

## ► Learning Objectives

1. Explain the similarities and differences in planning variable overhead costs and fixed overhead costs
2. Develop budgeted variable overhead cost rates and budgeted fixed overhead cost rates
3. Compute the variable overhead flexible-budget variance, the variable overhead efficiency variance, and the variable overhead spending variance
4. Compute the fixed overhead flexible-budget variance, the fixed overhead spending variance, and the fixed overhead production-volume variance
5. Show how the 4-variance analysis approach reconciles the actual overhead incurred with the overhead amounts allocated during the period
6. Explain the relationship between the sales-volume variance and the production-volume variance
7. Calculate overhead variances in activity-based costing
8. Examine the use of overhead variances in nonmanufacturing settings

## What do this week's weather forecast and organization performance have in common?

Most of the time, reality doesn't match expectations. Cloudy skies that cancel a little league game may suddenly let the sun shine through just as the vans are packed. Jubilant business owners may change their tune when they tally their monthly bills and discover that skyrocketing operation costs have significantly reduced their profits. Differences, or variances, are all around us.

For organizations, variances are of great value because they highlight the areas where performance most lags expectations. By using this information to make corrective adjustments, companies can achieve significant savings, as the following article shows.

## Overhead Cost Variances Force Macy's to Shop for Changes in Strategy<sup>1</sup>

Managers frequently review the differences, or variances, in overhead costs and make changes in the operations of a business. Sometimes staffing levels are increased or decreased, while at other times managers identify ways to use fewer resources like, say, office supplies and travel for business meetings that don't add value to the products and services that customers buy.

At the department-store chain Macy's, however, managers analyzed overhead cost variances and changed the way the company purchased the products it sells. In 2005, when Federated Department Stores and the May Department Store Company merged, Macy's operated seven buying offices across the United States. Each of these offices was responsible for purchasing some of the clothes, cosmetics, jewelry, and many other items Macy's sells. But overlapping responsibilities, seasonal buying patterns (clothes are generally purchased in the spring and fall) and regional differences in costs and salaries (for example, it costs more for employees and rent in San Francisco than Cincinnati) led to frequent and significant variances in overhead costs.

These overhead costs weighed on the company as the retailer struggled with disappointing sales after the merger. As a result, Macy's leaders felt pressured to reduce its costs that were not directly related to selling merchandise in stores and online.

<sup>1</sup> Sources: Boyle, Matthew. 2009. A leaner Macy's tries to cater to local tastes. *BusinessWeek.com*, September 3; Kapner, Suzanne. 2009. Macy's looking to cut costs. *Fortune*, January 14. [http://money.cnn.com/2009/01/14/news/companies/macys\\_consolidation.fortune/](http://money.cnn.com/2009/01/14/news/companies/macys_consolidation.fortune/); *Macy's 2009 Corporate Fact Book*. 2009. Cincinnati: Macy's, Inc., 7.

In early 2009, the company announced plans to consolidate its network of seven buying offices into one location in New York. With all centralized buying and merchandise planning in one location, Macy's buying structure and overhead costs were in line with how many other large chains operate, including JCPenney and Kohl's. All told, the move to centralized buying would generate \$100 million in annualized cost savings for the company.

While centralized buying was applauded by industry experts and shareholders, Macy's CEO Terry Lundgren was concerned about keeping a "localized flavor" in his stores. To ensure that nationwide buying accommodated local tastes, a new team of merchants was formed in each Macy's market to gauge local buying habits. That way, the company could reduce its overhead costs while ensuring that Macy's stores near water parks had extra swimsuits.

Companies such as DuPont, International Paper, and U.S. Steel, which invest heavily in capital equipment, or Amazon.com and Yahoo!, which invest large amounts in software, have high overhead costs. As the Macy's example suggests, understanding the behavior of overhead costs, planning for them, performing variance analysis, and acting appropriately on the results are critical for a company.

In this chapter, we will examine how flexible budgets and variance analysis can help managers plan and control overhead costs. Chapter 7 emphasized the direct-cost categories of direct materials and direct manufacturing labor. In this chapter, we focus on the indirect-cost categories of variable manufacturing overhead and fixed manufacturing overhead. Finally, we explain why managers should be careful when interpreting variances based on overhead-cost concepts developed primarily for financial reporting purposes.

## Planning of Variable and Fixed Overhead Costs

We'll use the Webb Company example again to illustrate the planning and control of variable and fixed overhead costs. Recall that Webb manufactures jackets that are sold to distributors who in turn sell to independent clothing stores and retail chains. For simplicity, we assume Webb's only costs are *manufacturing* costs. For ease of exposition, we use the term overhead costs instead of manufacturing overhead costs. Variable (manufacturing) overhead costs for Webb include energy, machine maintenance, engineering support, and indirect materials. Fixed (manufacturing) overhead costs include plant leasing costs, depreciation on plant equipment, and the salaries of the plant managers.



### Learning Objective 1

Explain the similarities and differences in planning variable overhead costs and fixed overhead costs

... for both, plan only essential activities and be efficient; fixed overhead costs are usually determined well before the budget period begins

## Planning Variable Overhead Costs

To effectively plan variable overhead costs for a product or service, managers must focus attention on the activities that create a superior product or service for their customers and eliminate activities that do not add value. Webb’s managers examine how each of their variable overhead costs relates to delivering a superior product or service to customers. For example, customers expect Webb’s jackets to last, so managers at Webb consider sewing to be an essential activity. Therefore, maintenance activities for sewing machines—included in Webb’s variable overhead costs—are also essential activities for which management must plan. In addition, such maintenance should be done in a cost-effective way, such as by scheduling periodic equipment maintenance rather than waiting for sewing machines to break down. For many companies today, it is critical to plan for ways to become more efficient in the use of energy, a rapidly growing component of variable overhead costs. Webb installs smart meters in order to monitor energy use in real time and steer production operations away from peak consumption periods.

## Planning Fixed Overhead Costs

Effective planning of fixed overhead costs is similar to effective planning for variable overhead costs—planning to undertake only essential activities and then planning to be efficient in that undertaking. But in planning fixed overhead costs, there is one more strategic issue that managers must take into consideration: choosing the appropriate level of capacity or investment that will benefit the company in the long run. Consider Webb’s leasing of sewing machines, each having a fixed cost per year. Leasing more machines than necessary—if Webb overestimates demand—will result in additional fixed leasing costs on machines not fully used during the year. Leasing insufficient machine capacity—say, because Webb underestimates demand or because of limited space in the plant—will result in an inability to meet demand, lost sales of jackets, and unhappy customers. Consider the example of AT&T, which did not foresee the iPhone’s appeal or the proliferation of “apps” and did not upgrade its network sufficiently to handle the resulting data traffic. AT&T has since had to impose limits on how customers can use the iPhone (such as by curtailing tethering and the streaming of Webcasts). In December 2009, AT&T had the lowest customer satisfaction ratings among all major carriers.

The planning of fixed overhead costs differs from the planning of variable overhead costs in one important respect: timing. At the start of a budget period, management will have made most of the decisions that determine the level of fixed overhead costs to be incurred. But, it’s the day-to-day, ongoing operating decisions that mainly determine the level of variable overhead costs incurred in that period. In health care settings, for example, variable overhead, which includes disposable supplies, unit doses of medication, suture packets, and medical waste disposal costs, is a function of the number and nature of procedures carried out, as well as the practice patterns of the physicians. However, the majority of the cost of providing hospital service is related to buildings, equipment, and salaried labor, which are fixed overhead items, unrelated to the volume of activity.<sup>2</sup>

### Decision Point

How do managers plan variable overhead costs and fixed overhead costs?

### Learning Objective 2

Develop budgeted variable overhead cost rates

... budgeted variable costs divided by quantity of cost-allocation base

and budgeted fixed overhead cost rates

... budgeted fixed costs divided by quantity of cost-allocation base

## Standard Costing at Webb Company

Webb uses standard costing. The development of standards for Webb’s direct manufacturing costs was described in Chapter 7. This chapter discusses the development of standards for Webb’s manufacturing overhead costs. **Standard costing** is a costing system that (a) traces direct costs to output produced by multiplying the standard prices or rates by the standard quantities of inputs allowed for actual outputs produced and (b) allocates overhead costs on the basis of the standard overhead-cost rates times the standard quantities of the allocation bases allowed for the actual outputs produced.

<sup>2</sup> Related to this, free-standing surgery centers have thrived because they have an economic advantage of lower fixed overhead when compared to a traditional hospital. For an enlightening summary of costing issues in health care, see A. Macario, “What Does One Minute of Operating Room Time Cost?” Stanford University School of Medicine (2009).

The standard cost of Webb's jackets can be computed at the start of the budget period. This feature of standard costing simplifies record keeping because no record is needed of the actual overhead costs or of the actual quantities of the cost-allocation bases used for making the jackets. What is needed are the standard overhead cost rates for variable and fixed overhead. Webb's management accountants calculate these cost rates based on the planned amounts of variable and fixed overhead and the standard quantities of the allocation bases. We describe these computations next. Note that once standards have been set, the costs of using standard costing are low relative to the costs of using actual costing or normal costing.

## Developing Budgeted Variable Overhead Rates

Budgeted variable overhead cost-allocation rates can be developed in four steps. We use the Webb example to illustrate these steps. Throughout the chapter, we use the broader term "budgeted rate" rather than "standard rate" to be consistent with the term used in describing normal costing in earlier chapters. In standard costing, the budgeted rates are standard rates.

**Step 1: Choose the Period to Be Used for the Budget.** Webb uses a 12-month budget period. Chapter 4 (p. 103) provides two reasons for using annual overhead rates rather than, say, monthly rates. The first relates to the numerator (such as reducing the influence of seasonality on the cost structure) and the second to the denominator (such as reducing the effect of varying output and number of days in a month). In addition, setting overhead rates once a year saves management the time it would need 12 times during the year if budget rates had to be set monthly.

**Step 2: Select the Cost-Allocation Bases to Use in Allocating Variable Overhead Costs to Output Produced.** Webb's operating managers select machine-hours as the cost-allocation base because they believe that machine-hours is the only cost driver of variable overhead. Based on an engineering study, Webb estimates it will take 0.40 of a machine-hour per actual output unit. For its budgeted output of 144,000 jackets in 2011, Webb budgets 57,600 ( $0.40 \times 144,000$ ) machine-hours.

**Step 3: Identify the Variable Overhead Costs Associated with Each Cost-Allocation Base.** Webb groups all of its variable overhead costs, including costs of energy, machine maintenance, engineering support, indirect materials, and indirect manufacturing labor in a single cost pool. Webb's total budgeted variable overhead costs for 2011 are \$1,728,000.

**Step 4: Compute the Rate per Unit of Each Cost-Allocation Base Used to Allocate Variable Overhead Costs to Output Produced.** Dividing the amount in Step 3 (\$1,728,000) by the amount in Step 2 (57,600 machine-hours), Webb estimates a rate of \$30 per standard machine-hour for allocating its variable overhead costs.

In standard costing, the variable overhead rate per unit of the cost-allocation base (\$30 per machine-hour for Webb) is generally expressed as a standard rate per output unit. Webb calculates the budgeted variable overhead cost rate per output unit as follows:

$$\begin{aligned}
 &\text{Budgeted variable overhead cost rate} &&= && \text{Budgeted input allowed per output unit} && \times && \text{Budgeted variable overhead cost rate per input unit} \\
 &\text{per output unit} && && \text{output unit} && && \text{per input unit} \\
 & && && = && 0.40 \text{ hour per jacket} && \times && \$30 \text{ per hour} \\
 & && && = && \$12 \text{ per jacket}
 \end{aligned}$$

Webb uses \$12 per jacket as the budgeted variable overhead cost rate in both its static budget for 2011 and in the monthly performance reports it prepares during 2011.

The \$12 per jacket represents the amount by which Webb's variable overhead costs are expected to change with respect to output units for planning and control purposes. Accordingly, as the number of jackets manufactured increases, variable overhead costs are allocated to output units (for the inventory costing purpose) at the same rate of \$12 per jacket. Of course, this presents an overall picture of total variable overhead costs, which in reality consist of many items, including energy, repairs, indirect labor, and so on. Managers help control variable overhead costs by budgeting each line item and then investigating possible causes for any significant variances.

## Developing Budgeted Fixed Overhead Rates

Fixed overhead costs are, by definition, a lump sum of costs that remains unchanged in total for a given period, despite wide changes in the level of total activity or volume related to those overhead costs. Fixed costs are included in flexible budgets, but they remain the same total amount within the relevant range of activity regardless of the output level chosen to “flex” the variable costs and revenues. Recall from Exhibit 7-2, page 231 and the steps in developing a flexible budget, that the fixed-cost amount is the same \$276,000 in the static budget and in the flexible budget. Do not assume, however, that fixed overhead costs can never be changed. Managers can reduce fixed overhead costs by selling equipment or by laying off employees. But they are fixed in the sense that, unlike variable costs such as direct material costs, fixed costs do not *automatically* increase or decrease with the level of activity within the relevant range.

The process of developing the budgeted fixed overhead rate is the same as that detailed earlier for calculating the budgeted variable overhead rate. The four steps are as follows:

**Step 1: Choose the Period to Use for the Budget.** As with variable overhead costs, the budget period for fixed overhead costs is typically 12 months to help smooth out seasonal effects.

**Step 2: Select the Cost-Allocation Bases to Use in Allocating Fixed Overhead Costs to Output Produced.** Webb uses machine-hours as the only cost-allocation base for fixed overhead costs. Why? Because Webb’s managers believe that, in the long run, fixed overhead costs will increase or decrease to the levels needed to support the amount of machine-hours. Therefore, in the long run, the amount of machine-hours used is the only cost driver of fixed overhead costs. The number of machine-hours is the denominator in the budgeted fixed overhead rate computation and is called the **denominator level** or, in manufacturing settings, the **production-denominator level**. For simplicity, we assume Webb expects to operate at capacity in fiscal year 2011—with a budgeted usage of 57,600 machine-hours for a budgeted output of 144,000 jackets.<sup>3</sup>

**Step 3: Identify the Fixed Overhead Costs Associated with Each Cost-Allocation Base.** Because Webb identifies only a single cost-allocation base—machine-hours—to allocate fixed overhead costs, it groups all such costs into a single cost pool. Costs in this pool include depreciation on plant and equipment, plant and equipment leasing costs, and the plant manager’s salary. Webb’s fixed overhead budget for 2011 is \$3,312,000.

**Step 4: Compute the Rate per Unit of Each Cost-Allocation Base Used to Allocate Fixed Overhead Costs to Output Produced.** Dividing the \$3,312,000 from Step 3 by the 57,600 machine-hours from Step 2, Webb estimates a fixed overhead cost rate of \$57.50 per machine-hour:

$$\begin{array}{r} \text{Budgeted fixed} \\ \text{overhead cost per} \\ \text{unit of cost-allocation} \\ \text{base} \end{array} = \frac{\begin{array}{r} \text{Budgeted total costs} \\ \text{in fixed overhead cost pool} \\ \text{Budgeted total quantity of} \\ \text{cost-allocation base} \end{array}}{\begin{array}{r} \\ \\ \\ \end{array}} = \frac{\$3,312,000}{57,600} = \$57.50 \text{ per machine-hour}$$

In standard costing, the \$57.50 fixed overhead cost per machine-hour is usually expressed as a standard cost per output unit. Recall that Webb’s engineering study estimates that it will take 0.40 machine-hour per output unit. Webb can now calculate the budgeted fixed overhead cost per output unit as follows:

$$\begin{array}{r} \text{Budgeted fixed} \\ \text{overhead cost per} \\ \text{output unit} \end{array} = \begin{array}{r} \text{Budgeted quantity of} \\ \text{cost-allocation} \\ \text{base allowed per} \\ \text{output unit} \end{array} \times \begin{array}{r} \text{Budgeted fixed} \\ \text{overhead cost} \\ \text{per unit of} \\ \text{cost-allocation base} \end{array} \\ = 0.40 \text{ of a machine-hour per jacket} \times \$57.50 \text{ per machine-hour} \\ = \$23.00 \text{ per jacket}$$

<sup>3</sup> Because Webb plans its capacity over multiple periods, anticipated demand in 2011 could be such that budgeted output for 2011 is less than capacity. Companies vary in the denominator levels they choose; some may choose budgeted output and others may choose capacity. In either case, the basic approach and analysis presented in this chapter is unchanged. Chapter 9 discusses choosing a denominator level and its implications in more detail.

When preparing monthly budgets for 2011, Webb divides the \$3,312,000 annual total fixed costs into 12 equal monthly amounts of \$276,000.

## Variable Overhead Cost Variances

We now illustrate how the budgeted variable overhead rate is used in computing Webb’s variable overhead cost variances. The following data are for April 2011, when Webb produced and sold 10,000 jackets:

	Actual Result	Flexible-Budget Amount
1. Output units (jackets)	10,000	10,000
2. Machine-hours per output unit	0.45	0.40
3. Machine-hours (1 × 2)	4,500	4,000
4. Variable overhead costs	\$130,500	\$120,000
5. Variable overhead costs per machine-hour (4 ÷ 3)	\$ 29.00	\$ 30.00
6. Variable overhead costs per output unit (4 ÷ 1)	\$ 13.05	\$ 12.00

As we saw in Chapter 7, the flexible budget enables Webb to highlight the differences between actual costs and actual quantities versus budgeted costs and budgeted quantities for the actual output level of 10,000 jackets.

### Flexible-Budget Analysis

The **variable overhead flexible-budget variance** measures the difference between actual variable overhead costs incurred and flexible-budget variable overhead amounts.

$$\begin{aligned}
 \text{Variable overhead flexible-budget variance} &= \text{Actual costs incurred} - \text{Flexible-budget amount} \\
 &= \$130,500 - \$120,000 \\
 &= \$10,500 \text{ U}
 \end{aligned}$$

This \$10,500 unfavorable flexible-budget variance means Webb’s actual variable overhead exceeded the flexible-budget amount by \$10,500 for the 10,000 jackets actually produced and sold. Webb’s managers would want to know why actual costs exceeded the flexible-budget amount. Did Webb use more machine-hours than planned to produce the 10,000 jackets? If so, was it because workers were less skilled than expected in using machines? Or did Webb spend more on variable overhead costs, such as maintenance?

Just as we illustrated in Chapter 7 with the flexible-budget variance for direct-cost items, Webb’s managers can get further insight into the reason for the \$10,500 unfavorable variance by subdividing it into the efficiency variance and spending variance.

### Variable Overhead Efficiency Variance

The **variable overhead efficiency variance** is the difference between actual quantity of the cost-allocation base used and budgeted quantity of the cost-allocation base that should have been used to produce actual output, multiplied by budgeted variable overhead cost per unit of the cost-allocation base.

$$\begin{aligned}
 \text{Variable overhead efficiency variance} &= \left( \begin{array}{l} \text{Actual quantity of} \\ \text{variable overhead} \\ \text{cost-allocation base} \\ \text{used for actual} \\ \text{output} \end{array} - \begin{array}{l} \text{Budgeted quantity of} \\ \text{variable overhead} \\ \text{cost-allocation base} \\ \text{allowed for} \\ \text{actual output} \end{array} \right) \times \begin{array}{l} \text{Budgeted variable} \\ \text{overhead cost per unit} \\ \text{of cost-allocation base} \end{array} \\
 &= (4,500 \text{ hours} - 0.40 \text{ hr./unit} \times 10,000 \text{ units}) \times \$30 \text{ per hour} \\
 &= (4,500 \text{ hours} - 4,000 \text{ hours}) \times \$30 \text{ per hour} \\
 &= \$15,000 \text{ U}
 \end{aligned}$$

**Decision Point**

How are budgeted variable overhead and fixed overhead cost rates calculated?

**Learning Objective 3**

Compute the variable overhead flexible-budget variance, . . . difference between actual variable overhead costs and flexible-budget variable overhead amounts

the variable overhead efficiency variance, . . . difference between actual quantity of cost-allocation base and budgeted quantity of cost-allocation base

and the variable overhead spending variance . . . difference between actual variable overhead cost rate and budgeted variable overhead cost rate

Columns 2 and 3 of Exhibit 8-1 depict the variable overhead efficiency variance. Note the variance arises solely because of the difference between actual quantity (4,500 hours) and budgeted quantity (4,000 hours) of the cost-allocation base. The variable overhead efficiency variance is computed the same way the efficiency variance for direct-cost items is (Chapter 7, pp. 236–239). However, the interpretation of the variance is quite different. Efficiency variances for direct-cost items are based on differences between actual inputs used and budgeted inputs allowed for actual output produced. For example, a forensic laboratory (the kind popularized by television shows such as *CSI* and *Dexter*) would calculate a direct labor efficiency variance based on whether the lab used more or fewer hours than the standard hours allowed for the actual number of DNA tests. In contrast, the efficiency variance for variable overhead cost is based on the efficiency with which *the cost-allocation base* is used. Webb's unfavorable variable overhead efficiency variance of \$15,000 means that the actual machine-hours (the cost-allocation base) of 4,500 hours turned out to be higher than the budgeted machine-hours of 4,000 hours allowed to manufacture 10,000 jackets.

The following table shows possible causes for Webb's actual machine-hours exceeding budgeted machine-hours and management's potential responses to each of these causes.

Possible Causes for Exceeding Budget	Potential Management Responses
1. Workers were less skilled than expected in using machines.	1. Encourage the human resources department to implement better employee-hiring practices and training procedures.
2. Production scheduler inefficiently scheduled jobs, resulting in more machine-hours used than budgeted.	2. Improve plant operations by installing production scheduling software.
3. Machines were not maintained in good operating condition.	3. Ensure preventive maintenance is done on all machines.
4. Webb's sales staff promised a distributor a rush delivery, which resulted in more machine-hours used than budgeted.	4. Coordinate production schedules with sales staff and distributors and share information with them.
5. Budgeted machine time standards were set too tight.	5. Commit more resources to develop appropriate standards.

Management would assess the cause(s) of the \$15,000 U variance in April 2011 and respond accordingly. Note how, depending on the cause(s) of the variance, corrective actions may need to be taken not just in manufacturing but also in other business functions of the value chain, such as sales and distribution.

### Exhibit 8-1

Columnar Presentation of Variable Overhead Variance Analysis: Webb Company for April 2011<sup>a</sup>

	Actual Costs Incurred: Actual Input Quantity × Actual Rate (1)	Actual Input Quantity × Budgeted Rate (2)	Flexible Budget: Budgeted Input Quantity Allowed for Actual Output × Budgeted Rate (3)
	(4,500 hrs. × \$29/hr.) = \$130,500	(4,500 hrs. × \$30/hr.) = \$135,000	(0.40 hr./unit × 10,000 units × \$30/hr.) 4,000 hrs. × \$30/hr. \$120,000
Level 3		\$4,500 F	\$15,000 U
		Spending variance	Efficiency variance
Level 2		\$10,500 U	
		Flexible-budget variance	

<sup>a</sup>F = favorable effect on operating income; U = unfavorable effect on operating income.

Webb's managers discovered that one reason the machines operated below budgeted efficiency levels in April 2011 was insufficient maintenance performed in the prior two months. A former plant manager delayed maintenance in a presumed attempt to meet monthly budget cost targets. As we discussed in Chapter 6, managers should not be focused on meeting short-run budget targets if they are likely to result in harmful long-run consequences. Webb is now strengthening its internal maintenance procedures so that failure to do monthly maintenance as needed will raise a "red flag" that must be immediately explained to management. Another reason for actual machine-hours exceeding budgeted machine-hours was the use of underskilled workers. As a result, Webb is initiating steps to improve hiring and training practices.

## Variable Overhead Spending Variance

The **variable overhead spending variance** is the difference between actual variable overhead cost per unit of the cost-allocation base and budgeted variable overhead cost per unit of the cost-allocation base, multiplied by the actual quantity of variable overhead cost-allocation base used for actual output.

$$\begin{aligned}
 \text{Variable overhead spending variance} &= \left( \begin{array}{cc} \text{Actual variable} & \text{Budgeted variable} \\ \text{overhead cost per unit} & \text{overhead cost per unit} \\ \text{of cost-allocation base} & \text{of cost-allocation base} \end{array} \right) \times \begin{array}{c} \text{Actual quantity of} \\ \text{variable overhead} \\ \text{cost-allocation base} \\ \text{used for actual output} \end{array} \\
 &= (\$29 \text{ per machine-hour} - \$30 \text{ per machine-hour}) \times 4,500 \text{ machine-hours} \\
 &= (-\$1 \text{ per machine-hour}) \times 4,500 \text{ machine-hours} \\
 &= \$4,500 \text{ F}
 \end{aligned}$$

Since Webb operated in April 2011 with a lower-than-budgeted variable overhead cost per machine-hour, there is a favorable variable overhead spending variance. Columns 1 and 2 in Exhibit 8-1 depict this variance.

To understand the favorable variable overhead spending variance and its implications, Webb's managers need to recognize why *actual* variable overhead cost per unit of the cost-allocation base (\$29 per machine-hour) is *lower* than the *budgeted* variable overhead cost per unit of the cost-allocation base (\$30 per machine-hour). Overall, Webb used 4,500 machine-hours, which is 12.5% greater than the flexible-budget amount of 4,000 machine hours. However, actual variable overhead costs of \$130,500 are only 8.75% greater than the flexible-budget amount of \$120,000. Thus, relative to the flexible budget, the percentage increase in actual variable overhead costs is *less* than the percentage increase in machine-hours. Consequently, actual variable overhead cost per machine-hour is lower than the budgeted amount, resulting in a favorable variable overhead spending variance.

Recall that variable overhead costs include costs of energy, machine maintenance, indirect materials, and indirect labor. Two possible reasons why the percentage increase in actual variable overhead costs is less than the percentage increase in machine-hours are as follows:

1. Actual prices of individual inputs included in variable overhead costs, such as the price of energy, indirect materials, or indirect labor, are lower than budgeted prices of these inputs. For example, the actual price of electricity may only be \$0.09 per kilowatt-hour, compared with a price of \$0.10 per kilowatt-hour in the flexible budget.
2. Relative to the flexible budget, the percentage increase in the actual usage of individual items in the variable overhead-cost pool is less than the percentage increase in machine-hours. Compared with the flexible-budget amount of 30,000 kilowatt-hours, suppose actual energy used is 32,400 kilowatt-hours, or 8% higher. The fact that this is a smaller percentage increase than the 12.5% increase in machine-hours (4,500 actual machine-hours versus a flexible budget of 4,000 machine hours) will lead to a favorable variable overhead spending variance. The favorable spending variance can be partially or completely traced to the efficient use of energy and other variable overhead items.

As part of the last stage of the five-step decision-making process, Webb's managers will need to examine the signals provided by the variable overhead variances to *evaluate performance and learn*. By understanding the reasons for these variances, Webb can take appropriate actions and make more precise predictions in order to achieve improved results in future periods.

For example, Webb's managers must examine why actual prices of variable overhead cost items are different from budgeted prices. The price effects could be the result of skillful negotiation on the part of the purchasing manager, oversupply in the market, or lower quality of inputs such as indirect materials. Webb's response depends on what is believed to be the cause of the variance. If the concerns are about quality, for instance, Webb may want to put in place new quality management systems.

Similarly, Webb's managers should understand the possible causes for the efficiency with which variable overhead resources are used. These causes include skill levels of workers, maintenance of machines, and the efficiency of the manufacturing process. Webb's managers discovered that Webb used fewer supervision resources per machine-hour because of manufacturing process improvements. As a result, they began organizing crossfunctional teams to see if more process improvements could be achieved.

We emphasize that a favorable variable overhead spending variance is not always desirable. For example, the variable overhead spending variance would be favorable if Webb's managers purchased lower-priced, poor-quality indirect materials, hired less-talented supervisors, or performed less machine maintenance. These decisions, however, are likely to hurt product quality and harm the long-run prospects of the business.

To clarify the concepts of variable overhead efficiency variance and variable overhead spending variance, consider the following example. Suppose that (a) energy is the only item of variable overhead cost and machine-hours is the cost-allocation base; (b) actual machine-hours used equals the number of machine hours under the flexible budget; and (c) the actual price of energy equals the budgeted price. From (a) and (b), it follows that there is no efficiency variance — the company has been efficient with respect to the number of machine-hours (the cost-allocation base) used to produce the actual output. However, and despite (c), there could still be a spending variance. Why? Because even though the company used the correct number of machine hours, the energy consumed *per machine hour* could be higher than budgeted (for example, because the machines have not been maintained correctly). The cost of this higher energy usage would be reflected in an unfavorable spending variance.

## Journal Entries for Variable Overhead Costs and Variances

We now prepare journal entries for Variable Overhead Control and the contra account Variable Overhead Allocated.

Entries for variable overhead for April 2011 (data from Exhibit 8-1) are as follows:

1. Variable Overhead Control	130,500	
Accounts Payable and various other accounts		130,500
To record actual variable overhead costs incurred.		
2. Work-in-Process Control	120,000	
Variable Overhead Allocated		120,000
To record variable overhead cost allocated		
(0.40 machine-hour/unit × 10,000 units × \$30/machine-hour). (The costs accumulated in Work-in-Process Control are transferred to Finished Goods Control when production is completed and to Cost of Goods Sold when the products are sold.)		
3. Variable Overhead Allocated	120,000	
Variable Overhead Efficiency Variance	15,000	
Variable Overhead Control		130,500
Variable Overhead Spending Variance		4,500
To record variances for the accounting period.		

These variances are the underallocated or overallocated variable overhead costs. At the end of the fiscal year, the variance accounts are written off to cost of goods sold if immaterial in amount. If the variances are material in amount, they are prorated among Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold on the basis of the variable overhead allocated to these accounts, as described in Chapter 4, pages 117–122. As we discussed in Chapter 7, only unavoidable costs are prorated. Any part of the variances attributable to avoidable inefficiency are written off in the period. Assume that the balances in the variable overhead variance accounts as of April 2011 are also the balances at the end of the 2011 fiscal year and are immaterial in amount. The following journal entry records the write-off of the variance accounts to cost of goods sold:

Cost of Goods Sold	10,500	
Variable Overhead Spending Variance	4,500	
Variable Overhead Efficiency Variance		15,000

We next consider fixed overhead cost variances.

## Fixed Overhead Cost Variances

The flexible-budget amount for a fixed-cost item is also the amount included in the static budget prepared at the start of the period. No adjustment is required for differences between actual output and budgeted output for fixed costs, because fixed costs are unaffected by changes in the output level within the relevant range. At the start of 2011, Webb budgeted fixed overhead costs to be \$276,000 per month. The actual amount for April 2011 turned out to be \$285,000. The **fixed overhead flexible-budget variance** is the difference between actual fixed overhead costs and fixed overhead costs in the flexible budget:

$$\begin{aligned} \text{Fixed overhead flexible-budget variance} &= \text{Actual costs incurred} - \text{Flexible-budget amount} \\ &= \$285,000 - \$276,000 \\ &= \$9,000 \text{ U} \end{aligned}$$

The variance is unfavorable because \$285,000 actual fixed overhead costs exceed the \$276,000 budgeted for April 2011, which decreases that month's operating income by \$9,000.

The variable overhead flexible-budget variance described earlier in this chapter was subdivided into a spending variance and an efficiency variance. There is not an efficiency variance for fixed overhead costs. That's because a given lump sum of fixed overhead costs will be unaffected by how efficiently machine-hours are used to produce output in a given budget period. As we will see later on, this does not mean that a company cannot be efficient or inefficient in its use of fixed-overhead-cost resources. As Exhibit 8-2 shows, because there is no efficiency variance, the **fixed overhead spending variance** is the same amount as the fixed overhead flexible-budget variance:

$$\begin{aligned} \text{Fixed overhead spending variance} &= \text{Actual costs incurred} - \text{Flexible-budget amount} \\ &= \$285,000 - \$276,000 \\ &= \$9,000 \text{ U} \end{aligned}$$

Reasons for the unfavorable spending variance could be higher plant-leasing costs, higher depreciation on plant and equipment, or higher administrative costs, such as a higher-than-budgeted salary paid to the plant manager. Webb investigated this variance and found that there was a \$9,000 per month unexpected increase in its equipment-leasing costs. However, management concluded that the new lease rates were competitive with lease rates available elsewhere. If this were not the case, management would look to lease equipment from other suppliers.

### Decision Point

What variances can be calculated for variable overhead costs?

### Learning Objective 4

Compute the fixed overhead flexible-budget variance,

... difference between actual fixed overhead costs and flexible-budget fixed overhead amounts

the fixed overhead spending variance,

... same as the preceding explanation

and the fixed overhead production-volume variance

... difference between budgeted fixed overhead and fixed overhead allocated on the basis of actual output produced

**Exhibit 8-2**Columnar Presentation of Fixed Overhead Variance Analysis: Webb Company for April 2011<sup>a</sup>

	Actual Costs Incurred (1)	Flexible Budget: Same Budgeted Lump Sum (as in Static Budget) Regardless of Output Level (2)	Allocated: Budgeted Input Quantity Allowed for Actual Output × Budgeted Rate (3)
			(0.40 hr./unit × 10,000 units × \$57.50/hr.) (4,000 hrs. × \$57.50/hr.)
	\$285,000	\$276,000	\$230,000
Level 3	↑	↑	↑
	9,000 U		\$46,000 U
	Spending variance		Production-volume variance
Level 2	↑	↑	
	\$9,000 U		
	Flexible-budget variance		

<sup>a</sup>F = favorable effect on operating income; U = unfavorable effect on operating income.

## Production-Volume Variance

We now examine a variance—the production-volume variance—that arises only for fixed costs. Recall that at the start of the year, Webb calculated a budgeted fixed overhead rate of \$57.50 per machine hour. Under standard costing, Webb's budgeted fixed overhead costs are allocated to actual output produced during the period at the rate of \$57.50 per standard machine-hour, equivalent to a rate of \$23 per jacket (0.40 machine-hour per jacket × \$57.50 per machine-hour). If Webb produces 1,000 jackets, \$23,000 (\$23 per jacket × 1,000 jackets) out of April's budgeted fixed overhead costs of \$276,000 will be allocated to the jackets. If Webb produces 10,000 jackets, \$230,000 (\$23 per jacket × 10,000 jackets) will be allocated. Only if Webb produces 12,000 jackets (that is, operates at capacity), will all \$276,000 (\$23 per jacket × 12,000 jackets) of the budgeted fixed overhead cost be allocated to the jacket output. The key point here is that even though Webb budgets fixed overhead costs to be \$276,000, it does not necessarily allocate all these costs to output. The reason is that Webb budgets \$276,000 of fixed costs to support its planned production of 12,000 jackets. If Webb produces fewer than 12,000 jackets, it only allocates the budgeted cost of capacity actually needed and used to produce the jackets.

The **production-volume variance**, also referred to as the **denominator-level variance**, is the difference between budgeted fixed overhead and fixed overhead allocated on the basis of actual output produced. The allocated fixed overhead can be expressed in terms of allocation-base units (machine-hours for Webb) or in terms of the budgeted fixed cost per unit:

$$\begin{aligned}
 \text{Production volume variance} &= \text{Budgeted fixed overhead} - \text{Fixed overhead allocated for actual output units produced} \\
 &= \$276,000 - (0.40 \text{ hour per jacket} \times \$57.50 \text{ per hour} \times 10,000 \text{ jackets}) \\
 &= \$276,000 - (\$23 \text{ per jacket} \times 10,000 \text{ jackets}) \\
 &= \$276,000 - \$230,000 \\
 &= \$46,000 \text{ U}
 \end{aligned}$$

As shown in Exhibit 8-2, the budgeted fixed overhead (\$276,000) will be the lump sum shown in the static budget and also in any flexible budget within the relevant range. Fixed overhead allocated (\$230,000) is the amount of fixed overhead costs allocated; it is calculated by multiplying the number of output units produced during the budget period (10,000 units) by the budgeted cost per output unit (\$23). The \$46,000 U production-volume variance can

also be thought of as \$23 per jacket  $\times$  2,000 jackets that were *not* produced (12,000 jackets planned – 10,000 jackets produced). We will explore possible causes for the unfavorable production-volume variance and its management implications in the following section.

Exhibit 8-3 is a graphic presentation of the production-volume variance. Exhibit 8-3 shows that for planning and control purposes, fixed (manufacturing) overhead costs do not change in the 0- to 12,000-unit relevant range. Contrast this behavior of fixed costs with how these costs are depicted for the inventory costing purpose in Exhibit 8-3. Under generally accepted accounting principles, fixed (manufacturing) overhead costs are allocated as an inventoriable cost to the output units produced. Every output unit that Webb manufactures will increase the fixed overhead allocated to products by \$23. That is, for purposes of allocating fixed overhead costs to jackets, these costs are viewed *as if* they had a variable-cost behavior pattern. As the graph in Exhibit 8-3 shows, the difference between the fixed overhead costs budgeted of \$276,000 and the \$230,000 of costs allocated is the \$46,000 unfavorable production-volume variance.

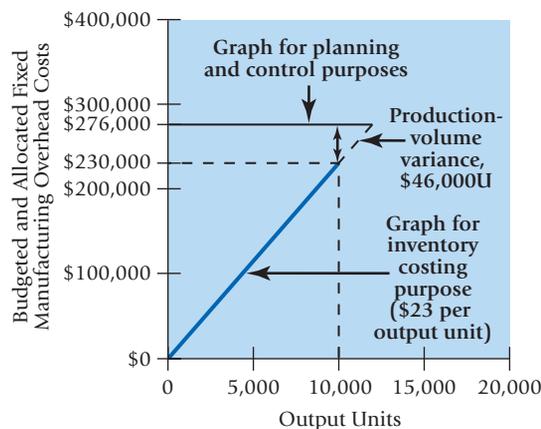
Managers should always be careful to distinguish the true behavior of fixed costs from the manner in which fixed costs are assigned to products. In particular, while fixed costs are unitized and allocated for inventory costing purposes in a certain way, as described previously, managers should be wary of using the same unitized fixed overhead costs for planning and control purposes. When forecasting fixed costs, managers should concentrate on total lump-sum costs. Similarly, when managers are looking to assign costs for control purposes or identify the best way to use capacity resources that are fixed in the short run, we will see in Chapters 9 and Chapter 11 that the use of unitized fixed costs often leads to incorrect decisions.

## Interpreting the Production-Volume Variance

Lump-sum fixed costs represent costs of acquiring capacity that do not decrease automatically if the resources needed turn out to be less than the resources acquired. Sometimes costs are fixed for a specific time period for contractual reasons, such as an annual lease contract for a plant. At other times, costs are fixed because capacity has to be acquired or disposed of in fixed increments, or lumps. For example, suppose that acquiring a sewing machine gives Webb the ability to produce 1,000 jackets. Then, if it is not possible to buy or lease a fraction of a machine, Webb can add capacity only in increments of 1,000 jackets. That is, Webb may choose capacity levels of 10,000; 11,000; or 12,000 jackets, but nothing in between.

Webb's management would want to analyze why this overcapacity occurred. Is demand weak? Should Webb reevaluate its product and marketing strategies? Is there a quality problem? Or did Webb make a strategic mistake by acquiring too much capacity? The causes of the \$46,000 unfavorable production-volume variance will drive the actions Webb's managers will take in response to this variance.

In contrast, a favorable production-volume variance indicates an overallocation of fixed overhead costs. That is, the overhead costs allocated to the actual output produced exceed the budgeted fixed overhead costs of \$276,000. The favorable production-volume variance comprises the fixed costs recorded in excess of \$276,000.



### Exhibit 8-3

Behavior of Fixed Manufacturing Overhead Costs: Budgeted for Planning and Control Purposes and Allocated for Inventory Costing Purposes for Webb Company for April 2011

Be careful when drawing conclusions regarding a company's decisions about capacity planning and usage from the type (that is, favorable, F, or unfavorable, U) or the magnitude associated with a production-volume variance. To interpret the \$46,000 unfavorable variance, Webb should consider why it sold only 10,000 jackets in April. Suppose a new competitor had gained market share by pricing below Webb's selling price. To sell the budgeted 12,000 jackets, Webb might have had to reduce its own selling price on all 12,000 jackets. Suppose it decided that selling 10,000 jackets at a higher price yielded higher operating income than selling 12,000 jackets at a lower price. The production-volume variance does not take into account such information. The failure of the production-volume variance to consider such information is why Webb should not interpret the \$46,000 U amount as the total economic cost of selling 2,000 jackets fewer than the 12,000 jackets budgeted. If, however, Webb's managers anticipate they will not need capacity beyond 10,000 jackets, they may reduce the excess capacity, say, by canceling the lease on some of the machines.

Companies plan their plant capacity strategically on the basis of market information about how much capacity will be needed over some future time horizon. For 2011, Webb's budgeted quantity of output is equal to the maximum capacity of the plant for that budget period. Actual demand (and quantity produced) turned out to be below the budgeted quantity of output, so Webb reports an unfavorable production-volume variance for April 2011. However, it would be incorrect to conclude that Webb's management made a poor planning decision regarding plant capacity. Demand for Webb's jackets might be highly uncertain. Given this uncertainty and the cost of not having sufficient capacity to meet sudden demand surges (including lost contribution margins as well as reduced repeat business), Webb's management may have made a wise choice in planning 2011 plant capacity. Of course, if demand is unlikely to pick up again, Webb's managers may look to cancel the lease on some of the machines or to sublease the machines to other parties with the goal of reducing the unfavorable production-volume variance.

Managers must always explore the why of a variance before concluding that the label unfavorable or favorable necessarily indicates, respectively, poor or good management performance. Understanding the reasons for a variance also helps managers decide on future courses of action. Should Webb's managers try to reduce capacity, increase sales, or do nothing? Based on their analysis of the situation, Webb's managers decided to reduce some capacity but continued to maintain some excess capacity to accommodate unexpected surges in demand. Chapter 9 and Chapter 13 examine these issues in more detail. The Concepts in Action feature on page 280 highlights another example of managers using variances, and the reasons behind them, to help guide their decisions.

Next we describe the journal entries Webb would make to record fixed overhead costs using standard costing.

## Journal Entries for Fixed Overhead Costs and Variances

We illustrate journal entries for fixed overhead costs for April 2011 using Fixed Overhead Control and the contra account Fixed Overhead Allocated (data from Exhibit 8-2).

1. Fixed Overhead Control	285,000	
Salaries Payable, Accumulated Depreciation, and various other accounts		285,000
To record actual fixed overhead costs incurred.		
2. Work-in-Process Control	230,000	
Fixed Overhead Allocated		230,000
To record fixed overhead costs allocated		
(0.40 machine-hour/unit × 10,000 units × \$57.50/machine-hour). (The costs accumulated in Work-in-Process Control are transferred to Finished Goods Control when production is completed and to Cost of Goods Sold when the products are sold.)		
3. Fixed Overhead Allocated	230,000	
Fixed Overhead Spending Variance	9,000	
Fixed Overhead Production-Volume Variance	46,000	
Fixed Overhead Control		285,000
To record variances for the accounting period.		

Overall, \$285,000 of fixed overhead costs were incurred during April, but only \$230,000 were allocated to jackets. The difference of \$55,000 is precisely the underallocated fixed overhead costs that we introduced when studying normal costing in Chapter 4. The third entry illustrates how the fixed overhead spending variance of \$9,000 and the fixed overhead production-volume variance of \$46,000 together record this amount in a standard costing system.

At the end of the fiscal year, the fixed overhead spending variance is written off to cost of goods sold if it is immaterial in amount, or prorated among Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold on the basis of the fixed overhead allocated to these accounts as described in Chapter 4, pages 117–122. Some companies combine the write-off and proration methods—that is, they write off the portion of the variance that is due to inefficiency and could have been avoided and prorate the portion of the variance that is unavoidable. Assume that the balance in the Fixed Overhead Spending Variance account as of April 2011 is also the balance at the end of 2011 and is immaterial in amount. The following journal entry records the write-off to Cost of Goods Sold.

Cost of Goods Sold	9,000	
Fixed Overhead Spending Variance		9,000

We now consider the production-volume variance. Assume that the balance in Fixed Overhead Production-Volume Variance as of April 2011 is also the balance at the end of 2011. Also assume that some of the jackets manufactured during 2011 are in work-in-process and finished goods inventory at the end of the year. Many management accountants make a strong argument for writing off to Cost of Goods Sold and not prorating an unfavorable production-volume variance. Proponents of this argument contend that the unfavorable production-volume variance of \$46,000 measures the cost of resources expended for 2,000 jackets that were not produced ( $\$23 \text{ per jacket} \times 2,000 \text{ jackets} = \$46,000$ ). Prorating these costs would inappropriately allocate fixed overhead costs incurred for the 2,000 jackets that were not produced to the jackets that were produced. The jackets produced already bear their representative share of fixed overhead costs of \$23 per jacket. Therefore, this argument favors charging the unfavorable production-volume variance against the year's revenues so that fixed costs of unused capacity are not carried in work-in-process inventory and finished goods inventory.

There is, however, an alternative view. This view regards the denominator level chosen as a “soft” rather than a “hard” measure of the fixed resources required and needed to produce each jacket. Suppose that either because of the design of the jacket or the functioning of the machines, it took more machine-hours than previously thought to manufacture each jacket. Consequently, Webb could make only 10,000 jackets rather than the planned 12,000 in April. In this case, the \$276,000 of budgeted fixed overhead costs support the production of the 10,000 jackets manufactured. Under this reasoning, prorating the fixed overhead production-volume variance would appropriately spread fixed overhead costs among Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold.

What about a favorable production-volume variance? Suppose Webb manufactured 13,800 jackets in April 2011.

$$\begin{aligned}
 \text{Production-volume variance} &= \text{Budgeted fixed overhead} - \text{Fixed overhead allocated using} \\
 &\quad \text{budgeted cost per output unit overhead} - \text{allowed for actual output produced} \\
 &= \$276,000 - (\$23 \text{ per jacket} \times 13,800 \text{ jackets}) \\
 &= \$276,000 - \$317,400 = \$41,400 \text{ F}
 \end{aligned}$$

Because actual production exceeded the planned capacity level, clearly the fixed overhead costs of \$276,000 supported production of, and so should be allocated to, all 13,800 jackets. Prorating the favorable production-volume variance achieves this outcome and reduces the amounts in Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold. Proration is also the more conservative approach in the sense that it results in a lower

operating income than if the entire favorable production-volume variance were credited to Cost of Goods Sold.

One more point is relevant to the discussion of whether to prorate the production-volume variance or to write it off to cost of goods sold. If variances are always written off to cost of goods sold, a company could set its standards to either increase (for financial reporting purposes) or decrease (for tax purposes) operating income. In other words, always writing off variances invites gaming behavior. For example, Webb could generate a favorable (unfavorable) production-volume variance by setting the denominator level used to allocate fixed overhead costs low (high) and thereby increase (decrease) operating income. The proration method has the effect of approximating the allocation of fixed costs based on actual costs and actual output so it is not susceptible to the manipulation of operating income via the choice of the denominator level.

There is no clear-cut or preferred approach for closing out the production-volume variance. The appropriate accounting procedure is a matter of judgment and depends on the circumstances of each case. Variations of the proration method may be desirable. For example, a company may choose to write off a portion of the production-volume variance and prorate the rest. The goal is to write off that part of the production-volume variance that represents the cost of capacity not used to support the production of output during the period. The rest of the production-volume variance is prorated to Work-in-Process Control, Finished Goods Control, and Cost of Goods Sold.

If Webb were to write off the production-volume variance to cost of goods sold, it would make the following journal entry.

Cost of Goods Sold	46,000
Fixed Overhead Production-Volume Variance	46,000

### Decision Point

What variances can be calculated for fixed overhead costs?

## Learning Objective 5

Show how the 4-variance analysis approach reconciles the actual overhead incurred with the overhead amounts allocated during the period

... the 4-variance analysis approach identifies spending and efficiency variances for variable overhead costs and spending and production-volume variances for fixed overhead costs

## Integrated Analysis of Overhead Cost Variances

As our discussion indicates, the variance calculations for variable overhead and fixed overhead differ:

- Variable overhead has no production-volume variance.
- Fixed overhead has no efficiency variance.

Exhibit 8-4 presents an integrated summary of the variable overhead variances and the fixed overhead variances computed using standard costs for April 2011. Panel A shows the variances for variable overhead, while Panel B contains the fixed overhead variances. As you study Exhibit 8-4, note how the columns in Panels A and B are aligned to measure the different variances. In both Panels A and B,

- the difference between columns 1 and 2 measures the spending variance.
- the difference between columns 2 and 3 measures the efficiency variance (if applicable).
- the difference between columns 3 and 4 measures the production-volume variance (if applicable).

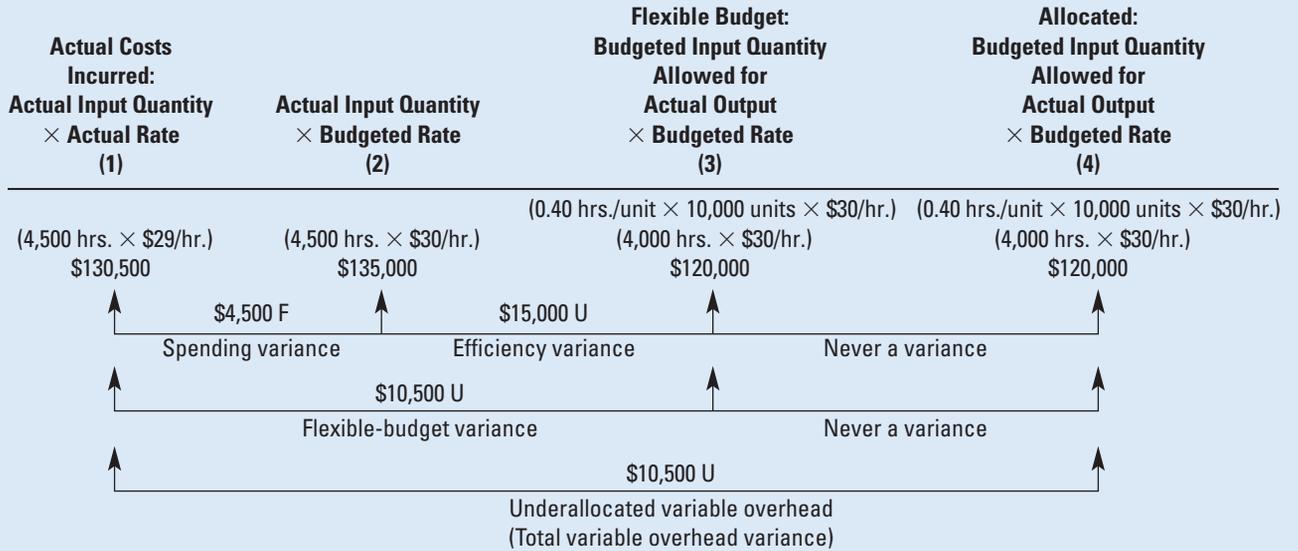
Panel A contains an efficiency variance; Panel B has no efficiency variance for fixed overhead. As discussed earlier, a lump-sum amount of fixed costs will be unaffected by the degree of operating efficiency in a given budget period.

Panel A does not have a production-volume variance, because the amount of variable overhead allocated is always the same as the flexible-budget amount. Variable costs never have any unused capacity. When production and sales decline from 12,000 jackets to 10,000 jackets, budgeted variable overhead costs proportionately decline. Fixed costs are different. Panel B has a production-volume variance (see Exhibit 8-3) because Webb had to acquire the fixed manufacturing overhead resources it had committed to when it planned production of 12,000 jackets, even though it produced only 10,000 jackets and did not use some of its capacity.

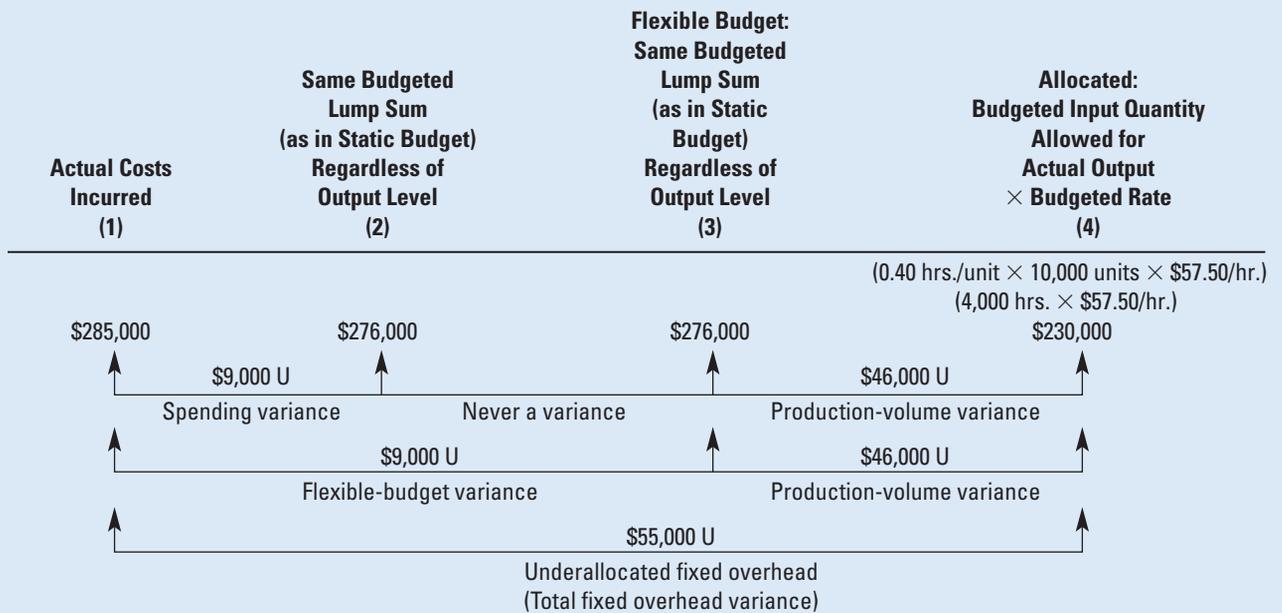
**Exhibit 8-4**

Columnar Presentation of Integrated Variance Analysis: Webb Company for April 2011<sup>a</sup>

**PANEL A: Variable (Manufacturing) Overhead**



**PANEL B: Fixed (Manufacturing) Overhead**



<sup>a</sup>F = favorable effect on operating income; U = unfavorable effect on operating income.

**4-Variance Analysis**

When all of the overhead variances are presented together as in Exhibit 8-4, we refer to it as a 4-variance analysis:

	4-Variance Analysis		
	Spending Variance	Efficiency Variance	Production-Volume Variance
Variable overhead	\$4,500 F	\$15,000 U	Never a variance
Fixed overhead	\$9,000 U	Never a variance	\$46,000 U

Note that the 4-variance analysis provides the same level of information as the variance analysis carried out earlier for variable overhead and fixed overhead separately (in Exhibits 8-1 and 8-2, respectively), but it does so in a unified presentation that also indicates those variances that are never present.

As with other variances, the variances in Webb's 4-variance analysis are not necessarily independent of each other. For example, Webb may purchase lower-quality machine fluids (leading to a favorable variable overhead spending variance), which results in the machines taking longer to operate than budgeted (causing an unfavorable variable overhead efficiency variance), and producing less than budgeted output (causing an unfavorable production-volume variance).

## Combined Variance Analysis

Detailed 4-variance analyses are most common in large, complex businesses, because it is impossible for managers at large companies, such as General Electric and Disney, to keep track of all that is happening within their areas of responsibility. The detailed analyses help managers identify and focus attention on the areas not operating as expected. Managers of small businesses understand their operations better based on personal observations and nonfinancial measures. They find less value in doing the additional measurements required for 4-variance analyses. For example, to simplify their costing systems, small companies may not distinguish variable overhead incurred from fixed overhead incurred because making this distinction is often not clear-cut. As we saw in Chapter 2 and will see in Chapter 10, many costs such as supervision, quality control, and materials handling have both variable- and fixed-cost components that may not be easy to separate. Managers may therefore use a less detailed analysis that *combines* the variable overhead and fixed overhead into a single total overhead.

When a single total overhead cost category is used, it can still be analyzed in depth. The variances are now the sums of the variable overhead and fixed overhead variances for that level, as computed in Exhibit 8-4. The combined variance analysis looks as follows:

Combined 3-Variance Analysis			
	Spending Variance	Efficiency Variance	Production-Volume Variance
Total overhead	\$4,500 U	\$15,000 U	\$46,000 U

The accounting for 3-variance analysis is simpler than for 4-variance analysis, but some information is lost. In particular, the 3-variance analysis combines the variable and fixed overhead spending variances into a single total overhead spending variance.

Finally, the overall **total-overhead variance** is given by the sum of the preceding variances. In the Webb example, this equals \$65,500 U. Note that this amount, which aggregates the flexible-budget and production-volume variances, equals the total amount of underallocated (or underapplied) overhead costs. (Recall our discussion of underallocated overhead costs in normal costing from Chapter 4, page 118.) Using figures from Exhibit 8-4, the \$65,500 U total-overhead variance is the difference between (a) the total actual overhead incurred ( $\$130,500 + \$285,000 = \$415,500$ ) and (b) the overhead allocated ( $\$120,000 + \$230,000 = \$350,000$ ) to the actual output produced. If the total-overhead variance were favorable, it would have corresponded instead to the amount of overapplied overhead costs.

### Decision Point

What is the most detailed way for a company to reconcile actual overhead incurred with the amount allocated during a period?

## Production-Volume Variance and Sales-Volume Variance

As we complete our study of variance analysis for Webb Company, it is helpful to step back to see the “big picture” and to link the accounting and performance evaluation functions of standard costing. Exhibit 7-2, page 231, subdivided the static-budget variance of \$93,100 U into a flexible-budget variance of \$29,100 U and a sales-volume variance of \$64,000 U. In both Chapter 7 and this chapter, we presented more detailed variances that subdivided, whenever possible, individual flexible-budget variances for

selling price, direct materials, direct manufacturing labor, variable overhead, and fixed overhead. Here is a summary:

Selling price	\$50,000 F
Direct materials (Price, \$44,400 F + Efficiency, \$66,000 U)	21,600 U
Direct manufacturing labor (Price, \$18,000 U + Efficiency, \$20,000 U)	38,000 U
Variable overhead (Spending, \$4,500 F + Efficiency, \$15,000 U)	10,500 U
Fixed overhead (Spending, \$9,000 U)	<u>9,000 U</u>
Total flexible budget variance	<u>\$29,100 U</u>

We also calculated one other variance in this chapter, the production-volume variance, which is not part of the flexible-budget variance. Where does the production-volume variance fit into the “big picture”? As we shall see, the production-volume variance is a component of the sales-volume variance.

Under our assumption of actual production and sales of 10,000 jackets, Webb’s costing system debits to Work-in-Process Control the standard costs of the 10,000 jackets produced. These amounts are then transferred to Finished Goods and finally to Cost of Goods Sold:

Direct materials (Chapter 7, p. 240, entry 1b)	
(\$60 per jacket × 10,000 jackets)	\$ 600,000
Direct manufacturing labor (Chapter 7, p. 240, entry 2)	
(\$16 per jacket × 10,000 jackets)	160,000
Variable overhead (Chapter 8, p. 270, entry 2)	
(\$12 per jacket × 10,000 jackets)	120,000
Fixed overhead (Chapter 8, p. 274, entry 2)	
(\$23 per jacket × 10,000 jackets)	<u>230,000</u>
Cost of goods sold at standard cost	
(\$111 per jacket × 10,000 jackets)	<u>\$1,110,000</u>

Webb’s costing system also records the revenues from the 10,000 jackets sold at the budgeted selling price of \$120 per jacket. The net effect of these entries on Webb’s budgeted operating income is as follows:

Revenues at budgeted selling price	
(\$120 per jacket × 10,000 jackets)	\$1,200,000
Cost of goods sold at standard cost	
(\$111 per jacket × 10,000 jackets)	<u>1,110,000</u>
Operating income based on budgeted profit per jacket	
(\$9 per jacket × 10,000 jackets)	<u>\$ 90,000</u>

*A crucial point to keep in mind is that in standard costing, fixed overhead cost is treated as if it is a variable cost.* That is, in determining the budgeted operating income of \$90,000, only \$230,000 (\$23 per jacket × 10,000 jackets) of fixed overhead is considered, whereas the budgeted fixed overhead costs are \$276,000. Webb’s accountants then record the \$46,000 unfavorable production-volume variance (the difference between budgeted fixed overhead costs, \$276,000, and allocated fixed overhead costs, \$230,000, p. 274, entry 2), as well as the various flexible-budget variances (including the fixed overhead spending variance) that total \$29,100 unfavorable (see Exhibit 7-2, p. 231). This results in actual operating income of \$14,900 as follows:

Operating income based on budgeted profit per jacket	
(\$9 per jacket × 10,000 jackets)	\$ 90,000
Unfavorable production-volume variance	<u>(46,000)</u>
Flexible-budget operating income (Exhibit 7-2)	44,000
Unfavorable flexible-budget variance for operating income (Exhibit 7-2)	<u>(29,100)</u>
Actual operating income (Exhibit 7-2)	<u>\$ 14,900</u>

## Learning Objective 6

Explain the relationship between the sales-volume variance and the production-volume variance

... the production-volume and operating-income volume variances together comprise the sales-volume variance

## Concepts in Action

### Variance Analysis and Standard Costing Help Sandoz Manage Its Overhead Costs



In the United States, the importance of generic pharmaceuticals is growing dramatically. In recent years, Wal-Mart has been selling hundreds of generic drugs for \$4 per prescription, a price many competitors have since matched. Moreover, with recent legislation extending health insurance coverage to 32 million previously uninsured Americans, the growing use of generic drugs is certain to accelerate, a trend rooted both in demographics—the aging U.S. population takes more drugs each year—and in the push to cut health care costs.

Sandoz US, a \$7.5 billion subsidiary of Swiss-based Novartis AG, is one of the largest developers of generic pharmaceutical substitutes for market-leading therapeutic drugs. Market pricing pressure means that Sandoz, Teva Pharmaceutical, and other generic manufacturers operate on razor-thin margins. As a result, along with an intricate analysis of direct-cost variances, firms like Sandoz must also tackle the challenge of accounting for overhead costs. Sandoz uses standard costing and variance analysis to manage its overhead costs.

Each year, Sandoz prepares an overhead budget based on a detailed production plan, planned overhead spending, and other factors, including inflation, efficiency initiatives, and anticipated capital expenditures and

depreciation. Sandoz then uses activity-based costing techniques to assign budgeted overhead costs to different work centers (for example, mixing, blending, tableting, testing, and packaging). Finally, overhead costs are assigned to products based on the activity levels required by each product at each work center. The resulting standard product cost is used in product profitability analysis and as a basis for making pricing decisions. The two main focal points in Sandoz's performance analyses are overhead absorption analysis and manufacturing overhead variance analysis.

Each month, Sandoz uses absorption analysis to compare actual production and actual costs to the standard costs of processed inventory. The monthly analysis evaluates two key trends:

1. Are costs in line with the budget? If not, the reasons are examined and the accountable managers are notified.
2. Are production volume and product mix conforming to plan? If not, Sandoz reviews and adjusts machine capacities and the absorption trend is deemed to be permanent. Plant management uses absorption analysis as a compass to determine if it is on budget and has an appropriate capacity level to efficiently satisfy the needs of its customers.

Manufacturing overhead variances are examined at the work center level. These variances help determine when equipment is not running as expected, which leads to repair or replacement. Variances also help in identifying inefficiencies in processing and setup and cleaning times, which leads to more efficient ways to use equipment. Sometimes, manufacturing overhead variance analysis leads to the review and improvement of the standards themselves—a critical element in planning the level of plant capacity. Management reviews current and future capacity use on a monthly basis, using standard hours entered into the plan's enterprise resource planning system. The standards are a useful tool in identifying capacity constraints and future capital needs.

As the plant controller remarked, "Standard costing at Sandoz produces costs that are not only understood by management accountants and industrial engineers, but by decision makers in marketing and on the production floor. Management accountants at Sandoz achieve this by having a high degree of process understanding and involvement. The result is better pricing and product mix decisions, lower waste, process improvements, and efficient capacity choices—all contributing to overall profitability."

*Source: Booming US Generic Drug Market. Delhi, India: RNCOS Ltd, 2010; Conversations with, and documents prepared by, Eric Evans and Erich Erchr (of Sandoz US), 2004; Day, Kathleen. 2006. Wal-Mart sets \$4 price for many generic drugs. *Washington Post*, September 22; Halpern, Steven. 2010. Teva: Generic gains from health care reform. *AOL Inc.* "Blogging Stocks" blog, May 13. <http://www.bloggingstocks.com/2010/05/13/teva-teva-generic-gains-from-healthcare-reform/>*

In contrast, the static-budget operating income of \$108,000 (p. 229) is not entered in Webb's costing system, because standard costing records budgeted revenues, standard costs, and variances only for the 10,000 jackets actually produced and sold, not for the 12,000 jackets that were *planned* to be produced and sold. As a result, the sales-volume variance of \$64,000 U, which is the difference between static-budget operating income,

\$108,000, and flexible-budget operating income, \$44,000 (Exhibit 7-2, p. 231), is never actually recorded in standard costing. Nevertheless, the sales-volume variance is useful because it helps managers understand the lost contribution margin from selling 2,000 fewer jackets (the sales-volume variance assumes fixed costs remain at the budgeted level of \$276,000).

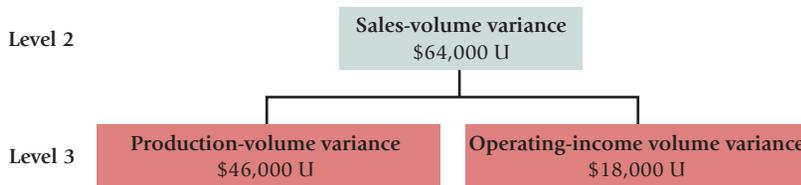
The sales-volume variance has two components. They are as follows:

1. A difference between the static-budget operating income of \$108,000 for 12,000 jackets and budgeted operating income of \$90,000 for 10,000 jackets. This is the **operating-income volume variance** of \$18,000 U (\$108,000 – \$90,000), and reflects the fact that Webb produced and sold 2,000 fewer units than budgeted.
2. A difference between the budgeted operating income of \$90,000 and the flexible budget operating income of \$44,000 (Exhibit 7-2, p. 231) for the 10,000 actual units. This difference arises because Webb’s costing system treats fixed costs as if they behave in a variable manner and so assumes fixed costs equal the allocated amount of \$230,000, rather than the budgeted fixed costs of \$276,000. Of course, the difference between the allocated and budgeted fixed costs is precisely the production-volume variance of \$46,000 U.

In summary, we have the following:

	Operating-income volume variance	\$18,000 U
(+)	Production-volume variance	<u>46,000 U</u>
Equals	Sales-volume variance	<u>\$64,000 U</u>

That is, the sales-volume variance is comprised of operating-income volume and production-volume variances.



**Decision Point**

What is the relationship between the sales-volume variance and the production-volume variance?

## Variance Analysis and Activity-Based Costing

Activity-based costing (ABC) systems focus on individual activities as the fundamental cost objects. ABC systems classify the costs of various activities into a cost hierarchy—output unit-level costs, batch-level costs, product-sustaining costs, and facility-sustaining costs (see p. 149). In this section, we show how a company that has an ABC system and batch-level costs can benefit from variance analysis. Batch-level costs are the costs of activities related to a group of units of products or services rather than to each individual unit of product or service. We illustrate variance analysis for variable batch-level direct costs and fixed batch-level setup overhead costs.<sup>4</sup>

Consider Lyco Brass Works, which manufactures many different types of faucets and brass fittings. Because of the wide range of products it produces, Lyco uses an activity-based costing system. In contrast, Webb uses a simple costing system because it makes only one type of jacket. One of Lyco’s products is Elegance, a decorative brass faucet for home spas. Lyco produces Elegance in batches.

For each product Lyco makes, it uses dedicated materials-handling labor to bring materials to the production floor, transport work in process from one work center to the next, and take the finished goods to the shipping area. Therefore, materials-handling labor costs for Elegance are direct costs of Elegance. Because the materials for a batch are moved together, materials-handling labor costs vary with number of batches rather than with number of units in a batch. Materials-handling labor costs are variable direct batch-level costs.

**Learning Objective 7**

Calculate variances in activity-based costing  
 . . . compare budgeted and actual overhead costs of activities

<sup>4</sup> The techniques we demonstrate can be applied to analyze variable batch-level overhead costs as well.

To manufacture a batch of Elegance, Lyco must set up the machines and molds. Setting up the machines and molds requires highly trained skills. Hence, a separate setup department is responsible for setting up machines and molds for different batches of products. Setup costs are overhead costs of products. For simplicity, assume that setup costs are fixed with respect to the number of setup-hours. They consist of salaries paid to engineers and supervisors and costs of leasing setup equipment.

Information regarding Elegance for 2012 follows:

	Actual Result	Static-Budget Amount
1. Units of Elegance produced and sold	151,200	180,000
2. Batch size (units per batch)	140	150
3. Number of batches (Line 1 ÷ Line 2)	1,080	1,200
4. Materials-handling labor-hours per batch	5.25	5
5. Total materials-handling labor-hours (Line 3 × Line 4)	5,670	6,000
6. Cost per materials-handling labor-hour	\$ 14.50	\$ 14
7. Total materials-handling labor costs (Line 5 × Line 6)	\$ 82,215	\$ 84,000
8. Setup-hours per batch	6.25	6
9. Total setup-hours (Line 3 × Line 8)	6,750	7,200
10. Total fixed setup overhead costs	\$220,000	\$216,000

## Flexible Budget and Variance Analysis for Direct Labor Costs

To prepare the flexible budget for materials-handling labor costs, Lyco starts with the actual units of output produced, 151,200 units, and proceeds with the following steps.

**Step 1: Using Budgeted Batch Size, Calculate the Number of Batches that Should Have Been Used to Produce Actual Output.** At the budgeted batch size of 150 units per batch, Lyco should have produced the 151,200 units of output in 1,008 batches (151,200 units ÷ 150 units per batch).

**Step 2: Using Budgeted Materials-Handling Labor-Hours per Batch, Calculate the Number of Materials-Handling Labor-Hours that Should Have Been Used.** At the budgeted quantity of 5 hours per batch, 1,008 batches should have required 5,040 materials-handling labor-hours (1,008 batches × 5 hours per batch).

**Step 3: Using Budgeted Cost per Materials-Handling Labor-Hour, Calculate the Flexible-Budget Amount for Materials-Handling Labor-Hours.** The flexible-budget amount is 5,040 materials-handling labor-hours × \$14 budgeted cost per materials-handling labor-hour = \$70,560.

Note how the flexible-budget calculations for materials-handling labor costs focus on batch-level quantities (materials-handling labor-hours per batch rather than per unit). Flexible-budget quantity computations focus at the appropriate level of the cost hierarchy. For example, because materials handling is a batch-level cost, the flexible-budget quantity calculations are made at the batch level—the quantity of materials-handling labor-hours that Lyco should have used based on the number of batches it should have used to produce the actual quantity of 151,200 units. If a cost had been a product-sustaining cost—such as product design cost—the flexible-budget quantity computations would focus at the product-sustaining level, for example, by evaluating the actual complexity of product design relative to the budget.

The flexible-budget variance for materials-handling labor costs can now be calculated as follows:

$$\begin{aligned}
 \text{Flexible-budget} &= \text{Actual costs} - \text{Flexible-budget costs} \\
 \text{variance} &= (5,670 \text{ hours} \times \$14.50 \text{ per hour}) - (5,040 \text{ hours} \times \$14 \text{ per hour}) \\
 &= \$82,215 - \$70,560 \\
 &= \$11,655 \text{ U}
 \end{aligned}$$

The unfavorable variance indicates that materials-handling labor costs were \$11,655 higher than the flexible-budget target. We can get some insight into the possible reasons for this unfavorable outcome by examining the price and efficiency components of the flexible-budget variance. Exhibit 8-5 presents the variances in columnar form.

$$\begin{aligned}
 \text{Price variance} &= \left( \begin{array}{c} \text{Actual price} \\ \text{of input} \end{array} - \begin{array}{c} \text{Budgeted price} \\ \text{of input} \end{array} \right) \times \begin{array}{c} \text{Actual quantity} \\ \text{of input} \end{array} \\
 &= (\$14.50 \text{ per hour} - \$14 \text{ per hour}) \times 5,670 \text{ hours} \\
 &= \$0.50 \text{ per hour} \times 5,670 \text{ hours} \\
 &= \$2,835 \text{ U}
 \end{aligned}$$

The unfavorable price variance for materials-handling labor indicates that the \$14.50 actual cost per materials-handling labor-hour exceeds the \$14.00 budgeted cost per materials-handling labor-hour. This variance could be the result of Lyco’s human resources manager negotiating wage rates less skillfully or of wage rates increasing unexpectedly due to scarcity of labor.

$$\begin{aligned}
 \text{Efficiency variance} &= \left( \begin{array}{c} \text{Actual} \\ \text{quantity of} \\ \text{input used} \end{array} - \begin{array}{c} \text{Budgeted quantity} \\ \text{of input allowed} \\ \text{for actual output} \end{array} \right) \times \begin{array}{c} \text{Budgeted price} \\ \text{of input} \end{array} \\
 &= (5,670 \text{ hours} - 5,040 \text{ hours}) \times \$14 \text{ per hour} \\
 &= 630 \text{ hours} \times \$14 \text{ per hour} \\
 &= \$8,820 \text{ U}
 \end{aligned}$$

The unfavorable efficiency variance indicates that the 5,670 actual materials-handling labor-hours exceeded the 5,040 budgeted materials-handling labor-hours for actual output. Possible reasons for the unfavorable efficiency variance are as follows:

- Smaller actual batch sizes of 140 units, instead of the budgeted batch sizes of 150 units, resulting in Lyco producing the 151,200 units in 1,080 batches instead of 1,008 (151,200 ÷ 150) batches
- Higher actual materials-handling labor-hours per batch of 5.25 hours instead of budgeted materials-handling labor-hours of 5 hours

Reasons for smaller-than-budgeted batch sizes could include quality problems when batch sizes exceed 140 faucets and high costs of carrying inventory.

**Exhibit 8-5** Columnar Presentation of Variance Analysis for Direct Materials-Handling Labor Costs: Lyco Brass Works for 2012<sup>a</sup>

	<b>Actual Costs Incurred: Actual Input Quantity × Actual Rate (1)</b>	<b>Actual Input Quantity × Budgeted Rate (2)</b>	<b>Flexible Budget: Budgeted Input Quantity Allowed for Actual Output × Budgeted Rate (3)</b>
	(5,670 hours × \$14.50 per hour) \$82,215	(5,670 hours × \$14 per hour) \$79,380	(5,040 hours × \$14 per hour) \$70,560
Level 3	↑	↑	↑
		\$2,835 U	\$8,820 U
Level 2	↑	↑	↑
		Price variance	Efficiency variance
		\$11,655 U	
		Flexible-budget variance	

<sup>a</sup>F = favorable effect on operating income; U = unfavorable effect on operating income.

Possible reasons for larger actual materials-handling labor-hours per batch are as follows:

- Inefficient layout of the Elegance production line
- Materials-handling labor having to wait at work centers before picking up or delivering materials
- Unmotivated, inexperienced, and underskilled employees
- Very tight standards for materials-handling time

Identifying the reasons for the efficiency variance helps Lyco’s managers develop a plan for improving materials-handling labor efficiency and to take corrective action that will be incorporated into future budgets.

We now consider fixed setup overhead costs.

### Flexible Budget and Variance Analysis for Fixed Setup Overhead Costs

Exhibit 8-6 presents the variances for fixed setup overhead costs in columnar form.

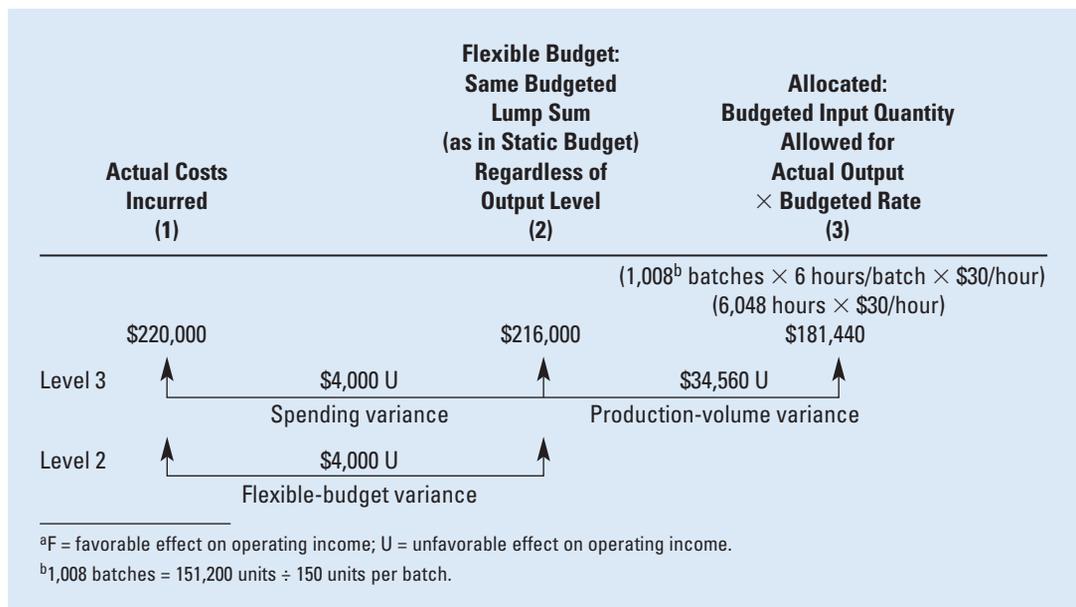
Lyco’s fixed setup overhead flexible-budget variance is calculated as follows:

$$\begin{aligned}
 \text{Fixed-setup overhead flexible-budget variance} &= \text{Actual costs incurred} - \text{Flexible-budget costs} \\
 &= \$220,000 - \$216,000 \\
 &= \$4,000 \text{ U}
 \end{aligned}$$

Note that the flexible-budget amount for fixed setup overhead costs equals the static-budget amount of \$216,000. That’s because there is no “flexing” of fixed costs. Moreover, because fixed overhead costs have no efficiency variance, the fixed setup overhead spending variance is the same as the fixed overhead flexible-budget variance. The spending variance could be unfavorable because of higher leasing costs of new setup equipment or higher salaries paid to engineers and supervisors. Lyco may have incurred these costs to alleviate some of the difficulties it was having in setting up machines.

**Exhibit 8-6**

Columnar Presentation of Fixed Setup Overhead Variance Analysis: Lyco Brass Works for 2012<sup>a</sup>



To calculate the production-volume variance, Lyco first computes the budgeted cost-allocation rate for fixed setup overhead costs using the same four-step approach described on page 266.

**Step 1: Choose the Period to Use for the Budget.** Lyco uses a period of 12 months (the year 2012).

**Step 2: Select the Cost-Allocation Base to Use in Allocating Fixed Overhead Costs to Output Produced.** Lyco uses budgeted setup-hours as the cost-allocation base for fixed setup overhead costs. Budgeted setup-hours in the static budget for 2012 are 7,200 hours.

**Step 3: Identify the Fixed Overhead Costs Associated with the Cost-Allocation Base.** Lyco's fixed setup overhead cost budget for 2012 is \$216,000.

**Step 4: Compute the Rate per Unit of the Cost-Allocation Base Used to Allocate Fixed Overhead Costs to Output Produced.** Dividing the \$216,000 from Step 3 by the 7,200 setup-hours from Step 2, Lyco estimates a fixed setup overhead cost rate of \$30 per setup-hour:

$$\begin{aligned}
 &\text{Budgeted fixed setup overhead cost per unit of cost-allocation base} &&= \frac{\text{Budgeted total costs in fixed overhead cost pool}}{\text{Budgeted total quantity of cost-allocation base}} &&= \frac{\$216,000}{7,200 \text{ setup hours}} \\
 &&&= \$30 \text{ per setup-hour} \\
 &\text{Production-volume variance for fixed setup overhead costs} &&= \text{Budgeted fixed setup overhead costs} - \text{Fixed setup overhead allocation using budgeted input allowed for actual output units produced} \\
 &&&= \$216,000 - (1,008 \text{ batches} \times 6 \text{ hours/batch}) \times \$30/\text{hour} \\
 &&&= \$216,000 - (6,048 \text{ hours} \times \$30/\text{hour}) \\
 &&&= \$216,000 - \$181,440 \\
 &&&= \$34,560 \text{ U}
 \end{aligned}$$

During 2012, Lyco planned to produce 180,000 units of Elegance but actually produced 151,200 units. The unfavorable production-volume variance measures the amount of extra fixed setup costs that Lyco incurred for setup capacity it had but did not use. One interpretation is that the unfavorable \$34,560 production-volume variance represents inefficient use of setup capacity. However, Lyco may have earned higher operating income by selling 151,200 units at a higher price than 180,000 units at a lower price. As a result, Lyco's managers should interpret the production-volume variance cautiously because it does not consider effects on selling prices and operating income.

## Overhead Variances in Nonmanufacturing Settings

Our Webb Company example examines variable manufacturing overhead costs and fixed manufacturing overhead costs. Should the overhead costs of the nonmanufacturing areas of the company be examined using the variance analysis framework discussed in this chapter? Companies often use variable-cost information pertaining to nonmanufacturing, as well as manufacturing, costs in pricing and product mix decisions. Managers consider variance analysis of all variable overhead costs when making such decisions and when managing costs. For example, managers in industries in which distribution costs are high, such as automobiles, consumer durables, and cement and steel, may use standard costing to give reliable and timely information on variable distribution overhead spending variances and efficiency variances.

Consider service-sector companies such as airlines, hospitals, hotels, and railroads. The measures of output commonly used in these companies are passenger-miles flown,

### Decision Point

How can variance analysis be used in an activity-based costing system?

### Learning Objective 8

Examine the use of overhead variances in nonmanufacturing settings

... analyze nonmanufacturing variable overhead costs for decision making and cost management; fixed overhead variances are especially important in service settings

patient days provided, room-days occupied, and ton-miles of freight hauled, respectively. Few costs can be traced to these outputs in a cost-effective way. The majority of costs are fixed overhead costs, such as the costs of equipment, buildings, and staff. Using capacity effectively is the key to profitability, and fixed overhead variances can help managers in this task. Retail businesses, such as Kmart, also have high capacity-related fixed costs (lease and occupancy costs). In the case of Kmart, sales declines resulted in unused capacity and unfavorable fixed-cost variances. Kmart reduced fixed costs by closing some of its stores, but it also had to file for Chapter 11 bankruptcy in January 2002.

Consider the following data for the mainline operations of United Airlines for selected years from the past decade. Available seat miles (ASMs) are the actual seats in an airplane multiplied by the distance traveled.

Year	Total ASMs (Millions) (1)	Operating Revenue per ASM (2)	Operating Cost per ASM (3)	Operating Income per ASM (4) = (2) – (3)
2000	175,485	11.0 cents	10.6 cents	0.4 cents
2003	136,630	9.6 cents	10.5 cents	–0.9 cents
2006	143,095	11.5 cents	11.2 cents	0.3 cents
2008	135,861	12.6 cents	15.7 cents	–3.1 cents

After September 11, 2001, as air travel declined, United's revenues decreased but a majority of its costs comprising fixed costs of airport facilities, equipment, and personnel did not. United had a large unfavorable production-volume variance as its capacity was underutilized. As column 1 of the table indicates, United responded by reducing its capacity substantially over the next few years. Available seat miles declined from 175,485 million in 2000 to 136,630 million in 2003. Yet, United was unable to fill even the planes it had retained, so revenue per ASM declined (column 2) and cost per ASM stayed roughly the same (column 3). United filed for Chapter 11 bankruptcy in December 2002 and began seeking government guarantees to obtain the loans it needed. Subsequently, strong demand for airline travel, as well as yield improvements gained by more efficient use of resources and networks, led to increased traffic and higher average ticket prices. By maintaining a disciplined approach to capacity and tight control over growth, United saw close to a 20% increase in its revenue per ASM between 2003 and 2006. The improvement in performance allowed United to come out of bankruptcy on February 1, 2006. In the past year, however, the severe global recession and soaring jet fuel prices have had a significant negative impact on United's performance (and that of its competitor airlines), as reflected in the negative operating income for 2008.

## Financial and Nonfinancial Performance Measures

The overhead variances discussed in this chapter are examples of financial performance measures. As the preceding examples illustrate, nonfinancial measures such as those related to capacity utilization and physical measures of input usage also provide useful information. Returning to the Webb example one final time, we can see that nonfinancial measures that managers of Webb would likely find helpful in planning and controlling its overhead costs include the following:

1. Quantity of actual indirect materials used per machine-hour, relative to quantity of budgeted indirect materials used per machine-hour
2. Actual energy used per machine-hour, relative to budgeted energy used per machine-hour
3. Actual machine-hours per jacket, relative to budgeted machine-hours per jacket

These performance measures, like the financial variances discussed in this chapter and Chapter 7, can be described as signals to direct managers' attention to problems. These

nonfinancial performance measures probably would be reported daily or hourly on the production floor. The overhead variances we discussed in this chapter capture the financial effects of items such as the three factors listed, which in many cases first appear as nonfinancial performance measures. An especially interesting example along these lines comes from Japan, where some companies have introduced budgeted-to-actual variance analysis and internal trading systems among group units as a means to rein in their CO<sub>2</sub> emissions. The goal is to raise employee awareness of emissions reduction in preparation for the anticipated future costs of greenhouse-gas reduction plans being drawn up by the new Japanese government.

Finally, both financial and nonfinancial performance measures are used to evaluate the performance of managers. Exclusive reliance on either is always too simplistic because each gives a different perspective on performance. Nonfinancial measures (such as those described previously) provide feedback on individual aspects of a manager’s performance, whereas financial measures evaluate the overall effect of and the tradeoffs among different nonfinancial performance measures. We provide further discussion of these issues in Chapters 13, 19, and 23.

**Decision Point**

How are overhead variances useful in nonmanufacturing settings?

## Problem for Self-Study

Nina Garcia is the newly appointed president of Laser Products. She is examining the May 2012 results for the Aerospace Products Division. This division manufactures wing parts for satellites. Garcia’s current concern is with manufacturing overhead costs at the Aerospace Products Division. Both variable and fixed overhead costs are allocated to the wing parts on the basis of laser-cutting-hours. The following budget information is available:

Budgeted variable overhead rate	\$200 per hour
Budgeted fixed overhead rate	\$240 per hour
Budgeted laser-cutting time per wing part	1.5 hours
Budgeted production and sales for May 2012	5,000 wing parts
Budgeted fixed overhead costs for May 2012	\$1,800,000

Actual results for May 2012 are as follows:

Wing parts produced and sold	4,800 units
Laser-cutting-hours used	8,400 hours
Variable overhead costs	\$1,478,400
Fixed overhead costs	\$1,832,200

1. Compute the spending variance and the efficiency variance for variable overhead.
2. Compute the spending variance and the production-volume variance for fixed overhead.
3. Give two explanations for each of the variances calculated in requirements 1 and 2.

**Required**

### Solution

- 1 and 2. See Exhibit 8-7.
3. a. Variable overhead spending variance, \$201,600 F. One possible reason for this variance is that the actual prices of individual items included in variable overhead (such as cutting fluids) are lower than budgeted prices. A second possible reason is that the percentage increase in the actual quantity usage of individual items in the variable overhead cost pool is less than the percentage increase in laser-cutting-hours compared to the flexible budget.
- b. Variable overhead efficiency variance, \$240,000 U. One possible reason for this variance is inadequate maintenance of laser machines, causing them to take more laser-cutting time per wing part. A second possible reason is use of undermotivated, inexperienced, or underskilled workers with the laser-cutting machines, resulting in more laser-cutting time per wing part.

**Exhibit 8-7**

Columnar Presentation of Integrated Variance Analysis: Laser Products for May 2012<sup>a</sup>

**PANEL A: Variable (Manufacturing) Overhead**

Actual Costs Incurred: Actual Input Quantity × Actual Rate (1)	Actual Input Quantity × Budgeted Rate (2)	Flexible Budget: Budgeted Input Quantity Allowed for Actual Output × Budgeted Rate (3)	Allocated: Budgeted Input Quantity Allowed for Actual Output × Budgeted Rate (4)
(8,400 hrs. × \$176/hr.) \$1,478,400	(8,400 hrs. × \$200/hr.) \$1,680,000	(1.5 hrs./unit × 4,800 units × \$200/hr.) (7,200 hrs. × \$200/hr.) \$1,440,000	(1.5 hrs./unit × 4,800 units × \$200/hr.) (7,200 hrs. × \$200/hr.) \$1,440,000
\$201,600 F Spending variance		\$240,000 U Efficiency variance	
\$38,400 U Flexible-budget variance		Never a variance	
\$38,400 U Underallocated variable overhead (Total variable overhead variance)			

**PANEL B: Fixed (Manufacturing) Overhead**

Actual Costs Incurred (1)	Same Budgeted Lump Sum (as in Static Budget) Regardless of Output Level (2)	Flexible Budget: Same Budgeted Lump Sum (as in Static Budget) Regardless of Output Level (3)	Allocated: Budgeted Input Quantity Allowed for Actual Output × Budgeted Rate (4)
\$1,832,200	\$1,800,000	\$1,800,000	(1.5 hrs./unit × 4,800 units × \$240/hr.) (7,200 hrs. × \$240/hr.) \$1,728,000
\$32,200 U Spending variance		\$72,000 U Production-volume variance	
\$32,200 U Flexible-budget variance		\$72,000 U Production-volume variance	
\$104,200 U Underallocated fixed overhead (Total fixed overhead variance)			

<sup>a</sup>F = favorable effect on operating income; U = unfavorable effect on operating income.

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- c. Fixed overhead spending variance, \$32,200 U. One possible reason for this variance is that the actual prices of individual items in the fixed-cost pool unexpectedly increased from the prices budgeted (such as an unexpected increase in machine leasing costs). A second possible reason is misclassification of items as fixed that are in fact variable.
- d. Production-volume variance, \$72,000 U. Actual production of wing parts is 4,800 units, compared with 5,000 units budgeted. One possible reason for this variance is demand factors, such as a decline in an aerospace program that led to a decline in demand for aircraft parts. A second possible reason is supply factors, such as a production stoppage due to labor problems or machine breakdowns.

## Decision Points

The following question-and-answer format summarizes the chapter's learning objectives. Each decision presents a key question related to a learning objective. The guidelines are the answer to that question.

### Decision

1. How do managers plan variable overhead costs and fixed overhead costs?
2. How are budgeted variable overhead and fixed overhead cost rates calculated?
3. What variances can be calculated for variable overhead costs?
4. What variances can be calculated for fixed overhead costs?
5. What is the most detailed way for a company to reconcile actual overhead incurred with the amount allocated during a period?
6. What is the relationship between the sales-volume variance and the production-volume variance?
7. How can variance analysis be used in an activity-based costing system?
8. How are overhead variances useful in nonmanufacturing settings?

### Guidelines

- Planning of both variable and fixed overhead costs involves undertaking only activities that add value and then being efficient in that undertaking. The key difference is that for variable-cost planning, ongoing decisions during the budget period play a much larger role; whereas for fixed-cost planning, most key decisions are made before the start of the period.
- The budgeted variable (fixed) overhead cost rate is calculated by dividing the budgeted variable (fixed) overhead costs by the denominator level of the cost-allocation base.
- When the flexible budget for variable overhead is developed, an overhead efficiency variance and an overhead spending variance can be computed. The variable overhead efficiency variance focuses on the difference between the actual quantity of the cost-allocation base used relative to the budgeted quantity of the cost-allocation base. The variable overhead spending variance focuses on the difference between the actual variable overhead cost per unit of the cost-allocation base relative to the budgeted variable overhead cost per unit of the cost-allocation base.
- For fixed overhead, the static and flexible budgets coincide. The difference between the budgeted and actual amount of fixed overhead is the flexible-budget variance, also referred to as the spending variance. The production-volume variance measures the difference between budgeted fixed overhead and fixed overhead allocated on the basis of actual output produced.
- A 4-variance analysis presents spending and efficiency variances for variable overhead costs and spending and production-volume variances for fixed overhead costs. By analyzing these four variances together, managers can reconcile the actual overhead costs with the amount of overhead allocated to output produced during a period.
- The production-volume variance is a component of the sales-volume variance. The production-volume and operating-income volume variances together comprise the sales-volume variance.
- Flexible budgets in ABC systems give insight into why actual activity costs differ from budgeted activity costs. Using output and input measures for an activity, a 4-variance analysis can be conducted.
- Managers consider variance analysis of all variable overhead costs, including those outside the manufacturing function, when making pricing and product mix decisions and when managing costs. Fixed overhead variances are especially important in service settings, where using capacity effectively is the key to profitability. In all cases, the information provided by variances can be supplemented by the use of suitable nonfinancial metrics.

## Terms to Learn

The chapter and the Glossary at the end of the book contain definitions of the following important terms:

denominator level (p. 266)	operating-income volume variance (p. 281)	variable overhead efficiency variance (p. 267)
denominator-level variance (p. 272)	production-denominator level (p. 266)	variable overhead flexible-budget variance (p. 267)
fixed overhead flexible-budget variance (p. 271)	production-volume variance (p. 272)	variable overhead spending variance (p. 269)
fixed overhead spending variance (p. 271)	standard costing (p. 264)	
	total-overhead variance (p. 278)	

## Assignment Material



### Questions

- 8-1** How do managers plan for variable overhead costs?
- 8-2** How does the planning of fixed overhead costs differ from the planning of variable overhead costs?
- 8-3** How does standard costing differ from actual costing?
- 8-4** What are the steps in developing a budgeted variable overhead cost-allocation rate?
- 8-5** What are the factors that affect the spending variance for variable manufacturing overhead?
- 8-6** Assume variable manufacturing overhead is allocated using machine-hours. Give three possible reasons for a favorable variable overhead efficiency variance.
- 8-7** Describe the difference between a direct materials efficiency variance and a variable manufacturing overhead efficiency variance.
- 8-8** What are the steps in developing a budgeted fixed overhead rate?
- 8-9** Why is the flexible-budget variance the same amount as the spending variance for fixed manufacturing overhead?
- 8-10** Explain how the analysis of fixed manufacturing overhead costs differs for (a) planning and control and (b) inventory costing for financial reporting.
- 8-11** Provide one caveat that will affect whether a production-volume variance is a good measure of the economic cost of unused capacity.
- 8-12** "The production-volume variance should always be written off to Cost of Goods Sold." Do you agree? Explain.
- 8-13** What are the variances in a 4-variance analysis?
- 8-14** "Overhead variances should be viewed as interdependent rather than independent." Give an example.
- 8-15** Describe how flexible-budget variance analysis can be used in the control of costs of activity areas.



### Exercises

**8-16 Variable manufacturing overhead, variance analysis.** Esquire Clothing is a manufacturer of designer suits. The cost of each suit is the sum of three variable costs (direct material costs, direct manufacturing labor costs, and manufacturing overhead costs) and one fixed-cost category (manufacturing overhead costs). Variable manufacturing overhead cost is allocated to each suit on the basis of budgeted direct manufacturing labor-hours per suit. For June 2012 each suit is budgeted to take four labor-hours. Budgeted variable manufacturing overhead cost per labor-hour is \$12. The budgeted number of suits to be manufactured in June 2012 is 1,040.

Actual variable manufacturing costs in June 2012 were \$52,164 for 1,080 suits started and completed. There were no beginning or ending inventories of suits. Actual direct manufacturing labor-hours for June were 4,536.

#### Required

1. Compute the flexible-budget variance, the spending variance, and the efficiency variance for variable manufacturing overhead.
2. Comment on the results.

**8-17 Fixed manufacturing overhead, variance analysis (continuation of 8-16).** Esquire Clothing allocates fixed manufacturing overhead to each suit using budgeted direct manufacturing labor-hours per suit. Data pertaining to fixed manufacturing overhead costs for June 2012 are budgeted, \$62,400, and actual, \$63,916.

#### Required

1. Compute the spending variance for fixed manufacturing overhead. Comment on the results.
2. Compute the production-volume variance for June 2012. What inferences can Esquire Clothing draw from this variance?

**8-18 Variable manufacturing overhead variance analysis.** The French Bread Company bakes baguettes for distribution to upscale grocery stores. The company has two direct-cost categories: direct materials and direct manufacturing labor. Variable manufacturing overhead is allocated to products on the basis of standard direct manufacturing labor-hours. Following is some budget data for the French Bread Company:

Direct manufacturing labor use	0.02 hours per baguette
Variable manufacturing overhead	\$10.00 per direct manufacturing labor-hour

The French Bread Company provides the following additional data for the year ended December 31, 2012:

Planned (budgeted) output	3,200,000 baguettes
Actual production	2,800,000 baguettes
Direct manufacturing labor	50,400 hours
Actual variable manufacturing overhead	\$680,400

1. What is the denominator level used for allocating variable manufacturing overhead? (That is, for how many direct manufacturing labor-hours is French Bread budgeting?)
2. Prepare a variance analysis of variable manufacturing overhead. Use Exhibit 8-4 (p. 277) for reference.
3. Discuss the variances you have calculated and give possible explanations for them.

**Required**

**8-19 Fixed manufacturing overhead variance analysis (continuation of 8-18).** The French Bread Company also allocates fixed manufacturing overhead to products on the basis of standard direct manufacturing labor-hours. For 2012, fixed manufacturing overhead was budgeted at \$4.00 per direct manufacturing labor-hour. Actual fixed manufacturing overhead incurred during the year was \$272,000.

1. Prepare a variance analysis of fixed manufacturing overhead cost. Use Exhibit 8-4 (p. 277) as a guide.
2. Is fixed overhead underallocated or overallocated? By what amount?
3. Comment on your results. Discuss the variances and explain what may be driving them.

**Required**

**8-20 Manufacturing overhead, variance analysis.** The Solutions Corporation is a manufacturer of centrifuges. Fixed and variable manufacturing overheads are allocated to each centrifuge using budgeted assembly-hours. Budgeted assembly time is two hours per unit. The following table shows the budgeted amounts and actual results related to overhead for June 2012.

 Home    Insert    Page Layout    Formulas    Data    Review    View							
	A	B	C	D	E	F	G
1	<b>The Solutions Corporation (June 2012)</b>					<b>Actual Results</b>	<b>Static Budget</b>
2	Number of centrifuges assembled and sold					216	200
3	Hours of assembly time					411	
4	Variable manufacturing overhead cost per hour of assembly time						\$30.00
5	Variable manufacturing overhead costs					\$12,741	
6	Fixed manufacturing overhead costs					\$20,550	\$19,200

1. Prepare an analysis of all variable manufacturing overhead and fixed manufacturing overhead variances using the columnar approach in Exhibit 8-4 (p. 277).
2. Prepare journal entries for Solutions' June 2012 variable and fixed manufacturing overhead costs and variances; write off these variances to cost of goods sold for the quarter ending June 30, 2012.
3. How does the planning and control of variable manufacturing overhead costs differ from the planning and control of fixed manufacturing overhead costs?

**Required**

**8-21 4-variance analysis, fill in the blanks.** Rozema, Inc., produces chemicals for large biotech companies. It has the following data for manufacturing overhead costs during August 2013:

	Variable	Fixed
Actual costs incurred	\$31,000	\$18,000
Costs allocated to products	33,000	14,600
Flexible budget	_____	13,400
Actual input × budgeted rate	30,800	_____

Use F for favorable and U for unfavorable:

	Variable	Fixed
(1) Spending variance	\$ _____	\$ _____
(2) Efficiency variance	_____	_____
(3) Production-volume variance	_____	_____
(4) Flexible-budget variance	_____	_____
(5) Underallocated (overallocated) manufacturing overhead	_____	_____

**8-22 Straightforward 4-variance overhead analysis.** The Lopez Company uses standard costing in its manufacturing plant for auto parts. The standard cost of a particular auto part, based on a denominator level of 4,000 output units per year, included 6 machine-hours of variable manufacturing overhead at \$8 per hour and 6 machine-hours of fixed manufacturing overhead at \$15 per hour. Actual output produced was 4,400 units. Variable manufacturing overhead incurred was \$245,000. Fixed manufacturing overhead incurred was \$373,000. Actual machine-hours were 28,400.

**Required**

1. Prepare an analysis of all variable manufacturing overhead and fixed manufacturing overhead variances, using the 4-variance analysis in Exhibit 8-4 (p. 277).
2. Prepare journal entries using the 4-variance analysis.
3. Describe how individual fixed manufacturing overhead items are controlled from day to day.
4. Discuss possible causes of the fixed manufacturing overhead variances.

**8-23 Straightforward coverage of manufacturing overhead, standard-costing system.** The Singapore division of a Canadian telecommunications company uses standard costing for its machine-paced production of telephone equipment. Data regarding production during June are as follows:

Variable manufacturing overhead costs incurred	\$618,840
Variable manufacturing overhead cost rate	\$8 per standard machine-hour
Fixed manufacturing overhead costs incurred	\$145,790
Fixed manufacturing overhead costs budgeted	\$144,000
Denominator level in machine-hours	72,000
Standard machine-hour allowed per unit of output	1.2
Units of output	65,500
Actual machine-hours used	76,400
Ending work-in-process inventory	0

**Required**

1. Prepare an analysis of all manufacturing overhead variances. Use the 4-variance analysis framework illustrated in Exhibit 8-4 (p. 277).
2. Prepare journal entries for manufacturing overhead costs and their variances.
3. Describe how individual variable manufacturing overhead items are controlled from day to day.
4. Discuss possible causes of the variable manufacturing overhead variances.

**8-24 Overhead variances, service sector.** Meals on Wheels (MOW) operates a meal home-delivery service. It has agreements with 20 restaurants to pick up and deliver meals to customers who phone or fax orders to MOW. MOW allocates variable and fixed overhead costs on the basis of delivery time. MOW's owner, Josh Carter, obtains the following information for May 2012 overhead costs:

Home Insert Page Layout Formulas Data Review				
A		B	C	
1	<b>Meals on Wheels (May 2012)</b>	<b>Actual Results</b>	<b>Static Budget</b>	
2	Output units (number of deliveries)	8,800	10,000	
3	Hours per delivery		0.70	
4	Hours of delivery time	5,720		
5	Variable overhead cost per hour of delivery time		\$ 1.50	
6	Variable overhead costs	\$10,296		
7	Fixed overhead costs	\$38,600	\$35,000	

1. Compute spending and efficiency variances for MOW's variable overhead in May 2012.
2. Compute the spending variance and production-volume variance for MOW's fixed overhead in May 2012.
3. Comment on MOW's overhead variances and suggest how Josh Carter might manage MOW's variable overhead differently from its fixed overhead costs.

**Required**

**8-25 Total overhead, 3-variance analysis.** Furniture, Inc., specializes in the production of futons. It uses standard costing and flexible budgets to account for the production of a new line of futons. For 2011, budgeted variable overhead at a level of 3,600 standard monthly direct labor-hours was \$43,200; budgeted total overhead at 4,000 standard monthly direct labor-hours was \$103,400. The standard cost allocated to each output included a total overhead rate of 120% of standard direct labor costs. For October, Furniture, Inc., incurred total overhead of \$120,700 and direct labor costs of \$128,512. The direct labor price variance was \$512 unfavorable. The direct labor flexible-budget variance was \$3,512 unfavorable. The standard labor price was \$25 per hour. The production-volume variance was \$34,600 favorable.

1. Compute the direct labor efficiency variance and the spending and efficiency variances for overhead. Also, compute the denominator level.
2. Describe how individual variable overhead items are controlled from day to day. Also, describe how individual fixed overhead items are controlled.

**Required**

**8-26 Overhead variances, missing information.** Dvent budgets 18,000 machine-hours for the production of computer chips in August 2011. The budgeted variable overhead rate is \$6 per machine-hour. At the end of August, there is a \$375 favorable spending variance for variable overhead and a \$1,575 unfavorable spending variance for fixed overhead. For the computer chips produced, 14,850 machine-hours are budgeted and 15,000 machine-hours are actually used. Total actual overhead costs are \$120,000.

1. Compute efficiency and flexible-budget variances for Dvent's variable overhead in August 2011. Will variable overhead be over- or underallocated? By how much?
2. Compute production-volume and flexible-budget variances for Dvent's fixed overhead in August 2011. Will fixed overhead be over- or underallocated? By how much?

**Required**

**8-27 Identifying favorable and unfavorable variances.** Purdue, Inc., manufactures tires for large auto companies. It uses standard costing and allocates variable and fixed manufacturing overhead based on machine-hours. For each independent scenario given, indicate whether each of the manufacturing variances will be favorable or unfavorable or, in case of insufficient information, indicate "CBD" (cannot be determined).

Scenario	Variable Overhead Spending Variance	Variable Overhead Efficiency Variance	Fixed Overhead Spending Variance	Fixed Overhead Production-Volume Variance
Production output is 4% less than budgeted, and actual fixed manufacturing overhead costs are 5% more than budgeted				
Production output is 12% less than budgeted; actual machine-hours are 7% more than budgeted				
Production output is 9% more than budgeted				
Actual machine-hours are 20% less than flexible-budget machine-hours				
Relative to the flexible budget, actual machine-hours are 12% less, and actual variable manufacturing overhead costs are 20% greater				

**8-28 Flexible-budget variances, review of Chapters 7 and 8.** David James is a cost accountant and business analyst for Doorknob Design Company (DDC), which manufactures expensive brass doorknobs. DDC uses two direct cost categories: direct materials and direct manufacturing labor. James feels that manufacturing overhead is most closely related to material usage. Therefore, DDC allocates manufacturing overhead to production based upon pounds of materials used.

At the beginning of 2012, DDC budgeted annual production of 400,000 doorknobs and adopted the following standards for each doorknob:

	Input	Cost/Doorknob
Direct materials (brass)	0.3 lb. @ \$10/lb.	\$ 3.00
Direct manufacturing labor	1.2 hours @ \$20/hour	24.00
Manufacturing overhead:		
Variable	\$6/lb. × 0.3 lb.	1.80
Fixed	\$15/lb. × 0.3 lb.	4.50
Standard cost per doorknob		<u>\$33.30</u>

Actual results for April 2012 were as follows:

Production	35,000 doorknobs
Direct materials purchased	12,000 lb. at \$11/lb.
Direct materials used	10,450 lb.
Direct manufacturing labor	38,500 hours for \$808,500
Variable manufacturing overhead	\$64,150
Fixed manufacturing overhead	\$152,000

**Required**

- For the month of April, compute the following variances, indicating whether each is favorable (F) or unfavorable (U):
  - Direct materials price variance (based on purchases)
  - Direct materials efficiency variance
  - Direct manufacturing labor price variance
  - Direct manufacturing labor efficiency variance
  - Variable manufacturing overhead spending variance
  - Variable manufacturing overhead efficiency variance
  - Production-volume variance
  - Fixed manufacturing overhead spending variance
- Can James use any of the variances to help explain any of the other variances? Give examples.



**Problems**

**8-29 Comprehensive variance analysis.** Kitchen Whiz manufactures premium food processors. The following is some manufacturing overhead data for Kitchen Whiz for the year ended December 31, 2012:

Manufacturing Overhead	Actual Results	Flexible Budget	Allocated Amount
Variable	\$ 76,608	\$ 76,800	\$ 76,800
Fixed	350,208	348,096	376,320

Budgeted number of output units: 888

Planned allocation rate: 2 machine-hours per unit

Actual number of machine-hours used: 1,824

Static-budget variable manufacturing overhead costs: \$71,040

**Required**

Compute the following quantities (you should be able to do so in the prescribed order):

- Budgeted number of machine-hours planned
- Budgeted fixed manufacturing overhead costs per machine-hour
- Budgeted variable manufacturing overhead costs per machine-hour
- Budgeted number of machine-hours allowed for actual output produced
- Actual number of output units
- Actual number of machine-hours used per output unit

**8-30 Journal entries (continuation of 8-29).**

1. Prepare journal entries for variable and fixed manufacturing overhead (you will need to calculate the various variances to accomplish this).
2. Overhead variances are written off to the Cost of Goods Sold (COGS) account at the end of the fiscal year. Show how COGS is adjusted through journal entries.

**Required**

**8-31 Graphs and overhead variances.** Best Around, Inc., is a manufacturer of vacuums and uses standard costing. Manufacturing overhead (both variable and fixed) is allocated to products on the basis of budgeted machine-hours. In 2012, budgeted fixed manufacturing overhead cost was \$17,000,000. Budgeted variable manufacturing overhead was \$10 per machine-hour. The denominator level was 1,000,000 machine-hours.

1. Prepare a graph for fixed manufacturing overhead. The graph should display how Best Around, Inc.'s fixed manufacturing overhead costs will be depicted for the purposes of (a) planning and control and (b) inventory costing.
2. Suppose that 1,125,000 machine-hours were allowed for actual output produced in 2012, but 1,150,000 actual machine-hours were used. Actual manufacturing overhead was \$12,075,000, variable, and \$17,100,000, fixed. Compute (a) the variable manufacturing overhead spending and efficiency variances and (b) the fixed manufacturing overhead spending and production-volume variances. Use the columnar presentation illustrated in Exhibit 8-4 (p. 277).
3. What is the amount of the under- or overallocated variable manufacturing overhead and the under- or overallocated fixed manufacturing overhead? Why are the flexible-budget variance and the under- or overallocated overhead amount always the same for variable manufacturing overhead but rarely the same for fixed manufacturing overhead?
4. Suppose the denominator level was 1,360,000 rather than 1,000,000 machine-hours. What variances in requirement 2 would be affected? Recompute them.

**Required**

**8-32 4-variance analysis, find the unknowns.** Consider the following two situations—cases A and B— independently. Data refer to operations for April 2012. For each situation, assume standard costing. Also assume the use of a flexible budget for control of variable and fixed manufacturing overhead based on machine-hours.

	Cases	
	A	B
(1) Fixed manufacturing overhead incurred	\$ 84,920	\$23,180
(2) Variable manufacturing overhead incurred	\$120,000	—
(3) Denominator level in machine-hours	—	1,000
(4) Standard machine-hours allowed for actual output achieved	6,200	—
(5) Fixed manufacturing overhead (per standard machine-hour)	—	—
<b>Flexible-Budget Data:</b>		
(6) Variable manufacturing overhead (per standard machine-hour)	—	\$ 42.00
(7) Budgeted fixed manufacturing overhead	\$ 88,200	\$20,000
(8) Budgeted variable manufacturing overhead <sup>a</sup>	—	—
(9) Total budgeted manufacturing overhead <sup>a</sup>	—	—
<b>Additional Data:</b>		
(10) Standard variable manufacturing overhead allocated	\$124,000	—
(11) Standard fixed manufacturing overhead allocated	\$ 86,800	—
(12) Production-volume variance	—	\$ 4,000 F
(13) Variable manufacturing overhead spending variance	\$ 4,600 F	\$ 2,282 F
(14) Variable manufacturing overhead efficiency variance	—	\$ 2,478 F
(15) Fixed manufacturing overhead spending variance	—	—
(16) Actual machine-hours used	—	—

<sup>a</sup>For standard machine-hours allowed for actual output produced.

Fill in the blanks under each case. [*Hint:* Prepare a worksheet similar to that in Exhibit 8-4 (p. 277). Fill in the knowns and then solve for the unknowns.]

**Required**

**8-33 Flexible budgets, 4-variance analysis.** (CMA, adapted) Nolton Products uses standard costing. It allocates manufacturing overhead (both variable and fixed) to products on the basis of standard direct manufacturing labor-hours (DLH). Nolton develops its manufacturing overhead rate from the current annual budget. The manufacturing overhead budget for 2012 is based on budgeted output of 720,000 units, requiring 3,600,000 DLH. The company is able to schedule production uniformly throughout the year.

A total of 66,000 output units requiring 315,000 DLH was produced during May 2012. Manufacturing overhead (MOH) costs incurred for May amounted to \$375,000. The actual costs, compared with the annual budget and 1/12 of the annual budget, are as follows:

Annual Manufacturing Overhead Budget 2012					
	Total Amount	Per Output Unit	Per DLH Input Unit	Monthly MOH Budget May 2012	Actual MOH Costs for May 2012
Variable MOH					
Indirect manufacturing labor	\$ 900,000	\$1.25	\$0.25	\$ 75,000	\$ 75,000
Supplies	1,224,000	1.70	0.34	102,000	111,000
Fixed MOH					
Supervision	648,000	0.90	0.18	54,000	51,000
Utilities	540,000	0.75	0.15	45,000	54,000
Depreciation	1,008,000	1.40	0.28	84,000	84,000
Total	<u>\$4,320,000</u>	<u>\$6.00</u>	<u>\$1.20</u>	<u>\$360,000</u>	<u>\$375,000</u>

**Required** Calculate the following amounts for Nolton Products for May 2012:

- Total manufacturing overhead costs allocated
- Variable manufacturing overhead spending variance
- Fixed manufacturing overhead spending variance
- Variable manufacturing overhead efficiency variance
- Production-volume variance

Be sure to identify each variance as favorable (F) or unfavorable (U).

**8-34 Direct Manufacturing Labor and Variable Manufacturing Overhead Variances.** Sarah Beth's Art Supply Company produces various types of paints. Actual direct manufacturing labor hours in the factory that produces paint have been higher than budgeted hours for the last few months and the owner, Sarah B. Jones, is concerned about the effect this has had on the company's cost overruns. Because variable manufacturing overhead is allocated to units produced using direct manufacturing labor hours, Sarah feels that the mismanagement of labor will have a twofold effect on company profitability. Following are the relevant budgeted and actual results for the second quarter of 2011.

	Budget Information	Actual Results
Paint set production	25,000	29,000
Direct manuf. labor hours per paint set	2 hours	2.3 hours
Direct manufacturing labor rate	\$10/hour	\$10.40/hour
Variable manufacturing overhead rate	\$20/hour	\$18.95/hour

- Required**
- Calculate the direct manufacturing labor price and efficiency variances and indicate whether each is favorable (F) or unfavorable (U).
  - Calculate the variable manufacturing overhead spending and efficiency variances and indicate whether each is favorable (F) or unfavorable (U).
  - For both direct manufacturing labor and variable manufacturing overhead, do the price/spending variances help Sarah explain the efficiency variances?
  - Is Sarah correct in her assertion that the mismanagement of labor has a twofold effect on cost overruns? Why might the variable manufacturing overhead efficiency variance not be an accurate representation of the effect of labor overruns on variable manufacturing overhead costs?

**8-35 Activity-based costing, batch-level variance analysis.** Pointe's Fleet Feet, Inc., produces dance shoes for stores all over the world. While the pairs of shoes are boxed individually, they are crated and shipped in batches. The shipping department records both variable direct batch-level costs and fixed batch-level overhead costs. The following information pertains to shipping department costs for 2011.

	Static-Budget Amounts	Actual Results
Pairs of shoes shipped	250,000	175,000
Average number of pairs of shoes per crate	10	8
Packing hours per crate	1.1 hours	0.9 hour
Variable direct cost per hour	\$22	\$24
Fixed overhead cost	\$55,000	\$52,500

1. What is the static budget number of crates for 2011?
2. What is the flexible budget number of crates for 2011?
3. What is the actual number of crates shipped in 2011?
4. Assuming fixed overhead is allocated using crate-packing hours, what is the predetermined fixed overhead allocation rate?
5. For variable direct batch-level costs, compute the price and efficiency variances.
6. For fixed overhead costs, compute the spending and the production-volume variances.

**Required**

**8-36 Activity-based costing, batch-level variance analysis.** Jo Nathan Publishing Company specializes in printing specialty textbooks for a small but profitable college market. Due to the high setup costs for each batch printed, Jo Nathan holds the book requests until demand for a book is approximately 500. At that point Jo Nathan will schedule the setup and production of the book. For rush orders, Jo Nathan will produce smaller batches for an additional charge of \$400 per setup.

Budgeted and actual costs for the printing process for 2012 were as follows:

	Static-Budget Amounts	Actual Results
Number of books produced	300,000	324,000
Average number of books per setup	500	480
Hours to set up printers	8 hours	8.2 hours
Direct variable cost per setup-hour	\$40	\$39
Total fixed setup overhead costs	\$105,600	\$119,000

1. What is the static budget number of setups for 2012?
2. What is the flexible budget number of setups for 2012?
3. What is the actual number of setups in 2012?
4. Assuming fixed setup overhead costs are allocated using setup-hours, what is the predetermined fixed setup overhead allocation rate?
5. Does Jo Nathan's charge of \$400 cover the budgeted direct variable cost of an order? The budgeted total cost?
6. For direct variable setup costs, compute the price and efficiency variances.
7. For fixed setup overhead costs, compute the spending and the production-volume variances.
8. What qualitative factors should Jo Nathan consider before accepting or rejecting a special order?

**Required**

**8-37 Production-Volume Variance Analysis and Sales Volume Variance.** Dawn Floral Creations, Inc., makes jewelry in the shape of flowers. Each piece is hand-made and takes an average of 1.5 hours to produce because of the intricate design and scrollwork. Dawn uses direct labor hours to allocate the overhead cost to production. Fixed overhead costs, including rent, depreciation, supervisory salaries, and other production expenses, are budgeted at \$9,000 per month. These costs are incurred for a facility large enough to produce 1,000 pieces of jewelry a month.

During the month of February, Dawn produced 600 pieces of jewelry and actual fixed costs were \$9,200.

1. Calculate the fixed overhead spending variance and indicate whether it is favorable (F) or unfavorable (U).
2. If Dawn uses direct labor hours available at capacity to calculate the budgeted fixed overhead rate, what is the production-volume variance? Indicate whether it is favorable (F) or unfavorable (U).
3. An unfavorable production-volume variance is a measure of the under-allocation of fixed overhead cost caused by production levels at less than capacity. It therefore could be interpreted as the economic cost of unused capacity. Why would Dawn be willing to incur this cost? Your answer should separately consider the following two unrelated factors:
  - a. Demand could vary from month to month while available capacity remains constant.
  - b. Dawn would not want to produce at capacity unless it could sell all the units produced. What does Dawn need to do to raise demand and what effect would this have on profit?
4. Dawn's budgeted variable cost per unit is \$25 and it expects to sell its jewelry for \$55 apiece. Compute the sales-volume variance and reconcile it with the production-volume variance calculated in requirement 2. What does each concept measure?

**Required**

**8-38 Comprehensive review of Chapters 7 and 8, working backward from given variances.** The Mancusco Company uses a flexible budget and standard costs to aid planning and control of its machining manufacturing operations. Its costing system for manufacturing has two direct-cost categories (direct materials and direct manufacturing labor—both variable) and two overhead-cost categories (variable manufacturing overhead and fixed manufacturing overhead, both allocated using direct manufacturing labor-hours).

At the 40,000 budgeted direct manufacturing labor-hour level for August, budgeted direct manufacturing labor is \$800,000, budgeted variable manufacturing overhead is \$480,000, and budgeted fixed manufacturing overhead is \$640,000.

The following actual results are for August:

Direct materials price variance (based on purchases)	\$176,000 F
Direct materials efficiency variance	69,000 U
Direct manufacturing labor costs incurred	522,750
Variable manufacturing overhead flexible-budget variance	10,350 U
Variable manufacturing overhead efficiency variance	18,000 U
Fixed manufacturing overhead incurred	597,460
Fixed manufacturing overhead spending variance	42,540 F

The standard cost per pound of direct materials is \$11.50. The standard allowance is three pounds of direct materials for each unit of product. During August, 30,000 units of product were produced. There was no beginning inventory of direct materials. There was no beginning or ending work in process. In August, the direct materials price variance was \$1.10 per pound.

In July, labor unrest caused a major slowdown in the pace of production, resulting in an unfavorable direct manufacturing labor efficiency variance of \$45,000. There was no direct manufacturing labor price variance. Labor unrest persisted into August. Some workers quit. Their replacements had to be hired at higher wage rates, which had to be extended to all workers. The actual average wage rate in August exceeded the standard average wage rate by \$0.50 per hour.

**Required**

- Compute the following for August:
  - Total pounds of direct materials purchased
  - Total number of pounds of excess direct materials used
  - Variable manufacturing overhead spending variance
  - Total number of actual direct manufacturing labor-hours used
  - Total number of standard direct manufacturing labor-hours allowed for the units produced
  - Production-volume variance
- Describe how Mancusco's control of variable manufacturing overhead items differs from its control of fixed manufacturing overhead items.

**8-39 Review of Chapters 7 and 8, 3-variance analysis.** (CPA, adapted) The Beal Manufacturing Company's costing system has two direct-cost categories: direct materials and direct manufacturing labor. Manufacturing overhead (both variable and fixed) is allocated to products on the basis of standard direct manufacturing labor-hours (DLH). At the beginning of 2012, Beal adopted the following standards for its manufacturing costs:

	Input	Cost per Output Unit
Direct materials	3 lb. at \$5 per lb.	\$ 15.00
Direct manufacturing labor	5 hrs. at \$15 per hr.	75.00
Manufacturing overhead:		
Variable	\$6 per DLH	30.00
Fixed	\$8 per DLH	40.00
Standard manufacturing cost per output unit		<u>\$160.00</u>

The denominator level for total manufacturing overhead per month in 2012 is 40,000 direct manufacturing labor-hours. Beal's flexible budget for January 2012 was based on this denominator level. The records for January indicated the following:

Direct materials purchased	25,000 lb. at \$5.20 per lb.
Direct materials used	23,100 lb.
Direct manufacturing labor	40,100 hrs. at \$14.60 per hr.
Total actual manufacturing overhead (variable and fixed)	\$600,000
Actual production	7,800 output units

**Required**

- Prepare a schedule of total standard manufacturing costs for the 7,800 output units in January 2012.
- For the month of January 2012, compute the following variances, indicating whether each is favorable (F) or unfavorable (U):
  - Direct materials price variance, based on purchases
  - Direct materials efficiency variance
  - Direct manufacturing labor price variance
  - Direct manufacturing labor efficiency variance
  - Total manufacturing overhead spending variance
  - Variable manufacturing overhead efficiency variance
  - Production-volume variance

**8-40 Non-financial variances.** Supreme Canine Products produces high quality dog food distributed only through veterinary offices. To ensure that the food is of the highest quality and has taste appeal, Supreme

has a rigorous inspection process. For quality control purposes, Supreme has a standard based on the pounds of food inspected per hour and the number of pounds that pass or fail the inspection.

Supreme expects that for every 15,000 pounds of food produced, 1,500 pounds of food will be inspected. Inspection of 1,500 pounds of dog food should take 1 hour. Supreme also expects that 6% of the food inspected will fail the inspection. During the month of May, Supreme produced 3,000,000 pounds of food and inspected 277,500 pounds of food in 215 hours. Of the 277,500 pounds of food inspected, 15,650 pounds of food failed to pass the inspection.

1. Compute two variances that help determine whether the time spent on inspections was more or less than expected. (Follow a format similar to the one used for the variable overhead spending and efficiency variances, but without prices.)
2. Compute two variances that can be used to evaluate the percentage of the food that fails the inspection.

**Required**

**8-41 Overhead variances and sales volume variance.** Eco-Green Company manufactures cloth shopping bags that it plans to sell for \$5 each. Budgeted production and sales for these bags for 2011 is 800,000 bags, with a standard of 400,000 machine hours for the whole year. Budgeted fixed overhead costs are \$470,000, and variable overhead cost is \$1.60 per machine hour.

Because of increased demand, actual production and sales of the bags for 2010 are 900,000 bags using 440,000 actual machine hours. Actual variable overhead costs are \$699,600 and actual fixed overhead is \$501,900. Actual selling price is \$6 per bag.

Direct materials and direct labor actual costs were the same as standard costs, which were \$1.20 per unit and \$1.80 per unit, respectively.

1. Calculate the variable overhead and fixed overhead variances (spending, efficiency, spending and volume).
2. Create a chart like that in Exhibit 7-2 showing Flexible Budget Variances and Sales Volume Variances for revenues, costs, contribution margin, and operating income.
3. Calculate the operating income based on budgeted profit per shopping bag.
4. Reconcile the budgeted operating income from requirement 3 to the actual operating income from your chart in requirement 2.
5. Calculate the operating income volume variance and show how the sales volume variance is comprised of the production volume variance and the operating income volume variance.

**Required**

### Collaborative Learning Problem

**8-42 Overhead variances, ethics.** Zeller Company uses standard costing. The company has two manufacturing plants, one in Nevada and the other in Ohio. For the Nevada plant, Zeller has budgeted annual output of 4,000,000 units. Standard labor hours per unit are 0.25, and the variable overhead rate for the Nevada plant is \$3.25 per direct labor hour. Fixed overhead for the Nevada plant is budgeted at \$2,500,000 for the year.

For the Ohio plant, Zeller has budgeted annual output of 4,200,000 units with standard labor hours also 0.25 per unit. However, the variable overhead rate for the Ohio plant is \$3 per hour, and the budgeted fixed overhead for the year is only \$2,310,000.

Firm management has always used variance analysis as a performance measure for the two plants, and has compared the results of the two plants.

Jack Jones has just been hired as a new controller for Zeller. Jack is good friends with the Ohio plant manager and wants him to get a favorable review. Jack suggests allocating the firm's budgeted common fixed costs of \$3,150,000 to the two plants, but on the basis of one-third to the Ohio plant and two-thirds to the Nevada plant. His explanation for this allocation base is that Nevada is a more expensive state than Ohio.

At the end of the year, the Nevada plant reported the following actual results: output of 3,900,000 using 1,014,000 labor hours in total, at a cost of \$3,244,800 in variable overhead and \$2,520,000 in fixed overhead. Actual results for the Ohio plant are an output of 4,350,000 units using 1,218,000 labor hours with a variable cost of \$3,775,800 and fixed overhead cost of \$2,400,000. The actual common fixed costs for the year were \$3,126,000.

1. Compute the budgeted fixed cost per labor hour for the fixed overhead separately for each plant:
  - a. Excluding allocated common fixed costs
  - b. Including allocated common fixed costs
2. Compute the variable overhead spending variance and the variable overhead efficiency variance separately for each plant.
3. Compute the fixed overhead spending and volume variances for each plant:
  - a. Excluding allocated common fixed costs
  - b. Including allocated common fixed costs
4. Did Jack Jones's attempt to make the Ohio plant look better than the Nevada plant by allocating common fixed costs work? Why or why not?
5. Should common fixed costs be allocated in general when variances are used as performance measures? Why or why not?
6. What do you think of Jack Jones's behavior overall?

**Required**