy's most popular product is strawberry jam. The jam is produced in 10-gallon batches, and each batch requires six quarts of good strawberries. The fresh strawberries are sorted by hand before entering the production process. Because of imperfections in the strawberries and spoilage, one quart of strawberries is discarded for every four quarts of acceptable berries. Three minutes is the standard direct labor time required for sorting strawberries in order to obtain one quart of strawberries. The acceptable strawberries are then processed with the other ingredients: processing requires 12 minutes of direct labor time per batch. After processing, the jam is packaged in quart containers. Doug has gathered the following information from Joe Adams, Quincy's cost accountant, relative to processing the strawberry jam.

a. Quincy purchases strawberries at a cost of $0.80 per quart. All other ingredients cost a total of $0.45 per gallon.
b. Direct labor is paid at the rate of $9.00 per hour.

c. The total cost of direct material and direct labor required to package the jam is $0.38 per quart.

Joe has a friend who owns a strawberry farm that has been losing money in recent years. Because of good crops, there has been an oversupply of strawberries, and prices have dropped to $0.50 per quart. Joe has arranged for Quincy to purchase strawberries from his friend's farm in hopes that the $0.80 per quart will put his friend's farm in the black.

Required:

1. Discuss which coworkers Doug probably consulted to set standards. What factors should Doug consider in establishing the standards for direct materials and direct labor?
2. Develop the standard cost sheet for the prime costs of a 10-gallon batch of strawberry jam.
3. Citing the specific standards of the IMA code of ethics described in Chapter 1, explain why Joe's behavior regarding the cost information provided to Doug is unethical. *(CMA adapted)*

9-2 Computation of Inputs Allowed, Direct Materials and Direct Labor

LO2 During the year, Vandy Company produced 300,000 drilling components for oil and gas rigs. Vandy's direct materials and direct labor standards are as follows:

Direct materials (6.25 lbs. @ $4)	$25.00
Direct labor (1.5 hrs. @ $13)	19.50

Required:

1. Compute the standard pounds of direct materials allowed for the production of 300,000 units.
2. Compute the standard direct labor hours allowed for the production of 300,000 units.

9-3 Direct Materials and Direct Labor Variances

LO3 Spreadsheet

Choco Company produces a popular candy bar called Megusta. The candy is produced in Cost Rica and exported to the United States. Recently, the company adopted the following standards for one 5-ounce bar of the candy:

Direct materials (5.5 oz. @ $0.06)	$0.33
Direct labor (0.05 hr. @ $2.00)	0.10
Standard prime cost	$0.43

During the first week of operation, the company experienced the following actual results:

a. Bars produced: 150,000.
b. Ounces of direct materials purchased: 855,000 ounces at $0.055.
c. There are no beginning or ending inventories of direct materials.
d. Direct labor: 7,800 hours at $2.25.

Required:

1. Compute price and usage variances for direct materials.
2. Compute the rate variance and the efficiency variance for direct labor.
3. Prepare the journal entries associated with direct materials and direct labor.

9-4 Overhead Variances, Four-Variance Analysis

LO4 Spreadsheet

Young, Inc., uses a standard costing system and develops its overhead rates from the current annual budget. The budget is based on an expected annual output of 220,000 units requiring 1,100,000 direct labor hours. (Practical capacity is 1,210,000 hours.) Annual budgeted overhead costs total $962,500, of which $412,500 is fixed overhead. A total of 228,800 units using 1,188,000 direct labor hours was produced during the year. Actual variable overhead costs for the year were $572,000, and actual fixed overhead costs were $440,000.

Required:

1. Compute the fixed overhead spending and volume variances. How would you interpret the spending variance? Discuss the possible interpretations of the volume variance. Which is most appropriate for this example?
2. Compute the variable overhead spending and efficiency variances. How is the variable overhead spending variance like the price variances of direct labor and direct materials? How is it different? How is the variable overhead efficiency variance related to the direct labor efficiency variance?

9-5 Overhead Variances, Two- and Three-Variance Analyses

LO4 Refer to the data in **Exercise 9-4**.

Required:

1. Compute overhead variances using a 2-variance analysis.
2. Compute overhead variances using a 3-variance analysis.
3. Illustrate how the 2- and 3-variance analyses are related to the 4-variance analysis.

9-6 Direct Materials Mix and Yield Variances

LO5 Verde Sabor produces a green enchilada sauce using tomatoes and green chili peppers. Verde developed the following standard cost sheet:

Direct Material	*Mix*	*Mix Proportion*	*SP*	*Standard Cost*
Tomatoes	630 ounces	0.90	$0.020	$12.60
Chili peppers	70	0.10	0.026	1.82
Total	700 ounces			$14.42
Yield	577.5 ounces			

On March 2, Verde produced a batch of 112,000 ounces with the following actual results:

Direct Material	*Actual Mix*
Tomatoes	89,600 ounces
Chili peppers	22,400
Total	112,000 ounces
Yield	88,900 ounces

Required:

1. Calculate the yield ratio.
2. Calculate the standard cost per unit of yield.
3. Calculate the direct materials yield variance.
4. Calculate the direct materials mix variance.

9-7 Direct Materials Variances, Journal Entries

LO3, LO5

Refer to **Exercise 9-6**. Verde Sabor purchased the amount used of each direct material input on March 2 for the following actual prices, tomatoes, $0.025 per ounce and chili peppers, $0.024 per ounce.

Required:

1. Compute and journalize the direct materials price variances.
2. Compute and journalize the direct materials usage variances.
3. Offer some possible reasons for why the variances occurred.

9-8 Direct Labor Mix and Yield Variances

LO5

Spreadsheet

Sanderson Company uses two types of direct labor for the manufacturing of its integrated electronic components: soldering and testing. Sanderson has developed the following standard mix for direct labor, where output is measured in number of circuit boards.

Direct Labor Type	*Mix*	*SP*	*Standard Cost*
Soldering	4 hrs.	$16	$64
Testing	1	11	11
Total	5 hrs.		$75
Yield	25 hours		

During the second week in April, Sanderson produced the following results:

Labor Type	*Actual Mix*
Soldering	30,000 hrs.
Testing	4,000
Total	34,000 hrs.
Yield	150,000 hours

Required:

1. Calculate the yield ratio.
2. Calculate the standard cost per unit of yield.
3. Calculate the direct labor yield variance.
4. Calculate the direct labor mix variance.

9-9 Direct Labor and Direct Materials Variances, Journal Entries

LO3

Molano Company produces ponchos. The company has established the following direct materials and direct labor standards for one poncho:

Wool (3 yds. @ $3)	$ 9.00
Labor (3.5 hrs. @ $5)	17.50
Total prime cost	$26.50

During the first quarter of the year, Molano produced 25,000 ponchos. The company purchased and used 78,200 yards of wool at $2.90 per yard. Actual direct labor used was 90,000 hours at $5.20 per hour.

Required:

1. Calculate the direct materials price and usage variances.
2. Calculate the direct labor rate and efficiency variances.
3. Prepare the journal entries for the direct materials and direct labor variances.
4. Describe how flexible budgeting variances relate to the direct materials and direct labor variances computed in Requirements 1 and 2.

9-10 Investigation of Variances

LO3 Franklin Company uses the following rule to determine whether direct labor efficiency variances ought to be investigated. A direct labor efficiency variance will be investigated anytime the amount exceeds the lesser of $16,000 or 10 percent of the standard labor cost. Reports for the past five weeks provided the following information:

Week	*LEV*	*Standard Labor Cost*
1	$14,000 F	$160,000
2	15,600 U	150,000
3	12,000 F	160,000
4	18,000 U	170,000
5	14,000 U	138,000

Required:

1. Using the rule provided, identify the cases that will be investigated.
2. Suppose that investigation reveals that the cause of an unfavorable direct labor efficiency variance is the use of lower-quality direct materials than are usually used. Who is responsible? What corrective action would likely be taken?
3. Suppose that investigation reveals that the cause of a significant favorable direct labor efficiency variance is attributable to a new approach to manufacturing that takes less labor time but causes more direct materials waste. Upon examining the direct materials usage variance, it is discovered to be unfavorable, and it is larger than the favorable direct labor efficiency variance. Who is responsible? What action should be taken? How would your answer change if the unfavorable variance were smaller than the favorable?

9-11 Overhead Variances, Four-Variance Analysis, Journal Entries

LO4 Jackman, Inc., uses a standard costing system. The predetermined overhead rates are calculated using practical capacity. Practical capacity for a year is defined as 1,000,000 units requiring 250,000 standard direct labor hours. Budgeted overhead for the year is $750,000, of which $300,000 is fixed overhead. During the year, 900,000 units were produced using 230,000 direct labor hours. Actual annual overhead costs totaled $800,000, of which $300,000 is fixed overhead.

Required:

1. Calculate the fixed overhead spending and volume variances. Explain the meaning of the volume variance to the manager of Jackman.
2. Calculate the variable overhead spending and efficiency variances. Is the spending variance the same as the direct materials price variance? If not, explain how it differs.
3. Prepare the journal entries that reflect the following:
   a. Assignment of overhead to production.
   b. Recognition of the incurrence of actual overhead.
   c. Recognition of overhead variances.
   d. Closing out overhead variances, assuming they are not material.

PROBLEMS

9-12 Standard Costs, Decomposition of Budget Variances, Direct Materials and Direct Labor

LO2, LO3

Vaquero Corporation produces cowboy boots. The company uses a standard costing system and has set the following standards for direct materials and direct labor (for one pair of boots):

Leather (6 strips @ $10)	$60
Direct labor (2 hrs. @ $12)	24
Total prime cost	$84

During the year, Vaquero produced 8,000 pairs of boots. The actual leather purchased was 49,600 strips at $9.98 per strip. There were no beginning or ending inventories of leather. Actual direct labor was 16,800 hours at $12.25 per hour.

Required:

1. Compute the costs of leather and direct labor that should have been incurred for the production of 8,000 pairs of boots.
2. Compute the total budget variances for direct materials and direct labor.
3. Break down the total budget variance for direct materials into a price variance and a usage variance. Prepare the journal entries associated with these variances.
4. Break down the total budget variance for direct labor into a rate variance and an efficiency variance. Prepare the journal entries associated with these variances.

9-13 Overhead Application, Overhead Variances, Journal Entries

LO4

Spreadsheet

Iverson Company produces microwave ovens. Iverson's plant in Buffalo uses a standard costing system. The standard costing system relies on direct labor hours to assign overhead costs to production. The direct labor standard indicates that four direct labor hours should be used for every microwave unit produced. (The Buffalo plant produces only one model.) The normal production volume is 120,000 units. The budgeted overhead for the coming year is as follows:

Fixed overhead	$1,286,400
Variable overhead	888,000*

*At normal volume.

Iverson applies overhead on the basis of direct labor hours.

During the year, Iverson produced 119,000 units, worked 487,900 direct labor hours, and incurred actual fixed overhead costs of $1.3 million and actual variable overhead costs of $927,010.

Required:

1. Calculate the standard fixed overhead rate and the standard variable overhead rate.
2. Compute the applied fixed overhead and the applied variable overhead. What is the total fixed overhead variance? Total variable overhead variance?
3. Break down the total fixed overhead variance into a spending variance and a volume variance. Discuss the significance of each.
4. Compute the variable overhead spending and efficiency variances. Discuss the significance of each.
5. Now assume that Iverson's cost accounting system reveals only the total actual overhead. In this case, a 3-variance analysis can be performed. Using the relationships between a 3- and 4-variance analysis, indicate the values for the three overhead variances.
6. Prepare the journal entries that would be related to fixed and variable overhead during the year and at the end of the year. Assume variances are closed to Cost of Goods Sold.

9-14 Direct Materials, Direct Labor, and Overhead Variances, Journal Entries

LO3, LO4

The Bartlesville plant of Harmon Company produces an industrial chemical. At the beginning of the year, the Bartlesville plant had the following standard cost sheet:

Direct materials (10 lbs. @ $1.60)	$16.00
Direct labor (0.75 hr. @ $18.00)	13.50
Fixed overhead (0.75 hr. @ $4.00)	3.00
Variable overhead (0.75 hr. @ $3.00)	2.25
Standard cost per unit	$34.75

The Bartlesville plant computes its overhead rates using practical volume, which is 72,000 units. The actual results for the year are as follows:

a. Units produced: 70,000.
b. Direct materials purchased: 744,000 pounds at $1.50 per pound.
c. Direct materials used: 736,000 pounds.
d. Direct labor: 56,000 hours at $17.90 per hour.
e. Fixed overhead: $214,000.
f. Variable overhead: $175,400.

Required:

1. Compute price and usage variances for direct materials.
2. Compute the direct labor rate and labor efficiency variances.
3. Compute the fixed overhead spending and volume variances. Interpret the volume variance.
4. Compute the variable overhead spending and efficiency variances.
5. Prepare journal entries for the following:
   a. The purchase of direct materials.
   b. The issuance of direct materials to production (Work in Process).
   c. The addition of direct labor to Work in Process.
   d. The addition of overhead to Work in Process.

(continued)

e. The incurrence of actual overhead costs.
f. Closing out of variances to Cost of Goods Sold.

9-15 Solving for Unknowns

LO2, LO3, LO4

Misterio Company uses a standard costing system. During the past quarter, the following variances were computed:

Variable overhead efficiency variance	$ 24,000 U
Direct labor efficiency variance	120,000 U
Direct labor rate variance	10,400 U

Misterio applies variable overhead using a standard rate of $2 per direct labor hour allowed. Two direct labor hours are allowed per unit produced. (Only one type of product is manufactured.) During the quarter, Misterio used 30 percent more direct labor hours than should have been used.

Required:

1. What were the actual direct labor hours worked? The total hours allowed?
2. What is the standard hourly rate for direct labor? The actual hourly rate?
3. How many actual units were produced?

9-16 Basic Variance Analysis, Revision of Standards, Journal Entries

LO1, LO2, LO3, LO4

Nosemer Company produces engine parts for large motors. The company uses a standard cost system for production costing and control. The standard cost sheet for one of its higher volume products (a valve), is as follows:

Direct materials (5 lbs. @ $4.00)	$20.00
Direct labor (1.4 hrs. @ $10.50)	14.70
Variable overhead (1.4 hrs. @ $6.00)	8.40
Fixed overhead (1.4 hrs. @ $3.00)	4.20
Standard unit cost	$47.30

During the year, Nosemer experienced the following activity relative to the production of valves:

a. Production of valves totaled 25,000 units.
b. A total of 130,000 pounds of direct materials was purchased at $3.70 per pound.
c. There were 10,000 pounds of direct materials in beginning inventory (carried at $4 per pound). There was no ending inventory.
d. The company used 36,500 direct labor hours at a total cost of $392,375.
e. Actual fixed overhead totaled $95,000.
f. Actual variable overhead totaled $210,000.

Nosemer produces all of its valves in a single plant. Normal activity is 22,500 units per year. Standard overhead rates are computed based on normal activity measured in standard direct labor hours.

Required:

1. Compute the direct materials price and usage variances.
2. Compute the direct labor rate and efficiency variances.
3. Compute overhead variances using a 2-variance analysis.
4. Compute overhead variances using a 4-variance analysis.
5. Assume that the purchasing agent for the valve plant purchased a lower-quality direct material from a new supplier. Would you recommend that the company

continue to use this cheaper direct material? If so, what standards would likely need revision to reflect this decision? Assume that the end product's quality is not significantly affected.

6. Prepare all possible journal entries (assuming a 4-variance analysis of overhead variances).

9-17 Unit Costs, Multiple Products, Variance Analysis, Journal Entries

LO1, LO2, LO3, LO4

Business Specialty, Inc., manufactures two staplers: small and regular. The standard quantities of direct labor and direct materials per unit for the year are as follows:

	Small	*Regular*
Direct materials (oz.)	6.0	10.00
Direct labor (hrs.)	0.1	0.15

The standard price paid per pound of direct materials is $1.60. The standard rate for labor is $8.00. Overhead is applied on the basis of direct labor hours. A plantwide rate is used. Budgeted overhead for the year is as follows:

Budgeted fixed overhead	$360,000
Budgeted variable overhead	480,000

The company expects to work 12,000 direct labor hours during the year; standard overhead rates are computed using this activity level. For every small stapler produced, the company produces two regular staplers.

Actual operating data for the year are as follows:

a. Units produced: small staplers, 35,000; regular staplers, 70,000.
b. Direct materials purchased and used: 56,000 pounds at $1.55—13,000 for the small stapler and 43,000 for the regular stapler. There were no beginning or ending direct materials inventories.
c. Direct labor: 14,800 hours—3,600 hours for the small stapler; 11,200 hours for the regular stapler. Total cost of direct labor: $114,700.
d. Variable overhead: $607,500.
e. Fixed overhead: $350,000.

Required:

1. Prepare a standard cost sheet showing the unit cost for each product.
2. Compute the direct materials price and usage variances for each product. Prepare journal entries to record direct materials activity.
3. Compute the direct labor rate and efficiency variances. Prepare journal entries to record direct labor activity.
4. Compute the variances for fixed and variable overhead. Prepare journal entries to record overhead activity. All variances are closed to Cost of Goods Sold.
5. Assume that you know only the total direct materials used for both products and the total direct labor hours used for both products. Can you compute the total direct materials and direct labor usage variances? Explain.

9-18 Direct Materials Usage Variance, Direct Materials Mix and Yield Variances

LO3, LO5

Limpio, Inc., produces a key ingredient for liquid laundry detergents. Two chemical solutions, Chem A and Chem B, are mixed and heated to produce a cleansing chemical that is sold to companies that produce liquid detergents. The cleansing ingredient is produced in batches and has the following standards:

Direct Material	*Standard Mix*	*Standard Unit Price*	*Standard Cost*
Chem A	15,000 gallons	$2.00 per gallon	$30,000
Chem B	5,000	3.00	15,000
Total	20,000 gallons		$45,000
Yield	15,000 gallons		

During March, the following actual production information was provided:

Direct Material	*Actual Mix*
Chem A	140,000 gallons
Chem B	60,000
Total	200,000 gallons
Yield	158,400 gallons

Required:

1. Compute the direct materials mix and yield variances.
2. Compute the total direct materials usage variance for Chem A and Chem B. Show that the total direct materials usage variance is equal to the sum of the direct materials mix and yield variances.

9-19 Direct Labor Efficiency Variance, Direct Labor Mix and Yield Variances

LO3, LO5

Refer to the data in **Problem 9-18**. Limpio, Inc., also uses two different types of direct labor in producing the cleansing chemical: mixing and drum-filling labor (the completed product is placed into 50-gallon drums). For each batch of 20,000 gallons of direct materials input, the following standards have been developed for direct labor:

Direct Labor Type	*Mix*	*SP*	*Standard Cost*
Mixing	2,000 hrs.	$11.00	$22,000
Drum-filling	1,000	8.00	8,000
Total	3,000 hrs.		$30,000
Yield	15,000 gallons		

The actual direct labor hours used for the output produced in March are also provided:

Labor Type	*Mix*
Mixing	18,000 hrs.
Drum-filling	12,000
Total	30,000 hrs.
Yield	158,400 gallons

Required:

1. Compute the direct labor mix and yield variances.
2. Compute the total direct labor efficiency variance. Show that the total direct labor efficiency variance is equal to the sum of the direct labor mix and yield variances.

9-20 Direct Materials Usage Variances, Direct Materials Mix and Yield Variances

LO3, LO5

CMA

Energy Products Company produces a gasoline additive, Gas Gain. This product increases engine efficiency and improves gasoline mileage by creating a more complete burn in the combustion process.

Careful controls are required during the production process to ensure that the proper mix of input chemicals is achieved and that evaporation is controlled. If the controls are not effective, there can be a loss of output and efficiency.

The standard cost of producing a 500-liter batch of Gas Gain is $135. The standard direct materials mix and related standard cost of each chemical used in a 500-liter batch are as follows:

Chemical	*Mix*	*SP*	*Standard Cost*
Echol	200 liters	$0.200	$ 40.00
Protex	100	0.425	42.50
Benz	250	0.150	37.50
CT-40	50	0.300	15.00
Total	600 liters		$135.00

The quantities of chemicals purchased and used during the current production period are shown in the following schedule. A total of 140 batches of Gas Gain were manufactured during the current production period. Energy Products determines its cost and chemical usage variations at the end of each production period.

Chemical	*Quantity Used*
Echol	26,600 liters
Protex	12,880
Benz	37,800
CT-40	7,140
Total	84,420 liters

Required:

Compute the total direct materials usage variance, and then break down this variance into its mix and yield components. *(CMA adapted)*

9-21 Solving for Unknowns, Overhead Analysis

LO3, LO4

Nuevo Company produces a single product. Nuevo employs a standard cost system and uses a flexible budget to predict overhead costs at various levels of activity. For the most recent year, Nuevo used a standard overhead rate equal to $6.25 per direct labor hour. The rate was computed using expected activity. Budgeted overhead costs are $80,000 for 10,000 direct labor hours and $120,000 for 20,000 direct labor hours. During the past year, Nuevo generated the following data:

a. Actual production: 4,000 units.
b. Fixed overhead volume variance: $1,750 U.

c. Variable overhead efficiency variance: $3,200 F.
d. Actual fixed overhead costs: $41,335.
e. Actual variable overhead costs: $70,000.

Required:

1. Determine the fixed overhead spending variance.
2. Determine the variable overhead spending variance.
3. Determine the standard hours allowed per unit of product.
4. Assuming the standard labor rate is $9.50 per hour, compute the direct labor efficiency variance.

9-22 Flexible Budget, Standard Cost Variances, T-Accounts

LO1, LO3, LO4

Correr Company manufactures a line of running shoes. At the beginning of the period, the following plans for production and costs were revealed:

Units to be produced and sold	25,000
Standard cost per unit:	
Direct materials	$10
Direct labor	8
Variable overhead	4
Fixed overhead	3
Total unit cost	$25

During the year, 30,000 units were produced and sold. The following actual costs were incurred:

Direct materials	$320,000
Direct labor	220,000
Variable overhead	125,000
Fixed overhead	89,000

There were no beginning or ending inventories of direct materials. The direct materials price variance was $5,000 unfavorable. In producing the 30,000 units, a total of 39,000 hours were worked, 4 percent more hours than the standard allowed for the actual output. Overhead costs are applied to production using direct labor hours.

Required:

1. Prepare a performance report comparing expected costs to actual costs.
2. Determine the following:
   a. Direct materials usage variance.
   b. Direct labor rate variance.
   c. Direct labor usage variance.
   d. Fixed overhead spending and volume variances.
   e. Variable overhead spending and efficiency variances.
3. Use T-accounts to show the flow of costs through the system. In showing the flow, you do not need to show detailed overhead variances. Show only the over- and underapplied variances for fixed and variable overhead.

9-23 Standard Costing: Planned Variances

LO2, LO3

As part of its cost control program, Tracer Company uses a standard costing system for all manufactured items. The standard cost for each item is established at the be-

CMA

ginning of the fiscal year, and the standards are not revised until the beginning of the next fiscal year. Changes in costs, caused during the year by changes in direct materials or direct labor inputs or by changes in the manufacturing process, are recognized as they occur by the inclusion of planned variances in Tracer's monthly operating budgets.

The following direct labor standard was established for one of Tracer's products, effective June 1, 2007, the beginning of the fiscal year:

Assembler A labor (5 hrs. @ $10)	$ 50
Assembler B labor (3 hrs. @ $11)	33
Machinist labor (2 hrs. @ $15)	30
Standard cost per 100 units	$113

The standard was based on the direct labor being performed by a team consisting of five persons with Assembler A skills, three persons with Assembler B skills, and two persons with machinist skills; this team represents the most efficient use of the company's skilled employees. The standard also assumed that the quality of direct materials that had been used in prior years would be available for the coming year.

For the first seven months of the fiscal year, actual manufacturing costs at Tracer have been within the standards established. However, the company has received a significant increase in orders, and there is an insufficient number of skilled workers to meet the increased production. Therefore, beginning in January, the production teams will consist of eight persons with Assembler A skills, one person with Assembler B skills, and one person with machinist skills. The reorganized teams will work more slowly than the normal teams, and as a result, only 80 units will be produced in the same time period in which 100 units would normally be produced. Faulty work has never been a cause for units to be rejected in the final inspection process, and it is not expected to be a cause for rejection with the reorganized teams.

Furthermore, Tracer has been notified by its direct materials supplier that lower-quality direct materials will be supplied beginning January 1. Normally, one unit of direct materials is required for each good unit produced, and no units are lost due to defective direct materials. Tracer estimates that 6 percent of the units manufactured after January 1 will be rejected in the final inspection process due to defective direct materials.

Required:

1. Determine the number of units of lower-quality direct materials that Tracer Company must enter into production in order to produce 47,000 good finished units.
2. How many hours of each class of direct labor must be used to manufacture 47,000 good finished units?
3. Determine the amount that should be included in Tracer's January operating budget for the planned direct labor variance caused by the reorganization of the direct labor teams and the lower-quality direct materials. *(CMA adapted)*

9-24 Variance Analysis in a Process-Costing Setting (Chapter 6 required), Service Firm

LO2, LO3 Aspen Medical Laboratory performs comprehensive blood tests for physicians and clinics throughout the Southwest. Aspen uses a standard process-costing system for its comprehensive blood work. Skilled technicians perform the blood tests. Because Aspen uses a standard costing system, equivalent units are calculated using the FIFO method. The standard cost sheet for the blood test follows (these standards were used throughout the calendar year):

Direct materials (4 oz. @ $4.50)	$18
Direct labor (2 hrs. @ $18.00)	36
Variable overhead (2 hrs. @ $5.00)	10
Fixed overhead (2 hrs. @ $10.00)	20
Standard cost per test	$84

For the month of November, Aspen reported the following actual results:

a. Beginning work in process: 1,250 tests, 60 percent complete.
b. Tests started: 25,000.
c. Ending work in process: 2,500 tests, 40 percent complete.
d. Direct labor: 47,000 hours at $19 per hour.
e. Direct materials purchased and used: 102,000 at $4.25 per ounce.
f. Variable overhead: $144,000.
g. Fixed overhead: $300,000.
h. Direct materials are added at the beginning of the process.

Required:

1. Explain why the FIFO method is used for process costing when a standard costing system has been adopted.
2. Calculate the cost of goods transferred out (tests completed and transferred out) for the month of November. Does standard costing simplify process costing? Explain.
3. Calculate price and quantity variances for direct materials and direct labor.

9-25 Setting Standards, Calculating and Using Variances

LO1, LO3

CMA

Leather Works is a family-owned maker of leather travel bags and briefcases located in the northeastern part of the United States. Foreign competition has forced its owner, Heather Gray, to explore new ways to meet the competition. One of her cousins, Walace Hayes, who recently graduated from college with a major in accounting, told her about the use of cost variance analysis to learn about efficiencies of production.

In May 2006, Heather asked Matt Jones, chief accountant, and Alfred Prudest, production manager, to implement a standard costing system. Matt and Alfred, in turn, retained Shannon Leikam, an accounting professor at Harding's College, to set up a standard costing system by using information supplied to her by Matt's and Alfred's staff. To verify that the information was accurate, Shannon visited the plant and measured workers' output using time and motion studies. During those visits, she was not accompanied by either Matt or Alfred, and the workers knew about Shannon's schedule in advance. The cost system was implemented in June 2006.

Recently, the following dialogue took place among Heather, Matt, and Alfred:

HEATHER: How is the business performing?

ALFRED: You know, we are producing a lot more than we used to, thanks to the contract that you helped obtain from Lean, Inc., for laptop covers. (Lean is a national supplier of computer accessories.)

MATT: Thank goodness for that new product. It has kept us from sinking even more due to the inroads into our business made by those foreign suppliers of leather goods.

HEATHER: What about the standard costing system?

MATT: The variances are mostly favorable, except for the first few months when the supplier of leather started charging more.

HEATHER: How did the union members take to the standards?

ALFRED: Not bad. They grumbled a bit at first, but they have taken it in stride. We've consistently shown favorable direct labor efficiency variances and direct materials usage variances. The direct labor rate variance has been flat.

MATT: It should be since direct labor rates are negotiated by the union representative at the start of the year and remain the same for the entire year.

HEATHER: Matt, would you send me the variance report for laptop covers immediately?

The following chart summarizes the direct materials and direct labor variances from November 2006 through April 2007 (extracted form the report provided by Matt) Standards for each laptop cover are as follows:

a. Three feet of direct materials at $7.50 per foot.
b. Forty-five minutes of direct labor at $14 per hour.

Month	*Actual Cost (Direct Materials + Direct Labor)*	*Direct Materials Price Variance*	*Direct Materials Efficiency Variance*	*Direct Labor Rate Variance*	*Direct Labor Efficiency Variance*
November	$150,000	$10,000 U	$5,000 F	$100 U	$5,000 F
December	155,000	11,000 U	5,200 F	110 U	6,500 F
January	152,000	10,100 U	4,900 F	105 U	7,750 F
February	151,000	9,900 U	4,500 F	95 U	6,950 F
March	125,000	9,000 U	3,000 F	90 U	8,200 F
April	115,000	8,000 U	2,000 F	90 U	8,500 F

In addition, the data for May 2007, but not the variances for the month, are as follows:

Laptop covers made in May	2,900 units
Total actual direct materials costs incurred	$68,850
Actual quantity of direct materials purchased and used	8,500 feet
Total actual direct labor cost incurred	$25,910
Total actual direct labor hours	1,837.6 hours

Actual direct labor cost per hour exceeded the budgeted rate by $0.10 per hour.

Required:

1. For May 2007, calculate the price and quantity variances for direct labor and direct materials.
2. Discuss the trend of the direct materials and labor variances.
3. What type of actions must the workers have taken during the period they were being observed for the setting of standards?
4. What can be done to ensure that the standards are set correctly? *(CMA adapted)*

9-26 Collaborative Learning Exercise: Structured Problem Solving; Three Stay, One Stray: Establishment of Standards, Variance Analysis

LO1, LO2, LO3

Tasty Apple, an apple chip manufacturer, was established in 1972 by Katherine English. In 2002, Katherine English died, and her son, Mark, took control of the business. By 2007, the company was facing stiff competition from national snack-food companies. Mark was advised that the company's plants needed to gain better control over production costs. To achieve this objective, he hired a consultant to install a standard costing system. To help the consultant in establishing the necessary standards, Mark sent her the following memo:

MEMO

To: Darlene Swasey, CMA

From: Mark English, President, Tasty Apple

Subject: Description and Data Relating to the Production of Our Cinnamon Apple Chips

Date: November 28, 2007

The manufacturing process for our chips begins when the apples are placed into a large vat in which they are automatically washed. After washing, the apples flow directly to equipment that automatically peels and removes the apple's core. The peeled and decored apples then pass by inspectors who manually cut out deep bruises or other blemishes. After inspection, the apples are automatically sliced and dropped into the cooking oil. The frying process is closely monitored by an employee. After they are cooked, the chips pass by more inspectors, who sort out the unacceptable finished chips (those that are discolored or too small). The chips then continue on the conveyor belt to a bagging machine that bags them in 1-pound bags. The bags are then placed in a box and shipped. Each box holds 16 bags.

The raw apple pieces (bruised and blemished), peelings, and rejected finished chips are sold to animal feed producers for $0.08 per pound. The cores are sold to a juice producer for $0.16 per pound. The company uses this revenue to reduce the cost of apples; we would like this fact reflected in the price standard relating to apples.

Tasty Apple purchases high-quality apples at a cost of $0.256 per pound. Each apple averages 4.25 ounces. Under efficient operating conditions, it takes four apples to produce one 16-ounce bag of chips. Although we label bags as containing 16 ounces, we actually place 16.2 ounces in each bag. We plan to continue this policy to ensure customer satisfaction. In addition to apples, other raw materials are the cooking oil, cinnamon, bags, and boxes. Cooking oil costs $0.04 per ounce, and we use 3.3 ounces of oil per bag of chips. The cost of cinnamon is so small that we add it to overhead. Bags cost $0.12 each and boxes $0.62.

Our plant produces 9.2 million bags of chips per year. A recent engineering study revealed that we would need the following direct labor hours to produce this quantity if our plant operates at peak efficiency:

Raw apple inspection	3,150
Finished chip inspection	12,000
Frying monitor	6,300
Machine operators	6,300
Boxing	16,250

I'm not sure that we can achieve the level of efficiency advocated by the study. In my opinion, the plant is operating efficiently for the level of output indicated if the hours allowed are about 10 percent higher.

The hourly labor rates agreed upon with the union are as follows:

Raw apple inspectors	$17.68
Finished chip inspectors	13.00
Frying monitor	16.00
Boxing	13.68
Machine operators	15.00

Overhead is applied on the basis of direct labor dollars. We have found that variable overhead averages about 112 percent of our direct labor cost. Our fixed overhead is budgeted at $2,419,026 for the coming year.

Required:

Form groups of three or four students. Each group should complete the following requirements. One member from each group will rotate to another group. The rotating member has the responsibility of comparing and contrasting the solution of his or her group with that of the group being visited.

1. Discuss the benefits of a standard costing system for Tasty Apple.
2. Discuss the president's concern about using the result of the engineering study to set the labor standards. What standard would you recommend?
3. Develop a standard cost sheet for Tasty Apple's cinnamon apple chips.
4. Suppose that the level of production was 9.2 million bags of apple chips for the year as planned. Assuming that 9.8 million pounds of apples were used, compute the direct materials usage variance for apples.

9-27 Cyber Research Case

Setting and Using Standards in a Service Setting

LO1, LO3 Standard costing concepts can also be applied to services. Standard service costs are similar in concept to standard product costs. In the medical field, costs of caring for a patient have been increasing at a high rate for many years. Hospitals, for example, have often been paid on a retrospective basis. Essentially, they have been able to recover (from Medicare or their insurers) most of what they spent in treating a patient. Hospitals have thus had very little incentive to control costs. Some argue that retrospective payments encourage hospitals to acquire new and expensive technology and to offer more and more complex procedures. Prospective payments have emerged as an alternative to retrospective payments. Recently a new type of prospective payment has emerged known as "per-case payment."

Required:

Conduct an Internet search on per-case payments, and answer the following questions:

1. What is per-case payment?
2. Explain the following: "Per-case payment can become a viable payment scheme only if the hospital's case mix can be properly measured."
3. Discuss the merits of using diagnostic related groups (DRGs) to measure case mix.
4. Patient management categories (PMCs) have been suggested as an alternative approach to measuring case mix. Define PMCs, and discuss their merits.
5. Describe how the per-case payment approaches are forms of standard costing discussed in this chapter.