

# Global Text



*Alan Campbell*

Accounting Principles  
A Business Perspective  
Volume 2 Managerial Accounting

# Accounting Principles: A Business Perspective

First Global Text Edition, Volume 2  
Managerial Accounting

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# 19. Process: Cost systems

## Learning objectives

After studying this chapter, you should be able to:

- Describe the types of operations that require a process cost system.
- Distinguish between process and job costing systems.
- Discuss the concept of equivalent units in a process cost system.
- Compute equivalent units of production and unit costs under the average cost procedure.
- Prepare a production cost report for a process cost system and discuss its relationship to the Work in Process Inventory account.
- Distinguish between normal and abnormal spoilage.
- Compute equivalent units of production and unit costs under the first-in first-out (FIFO) system (Appendix 19-A).
- Discuss how joint costs are allocated to joint products (Appendix 19-B).

This chapter continues the discussion of cost accumulation systems. In Chapter 18, we explained and illustrated job costing. The **job cost system (job costing)** accumulates costs incurred to produce a product according to individual jobs. For example, construction companies use job costing to keep track of the costs of each construction job.

This chapter discusses another cost accumulation system, process costing. The chapter begins with a discussion of the nature of a process cost system. We review the similarities and differences between job costing and process costing. We also present an extended illustration of process costing that includes a discussion of equivalent units of production and the production cost report. In the chapter appendixes, we discuss and illustrate FIFO process costing and the allocation of joint product costs.

## Nature of a process cost system

Many businesses produce large quantities of a single product or similar products. Pepsi-Cola makes soft drinks, Exxon Mobil produces oil, and Kellogg Company produces breakfast cereals on a continuous basis over long periods. For these kinds of products, companies do not have separate jobs. Instead, production is an ongoing process.

A **process cost system (process costing)** accumulates costs incurred to produce a product according to the processes or departments a product goes through on its way to completion. Companies making paint, gasoline, steel, rubber, plastic, and similar products using process costing. In these types of operations, accountants must accumulate costs for each process or department involved in making the product. Accountants compute the cost per unit by first accumulating costs for the entire period (usually a month) for each process or department. Second,

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they divide the accumulated costs by the number of units produced (tons, pounds, gallons, or feet) in that process or department.

In "A broader perspective: Producing cans of Coca-Cola", we describe production in bottling and canning plants that use a process cost system. Job costing and process costing have important similarities:

- Both job and process cost systems have the same goal: to determine the cost of products.
- Both job and process cost systems have the same cost flows. Accountants record production in separate accounts for materials inventory, labor, and overhead. Then, they transfer the costs to a Work in Process Inventory account.
- Both job and process cost systems use predetermined overhead rates (defined in Chapter 18) to apply overhead.

Job costing and process costing systems also have their significant differences:

- Types of products produced. Companies that use job costing work on many different jobs with different production requirements during each period. Companies that use process costing produce a single product, either on a continuous basis or for long periods. All the products that the company produces under process costing are the same.
- Cost accumulation procedures. Job costing accumulates costs by individual jobs. Process costing accumulates costs by process or department.
- Work in Process Inventory accounts. Job cost systems have one Work in Process Inventory account for each job. Process cost systems have a Work in Process Inventory account for each department or process.

Exhibit 1 shows the cost flows in a process cost system that processes the products in a specified sequential order. That is, the production and processing of products begin in Department A. From Department A, products go to Department B. Department B inputs direct materials and further processes the products. Then Department B transfers the products to Finished Goods Inventory. For illustration purposes, we assume that all the process cost systems in this chapter are sequential. There are many production flow combinations; Exhibit 2 presents three possible production flow combinations.

### Process costing illustration

Assume that Jax Company manufactures and sells a chemical product used to clean kitchen counters and sinks. The company processes the product in two departments. Department A crushes powders and blends the basic materials. Department B packages the product and transfers it to finished goods. Exhibit 2 shows this manufacturing process.

The June production and cost data for Jax Company are:

	<b>Department A</b>	<b>Department B</b>
Beginning inventory	-0-	-0-
Units started, completed, and transferred	11,000	9,000
Units on hand June 30, partially completed	-0-	2,000
Direct materials	\$16,500	\$1,100
Direct labor	2,500	2,880
Actual overhead	7,500	8,600
Applied overhead	7,400	8,880

**Illustration 19.1** Cost Flows in a Process Cost System

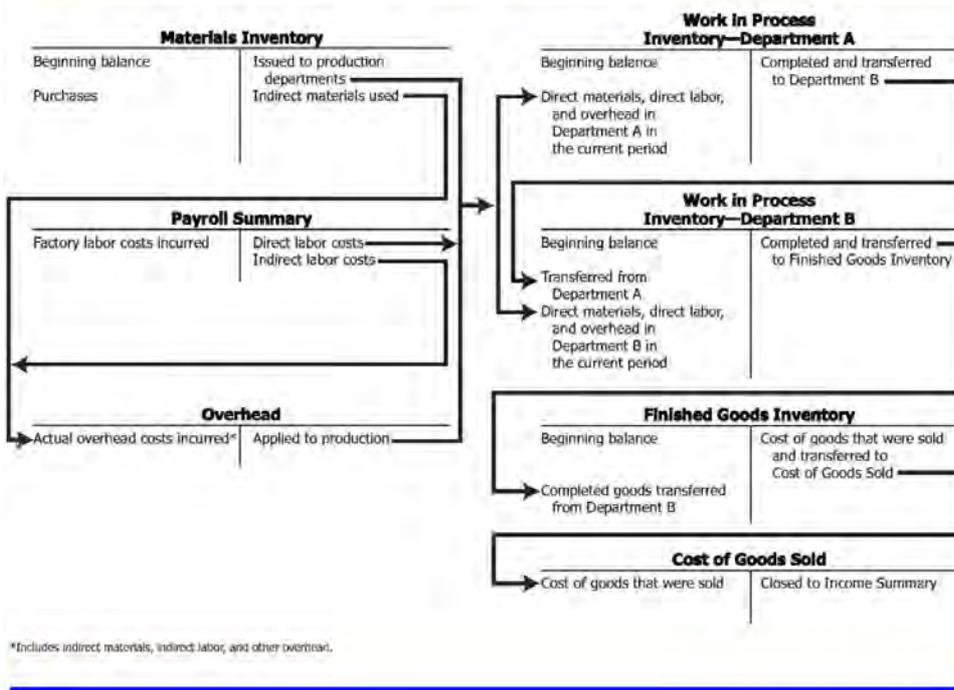


Exhibit 1: Cost flows in a process cost system

(Jax's accountant applies manufacturing overhead in Departments A and B based on the machine-hours used in production.) From these data, we can construct and summarize the Work in Process Inventory—Department A account below.

Work in process inventory – Department A		
Direct materials	16,500	Transferred to department B: 11,000 units @ \$2.40
Direct labor	2,500	
Applied overhead	7,400	
Balance	-0-	

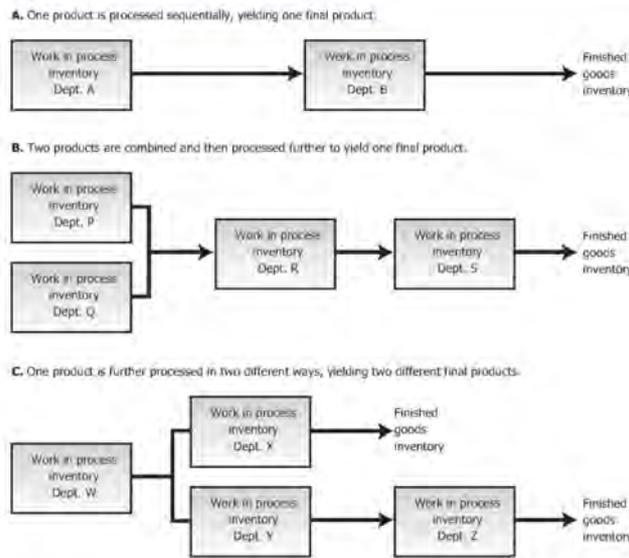
Department A completed all the units it started in June and transferred them to Department B. So all the costs assigned to these units were transferred to Department B. Jax's accountant computed the unit costs in Department A by dividing the USD 26,400 total costs by the 11,000 units completed and transferred. The result is USD 2.40, the average unit cost of 11,000 units.

Computations are seldom this simple; one complication is partially completed inventories. Consider Department B, for example. Before Department B transfers the cost of completed units, its Work in Process Inventory account for June is as follows:

Work in process inventory – Department B	
Transferred in from department A	26,400
Costs added in Dept. B:	
Direct materials	1,100
Direct labor	2,880
Applied overhead	8,880
Balance	39,260

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**Illustration 19.2 Possible Production Flow Combinations**



**Illustration 19.3 Product Flows in a Process Cost System (Jax Company example)**

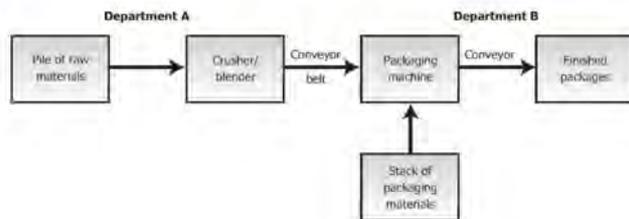


Exhibit 2: Possible production flow combinations

**A broader perspective:**

**Producing cans of Coca-Cola®**

How was the Diet Coke® I just finished drinking produced? A Coca-Cola bottling plant purchased cola syrup or a concentrate from The Coca-Cola Company, combined it with carbonated water, put it in cans, and sealed the cans. (Although these plants are usually called bottling plants, they also produce cans of Coke®.)

In a bottling plant, the first process combines the syrup or concentrate with carbonated water to make cola. In a second process, empty cans are rinsed and inspected. A third process combines these two materials by pouring the cola into the cans. Next, tops are placed on the cans. Finally, the cans are combined into packages. This completes the work in process stage.

The product enters finished goods inventory when it is sent to the warehouse. The product becomes cost of goods sold to the bottling plants when it is shipped to distributors or retail outlets.

Source: Based on the authors' research and documents provided by The Coca-Cola Company. Coca-Cola, Diet Coke, and Coke are registered trademarks of The Coca-Cola Company.

Recall that direct materials, direct labor, and applied overhead are product costs; that is, the costs attach to the product. Thus, Transferred in from Department A in the T-account represents the direct materials, direct labor, and applied overhead costs assigned to products in Department A. These costs have followed the physical units to Department B.

Now, Jax's accountant must divide the USD 39,260 total costs charged to Department B in June between the units transferred out and those remaining on hand in the department. The accountant cannot divide USD 39,260 by 11,000 units to get an average unit cost because the 11,000 units are not alike. Department B has 9,000 finished units and has 2,000 partially finished units. To solve this problem, the accountant uses the concept of equivalent units of production, which we discuss next.

Essentially, the concept of **equivalent units** involves expressing a given number of partially completed units as a smaller number of fully completed units. For example, if we bring 1,000 units to a 40 per cent state of completion, this is equivalent to 400 units that are 100 per cent complete. Accountants base this concept on the supposition that a company must incur approximately the same amount of costs to bring 1,000 units to a 40 per cent level of completion as it would to complete 400 units.

On the next page look at Exhibit 3, a diagram of the concept of equivalent units. As you examine the diagram, think of the amount of water in the glasses as costs that the company has already incurred.

The beginning step in computing Department B's equivalent units for Jax Company is determining the stage of completion of the 2,000 unfinished units. These units are 100 per cent complete as to **transferred-in costs**; if they were not, Department A would not have transferred them to Department B. In Department B, however, the units may be in different stages of completion regarding the materials, labor, and overhead costs. Assume that Department B adds all materials at the beginning of the production process. Then both ending inventory and units transferred out would be 100 per cent complete as to materials. Therefore, equivalent production for materials would be 11,000 units.

Accountants often assume that units are at the same stage of completion for both labor and overhead. Accountants call the combined labor and overhead costs conversion costs. **Conversion costs** are those costs incurred to convert raw materials into the final product.

Let us assume that, on average, the 2,000 units in ending inventory are 40 per cent complete as to conversion costs. This means that Department B transferred out 9,000 units fully completed and brought 2,000 units to a 40 per cent completion state. Department B now has an equivalent of 800 fully completed units remaining in inventory ( $800 = 2,000 \times 40$  per cent). The equivalent units for labor and overhead would therefore be 9,800 units.

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**Illustration 19.4 The Concept of Equivalent Units**

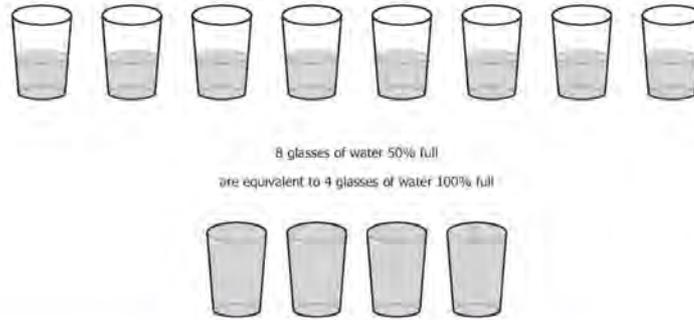


Exhibit 3: The concept of equivalent units

The formula for equivalent units for each cost element (transferred-in, materials, and conversion) is:

$$\text{Equivalent units} = \text{Units completed} + (\text{Units in ending inventory} \times \text{per cent complete})$$

When we know the equivalent units of production, we can compute unit costs for transferred-in, materials, and conversion elements. The average unit cost formulas for each cost element are:

$$\text{Unit cost for transferred} = \frac{\text{Total transferred costs}}{\text{Equivalent units for transferred costs}}$$

$$\text{Unit cost for materials} = \frac{\text{Total materials costs}}{\text{Equivalent units for conversion costs}}$$

$$\text{Unit cost for conversion} = \frac{\text{Total conversion costs}}{\text{Equivalent units for conversion costs}}$$

Now we can compute unit costs for each element in Department B as follows:

	<b>Transferred-in</b>	<b>Materials</b>	<b>Conversion</b>	<b>Total</b>
Costs to be accounted for:				
Charged to Department B	\$26,000	\$1,100	\$11,760*	\$39,260
Equivalent units	11,000	11,000	9,800†	
Unit costs	\$ 2.40	\$ 0.10	\$ 1.20	\$ 4.70

\*Conversion costs consist of direct labor + overhead (\$2,880 + \$8,880).

†Units transferred out (9,000) + equivalent units in ending inventory (800).

We can use the USD 3.70 computed unit costs to divide Department B's USD 39,260 June costs between the units completed and transferred out and the units remaining in the department's ending inventory. We do this in the following table:

	<b>Transferred-in (@ \$2.40)</b>	<b>Materials (@ \$0.10)</b>	<b>Conversion (@ \$1.20)</b>	<b>Total</b>
Costs accounted for:				
Units completed and transferred out (9,000 units)	\$21,600	\$900	\$10,800	\$33,300
Units remaining in ending inventory (2,000 units)	4,800	200	960*	5,960
Costs accounted for	\$26,400	\$1,100	\$11,760	\$39,260

\*Equivalent units = 800 units

The USD 33,300 total costs transferred out of Department B consist of USD 21,600 transferred in from Department A (9,000 X USD 2.40), USD 900 of materials costs (9,000 X USD 0.10), and USD 10,800 of conversion costs (9,000 X USD 1.20), or a total cost of USD 3.70 per unit. The 2,000 units of ending inventory in Department B are fully complete as to costs transferred in from Department A and materials and 40 per cent complete as to conversion. We calculate the ending inventory cost as follows:

Costs from Department A (2,000 x \$2.40)		\$4,500
Costs added by Department B:		
Materials (2,000 x \$0.10)	\$200	
Conversion (800 equivalent units x \$1.20)	960	1160
Total cost of ending inventory		\$5,960

Jax carries units transferred out of Department B in finished goods inventory at a cost of USD 3.70 each until they are sold. Then, Jax charges the cost of units sold to Cost of Goods Sold.

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### An ethical perspective: Rynco Scientific Corporation

Rynco Scientific Corporation was a manufacturer of contact lenses that the Securities and Exchange Commission (SEC) investigated concerning the way it computed equivalent units of production. According to the SEC, Rynco made errors in calculating the equivalent units of production that materially overstated its ending inventory, and understated its losses. As a result of the SEC's investigation, Rynco agreed to hire an accounting firm to conduct a thorough study of its financial statements for a five-year period, and it agreed to restate its financial statements to conform to generally accepted accounting principles.

We have discussed how to determine the costs of each cost element placed in production, transferred to finished goods inventory, and charged to cost of goods sold. Now let us look at the summary of the journal entries for these activities for the month of June.

1.	Work in process inventory – Department A (+A)	16,500	
	Work in process inventory – Department B (+A)	1,100	
	Materials inventory (-A)		17,600
	To record materials placed in production in June.		
2.	Work in process inventory – Department A (+A)	2,500	
	Work in process inventory – Department B (+A)	2,880	
	Payroll summary (+L)		5,380
	To assign labor costs to departments.		
3.	Work in process inventory – Department A (+A)	7,400	
	Work in process inventory – Department B (+A)	8,880	
	Overhead (or manufacturing overhead) (+SE)		16,280
	To apply overhead to production.		
4.	Work in process inventory – Department B (+A)	26,400	
	Work in process inventory – Department A (-A)		26,400
	To record transfer of goods from Department A to Department B.		
5.	Overhead (of Manufacturing Overhead) (-SE)	16,100	
	Various accounts – Cash, Accounts payable, accruals, and accumulated depreciation (varies)		16,100
	To record actual overhead costs incurred in June.		
6.	Finished goods inventory (+A)	33,300	
	Work in process inventory – Department B (-A)		33,300

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To record transfer of completed goods from Department B to finished goods.

If Jax Company sold 6,000 of these completed units in June at USD 10 per unit on account, it would make the following entries:

7. Accounts receivable (+A)	60,000	
Sales (+SE)		60,000
To record sales on account.		
8. Cost of goods sold (-SE)	22,200	
Finished goods inventory (-A)		22,200
To record cost of goods sold in June, 6,000 units @ \$3.70.		

The key document in a process costing system is the production cost report. A **production cost report** shows both the flow of units and the flow of costs through a processing center. It also shows how accountants divide these costs between the cost of units completed and transferred out and the cost of units still in the processing center's ending inventory. This report makes the equivalent unit and unit cost computations easier.

To illustrate the preparation of a production cost report with partially completed beginning and ending inventories, assume the following June 2011 data for Department 3 of a different company, Storey Company:

<b>Units</b>	
Units in beginning inventory, complete as to materials, 60% complete as to conversion costs	6,000
Units transferred in from Department 2	18,000
Units completed and transferred out	16,000
Units in ending inventory, completed as to materials, 50% complete as to conversion costs	8,000

<b>Costs</b>		
Cost of beginning inventory:		
Costs transferred in from Department 2 in May	\$12,000	
Materials added in May in Department 3	6,000	
Conversion costs (labor and overhead)	3,000	\$21,000
Costs transferred in from Department 2 in June		37,200
Costs added in Department 3 in June:		
Materials	\$18,480	
Conversion (equal amounts of labor and overhead)	18,000	36,480
Total costs in beginning inventory and placed in production in Department 3 in June		\$94,680

The preparation of the production cost report includes the following four steps:

- Trace the physical flow of the units through the production department.
- Convert actual units to equivalent units.
- Compute unit costs for each cost element.
- Distribute the total cost between the units completed and transferred out and the units remaining in the ending inventory.

Using the June data, Storey developed the production cost report for Department 3 shown in Exhibit 5.

The first step in the preparation of a production cost report is to trace the physical flow of actual units in and out of Department 3. The units section in Exhibit 5 shows that Department 3 had 6,000 units in the June beginning inventory. Department 3 also had 18,000 units transferred in from Department 2. This makes a total of 24,000 units for which Department 3 must account.

Of these 24,000 units, Department 3 completed and transferred out 16,000 units (either to the next processing department or to finished goods). At the end of the month, Department 3 had 8,000 partially completed units. These 8,000 units are the June ending inventory. Now we are ready for the second step in the preparation of the production cost report—to convert actual units to equivalent units.

Storey Company's cost of production report uses the average cost procedure. Under the **average cost procedure**, the number of equivalent units for each cost element equals the number of units transferred out plus the number of equivalent units of that cost element in the ending inventory. The average cost procedure does not consider the number of units in the beginning inventory and the degree of completion of the beginning inventory. Alternatively, Storey could use First-in, First-out (FIFO) or Last-in, First-out (LIFO). We use the average cost procedure in this chapter because it is simpler and commonly used in practice.

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<b>Storey Company Production Cost Report - For the month of June 2011</b>					
<b>Units</b>	<b>Actual units</b>	<b>Department 3 Transferred- in</b>	<b>Equivalent units Materials</b>	<b>Conversion</b>	
Units in beginning inventory	6,000				
Units transferred in from Department 2	18,000				
Units to be accounted for	24,000				
Units completed and transferred out	16,000	16,000	16,000	16,000	
Units in ending inventory*	8,000	8,000	8,000	4,000	
Units accounted for	24,000	24,000	24,000	20,000	
<b>Costs</b>		<b>Transferred- in</b>	<b>Materials</b>	<b>Conversion</b>	<b>Total</b>
Costs to be accounted for:					
Costs in beginning inventory		\$12,000	\$6,000	\$3,000	\$21,000
Costs transferred in from Department 2 in June		37,200			37,200
Costs added in Department 3			18,480	18,000	36,480
Costs to be accounted for		\$49,200	\$24,480	\$21,000	\$94,680
Equivalent units (from above)	24,000	24,000	24,000	20,000	
Unit cost (per equivalent unit)†		\$2.05	\$1.02	\$1.05	\$4.12
Costs accounted for:					
Units completed and transferred out (16,000 units)		\$32,800	\$16,320	\$16,800	\$65,920
Units remaining in ending inventory (8,000 units)*		16,400	8,160	4,200	28,760
Costs accounted for		\$49,200	\$24,480	\$21,000	\$94,680

\*Inventory is complete as to materials added, 50% complete as to conversion.

† Unit cost equals costs to be accounted to divided for divided by equivalent units.

### Exhibit 4: Production cost report

Storey's units in the ending inventory are fully complete as to costs transferred in and materials cost. Therefore, the number of equivalent units for each of these cost elements is 24,000 (16,000 units completed and transferred out + [8,000 units in the ending inventory X 100 per cent complete for transferred-in costs and materials costs]). The 8,000 units remaining in ending inventory are 50 per cent complete as to conversion. Therefore, there are 20,000 equivalent units with regards to conversion—16,000 units transferred out plus 8,000 units in ending inventory that were 50 per cent complete.

Once a company has computed its equivalent units, it must calculate the unit costs. This is the third step in preparing the production cost report. Each cost element of production—costs transferred in, materials, and conversion—has accumulated costs. Notice in Exhibit 4 that for each cost element, we total the costs of beginning inventory and costs of the current month. We refer to the total costs charged to a department as costs to be accounted for. These costs must either be transferred out or appear in the ending inventory of Department 3.

To determine the cost per equivalent unit for each cost element, divide the total cost for each cost element by the equivalent units of production related to that cost element. (Since we totaled all costs for each cost element before the division, we can average the computed unit costs across the current and prior period.) Exhibit 4 shows the average per unit costs for June as transferred-in costs, USD 2.05; materials costs, USD 1.02; and conversion costs, USD 1.05. In monitoring these costs closely for cost control purposes, management watches for extreme fluctuations from one month to the next.

The last step in preparing the production cost report is to allocate costs between the units completed and transferred out and the units remaining in ending inventory. The units transferred out were fully complete as to all elements of production. Therefore, we can multiply the 16,000 units by USD 4.12, the total cost per unit. The result, USD 65,920, is the amount Storey assigns to the next department as cost transferred in or to finished goods as the cost of completed current period production. We now compute the cost of ending inventory as follows:

8,000 equivalent units transferred in @ \$2.05  
8,000 equivalent units of materials costs @ \$1.02  
4,000 equivalent units of conversion costs @ \$1.05  
Total cost of ending inventory

The sum of the ending inventory cost and the cost of the units transferred out must equal the total costs to be accounted for. This built-in check determines whether the company has properly followed the procedures of cost allocation. As shown in the production cost report, Department 3 adds the USD 65,920 costs transferred out to the USD 28,760 ending inventory cost. The total equals the USD 94,680 for which Department 3 must account.

Some companies replace the production cost report with three schedules. The first schedule is the schedule of equivalent production. This schedule computes the equivalent units of production for the period for transferred-in, materials, and conversion costs. The second schedule is the unit cost analysis schedule. This schedule sums all the costs charged to the Work in Process Inventory account of each production process department. Then it calculates the cost per equivalent unit for transferred-in, materials, and conversion costs. The third schedule is the cost summary schedule. This schedule uses the results of the preceding two schedules to distribute the total costs accumulated during the period among all the units of output. Companies generally show these three schedules in a process cost analysis report.

Companies that use a process cost system may use the **first-in, first-out (FIFO) method** instead of the average cost procedure. Generally, under FIFO, the equivalent number of units for each cost element consists of:

- Work needed to complete the units in beginning inventory.
- Work done on units started and completed during the period.
- Work done on partially completed units in ending inventory.

Appendix 19-A, at the end of this chapter, illustrates this method.

Now that you have studied both job costing in Chapter 18 and process costing in this chapter, you can appreciate why manufacturing companies must accurately account for product unit costs. Without accurate cost accounting information, a manufacturing company cannot determine the cost of its products for managerial decision making or prepare accurate financial statements.

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### Process costing in service organizations

Service organizations that provide similar services to a variety of customers are potential users of process costing. For example, a clinic dispensing flu shots, a delicatessen selling only pastrami sandwiches, and a photo shop that processes pictures could use process costing. In manufacturing, the difficult task is to match period costs with the units produced that period, which is why companies compute equivalent units of production. (And that is what most people find difficult about process costing.)

Generally, service companies complete the service by the end of the period and have no work in process at the end of the period. Nurses do not leave for home halfway through giving a flu shot, and the delicatessen does not partially serve a sandwich one month and complete it the next. Consequently, there is no need to compute equivalent units, which simplifies process costing.

Note that some service companies do have partially completed work at the end of the period. Certain types of dry cleaning and photo processing may still be in process at the end of a period. You could apply the methods described in this chapter for manufacturing to those service companies. For materials, you could substitute any significant supplies, and for conversion costs, service labor and overhead.

### Spoilage

If you have ever tried to make something that did not work out, you know the concept of spoilage. **Spoilage** refers to the loss of goods during production. For example, suppose some of the cans are dented during the canning of tuna fish. Accountants would treat the cost of the dented cans of tuna fish as spoilage.

Accountants treat spoilage either as normal spoilage or abnormal spoilage. **Normal spoilage** occurs in the normal production process. Accountants generally assign normal spoilage costs to the good units produced. According to one method found in practice, accountants divide the total cost of production by the good units produced.

For example, suppose the total cost of producing tuna fish for one day is USD 100,000. The company produced 220,000 cans of tuna fish, but 20,000 cans of tuna fish did not meet quality inspection requirements. Consequently, these 20,000 units were considered to be spoiled in the normal production process. One way accountants deal with the cost of such normal spoilage is to compute the cost per good unit by dividing total production costs by the number of good cans of tuna fish produced. That is:

$$\text{Cost per good unit} = \frac{\text{USD } 100,000}{200,000 \text{ good units produced}}$$

$$= \text{USD } 0.50 \text{ per good unit produced}$$

**Abnormal spoilage** refers to spoilage that exceeds the amount expected under normal operating conditions. For example, if denting the tuna fish cans is unusual, accountants would treat the cost of those dented cans of tuna fish as abnormal spoilage. Whereas normal spoilage costs are assigned to good products, abnormal spoilage costs are typically expensed. Thus, accountants treat normal spoilage as a product cost and abnormal spoilage as a period cost.

Advocates of total quality management may prefer to classify all spoilage as abnormal. Normal spoilage costs are buried in the costs of the good products. Unless management personnel ask for a special analysis of spoilage costs,

they will not know whether the spoilage costs are a small per cent or a large per cent of product costs. For example, management could see a report on tuna fish production costs stating the cost is USD 0.50 per can, but they do not know how much of the USD 0.50 was the cost of spoilage.

We recommend that accountants report spoilage costs to management, whether normal spoilage or abnormal spoilage, so management can make informed decisions to reduce spoilage.

### Understanding the learning objectives

- Process cost systems are used for businesses that produce products on a continuous basis over long periods.
- Paint, paper, chemicals, gasoline, beverages, and food products should be accounted for under a process cost system.
- Types of products produced under each system: Companies that use job costing work on many different jobs with different production requirements during each period. Companies that use process costing produce a single product, either on a continuous basis or for long periods.
- Cost accumulation procedures used under each system: Job costing accumulates costs by individual jobs. Process costing accumulates costs by process or department.
- Work in Process accounts: Job cost systems have a Work in Process Inventory account for each job. Process cost systems have a Work in Process Inventory account for each department or process.
- Whenever partially completed inventories are present, the number of equivalent units of production must be computed. Basically, the concept of equivalent units involves expressing a given number of partially completed units as a smaller number of fully completed units.
- As a simple example of equivalent units, two apples that are half eaten are equivalent to one whole apple eaten. In manufacturing, we estimate the degree of completion for a group of products with respect to transferred-in, materials, and conversion (direct labor and overhead). Accountants base the concept of equivalent units on the supposition that a company must incur approximately the same costs to partially complete a large number of units as to totally complete a smaller number of units.
- Accountants compute equivalent units of production for transferred-in units, materials, and conversion. For each of these categories, the number of units transferred out is added to the equivalent units remaining in ending work in process in the department.
- Unit costs for the three categories—transferred-in units, materials, and conversion—are determined by dividing the equivalent units into the cost in beginning inventory plus the costs transferred in or added in the department during this period.
- A production cost report shows both the flow of units and the flow of costs through a processing center. The report is divided into two parts. The first part traces the physical flow of the units through the production department and converts actual units to equivalent units. The second part shows the costs to be accounted for, computes unit costs based on equivalent units as determined in the first part, and shows how the costs were accounted for by adding the costs completed and transferred out with the costs remaining in ending inventory. The costs to be accounted for and the costs accounted for must balance.

## 19. Process: Cost systems

- The production cost report provides a check on the Work in Process Inventory account. Each processing department normally has its own Work in Process Inventory account and related production cost report. The separate items that make up work in process inventory—direct labor, direct materials, applied overhead, and cost of units transferred in and out—can be traced from the production cost report to the Work in Process Inventory account (and vice versa) during a given period.
- Normal spoilage occurs in the normal course of production and is treated as a product cost. Abnormal spoilage exceeds the spoilage that occurs in the normal course of production and is treated as a period cost.
- Under FIFO equivalent units of production are computed by taking the equivalent units of work done to complete the beginning inventory, plus units started and completed during the current period, plus equivalent units of work done on the ending inventory. As is true under the average cost method, the equivalent units usually differ between materials and conversion.
- Unit costs for the three categories—transferred-in units, materials, and conversion—are determined by dividing cost to be accounted for during the period by units produced during the period.
- The physical measures method allocates joint product costs based on physical measures, such as units, pounds, or liters.
- The relative sales value method is the most commonly used method to allocate joint product costs. It is based on the relative sales values of the products at the split-off point.

### Appendix 19A: The FIFO process cost method

In this chapter, the discussion assumed the use of the average cost method for determining unit costs under process costing. Another acceptable method for determining unit cost under process costing is the first-in, first-out (FIFO) cost method. This appendix presents a detailed illustration of the FIFO process costing system.

The following table shows how the computation of equivalent units differs between the average cost method and the FIFO cost method:

<b>Average cost method</b>	<b>FIFO cost method</b>
Equivalent units of production = Units completed this period + Equivalent units of work done on the ending inventory	Equivalent units of production = equivalent units of work done to complete the beginning inventory + units started and completed this period + Equivalent units of work done on the ending inventory

To illustrate the computation of equivalent units under the FIFO method, assume the following facts:

Beginning inventory, 3,000 units, 40% complete  
 Units started this period, 10,000 units  
 Ending inventory, 5,000 units, 20% complete

The equivalent production for the period would be:

Equivalent units of work done to complete the beginning inventory (3,000 × 0.60)	1,800
Units started and completed this period (10,000 – 5,000 in ending inventory)	5,000
Equivalent units of work done to partially complete the ending inventory (5,000 × 0.20)	1,000
Equivalent units of production	7,800

As is true under the average cost method, the number of equivalent units usually differs between materials and conversion.

### FIFO process costing—An illustration

To illustrate more completely the operation of the FIFO process cost method, we use an example of the month of June production costs for a company having Departments A and B. Both departments add materials only at the beginning of processing. Department A has no May 31 inventory. The May 31 inventory in Department B consists of 2,000 units that are fully complete as to materials and 50 per cent complete as to conversion. This inventory has accumulated costs of USD 6,180.

The following transactions and additional data summarize manufacturing operations in both departments for June:

Raw materials purchased on account, USD 25,000.

Direct materials issued: Department A (14,000 units at USD 1.50), USD 21,000; and Department B (10,000 units at USD 0.13), USD 1,300.

Indirect materials issued: Department A, USD 400; and Department B, USD 200.

Labor costs: direct labor, Department A, USD 6,600, Department B, USD 5,400; and indirect labor, USD 3,000.

Manufacturing overhead is applied as follows: USD 5,280 in Department A and USD 5,400 in Department B.

Other manufacturing overhead incurred:

Repairs (on account)	\$2,100
Depreciation	3,000
Utilities (on account)	3,000
	\$8,100

- Production reports show the following for June:

	<b>Department A</b>	<b>Department B</b>
Beginning inventory	-0-	2,000
Units started	14,000	10,000
Units completed and transferred out	10,000	9,000
Units in inventory, June 30	4,000	3,000
Estimated percentage	50	33 1/3

- Sales for the month on account, 15,000 units at USD 6 per unit.
- The company computed cost of goods sold at USD 55,866 on a FIFO basis.

The general journal entries and their explanation follow:

1.	Materials inventory (+A)	25,000	
	Accounts payable (+L)		25,000
	To record materials purchased on account.		
2.	Work in process – Department A (+A)	21,000	
	Work in process – Department B (+A)	1,300	
	Manufacturing overhead (-SE)	600	
	Materials inventory (+L)		22,900
	To record direct and indirect materials used.		
3.	Work in process – Department A (+A)	6,600	
	Work in process – Department B (+A)	5,400	
	Manufacturing overhead (+SE)	3,000	
	Payroll summary (-SE)		15,000
	To distribute labor.		
4.	Work in process – Department A (+L)	5,280	
	Work in process – Department B (-A)	5,400	

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Manufacturing overhead (+A) To record assignment of overhead to production.	10,680	
5. Manufacturing overhead (-A)	8,100	
Accounts payable (+A)		5,100
Accumulated depreciation – Plant and equipment (-A) To record various overhead costs incurred.		3,000
6. Work in process – Department B (+A)	24,900	
Work in process – Department A (+SE) To record transfer of completed production from Department A to Department B. (For details of computation, see production cost report of Department A in Exhibit 6).		24,900
7. Accounts receivable (-SE)	90,000	
Sales (-A) To record sales for the month.		90,000
8. Cost of goods sold	55,866	
Finished goods To record cost of goods sold.		55,866

As noted in the journal entries for June's manufacturing operations, the production cost report provided the dollar amounts of certain entries. For product costing purposes, the production cost report is the primary report in a process cost system. The chapter illustration of the production cost report shows the units and costs charged to a department, the disposition of these units and costs, and, typically, some of the supporting details and computations.

**Production cost report—Department A** To illustrate flexibility in format, Exhibit 5 shows the production cost report for Department A in a format different from the one in the chapter. Note that Department A placed 14,000 units into production. Then, Department A completed and transferred out 10,000 units. Department A retained the remaining 4,000 partially completed units in the department. The footnote in the illustration shows the computation of equivalent units.

<b>Department A</b>			
<b>Production cost report</b>			
<b>For the month ended 2011 June 30</b>			
Units in beginning inventory		-0-	
Units started during period		14,000	
Units to be accounted for		14,000	
Units completed and transferred out		10,000	
Units in ending inventory		4,000	
Units accounted for		14,000	
<b>Costs</b>	<b>Equivalent units</b>	<b>Total cost</b>	<b>Current unit cost</b>
Costs to be accounted for:			
Costs added during the month:			
Direct materials	14,000*	\$21,000	\$1.50
Conversion	12,000*	11,880	0.99
Costs added in month and costs to be accounted for		\$32,880	\$2.49
Costs accounted for:			
Cost of ending inventory:			
Direct materials (4,000 x 100% x \$1.50)		\$6,000	
Conversion (4,000 x 50% x \$0.99)		1,980	
Total cost of ending inventory		\$7,980	
Cost of 10,000 units transferred out		24,900	\$2.49
Costs accounted for		\$32,880	

\*Supporting computations and data:

	<b>Materials</b>	<b>Conversion</b>
Computations of equivalent units:		
Equivalent units to complete beginning inventory	-0-	-0-
Units started and completed	10,000	10,000
Equivalent units in partially completed ending inventory	4,000	2,000
Equivalent units of production for month	14,000	12,000

	<b>Materials</b>	<b>Conversion</b>
Computations of equivalent units:		
Equivalent units to complete beginning inventory	-0-	-0-
Units started and completed	10,000	10,000
Equivalent units in partially completed ending inventory	4,000	2,000
Equivalent units of production for month	14,000	12,000

#### Exhibit 5: Production cost report—Department A

The costs section of the report shows that the only costs to be accounted for were those added in the department in June. These costs include USD 21,000 for materials and USD 11,880 for conversion, totaling USD 32,880. Department A had no beginning inventory and no transfers in. Note how Department A determines its unit costs for each of the two elements of manufacturing costs (USD 1.50 for materials and USD 0.99 for conversion). The total current unit cost is USD 2.49. The report shows the disposition of the costs—the cost of the units transferred to Department B (USD 24,900) and the amount of ending inventory remaining in Department A (USD 7,980 based on current unit costs). The units transferred to Department B have the same unit cost as the unit cost in Department A for the month. The current unit cost and the cost of the transferred units is not always the same, as we will show for Department B in Exhibit 6.

#### **Department B Production cost report For the month ended 2011 June 30**

Units			
Units in beginning inventory			2,000
Units started during period			10,000
Units to be accounted for			12,000
Units completed and transferred out			9,000
Units in ending inventory			3,000
Units accounted for			12,000
<b>Costs</b>	<b>Equivalent units</b>	<b>Total cost</b>	<b>Current unit cost</b>
Costs to be accounted for:			
Costs added during the month:			
Direct materials	10,000*	\$ 1,300	\$ 0.13
Conversion	9,000*	10,800	1.20
Costs added during the month		\$12,100	\$ 1.33
Costs in beginning inventory		6,180	
Costs transferred in from Department A		24,900	
Total costs to be accounted for		\$43,180	
Costs accounted for:			
Cost of ending inventory:			
Transferred in from Department A (3,000 units at \$2.49)		\$ 7,340	
Direct materials (3,000 x 100% x \$0.13)		390	
Conversion (3,000 x 1/3 x \$1.20)		1,200	
Total cost of ending inventory		\$ 9,060	
Cost of 9,000 units transferred out		34,120	\$3.791

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Costs accounted for	\$43,180	
*Supporting computations and data:		
	<b>Materials</b>	<b>Conversion</b>
Computations of equivalent units:		
Equivalent units to complete beginning inventory	-0-	1,000
Units started and completed	7,000	7,000
Equivalent units in partially completed ending inventory	3,000	1,000
Equivalent units of production for the month	10,000	9,000

Beginning and ending inventories are complete as to materials. Beginning inventory is 50% complete and ending inventory 33 1/2% complete as to processing.

### Exhibit 6: Production cost report—Department B

**Production cost report—Department B** The production cost report for Department B (Exhibit 6) is similar to that of Department A. Note how the report highlights the current unit cost of the operations performed in the department. Note also that Department B must account for the costs in the beginning inventory and the cost of the units transferred in from Department A. Department B determines the cost of the ending inventory through the use of the current month's unit cost (USD 1.33). All of Department B's other costs are included in the costs of the 9,000 units transferred to Finished Goods.

In the production cost report in Exhibit 6, we determine the cost of units transferred out by subtracting the cost of the ending inventory from the total costs to be accounted for (USD 43,180 - USD 9,060 = USD 34,120). We can compute average unit cost of USD 3.791 by dividing USD 34,120 by the 9,000 units transferred out.

### Appendix 19B: Allocation of joint costs

A company incurs **joint costs** when it produces two or more products through the same production process or from a common raw material. The company produces these products simultaneously. The products are not identifiable as different individual products until a particular point in the manufacturing process known as the split-off point.

The **split-off point** is a certain stage of production at which the separate products become identifiable from a common processing unit. We refer to any costs beyond the split-off point as separable costs because they can be directly traced to individual products. Examples of joint products are petroleum products, lumber, flour milling, dairy products, and chemicals. In Exhibit 7, we show the joint production process.

By definition, joint costs are not identified with individual products. Any allocation of joint costs to one of the products is inherently arbitrary. Many companies do not allocate joint costs to particular products for managerial decision making because the allocated numbers could be misleading to decision makers.<sup>1</sup> The accounting problem we face is how to allocate the joint costs that a company incurred before the products become separately identified. Commonly used methods to allocate joint costs are the physical measures method and the relative sales value method.

The **physical measures method** allocates joint costs on the basis of physical measures such as units, pounds, or liters.

<sup>1</sup> For example, a survey of oil refineries indicated that seven of the nine companies did not allocate joint costs. See K. Slater and C. Wooton, *A Study of Joint and By-Product Costing in the U.K.* (Reprint, London: Chartered Institute of Management Accountants, 1988), p. 110.

To illustrate, assume that Roy Company produces two grades of oil, product A and product B, through a joint process. The cost and production data of Roy Company for July are:

	Product A	Product B	Total
Units (barrels) produced	15,000	25,000	40,000
Unit selling price at split-off	\$ 15	\$ 6	
Revenue at split-off	\$225,000	\$150,000	
Joint product costs:			
Direct materials			\$125,000
Direct labor			105,000
Manufacturing overhead			70,000
			\$300,000

**Illustration 19.8** Production Cost Report—Department B



Exhibit 7: Production cost report-Department B

The physical measures method uses a ratio of the physical volume of each product to total volume as a basis for allocation of joint costs. We compute the allocation of joint costs to each product as follows:

	Total barrels	Ratio	Joint costs	Allocated joint costs
Product A	15,000	$\frac{15,000}{40,000}$	$15,000 \times \$300,000$	\$112,500
Product B	25,000	$\frac{25,000}{40,000}$	$25,000 \times \$300,000$	187,500
	40,000			\$300,000

If Roy Company sells both products without further processing, the gross margin for product A is USD 112,500, or USD 225,000 less USD 112,500. Product B incurs a loss of USD 37,500, or USD 150,000 less USD 112,500. Even though the physical measures method is easy to use, it often has no relationship to the revenue-generating power of each product. In this instance, product B suffers a loss of USD 37,500 because the company allocated a high portion of joint costs based on product B's high volume of physical units even though its selling price is less than that of product A.

Keep in mind that the joint costs cannot be directly assigned to one product because joint costs are inseparable between the products. Thus, because any allocation of joint costs to one product is arbitrary, the resulting measures of each product's income are arbitrary.

The **relative sales value method** is a commonly used basis to allocate joint costs at the split-off point. Accountants use the relative sales value method because it matches joint costs with revenue much like the matching concept.

Using the relative sales value method, Roy Company would allocate the joint costs as follows:

	Sales value at split-off	Ratio	Joint costs	Allocated joint costs
Product A:	\$225,000	$\frac{225,000}{375,000}$	$225,000 \times \$300,000$	\$180,000
(\$15 x 15,000)				
Product B:	150,000	$\frac{150,000}{375,000}$	$150,000 \times \$300,000$	120,000
(\$6 x 25,000)				
	\$375,000			\$300,000

## 19. Process: Cost systems

The allocation ratios of 60 per cent and 40 per cent, respectively, for product A and product B result in allocated joint costs of USD 180,000 to product A, and USD 120,000 to product B.

To compare the physical measures method and the relative sales value method, assume Roy Company has no inventory at the end of July. A partial July income statement would appear as shown:

	<b>Product A</b>		<b>Product B</b>	
	<b>Physical Measures Method</b>	<b>Relative Sales Value Method</b>	<b>Physical Measures Method</b>	<b>Relative Sales Value Method</b>
Sales	\$225,000	\$225,000	\$150,000	\$150,000
Cost of goods sold	112,500	180,000	187,500	120,000
Gross margin	\$112,500	\$ 45,000	\$(37,500)	\$ 30,000

### Demonstration problem

Zarro, Inc., uses a process cost system to accumulate the costs it incurs to produce aluminum awning stabilizers from recycled aluminum cans. The May 1 inventory in the finishing department consisted of 36,000 units, fully complete as to materials and 80 per cent complete as to conversion. The beginning inventory cost of USD 288,000 consisted of USD 216,000 of costs transferred in from the molding department, USD 30,000 of finishing department materials costs, and USD 42,000 of finishing department conversion costs (conversion costs are direct labor and overhead). The costs incurred in the finishing department for May appear as follows:

Costs transferred in from molding department (excluding costs in beginning inventory)		\$720,000	
Costs added in finishing department in May (excluding costs in beginning inventory):	\$63,600		
Materials	131,376	194,976	
Conversion costs		\$914,976	

The finishing department received 120,000 units from the molding department in May. During May, 127,200 units were completed by the finishing department and transferred out. As of May 31, 28,800 units, complete as to materials and 60 per cent complete as to conversion, were left in inventory of the finishing department.

- Using the average cost procedure, prepare a production cost report for the finishing department for May.
- Compute the average unit cost for conversion in the finishing department in April.

### Solution to demonstration problem

a.

<b>Zarbo, Inc.</b>				
<b>Finishing department</b>				
<b>Production cost report</b>				
<b>For the month ending</b>				
<b>May 31</b>				
<b>Units</b>	<b>Actual units</b>	<b>Transferred -in</b>	<b>Equivalent units</b>	<b>Conversion</b>
			<b>Materials</b>	
Units in May 1 inventory	36,000			
Units transferred in	120,000			
Units to be accounted for	156,000			
Units completed and transferred out	127,000	127,200	127,200	127,200*
Units in May 31 inventory*	28,800	28,800	28,800	17,280†
Units accounted for	156,000	156,000	156,000	144,480

\*Inventory is complete as to materials, 60% complete as to conversion.

†(28,800 x 60% = 17,280).

<b>Costs</b>	<b>Transferred -in</b>	<b>Materials</b>	<b>Conversion</b>	<b>Total</b>
Costs to be accounted for:				
Costs in May 1 inventory	\$216,000	\$30,000	\$42,000*	\$288,000
Costs transferred in	720,000			720,000

Costs added in department	63,600	131,376	194,976	
Costs to be accounted for	\$936,000	\$93,600	\$ 173,376	\$1,202,976
Equivalent units (from above)	156,000	156,000	144,480	
Unit costs	\$ 6.00	\$ 0.60	\$ 1.20	\$7.80
Costs accounted for:				
Units completed and transferred out (127,200 units)	\$763,200	\$76,320	\$ 152,640*	\$992,160
Units remaining in May 31 inventory (28,800 units)	172,800	17,280	20,736*	210,816
Costs accounted for	\$936,000	\$93,600	\$173,376	\$1,202,976

\*17,280 equivalent units x \$1.20 = \$20,736.

b. The average unit cost for conversion in the finishing department in April was USD 1.46, calculated as

$$\frac{\text{USD}42,000}{(0.8 \times 36,000)}$$

### Key terms

**Abnormal spoilage** Spoilage that exceeds the amount expected under normal operating conditions.

**Average cost procedure** A method of computing equivalent units where the number of equivalent units for each cost element equals the number of units transferred out plus the number of equivalent units of that cost element in the ending inventory.

**Conversion costs** Costs of converting raw materials into the final product. Direct labor plus overhead.

**Equivalent units** A method of expressing a given number of partially completed units as a smaller number of fully completed units; for example, bringing 1,000 units to a 75 per cent level of completion is the equivalent of bringing 750 units to a 100 per cent level of completion.

**First-in, first-out (FIFO) method** A method of determining unit cost. This method computes equivalent units by adding equivalent units of work needed to complete the units in beginning inventory, work done on units started and completed during the period, and work done on partially completed units in ending inventory.

**Job cost system (job costing)** A manufacturing cost system that accumulates costs incurred to produce a product according to individual jobs.

**Joint costs** Those production costs incurred up to the point where the joint products split off from each other.

**Normal spoilage** Spoilage that occurs in the normal production process.

**Physical measures method** A method of allocating joint product costs on the basis of physical measures such as units, pounds, or liters.

**Process cost system (process costing)** A manufacturing cost system that accumulates costs incurred to produce a product according to the processes or departments a product goes through on its way to completion.

**Production cost report** A report that shows both the flow of units and the flow of costs through a processing center. It also shows how accountants divide these costs between the cost of units completed and transferred out and the cost of units still in the processing center's ending inventory.

**Relative sales value method** A method of allocating joint product costs on the basis of the relative market value at the split-off point.

**Split-off point** A certain stage of production at which the separate products become identifiable from a common processing unit.

**Spoilage** The loss of goods during production.

**Transferred-in costs** Costs associated with physical units that were accumulated in previous processing centers.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

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In process costing, costs are accumulated by process or department.

Both job and process cost systems can only have one Work in Process Inventory account.

The first step in computing equivalent units is to determine the amount of materials being used.

Abnormal spoilage is treated as a product cost.

(Based on Appendix 19-B.) A commonly used basis to allocate joint costs is the relative sales value of the products at the split-off point.

### Multiple choice

Select the best answer for each of the following questions.

Which of the following does not apply to process costing?

- a. Uses the equivalent unit concept.
- b. Includes overhead in product costs.
- c. Costs of production are first recorded in Work in Process Inventory accounts then transferred to Finished Goods Inventory and Cost of Goods Sold.
- d. Keeps track of the actual cost of each individual unit produced.

Which of the following formulas is the correct formula for equivalent units of production under the average cost procedure?

- a.  $\text{Units completed} - [\text{Units in ending inventory} \times \text{Percentage complete}] = \text{Equivalent production}$
- b.  $\text{Units completed} - [\text{Units in beginning inventory} \times \text{Percentage complete}] = \text{Equivalent production}$
- c.  $\text{Units completed} + [\text{Units in ending inventory} \times \text{Percentage complete}] = \text{Equivalent production}$
- d. None of the above.

Using the following data, compute the ending inventory cost:

1,000 units are in ending inventory in Department B. The 1,000 units are fully complete as to materials and 20 per cent complete as to conversion. The unit cost for materials is USD 0.05, and conversion unit cost equals USD 0.60. The unit cost of goods transferred in from Department A is USD 1.20.

- a. USD 1,370.
- b. USD 1,170.
- c. USD 1,320.
- d. USD 1,250.

A production cost report reports which of the following:

- a. Units in a production department.
- b. Costs related to production.

- c. Unit costs.
- d. Equivalent units.
- e. All of the above are included in the production cost report.

(Based on Appendix 19-A) Compute the equivalent units of production under the FIFO method using this data:

Beginning inventory, 1,500 units—40 per cent complete

Units started this period, 5,000 units

Ending inventory, 2,500 units—20 per cent complete

- a. 3,000.
- b. 3,900.
- c. 3,400.
- d. 3,600.

Now refer to “Answers to self-test” at the end of the chapter to check your answers.

## Questions

- Define process costing and describe the types of companies that use process costing.
- How does a process cost system differ from a job costing system?
- Would a lumber mill use process or job costing?
- What is meant by the term equivalent units? Of what use is the computation of the numbers of equivalent units of production?
- Distinguish between the number of units completed and transferred during a period and the equivalent units for the same period.
- Under what circumstances would the number of equivalent units of materials differ from the number of equivalent units of labor and overhead in the same department in the same period? Under what circumstances would they be the same?
- When transferring goods from one department to another, which accounts require journal entries?
- Units are usually assumed to be at the same stage of completion for both labor and overhead. What is the reason for this assumption?
- What is the basic information conveyed by a production cost report?
- What are the four steps in preparing a production cost report?
- What is meant by average cost procedure? What other two cost flow assumptions could be used?
- Would an automobile plant that makes specialty race cars use job costing or process costing? Would an automobile plant that makes all terrain vehicles use job costing or process costing? Explain your answer.

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- What is the difference between normal and abnormal spoilage?
- Why might an advocate of total quality management prefer to see all spoilage labeled as abnormal?
- Show the differences between computing equivalent units of production using the average cost method and FIFO cost method (Appendix 19A).
- Describe the relative sales value method and show how it is used (Appendix 19B).
- **Real world question** Refer to "A broader perspective: Producing cans of Coca-Cola". Describe the different processes used in a cola bottling plant.
- **Real world question** Does The Coca-Cola Company use a process cost system or a job costing system in its bottling plants? Why?
- **Real world question** Name five companies that probably use process costing.

### Exercises

**Exercise A** Using the average cost method, compute the equivalent units of production in each of the following cases:

a. Units started in production during the month, 72,000; units completed and transferred, 52,800; and units in process at the end of the month (100 per cent complete as to materials; 60 per cent complete as to conversion), 19,200. (There was no beginning inventory.)

b. Units in process at the beginning of the month (100 per cent complete as to materials; 30 per cent complete as to conversion), 12,000; units started during the month, 48,000; and units in process at the end of the month (100 per cent complete as to materials; 40 per cent complete as to conversion), 24,000.

**Exercise B** In Department C, materials are added at the beginning of the process. There were 1,000 units in beginning inventory, 10,000 units were started during the month, and 7,000 units were completed and transferred to finished goods inventory. The ending inventory in Department C in June was 40 per cent complete as to conversion costs. Under the average cost method, what are the equivalent units of production for materials and conversion?

**Exercise C** In Department D, materials are added uniformly throughout processing. The beginning inventory was considered 80 per cent complete, as was the ending inventory. Assume that there were 6,000 units in the beginning inventory and 20,000 in the ending inventory, and that 80,000 units were completed and transferred out of Department D. What are the equivalent units for the period using the average cost method?

**Exercise D** If in the previous exercise the total costs charged to the department amounted to USD 960,000, including the USD 48,000 cost of the beginning inventory, what is the cost of the units completed and transferred out?

**Exercise E** The following data relate to Work in Process—Department C, in which all materials are added at the start of processing:

**Work in process – Department C:  
Inventory, March 1:**

Materials cost (1,200 pounds; 100% complete)	\$7,020
--	---------

Conversion cost (20% complete)	1,804
Costs incurred this period:	
Direct materials used (9,000 pounds)	\$36,330
Direct labor	10,880
Overhead	17,820
Inventory, March 31	
Materials cost (1,800 pounds, 100% complete)	?
Conversion cost (1,800 pounds, 80% complete)	?
Pounds of product transferred out:	8,400

Using these data, compute:

- The unit cost per equivalent unit for materials and conversion (use the average cost method).
- The cost of the product transferred out.

### Problems

**Problem A** The following data refer to a production center of Sipp-Fizz, a soft drink bottler:

Work in process inventory, August 1, 4,000 units (units equal 12-bottle cases):	
Direct materials	\$12,000
Direct labor	6,120
Manufacturing overhead applied	8,000
	\$26,120
Units started in August	12,000
Costs incurred in August:	
Direct materials	\$36,000
Direct labor	48,000
Manufacturing overhead applied	60,000

The beginning inventory was 100 per cent complete for materials and 50 per cent complete for conversion costs.

The ending inventory on August 31 consisted of 6,000 units (100 per cent complete for materials, 70 per cent complete for conversion costs).

Compute the following:

- Number of units completed and transferred to finished goods inventory.
- The equivalent units of production for materials and conversion costs using the average cost method.
- Cost per equivalent unit for materials and conversion costs.
- Cost of units completed and transferred.
- Cost of ending inventory.

**Problem B** The following information relates to Aromatic Company for its line of perfume products for the month ended March 31:

Units in beginning inventory (units equal cases of product)	2,7000
Cost of units in beginning inventory:	
Materials	\$40,500
Conversion	\$ 18,900
Units placed in production	54,000
Cost incurred during current period:	
Materials	\$239,598
Conversion	\$215,310
Units remaining in ending inventory (100% complete as to materials,	3,000

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60% complete as to conversion)

Prepare a production cost report for the month ended March 31, using the average cost method.

**Problem C** Shine Company uses a process cost system to account for the costs incurred in making its single product, a hair conditioner. This product is processed in Department A and then in Department B. Materials are added in both departments. Production for May was as follows:

	Department A	Department B
Units started or transferred in	200,000	160,000
Units completed and transferred out	160,000	120,000
Stage of completion of May 31 inventory:		
Materials	100%	80%
Conversion	50%	40%
Costs incurred this month:		
Direct materials costs	\$200,000	\$304,000
Conversion costs	\$540,000	\$272,000

There was no May 1 inventory in either department.

- Prepare a production cost report for Department A in May.
- Prepare a production cost report for Department B in May.

**Problem D** A bottling company bottles soft drinks using a process cost system. Following are cost and production data for the mixing department for June:

	Units	Materials costs	Conversion costs
Inventory, June 1	56,000	\$11,620	\$16,240
Placed in production in June	133,000	29,960	41,720
Inventory, June 30	63,000	?	?

The June 30 inventory was 100 per cent complete as to materials and 30 per cent complete as to conversion.

Prepare a production cost report for the month ended June 30 using the average cost method.

**Problem E** Refer to the facts given in the previous problem. Assume the beginning inventory on June 1 was 100 per cent complete as to materials and 25 per cent complete as to conversion.

- Prepare a production cost report for the month ended June 30, using FIFO. Round unit costs to the nearest cent.
- Why are ending inventory amounts different than those for the previous problem?

**Problem F** Quality Lumber Company produces two products from logs, Grade A lumber and Grade B lumber. The following events took place in June:

	Grade A	Grade B	Total
Units produced	80,000	120,000	200,000
Unit selling price at split-off	\$4.00	\$2.00	
Joint costs	?	?	\$120,000

- Allocate the joint costs to the two products using the physical measures method.
- Allocate the joint costs to the two products using the relative sales value method.
- Explain the difference in unit costs using the two methods.
- What are advantages of the relative sales value method if all of Grade A lumber has been sold and none of Grade B lumber has been sold at the end of a month?

### Alternate problems

**Alternate problem A** Pure Aqua Company is a producer of flavored mineral water. These data are for its March production:

Work in process inventory, March 1, 3,000 (units equal cases):	
Direct materials	\$12,600
Direct labor	6,000
Manufacturing overhead (1,500 machine-hours at \$6 per machine-hours)	9,000
	\$27,600
Units started in March	9,000
Costs incurred in March:	
Direct materials	\$36,360
Direct labor	55,200
Manufacturing overhead applied (13,800 machine-hours)	?

The ending inventory consisted of 4,500 units (100 per cent complete as to materials, 60 per cent complete as to conversion).

Compute the following:

- Number of units completed and transferred to finished goods inventory.
- The equivalent units of production for materials and conversion costs using the average cost method.
- Cost per equivalent unit for materials and conversion costs.
- Cost of units completed and transferred.
- Cost of ending inventory.

**Alternate problem B** The following data pertain to a production center of Sunbelt Company, a maker of sunscreen products:

	Units	Materials costs	Conversion costs
Inventory, October 1	70,000	\$12,000	\$16,000
Placed in production in October	200,000	20,400	18,200
Inventory, October 31	100,000	?	?

The October 31 inventory was 100 per cent complete as to materials and 20 per cent complete as to conversion costs.

Prepare a production cost report for the month ended October 31, using the average cost method.

**Alternate problem C** Healthbar Company produces a health food and determines product costs using a process cost system. The product is moved through two departments, mixing and bottling. Production and cost data for the bottling department in August follow.

Work in process, August 1 (30,000 pints):	
Costs transferred in	\$30,000
Materials costs	15,000
Conversion costs	9,000
Costs incurred in August:	
Transferred in (100,000 pints)	\$100,00
	0
Materials costs	50,000
Conversion costs	39,300

All materials are added at the beginning of the bottling process. Ending inventory consists of 25,000 pints, 100 per cent complete as to materials and 40 per cent complete as to conversion.

19. Process: Cost systems

Prepare a production cost report for August using the average cost method.

Beyond the numbers—Critical thinking

**Business decision case A** Bicycles Plus, Inc., produces bicycles. While the company has developed a per unit cost, it has not been able to break down its costs in each of its three departments: frames, assembling, and finishing. Karol Ring, the production manager, has been concerned with cost overruns during July in the frames department, which produces the bicycle frames.

On July 1, the frames department had 6,000 units in its work in process inventory. These units were 100 per cent complete as to materials and 40 per cent complete as to conversion. The department had incurred USD 12,000 in materials costs and USD 90,000 in conversion costs in processing these 6,000 units.

The department handled 30,000 units during the month, including the 6,000 units in beginning inventory on July 1. At the end of the month, the department's work in process included 3,600 units that were 100 per cent complete as to materials and 30 per cent complete as to conversion. The month's costs were allocated on the number of units processed during the month as follows:

	Materials	Conversion
Costs	\$60,000	\$300,216
Units handled during month	30,000	30,000
Cost per unit	\$ 2	\$ 10

The USD 12 per unit cost was assigned in a way that resulted in the following costs:

	Beginning work in process	Work started and completed	Ending work in process
Cost per unit incurred during the month:			
Units	6,000	20,400	3,600
Cost per unit	\$12	\$12	\$12

Ring realized that this per unit cost is incorrect and asks you to develop a better method of computing these costs for the month ended July 31.

- How would you recommend that July's costs be assigned to the units produced? How would this differ from the present method?
- To justify your recommendation, recalculate July's costs using your recommendation. Present your analysis in a production cost report.

**Ethics case – Writing experience B** Steve Yung works in the inventory control group at a company that produces stone-washed jeans. A good friend manages the Stitching Department at the same company. At the end of a recent month, Yung reviewed the Stitching Department's production cost report and found the department had no beginning Work in Process Inventory, had started 27,000 pairs of jeans, and had produced only 24,000 pairs. That leaves 3,000 pairs in ending inventory, Yung thought, that is a lot of jeans they did not finish.

Later, Yung visited his friend who managed the Stitching Department. "Why all the ending inventory?" he asked.

"One of the new workers set several machines wrong, and the stitching was bad on 2,400 pairs," the manager replied. "We set those aside, and we will fix them when we have some free time. The other 600 pairs are complete now, and have been transferred out. Our entire operation was slower because of the machine problem."

"Company policy is to send all defective products to the Rework Department. They can fix the jeans. That is their job," Yung said.

"No way!" exclaimed the Stitching Department manager. "We would all be in trouble if plant management finds out. The worker who messed up would probably be fired. I do not want that. This is our little problem, and we will take care of it."

- a. What should Yung do?
- b. Would your answer change if Yung learned that the Stitching Department had fixed the jeans and sent them on to the next department?

**Financial analysis C** Suppose a bottling company made an error in estimating the stage of completion of its work in process inventory. Suppose the costs in beginning inventory and the costs transferred in were correct, but the company overstated the stage of completion for both materials and conversion costs in ending Work in Process Inventory causing ending Work in Process Inventory to be USD 100,000 too high. The beginning and ending Finished Goods Inventory amounts are correct. What effect would this error have on the company's last year's financial statements?

**Group project D** In groups of 3 or 4 students, write a paper on the topic, "How scientific is the allocation of joint costs to products?" Prepare the paper on a computer and prepare and edit several drafts before turning in the final paper. Use examples to demonstrate your points.

**Group project E** In teams of two or three students, interview the manager of a grocery store. What is the cost of spoilage in the vegetable and fruit section as a percentage of the total cost of goods sold? Does the manager differentiate between normal and abnormal spoilage? If so, provide some examples. Each team should write a memorandum to the instructor summarizing the results of the interview. Information contained in the memo should include:

Date:

To:

From:

Subject:

Content of the memo must include the name and title of the person interviewed, name of the company, and information responding to the questions above.

**Group project F** In teams of two or three students, interview the manager of a fast food restaurant such as McDonald's. What is the cost of spoilage as a percentage of the total cost of goods sold? Does the manager differentiate between normal and abnormal spoilage? If so, provide some examples. Each team should write a memorandum to the instructor summarizing the results of the interview. Information contained in the memo should include:

Date:

To:

## 19. Process: Cost systems

From:

Subject:

Content of the memo must include the name and title of the person interviewed, name of the company, and information responding to the questions above.

### Using the Internet—A view of the real world

Using the Internet as a research tool, describe the conversion activities (or processes) involved in producing oil or oil-related products. Your description should include examples of raw materials used as inputs, production activities required to convert inputs into products, and resulting outputs (finished goods). Write your report in the form of a memorandum. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to attach your research materials obtained from the Internet to the memorandum.

Using the Internet as a research tool, describe the conversion activities (or processes) involved in producing milk or milk-related products. Your description should include examples of raw materials used as inputs, production activities required to convert inputs into products, and resulting outputs (finished goods). Write your report in the form of a memorandum. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to attach your research materials obtained from the Internet to the memorandum.

### Answers to self-test

#### True-false

**True.** In process costing, costs are accumulated by process or department.

**False.** Job cost systems have one Work in Process Inventory account for each job, and process cost systems have a Work in Process Inventory account for each process or department.

**False.** The initial step in computing equivalent units is to determine either the stage of completion or the number of partially complete units.

**False.** Abnormal spoilage is treated as a period cost.

**True.** The relative sales value of the products at the split-off point is a commonly used basis to allocate joint costs.

#### Multiple-choice

**d.** Process costing does not keep track of the actual cost of each individual unit produced.

**c.**  $\text{Units completed} + [\text{Units in ending inventory} \times \text{Percentage complete}] = \text{Equivalent production}$

**a.** USD 1,370  $[\text{USD } 1,200 + (1,000 \times \text{USD } .05) + (200 \times \text{USD } .60)]$

**e.** Items **a** through **d** are included in the production cost report.

**b.** The equivalent production for the period would be:

Equivalent units of work done to complete the beginning inventory 900  
(1,500 × 0.60)

Units started and completed this period (5,000 – 2,500)	2,500
Equivalent units of work done to partially complete the 500 ending inventory (2,500 x 0.20)	
Equivalent units of production	3,900

### Comprehensive review problem

The Compack Company assembles personal computers. Personal computers go through several departments where sub assemblies are unpacked and checked, the circuit board is attached, the product is tested and repaired if defective, and the computers are packed carefully for shipping. Each order is treated as a job, and the entire job is shipped at once. The company keeps track of costs by job and calculates the equivalent stage of completion for each job based on machine-hours.

Although the company has grown rapidly, it has yet to show a profit. You have been called in as a consultant. Management believes some jobs are profitable and others are not, but it is not clear which are profitable. The accounting system is almost nonexistent; however, you piece together the following information for April:

- Production:

- Completed Job No. 101.
- Started and completed Job No. 102.
- Started Job No. 103.

- Inventory values:

- Work in process inventory:

March 31: Job No. 101	
Direct materials	\$60,000
Direct labor	9,600
Overhead	14,400
April 30: Job No. 103	
Direct materials	\$45,000
Direct labor	10,400
Overhead	15,600

b. Job No. 101 was exactly one-half finished in direct labor-hours and machine-hours at the beginning of April, and Job No. 103 was exactly one-half complete in direct labor-hours and machine-hours at the end of April. However, all of the direct materials necessary to do the entire job were charged to each job as soon as the job was started.

- There were no direct materials inventories or finished goods inventories at either March 31 or April 30.

- Manufacturing overhead is applied at USD 30 per machine-hour. The company used 1,600 machine-hours during April, 480 machine-hours on Job 101 and 600 machine-hours on Job 102. The actual overhead for the month of April was USD 50,000.

- Cost of goods sold (before adjustment for over applied or under applied overhead):

Job No. 101:	
Materials	\$60,000
Labor	?
Overhead	?
Total	?
Job No. 102:	
Materials	?

## 19. Process: Cost systems

Labor ?  
Overhead ?  
Total ?

- Overhead was applied to jobs using the predetermined rate of USD 30 per machine-hour. The same rate had been used since the company began operations. Over- or under applied overhead is debited or credited to Cost of Goods Sold.
  - All direct materials were purchased on account. Direct materials purchased in April amounted to USD 150,000.
  - Direct labor costs charged to jobs in April were USD 32,000. All labor costs were the same rate per hour for April for all laborers.
- a. Compute the cost of each job, whether in inventory or sold.
  - b. Show the transactions in journal entry form. Use a separate Work in Process Inventory account for each job.
  - c. Prepare an income statement for April assuming revenue was USD 250,000 and selling and administrative expenses were USD 60,000.

# 20. Using accounting for quality and cost management

## Learning objectives

After studying this chapter, you should be able to:

- Describe why managers need good accounting information to be competitive in the new production environment.
- Identify ways to improve quality.
- Develop measures of performance that help achieve high quality.
- Understand how the balanced scorecard helps organizations recognize and deal with opposing responsibilities.
- Explain how just-in-time purchasing and production can reduce costs and improve quality.
- Compare and contrast accounting in just-in-time settings with accounting in traditional settings.
- Define activity-based costing and explain its benefit to companies.
- List the four steps in activity-based costing.
- Compare product costs using activity-based costing with product costs using traditional costing methods.
- Describe the strategic and behavioral advantages of activity-based management.

## Importance of good accounting information

Have you ever purchased a product and found it to be defective? If so, you may have sworn to yourself that you would never buy one of those again. By doing so, you have demonstrated why high-quality products are essential for business success. Successful companies remain in business by seeking continual improvement in the quality of their products. For example, Territory Ahead, a merchandising company tells its customers to please hassle them if not completely satisfied. Nordstrom's department stores, Southwest Airlines Company, and Apple . are companies that have built reputations based on the notion of hassle us if you are not completely satisfied.

In its plant near Nashville, Tennessee, USA, Nissan Motor Corporation places some of the previous day's production of cars and trucks in the lobby with charts showing the number of production defects for that day. Displaying products and reporting on performance gives workers a sense of pride in their work and an incentive to reduce defects.

## 20. Using accounting for quality and cost management

### Quality and the new production environment

Attention to quality is an important feature of the new production environment. The phrase, new production environment, refers to an environment in which company managers are concerned with (1) improving customer service and product quality and (2) reducing costs. Both actions are necessary to stay competitive.

In the new production environment, new technology is helping managers improve quality and reduce costs. Computer-assisted manufacturing enables managers to reduce inventories, yet respond quickly to customers' needs. For example, robots perform certain repetitive functions more reliably than humans. Computerized airline reservations systems also provide better customer service at a lower cost to airlines.

The new production environment is rooted in the new management philosophies that we discuss in this chapter. For example, managers now use nonfinancial as well as financial measures of quality performance. Many companies have adopted a just-in-time philosophy for managing purchasing and production. Managerial accountants are restructuring costing systems to provide activity-based costs resulting in better managerial decision making. Many observers believe that United States industry has fallen behind foreign competitors because managers and accountants have not worked together to produce the information management needs to make good decisions.

### Improving quality

To make decisions about the costs and benefits of quality, we need to know what those costs and benefits of quality are. Managers at Texas Instruments have placed the costs of quality in these four categories:<sup>2</sup>

- **Prevention costs.** Prevention costs cover the cost of preventing poor-quality products from being produced. Prevention costs include training employees to do quality work.
- **Appraisal costs.** Appraisal costs are the costs of detecting poor-quality products. Appraisal costs include the costs of inspecting materials when purchased and product testing during production.
- **Internal failure costs.** Internal failure costs are the costs of producing poor-quality products detected before products are shipped to customers. Internal failure costs include the costs of reworking poor-quality products to bring their quality up to specifications.
- **External failure costs.** External failure costs are the costs incurred because customers purchased poor-quality products. External failure costs include the costs of dealing with returned products and future lost profits because customers are dissatisfied.

The manager's task is to minimize the sum of these costs. By incurring substantial costs of prevention, for example, a company might reduce costs of appraisal, internal failure, and external failure costs. This idea is a modern adaptation of the old saying, "An ounce of prevention is worth a pound of cure". Small prevention costs may even result in large cost savings in the other three categories.

Assume Diana's Secret is a company that sells clothing through catalogs. A marketing manager concerned about customer satisfaction noticed a substantial amount of returned merchandise. Upon investigating, the manager discovered that most returns were due to an incorrect color or size; most of these errors could be traced to mistakes made by order takers who had not been adequately trained.

<sup>2</sup> "Texas Instruments: Cost of Quality (A)" (Boston: Harvard Business School, Case 9-189-029).

The company decided to invest USD 5,000 per month in a training program for order takers. After the training program started, the amount of returned merchandise dropped dramatically. Working with people in the marketing department, accountants estimated the company saved USD 4,000 per month by having less returned merchandise and fewer refilled orders. In addition, marketing managers believed Diana's Secret's profits increased by USD 2,000 to USD 10,000 per month because of increased customer satisfaction. Management considered the USD 5,000 cost of prevention to be justified by the benefits of reduced returned merchandise and increased customer satisfaction.

As you already may have figured out, measuring the cost of quality has a major disadvantage. It is difficult to measure increased customer satisfaction (reflected in sales) resulting from additional spending on prevention costs (or any of the four categories), and it is difficult to measure decreased customer satisfaction resulting from a reduction in prevention costs. For example, if prevention costs are reduced, how do we measure lost sales as a result of this reduction? Conversely, how do we measure the increase in sales directly associated with an increase in prevention costs? It is difficult to accurately measure the change in sales specifically resulting from either scenario.

A current theme in business today is that "quality is free". The belief is that if quality is built into the product, the resulting benefits in customer satisfaction, reduced rework and warranty costs, and other important factors far outweigh the costs of improving quality. Cost-benefit analyses are no longer the primary focus in improving quality. Instead, the emphasis is on improving quality with the understanding that quality is free in the long run.

Those who subscribe to the quality is free concept believe that zero defects is the only acceptable goal. The production process should be continuously improved. The result? Quality will improve, customers will be increasingly satisfied, and the cost of improving quality will pay for itself through increased sales and lower costs (providing for increased profit margins).

Although both cost of quality and quality is free concepts strive for improved quality, the cost of quality approach assumes a cost-benefit trade-off when spending money on quality improvement. The quality is free approach assumes that the long-run benefits will always outweigh the costs of improving quality. One thing is for certain: quality is important to the success of any company!

The key quality concept in the new production environment is total quality management. **Total quality management (TQM)** is defined as managing the entire organization so it excels in its goods and services that are important to the customer. The key ideas are that the organization strives for excellence and that quality is ultimately defined by the customer.

**Customer-driven quality standards** Total quality management means that your goods and services are not excellent until the customer says they are excellent. It is not enough for production managers or engineers to say an automobile is well-designed and produced; customers must say they like it—a lot. TQM means translating customer needs and wants into specifications for product design. Southwest Airlines learned that customers want flights to leave and arrive on time. No amount of free food and beverages served to placate customers made up for late arrivals, missed connections, missed meetings, and missed birthday parties. So Southwest Airlines went to work to improve those things its customers wanted most; namely, on-time departures and arrivals. (Actually, the customers wanted on-time arrivals more than on-time departures, but on-time departures help you on-time arrivals.)

## 20. Using accounting for quality and cost management

How do companies identify quality problems? Three methods managers use to identify quality problems are the following:

- Control charts.
- Pareto diagrams.
- Cause and effect analyses.

**Control charts** **Control charts** help managers distinguish between random or routine variations in quality and variations that should be investigated. For example, the managers of CD, Inc., expect some returned merchandise and do not panic because a customer returns merchandise. They use a control chart to plot data that shows trends or unusually high rates of returned merchandise.

Look at Exhibit 15, a control chart for product defects in producing compact disc players at CD, Inc. Every compact disc player is tested to ensure it works. Those products failing the test are reworked or scrapped, an example of internal failure cost. Management expects an average failure rate of 2 per cent of the daily production. Management has set an upper limit for failure at 4 per cent of daily production. If the failure rate exceeds 4 per cent, management investigates to find out what is causing such a high rate.

Quality testers continuously record failure rates at CD, Inc. Managers can call up the results on their computers at any time. Note in Exhibit 15 that Wednesday's results exceeded the 4 per cent limit. Management investigated the problem Wednesday afternoon and found a machine improperly installing a switch. The machine was fixed Wednesday night and production returned to normal on Thursday.

**Illustration 20.1** Control Chart for Defective Products

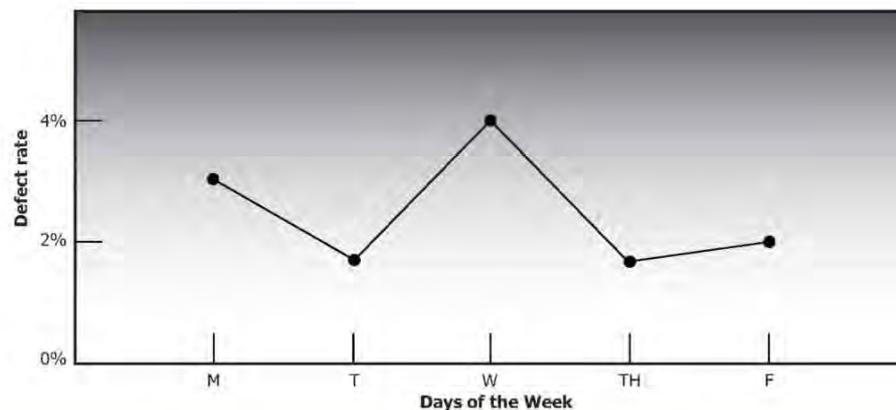


Exhibit 8: Control chart for defective products

**Pareto diagrams** **Pareto diagrams** indicate how frequently each type of failure occurs. Note the Pareto diagram for compact disc player production at CD, Inc., in Exhibit 9. Pareto diagrams have more information than simple control charts, but they require quality testers to classify and report defects. Managers learn more about the causes of problems from Pareto diagrams than they do from control charts.

**Illustration 20.2** Pareto Diagram for Production at CD, Inc.

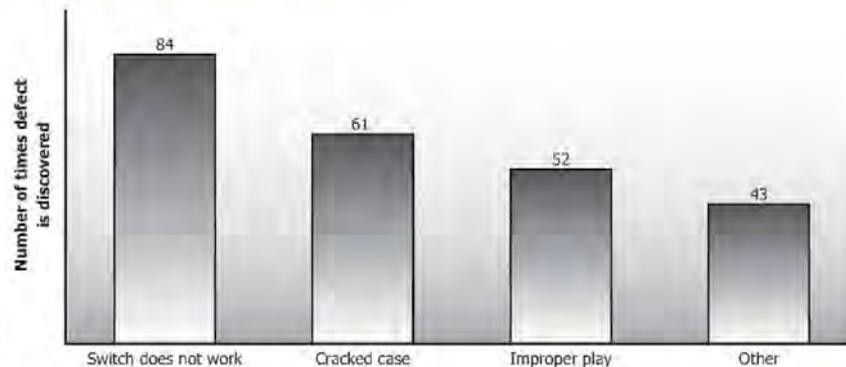


Exhibit 9: Pareto diagram for production at CD, Inc.

**Cause-and-effect analysis** **Cause-and-effect analysis** identifies potential causes of defects. Consider the problem of cracked compact disc player cases, for example. Cracked cases could be due to breakage during production, faulty materials, or other handling problems. Managers must know the cause of problems to solve them. It makes no sense to focus on product handling, for example, if the problem is purchasing poor-quality materials.

### Quality and customer satisfaction measures

Quality-oriented organizations continually monitor the quality of their products and solicit feedback from customers to assess their satisfaction with goods and services. For instance, in Exhibit 16 the second nonfinancial measure deals with delivery performance. Delivery performance is critical to success for companies such as FedEx, UPS, the US Postal Service, and other delivery services.

Performance measure	Objective
1. Quality control	
Number of customer complaints	Create customer satisfaction
Number of defects	Make a high-quality product
2. Delivery performance	
Percentage of on-time deliveries	Increase on-time deliveries
3. Materials waste	
Scrap and waste as a percentage of total materials used	Decrease scrap and waste; improve the quality of products
4. Machine downtime	
Percentage of time machines are not working	Decrease machine downtime; increase on-time delivery to customers

Exhibit 10: Nonfinancial performance measures

The success of Lands' End, L. L. Bean, The Territory Ahead, and other companies that sell through catalogs depends on quick delivery of their merchandise. Bottlers of soft drinks such as PepsiCola and canneries like Campbell Soup require precisely timed deliveries of cans and bottles. Ideally, the truck or railroad car unloads containers right onto the production line.

## 20. Using accounting for quality and cost management

Nonfinancial performance measures are particularly important to motivate people to provide high-quality products and excellent customer service. For example, Exhibit 16 presents four nonfinancial performance measures used by managers to evaluate performance in providing quality products and service at a reasonable cost.

**Quality control** The first set of measures in Exhibit 16 reflect quality control. Firms measure their product quality by the number and type of customer complaints or by the number of product defects. By reducing the number of product defects, companies reduce the number of customer complaints. The objective is to increase customer satisfaction with the product, reduce the costs of dealing with customer complaints, and reduce the costs of repairing products or providing a new service.

**Delivery performance** The second type of nonfinancial measure in Exhibit 16 deals with delivery performance. As we noted earlier, delivery performance is critical for many companies. Domino's Pizza bases its success on delivery service. The objective is to deliver goods and services when promised. To achieve this objective, companies keep track of the percentage of total deliveries that are on time.

**Materials waste** Companies can take several steps to reduce materials waste, the third type of nonfinancial measure. They can purchase a higher quality of raw materials so there is less waste from defective materials, increase employee training so workers make fewer mistakes, and improve the production process. Reducing waste can improve quality. The causes of waste are often the causes of poor quality. For example, waste may reflect poor training of employees. Improving training could improve the quality of their work on all products, not just those that result in waste. Generally, workers are motivated to find ways to reduce waste when companies keep track of the quantity of materials wasted every day. Companies sometimes provide immediate feedback to workers the next day, often in the form of large charts showing the previous day's waste.

**Machine downtime** The fourth type of nonfinancial measure, machine downtime, is very important in all companies. At some automobile assembly plants, workers have the authority to stop the assembly line when they see something wrong. It should come as no surprise that such an action brings a lot of attention to the problem from many people in the plant. Stopping production causes a loss of output while people wait for the machinery to start up again. Machine downtime also can cause customer dissatisfaction and loss of sales. You may have experienced this dissatisfaction at a bank when you could not be served because the computer was down, or when your airline flight was canceled because of an airplane's maintenance problems.

People like to take pride in their work. Surveys indicate that workers prefer to do high-quality work rather than low-quality work. Companies generally find that workers respond favorably to performance measures and incentives measuring and rewarding high-quality work.

Many companies use high quality as their strategic advantage. For example, FedEx entered the air courier business with a promise that it would guarantee delivery the next day by mid-morning. By continually delivering on this promise, the company built up trust in its customers. Canon and Honda are other well-known companies that have used product quality to compete effectively.

**Benchmarking** is the continuous process of measuring how well one is doing against performance levels either inside or outside of the organization. For instance, students often benchmark by comparing their performance against the professor's standards or other students' performance. Students often are interested in how well

graduates of their school compare to graduates of other schools on CPA exams, bar exams, or other standardized exams.

Companies are benchmarking in a similar way. American Airlines looks at its own on-time arrival performance by computing the percentage of its flights that land within 15 minutes of their scheduled arrival time. The company compares the results with its own past experience and with its competitors' performance. American Airlines also compares its own per cent of lost luggage to its own past experience and the performance of major competitors such as United Airlines and Delta Air Lines.

Benchmarking transforms the theory of quality products or service into practice. Benchmarking focuses attention on the objective. When American Airlines benchmarks on-time arrivals, it focuses the attention of its pilots, ground crews, mechanics, and everyone else on ways to improve on-time arrival performance.

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### An accounting perspective:

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#### Managers executed for poor quality

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##### Business insight

Eighteen managers were executed for poor product quality in a refrigerator plant on the outskirts of Beijing, China. The managers—12 men and 6 women—were taken to a rice paddy outside of the factory and shot while plant workers watched.

A government official stated the action was required for committing unpardonable sins against the people of China. Apparently, workers complained the managers were forcing the production of poor quality products. When workers complained that components did not meet specifications and the refrigerators did not function as required, the managers told them to ship the products. Customers also had complained. This factory had a reputation for turning out poor quality products.

Source: Authors' research.

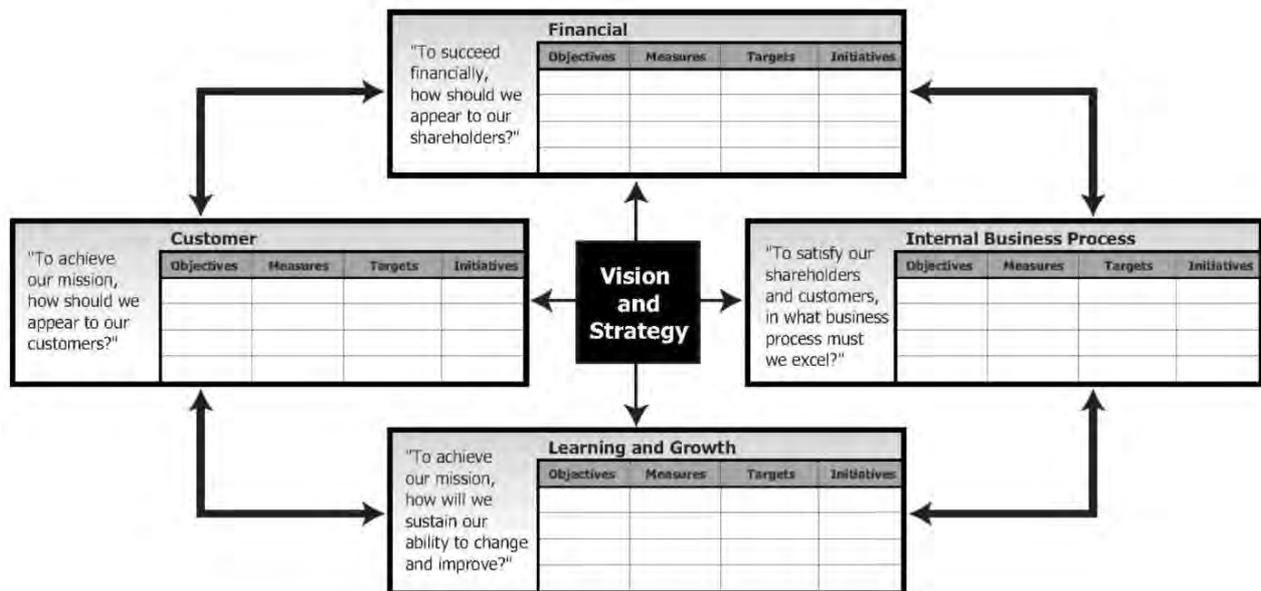
The **balanced scorecard** is a set of performance targets and results that show an organization's performance in meeting its objectives to its stakeholders. It is a management tool that recognizes organizational responsibility to different stakeholder groups, such as employees, suppliers, customers, business partners, the community, and shareholders. Often different stakeholders have different needs or desires that the managers of the organization must balance. The concept of a balanced scorecard is to measure how well the organization is doing in view of those competing stakeholder concerns.

An example of a balanced scorecard is shown in Exhibit 11. As you can see, the focus is to balance the efforts of the organization between the financial, customer, process, and innovative responsibilities. Traditionally, business organizations have focused on financial results, which mainly have reflected the shareholders' interests. In recent years, organizations have shifted attention to customer issues, such as quality and service, to employees, and to the community. For example, Ben & Jerry's Ice Cream measures its social performance along with financial

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performance and presents a social audit in its annual report next to its financial audit. Johnson & Johnson's code of conduct makes it clear that the company has a responsibility to several competing stakeholders.

**Illustration 20.4** Balanced Scorecard



Source: R. S. Kaplan and D. P. Norton, "Using the Balanced Scorecard as a Strategic Management System," *Harvard Business Review*, January–February 1996.

**Exhibit 11: Balanced scorecard**

The balanced scorecard has been developed and used in many companies. It primarily has been used at the top management level to support the organization's development of strategies. For example, Kaplan and Norton describe the development of the balanced scorecard at an insurance company as follows:<sup>3</sup>

**Step 1:** Ten of the company's top executives formed a team to clarify the company's strategy and objectives to meet responsibilities.

**Step 2:** The top three layers of the company's management (100 people) were brought together to discuss the new strategy and to develop performance measures for each part of the company. These performance measures became the scorecards for each part of the business and reflected the company's desired balance in satisfying different stakeholders.

**Step 3:** Managers began eliminating programs that were not contributing to the company's objectives.

**Step 4:** Top management reviewed the scorecards for each part of the organization.

**Step 5:** Based on its reviews in step 4, top management went back to step 1 to refine and further clarify the company's strategy and objectives.

<sup>3</sup> Based on R. S. Kaplan and D. P. Norton, "Using the Balanced Scorecard as a Strategic Management System," *Harvard Business Review*, January-February 1996.

Organizations using the balanced scorecard generally have found it to be helpful for top and middle management to shape and clarify organization goals and strategy in the face of competing stakeholder wants.

### Just-in-time method

Innovations in purchasing, production, and inventory management have the potential to revolutionize companies. One of these innovations is the **just-in-time (JIT) method**. Companies that use just-in-time methods purchase materials just in time for production, produce parts just when needed in the production process, and complete finished goods just in time for sale.

The principal feature of the just-in-time system is that production does not begin on an item until an order is received. When a company receives an order it buys the raw materials, and the production cycle begins. As soon as the order is filled, production ends. Consequently, just-in-time requires immediate correction of processes or people making defective products because there is no inventory where defective products can await reworking or scrapping.

In theory, a JIT system eliminates the need for inventories because no production takes place until the company knows its products will be sold. As a practical matter, companies using this system normally have a backlog of orders so they can keep their production operations going. The benefits of the JIT system would be lost if a company had to shut down its operations for lengthy periods while waiting for new orders.

Just-in-time helps assure quality. If a unit is defective, employees cannot simply put it aside in inventory. Production workers and machines must do it right the first time.

To achieve just-in-time production, many companies install a system of flexible manufacturing. A flexible manufacturing system is computer-based; it enables companies to make a variety of products with a minimum of setup time. The system does what its name implies: it enables companies to be flexible in making products just-in-time to fill customers' orders.

For example, consider a company that makes after-market running boards for trucks. Customers install these running boards on trucks after they purchase them. By using flexible manufacturing, the company that makes these running boards produces one set of running boards for a particular model of Dodge then one set for a particular GMC model, and so forth to fill customer orders. A traditional production system, by contrast, would produce numerous sets of running boards for the Dodge which would remain in inventory until needed to fill customer orders. The traditional company would then produce numerous sets of running boards for the GMC and place them in inventory until needed to fill customer orders.

Just-in-time is part of a lean production philosophy that has helped many companies successfully reduce costs and increase quality. One feature of lean production is the absence of shelves, floor space, and other places used to store partially finished products. For an example of lean production, imagine you are building a house and you have just enough materials arriving just when you need them. You do not have extra lumber lying about in case you make a mistake cutting the boards the first time. If your supplier of plumbing products does not deliver in time for your needs, you have to shut down production until the plumbing products arrive. As you can see, lean production requires high levels of efficiency and quality.



Accounts payable (+L)	30,000
To record the purchase of materials.	
(2) Work in process inventory (+A)	45,000
Materials inventory (-A)	30,000
Payroll summary (+L)	6,000
Overhead (applied) (+SE)	9,000
To record production costs in the work in process account.	
(3) Finished goods inventory (+A)	40,500
Work in process inventory (-A)	40,500
To transfer product from work in process to finished goods.	
(4) Cost of goods sold (-SE)	40,500
Finished goods inventory (-A)	40,500
To record the cost of the goods sold.	

**Just-in-time and backflush costing** Using a just-in-time accounting system, the accountants would initially assume the company has no inventories. Therefore, they would debit all costs directly to Cost of Goods Sold, as follows:

(1) Cost of goods sold (-SE)	30,000
Accounts payable (+L)	30,000
To record the use of materials.	
(2) Cost of goods sold (-SE)	15,000
Payroll summary (+L)	6,000
Overhead (applied) (+SE)	9,000
To record other manufacturing costs.	

Upon learning the company has USD 4,500 of inventory in work in process, the accountants would back out USD 4,500 from Cost of Goods Sold, as follows:

(3) Work in process inventory (+A)	4,500
Cost of goods sold (+SE)	4,500
To record inventory.	

This last entry is the backflush costing step. These entries appear in T-accounts in Exhibit 12.

Just-in-time production simplifies accounting procedures. If the costs of these sunscreen bottles were charged into production using traditional costing methods, it would be necessary to debit the materials costs to a Materials Inventory account. As the materials were used, their costs would be transferred to Work in Process Inventory and other manufacturing costs would be charged to Work in Process Inventory. As goods were completed, costs would be transferred out of Work in Process Inventory, into Finished Goods Inventory, and finally, into Cost of Goods Sold. Exhibit 12 contrasts traditional versus just-in-time cost flows.

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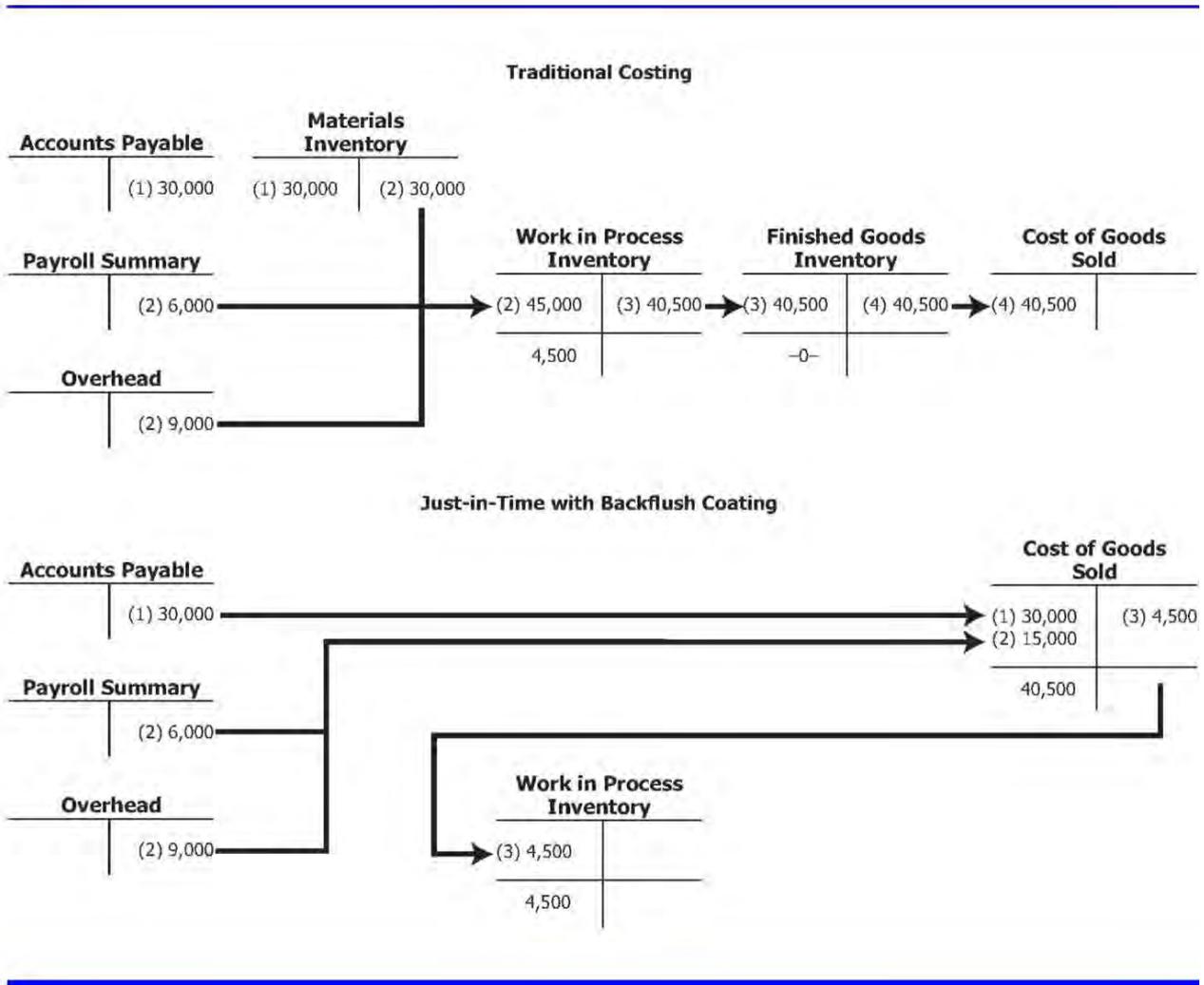


Exhibit 12: Traditional versus just-in-time cost flows

By reducing inventories, a just-in-time system offers potentially great cost savings. As noted earlier, it simplifies the accounting system. By reducing inventories, it releases investment dollars for use elsewhere and frees space that the inventory previously occupied. Companies also have found that reducing inventories where defective products could be hidden helps management detect production problems more quickly. By tying JIT to quality improvement programs, companies move toward zero defect production.

**Activity-based costing and management**

Suppose you go to a movie theater that has five screens showing five different movies. Jerome Justin works for the movie theater selling tickets for all five movies. Suppose management wants to know the cost of selling tickets per movie and asks you to assign Justin's wages to each of the five movies. How would you assign his wages?

You could simply divide Justin's wages by the number of movies and allocate 20 per cent of his salary to each movie. Or you could figure out how many tickets he sold to each movie, and allocate his wages on the basis of ticket sales. For example, if 50 per cent of the ticket sales were for *Avatar*, you might allocate 50 per cent of Justin's

wages to *Avatar*. You probably also could think of additional ways to allocate Justin's wages. No matter how we allocate Justin's wages, his wages would not be directly traceable to one of the movies if he sold tickets for all five movies. In short, the allocation of Justin's wages to a particular movie is at least somewhat arbitrary because alternative methods could allocate different amounts of Justin's wages to each movie. Justin's wages would be indirect costs to the different movies because his wages could not be directly assigned to any one of the movies.

By definition, the allocation of indirect costs is at least somewhat arbitrary. Nevertheless, accountants have discovered that they can improve the ways costs are assigned, such as to movies in this case, by using activity-based costing.

**Activity-based costing** is a costing method that assigns indirect costs to activities and to the products based on each product's use of activities. Activity-based costing is based on the premise: Products consume activities; activities consume resources.

Numerous companies, such as HP, Caterpillar, and IBM, have implemented activity-based costing. Activity-based costing (ABC) has revealed startling information in these companies. For example, after installing new costing methods, one well-known company found that one of its products, a printed circuit board, was generating negative margins of 46 per cent.

Activity-based costing identifies the activities generating costs and assigns costs to those activities. Take the earlier Justin example. By focusing on Justin's activities, management could learn what caused costs and find ways to improve Justin's efficiency. Suppose that by studying Justin's activities, management learns he spends 40 per cent of his time answering questions about movies, 40 per cent of his time selling tickets, and 20 per cent doing nothing. Based on this information, management could think about better ways to use Justin's time. By improving their signs and posting information about the movies, management could reassign Justin to other tasks.

Closely related to activity-based costing is the notion of activity-based management (ABM). Using activity-based management, managers identify which activities consume resources. The focus is then to effectively manage costly activities with the goal of reducing costs and improving quality. Consider Justin and the movie theater again. Using activity-based management, managers would identify what Justin did with his time and perhaps find ways to help him become more efficient.

The following discussion at a textile company that makes jeans demonstrates important issues about the difficulty with traditional cost allocation methods and the advantages of activity-based costing. The participants are concerned about their company's ability to compete with foreign manufacturers that have lower labor costs. Many people in the company believe the company's managerial accounting system provides inadequate information. In this discussion, George, a managerial accountant, reports on his recent study of activity-based costing.

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### A broader perspective:

#### HP

When a division of Hewlett-Packard Company introduced the just-in-time production method, the accountants found their traditional methods of cost accounting were no longer applicable. Reducing

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the work in process and finished goods inventories meant the accountants no longer needed to keep detailed records for inventory valuation.

Lowering inventories to immaterial levels for financial reporting purposes reduces the amount of accounting time required to make journal entries to transfer costs between inventory accounts. This Hewlett-Packard plant saved an estimated 100,000 journal entries per month by simplifying the accounting for work in process inventories.

JIT did not eliminate the need for product costing. Managers needed to know how much products cost so they could make decisions, plan, and evaluate performance. After simplifying inventory accounting at the Hewlett-Packard plant, the accountants turned their attention to providing better information in a form managers could understand and use. The accountants found their new role in helping managers plan and control production exciting and challenging.

Source: Authors' research.

**George (managerial accountant):** I have been reading a lot of articles about companies like Ford and HP that have discovered major problems with their cost systems. Their symptoms are similar to ours. Namely, they cannot lower prices to be competitive on high-volume products, and their profits are shrinking.

**Pam (company president):** That sounds like us! What are they doing about it?

**George:** Well, they are putting in a new type of cost system called activity-based costing, or ABC for short. This system gives more detailed and better estimates of product costs, which helps their friends in marketing set prices. Applying this to ourselves, we may find, for example, that activity-based costing could reveal that the cost of skirts is lower than we thought, meaning we could lower our prices.

**Lynn (vice president of marketing):** That would be good news, but I thought costs were pretty cut-and-dried. How can a product cost less under one cost system than under another?

**George:** Actually, Lynn, the product does not cost less under one system or another. Our problem is that no cost system measures costs perfectly. We are able to trace some costs directly to the product. For example, we are pretty accurate in measuring the cost of denim, which is a direct material, in each of our shirts, pants, jackets, and so forth.

Overhead costs are another matter. Overhead includes costs like electricity to run machines and salaries of product designers and inspectors. All these costs are allocated to products. We know quality control inspectors cost money, but we do not know how much of that cost is caused by a particular jacket or pair of pants. So we make some assumptions about the relation between products and overhead costs. For example, we typically allocate overhead based on machine-hours required to stitch and fasten snaps. While that is probably a reasonable way to allocate the costs of electricity to run machines, its not a desirable way to allocate the cost of quality control inspectors.

**Pam:** As I understand it, overhead allocation is somewhat arbitrary. How will activity-based costing help?

**George:** Activity-based costing provides more accurate information because we can identify which activities cause costs, and we can determine the cost of the activity. Activity-based costing identifies and measures the costs of performing the activities that go into a product much better than traditional cost methods. For example, if a particular jacket requires 10 inspections for a production run of 1,000 jackets, we figure out the cost of those inspections and assign that cost to the production run for this particular jacket.

**Martha (vice president of production):** That makes sense to me. But exactly how would activity-based costing help us cut production costs?

**George:** Once we identify activities that cause costs, we can eliminate or modify costly activities. For example, if we find that a jacket requires too many costly inspections, we could redesign the jacket to reduce the need for inspections. Our current cost system allocates all overhead costs, including inspection costs, to products based on machine-hours. We really do not know how much it costs to make an inspection and how much inspection cost is required by each product.

**Pam:** George, why have you not used activity-based costing before?

**George (feeling somewhat defensive):** Because activity-based costing provides more information, it takes more time than traditional cost systems. New accounting methods sound great in theory, but there must be enough benefit from improved management decisions to justify the additional work required to provide numbers. Until now, I did not think activity-based costing would pass a cost-benefit test.

**Pam:** I see many benefits in better pricing, reducing the costs of high-cost activities, and possibly dropping some products if we learn that their costs are too high. Our long-term strategy calls for new product lines in new markets where we are low-cost, low-price producers. We need the best cost information we can get to succeed in those markets. George, what do you need to get started developing an activity-based costing system for us?

**George:** I need a lot of support. Installing a new cost system requires teamwork between management, accounting, marketing, engineering, production, purchasing, and everybody else. This is not something to be done in an ivory tower.

Remember these important points about activity-based costing:

- The allocation of indirect costs is at least somewhat arbitrary, even using sophisticated accounting methods.
- Activity-based costing provides more detailed measures of costs than traditional allocation methods.
- Activity-based costing can help marketing people by providing more accurate product cost numbers for decisions about pricing and which unprofitable products the company should eliminate.
- Production also benefits because activity-based costing provides better information about the cost of each activity. In practice, ABC helps managers identify cost-causing activities. To manage costs, production managers learn to manage the activities that cause costs.
- Activity-based costing provides more information about product costs than traditional methods but requires more record-keeping. Managers must decide whether the benefits or improved decisions justify the additional record-keeping cost.

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- Installing activity-based costing requires teamwork among accountants, production managers, marketing managers, and other nonaccounting people.

Next, we discuss the methods used for activity-based costing and illustrate them with an example.

### Methods used for activity-based costing

Activity-based costing requires accountants to use the following four steps:

- Identify the activities that consume resources and assign costs to those activities. Purchasing materials would be an activity, for example.
- Identify the cost drivers associated with each activity. A **cost driver** is an activity or transaction that causes costs to be incurred. For the purchasing materials activity, the cost drivers could be the number of orders placed or the number of items ordered. Each activity could have multiple cost drivers.
- Compute a cost rate per cost driver unit. The cost driver rate could be the cost per purchase order, for example.
- Assign costs to products by multiplying the cost driver rate times the volume of cost driver units consumed by the product. For example, the cost per purchase order times the number of orders required for Product A for the month of December would measure the cost of the purchasing activity for Product A for December.

The next section describes these four steps.

Step one is often the most interesting and challenging part of the exercise. This step requires people to understand all of the activities required to make the product. Imagine the activities involved in making a simple product like a pizza—ordering, receiving and inspecting materials, making the dough, putting on the ingredients, baking, and so forth. Or imagine the activities involved in making a complex product such as an automobile or computer.

**Complexity as an activity that consumes resources** One of the lessons of activity-based costing has been that the more complex the business, the higher the indirect costs. Imagine that each month you produce 100,000 gallons of vanilla ice cream and your friend produces 100,000 gallons of 39 different flavors of ice cream. Further, assume your ice cream is sold only in one liter containers, while your friend sells ice cream in various containers. Your friend has more complicated ordering, storage, product testing (one of the more desirable jobs, nevertheless), and packing in containers. Your friend has more machine setups, too. Presumably, you can set the machinery to one setting to obtain the desired product quality and taste. Your friend has to set the machines each time a new flavor is produced. Although both of you produce the same total volume of ice cream, it is not hard to imagine that your friend's overhead costs would be considerably higher.

In Exhibit 13, we present several examples of the cost drivers companies use. Most cost drivers are related to either the volume of production or to the complexity of the production or marketing process. In deciding which cost drivers to use, managers consider these three factors:

<b>Cost driver</b>	<b>Cost of assigned cost driver</b>
Miles driven	Automobile costs
Machine-hours	Electricity to run machines
Customers served	Overhead in a bank
Flight hours	Airplane maintenance costs
Number of customers	Selling costs

#### Exhibit 13: Cost drivers

- **Causal relation.** Choosing a cost driver that causes the cost is ideal. For example, suppose students in biology classes are messier than students in history classes. As a result, the university does more maintenance per square foot in biology classrooms and labs than in history classrooms. Further, it is possible to keep track of the time maintenance people spend cleaning classrooms and labs. The university could assign maintenance costs based on the time spent in history classrooms and in biology classrooms and labs, respectively, to the history and biology departments.
- **Benefits received.** Choose a cost driver so costs are assigned in proportion to benefits received. For example, if the physics department in a university benefits more from the university's supercomputer than the German department does, the university should select a cost driver that recognizes such differences in benefits. The cost driver could be the number of faculty and/or students in each department who use the computer.
- **Reasonableness.** Some costs that cannot be linked to products based on causality or benefits received are assigned on the basis of reasonableness.

In general, predetermined rates for allocating indirect costs to products are computed as follows:

$$\text{Predetermined indirect cost rate} = \frac{\text{Estimated indirect cost}}{\text{Estimated volume of the allocation base}}$$

This formula applies to all indirect costs, whether manufacturing overhead, administrative costs, distribution costs, selling costs, or any other indirect cost.

Using activity-based costing, we first define the notion of an activity center. An **activity center** is a unit of the organization that performs some activity. For example, the costs of setting up machines would be assigned to the activity center that sets up machines. This means that each activity has associated costs. When the cost driver is the number of inspections, for example, the company must keep track of the cost of inspections.

Workers and machines perform activities on each product as it is produced. Accountants allocate costs to products by multiplying each activity's indirect cost rate by the volume of activity used in making the product.

The following example illustrates how unit costs are computed when companies use activity-based costing. We contrast the results using activity-based costing to those using a departmental rate.

Assume High Challenge Company makes two products, touring bicycles and mountain bicycles. The touring bicycles product line is a high-volume line, while the mountain bicycle is a low-volume, specialized product.

**Traditional costing method** Using a traditional costing method, assume that High Challenge Company followed this procedure to allocate manufacturing overhead costs to the two products for the month of January 2011.

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- Managers and accountants developed an overhead rate based on the following data for 2011:

Overhead for department A for 2011	\$2,000,000
Machine-hours worked during 2011 in department A	20,000 hours
Department A overhead rate (\$2,000,000/20,000 hours)	\$100 per machine-hour

- To compare activity-based costing with the company's traditional method, the accountants selected the month of January to study. At the end of January 2011 the following information was available for the month:

Actual machine-hours used in January 2011:

Touring bicycle products	1,500
Mountain bicycle products	500
Total	2,000

- Using a traditional costing method, accountants then allocated overhead to the products worked on in January using the overhead rate of USD 100 per machine-hour times the machine-hours worked on each product in Department A during January:

Overhead allocated to products worked on in January:

Touring bicycles (\$100 x 1,500 hours)	\$150,000
Mountain bicycles (\$100 x 500 hours)	50,000
Total overhead	\$200,000

In using activity-based costing, the company identified four activities that were important cost drivers and a cost driver used to allocate overhead. These activities were (1) purchasing materials, (2) setting up machines when a new product was started, (3) inspecting products, and (4) operating machines.

Accountants estimated the overhead and the volume of events for each activity. For example, management estimated the company would purchase 100,000 pieces of materials that would require overhead costs of USD 200,000 for the year. These overhead costs included salaries of people to purchase, inspect, and store materials. Consequently, each piece of material used to make a product would be assigned an overhead cost of USD 2.00 (USD 200,000/100,000 pieces).

These estimates made in 2010 were used during all of 2011. In practice, companies most frequently set rates for the entire year, although some set rates for shorter periods, such as a quarter. Look at the overhead rates computed for the four activities in Exhibit 14. Note that the total overhead for 2011 is USD 2,000,000 using activity-based costing, just as it was using a traditional costing method. The total amount of overhead should be the same whether using activity-based costing or traditional methods of cost allocation to products. The primary difference between activity-based costing and the traditional allocation methods is the amount of detail; particularly, the number of activities used to assign overhead costs to products. Traditional allocation uses just one activity, such as machine-hours. Activity-based costing used four activities in this case. In practice, companies using activity-based costing generally use more than four activities because more than four activities are important. We used four to keep the illustration as simple as possible. (Many companies that use traditional allocation methods use just one activity, as we have in this example.)

(1) Activity	(2) Cost driver used to allocate overhead cost driver	(3) Overhead cost for the activity	(4) Cost driver units for 2011	(5) Rate: column (3)/column (4)
1. Purchasing materials	Pieces of materials in each unit	\$ 200,000	100,000 pieces	\$2/piece
2. Machine setups	Machine setups	800,000	400 setups	\$2,000/setup
3. Inspections	Inspection hours	400,000	4,000 hours	\$100/hour
4. Running machines	Machine-hours	600,000	20,000	\$30/hour
Total overhead		\$ 2,000,000		

Exhibit 14: Overhead rates for activity-based costing

For January 2011, the High Challenge Company has the following information about the actual number of cost driver units for each of the two products:

	Touring bicycles	Mountain bicycles
1. Purchasing materials	6,000 pieces	4,000 pieces
2. Machine setups	10 setups	30 setups
3. Inspections	200 hours	200 hours
4. Running machines	1,500 hours	500 hours

Multiplying the actual activity events for each product times the predetermined rates computed earlier resulted in the overhead allocated to the two products shown in Exhibit 8.

Activity	Rate	Touring Actual cost driver units	Bicycles Cost allocated to Product	Mountain Actual cost driver units	Bicycles Cost allocated to product
1. Purchasing materials	\$2/piece	6,000 pieces	\$12,000	4,000 pieces	\$ 8,000
2. Machine setups	\$2,000/setup	10 setups	20,000	30 setups	60,000
3. Inspections	\$100/hour	200 hours	20,000	200 hours	20,000
4. Running machines	\$30/hour	1,500 hours	45,000	500 hours	15,000
Total cost allocated to each product			\$97,000		\$ 103,000

Exhibit 15: Overhead costs assigned to products using activity-based costing

Now we can compare the overhead allocated to the two product lines using the traditional method and activity-based costing, as follows:

	Touring bicycles	Mountain bicycles
Traditional method	\$150,000	\$50,000
Activity-based costing	97,000	103,000

**Unit costs** Assume High Challenge Company produced 1,000 units of touring bicycles and 200 units of mountain bicycles in January. The direct materials cost is USD 100 per unit for touring bicycles and USD 200 per unit for mountain bicycles. Direct labor cost is USD 20 per unit for touring bicycles and USD 30 per unit for mountain bicycles. Comparing the overhead allocations using the department allocation and the activity-based costing allocation reveals the differences in unit costs, as we show in Exhibit 10.

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	Traditional Costing		Activity-based Costing	
	Touring bicycles	Mountain bicycles	Touring bicycles	Mountain bicycles
Direct materials	\$ 100	\$200	\$100	\$200
Direct labor	20	30	20	30
Overhead	150 <sup>a</sup>	250 <sup>b</sup>	97	515 <sup>d</sup>
Total	\$270	\$480	\$217	\$745

<sup>a</sup> \$150 = overhead cost allocation to products using departmental rate divided by number of units produced = \$150,000/1,000 units.

<sup>b</sup> \$250 = overhead cost allocation to products using departmental rate divided by number of units produced = \$50,000/200 units.

<sup>c</sup> \$97 = overhead cost allocation to products using activity-based costing divided by number of units produced = \$97,000/1,000 units.

<sup>d</sup> \$515 = overhead cost allocation to products using activity-based costing divided by number of units produced = \$103,000/200 units.

### Exhibit 16: Comparison of product costs using traditional costing and activity-based costing

**Analysis** More overhead is allocated to the lower volume mountain bicycles using activity-based costing. The mountain bicycles are allocated more overhead per unit primarily because activity-based costing recognizes the need for more setups for mountain bicycles and for as many inspection hours for the more specialized mountain bicycles as for the higher volume touring bicycles. By failing to assign costs to all of the activities, touring bicycles were subsidizing mountain bicycles. Many companies have found themselves in similar situations. Activity-based costing has revealed that low-volume, specialized products have been the cause of greater costs than managers had realized.

### Impact of new production environment on cost drivers

When cost systems were first developed in industry, companies were far more labor intensive than they are today. The majority of the overhead cost was related to the support of labor, so it made sense to allocate overhead to products based on the amount of labor in the products. Labor is still a major product cost in many companies, especially service organizations such as public accounting firms. Often they allocate overhead to products (which are called jobs) on the basis of the amount of labor in the product.

As manufacturers and service companies have become more automated, direct labor has become less appropriate as a basis for allocating overhead. Direct labor has shrunk to less than 5 per cent of product costs in many companies and overhead has increased. Thus, companies that continue to allocate overhead to products based on direct labor are seeing rates increase as high as 500 per cent or more. (Some overhead rates are more than 1,000 per cent of direct labor costs.)

When labor is such a small part of product costs, there is little—if any—relationship between labor and overhead. Further, small errors in assigning labor to products are magnified many times when overhead rates are several hundred per cent of labor costs, or more.

Finally, allocating overhead on the basis of direct labor sends signals that direct labor is more expensive than it really is. This also creates tremendous incentives to reduce the labor content of products. While this may be desirable in particular circumstances, such decisions should be based on accurate cost numbers, not numbers heavily biased because of an arbitrary cost allocation method.

### Activity-based costing in marketing

Activity-based costing is not limited to the cost of producing goods and services; companies also apply it to marketing or administrative activities. The principles and methods are the same as discussed earlier: (1) identify activities or cost drivers, (2) compute an indirect cost rate for each activity, and (3) allocate indirect costs by multiplying the indirect cost rate for each activity by the volume of activities.

Instead of computing a cost of production, however, accountants compute a cost of performing an administrative or marketing service. Tissue products, for example, can be sold to grocery stores, convenience stores, the industrial market, and other channels of distribution. Each channel has different activities:

- Convenience stores would require many shipments in small orders and considerable marketing support.
- Grocery stores would require relatively large shipments, a variety of products, and considerable marketing support.
- Industrial users would involve brokers, minimum marketing support, and large orders.

Information on the cost of alternative channels of distribution is useful to marketing managers who make decisions about which channel to use. In this case, obvious cost drivers would include the number of shipments per period, size of shipment, number of products in a shipment, and measures of merchandising support.

### **Strategic use of activity-based management**

Many believe activity-based costing offers strategic opportunities for companies. One of the key ways companies develop a competitive advantage is by becoming low-cost producers or sellers. Companies such as Wal-Mart Stores in retailing, UPS in delivery services, and Southwest Airlines in the airline industry have created competitive advantages by reducing costs. Professor Michael Porter of the Harvard Business School, among others, has pointed out that certain companies have learned to use the information they have gained from their cost systems to make substantial price cuts to increase market share.

Activity-based costing plays an important role in companies' strategies and long-range plans to develop a competitive cost advantage. Activity-based costing focuses attention on activities. Cost reduction generally requires a change in activities. Although top management can send notices asking company employees to reduce costs, the implementation requires a change in activities. If you have been in school during a period when education costs were cut, you know that achieving the cut required a change in activities such as canceled classes, larger class sizes, and reduced services. It is impossible to know the effect of a change in activities on costs without the cost information provided by activity-based costing.

### **Behavioral and implementation issues**

Accountants cannot implement activity-based costing without becoming familiar with the operations of the company. In identifying activities, accountants team up with management and people from production, engineering, marketing, and other departments in identifying the activities that drive the company's costs. This often creates discomfort at first as accountants are forced to deal with unfamiliar areas; in the long run their familiarity with the company's operating activities can improve their contribution to the company. Nonaccounting personnel also feel a greater sense of ownership of the numbers reported by the accounting system so accounting improves its credibility among nonaccountants.

One of the problems encountered when implementing activity-based costing is the failure to get influential people in the organization to buy into the process. Accounting methods in companies are like rules in sports; people become accustomed to playing by the rules and oppose changing to something unknown.

For example, two analysts at one company spent several months of their time and hundreds of hours of computer time to develop an activity-based costing system. Their analysis revealed several hundred products that

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were clearly unprofitable and should be eliminated. However, the key managers who made product elimination decisions agreed to drop only about 20 products. Why? The analysts had failed to talk to these key managers early in the process. When presented with the final results, these managers raised numerous objections that the analysts had not anticipated. Moral: If you are involved in trying to make a change, get all of the people who are important to that change to buy into the process early.

### Opportunities to improve activity-based costing in practice

The use of activity-based costing in industry is relatively new. Companies are continually encountering limitations and finding ways to improve activity-based costing. A philosopher once said that our knowledge is like a circle; the more we know, the larger the circle. But the larger the circle, the greater its boundary and the more we realize the limits of our knowledge. Activity-based costing has shown managers they have much to learn about the cost of the activities required to make their products.

#### Understanding the learning objectives

- The new production environment refers to an environment in which company managers are concerned with (1) improving quality and (2) reducing costs. Accounting information can help managers assess the costs of quality and reduce the costs of making products.
- Three methods managers use to identify quality problems are control charts, Pareto diagrams, and cause and effect analyses.
- Knowing the four costs of quality—prevention, appraisal, internal failure, and external failure—can help managers minimize the cost of quality while providing high-quality products to customers.
- Four such measures are quality control, delivery performance, materials waste, and machine downtime.
- Managers can use benchmarking to focus attention on measuring how well one is doing against levels of performance either inside or outside of the organization.
- The balanced scorecard is a set of performance targets and results that show an organization's performance in meeting its stakeholder objectives.
- JIT substantially reduces or eliminates the need for inventories and improves quality by eliminating the flexibility provided by inventories. Products must be produced properly the first time.
- Just-in-time accounting procedures normally debit all costs directly to cost of goods sold and bypass the usual inventory accounts. When it is necessary to report inventories in financial statements, the inventory amounts are backed out of the Cost of Goods Sold account.
- Activity-based costing is a costing method that assigns costs to activities and then to the products based on each product's use of activities. Activity-based costing is based on the premise that products consume activities; activities consume resources.
- Companies benefit from activity-based costing because managers have more detailed information about the cost of activities and better product cost information.

- First, identify the activities that consume resources and assign costs to those activities. Second, identify the cost drivers associated with each activity. Third, compute a cost rate per cost driver unit. Fourth, assign costs to products by multiplying the cost driver rate times the volume of cost driver units consumed by the product.
- In many companies, activity-based costing has revealed that low-volume, specialized products have been more costly than managers had realized.
- By focusing attention on activities that cause costs, activity-based management helps managers eliminate activities that consume resources, thereby becoming more efficient and competitive.

### Demonstration problem

To continue the text example, consider December 2011 for High Challenge Company. Recall that the departmental overhead rate for 2011 was USD 100 per machine-hour. The following information for December is available:

	<b>Touring bicycles</b>	<b>Mountain bicycles</b>
Machine-hours	2,000	1,000
Units	1,300	400
<b>Activities</b>		
1. Purchasing materials	10,000 pieces	10,000 pieces
2. Machine setups	15 setups	40 setups
3. Inspections	200 hours	400 hours
4. Running machines	2,000 hours	1,000 hours

Compute the costs in total and per unit for touring bicycle and mountain bicycle products using both the traditional method based on machine-hours to allocate overhead and the activity-based costing rates. The actual activity levels for December are given in this problem; however, you should use the rates presented earlier in the text. Do not assume that the total overhead assigned to products for December using activity-based costing necessarily equals the total overhead allocated using the departmental allocation rate. Assume the direct materials costs are USD 100 and USD 200 per unit for touring bicycles and mountain bicycles, respectively; and direct labor costs are USD 20 and USD 30 per unit, respectively. Production was 1,300 touring bicycles and 400 mountain bicycles. Round unit costs to the nearest dollar.

### Solution to demonstration problem

Overhead costs allocated to products using the traditional method:

Touring bicycles (\$100 x 2,000 machine-hours)	\$200,000
Mountain bicycles (\$100 x 1,000 machine-hours)	100,000
<b>Total</b>	<b>\$300,000</b>

Overhead costs assigned to products using activity-based costing:

<b>Activity</b>	<b>Rate</b>	<b>Touring Bicycles Actual cost driver units</b>	<b>Bicycles Cost allocated to product</b>	<b>Mountain Bicycles Actual cost driver units</b>	<b>Bicycles Cost allocated to product</b>
1. Purchasing materials	\$2/piece	10,000 pieces	\$ 20,000	10,000 pieces	\$ 20,000
2. Machine setups	\$2,000/setup	15 setups	30,000	40 setups	80,000
3. Inspections	\$100/hour	200 hours	20,000	400 hours	40,000
4. Running machines	\$30/hour	2,000 hours	60,000	1,000	30,000
<b>Total cost allocated to each product</b>			<b>\$ 130,000</b>		<b>\$ 170,000</b>

Comparison of product costs using traditional costing and activity-based costing:

### **Traditional Costing    Activity-based Costing**

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	<b>Touring bicycles</b>	<b>Mountain bicycles</b>	<b>Touring bicycles</b>	<b>Mountain bicycles</b>
Direct materials	\$100	\$200	\$100	\$200
Direct labor	20	30	20	30
Overhead	154 <sup>a</sup>	250 <sup>b</sup>	100 <sup>c</sup>	425 <sup>d</sup>
Total	\$274	\$480	\$220	\$655

<sup>a</sup> \$154 = overhead cost allocation to products using departmental rate divided by number of units produced = \$200,000/1,300 units.

<sup>b</sup> \$250 = overhead cost allocation to products using departmental rate divided by number of units produced = \$100,000/400 units.

<sup>c</sup> \$100 = overhead cost allocation to products using activity-based costing divided by number of units produced = \$130,000/1,300 units.

<sup>d</sup> \$425 overhead cost allocation to products using activity-based costing divided by number of units produced = \$170,000/400 units.

### Key terms

**Activity-based costing** A costing method that first assigns costs to activities, then assigns costs to products based on their consumption of activities.

**Activity center** An activity center is a unit of the organization that performs some activity.

**Backflush costing** Backflush costing is a method of assigning costs to inventories backwards from Cost of Goods Sold to Work in Process or Finished Goods Inventory accounts.

**Balanced scorecard** A set of performance targets and results that show an organization's performance in meeting its responsibilities to various stakeholders.

**Benchmarking** Benchmarking is the continuous process of measuring how well one is doing against performance levels either inside or outside of the organization.

**Cause-and-effect analysis** Cause-and-effect analysis identifies potential causes of defects.

**Control charts** Control charts help managers distinguish between random or routine variations in quality and variations that they should investigate.

**Cost driver** A cost driver is an activity or transaction that causes costs to be incurred.

**Just-in-time (JIT) method** The just-in-time method manages purchasing and production so that materials are purchased just in time for production, parts are produced just when needed for the next step in the production process, and finished goods are completed just in time for sale.

**Pareto diagrams** Pareto diagrams indicate how frequently each type of failure occurs.

**Total quality management (TQM)** Defined as managing the entire organization so it excels in its goods and services that are important to the customer.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

In Texas Instruments' cost of quality program, the managers' task was to maximize the sum of prevention, appraisal, internal failure, and external failure costs.

Control charts are a means of distinguishing between random or routine variation in product quality and variations that managers should investigate.

The allocation of indirect costs is never arbitrary.

A cost driver is an activity or transaction that causes costs to be incurred.

The formula for computing an indirect cost rate has the cost in the numerator and the volume of the cost driver or allocation base in the denominator.

#### Multiple-choice

Select the best answer for each of the following questions.

The new production environment refers to an environment in which company managers are concerned with:

a. Improving customer service and product quality.

- b. Reducing costs.
- c. Increasing government regulation.
- d. a and b above.
- e. All of the above.

Just-in-time production and purchasing methods:

- a. Must be used in conjunction with activity- based costing.
- b. Require government regulation.
- c. Eliminate the need for inventories in theory because production does not take place until it is known the item will be sold.
- d. Require the use of Pareto charts.
- e. All of the above.

UR Company has two products, U and R. Overhead costs are presently allocated to the two products based on the labor-hours used to produce each product. It takes one labor-hour to make one unit of each product. The chief financial officer has suggested converting to activity-based costing. She collected the data shown below for three cost drivers and activities to be used under activity-based costing:

Activity	Cost driver	Amount	Volume	
			U	R
Production	Number of setups	\$82,000	8	12
Quality control	Number of inspections	48,000	56	24
Packaging costs	Number of units produced	130,000	80,000	50,000
Total overhead		\$260,000		

What is the total overhead allocated to Product U using the current method of allocating overhead based on labor-hours (80,000 labor-hours for U and 50,000 labor-hours for R)?

- a. USD 113,600.
- b. USD 130,000.
- c. USD 146,400.
- d. USD 160,000.
- e. None of the above.

Refer to the facts for in the above question. What is the overhead per unit assigned to Product R using activity-based costing? (Round to the nearest cent.)

- a. USD 2.60.
- b. USD 2.27.
- c. USD 2.00.
- d. USD 1.83.

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e. None of the above.

Now turn to “Answers to self-test” at the end of the chapter to check your answers.

### Questions

- To what does the phrase new production environment refer?
- Explain the purpose of using control charts, Pareto diagrams, and cause and effect analyses. You may find it useful to use examples.
- Audio Company makes compact disc players. After producing a compact disc player, the company tests it, then scraps it because it does not work. Is this an example of an internal failure cost, an appraisal cost, or a prevention cost?
- A company's performance measure is the number of customer complaints. Why would the company measure the number of customer complaints?
- A company's performance measure is the percentage of time that machines are not working. Why would the company measure the percentage of time that the machines are not working?
- How could reducing materials waste during production improve the quality of products?
- What is benchmarking? Give an example of benchmarking that you might use.
- What is the benefit to American Airlines of benchmarking on-time airplane arrivals?
- How does just-in-time help assure quality of production?
- Elimination of inventories through a just-in-time (JIT) method is believed to result in different types of cost savings. Give an example of a type of savings from JIT.
- What is the difference between accounting for costs using a JIT method and using traditional cost flows through inventory accounts?
- What operating conditions are necessary for a company to make use of a JIT method?
- What is the difference between activity-based costing and activity-based management?
- Activity-based costing methods use four steps in computing a product's cost. What are these steps?
- "Activity-based costing is great for manufacturing plants, but does not really address the needs of the service sector." Do you agree with this statement? Explain.
- What is a cost driver? Give three examples.
- The vice president of marketing wonders how products can cost less under one cost system than under another. How would you respond to her question "Are not costs cut-and-dried?"
- A drawback to activity-based costing is that it requires more record-keeping and extensive teamwork between all departments. What are the potential benefits of a more detailed product cost system?
- Give three criteria for choosing cost drivers for allocating costs to products.

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- "Activity-based costing is for accountants and production managers. I plan to be a marketing specialist so ABC will not help me." Do you agree with this statement? Explain.
- Observe the workings of a food service or coffee house. What activities are being performed? Give examples of some cost drivers that cause the cost of those activities. (For example, cooking food is an activity; the number of meals could be a cost driver for the cooking activity.)
- Observe the workings of a bank, credit union, or savings and loan institution. What activities are being performed? Give examples of some cost drivers that cause the cost of those activities. (For example, opening checking accounts is an activity; the number of accounts opened could be a cost driver for the opening accounts activity.)
- Activity-based costing assigns costs to activities that consume resources and to the products based on each product's use of activities. What is a benefit of this approach compared to a traditional approach that allocates costs to products based on the machine-hours used to produce the product?
- What is a balanced scorecard?
- **Real world question** Refer to the discussion "A broader perspective: HP" of the impact of just-in-time on accounting methods at HP. What effect did the implementation have on the HP plant's accounting methods?
- **Real world question** Why might Domino's Pizza make such a big deal out of delivering pizzas within 30 minutes?

### Exercises

**Exercise A** Classify Curly Company's costs for a typical month into prevention costs, appraisal costs, internal failure costs, and external failure costs:

Inspection at the end of the production process	\$10,000
Scrap	9,000
Design work to improve the way products are made	12,000
Cost of customer complaints	20,000
Employee training	6,000
Incoming materials inspection	5,000

Suppose Curly Company could increase employee training by USD 7,500 per month, and thereby reduce internal failure and external failure costs by 20 per cent each per month. (Appraisal costs would not be affected.) Would this be a wise thing for Curly Company to do?

**Exercise B** You have been hired by a food service organization on campus to help assess the quality of food services in the student union building. The following food service information is for the month of February:

Customer complaints	60
Waste as a percentage of total food prepared	10%
Cases of food poisoning	2

What additional information would you like to have to assess the quality of the food service organization's performance?

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**Exercise C** Network, Inc., manufactures networking devices for personal computer systems, using just-in-time methods. After receiving an order for 300 devices, the company bought materials (for cash) costing USD 14,000 to fill this order. It incurred labor and overhead costs of USD 48,000, of which USD 10,000 was for wages and the rest overhead.

After the production was finished, but before all goods were sold, the company needed to compute an inventory cost for financial statement purposes. The cost of finished goods inventory was USD 2,480.

- Use T-accounts to show the flow of costs under a traditional costing system.
- Prepare journal entries for these transactions using backflush costing.
- Use T-accounts to show the flow of costs using a JIT system with backflush costing.

**Exercise D** Quality Sound Corporation produces two types of compact discs (CDs), one is to install on touring bicycles and the other is a high-grade product for home and car use. The touring bicycles' CDs are designed for durability rather than accurate sound reproduction. The company only recently began producing the high-grade disc. Management believes the accounting system may not be accurately allocating costs to products.

Management asked you to investigate the cost allocation problem. You found that manufacturing overhead is currently assigned based on the direct labor costs in the products. For your investigation, you are using data from last year. Last year's manufacturing overhead was USD 440,000 based on production of 320,000 touring bicycle CDs and 100,000 high-grade CDs. Direct labor and direct materials costs were as follows:

	<b>Touring bicycle</b>	<b>High grade</b>	<b>Total</b>
Direct labor	\$180,000	\$60,000	\$240,000
Materials	120,000	112,000	232,000

Management believes three activities cause overhead costs. The cost drivers and related costs for your analysis are as follows:

<b>Cost drivers</b>	<b>Cost assigned</b>	<b>Activity Touring bicycle</b>	<b>Level High grade</b>	<b>Total</b>
Number of production runs	\$200,000	40	10	50
Quality tests performed	180,000	12	18	30
Shipping orders processed	60,000	100	50	150
Total overhead	\$440,000			

- How much of the overhead would be assigned to each product if the three cost drivers are used to allocate overhead? What would be the cost per unit (including materials, labor, and overhead) for each product if overhead is assigned to products using the three cost drivers?
- How much of the overhead would be assigned to each product if direct labor costs had been used as the basis for allocating overhead to each product? What would be the cost per unit (including materials, labor, and overhead) for each product if overhead is allocated to products using direct labor cost as the allocation base?

**Exercise E** Landscape, Inc., is a lawn and garden service. The company originally specialized in serving small residential clients; recently it has started contracting for work on larger office building grounds.

Employees worked a total of 10,000 hours last year, 6,500 on residential jobs and 3,500 on commercial jobs. Wages amounted to USD 10 per hour for all work done. Materials used are included in overhead and called supplies. All overhead is allocated on the basis of labor-hours worked, which is also the basis for customer charges.

Landscape, Inc., can charge USD 30 per hour for residential work but, because of greater competition for commercial accounts, only USD 20 per hour for commercial work.

a. Using labor-hours as the basis for allocating overhead, what was the gross margin (revenues minus labor and overhead expense) for (1) commercial and (2) residential service? Assume overhead was USD 50,000.

b. Overhead consists of transportation, lawn mowing and landscaping equipment costs, depreciation on equipment, supplies, fuels, and maintenance. These costs can be traced to the following activities:

Activity	Cost driver	Cost	Activity Level	
			Commercial	Residential
Transportation	Clients served	\$10,000	15	45
Equipment costs:				
Fuel, maintenance, depreciation	Equipment hours	25,000	3,000	2,000
Supplies	Square yards serviced per year	15,000	100,000	50,000
Total overhead		\$50,000		

Recalculate gross margin for commercial and residential services based on these cost driver bases.

c. Would you advise Landscape, Inc., to drop either the residential or commercial service based on your analysis? Explain.

### Problems

**Problem A** Here are cost items from Huskie Company's accounts for a typical month:

Inspection at the end of the production process	\$80,000
Cost of returned goods	36,000
Design work to improve the way products are made	48,000
Repairs to satisfy customer complaints	20,000
Employee training	24,000
Incoming materials inspection	20,000
Scrap	36,000

a. Classify these items into prevention costs, appraisal costs, internal failure costs, and external failure costs.

b. Suppose Huskie Company could spend an additional USD 40,000 per month on design work to improve the way products are made, and thereby reduce internal failure and external failure costs by 30 per cent each per month. (Appraisal costs would not be affected.) Would this be a wise thing for Huskie Company to do?

c. Give two examples of additional nonfinancial quality measures that Huskie Company could use to help improve quality. (Hint: See Exhibit 16.)

**Problem B** You have been hired by Bucks 'R' Us Bank to help assess the quality of their services. This information is for the month of March:

Customer complaints	60
Average customer waiting time	22 minutes
Number of lost files	2
Lawsuits filed against the bank	1

What additional information would you like to have to assess the quality of the bank's performance?

**Problem C** Heatseek Precision Instruments produces sensitive heat measurement meters. The company has a large backlog of orders and no beginning inventories because all units in production last year were sold by the end of the year. At the start of this year, an order was received for 2,000 meters.

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The company purchased and used USD 105,000 of materials in production for this order. Direct labor costs of USD 320,000 were incurred, and overhead costs of USD 520,000 were applied. Goods representing 10 per cent of these costs were still in finished goods inventory at the end of the period.

- Use T-accounts to show the flow of costs under a traditional costing system.
- Prepare journal entries for these transactions using backflush costing.
- Use T-accounts to show the flow of costs using a JIT system with backflush costing.

**Problem D** C & W Corporation manufactures travel clocks and watches. Overhead costs are currently allocated using direct labor-hours, but the controller has recommended using an activity-based costing system based on the following data:

Activity	Cost driver	Cost	Activity Level	
			Travel clocks	Watches
Production setup	Setups	\$100,000	20	30
Material handling and requisition	Parts	30,000	24	36
Packaging and shipping	Units shipped	60,000	80,000	120,000
Total overhead		\$190,000		

- Compute the amount of total overhead allocated to each of the products under activity-based costing.
- Compute the amount of total overhead allocated to each product using labor-hours as the allocation base. Assume labor-hours required to assemble each unit are .5 per travel clock and 1.0 per watch, and that 80,000 travel clocks and 120,000 watches were produced.
- Should the company follow the controller's recommendations?

**Problem E** Sunshield Company makes three types of sunglasses: Nerds, Stars, and Fashions. Sunshield presently allocates overhead to products using a rate based on direct labor-hours. A consultant recommended that Sunshield switch to activity-based costing. Management decided to give ABC a try and identified the following activities, cost drivers, and costs for a typical year for each activity center. Use this information to compute the overhead rates for each cost driver.

Activity	Recommended cost driver	Costs	Cost driver units
Production setup	Production runs	\$ 30,000	100
Order processing	Orders	50,000	200
Materials handling	Pounds of materials used	20,000	8,000
Equipment depreciation and maintenance	Machine-hours	60,000	10,000
Quality management	Inspections	50,000	40
Packing and shipping	Units shipped	40,000	20,000
Total overhead		\$250,000	

In addition, there are 2,500 direct labor-hours in a typical year.

Assume the following activities occurred in February of 2011:

	Nerds	Stars	Fashions
Units produced	1,000	500	400
Direct materials costs	\$4,000	\$2,500	\$2,000
Direct labor-hours	100	100	89
Orders	8	8	4
Production runs	2	4	8
Pounds of material	400	200	200
Machine-hours	500	300	300

Inspections	2	2	2
Units shipped	1,000	500	300

Direct labor costs are USD 15 per hour.

a. Compute an overhead allocation rate (1) for each of the cost drivers recommended by the consultant and (2) for direct labor.

b. Management wants to compare the product costs using ABC and the traditional method for the month of February. Compute the production costs for each product for February using direct labor-hours as the allocation base. (Note: Production costs are direct materials, direct labor, and overhead.)

c. To derive product costs under ABC, compute the production costs for each product for February using the cost drivers recommended by the consultant.

d. Management has seen your numbers and wants to know how you account for the discrepancy between the product costs using direct labor-hours as the allocation base and using activity-based costing. Write a brief response to management.

**Problem F** Filmworks Photography offers two types of services, student portraits and family portraits. Last year, Filmworks had the following costs and revenues:

<b>Filmworks Photography</b>			
<b>Income statement</b>			
	<b>Deluxe</b>	<b>Family</b>	<b>Total</b>
<b>Revenue</b>	\$180,000	\$200,000	\$380,000
Direct materials	25,000	25,000	50,000
Direct labor	90,000	60,000	150,000
Indirect costs:			
Administration	-----	-----	25,000
Production setup	-----	-----	50,000
Quality control	-----	-----	25,000
Marketing	-----	-----	20,000
Operating profit			\$60,000

Filmworks Photography currently uses labor costs to allocate all overhead, but management is considering implementing an activity-based costing system. After interviewing the sales and production staff, management decides to allocate administrative costs on the basis of direct labor costs and to use the following bases to allocate the remaining overhead:

<b>Activity</b>	<b>Cost driver</b>	<b>Cost driver</b>		<b>Units</b>	
		<b>Student</b>	<b>Family</b>	<b>Student</b>	<b>Family</b>
Production setup	Photo sessions	150	250		
Quality control	Customer inspections	300	200		
Marketing	Advertisements	60	40		

a. Complete the income statement using these activity bases.

b. Write a report describing how management might use activity-based costing to reduce costs.

c. Restate the income statement for Filmworks Photography using direct labor costs as the only overhead allocation base.

d. Write a report to management stating why product line profits differ using activity-based costing compared to the traditional approach. Indicate whether the activity-based costing method provides more accurate information

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and why (if you believe it does provide more accurate information). Indicate in your report how the use of labor-based overhead allocation could result in Filmworks Photography management making suboptimal decisions.

### Alternate problems

**Alternate problem A** These cost items are from Rocket Company's accounts for a typical month:

Design work to improve the way products are made	\$48,000
Warranty work to satisfy customer complaints	24,000
Employee training	36,000
Incoming materials inspection	40,000
Scrap	36,000
Cost of returned goods	48,000
Inspection at the end of the production process	60,000

- Classify these items into prevention costs, appraisal costs, internal failure costs, and external failure costs.
- Suppose Rocket Company could spend an additional USD 40,000 per month on incoming materials inspection, and thereby reduce internal failure and external failure costs by 20 per cent each per month. Would this be a wise thing for Rocket Company to do?
- Give two examples of additional nonfinancial quality measures that Rocket Company could use to help improve quality. (Hint: See Exhibit 16.)

**Alternate problem B** You have been hired by Student Health Services to help assess the quality of their services. You have been looking over the following information for the month of May:

Number of patient complaints	120
Minutes the average patient waits	3.8
Cases of missed diagnosis	4

What additional information would you like to have to assess the quality of the organization's performance?

**Alternate problem C** Precision Instruments produces high-tech devices. The company has a large backlog of orders and had no beginning inventories because all units in production last year were sold by the end of the year. At the start of this year, the firm received an order for 6,000 items.

The company purchased and used USD 200,000 of materials in production for this order. Direct labor costs of USD 150,000 and overhead costs of USD 400,000 were incurred. Goods representing 10 per cent of these costs were still in finished goods inventory at the end of the period.

- Use T-accounts to show the flow of costs under a traditional costing system.
- Prepare journal entries for these transactions using backflush costing.
- Use T-accounts to show the flow of costs using a JIT system with backflush costing.

**Alternate problem D** The manager of Rafting Excursions uses activity-based costing to compute the costs of her raft trips. Each raft holds six paying customers and a guide. She offers two types of raft trips, a three-day float trip for beginners, and a three-day white-water trip for seasoned rafters. The breakdown of costs is as follows:

Activities (with cost drivers)	Costs per float trip	Costs per white-water trip
Advertising (trips)	\$430	\$430
Permit to use the river (trips)	60	100
Equipment use (trips, people)	40 + 10 per person	80 + \$16 per person
Insurance (trips)	150	300
Paying guide (trips, guides)	600 per guide	800 per guide
Food (people)	120 per person	120 per person

- Compute the cost of a 28-person (including guides) float trip with four rafts and four guides.
- Compute the cost of a 28-person (including guides) white-water trip with four rafts and four guides.
- How much should the manager charge each customer if she wants to cover her costs?

**Alternate problem E** Shoe Express, Inc., manufactures two types of shoes, B-Ball and Marathon. The B-Ball shoe has a complex design that uses gel-filled compartments to provide support. The Marathon shoe is simpler to manufacture and uses conventional foam padding. Last year, Shoe Express had the following revenues and costs:

<b>Shoe Express, Inc. Income Statement</b>			
	<b>B-Ball</b>	<b>Marathon Total</b>	
Revenue	\$390,000	\$368,000	\$758,000
Direct materials	110,000	100,000	210,000
Direct labor	80,000	40,000	120,000
Indirect costs:			
Administration	-----	-----	40,000
Production setup	-----	-----	90,000
	-----	-----	
Quality control	-----	-----	60,000
Advertising	-----	-----	120,000
Net income before taxes			\$118,000

Shoe Express currently uses labor costs to allocate all overhead, but management is considering implementing an activity-based costing system. After interviewing the sales and production staff, management decides to allocate administrative costs on the basis of direct labor costs, but to use the following bases to allocate the remaining overhead:

Activity	Cost drivers	ActivityLevel	
		B-ball	Marathon
Production setup	Production runs	20	20
Quality control	Inspections	40	20
Advertising	Advertisements	12	48

- Complete the income statement using these activity bases.
- Write a brief report indicating how management could use activity-based costing to reduce costs.
- Restate the income statement for Shoe Express, Inc., using direct labor costs as the only overhead allocation base.
- Write a report to management stating why product line profits differ using activity-based costing compared to the traditional approach. Indicate whether the activity-based costing method provides more accurate information and why (if you believe it does provide more accurate information). Indicate in your report how the use of labor-based overhead allocation could result in Shoe Express management making suboptimal decisions.

#### Beyond the numbers—Critical thinking

**Business decision case A** Many companies recognize that their cost systems are inadequate for today's global market. Managers in companies selling multiple products are making important product decisions based on distorted cost information.

Write a short paper describing the benefits management should expect from implementing activity-based costing.

## 20. Using accounting for quality and cost management

**Business decision case B** A company that makes Halloween costumes is considering using just-in-time purchasing and production methods. Write a short paper describing the problems this company might face in using just-in-time.

**Business decision case C** Managers at Texas Instruments developed these four cost-of-quality categories: prevention costs, appraisal costs, internal failure costs, and external failure costs. Give an example of a cost for each of these four categories. Would minimizing the sum of these four costs assure high-quality products? Why or why not? Write a short paper summarizing your analysis.

**Group project D** The chapter listed the following six important points to remember about activity-based costing. Following each point are the comments of a cynic in italics. After forming six groups, discuss one of these points in each group. How would you respond to the cynic's comments? (It is okay to agree; even cynics have good points to make.) Choose one group member to report your group's response to the class.

- The allocation of indirect costs is at least somewhat arbitrary, even using sophisticated accounting methods. (*"This means no method gives you a true cost; all are arbitrary. So why go to the trouble of implementing ABC?"*)
- Activity-based costing provides more detailed measures of costs than traditional allocation methods. (*"Who needs more detail? Life is already too complicated".*)
- Activity-based costing can help marketing people by providing more accurate product cost numbers for decisions about pricing and which unprofitable products the company should eliminate. (*"Why should accountants want to help marketing people?"*)
- Production also benefits because activity-based costing provides better information about the cost of each activity. In practice, ABC helps managers identify cost causing activities. To manage costs, production managers learn to manage the activities that cause costs. (*"If production people know their jobs, they do not need help from accountants".*)
- Activity-based costing provides more information about product costs than traditional methods but requires more record-keeping. Managers must decide whether the benefits of improved decisions justify the additional record-keeping cost. (*"ABC sounds like a lot of work. Why bother?"*)
- Installing activity-based costing requires teamwork among accountants, production managers, marketing managers, and other nonaccounting people. (*"You will never get these people to work together. Accountants and marketing people? You have got to be kidding!"*)

**Group project E** Form a group of three or four students and assume you are hired as business consultants for each of the cases below. Respond to each of the comments made in case 1 and case 2. Your response should assume you are talking directly to the CEO. State whether you agree or disagree with the statement and justify your response. (Hint: Consider the potential costs and benefits associated with each case.)

Case 1 Your group is meeting with the CEO of a relatively small company that produces one model of bicycles. After lengthy discussion regarding the company's costing system, the CEO makes the following statement: "From

what I have seen at other companies lately, activity-based costing is the wave of the future. Everyone, including us, should drop existing cost systems and adopt ABC!"

Case 2 Your group is meeting with the CEO of a relatively large company that produces hundreds of expensive custom computers. After lengthy discussion regarding the company's costing system, the CEO makes the following statement: "From what I have seen at other companies lately, activity-based costing is the wave of the future. Everyone, including us, should drop existing cost systems and adopt ABC!"

**Group project F** In teams of two or three, interview the manager of a retail (or wholesale) store such as a music store, an automobile parts store, or the parts department of an appliance dealership. Ask the manager how items are ordered to replace those sold. For example, does he or she order based on observing inventory levels or place an order each time a customer buys an item? Does he or she appear to use just-in-time inventory? Write a memorandum to the instructor summarizing the results of the interview. Information contained in the memo should include:

Date:

To:

From:

Subject:

Content of the memo must include the name and title of the person interviewed, name of the company, date of the interview, and the results of the interview.

**Group project G** In teams of two or three, observe an organization of your choice—wholesale, retail, or service. Give examples of warning and diagnostic signals the organization uses. How could it use control charts, Pareto charts, and cause-and-effect analysis?

#### [Using the Internet—A view of the real world](#)

The Malcolm Baldrige National Quality Award is awarded to companies meeting certain quality standards and criteria. This award is issued annually by the National Institute of Standards and Technology (NIST). Visit the following website:

<http://www.baldrige.nist.gov>

Click on "Criteria and their Impact". What criteria are used as a basis for making awards to applicants? Click on "Winners Showcase". Who were the most recent winners of the Baldrige Award? What products or services do these companies provide?

Based on the results of the previous Internet project, perform an Internet search to find at least one recent Baldrige Award winning company. Does the company provide information on the Internet about being the recipient of the award? If so, write a report summarizing this information. If not, search for a recent award winner that does provide this information, and write a report summarizing the information provided.

#### [Answers to self-test](#)

#### **True-false**

## 20. Using accounting for quality and cost management

**False.** The managers' task is to minimize these costs, not maximize them.

**True.** Control charts are a means of distinguishing between random or routine variations in product quality and variations that managers should investigate.

**False.** To the contrary, the allocation of indirect costs is, by definition, at least somewhat arbitrary.

**True.** A cost driver is an activity or transaction that causes costs to be incurred.

**True.** The formula for computing an indirect cost rate has the cost in the numerator and the volume of the cost driver or allocation base in the denominator.

### Multiple-choice

**d.** The new production environment refers to an environment in which company managers are concerned with improving customer service and product quality, and reducing costs.

**c.** Production does not begin on an item until an order is received.

**d.** USD 160,000

USD 260,000 / (80,000 hours + 50,000 hours) = USD 2. USD 2 X 80,000 hours = USD 160,000.

**b.** USD 2.27

First find the rates:

$$\frac{\text{USD } 82,000}{(8+12)} = \text{USD } 4,100. \quad \frac{\text{USD } 48,000}{(56+24)} = \text{USD } 600.$$

$$\frac{\text{USD } 130,000}{(80,000+50,000)} = \text{USD } 1.$$

Next assign overhead to Product R:

(USD 4,100 X 12) + (USD 600 X 24) + (USD 1 X 50,000) = USD 49,200 + USD 14,400 + USD 50,000 = USD 113,600.

Now find the unit cost:

$$\frac{\text{USD } 113,600}{50,000 \text{ units}} = \text{USD } 2.27.$$

# 21. Cost-volume-profit analysis

## Learning objectives

After studying this chapter, you should be able to:

- Explain and describe cost behavior patterns.
- Separate mixed costs into fixed and variable components using the scatter diagram and high-low method.
- Explain the relationship among costs, volume, revenue, and profits.
- Find the break-even point.
- Compute the margin of safety.
- Demonstrate applications of cost-volume-profit analysis.
- List the assumptions underlying cost-volume-profit analysis.
- Describe how computer spreadsheets expand your capability to use cost-volume-profit analysis.
- Describe the impact of automation on fixed-variable cost relationships.

## A manager's perspective

### **Renee Vaughn**

*Manager, Administration and Special Projects*

*Public and Media Relations*

*The Coca-Cola Company*

I am responsible for providing scheduling and assisting with staffing with the Public and Media Relations group. This requires anticipating needs for the group and planning accordingly. I also administer budgets for three departments (about 35 employees).

I began my professional career in an elementary school district administration office, serving as an administrative assistant for the superintendent of schools. I learned to plan and manage budgets in that capacity. At The Coca-Cola Company, once a budget is created at the departmental level, it is tracked on a monthly basis by reviewing all spending by account and in total. We also review a rolling estimate of annual expenses and adjust the budget accordingly.

We plan for non-project capital budgeting a year in advance, which enables us to order computer, fax, and other office equipment as well as make other necessary major purchases. If an unforeseen need develops, we will review our plan and make revisions as necessary on a case-by-case basis.

## 21. Cost-volume-profit analysis

Assume that a student organization wants to show movies on campus. The organization can rent a particular movie for one weekend for USD 1,000. Rent for an auditorium, salaries for ticket takers and other personnel, and other fixed costs would amount to USD 800 for the weekend. The organization would sell tickets for USD 4 per person. In addition, profits from the sale of soft drinks, popcorn, and candy are estimated to be USD 1 per ticket holder. How many people would have to buy tickets to justify renting the movie? (The answer is 360 ticket-buyers as shown in the solution to Demonstration problem at the end of this chapter.)

Solving problems like this requires an understanding of the relationship between costs, revenue, and volume. This chapter discusses the use of cost-volume-profit analysis for decision making and planning. (Although accountants call this topic cost-volume-profit analysis, it could just as easily have been called cost-volume- revenue analysis.) All of the analysis in this chapter is on a before-tax basis.

In this chapter we will focus on short-run decisions. The term **short run** describes a time frame during which a company's management cannot change the effects of certain past decisions. The short run is one year or less for practical purposes. For example, GM's decision to offer a special rebate starting January 5 and expiring on January 31 would be a short-run decision. In contrast, GM's decision to begin producing cars in China .

In the short run, we assume many costs are fixed and unchangeable, such as building rental expense. However, all costs are subject to change in the long run. Although we identify particular costs as fixed in this chapter, you should realize that costs fixed in the short run may change in the long run. Someday the building rental agreement will change, so the building rental expense will change.

### Cost behavior patterns

Exhibit 17 shows four basic cost behavior patterns: fixed, variable, mixed (semivariable), and step. As discussed in earlier chapters, **fixed costs** remain constant (in total) over some relevant range of output. Often, we describe them as time-related costs. Depreciation, insurance, property taxes, and administrative salaries are examples of fixed costs. Recall that so-called fixed costs are fixed in the short run but not necessarily in the long run.

For example, a local high-tech company did not lay off employees during a recent decrease in business volume because the management did not want to hire and train new people when business picked up again. Management treated direct labor as a fixed cost in this situation. Although volume decreased, direct labor costs remained fixed.

**Illustration 21.1 Four Cost Patterns**

**Reinforcing Problem**  
E21-1 Match cost behavior types with diagrams

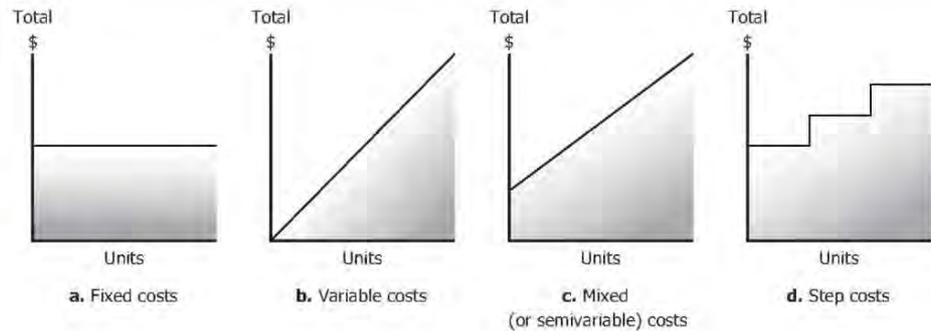


Exhibit 17: Four cost patterns

In contrast to fixed costs, **variable costs** vary (in total) directly with changes in volume of production or sales. In particular, total variable costs change as total volume changes. If pizza production increases from 100 10-inch pizzas to 200 10-inch pizzas per day, the amount of dough required per day to make 10-inch pizzas would double. The dough is a variable cost of pizza production. Direct materials and sales commissions are variable costs.

Direct labor is a variable cost in many cases. If the total direct labor cost increases as the volume of output increases and decreases as volume decreases, direct labor is a variable cost. Piecework pay is an excellent example of direct labor as a variable cost. In addition, direct labor is frequently a variable cost for workers paid on an hourly basis, as the volume of output increases, more workers are hired. However, sometimes the nature of the work or management policy does not allow direct labor to change as volume changes and direct labor can be a fixed cost.

Mixed costs have both fixed and variable characteristics. A **mixed cost** contains a fixed portion of cost incurred even when the facility is idle, and a variable portion that increases directly with volume. Electricity is an example of a mixed cost. A company must incur a certain cost for basic electrical service. As the company increases its volume of activity, it runs more machines and runs them longer. The firm also may extend its hours of operation. As activity increases, so does the cost of electricity.

Managers usually separate mixed costs into their fixed and variable components for decision-making purposes. They include the fixed portion of mixed costs with other fixed costs, while assuming the variable part changes with volume. Look at Exhibit 18 to see how to separate the fixed and variable portions of a mixed cost such as electricity.

## 21. Cost-volume-profit analysis

### Illustration 21.2 Separation of Mixed Costs into Fixed and Variable Parts

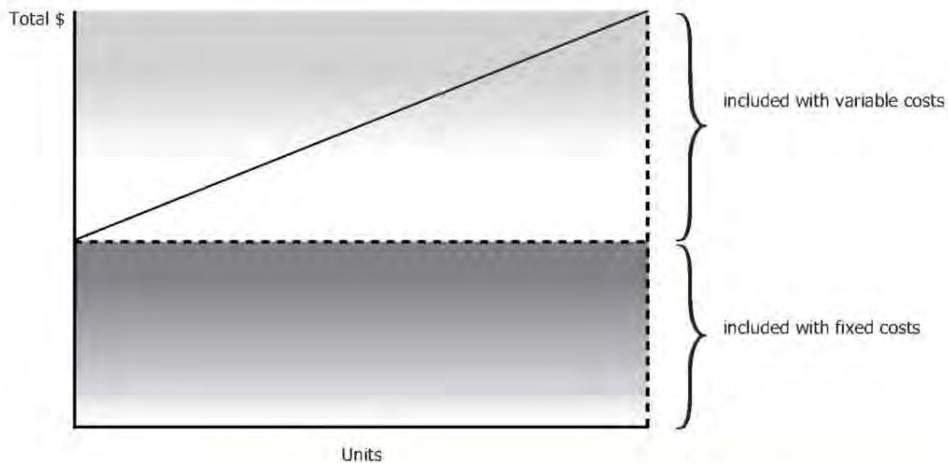


Exhibit 18: Separation of mixed costs into fixed and variable parts

A **step cost** remains constant at a certain fixed amount over a range of output (or sales). Then, at certain points, the step costs increase to higher amounts. Visually, step costs appear like stair steps, as shown in Exhibit 17.

Supervisors' salaries are an example of a step cost when companies hire additional supervisors as production increases. For instance, the local McDonald's restaurant has one supervisor until sales exceed 100 meals during the lunch hour. If sales regularly exceed 100 meals during that hour, the company adds a second supervisor. In Exhibit 19, we show a step cost for supervisors' salaries, assuming each supervisor is paid USD 2,000 per month. Step costs are sometimes labeled as step variable costs (many small steps) or step fixed costs (only a few large steps).

### Illustration 21.3 A Step Cost

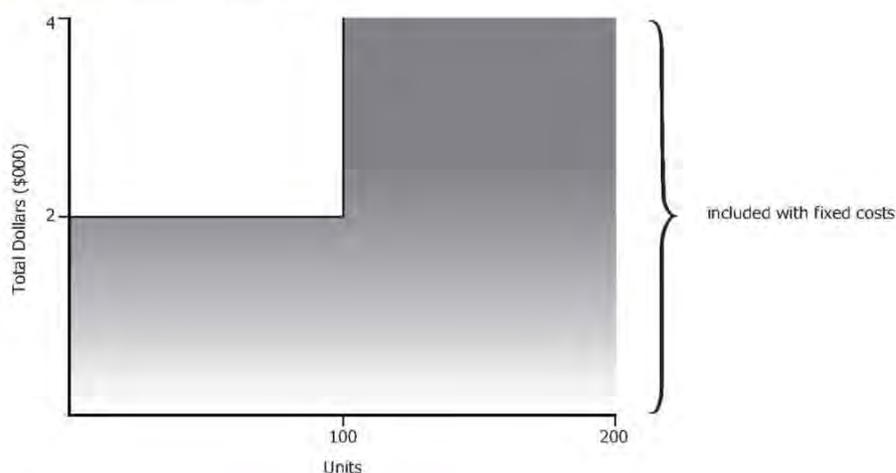


Exhibit 19: A step cost

Although we have described four different cost patterns (fixed, variable, mixed, and step), we simplify our discussions in this chapter by assuming managers can separate mixed and step costs into fixed and variable components.

Many costs do not vary in a strictly linear relationship with volume. Rather, costs may vary in a curvilinear pattern—a 10 per cent increase in volume may yield an 8 per cent change in total variable costs at lower output levels and an 11 per cent change in total variable costs at higher output levels. We show a curvilinear cost pattern in Exhibit 20.

Illustration 21.4 Curvilinear Cost Pattern

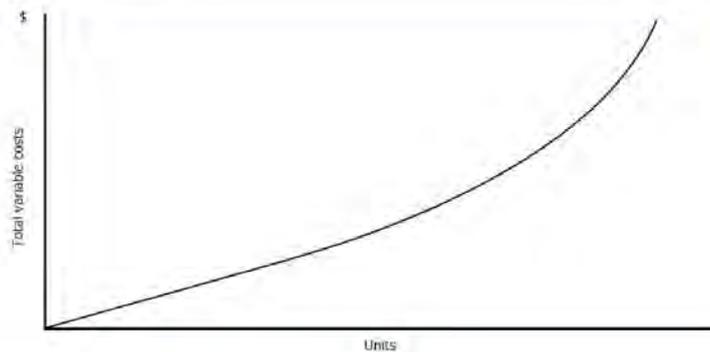


Exhibit 20: Curvilinear cost pattern

One way to deal with a curvilinear cost pattern is to assume a linear relationship between costs and volume within some relevant range. The **relevant range** is the range of production or sales volume over which the assumptions about cost behavior are valid. Look at Exhibit 21 to see how to apply the relevant range to a portion of the curvilinear cost curve. Within that relevant range, the total cost varies linearly with volume, at least approximately. Outside of the relevant range, we presume the assumptions about cost behavior may be invalid.

Illustration 21.5 Relevant Range

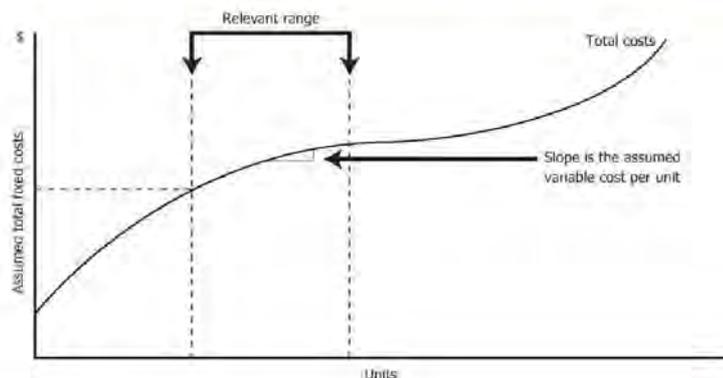


Exhibit 21: Relevant range

## 21. Cost-volume-profit analysis

Costs rarely behave in the simple way that would make life easy for decision makers. Even within the relevant range, the assumed cost behavior is usually only approximately linear. As decision makers, we have to live with the fact that cost estimates are not as precise as physical or engineering measurements.

### Methods for analyzing costs

You can use several methods to break down a mixed cost into its fixed and variable cost components. We present two of these methods—the scatter diagram and the high-low method.

A **scatter diagram** shows plots of actual costs incurred for various levels of activity. Assume the dots on the scatter diagram in Exhibit 22 represent total actual maintenance costs per month for a Federal Express fleet of delivery trucks. Each dot represents one month's activity for one city. For example, the left point represents a USD 38,000 cost for approximately 30,000 miles a month. The next point to the right represents USD 42,000 for approximately 40,000 miles for another month. We drew a line that appears to best fit the pattern of dots. The line we drew is subjective. If you were to draw such a line, your line would probably differ from ours.

Estimating fixed and variable costs using a scatter diagram is subjective. If your line through the dots in Exhibit 22 differs from ours, you would estimate different fixed and variable costs. Your line and cost estimates would not necessarily be right or wrong compared to ours, just different.

**Illustration 21.6** Scatter Diagram

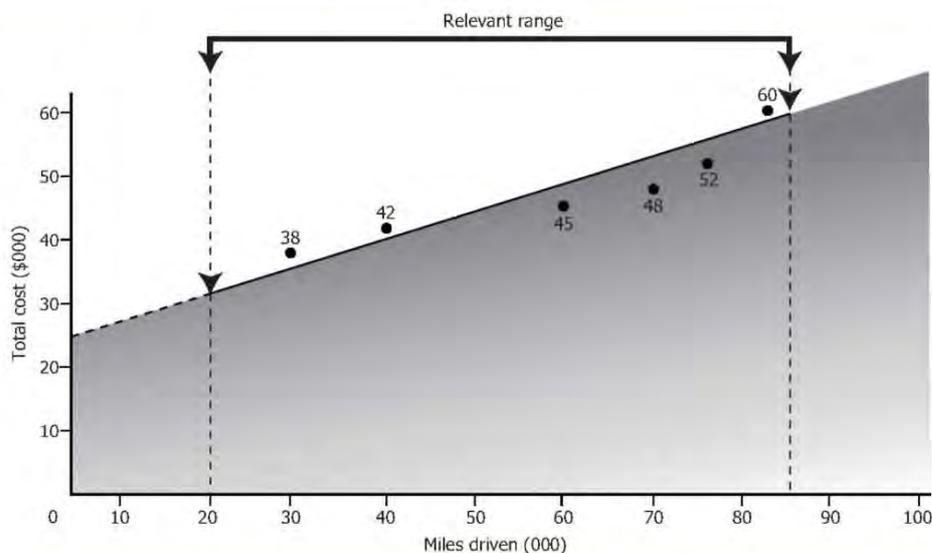


Exhibit 22: Scatter diagram

In Exhibit 22, our line intersects the vertical axis at USD 25,000, which we estimate to be the fixed portion of the mixed cost. We estimate the line would pass through a point representing a cost of USD 57,000 at a volume of 80,000 miles. Thus, our line rises from USD 25,000, representing 0 (zero) miles, to USD 57,000 over a volume of 80,000 miles on the horizontal axis. Based on that information, we can now compute the variable cost portion of the mixed cost as follows:

$$\frac{\text{USD } 57,000 - \text{USD } 25,000}{80,000 \text{ miles} - 0 \text{ miles}} = \text{USD } 0.40 \text{ per mile}$$

Using this result, we estimate the company's truck maintenance costs are USD 25,000 per month plus 40 cents for every mile driven.

You can also use the **high-low method** to identify the elements of mixed costs. This method uses only the highest and lowest points (levels of operation) on a scatter diagram to fit a line to the data.

To illustrate, the lowest point in Exhibit 22, is USD 38,000 of expense at 30,000 miles driven, and the highest point is USD 60,000 at 80,000 miles. Calculate the amount of variable cost per mile as follows:

$$\frac{\text{Change for cost}}{\text{Change for units}} = \frac{\text{USD } 60,000 - \text{USD } 38,000}{80,000 \text{ miles} - 30,000 \text{ miles}} = \frac{\text{USD } 22,000}{50,000 \text{ miles}} = \text{USD } 0.44 \text{ per mile}$$

To compute the fixed portion:

Total cost at 80,000 miles	\$60,000
Less: Variance cost at that level of output (80,000 x \$0.44)	35,200
Fixed cost at all levels of mileage within the relevant range	\$24,800

The high-low method is less precise than the scatter diagram because it uses only two data points in the computation. Either or both points may not be representative of the data as a whole.

Many people use more sophisticated statistical techniques to divide mixed costs into fixed and variable portions. Statistics and cost accounting texts discuss these techniques.

Now that you understand cost patterns and how to analyze costs, we will apply these concepts to the specific tools that managers use in short-term decision making. The first of these tools is cost-volume-profit (CVP) analysis.

### Cost-volume-profit (CVP) analysis

Companies use **cost-volume-profit (CVP) analysis** (also called break-even analysis) to determine what affects changes in their selling prices, costs, and/or volume will have on profits in the short run. A careful and accurate cost-volume-profit (CVP) analysis requires knowledge of costs and their fixed or variable behavior as volume changes.

A **cost-volume-profit chart** is a graph that shows the relationships among sales, costs, volume, and profit. Look at Exhibit 23, a cost-volume-profit chart for Video Productions, a company that produces videotapes. Each tape sells for USD 20. The variable cost per tape is USD 12, and the fixed costs per month are USD 40,000.

The total cost line in Exhibit 23 represents the fixed costs of USD 40,000 plus USD 12 per unit. Thus, if Video Productions produces and sells 6,000 tapes, the company's total costs are USD 112,000, made up of USD 40,000 fixed costs and USD 72,000 total variable costs (USD 72,000 = USD 12 per unit X 6,000 units produced and sold).

The total revenue line in Exhibit 23 shows how revenue increases as volume increases. Total revenue is USD 120,000 for sales of 6,000 tapes (USD 120,000 = USD 20 per unit X 6,000 units sold). In Exhibit 23, we demonstrate the effect of volume on revenue, costs, and net income, for a particular price, variable cost per unit, and fixed cost per period.

## 21. Cost-volume-profit analysis

**Illustration 21.7 The Cost-Volume-Profit Chart**

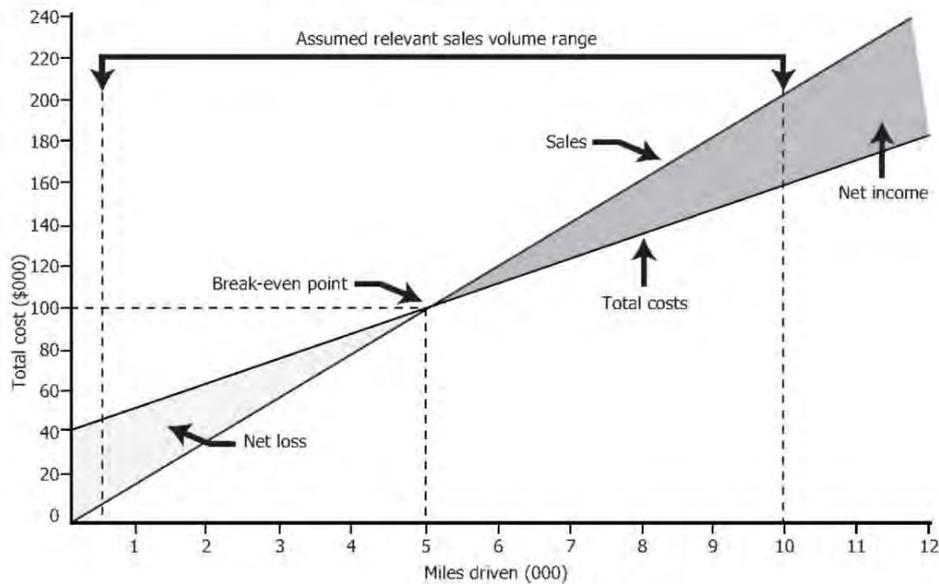


Exhibit 23: The cost-volume-profit chart

At each volume, one can estimate the company's profit or loss. For example, at a volume of 6,000 units, the profit is USD 8,000. We can find the net income either by constructing an income statement or using the profit equation. The income statement gives the following results for a volume of 6,000 units:

Revenue	\$120,000
Less: variable costs	72,000
Contribution margin	\$ 48,000
Less: Fixed costs	40,000
Net income	\$ 8,000

We have introduced a new term in this income statement—the contribution margin. The **contribution margin** is the amount by which revenue exceeds the variable costs of producing that revenue. We can calculate it on a per unit or total sales volume basis. On a per unit basis, the contribution margin for Video Productions is USD 8 (the selling price of USD 20 minus the variable cost per unit of USD 12).

The contribution margin indicates the amount of money remaining after the company covers its variable costs. This remainder contributes to the coverage of fixed costs and to net income. In Video Production's income statement, the USD 48,000 contribution margin covers the USD 40,000 fixed costs and leaves USD 8,000 in net income.

**Profit equation** The profit equation is just like the income statement, except it presents the analysis in a slightly different form. According to the **profit equation**:

$$\text{Net income} = \text{Revenue} - \text{Total variable costs} - \text{Fixed costs}$$

For Video Productions, the profit equation looks like this:

$$\text{Net income} = \text{USD } 120,000 - \text{USD } 72,000 - \text{USD } 40,000$$

Net income=USD8,000

Exhibit 23 shows cost data for Video Productions in a relevant range of output from 500 to 10,000 units. Recall the relevant range is the range of production or sales volume over which the basic cost behavior assumptions hold true. For volumes outside these ranges, costs behave differently and alter the assumed relationships. For example, if Video Productions produced and sold more than 10,000 units per month, it might be necessary to increase plant capacity (thus incurring additional fixed costs) or to work extra shifts (thus incurring overtime charges and other inefficiencies). In either case, the assumed cost relationships would no longer be valid.

### Finding the break-even point

A company breaks even for a given period when sales revenue and costs charged to that period are equal. Thus, the **break-even point** is that level of operations at which a company realizes no net income or loss.

A company may express a break-even point in dollars of sales revenue or number of units produced or sold. No matter how a company expresses its break-even point, it is still the point of zero income or loss. To illustrate the calculation of a break-even point, recall that Video Productions produces videotapes selling for USD 20 per unit. Fixed costs per period total USD 40,000, while variable cost is USD 12 per unit.

**Break-even in units** We compute the break-even point in units by dividing total fixed costs by the contribution margin per unit. The contribution margin per unit is USD 8 (USD 20 selling price per unit - USD 12 variable cost per unit). In the following break-even equation, BE refers to the break-even point:

$$\text{BE units} = \frac{\text{Fix costs}}{\text{Contribution margin per unit}}$$

$$\text{BE units} = \frac{\text{USD } 40,000}{\text{USD } 8 \text{ per unit}}$$

$$\text{BE units} = 5,000 \text{ units}$$

The result tells us that Video Productions breaks even at a volume of 5,000 units per month. We can prove that to be true by computing the revenue and total costs at a volume of 5,000 units. Revenue = 5,000 units X USD 20 sales price per unit = USD 100,000. Total costs = USD 100,000 = USD 40,000 fixed costs + USD 60,000 variable costs (USD 60,000 = USD 12 per unit X 5,000 units).

Look at Exhibit 23 and note that the revenue and total cost lines cross at 5,000 units—the break-even point. Video Productions has net income at volumes greater than 5,000, but it has losses at volumes less than 5,000 units.

**Break-even in sales dollars** Companies frequently think of volume in sales dollars instead of units. For a company such as GM that makes Cadillacs and certain small components, it makes no sense to think of a break-even point in units. GM breaks even in sales dollars.

The formula to compute the break-even point in sales dollars looks a lot like the formula to compute the break-even in units, except we divide fixed costs by the contribution margin ratio instead of the contribution margin per unit.

$$\text{BE dollars} = \frac{\text{Fix costs}}{\text{Contribution margin ratio}}$$

## 21. Cost-volume-profit analysis

### A broader perspective: Even colleges use CVP

The dean of the Business School at a particular university was considering whether to offer a seminar for executives. The tuition would be USD 650 per person. Variable costs, including meals, parking, and materials, would be USD 80 per person. Certain costs of offering the seminar, including advertising, instructors' fees, room rent, and audiovisual equipment rent, would not be affected by the number of people attending (within a "relevant range"). Such costs, which could be thought of as fixed costs, amounted to USD 8,000 for the seminar.

In addition to these costs, a number of staff, including the dean, would work on the program. Although the salaries paid to these staff were not affected by offering the seminar, working on it took these people away from other duties, thus creating an opportunity cost, estimated to be USD 7,000 for this seminar.

Given this information, the school estimated the break-even point to be  $(\text{USD } 8,000 + \text{USD } 7,000) / (\text{USD } 650 - \text{USD } 80) = 26.3$  students. If the school wanted at least to break even on this program, it should offer the program only if it expected at least 27 students to attend.

Based on the authors' research.

The **contribution margin ratio** expresses the contribution margin as a percentage of sales. To calculate this ratio, divide the contribution margin per unit by the selling price per unit, or total contribution margin by total revenues. Video Production's contribution margin ratio is:

$$\text{Contribution margin ratio} = \frac{\text{Contribution margin per unit}}{\text{Selling price per unit}}$$

$$\frac{\text{USD } 20 - \text{USD } 12}{\text{USD } 20} = \frac{\text{USD } 8}{\text{USD } 20}$$

$$= 0.40$$

Or, referring to the income statement in which Video Productions had a total contribution margin of USD 48,000 on revenues of USD 120,000, we compute the contribution margin ratio as follows:

$$\text{Contribution margin ratio} = \frac{\text{Total contribution margin}}{\text{Total revenues}}$$

$$= \frac{\text{USD } 48,000}{\text{USD } 120,000}$$

$$= 0.40$$

That is, for each dollar of sales, there is a USD 0.40 contribution to covering fixed costs and generating net income.

Using this ratio, we calculate Video Production's break-even point in sales dollars as:

$$\text{BE dollars} = \frac{\text{Fix costs}}{\text{Contribution margin rate}}$$

$$\text{BE dollars} = \frac{\text{USD } 40,000}{0.40}$$

$$= \text{USD } 100,000$$

The break-even volume of sales is USD 100,000 (5,000 units at USD 20 per unit). At this level of sales, fixed costs plus variable costs equal sales revenue, as shown here:

Revenue	\$120,000
Less: variable costs	72,000
Contribution margin	\$ 48,000
Less: Fixed costs	40,000
Net income	\$ 8,000

The cost-volume-profit chart in Exhibit 23 shows that in a period of complete idleness, Video Productions would lose USD 40,000 (the amount of fixed costs). However, when Video Productions has an output of 10,000 units, the company has net income of USD 40,000. Other points on the graph show that sales of 7,500 units results in USD 150,000 of revenue. At that point, Video Production's total costs amount to USD 130,000, leaving net income of USD 20,000.

Although you are likely to use cost-volume-profit analysis for a single product, you will more frequently use it in multi-product situations. The easiest way to use cost-volume-profit analysis for a multi-product company is to use dollars of sales as the volume measure. For CVP purposes, a multi-product company must assume a given product mix. **Product mix** refers to the proportion of the company's total sales attributable to each type of product sold.

To illustrate the computation of the break-even point for Wonderfood, a multi-product company that makes three types of cereal, assume the following historical data:

	Product							
	1		2		3		Total	
	Amount	Per cent	Amount	Per cent	Amount	Per cent	Amount	Per cent
Sales	\$60,000	100%	\$30,000	100%	\$10,000	100%	\$100,000	100%
Less:								
Variable costs	40,000	67%	16,000	53%	4,000	40%	60,000	60%
Contribution margin	\$20,000	33%	\$14,000	47%	\$ 6,000	60%	\$ 40,000	40%

We use the data in the total columns to compute the break-even point. The contribution margin ratio is 40 per cent or (USD 40,000/USD 100,000). Assuming the product mix remains constant and fixed costs for the company are USD 50,000, break-even sales are USD 125,000, computed as follows:

$$\text{BE dollars} = \frac{\text{Fix costs}}{\text{Contribution margin ratio}}$$

$$\text{BE dollars} = \frac{\text{USD } 50,000}{0.40}$$

$$= \text{USD } 125,000$$

[To check our answer: (USD 125,000 X 0.40) - USD 50,000 = USD 0.]

To find the three product sales totals, we multiply total sales dollars by the per cent of product mix for each of the three products. The product mix for products 1, 2, and 3 is 60:30:10, respectively. That is, out of the USD 100,000 total sales, there were sales of USD 60,000 for product 1, USD 30,000 for product 2, and USD 10,000 for

## 21. Cost-volume-profit analysis

product 3. Therefore, the company has to sell USD 75,000 of product 1 (0.6 X USD 125,000), USD 37,500 of product 2 (0.3 X USD 125,000), and USD 12,500 of product 3 (0.1 X USD 125,000) to break even.

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### An accounting perspective:

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#### Business insight

The founder of Domino's Pizza, Inc. nearly went bankrupt several times before he finally made Domino's a financial success. One early problem was that the company was providing small pizzas that cost almost as much to make and just as much to deliver as larger pizzas. Because they were small, the company could not charge enough to cover its costs. At one point, the company's founder was so busy producing small pizzas that he did not have time to determine that the company was losing money on them.

If a company's current sales are more than its break-even point, it has a margin of safety equal to current sales minus break-even sales. The **margin of safety** is the amount by which sales can decrease before the company incurs a loss. For example, assume Video Productions currently has sales of USD 120,000 and its break-even sales are USD 100,000. The margin of safety is USD 20,000, computed as follows:

$$\begin{aligned}\text{Margin safety} &= \text{Current sales} - \text{Break-even sales} \\ &= \text{USD } 120,000 - \text{USD } 100,000 \\ &= \text{USD } 20,000\end{aligned}$$

Sometimes people express the margin of safety as a percentage, called the margin of safety rate. The **margin of safety rate** is equal to  $\frac{(\text{Current sales} - \text{Break} - \text{even sales})}{\text{Current sales}}$ . Using the data just presented, we compute the margin of safety rate as follows:

$$\begin{aligned}\text{Margin of safety rate} &= \frac{(\text{Current sales} - \text{Break} - \text{even sales})}{\text{Current sales}} \\ &= \frac{(\text{USD } 120,000 - \text{USD } 100,000)}{\text{USD } 120,000} \\ &= 16.67 \text{ per cent}\end{aligned}$$

This means that sales volume could drop by 16.67 per cent before the company would incur a loss.

### Cost-volume-profit analysis illustrated

CVP analysis has many applications. This section illustrates several applications using airline data.

The management of a major airline wishes to know how many seats must be sold on Flight 529 to break even. To solve this problem, management must identify and separate costs into fixed and variable categories.

The fixed costs of Flight 529 are the same regardless of the number of seats filled. Fixed costs include the fuel required to fly the plane and crew (with no passengers) to its destination; depreciation on the plane used on the flight; and salaries of required crew members, gate attendants, and maintenance and refueling personnel.

The variable costs vary directly with the number of passengers. Variable costs include snacks and beverages provided to passengers, baggage handling costs, and the cost of the additional fuel required to fly the plane with passengers to its destination. Management would express each variable cost on a per passenger basis.

Assume that after analyzing the various costs and separating them into fixed or variable categories, management finds the fixed costs for Flight 529 are USD 12,000 and variable costs are USD 25 per passenger. Tickets cost USD 125. Thus, the contribution margin ratio is 80 per cent or  $[(USD 125 - USD 25)/USD 125]$ .

We can express the break-even point either in sales dollars or in the number of passengers. The break-even point in sales dollars is:

$$\begin{aligned} \text{BE dollars} &= \frac{\text{Fix costs}}{\text{Contribution margin ratio}} \\ &= \frac{\text{USD } 12,000}{0.80} \\ &= \text{USD } 15,000 \end{aligned}$$

We can find the break-even point in number of passengers (units) by dividing fixed costs by the contribution margin per unit:

$$\begin{aligned} \text{BE units} &= \frac{\text{Fix costs}}{\text{Contribution margin per unit (passenger)}} \\ &= \frac{\text{USD } 12,000}{(\text{USD } 125 - \text{USD } 25)} \\ &= 120 \text{ passengers} \end{aligned}$$

To check our answers: 120 passengers X USD 125 ticket price = USD 15,000.

With a simple adjustment in the break-even formulas, CVP analysis can also show the sales volume needed to generate some desired level of net income (ignore taxes). To make this adjustment, management adds the desired net income amount to the fixed costs that must be covered. From this, management can determine the necessary sales volume in dollars or units to provide the desired net income. For example, assume management wishes to earn USD 8,000 of net income on Flight 529.

How many passenger tickets must the airline sell to earn USD 8,000? Remember, the contribution margin per ticket is USD 100. We compute the number of tickets to be sold to earn USD 8,000 on a flight as follows:

$$\begin{aligned} \text{Number of units} &= \frac{\text{Fix costs} + \text{Desired net income}}{\text{Contribution margin per unit}} \\ &= \frac{\text{USD } 12,000 + \text{USD } 8,000}{\text{USD } 100} \end{aligned}$$

## 21. Cost-volume-profit analysis

$$= \frac{\text{USD } 20,000}{\text{USD } 100}$$

$$= 200 \text{ tickets}$$

The airline must sell 200 tickets to earn net income of USD 8,000. To check our answer: (200 tickets X USD 125 sales price per ticket) - (200 tickets X USD 25 variable cost per ticket) - USD 12,000 fixed costs = USD 25,000 - USD 5,000 - USD 12,000 = USD 8,000.

The airline management can also use cost-volume-profit analysis to determine the effect of changing the sales price. To illustrate, assume that Flight 529 normally carries 150 passengers (sales of USD 18,750 and net income of USD 3,000), and the airline decides to increase ticket prices by 5 per cent. If variable and fixed costs remain constant and passenger load does not change, net income increases from USD 3,000 to USD 3,937.50 as follows:

$$\text{Revenue} - \text{Total variable costs} - \text{Fixed costs} = \text{Net income}$$

$$[\text{USD } 125[1.05] \times 150 \text{ passengers}] - (\text{USD } 25 \times 150 \text{ passengers}) - \text{USD } 12,000 = \text{NI}$$

$$\text{USD } 19,687.50 - \text{USD } 3,750 - \text{USD } 12,000 = \text{NI}$$

$$\text{USD } 3,937.50 = \text{NI}$$

Net income would rise by the entire amount of the price increase (USD 19,687.50 - USD 18,750 = USD 937.50).

Management can use cost-volume-profit analysis to calculate the sales needed to maintain net income when costs change. For example, assume both fixed and variable costs would increase for the airline if the price of fuel rises. Assume that fixed costs increase by USD 4,000 and variable costs increase by USD 6.25 per passenger. Variable costs are now 25 per cent, or (USD 31.25/USD 125), of the sales price. The contribution margin is now USD 93.75, or (USD 125 - USD 31.25), per passenger. The contribution margin ratio is now 75 per cent, or (USD 93.75/USD 125).

To maintain the current net income of USD 3,000, the airline needs to increase sales revenue to USD 25,333:

$$\text{Revenue required} = \frac{\text{Fix costs} + \text{Desired net income}}{\text{Contribution margin ratio}}$$

$$= \frac{\text{USD } 16,000 + \text{USD } 3,000}{0.75}$$

$$= \text{USD } 25,333$$

Management can also use its knowledge of cost-volume-profit relationships to determine whether to increase sales promotion costs in an effort to increase sales volume or to accept an order at a lower-than-usual price. In general, the careful study of cost behavior helps management plan future courses of action.

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### A broader perspective:

#### Major television networks are finding it harder to break even

With increasing competition from cable and satellite television, prerecorded videos, and independent stations, the three major television networks are facing smaller and smaller margins of

safety. Most new shows do not break even. Many do not even cover their variable costs and are dropped during the first season.

As the networks find it more and more difficult to break even on their regular shows, they are expanding into cable, satellite, and pay-per-view television. For example, the National Broadcasting Company (NBC), a major television network owned by General Electric Company, is part owner of a national cable channel and a sports channel. The company has also invested in CNBC, a cable network that specializes in consumer and business issues.

Based on the authors' research.

### Assumptions made in cost-volume-profit analysis

To summarize, the most important assumptions underlying CVP analysis are:

- Selling price, variable cost per unit, and total fixed costs remain constant through the relevant range. This means that a company can sell more or fewer units at the same price and that the company has no change in technical efficiency as volume changes.
- In multi-product situations, the product mix is known in advance.
- Costs can be accurately classified into their fixed and variable portions.

Critics may call these assumptions unrealistic in many situations, but they greatly simplify the analysis.

### Using computer spreadsheets for CVP analysis

Computer spreadsheet packages are well suited for CVP analysis because they enable managers to answer what-if questions. The cost and revenue items in CVP analysis are estimates, not actual results. Since they are used in planning and decision making, it is reasonable to ask whether plans or decisions would change if the estimates changed. The most important issue is whether the information is correct. The output is only as good as the information that goes in.

Consider the following example: The management of Prince Cruises wants to know what the income before taxes would be for a proposed product, a Caribbean cruise. The analyst prepared the following formulas for the spreadsheet:

- Revenue equals ticket price times number of passengers (amounts to be inserted for ticket price and number of passengers).
- Contribution margin equals (amount to be inserted) per cent of revenue.
- Fixed costs equal USD 200,000.
- Income equals revenue minus variable costs minus fixed costs.

Management then inserted various values for ticket price, number of passengers, the per cent of variable cost to revenue, and fixed costs, all per cruise. Exhibit 24 shows the results. Based on these results, management sees what combinations of ticket price, number of passengers, and contribution ratio are required for the cruise to be profitable.

## 21. Cost-volume-profit analysis

We show only a few of the possible combinations in Exhibit 24 to save space. Spreadsheets provide the advantage of a large number of possible combinations with minimal data entry.

Fixed cost	Ticket price	Number of passengers	Per cent contribution margin to revenue	Income
\$200,000	\$3,000	100	70%	\$10,000
200,000	3,000	80	70%	(32,000)
200,000	3,000	100	75%	25,000
200,000	3,000	80	75%	(20,000)
200,000	4,000	70	70%	(4,000)
200,000	4,000	50	70%	(60,000)
200,000	4,000	70	75%	10,000
200,000	4,000	50	75%	(50,000)

Exhibit 24: Spreadsheet analysis of CVP relationships

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### An accounting perspective:

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#### Uses of technology

Cost-volume-profit analysis using a computer spreadsheet is becoming routine. In many business meetings, we find one or more people crunching cost-volume-profit numbers on their notebook or laptop computers.

#### Effect of automation on cost-volume-profit analysis

Increasing automation does not affect the fundamental CVP model or the types of analysis we have discussed. However, it does affect the relative size of fixed and variable costs. As companies become more automated, they substitute machinery for labor. Companies that make this substitution often increase fixed costs and decrease variable costs. For example, when banks installed automated teller machines, their labor costs decreased but their fixed costs, including machine depreciation, increased.

When a company substitutes fixed costs for variable costs, the total cost line shifts up as shown in Exhibit 25. At low levels of volume, becoming more automated increases total costs, but at high levels of volume it decreases them. What does this do to the company's break-even point? It depends on where the revenue line crosses the total cost line.

### Illustration 21.9 Effects of Automation

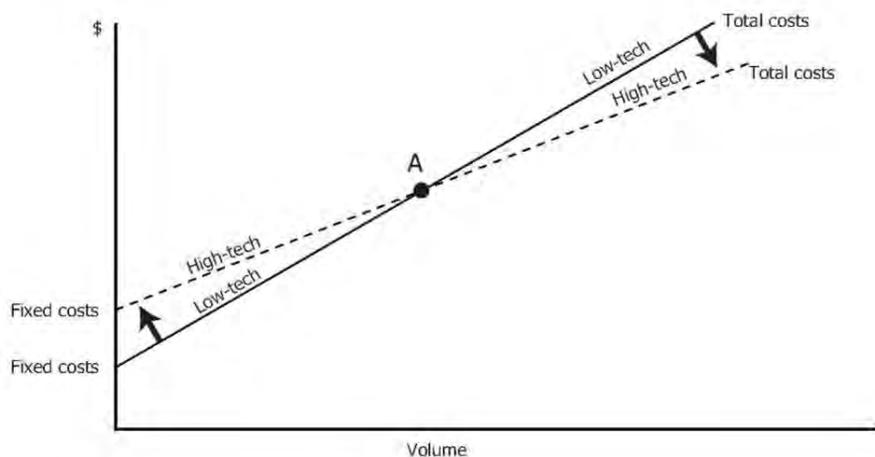


Exhibit 25: Effects of automation

If it crosses at low volumes, to the left of point A in Exhibit 25, then increasing automation increases the company's break-even point. At high volumes, however, if increasing automation lowers total costs, it lowers the company's break-even point.

In this chapter we began studying short-run decisions based on cost-volume-profit analysis. In Chapter 22 we will apply differential analysis to short-term decisions.

#### Understanding the learning objectives

- **Fixed costs.** These costs remain constant in total over some relevant range of output and are often described as time-related costs. Depreciation and insurance are examples.
- **Variable costs.** These costs vary in total directly with changes in the volume of production or sales. Direct materials and sales commissions are examples.
- **Mixed costs.** These costs contain a fixed portion of cost incurred even when the plant is completely idle and a variable portion that increases directly with production volume. Electricity is an example of a mixed cost.
- **Step costs.** These costs remain constant at a certain fixed amount over a short range of output (or sales) but increase to higher amounts at certain points. The cost of supervisors' salaries is an example.
- The scatter diagram shows plots of actual costs incurred for various levels of activity.
- The high-low method uses the highest and lowest points on a scatter diagram to fit a line to the data.
- Cost-volume-profit analysis (sometimes called break-even analysis) can determine what effects any changes in a company's selling prices, costs, and/or volume will have on net income in the short run.
- The break-even point is that level of operations at which a company realizes no income or loss.
- To compute the break-even point in sales dollars:

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$$\text{BE dollars} = \frac{\text{Fix costs}}{\text{Contribution margin ratio}}$$

Or, to express the break-even point in units:

$$\text{BE units} = \frac{\text{Fix costs}}{\text{Contribution margin per unit}}$$

- To compute the margin of safety:

Margin of safety = Current sales – Break-even sales

- Applications include calculation of the break-even point, calculation of the sales volume needed for a desired net income, calculation of the effect of changing price on net income, and calculation of the sales needed to maintain net income when costs change.
- Selling price, variable cost per unit, and total fixed costs remain constant through the relevant range.
- In multi-product situations, the product mix is known in advance.
- Costs can be accurately classified into their fixed and variable portions.
- Computer spreadsheet packages are well suited for CVP analysis because they enable managers to answer what-if questions.
- As companies become more automated, they substitute machinery for labor, which generally increases fixed costs and decreases variable costs.

### Demonstration problem

**Demonstration problem A** Davis Company has fixed costs of USD 625,000 per year and variable costs of USD 7.50 per unit. Its product sells for USD 12.50 per unit. Full capacity is 200,000 units. The contribution margin is USD 5 per unit (USD 12.50 - USD 7.50).

- Compute the break-even point in (1) sales dollars and (2) units.
- Compute the number of units the company must sell if it wishes to have net income of USD 300,000.

**Demonstration problem B** At the beginning of this chapter, we presented a problem: A campus organization wants to show movies. Recall that the movie rental would be USD 1,000. Rent for an auditorium, salaries to the ticket takers and other personnel, and other fixed costs would be USD 800 for the weekend. The organization would sell tickets for USD 4 per person. In addition, profits from the sale of soft drinks, popcorn, and candy are estimated to be USD 1 per ticket holder. How many people have to buy tickets for the organization to break even?

### Solution to demonstration problem

#### Solution to demonstration problem A

- (1) The contribution margin ratio is 0.40.

$$\text{BE dollars} = \frac{\text{Fix costs}}{\text{Contribution margin ratio}}$$

$$\text{BE dollars} = \frac{\text{USD } 625,000}{0.40}$$

= USD 1,562,500

$$(2) \text{ BE units} = \frac{\text{Fix costs}}{\text{Contribution margin per unit}}$$

$$\text{BE units} = \frac{\text{USD } 625,000}{\text{USD } 5}$$

= 125,000 units

$$b. \text{ Number of units} = \frac{\text{Fix cost} + \text{Desired net income}}{\text{Contribution margin per unit}}$$

$$= \frac{\text{USD } 625,000 + \text{USD } 300,000}{\text{USD } 5}$$

$$= \frac{\text{USD } 925,000}{\text{USD } 5}$$

= 185,000 units

### Solution to demonstration problem B

$$\text{Number of ticket buyers so they break even} = \frac{\text{USD } 1,000 + \text{USD } 800}{\text{USD } 4 + \text{USD } 1}$$

$$= \frac{\text{USD } 1,800}{\text{USD } 5}$$

= 360 ticket buyers

### Key terms\*

**Break-even point** That level of operations at which revenues for a period are equal to the costs assigned to that period so there is no net income or loss.

**Contribution margin** The amount by which revenue exceeds the variable costs of producing that revenue. The contribution margin per unit is the selling price minus the variable cost per unit.

**Contribution margin ratio** Contribution margin per unit divided by selling price per unit, or total contribution margin divided by total revenues.

**Cost-volume-profit (CVP) analysis** An analysis of the effect that any changes in a company's selling prices, costs, and/or volume will have on income (profits) in the short run. Also called break-even analysis.

**Cost-volume-profit (CVP) chart** A graph that shows the relationships among sales, volume, costs, and net income or loss.

**Fixed costs** Costs that remain constant (in total) over some relevant range of output.

**High-low method** A method used in dividing mixed costs into their fixed and variable portions. The high plot and low plot of actual costs are used to draw a line representing a total mixed cost.

**Margin of safety** Amount by which sales can decrease before a loss is incurred.

**Margin of safety rate** Margin of safety expressed as a percentage, which equals (Current sales – Break-even sales)/Current sales.

**Mixed cost** Contains a fixed portion of cost incurred even when the plant is completely idle and a variable portion that increases directly with production volume.

**Product mix** The proportion of the company's total sales attributable to each type of product sold.

**Profit equation** The equation is Net income = Revenue - Total variable costs - Fixed costs.

**Relevant range** The range of production or sales volume over which the assumptions about cost behavior are valid.

## 21. Cost-volume-profit analysis

**Scatter diagram** A diagram that shows plots of actual costs incurred for various levels of activity; it is used in dividing mixed costs into their fixed and variable portions.

**Short run** The time during which a company's management cannot change the effects of certain past decisions; often determined to be one year or less. In the short run, many costs are assumed to be fixed and unchangeable.

**Step cost** A cost that remains constant at a certain fixed amount over a range of output (or sales) but then keeps increasing to a higher amount at certain points.

**Variable costs** Costs that vary (in total) directly with changes in the volume of production or sales.

\*Some terms listed in earlier chapters are repeated here for your convenience.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

The scatter diagram method is less precise than the high-low method for evaluating costs.

A break-even point is expressed only in dollars of sales revenues.

Total contribution margin indicates the amount of money remaining after variable and fixed costs are covered.

The margin of safety is calculated using the following formula:

Margin of safety = Break-even sales - Current sales

Dollars of sales are used when computing the break-even point for a multi-product company.

#### Multiple-choice

Select the best answer for each of the following questions.

Under which of the following cost behavior patterns would electricity be categorized?

- a. Variable cost.
- b. Fixed cost.
- c. Mixed cost.
- d. Step cost.

Which of the following are characteristics of step costs?

- a. A fixed component.
- b. Costs increase in steps as production volume increases.
- c. Can remain constant over some relevant range of output.
- d. All of the above.

Using the following data, calculate the sales revenue needed to break even:

Selling price per unit USD 10

Fixed costs 20,000

Variable cost per unit 6

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- a. USD 40,000.
- b. USD 33,333.
- c. USD 50,000.
- d. USD 60,000.

Using the following data, calculate the contribution margin:

Selling price USD 20

Fixed costs 4

Variable cost 6

- a. USD 14.
- b. USD 10.
- c. USD 16.
- d. USD 18.

Using the following data, calculate the break-even point in units:

Selling price per unit USD 20

Fixed costs 28,000

Variable cost per unit 6

- a. 1,400 units.
- b. 2,800 units.
- c. 2,275 units.
- d. 2,000 units.

Which of the following describe(s) the underlying assumptions of cost-volume-profit analysis?

- a. Selling price, variable cost per unit, and total fixed costs remain constant through the relevant range.
- b. In multi-product situations, the product mix is known in advance.
- c. Costs can be accurately classified into their fixed and variable portions.
- d. All of the above.

Now turn to “Answers to self-test” at the end of the book to check your answers.

## Questions

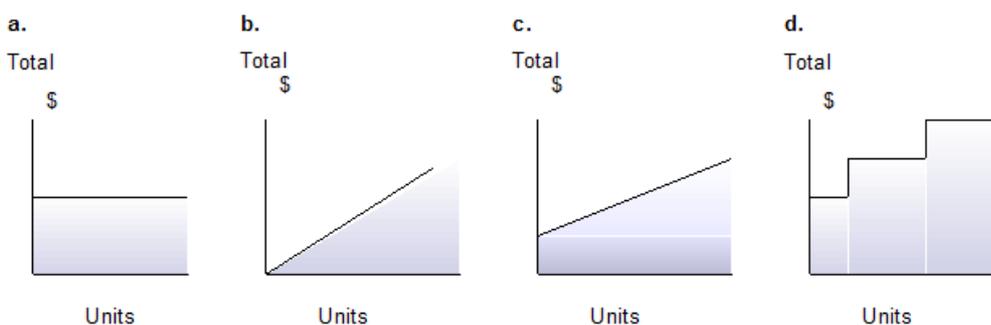
- Name and describe four cost behavior patterns.
- Describe two methods of determining the fixed and variable components of mixed costs.
- What is meant by the term break-even point?

## 21. Cost-volume-profit analysis

- What are two ways in which the break-even point can be expressed?
- What is the relevant range?
- What is the formula for calculating the break-even point in sales revenue?
- What formula is used to solve for the break-even point in units?
- How can the break-even formula be altered to calculate the number of units that must be sold to achieve a desired level of income?
- Why might a business wish to lower its break-even point? How would it go about lowering the break-even point?
- What effect would you expect the mechanization and automation of production processes to have on the break-even point?
- **Real world question** Assume your college is considering hiring a lecturer to teach a special class in communication skills. Identify at least two costs that college administrators might consider in deciding whether to hire the lecturer and add the class.
- **Real world question** Two enterprising students are considering renting space and opening a class video recording service. They would hire camera operators to record large introductory classes. The students taking the classes would be charged a fee to rent and view the video on their laptops or smart phones. Identify as many costs of this business as you can and indicate which would be variable and which would be fixed.

### Exercises

**Exercise A** Name and match the types of cost behavior with the appropriate diagram below:



**Exercise B** Research Inc., performs laboratory tests. Use the high-low method to determine the fixed and variable components of a mixed cost, given the following observations:

Volume (number of tests)	Total cost
4,800	\$6,000
19,200	9,600

**Exercise C** Compute the break-even point in sales dollars if fixed costs are USD 200,000 and the total contribution margin is 20 per cent of revenue.

**Exercise D** Barney Company makes and sells stuffed animals. One product, Michael Bears, sells for USD 28 per bear. Michael Bears have fixed costs of USD 100,000 per month and a variable cost of USD 12 per bear. How many Michael Bears must be produced and sold each month to break even?

**Exercise E** Peter Garcia Meza is considering buying a company if it will break even or earn net income on revenues of USD 80,000 per month. The company that Peter is considering sells each unit it produces for USD 5. Use the following cost data to compute the variable cost per unit and the fixed cost for the period. Calculate the break-even point in sales dollars. Should Peter buy this company?

Volume (units)	Cost
8,000	\$70,000
68,000	190,000

**Exercise F** Never Late Delivery currently delivers packages for USD 9 each. The variable cost is USD 3 per package, and fixed costs are USD 60,000 per month. Compute the break-even point in both sales dollars and units under each of the following independent assumptions. Comment on why the break-even points are different.

- The costs and selling price are as just given.
- Fixed costs are increased to USD 75,000.
- Selling price is increased by 10 per cent. (Fixed costs are USD 60,000.)
- Variable cost is increased to USD 4.50 per unit. (Fixed costs are USD 60,000 and selling price is USD 9.)

**Exercise G** Best Eastern Motel is a regional motel chain. Its rooms rent for USD 100 per night, on average. The variable cost is USD 40 a room per night. Fixed costs are USD 5,000,000 per year. The company currently rents 200,000 units per year, with each unit defined as one room for one night. Should this company undertake an advertising campaign resulting in a USD 500,000 increase in fixed costs per year, no change in variable cost per unit, and a 10 per cent increase in revenue (resulting from an increase in the number of rooms rented)? What is the margin of safety before and after the campaign?

**Exercise H** Fall-For-Fun Company sells three products. Last year's sales were USD 600,000 for parachutes, USD 800,000 for hang gliders, and USD 200,000 for bungee jumping harnesses. Variable costs were: parachutes, USD 400,000; hang gliders, USD 700,000; and bungee jumping harnesses, USD 100,000. Fixed costs were USD 240,000. Find (a) the break-even point in sales dollars and (b) the margin of safety.

**Exercise I** Early Horizons Day Care Center has fixed costs of USD 300,000 per year and variable costs of USD 10 per child per day. If it charges USD 25 a child per day, what will be its break-even point expressed in dollars of revenue? How much revenue would be required for Early Horizons Day Care to earn USD 100,000 net income per year?

### Problems

**Problem A** Assume the local franchise of Togorio Sandwich Company assigns you the task of estimating total maintenance cost on its delivery vehicles. This cost is a mixed cost. You receive the following data from past months:

Month	Units	Costs
March	8,000	\$14,000
April	10,000	14,960
May	9,000	15,200
June	11,000	15,920

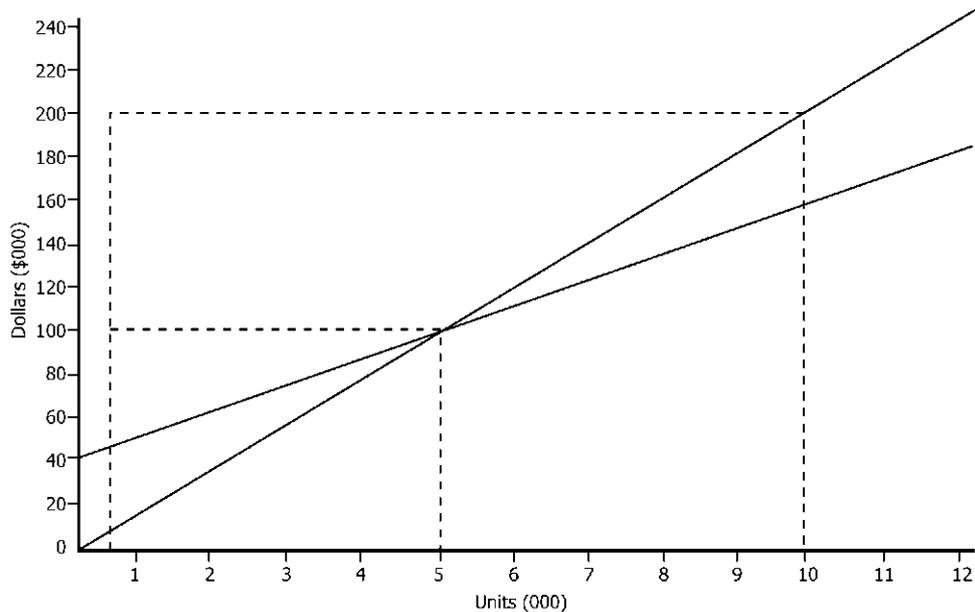
## 21. Cost-volume-profit analysis

July	10,000	15,920
August	13,000	16,880
September	14,000	18,080
October	18,000	19,280
November	20,000	21,200

a. Using the high-low method, determine the total amount of fixed costs and the amount of variable cost per unit. Draw the cost line.

b. Prepare a scatter diagram, plot the actual costs, and visually fit a linear cost line to the points. Estimate the amount of total fixed costs and the amount of variable cost per unit.

### Problem B



a. Using the preceding graph, label the relevant range, total costs, fixed costs, break-even point, and profit and loss areas.

b. At 8,000 units, what are the variable costs, fixed costs, sales, and contribution margin amounts in dollars?

c. At 8,000 units, is there net income or loss? How much?

**Problem C** The management of Bootleg Company wants to know the break-even point for its new line hiking boots under each of the following independent assumptions. The selling price is USD 50 pair of boots unless otherwise stated. (Each pair of boots is one unit.)

a. Fixed costs are USD 300,000; variable cost is USD 30 per unit.

b. Fixed costs are USD 300,000; variable cost is USD 20 per unit.

c. Fixed costs are USD 250,000; variable cost is USD 20 per unit.

d. Fixed costs are USD 250,000; selling price is USD 40; and variable cost is USD 30 per unit.

Compute the break-even point in units and sales dollars for each of the four independent case.

**Problem D** Refer to the previous problem. Bootleg Company's sales are USD 1,100,000. Determine the margin (safety in dollars for cases (a) through (d).

**Problem E** Using the data in the Bootleg Company problem (a through d), determine the level of sales dollars required achieve a net income of USD 125,000.

**Problem F** Bikes Unlimited, Inc., sells three types of bicycles. It has fixed costs of USD 258,000 per month. The sales and variable costs of these products for April follow:

	<b>Bikes</b>		
	<b>Racing</b>	<b>Mountain</b>	<b>Touring</b>
Sales	\$1,00,000	\$1,500,000	\$2,500,000
Variable costs	700,000	900,000	1,250,000

Compute the break-even point in sales dollars.

**Problem G** a. Assume that fixed costs of Celtics Company are USD 180,000 per year, variable cost is USD 12 per unit, and selling price is USD 30 per unit. Determine the break-even point in sales dollars.

b. Hawks Corporation breaks even when its sales amount to USD 89,600,000. In 2010, its sales were USD 14,400,000, and its variable costs amounted to USD 5,760,000. Determine the amount of its fixed costs.

c. The sales of Niners Corporation last year amounted to USD 20,000,000, its variable costs were USD 6,000,000, and its fixed costs were USD 4,000,000. At what level of sales dollars would the Niners Corporation break even?

d. What would have been the net income of the Niners Corporation in part (c), if sales volume had been 10 per cent higher but selling prices had remained unchanged?

e. What would have been the net income of the Niners Corporation in part (c), if variable costs had been 10 per cent lower?

f. What would have been the net income of the Niners Corporation in part (c), if fixed costs had been 10 per cent lower?

g. Determine the break-even point in sales dollars for the Niners Corporation on the basis of the data given in (e) and then in (f).

Answer each of the preceding questions.

**Problem H** After graduating from college, M. J. Orth started a company that produced cookbooks. After three years, Orth decided to analyze how well the company was doing. He discovered the company has fixed costs of USD 1,200,000 per year, variable cost of USD 14.40 per cookbook (on average), and a selling price of USD 26.90 per cookbook (on average).

How many units (that is, cookbooks) must be sold to break even? How many units will the company have to sell to earn USD 48,000?

**Problem I** The operating results for two companies follow:

	<b>Sierra</b>	<b>Olympias</b>
Sales (20,000) units	\$1,920,000	\$1,920,000
Variable costs	480,000	1,056,000
Contribution margin	1,440,000	864,000

## 21. Cost-volume-profit analysis

Fixed costs	960,000	384,00
Net income	480,000	480,000

a. Prepare a cost-volume-profit chart for Sierra Company, indicating the break-even point, the contribution margin, and the areas of income and losses.

b. Compute the break-even point of both companies in sales dollars and units.

c. Assume that without changes in selling price, the sales of each company decline by 10 per cent. Prepare income statements similar to the preceding statements for both companies.

**Problem J** Soundoff, Inc., a leading manufacturer of electronic equipment, decided to analyze the profitability of its new portable compact disc (CD) players. On the CD player line, the company incurred USD 2,520,000 of fixed costs per month while selling 20,000 units at USD 600 each. Variable cost was USD 240 per unit.

Recently, a new machine used in the production of CD players has become available; it is more efficient than the machine currently being used. The new machine would reduce the company's variable costs by 20 per cent, and leasing it would increase fixed costs by USD 96,000 per year.

a. Compute the break-even point in units assuming use of the old machine.

b. Compute the break-even point in units assuming use of the new machine.

c. Assuming that total sales remain at USD 12,000,000 and that the new machine is leased, compute the expected net income.

d. Should the new machine be leased? Why?

**Problem K** Surething CD Company reports sales of USD 720,000, variable costs of USD 432,000, and fixed costs of USD 108,000. If the company spends USD 72,000 on a sales promotion campaign, it estimates that sales will be increased by USD 270,000.

Determine whether the sales promotion campaign should be undertaken. Provide calculations.

### Alternate problems

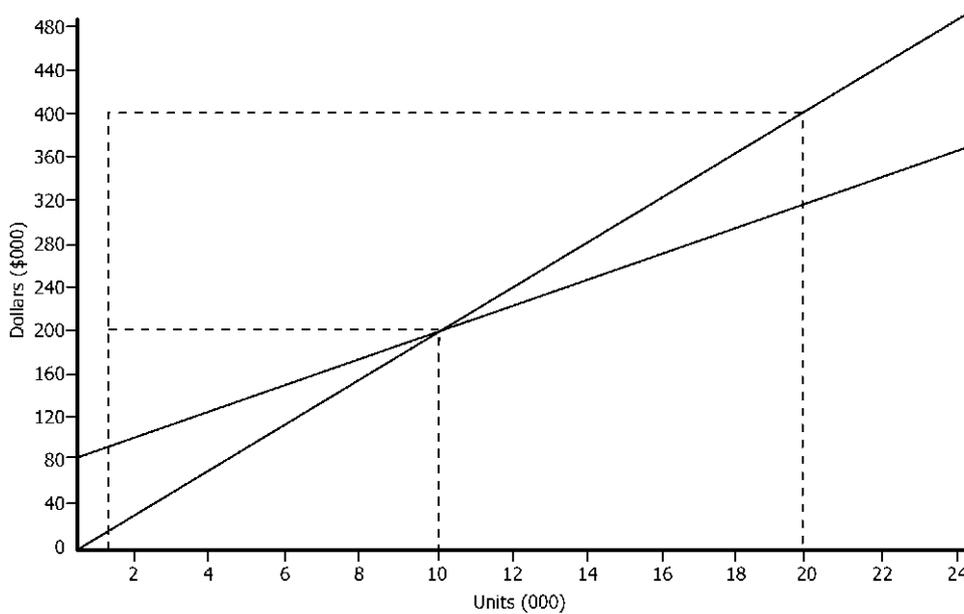
**Alternate problem A** Hear Right Company has identified certain variable and fixed costs in its production of hearing aids. Management wants you to divide one of its mixed costs into its fixed and variable portions. Here are the data for this cost:

Month	Units	Costs
January	20,800	\$57,600
February	20,000	54,000
March	22,000	58,500
April	25,600	57,600
May	28,400	58,500
June	30,000	62,100
July	32,800	63,900
August	35,600	68,400
September	37,600	72,000
October	40,000	77,400

a. Using the high-low method, determine the total amount of fixed costs and the amount of variable cost per unit. Draw the cost line.

b. Prepare a scatter diagram, plot the actual costs, and visually fit a linear cost line to the points. Estimate the amount of total fixed costs and the variable cost per unit.

**Alternate problem B**



- Using the preceding graph, label the relevant range, total costs, fixed costs, break-even point, and profit and loss areas.
- At 18,000 units, what would sales revenue, total costs, fixed and variable costs be?
- At 18,000 units, would there be a profit or loss? How much?

**Alternate problem C** Jefferson Company has a plant capacity of 100,000 units, at which level variable costs are USD 720,000. Fixed costs are expected to be USD 432,000. Each unit of product sells for USD 12.

- Determine the company's break-even point in sales dollars and units.
- At what level of sales dollars would the company earn net income of USD 144,000?
- If the selling price were raised to USD 14.40 per unit, at what level of sales dollars would the company earn USD 144,000?

**Alternate problem D** a. Determine the break-even point in sales dollars and units for Cowboys Company that has fixed costs of USD 63,000, variable cost of USD 24.50 per unit, and a selling price of USD 35.00 per unit.

- Wildcats Company breaks even when sales are USD 280,000. In March, sales were USD 670,000, and variable costs were USD 536,000. Compute the amount of fixed costs.
- Hoosiers Company had sales in June of USD 84,000; variable costs of USD 46,200; and fixed costs of USD 50,400. At what level of sales, in dollars, would the company break even?
- What would the break-even point in sales dollars have been in (c) if variable costs had been 10 per cent higher?
- What would the break-even point in sales dollars have been in (c) if fixed costs had been 10 per cent higher?

## 21. Cost-volume-profit analysis

f. Compute the break-even point in sales dollars for Hoosiers Company in (c) under the assumptions of (d) and (e) together.

Answer each of the preceding questions.

**Alternate problem E** See Right Company makes contact lenses. The company has a plant capacity of 200,000 units. Variable costs are USD 4,000,000 at 100 per cent capacity. Fixed costs are USD 2,000,000 per year, but this is true only between 50,000 and 200,000 units.

a. Prepare a cost-volume-profit chart for See Right Company assuming it sells its product for USD 40 each. Indicate on the chart the relevant range, break-even point, and the areas of net income and losses.

b. Compute the break-even point in units.

c. How many units would have to be sold to earn USD 200,000 per year?

**Alternate problem F** Mr Feelds Cookies has fixed costs of USD 360,000 per year. It sells three types of cookies. The cost and revenue data for these products follow:

	<b>Cookies</b>		
	<b>Cream cake</b>	<b>Goo fill</b>	<b>Sweet tooth</b>
Sales	\$64,000	\$95,000	\$131,000
Variable costs	38,400	55,100	66,000

Compute the break-even point in sales dollars.

### Beyond the numbers—Critical thinking

**Business decision case A** Quality Furniture Company is operating at almost 100 per cent of capacity. The company expects sales to increase by 25 per cent in 2011. To satisfy the demand for its product, the company is considering two alternatives: The first alternative would increase fixed costs by 15 per cent but not affect variable costs. The second alternative would not affect fixed costs but increase variable costs to 60 per cent of the selling price of the company's product.

This is Quality Furniture Company's condensed income statement for 2010:

Sales		\$3,600,000
Costs:		
Variable	\$1,620,000	
Fixed	330,000	1,950,000
Income before taxes		\$1,650,000

a. Determine the break-even point in sales dollars for 2011 under each of the alternatives.

b. Determine projected income for 2011 under each of the alternatives.

c. Which alternative would you recommend? Why?

**Business decision case B** When the Weidkamp Company's plant is completely idle, fixed costs amount to USD 720,000. When the plant operates at levels of 50 per cent of capacity or less, its fixed costs are USD 840,000; at levels more than 50 per cent of capacity, its fixed costs are USD 1,200,000. The company's variable costs at full capacity (100,000 units) amount to USD 1,800,000.

a. Assuming that the company's product sells for USD 60 per unit, what is the company's break-even point in sales dollars?

b. Using only the data given, at what level of sales would it be more economical to close the factory than to operate it? In other words, at what level would operating losses approximate the losses incurred if the factory closed down completely?

c. Assume that Weidkamp Company is operating at 50 per cent of its capacity and decides to reduce the selling price from USD 60 per unit to USD 36 per unit to increase sales. At what percentage of capacity must the company operate to break even at the reduced sales price?

**Business decision case C** Monroe Company has recently been awarded a contract to sell 25,000 units of its product to the federal government. Monroe manufactures the components of the product rather than purchasing them. When the news of the contract was released to the public, President Mary Monroe, received a call from the president of the McLean Corporation, Carl Cahn. Cahn offered to sell Monroe 25,000 units of a needed component, Part J, for USD 15.00 each. After receiving the offer, Monroe calls you into her office and asks you to recommend whether to accept or reject Cahn's offer.

You go to the company's records and obtain the following information concerning the production of Part J.

	<b>Costs at current production level (200,000 units)</b>
Direct labor	\$1,248,000
Direct materials	576,000
Manufacturing overhead	600,000
Total cost	\$2,424,000

You calculate the unit cost of Part J to be USD 12.12 or (USD 2,424,000/200,000). But you suspect that this unit cost may not hold true at all production levels. To find out, you consult the production manager. She tells you that to meet the increased production needs, equipment would have to be rented and the production workers would work some overtime. She estimates the machine rental to be USD 60,000 and the total overtime premiums to be USD 108,000. She provides you with the following information:

	<b>Costs at current production level (225,000 units)</b>
Direct labor	\$1,404,000
Direct materials	648,000
Manufacturing overhead (including equipment rental and overtime premiums)	828,000
Total cost	\$2,880,000

The production manager advises you to reject Cahn's offer, since the unit cost of Part J would be only USD 12.80 or (USD 2,880,000/225,000 units) with the additional costs of equipment rental and overtime premiums. This amount still is less than the USD 15.00 that Cahn would charge. Undecided, you return to your office to consider the matter further.

a. Using the high-low method, compute the variable cost portion of manufacturing overhead. (Remember that the costs of equipment rental and overtime premiums are included in manufacturing overhead. Subtract these amounts before performing the calculation).

b. Compute the total costs to manufacture the additional units of Part J. (Note: include overtime premiums as a part of direct labor.)

c. Compute the unit cost to manufacture the additional units of Part J.

## 21. Cost-volume-profit analysis

d. Write a report recommending that Monroe accept or reject Cahn's offer.

**Business decision case D** Refer to the "A broader perspective: Major television networks are finding it harder to break even" discussion of cost-volume-profit analysis for television networks. Write a memo to your instructor describing how the networks can reduce their break-even points.

**Group project E** In teams of two or three students, develop a cost-volume-profit equation for a new business that you might start. Examples of such businesses are a portable espresso bar, a pizza stand, a campus movie theater, a package delivery service, a campus-to-airport limousine service, and a T-shirt printing business.

Your equation should be in the form:  $\text{Profits} = (\text{Price per unit} \times \text{Volume}) - (\text{Variable cost per unit} \times \text{Volume}) - \text{Fixed costs per period}$ . Pick a period of time, say one month, and project the unit price, volume, unit variable cost, and fixed costs for the period. From this information, you will be able to estimate the profits—or losses—for the period. Select one spokesperson for your team to tell the class about your proposed business and its profits or losses. Good luck, and have fun.

**Group project F** Refer to "A broader perspective: Even colleges use CVP" discussion of how cost-volume-profit analysis is used by colleges. In teams of two or three students, write a memo to your instructor defining step costs and explain why the step costs identified in the case are classified as such. Also include in your memo how the school might lower its break-even point.

**Group project G** In teams of two or three students, address the following questions:

- Why would a company consider increasing automation and decreasing the use of labor if the result would be an increase in the break-even point?
- Would an increase in automation increase fixed costs over the short-run, long-run, or both?

Write a memo to your instructor that addresses both questions. Be sure to explain your answers.

### Using the Internet—A view of the real world

Visit the website for Intel Corporation, a high technology manufacturing company.

<http://www.intel.com>

Go to the company's most recent financial statements and review the consolidated statement of income. What additional information, if any, would you need to perform cost-volume-profit analysis? Why is this information excluded from Intel's income statement?

Visit the website for Wal-Mart Corporation, a retail company.

<http://www.walmart.com>

Go to the company's most recent financial statements and review the statement of income. What additional information, if any, would you need to perform cost-volume-profit analysis? Why is this information excluded from Wal-Mart Corporation's income statement?

### Answers to self-test

#### True-false

**False.** The high-low method is less precise than the scatter diagram because it requires only two data points in the computation.

**False.** The break-even point can also be expressed in units produced or sold.

**False.** Total contribution margin is the amount by which revenue exceeds variable costs of producing that revenue.

**False.** Margin of safety = Current sales - Break-even sales.

**True.** Dollars of sales are used as the measure of volume when a company has many different products.

### Multiple-choice

**c.** Electricity is a mixed cost.

**d.** Step costs have all of these characteristics—a fixed component, costs increase, and constancy over a relevant range for a step.

$$\mathbf{c.} \quad \text{BE dollars} = \frac{\text{Fix costs}}{\text{Contribution margin ratio}}$$

$$\text{Contribution margin ratio} = \frac{(\text{USD } 10 - \text{USD } 6)}{\text{USD } 10} = 0.40$$

$$\text{BE dollars} = \frac{\text{USD } 20,000}{0.40} = \text{USD } 50,000$$

**a.** Contribution margin = Selling price – Variable costs

$$= \text{USD } 20 - \text{USD } 6 = \text{USD } 14$$

$$\mathbf{d.} \quad \text{BE units} = \frac{\text{Fix costs}}{\text{Contribution margin per unit}}$$

$$\text{BE units} = \frac{\text{USD } 28,000}{\text{USD } 14 \text{ per unit}}$$

$$= 2,000$$

**d.** All of these are assumptions—prices and costs remain constant through the relevant range, product mix is known, and costs can be accurately classified into fixed and variable components.

# 22. Short-term decision making: Differential analysis

## Learning objectives

After studying this chapter, you should be able to:

- Compare and contrast contribution margin income statements to traditional income statements.
- Explain differential analysis and describe its components.
- Make pricing decisions using differential analysis.
- Use differential analysis to decide whether to accept or reject special orders.
- Decide whether to eliminate or add product lines or segments of the business using differential analysis.
- Use differential analysis to decide whether to sell joint products at the split-off point or process them further.
- Decide whether to make or buy products using differential analysis.
- Use differential analysis to decide whether to improve product quality.

In this chapter, we will discuss how companies use financial information in making decisions. The framework for our discussion is differential analysis. We begin by presenting an alternative to the traditional income statement format. This alternative, the contribution margin income statement, generally is more useful for the managerial decisions we discuss in this chapter. Then we discuss differential analysis as a method of choosing the best solution to decision problems. We also present several applications of differential analysis to managerial problems that you will likely encounter.

## Contribution margin income statements

Both this and the previous chapter discuss the use of accounting for managerial decision making. We have introduced the concepts of fixed and variable costs, and shown how you can use these concepts in making decisions. However, income statements published for external use do not break costs down into fixed and variable components. We now present another income statement that not only breaks down costs into their fixed and variable components but also presents the total contribution margin. The contribution margin income statement subtracts variable costs from revenues to show the contribution margin, and then subtracts fixed costs to derive net income.

You can see the differences between the traditional and contribution margin income statements by contrasting two income statements based on the same data. Assume Bart Company had the following data relating to manufacturing and sales activities for May 2011:

**Bart Company**  
**May 2011**

Variable manufacturing costs (per unit):

## 22. Short-term decision making: Differential analysis

Direct materials	\$ 1
Direct labor	1
Overhead	1
Total	3
Variable selling expenses (per unit)	\$0.50
Fixed costs:	
Manufacturing overhead (\$1.00 per unit for \$ 9,000 9,000 units)	
Selling expenses	15,000
Administrative expenses	18,000
Selling price (per unit)	\$ 9

Look at Exhibit 26, where we compare the traditional and contribution margin methods.

### A. Traditional method

<b>Bart company</b>	
<b>Income statement</b>	
<b>For the month ending 2011 May 31</b>	
Revenue (9,000 units at \$9 per unit)	\$81,000
Less: Cost of goods sold (9,000 units at \$4 manufacturing cost per unit:	36,000
Less: \$3 variable + \$1 fixed)	
Gross margin	\$45,000
Less: Selling and administrative expenses (9,000 units at \$0.50 variable selling cost	37,500
per unit, plus fixed costs of \$15,000 for selling and \$18,000 for administrative)	
Net income tax	\$7,500

### B. Contribution margin method

<b>Bart company</b>	
<b>Income statement</b>	
<b>For the month ending 2011 May 31</b>	
Revenue (9,000 units at \$9 per unit)	\$81,000
Less: Variable cost of goods sold (9,000 units at \$3 variable manufacturing cost per unit)	\$27,000
Variable selling expenses (9,000 units at \$0.50 per unit)	4,500
Total contribution margin	\$ 49,500
Less: Fixed manufacturing costs	\$ 9,000
Less: Fixed selling expenses	15,000
Less: Fixed administrative expenses	18,000
Net income before tax	\$ 7,500

#### Exhibit 26: Comparative income statements

The contribution margin method shows managers the amount of variable costs, the amount of fixed costs, and the contribution the company is making toward covering fixed costs and earning net income. For example, suppose the managers of Bart Company asked, "What would be the impact on net income if we increase sales units by 10 per cent without changing unit price or variable cost per unit or total fixed costs?" Looking at the contribution margin statement, we predict the following increases:

Revenue increase (10% of \$81,000)	\$8,100
Variable cost of goods sold increase (10% of \$27,000)	\$2,700
Increase in total variable selling expense (10% of \$4,500)	450
Increase in total contribution margin	\$4,950

If we assume no increase in fixed costs, we expect Bart's net income to increase by USD 4,950.

The traditional statement does not break down costs into fixed and variable components, so we cannot easily answer the question posed by Bart's management. Most companies use the traditional approach for external financial statements, but they use the contribution margin format for internal purposes because it is more

informative. Management often needs information on the contribution margin rather than the gross margin to calculate break-even points and make decisions regarding special-order pricing.

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### An accounting perspective:

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#### Uses of technology

Generating multiple financial reports in different formats does not mean companies must keep several sets of books. After data are entered into a database, it is relatively simple for computer software to generate several sets of financial statements—a contribution margin income statement for managers, a traditional income statement for external financial reporting, and yet another report for tax purposes. Two problems remain: First, the reports are only as good as the quality of the data in the database. Second, people who read the financial statements must be sufficiently informed to understand the differences in the way the information is presented.

#### Differential analysis

**Differential analysis** involves analyzing the different costs and benefits that would arise from alternative solutions to a particular problem. **Relevant revenues or costs** in a given situation are future revenues or costs that differ depending on the alternative course of action selected. **Differential revenue** is the difference in revenues between two alternatives. **Differential cost or expense** is the difference between the amounts of relevant costs for two alternatives.<sup>4</sup>

Future costs that do not differ between alternatives are irrelevant and may be ignored since they affect both alternatives similarly. Past costs, also known as **sunk costs**, are not relevant in decision making because they have already been incurred; therefore, these costs cannot be changed no matter which alternative is selected.

For certain decisions, revenues do not differ between alternatives. Under those circumstances, management should select the alternative with the least cost. In other situations, costs do not differ between alternatives. Accordingly, management should select the alternative that results in the largest revenue. Many times both future costs and revenues differ between alternatives. In these situations, the management should select the alternative that results in the greatest positive difference between future revenues and expenses (costs).

To illustrate relevant, differential, and sunk costs, assume that Joanna Bennett invested USD 400 in a tiller so she could till gardens to earn USD 1,500 during the summer. Not long afterward, Bennett was offered a job at a horse stable feeding horses and cleaning stalls for USD 1,200 for the summer. The costs that she would incur in tilling are USD 100 for transportation and USD 150 for supplies. The costs she would incur at the horse stable are USD 100 for transportation and USD 50 for supplies. If Bennett works at the stable, she would still have the tiller, which she could loan to her parents and friends at no charge.

The tiller cost of USD 400 is not relevant to the decision because it is a sunk cost. The transportation cost of USD 100 is also not relevant because it is the same for both alternatives. These costs and revenues are relevant:

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4 Some authors equate relevant cost and differential cost. This text uses the term relevant to identify which costs should be considered in a situation and the term differential to identify the amount by which these costs differ.

## 22. Short-term decision making: Differential analysis

	<b>Performing tilling service</b>	<b>Working at horse stable</b>	<b>Differential</b>
Revenues	\$1,500	\$1,200	\$300
Costs	150	50	100
Net benefit in favor of tilling service			\$200

Based on this differential analysis, Joanna Bennett should perform her tilling service rather than work at the stable. Of course, this analysis considers only cash flows; nonmonetary considerations, such as her love for horses, could sway the decision.

In many situations, total variable costs differ between alternatives while total fixed costs do not. For example, suppose you are deciding between taking the bus to work or driving your car on a particular day. The differential costs of driving a car to work or taking the bus would involve only the variable costs of driving the car versus the variable costs of taking the bus.

Suppose the decision is whether to drive your car to work every day for a year versus taking the bus for a year. If you bought a second car for commuting, certain costs such as insurance and an auto license that are fixed costs of owning a car would be differential costs for this particular decision.

Before studying the applications of differential analysis, you must realize that (1) two types of fixed costs exist and (2) opportunity costs are also relevant in choosing between alternatives. For this reason, we discuss committed fixed costs, discretionary fixed costs, and opportunity costs before concentrating on the applications of differential analysis.

Up to this point, we have treated fixed costs as if they were all alike. Now we describe two types of fixed costs—committed fixed costs and discretionary fixed costs.

**Committed fixed costs** **Committed fixed costs** relate to the basic facilities and organizational structure that a company must have to continue operations. These costs cannot be changed in the short run without seriously disrupting operations. Examples of committed fixed costs are leases on buildings and equipment and salaries of key executives. In the short run, these costs are not subject to the discretion or control of management. These costs result from past decisions that committed the company for several years. For instance, once a company constructs a building to house production operations, it is committed to use the building for many years. Thus, unlike some other types of fixed costs, the depreciation on that building is not as subject to management's control.

**Discretionary fixed costs** In contrast to committed fixed costs, management controls **discretionary fixed costs** from year to year. Each year management decides how much to spend on advertising, research and development, and employee training or development programs. Because it makes such decisions each year, these costs are under management's discretion. Management is not locked in or committed to a certain level of expense for longer than one budget period. In the next period, management may change the level of expense or eliminate the expense completely.

To some extent, management's philosophy can affect which fixed costs are committed and which are discretionary. For instance, some companies terminate people in the upper levels of management when they downsize, while other companies keep their management team intact. Thus, in some companies the salaries of top-level managers are discretionary while in other companies they are committed.

The discussion of committed fixed costs and discretionary fixed costs is relevant to CVP analysis. When almost all of a company's fixed costs are committed fixed costs, it has more difficulty reducing its break-even point for the next budget period than if most of its fixed costs are discretionary. A company with a large proportion of discretionary fixed costs may be able to reduce fixed costs dramatically in recessionary periods. By running lean, the company may show some income even when economic conditions are difficult. As a result, the company may enhance its chances of long-run survival.

Another cost concept relevant to decision making is opportunity cost. An **opportunity cost** is the potential benefit that is forgone by not following the next best alternative course of action. For example, assume that the two best uses of a plot of land are as a mobile home park (annual income of USD 100,000) and as a golf driving range (annual income of USD 60,000). The opportunity cost of using the land as a mobile home park is USD 60,000, while the opportunity cost of using the land as a driving range is USD 100,000.

Companies do not record opportunity costs in the accounting records because they are the costs of not following a certain alternative. Thus, opportunity costs are not transactions that occurred but that did not occur. However, opportunity cost is a relevant cost in many decisions because it represents a real sacrifice when one alternative is chosen instead of another.

### Applications of differential analysis

To illustrate the application of differential analysis to specific decision problems, we consider five decisions: (1) setting prices of products; (2) accepting or rejecting special orders; (3) adding or eliminating products, segments, or customers; (4) processing or selling joint products; and (5) deciding whether to make products or buy them. Although these five decisions are not the only applications of differential analysis, they represent typical short-term business decisions using differential analysis. Our discussion ignores income taxes.

When applying differential analysis to pricing decisions, each possible price for a given product represents an alternative course of action. The sales revenues for each alternative and the costs that differ between alternatives are the relevant amounts in these decisions. Total fixed costs often remain the same between pricing alternatives and, if so, may be ignored. In selecting a price for a product, the goal is to select the price at which total future revenues exceed total future costs by the greatest amount, thus maximizing income.

A high price is not necessarily the price that maximizes income. The product may have many substitutes. If a company sets a high price, the number of units sold may decline substantially as customers switch to lower-priced competitive products. Thus, in the maximization of income, the expected volume of sales at each price is as important as the contribution margin per unit of product sold. In making any pricing decision, management should seek the combination of price and volume that produces the largest total contribution margin. This combination is often difficult to identify in an actual situation because management may have to estimate the number of units that can be sold at each price.

For example, assume that a company selling fried chicken in the New York market estimates product demand for its large bucket of chicken for a particular period to be:

Choice	Demand
1	15,000 units at \$6 per unit
2	12,000 units at \$7 per unit
3	10,000 units at \$8 per unit
4	7,000 units at \$9 per unit

## 22. Short-term decision making: Differential analysis

The company's fixed costs of USD 20,000 per year are not affected by the different volume alternatives. Variable costs are USD 5 per unit. What price should be set for the product? Based on the calculations shown in the table below, the company should select a price of USD 8 per unit because choice (3) results in the greatest total contribution margin. In the short run, maximizing total contribution margin maximizes profits.

Choice	Contribution margin per unit*	Number of units	=	Total margin	Fixed costs	Net income (loss)
1	\$1	15,000		\$15,000	\$20,000	\$(5,000)
2	2	12,000		24,000	20,000	4,000
3	3	10,000		30,000	20,000	10,000
4	4	7,000		28,000	20,000	8,000

\*Sales price  
– Variable cost.

Sometimes management has an opportunity to sell its product in two or more markets at two or more different prices. Movie theaters, for example, sell tickets at discount prices to particular groups of people—children, students, and senior citizens. Differential analysis can determine whether companies should sell their products at prices below regular levels.

Good business management requires keeping the cost of idleness at a minimum. When operating at less than full capacity, management should seek additional business. Management may decide to accept such additional business at prices lower than average unit costs if the differential revenues from the additional business exceed the differential costs. By accepting special orders at a discount, businesses can keep people employed that they would otherwise lay off.

To illustrate, assume Rios Company produces and sells a single product with a variable cost of USD 8 per unit. (See Exhibit 27 for details.) Annual capacity is 10,000 units, and annual fixed costs total USD 48,000. The selling price is USD 20 per unit and production and sales are budgeted at 5,000 units. Thus, budgeted income before income taxes is USD 12,000, as shown in Exhibit 27.

Rios company Income statement For the period ending 2011 May 31		
Revenue (5,000 units at \$20)		\$100,000
Variable costs:		
Direct materials cost	\$20,000	
Labor	5,000	
Overhead	10,000	
Marketing and administrative costs	5,000	
Total variable costs (\$8 per unit)	\$40,000	
Fixed costs:		
Overhead	\$28,000	
Marketing and administrative costs	20,000	
Total fixed costs	48,000	
Total costs (\$17.60 per unit)	88,000	
Net income		\$12,000

Exhibit 27: Rios company before special order

Assume the company receives an order from a foreign distributor for 3,000 units at USD 10 per unit. This USD 10 price is not only half of the regular selling price per unit, but also less than the USD 17.60 average cost per unit (USD 88,000/5,000 units). However, the USD 10 price offered exceeds the variable cost per unit by USD 2. If the company accepts the order, net income increases to USD 18,000.

As shown in the income statement in Exhibit 28, revenue increases to USD 130,000 with the special order. Each of the variable costs increases in total by 60 per cent because total volume increases by 60 per cent (3,000 units in the special order/5,000 units regularly produced).

**Rios company**  
**Income statement**  
**For the period ending 2011 May**  
**31**

Revenue (5,000 units at \$20, 3,000 units at \$10)		\$130,000
Variable costs:		
Direct materials cost	\$32,000	
Labor	8,000	
Overhead	16,000	
Marketing and administrative costs	8,000	
Total variable costs (\$8 per unit)	\$64,000	
Fixed costs:		
Manufacturing overhead	\$28,000	
Marketing and administrative costs	20,000	
Total fixed costs	48,000	
Total costs (\$14 per unit)		112,000
Net income		\$18,000

Exhibit 28: Rios company if special order is accepted

Note that the fixed costs do not increase with the special order. Because the special order does not increase the fixed costs, the special order's revenues need only cover its variable costs.

If Rios Company continues to operate at 50 per cent capacity (producing 5,000 units) it would generate income of only USD 12,000. By accepting the special order, net income increases by USD 6,000.

Differential analysis would provide the following calculations:

	<b>Accept order</b>	<b>Reject order</b>	<b>Differential</b>
Revenues	\$130,000	\$100,000	\$30,000
Costs	112,000	88,000	24,000
Net benefit of accepting order			\$6,000

Variable costs set a floor for the selling price in special-order situations. Even if the price exceeds variable costs only slightly, the additional business increases net income, assuming fixed costs do not change. However, pricing just above variable costs of special-order business often brings only short-term increases in net income. In the long run, companies must cover all of their costs, not just the variable costs.

Periodically, management has to decide whether to add or eliminate certain products, segments, or customers. If you have watched a store or a plant open or close in your area, you have seen the results of these decisions. Differential analysis is useful in this decision making because a company's income statement does not automatically associate costs with certain products, segments, or customers. Thus, companies must reclassify costs as those that the action would change and those that it would not change.

If companies add or eliminate products, they usually increase or decrease variable costs. The fixed costs may change, but not in many cases. Management bases decisions to add or eliminate products only on the differential items; that is, the costs and revenues that change.

To illustrate, assume that the Campus Bookstore is considering eliminating its art supplies department. If the bookstore dropped the art supplies department, it would lose revenues of USD 100,000 annually. The bookstore's management assigns costs of USD 110,000 (USD 80,000 variable and USD 30,000 fixed) to the art supplies

## 22. Short-term decision making: Differential analysis

department. Therefore, art supplies has an apparent annual loss of USD 10,000 (USD 100,000 revenue minus USD 110,000 costs). But careful cost analysis reveals that if the art supplies department were dropped, the reduction in costs would be only USD 80,000. The USD 30,000 fixed costs were general bookstore fixed costs allocated to the art supplies department. These fixed costs would continue to be incurred and would not be saved by closing the art supplies department. Look at the differential analysis in Exhibit 29. Note that the art supplies department has been contributing USD 20,000 (USD 100,000 revenues - USD 80,000 variable costs) annually toward covering the fixed costs of the business. Consequently, its elimination could be a costly mistake unless there is a more profitable use for the vacated facilities.

	<b>Art Supplies Keep</b>	<b>Department Close</b>	<b>Differential</b>
Revenues	\$100,000	\$-0-	\$100,000
Variable costs	80,000	-0-	80,000
Fixed costs	30,000	30,000	-0-
Net benefit of keeping art supplies department			\$ 20,000

Exhibit 29: Differential analysis: Decision whether to close a department

If the company has a profitable alternative use for the vacated facilities, the potential income from that alternative represents an opportunity cost of retaining the product, segment, or customer. Assume, for example, that the bookstore could use the facilities currently occupied by the art supplies department to open a new department to display and sell personal computers, printers, and software. This new department would contribute USD 35,000 to the bookstore's income.

The relevant costs in the decision to retain the art supplies department are USD 115,000 (USD 80,000 of variable manufacturing costs and USD 35,000 of opportunity cost), while the relevant revenues are still USD 100,000. Therefore, the bookstore has a net disadvantage in keeping the art supplies department because it loses USD 15,000 compared to the computer department.

Sometimes two or more products result from a common raw material or production process; these products are called **joint products**. Companies can process these products further or sell them in their current condition. For instance, when Chevron refines crude oil, it produces a wide variety of fuels, solvents, lubricants, and residual petrochemicals.

Management can use differential analysis to decide whether to process a joint product further or to sell it in its present condition. **Joint costs** are those costs incurred up to the point where the joint products split off from each other. These costs are sunk costs and are not considered when deciding whether to process a joint product further before selling it or to sell it in its condition at the split-off point.

The following example illustrates the issue of whether to process or sell joint products. Assume that Pacific Paper, Inc., produces two paper products, A and B, from a common manufacturing process. Each of the products could either be sold in its present form or processed further and sold at a higher price. Data for both products follow:

<b>Product</b>	<b>Selling price per unit at split-off point</b>	<b>Cost per unit of further processing</b>	<b>Selling price per unit after further processing</b>
A	\$10	\$6	\$21
B	12	7	18

The differential revenues and costs of further processing of the two products are as follows:

Product	Different revenue of further processing	Differential cost of further processing	Net advantage (disadvantage) of further processing
A	\$11	\$6	\$5
B	6	7	(1)

Based on this analysis, Pacific Paper should process product A further to increase income by USD 5 per unit sold. The company should not process product B further because that would decrease income by USD 1 per unit sold.

Companies use this same form of differential analysis to decide whether they should discard their by-products or process them further. **By-products** are additional products resulting from the production of a main product and generally have a small market value compared to the main product. Sometimes companies consider by-products to be waste materials. For example, the bark from trees cut into lumber is a by-product of lumber production. Although a by-product, companies convert this bark into fuel or landscaping material. When the differential revenue of further processing exceeds the differential cost, firms should do further processing. As concerns increase about the effects of waste on the environment, companies find more and more waste materials that can be converted into by-products.

Managers also apply differential analysis to make-or-buy decisions. A **make-or-buy decision** occurs when management must decide whether to make or purchase a part or material used in manufacturing another product. Management must compare the price paid for a part with the additional costs incurred to manufacture the part. When most of the manufacturing costs are fixed and would exist in any case, it is likely to be more economical to make the part rather than buy it.

To illustrate the application of differential analysis to make-or-buy decisions, assume that Small Motor Company manufactures a part costing USD 6 for use in its toy automobile engines. Cost components are: materials, USD 3.00; labor, USD 1.50; fixed overhead costs, USD 1.05; and variable overhead costs, USD 0.45. Small could purchase the part for USD 5.25. Fixed overhead would presumably continue even if the part were purchased. The added costs of manufacturing amount to only USD 4.95 (USD 3.00 + USD 1.50 + USD 0.45). This amount is 30 cents per unit less than the purchase price of the part. Therefore, manufacturing the part should be continued as shown in the following analysis:

	Make	Buy	Differential
Costs	\$4.95	\$5.25	\$0.30
Net advantage of making			\$0.30

In make-or-buy decisions, management also should consider the opportunity cost of not utilizing the space for some other purpose. In the previous example, if the opportunity costs of not using this space in its best alternative use is more than 30 cents per unit times the number of units produced, the part should be purchased.

In some manufacturing situations, firms avoid a portion of fixed costs by buying from an outside source. For example, suppose eliminating a part would reduce production so that a supervisor's salary could be saved. In such a situation, firms should treat these fixed costs the same as variable costs in the analysis because they would be relevant costs.

Sometimes the cost to manufacture may be only slightly less than the cost of purchasing the part or material. Then management should place considerable weight on other factors such as the competency of existing personnel

## 22. Short-term decision making: Differential analysis

to undertake manufacturing the part or material, the availability of working capital, and the cost of any loans that may be necessary.

### Applying differential analysis to quality

High quality is essential to success in a competitive environment. Therefore, companies use differential analysis to make decisions about the quality of their products.

Assume Erie Waters produces bottled water. The variable cost of a case (12 one-liter bottles) is as follows:

Water and bottles	\$2.00
Inspection and rework costs	1.00
All other variable costs	3.00
Total variable cost per case	\$6.00

In addition, the company has USD 150,000 of fixed costs per year.

The company inspects the product at various stages. When inspectors find the water is below standard or the bottles have defects, production workers replace the water and/or the bottles. The cost of inspecting the product and replacing water and/or bottles averages USD 1.00 per case, and is shown as inspection and rework costs.

Management of Erie Waters is concerned about product quality. Despite the inspection just noted, management has learned that dissatisfied customers are switching to competitive products. Management is considering purchasing a high-quality water product. This product would increase water and bottle costs to USD 2.50 per case while decreasing inspection and rework costs to USD .40 per case. All other variable costs would remain at USD 3.00 per case. Erie Waters would sell this water for USD 8.00 per case. If the high-quality water is purchased, Erie Waters expects to sell 100,000 cases of water this year at USD 8.00 per case. If Erie continues to use the current low-quality water, the company expects to sell 90,000 cases of water this year at USD 8.00 per case. Fixed costs are USD 150,000 per year whether the company buys high-quality water or low-quality water. Should Erie Waters buy the high-quality water? We compare the two alternatives in Exhibit 30.

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### An accounting perspective:

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### Business insight

The 1950s through 1970s were boom periods for manufacturing companies in the United States. As one of the few industrial countries left intact after World War II, the United States had little competition from manufacturers in other countries. But, countries such as Japan, Taiwan and Korea made a comeback and dominated in steel, automobiles, and electronics.

By the end of the 20th century, US industry realized that without a substantial improvement in quality, it could not compete in worldwide markets.

	<b>Low-quality water (90,000 cases)</b>	<b>High-quality water (100,000 cases)</b>
Revenue at \$8.00 per case	\$ 720,000	\$ 800,000
Water and bottles at \$2.00 per case for low quality and \$2.50 per case for high quality	(180,000)	(250,000)
Inspection and rework at \$1.00 per case for low quality and \$0.40 per case for high quality	(90,000)	(40,000)
All other variable costs at \$3.00 per case	(270,000)	(300,000)
Fixed costs	(150,000)	(150,000)
Net income	\$ 30,000	\$ 60,000

### Exhibit 30: Decision whether to improve quality

Erie Waters should purchase the high-quality water because it increases net income from USD 30,000 to USD 60,000 per year. In addition, a high-quality product improves the company's prospects for maintaining or even increasing its market share in years to come. Many companies have learned the hard way that letting quality slip creates a bad reputation that is hard to overcome.

The focus of this chapter has been short-term decision making. Part of decision making involves planning through the use of budgets. The topic of Chapter 23 is budgeting—an important tool for company management.

### Understanding the learning objectives

- The contribution margin format separates fixed costs from variable costs; the traditional method does not.
- The contribution margin format reports contribution margin; the traditional method reports gross margin.

In a manufacturing company:

(a) Contribution margin = Revenue - Variable manufacturing costs - Variable nonmanufacturing costs

(b) Gross margin = Revenue - Cost of goods sold (where cost of goods sold equals Variable manufacturing cost of goods sold + Fixed manufacturing cost of goods sold)

- Differential analysis involves analyzing the different costs and benefits that would arise from alternative solutions to a particular situation.
- The components are: (1) differential revenue, the difference in revenue between two alternatives; and (2) differential cost or expense, the difference between relevant costs for two alternatives.
- In selecting a price for a product, the goal is to select the price at which total future revenues exceed total future variable costs by the greatest amount or, in other words, the price that results in the greatest total contribution margin.

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### A broader perspective: Differential analysis in sports

When the major sports teams acquire stars, many observers think the price is too high. By using differential analysis, the teams figure that the acquisition will be profitable for the club based on the increased ticket sales and other revenues that would follow the acquisition.

When the a major league baseball team acquires an expensive super-star many people in the baseball world wonder if it is a wise financial decision. In many cases, the team becomes a pennant contender after the acquisition, and attendance at their games increases dramatically compared to the previous year. The differential costs of acquiring the super-star appears to have been justified.

Sports teams routinely face make-or-buy decisions concerning their players. Some teams, such as the New York Yankees, have extensive farm systems. They usually develop players by bringing them up through the system. Teams also buy players by waiting until young players have proven themselves with other teams, then acquiring them. Variable costs set a floor for the selling price in cost analyses. Such pricing should be appraised concerning their long-range effects on company and industry price structures. In the long run, full costs must be covered.

- Costs must be reclassified as those that would be changed by the elimination and those that would not. In effect, one must simply assume elimination and compare the reduction in revenues with the eliminated costs.
- Joint costs are those costs incurred up to the point where the joint products split off from each other. These costs are sunk costs in deciding whether to process a joint product further before selling it or to sell it in its condition at the split-off point.
- A make-or-buy decision concerns whether to manufacture or purchase a part or material used in manufacturing of another product. The price that would be paid for the part if it were purchased is compared with the additional costs that would be incurred if the part were manufactured.
- High quality is essential to success in a competitive environment. Therefore, companies use differential analysis to make decisions about the quality of their products.

#### Demonstration problem

National Express, an international delivery service, is considering eliminating operations in Eastern Europe. If the company dropped the East European market, it would lose revenues of USD 1,000,000 annually. Management assigns costs of USD 1,200,000 (USD 800,000 variable and USD 400,000 fixed) to the East European market. Therefore, the East European market has an apparent annual loss of USD 200,000 per year (USD 1,000,000 revenue minus USD 1,200,000 costs). Careful cost analysis reveals that if East European operations were dropped, the reduction in costs would be only USD 800,000 of variable and USD 250,000 of fixed costs. The remaining USD 150,000 of fixed costs were general fixed costs the company allocated to the East European market. These costs would continue to be incurred and would not be saved by shutting down the East European market.

### Solution to demonstration problem

The differential analysis for National Express's analysis of its East European operations is as follows:

	<b>East European Operations Keep</b>	<b>Eliminate</b>	<b>Differential</b>
Revenues	\$1,000,000	\$ -0-	\$1,000,000
Variable costs	800,000	-0-	800,000
Fixed costs	400,000	150,000	250,000
Net advantage of keeping East European operations open			\$ (50,000)

Elimination of the East European market is justified according to this analysis. By eliminating this market, National Express would reduce revenues by USD 1,000,000 and would reduce costs by USD 1,500,000 (USD 800,000 + USD 250,000), resulting in a USD 50,000 benefit of closing the operations (or a USD 50,000 differential loss by keeping the operations open).

### Key terms\*

**By-products** Additional products resulting from the production of a main product. By-products generally have a small market value compared to the main product.

**Committed fixed costs** Costs relating to the basic facilities and organizational structure that a company must have to continue operations.

**Differential analysis** An analysis of the different costs and benefits that would arise from alternative solutions to a particular problem.

**Differential cost or expense** The difference between the amounts of relevant costs for two alternatives.

**Differential revenue** The difference between the amounts of relevant revenues for two alternatives.

**Discretionary fixed costs** Fixed costs subject to management control from year to year; an example is advertising expense.

**Joint costs** Those production costs incurred up to the point where the joint products split off from each other.

**Joint products** Two or more products resulting from a common raw material or production process.

**Make-or-buy decision** A decision concerning whether to manufacture or purchase a part or material used in manufacturing another product.

**Opportunity cost** The potential benefit that is forgone from not following the next best alternative course of action.

**Relevant revenues or costs** Revenues or costs that will differ in the future depending on which alternative course of action is selected.

**Sunk costs** Past costs that are not relevant in decision making because they have already been incurred.

\*Some terms listed in earlier chapters are repeated here for your convenience.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

Opportunity costs are recorded in the accounting records because they are the costs of not following a certain alternative.

Only variable costs can be differential costs.

Contribution margin is often more valuable to management than gross margin when making decisions.

It is important to estimate sunk costs for decision making.

## 22. Short-term decision making: Differential analysis

The decision whether to sell at the split-off point or process further is one that a petroleum company might make.

A restaurant's chef must decide whether to make soup from dry soup mix purchased at a store or to make the soup from scratch using vegetables, meats, and pasta. This decision is an example of a make-or-buy decision.

### Multiple choice

Select the best answer for each of the following questions.

Differential analysis is best described by which of the following statements:

- a. Determines only the difference in revenues between two alternatives.
- b. Analyzes opportunity costs.
- c. Determines only the difference between relevant costs for two alternatives.
- d. Analyzes future revenues and costs that differ depending on the course of action selected.

In selecting a price for a product using differential analysis, which of the following decisions should be made?

- a. The highest price should always be selected.
- b. The price that will result in the greatest total contribution margin, assuming fixed costs are the same for each price-quantity combination, should be selected.
- c. Total future revenues should exceed total future variable and fixed costs.
- d. All of the above.

Which of the following decisions involve differential analysis?

- a. The decision to close a segment of a business.
- b. The decision by a record store to add videotapes to its product line.
- c. The decision by a university to drop its intercollegiate football program.
- d. All of the above.

Assume Mikey Shoe Company is considering making special shoes just for Olympic athletes. In making this decision, how would you categorize the salary of the president of Mikey?

- a. Differential variable cost.
- b. Differential revenue.
- c. Discretionary fixed cost.
- d. Committed fixed cost.

Now turn to “Answer to self-test” at the end of the chapter to check your answers.

### Questions

- Identify types of decisions that can be made using differential analysis.

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- What is a committed fixed cost? Give some examples.
- What is a discretionary fixed cost? Give some examples.
- Give an example of a fixed cost that might be considered committed for one company and discretionary for another.
- What is the disadvantage of a company having all committed fixed costs? Explain.
- What is an opportunity cost? Give some examples.
- What essential feature distinguishes the contribution margin income statement from the traditional income statement?
- **Real world question** Give an example of a make-or-buy decision that you have made or someone you know has made.
- **Real world question** Give an example in which your campus bookstore replaces one of its departments with another it currently does not have. (For example, it stops selling magazines and starts selling cameras.) What revenues and costs would be differential?
- **Real world question** Assume that McDonald's, of McDonald's fast-food restaurants, currently buys its french fries from agricultural growers and food processors. In doing so, McDonald's has decided to buy the materials for its french fries instead of "make" them. (Assume that making french fries includes growing the potatoes.) What factors would go into McDonald's decision to buy instead of make french fries?
- **Real world question** Suppose that Wal-Mart, one of the fastest growing companies in the world, were to close one of its stores. Which differential revenues and costs would be affected by that decision?

## Exercises

**Exercise A** The following data are for Paso Robles Company for the year ended 2009 December 31:

Costs:	
Direct material	\$ 90,000
Direct labor	130,000
Manufacturing overhead:	
Variable	45,000
Fixed	90,000
Sales commissions (variable)	25,000
Sales salaries (fixed)	20,000
Administrative expenses (fixed)	35,000
Selling price per unit	\$ 10
Units produced and sold	60,000

Assume direct materials and direct labor are variable costs. Prepare a contribution margin income statement and a traditional income statement.

**Exercise B** Assume you had invested USD 1,000 in a lawn mower to set up a lawn mowing business for the summer. During the first week, you could choose either to mow the grounds at a housing development for USD 1,400 or to help paint a garage for USD 1,360. Each job would take one week. You cannot do both. You would incur additional costs of USD 160 for lawn mowing and USD 80 for garage painting. These costs include USD 60 under

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each alternative for transportation to the job. Prepare a schedule showing the net benefit or advantage of selecting one alternative over the other.

**Exercise C** The marketing department of Specialty Coffees estimates the following monthly demand for espresso in these four price-quantity relationships:

	<b>Demand</b>
1	9,000 cups at \$1.00 per cup
2	8,000 cups at \$1.25 per cup
3	6,000 cups at \$1.50 per cup
4	4,000 cups at \$1.75 per cup

The fixed costs of USD 3,000 per month are not affected by the different price-volume alternatives. Variable costs are USD 0.25 per cup. What price should Specialty Coffees set for espresso?

**Exercise D** Viking Corporation is operating at 80 per cent of capacity, which means it produces 8,000 units. Variable cost is USD 100 per unit. Wholesaler Y offers to buy 2,000 additional units at USD 120 per unit. Wholesaler Z proposes to buy 1,500 additional units at USD 140 per unit. Which offer, if either, should Viking Corporation accept? Fixed costs are not affected by accepting either offer.

**Exercise E** Analysis of Hair Care Company's citrus hair conditioner reveals that it is losing USD 5,000 annually. The company sells 5,000 units of citrus hair conditioner each year at USD 10 per unit. Variable costs are USD 6 per unit. None of the company's fixed costs would be saved if the citrus hair conditioner were eliminated. What would be the increase or decrease in company net income if citrus hair condition were eliminated?

**Exercise F** The luggage department of Sampson Company has revenues of USD 1,000,000; variable expenses of USD 250,000; direct fixed costs of USD 500,000; and allocated, indirect fixed costs of USD 300,000 in an average year. If the company eliminates this department, what would be the effect on net income?

**Exercise G** Raiders Company manufactures two joint products. At the split-off point, they have sales values of:

Product 1	\$18 per unit
Product 2	12 per unit

After further processing, the company can sell them for USD 36 and USD 16, respectively. Product 1 costs USD 12 per unit to process further and Product 2 costs USD 8 to process further. Should further processing be done on either or both of these products? Why or why not?

**Exercise H** Gopherit Corporation currently is manufacturing 40,000 units per year of a part used in its final product. The cost of producing this part is USD 50 per unit. The variable portion of this cost consists of direct materials of USD 25, direct labor of USD 15, and variable manufacturing overhead of USD 3. The company could earn USD 100,000 per year from the space now used to manufacture this part. Assuming equal quality and availability, what is the maximum price per unit that Gopherit Corporation should pay to buy the part rather than make it? (The total fixed costs would not be affected by this decision.)

**Exercise I** Ortez Company buys strawberries and produces strawberry jam. The variable cost of a case of strawberry jam is as follows:

Materials (strawberries and jars)	\$10.00
Inspection and rework costs	4.00
All other variable costs	8.00
Total variable cost per case	\$22.00

In addition, the company has USD 1,000,000 of fixed costs per year.

The company inspects the product at various stages. The cost of inspecting the product and replacing jam and/or jars averages USD 4.00 per case, shown as in the inspection and rework costs.

Management is considering purchasing high-quality strawberries. This would increase materials costs to USD 12.00 per case, while decreasing inspection and rework costs to USD 2.00 per case. All other costs would remain at USD 8.00 per case for variable costs and USD 1,000,000 for fixed costs whether or not the high-quality strawberries were purchased. Ortez's jam sells for USD 40 per case. If the high-quality strawberries were purchased, the company could sell 100,000 cases of jam this year at USD 40 per case. If the company continued to use the current low-quality berries, it could sell 80,000 cases of jam this year at USD 40 per case.

Should Ortez purchase the high-quality strawberries?

### Problems

**Problem A** Montonya Company has the following selected data for the current year:

Sales (10,000 units)	\$90,000
Direct materials	30,000
Direct labor costs	10,000
Variable manufacturing overhead	3,500
Fixed manufacturing overhead	7,500
Variable selling and administrative expenses	2,500
Fixed selling and administrative expenses	15,000

The company produced and sold 10,000 units. Direct materials and direct labor are variable costs.

- Prepare an income statement for the current year using the contribution margin format.
- Prepare an income statement for the current year using the traditional format.
- What additional information do you learn from the contribution margin format?

**Problem B** Pick-Me-Up Company is introducing a new coffee in its stores and must decide what price to set for the coffee beans. An estimated demand schedule for the product follows:

Price	One-pound units demanded
\$ 5	80,000
6	72,000
7	56,000
8	48,000
9	36,000
10	30,000

Estimated costs follow:

Variable manufacturing costs	\$2 per unit
Fixed manufacturing costs	\$40,000 per year
Variable selling and administrative costs	\$1 per unit
Fixed selling and administrative costs	\$20,000 per year

- Prepare a schedule showing management the total revenue, total cost, and total profit or loss for each selling price.
- Which price do you recommend to the management of Pick-Me-Up? Explain your answer.

**Problem C** Ocean View Company operates tour boats. Its predicted operations for the year are as follows:

Sales (1,000 tours per year)	\$400,000
Costs:	

## 22. Short-term decision making: Differential analysis

Variable	\$250 per tour
Fixed	\$100,000 per year

The company has received a request to offer 100 tours for USD 300 each. Ocean View has plenty of capacity to do these tours in addition to its regular business. Doing these tours would not affect the company's regular sales or its fixed costs.

- Should the company do the special tours for USD 300 per tour?
- What is the effect of the decision on the company's operating profit?

**Problem D** Following are sales and other operating data for the three products made and sold by Ranger Company:

	Product			
	A	B	C	Total
Sales	\$ 600,000	\$ 300,000	\$ 200,000	\$ 1,100,000
Manufacturing costs:				
Fixed	\$ 60,000	\$ 20,000	\$ 60,000	\$ 140,000
Variable	280,000	220,000	100,000	600,000
Selling and administrative expenses:				
Fixed	20,000	20,000	12,000	52,000
Variable	40,000	20,000	30,000	90,000
Total costs	\$ 400,000	\$ 280,000	\$ 202,000	\$ 882,000
Net income	\$ 200,000	\$ 20,000	\$ (2,000)	\$ 218,000

In view of the net loss for Product C, Ranger's management is considering dropping that product. All variable costs are direct costs and would be eliminated if Product C were dropped. Fixed costs are indirect costs; no fixed costs would be eliminated. Assume that the space used to produce Product C would be left idle.

Would you recommend the elimination of Product C? Give supporting computations.

**Problem E** Sierra Lumber Company produces lumber. The company has two grades of lumber at the split-off point, A and B. Grade A sells for USD 4 per board foot and Grade B sells for USD 2 per board foot. This lumber is suitable for framing and most exterior work but not for the interior of buildings. Either grade can be further processed to make it suitable for interior work at a cost of USD 1.20 per board foot. After this further processing, the firm can sell Grade A lumber for USD 5.50 per board foot and Grade B for USD 3.00 per board foot.

Would you recommend the company sell the lumber at the split-off point or process it further to make it suitable for interior work? Explain and give supporting computations.

**Problem F** Skate-Right Company, a skateboard manufacturer, is currently operating at 60 per cent capacity and producing about 8,000 units a year. To use more capacity, the manager has been considering the research and development department's suggestion that the company manufacture its own wheels.

Currently the company purchases wheels from a supplier at a unit price of USD 20. (Each unit is a set of wheels for a skateboard.) Estimates show the company can manufacture its own wheels at USD 10 for direct materials costs and USD 4 for direct labor cost per unit. The variable factory overhead is USD 1 per unit. The company's accountants would probably allocate another USD 6 per unit to the wheels.

- Should Skate-Right make or buy the wheels?

b. Suppose Skate-Right could rent out the factory space needed to make the wheels for USD 30,000 a month. How would this affect your decision in (a), if at all?

**Problem G** Quality Calc, Inc., purchases calculator components and assembles them into handheld calculators. The variable cost of one Model A-25 is as follows:

Materials	\$10
Inspection and rework costs	2
All other variable costs	5
Total variable cost per case	\$17

In addition, this product incurs USD 5,000,000 of fixed costs per year.

The company inspects the product at various stages. The cost of inspecting the product and replacing components averages USD 2 per calculator, shown as the inspection and rework costs.

Management is considering purchasing better components that would both increase quality and expand the calculator's capacity. These new components would increase materials costs to USD 12.50 per calculator, but would decrease inspection and rework costs to USD 1.50 per calculator. All other variables cost would remain at USD 5 per calculator. Fixed costs would remain at USD 5,000,000 per year.

Quality Calc currently sells each A-25 calculator for USD 25 at a volume of 1 million calculators per year. Management believes it can increase the price of the calculator (which would now be called the A-25 STAR) to USD 30 per calculator because of its increased capability. Sales volume would remain at 1 million calculators per year for the improved A-25 STAR. Should Quality Calc purchase the better components?

#### Alternate problems

**Alternate problem A** The following data are for Nets Company for the current year:

Sales (20,000 units)	\$750,000
Direct materials	270,000
Direct labor cost	90,000
Variable manufacturing overhead	27,000
Fixed manufacturing overhead	36,000
Variable selling and administrative expenses	45,000
Fixed selling and administrative expenses	150,000

The company produced and sold 20,000 units.

- Prepare an income statement for the current year using the contribution margin format.
- Prepare an income statement for the current year using the traditional format.
- What additional information does the contribution margin format provide compared to the traditional format?

**Alternate problem B** The Havana Company is introducing a new product and must decide its price. An estimated demand schedule for the product is as follows:

Price	Units demanded
\$ 5	20,000
6	18,000
7	14,000
8	12,000
9	9,000
10	8,000

Estimated costs are as follows:

## 22. Short-term decision making: Differential analysis

Variable manufacturing costs	\$2.20 per unit
Fixed manufacturing costs	\$20,000 per year
Variable selling and administrative costs	\$1.00 per unit
Fixed selling and administrative costs	\$5,000 per year

- Prepare a schedule showing the total revenue, total cost, and total profit or loss for each selling price.
- Which price should Havana select? Explain.

**Alternate problem C** Following are sales and other operating data for the three products made and sold by Marine Enterprises:

	Product			Total
	A	B	C	
Sales	\$150,000	\$90,000	\$240,000	\$480,000
Manufacturing costs:				
Fixed	\$ 15,000	\$25,000	\$ 30,000	\$ 70,000
Variable	120,000	35,000	134,000	289,000
Selling and administrative expenses:				
Fixed	5,000	30,000	10,000	45,000
Variable	2,500	5,000	6,000	13,500
Total costs	\$142,500	\$95,000	\$180,000	\$417,500
Net income (loss)	\$ 7,500	\$(5,000)	\$ 60,000	\$ 62,500

In view of the net loss shown for Product B, company management is considering dropping that product. All variable costs are direct costs and would be eliminated if Product B were dropped; all fixed costs are indirect costs and would not be eliminated. Assume that the space used to produce Product B would be left idle.

Would you recommend the elimination of Product B? Give supporting computations.

**Alternate problem D** Sailboard Enterprises, a wind sailing board manufacturer, is currently operating at 70 per cent capacity and producing about 20,000 units a year. To use more capacity, the manager has been considering the research and development department's suggestion that Sailboard manufacture its own sails. Currently Sailboard purchases sails from a supplier at a unit price of USD 100. Estimates show that Sailboard can manufacture its own sails for a USD 40 direct materials cost and a USD 32 direct labor cost per unit. The variable factory overhead is USD 8 per sail. The company's accountants would allocate fixed manufacturing overhead of USD 30 per sail to the sail production.

- Should Sailboard Enterprises make or buy the sails?
- Suppose that Sailboard Enterprises could rent out the part of the factory that would otherwise be used for sail manufacturing for USD 8,000 a month. How would this affect the decision in (a)?

**Alternate problem E** Cool-Snacks Company produces and sells ice cream for ice cream shops. Management is considering purchasing better ingredients. The variable cost of producing a gallon of ice cream is as follows:

Materials (cream, containers, etc.)	\$1.40
Inspection and replacement costs	.40
All other variable costs	.70
Total variable cost per gallon	\$2.50

In addition, the company has USD 1,000,000 of fixed costs per year.

The company inspects the product at various stages. The cost of inspecting the product and replacing ice cream averages USD 0.40 per gallon, shown as the inspection and replacement costs.

Management is considering purchasing high-quality ingredients, in particular, high-quality dairy products. These high-quality ingredients would increase materials costs to USD 1.80 per gallon, but would decrease inspection and replacement costs to USD 0.30 per gallon. All other costs would remain at USD 0.70 per gallon for variable costs and USD 1,000,000 for fixed costs whether or not the high-quality ingredients are purchased. If the high-quality ingredients are purchased, the company expects to sell 1,200,000 gallons of ice cream this year at USD 4 per gallon. If the company continues to use the current low-quality ingredients, the company expects to sell 1,000,000 gallons of ice cream at USD 3.50 per gallon. Should Cool-Snacks Company buy the high-quality ingredients for its ice cream?

### Beyond the numbers—Critical thinking

**Business decision case A** Prior to 2011, Starks Wholesalers Company had not kept department income statements. To achieve better management control, the company decided to install department-by-department accounts. At the end of 2011, the new accounts showed that although as a whole the business was profitable, the dry goods department had a substantial loss. The following income statement for the dry goods department reports on operations for 2011:

<b>Starks wholesalers company</b>		
<b>Dry goods department</b>		
<b>Partial income statement for 2011</b>		
Sales		\$1,200,000
Cost of goods sold		800,000
Gross margin		\$ 400,000
Costs:		
Payroll, direct labor, and supervision	\$120,000	
Commissions of sales staff <sup>a</sup>	60,000	
Rent <sup>b</sup>	40,000	
Insurance on inventory	20,000	
Depreciation <sup>c</sup>	80,000	
Administration and general office <sup>d</sup>	80,000	
Interest for inventory carrying costs <sup>e</sup>	10,000	
Total costs		410,000
Net income (loss)		\$ (10,000)

<sup>a</sup> All sales staff are compensated on straight commission on sales.

<sup>b</sup> Rent charged to departments on a square-foot basis. The company rents an entire building, and the dry goods department occupies 15% of the building.

<sup>c</sup> Depreciation is 8.5% of the cost of the departmental equipment.

<sup>d</sup> Allocated on basis of departmental sales as a fraction of total company sales.

<sup>e</sup> Based on average inventory quantity multiplied by the company's borrowing rate for three-month loans.

Analysis of these results has led management to suggest closing the dry goods department. Members of the management team agree that keeping the dry goods department is not essential to maintaining good customer relations and supporting the rest of the company's business. In other words, eliminating the dry goods department is expected to have no effect on the amount of business done by the other departments.

Prepare a written report recommending whether or not Starks should close the dry goods department. Explain why. State your assumptions.

**Business decision case B** After working for a software company for several years, Chris and Terry quit their jobs and set up their own consulting firm called C & T Software, Inc. Major customers include corporate, professional, and government organizations that are setting up information networks.

The cost per billable hour of service at the company's normal volume of 3,000 billable hours per month follows. (A billable hour is one hour billed to a client.)

## 22. Short-term decision making: Differential analysis

Average cost per hour billed to client:		
Variable labor – consultants		\$50
Variable overhead, including supplies and clerical support	20	
Fixed overhead, including allowance for unbilled hours	80	
		\$150
Marketing and administrative costs per billable hour (all fixed)	40	
Total hourly cost		\$190

Treat each of the following questions independently. Unless given otherwise, the regular fee per hour is USD 200.

a. How many hours must the firm bill per month to break even? (You may need to refer to Chapter 21 to answer this question.)

b. Market research estimates that a fee increase to USD 250 per hour would decrease monthly volume to 2,000 hours. The accounting department estimates that fixed overhead costs would be USD 120 per hour, while variable cost per hour would remain unchanged. What effect would a fee increase have on profits?

c. Assume C & T Software is operating at its normal volume of 3,000 hours per month. It has received a special request from one of its long-time customers to provide services on a special-order basis. Because of the long-term nature of the contract (four months) and the magnitude (1,000 hours per month), the customer believes a fee reduction is in order. C & T Software has a capacity limitation of 4,000 hours per month. Fixed costs would not change if the firm accepts the special order. What is the lowest fee C & T Software would be willing to charge?

**Business decision case C** Refer to "A broader perspective: Differential analysis in sports". In a memorandum to your instructor identify which costs and revenues you think would be differential for a sports team acquiring a major star like Bonds. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project D** In teams of two or three students, visit a local department store and imagine the types of costs that it would save if it closed a significant department (for example, the housewares department). List the types of costs that would be saved, but do not attempt to assign numbers to those costs. For example, would rent be saved? Would security be saved? What about taxes on inventories? Consider the effects of closing the department on the people who work there. As a team, write a memorandum describing the costs saved and the effects of closing a department in a local department store. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project E** A manager in your organization just received a special order at a price that is "below cost". The manager points to the document and says, "These are the kinds of orders that will get you in trouble. Every sale must bear its share of the full costs of running the business. If we sell below our full cost, we will be out of business in no time." In groups of two or three students, write a memorandum to your instructor stating whether you agree with this comment or not and explain why. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project F** Form a group of two or three students. Assume you are considering driving to a weekend resort for a quick break from school. What are the differential costs of operating your car for the drive? Write a

memorandum to your instructor addressing this question. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

#### Using the Internet—A view of the real world

Visit the website for Intel Corporation, a high technology manufacturing company.

<http://www.intel.com>

Go to the company's most recent financial statements and review the consolidated statement of income. Looking at the most recent year on the statement of income, assume 70 per cent of the cost of sales are variable costs and the remaining 30 per cent are fixed costs. Furthermore, assume all other costs and expenses (research and development, marketing, general and administrative, interest, taxes, etc.) are 60 per cent variable and 40 per cent fixed. Prepare an income statement using the contribution margin format. Be sure to submit a copy of Intel's consolidated statement of income with the contribution margin income statement.

Visit the following website for Wal-Mart, a retail company.

<http://www.walmart.com>

Go to the company's most recent financial statements and review the statement of income. Looking at the most recent year on the statement of income, assume 45 per cent of the cost of sales are variable costs and the remaining 55 per cent are fixed costs. Furthermore, assume all other costs and expenses (research and development, marketing, general and administrative, interest, taxes, etc.) are 30 per cent variable and 70 per cent fixed. Prepare an income statement using the contribution margin format. Be sure to submit a copy of Wal-Mart's income statement with the contribution margin income statement.

#### Answers to self-test

##### True-false

**False.** Opportunity costs are not recorded in the accounting records. However, opportunity costs are relevant costs in many decisions because they represent real sacrifices that come about because one alternative is chosen instead of another.

**False.** Fixed costs also can be differential costs. For example, the differential cost between operating at a production level of 40,000 units compared to 60,000 units might include increases in both variable and fixed costs.

**True.** The contribution margin is often more important to management because it is needed to calculate break-even points and make decisions.

**False.** Sunk costs are not relevant for decision making.

**True.** Petroleum companies make this decision; for example, they might decide whether to sell crude oil or refine it further into gasoline or other petroleum products.

**True.** A decision to make the soup from scratch is a make decision; deciding to make the soup from purchased mix is a buy decision.

##### Multiple-choice

**d.** Differential analysis estimates future revenues and costs that differ depending on the course of action.

## 22. Short-term decision making: Differential analysis

**b.** This is the best answer. Assuming fixed costs remain the same for each price-quantity combination, maximizing the total contribution margin maximizes net income. We did not choose (c) because it does not result in net income maximization, merely that net income be greater than zero.

**d.** All of these decisions involve differential analysis.

**d.** The president's salary would be a committed fixed cost. (Those who believe the salary should be a discretionary fixed cost have a good point.)

# 23. Budgeting for planning and control

## A manager's perspective

Jim Wardlaw

Regional Vice President and General Manager

Atlanta Region

The Coca-Cola Company

I began my career with The Coca-Cola Company as an account manager supplying product to local stores and restaurants in my territory. I then spent some time as Area Marketing Manager and Area Sales Development Manager before reaching my current position.

As Regional Vice President and General Manager, I oversee the administration and operations of a region spanning 150,000 square miles, and one of my primary objectives is to maintain a successful return on investment. I manage three division vice presidents and four regional vice presidents, and I try to spend about 60 percent of my time working with account managers who call on retail trade accounts.

In fact, a lot of my job is providing training and inspiration. We hold monthly meetings with each division to assess sales and provide motivation for the account managers. I also monitor daily key indicator reports to track sales performance in the region.

Behind increasing sales, a strong emphasis on training is one of my most important objectives. For example, Coca-Cola recently instituted a six-week training program for new account managers. The program brings new members of the sales team up to speed on the company and sales techniques, then puts them out in the field. Our sales base is constantly expanding, and we are starting to call on different buyers, so we need ongoing training to stay competitive.

All of this training helps the region achieve its number one objective—increasing sales and making the "bottom line". Sales for each division are closely monitored, and we measure employees' performances against the sales budget established for the region.

In managing your personal finances, you may prepare a written plan of your anticipated cash inflows and outflows. In fact, financial advisors often recommend that we prepare a written plan of cash inflows and outflows, then—here is the hard part—follow it. Such a written plan is a budget.

Companies prepare budgets to plan for and then control their revenues (inflows) and expenses (outflows). Failure to prepare a budget could lead to significant cash flow problems or even financial disaster for a company. In

## 23. Budgeting for planning and control

fact, one of the leading causes of failure in small businesses is failing to plan and control operations through the use of budgets.

This chapter first provides a conceptual foundation for budgeting. Then we describe and illustrate a master budget. The chapter concludes with special topics relating to budgeting.

### The budget—For planning and control

Time and money are scarce resources to all individuals and organizations; the efficient and effective use of these resources requires planning. Planning alone, however, is insufficient. Control is also necessary to ensure that plans actually are carried out. A **budget** is a tool that managers use to plan and control the use of scarce resources. A budget is a plan showing the company's objectives and how management intends to acquire and use resources to attain those objectives.

Companies, nonprofit organizations, and governmental units use many different types of budgets. Responsibility budgets, discussed in Chapter 25, are designed to judge the performance of an individual segment or manager. Capital budgets, discussed in Chapter 26, evaluate long-term capital projects such as the addition of equipment or the relocation of a plant. This chapter examines the **master budget**, which consists of a planned operating budget and a financial budget. The **planned operating budget** helps to plan future earnings and results in a projected income statement. The **financial budget** helps management plan the financing of assets and results in a projected balance sheet.

The budgeting process involves planning for future profitability because earning a reasonable return on resources used is a primary company objective. A company must devise some method to deal with the uncertainty of the future. A company that does no planning whatsoever chooses to deal with the future by default and can react to events only as they occur. Most businesses, however, devise a blueprint for the actions they will take given the foreseeable events that may occur.

A budget: (1) shows management's operating plans for the coming periods; (2) formalizes management's plans in quantitative terms; (3) forces all levels of management to think ahead, anticipate results, and take action to remedy possible poor results; and (4) may motivate individuals to strive to achieve stated goals.

Companies can use budget-to-actual comparisons to evaluate individual performance. For instance, the standard variable cost of producing a personal computer at IBM is a budget figure. This figure can be compared with the actual cost of producing personal computers to help evaluate the performance of the personal computer production managers and employees who produce personal computers. Chapter 24 illustrates this type of comparison.

Many other benefits result from the preparation and use of budgets. For example: (1) businesses can better coordinate their activities; (2) managers become aware of other managers' plans; (3) employees become more cost conscious and try to conserve resources; (4) the company reviews its organization plan and changes it when necessary; and (5) managers foster a vision that otherwise might not be developed.

The planning process that results in a formal budget provides an opportunity for various levels of management to think through and commit future plans to writing. In addition, a properly prepared budget allows management

to follow the management-by-exception principle by devoting attention to results that deviate significantly from planned levels. For all these reasons, a budget must clearly reflect the expected results.

Failing to budget because of the uncertainty of the future is a poor excuse for not budgeting. In fact, the less stable the conditions, the more necessary and desirable is budgeting, although the process becomes more difficult. Obviously, stable operating conditions permit greater reliance on past experience as a basis for budgeting. Remember, however, that budgets involve more than a company's past results. Budgets also consider a company's future plans and express expected activities. As a result, budgeted performance is more useful than past performance as a basis for judging actual results.

A budget should describe management's assumptions relating to: (1) the state of the economy over the planning horizon; (2) plans for adding, deleting, or changing product lines; (3) the nature of the industry's competition; and (4) the effects of existing or possible government regulations. If these assumptions change during the budget period, management should analyze the effects of the changes and include this in an evaluation of performance based on actual results.

Budgets are quantitative plans for the future. However, they are based mainly on past experience adjusted for future expectations. Thus, accounting data related to the past play an important part in budget preparation. The accounting system and the budget are closely related. The details of the budget must agree with the company's ledger accounts. In turn, the accounts must be designed to provide the appropriate information for preparing the budget, financial statements, and interim financial reports to facilitate operational control.

Management should frequently compare accounting data with budgeted projections during the budget period and investigate any differences. Budgeting, however, is not a substitute for good management. Instead, the budget is an important tool of managerial control. Managers make decisions in budget preparation that serve as a plan of action.

The period covered by a budget varies according to the nature of the specific activity involved. Cash budgets may cover a week or a month; sales and production budgets may cover a month, a quarter, or a year; and the general operating budget may cover a quarter or a year.

**Budgeting** involves the coordination of financial and nonfinancial planning to satisfy organizational goals and objectives. No foolproof method exists for preparing an effective budget. However, budget makers should carefully consider the conditions that follow:

**Top management support** All management levels must be aware of the budget's importance to the company and must know that the budget has top management's support. Top management, then, must clearly state long-range goals and broad objectives. These goals and objectives must be communicated throughout the organization. Long-range goals include the expected quality of products or services, growth rates in sales and earnings, and percentage-of-market targets. Overemphasis on the mechanics of the budgeting process should be avoided.

**Participation in goal setting** Management uses budgets to show how it intends to acquire and use resources to achieve the company's long-range goals. Employees are more likely to strive toward organizational goals if they participate in setting them and in preparing budgets. Often, employees have significant information that could help

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in preparing a meaningful budget. Also, employees may be motivated to perform their own functions within budget constraints if they are committed to achieving organizational goals.

**Communicating results** People should be promptly and clearly informed of their progress. Effective communication implies (1) timeliness, (2) reasonable accuracy, and (3) improved understanding. Managers should effectively communicate results so employees can make any necessary adjustments in their performance.

**Flexibility** If significant basic assumptions underlying the budget change during the year, the planned operating budget should be restated. For control purposes, after the actual level of operations is known, the actual revenues and expenses can be compared to expected performance at that level of operations.

**Follow-up** Budget follow-up and data feedback are part of the control aspect of budgetary control. Since the budgets are dealing with projections and estimates for future operating results and financial positions, managers must continuously check their budgets and correct them if necessary. Often management uses performance reports as a follow-up tool to compare actual results with budgeted results.

The term budget has negative connotations for many employees. Often in the past, management has imposed a budget from the top without considering the opinions and feelings of the personnel affected. Such a dictatorial process may result in resistance to the budget. A number of reasons may underlie such resistance, including lack of understanding of the process, concern for status, and an expectation of increased pressure to perform. Employees may believe that the performance evaluation method is unfair or that the goals are unrealistic and unattainable. They may lack confidence in the way accounting figures are generated or may prefer a less formal communication and evaluation system. Often these fears are completely unfounded, but if employees believe these problems exist, it is difficult to accomplish the objectives of budgeting.

Problems encountered with such imposed budgets have led accountants and management to adopt participatory budgeting. **Participatory budgeting** means that all levels of management responsible for actual performance actively participate in setting operating goals for the coming period. Managers and other employees are more likely to understand, accept, and pursue goals when they are involved in formulating them.

Within a participatory budgeting process, accountants should be compilers or coordinators of the budget, not preparers. They should be on hand during the preparation process to present and explain significant financial data. Accountants must identify the relevant cost data that enables management's objectives to be quantified in dollars. Accountants are responsible for designing meaningful budget reports. Also, accountants must continually strive to make the accounting system more responsive to managerial needs. That responsiveness, in turn, increases confidence in the accounting system.

Although many companies have used participatory budgeting successfully, it does not always work. Studies have shown that in many organizations, participation in the budget formulation failed to make employees more motivated to achieve budgeted goals. Whether or not participation works depends on management's leadership style, the attitudes of employees, and the organization's size and structure. Participation is not the answer to all the problems of budget preparation. However, it is one way to achieve better results in organizations that are receptive to the philosophy of participation.

A **master budget** consists of a projected income statement (planned operating budget) and a projected balance sheet (financial budget) showing the organization's objectives and proposed ways of attaining them. In Exhibit 31, we depict a flowchart of the financial planning process that you can use as an overview of the elements in a master budget. The remainder of this chapter describes how a company prepares a master budget. We emphasize the master budget because of its prime importance to financial planning and control in a business entity.

**Illustration 23.1** Flowchart of the Financial Planning Process

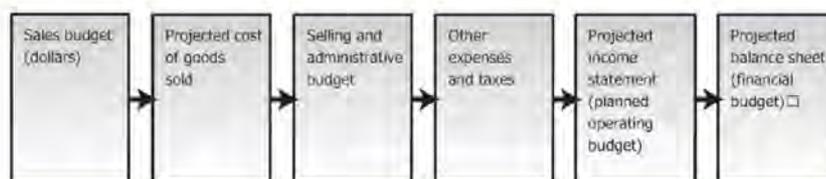


Exhibit 31: Flowchart of the financial planning process

The budgeting process starts with management's plans and objectives for the next period. These plans take into consideration various policy decisions concerning selling price, distribution network, advertising expenditures, and environmental influences from which the company forecasts its sales for the period (in units by product or product line). Managers arrive at the sales budget in dollars by multiplying sales units times sales price per unit. They use expected production, sales volume, and inventory policy to project cost of goods sold. Next, managers project operating expenses such as selling and administrative expenses.

This chapter cannot cover all areas of budgeting in detail—entire books have been written on budgeting. However, the following presentation provides an overview of a budgeting procedure that many successful companies have used. We begin by discussing the planned operating budget or projected income statement.

The projected balance sheet, or financial budget, depends on many items in the projected income statement. Thus, the logical starting point in preparing a master budget is the projected income statement, or planned operating budget. However, since the planned operating budget shows the net effect of many interrelated activities, management must prepare several supporting budgets (sales, production, and purchases, to name a few) before preparing the planned operating budget. The process begins with the sales budget.

**Sales budget** The cornerstone of the budgeting process is the sales budget because the usefulness of the entire operating budget depends on it. The sales budget involves estimating or forecasting how much demand exists for a company's goods and then determining if a realistic, attainable profit can be achieved based on this demand. Sales forecasting can involve either formal or informal techniques, or both.

Formal sales forecasting techniques often involve the use of statistical tools. For example, to predict sales for the coming period, management may use economic indicators (or variables) such as the gross national product or gross national personal income, and other variables such as population growth, per capita income, new construction, and population migration.

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To use economic indicators to forecast sales, a relationship must exist between the indicators (called independent variables) and the sales that are being forecast (called the dependent variable). Then management can use statistical techniques to predict sales based on the economic indicators.

Management often supplements formal techniques with informal sales forecasting techniques such as intuition or judgment. In some instances, management modifies sales projections using formal techniques based on other changes in the environment. Examples include the effect on sales of any changes in the expected level of advertising expenditures, the entry of new competitors, and/or the addition or elimination of products or sales territories. In other instances, companies do not use any formal techniques. Instead, sales managers and salespersons estimate how much they can sell. Managers then add up the estimates to arrive at total estimated sales for the period.

Usually, the sales manager is responsible for the sales budget and prepares it in units and then in dollars by multiplying the units by their selling price. The sales budget in units is the basis of the remaining budgets that support the operating budget.

**Production budget** The **production budget** considers the units in the sales budget and the company's inventory policy. Managers develop the production budget in units and then in dollars. Determining production volume is an important task. Companies should schedule production carefully to maintain certain minimum quantities of inventory while avoiding excessive inventory accumulation. The principal objective of the production budget is to coordinate the production and sale of goods in terms of time and quantity.

Companies using a just-in-time inventory system, which we discussed in Chapter 20, need to closely coordinate purchasing, sales, and production. In general, maintaining high inventory levels allows for more flexibility in coordinating purchases, sales, and production. However, businesses must compare the convenience of carrying inventory with the cost of carrying inventory; for example, they must consider storage costs and the opportunity cost of funds tied up in inventory.

Firms often subdivide the production budget into budgets for materials, labor, and manufacturing overhead. Usually materials, labor, and some elements of manufacturing overhead vary directly with production within a given relevant range of production. Fixed manufacturing overhead costs do not vary directly with production but are constant in total within a relevant range of production. For example, fixed manufacturing overhead costs may be USD 150,000 when production ranges from 60,000 to 80,000 units. However, when production is 80,001 to 95,000 units, the fixed manufacturing overhead costs might be USD 250,000. To determine fixed manufacturing overhead costs accurately, management must determine the relevant range for the expected level of operations.

**Selling, administrative, and other expense budgets (schedules)** The costs of selling a product are closely related to the sales forecast. Generally, the higher the forecast, the higher the selling expenses. Administrative expenses are likely to be less dependent on the sales forecast because many of the items are fixed costs (e.g. salaries of administrative personnel and depreciation of administrative buildings and office equipment). Managers must also estimate other expenses such as interest expense, income tax expense, and research and development expenses. Once management has prepared the planned operating budget, the next task is to prepare the financial budget (or projected balance sheet).

Preparing a projected balance sheet, or financial budget, involves analyzing every balance sheet account. The beginning balance for each account is the amount on the balance sheet prepared at the end of the preceding period. Then, managers consider the effects of any planned activities on each account. Many accounts are affected by items appearing in the operating budget and by either cash inflows or outflows. Cash inflows and outflows usually appear in a cash budget discussed later in the chapter.

The complexities encountered in preparing the financial budget often require the preparation of detailed schedules. These schedules analyze such things as planned accounts receivable collections and balances, planned material purchases, planned inventories, changes in all accounts affected by operating costs, and the amount of federal income taxes payable. Dividend policy, inventory policy, financing policy and constraints, credit policy, and planned capital expenditures also affect the amounts in the financial budget.

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### An accounting perspective:

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#### Business insight

To a manager, a budget is like an architect's blueprints or a house builder's plans. Like the blueprints, a budget shows the details of each part of the plan and how the various parts fit together into the overall plan. Production people focus on production plans, salespeople focus on sales plans, and financial people focus on projected cash receipts and disbursements. The general manager, like the house builder, must be able to see the big picture and tie all of the pieces together.

### The master budget illustrated

Earlier this chapter discussed general concepts relating to the preparation of a master budget. This section illustrates the step-by-step preparation of a master budget for 2010 for Leed Company, which manufactures low-priced running shoes.

A company develops its planned operating budget in units rather than dollars. Because revenues and many expenses vary with volume, they can be forecasted more easily after the company estimates sales and production quantities.

To illustrate this step, assume that Leed's management forecasts sales for the year 2010 at 100,000 units (each pair of shoes is one unit). Quarterly sales are expected to be 20,000, 35,000, 20,000, and 25,000 units, reflecting higher demand for shoes in the late spring and again around Christmas.

Assuming the company's policy is to stabilize production, it would produce 100,000 units uniformly throughout the year. Therefore, production would be 25,000 units per quarter (100,000 units/four quarters). To simplify our example, assume the company has no beginning or ending work in process inventories (although it would be equivalent to assume that work in process inventories would remain at a constant amount throughout the year). Finished goods inventory on 2010 January 1, is 10,000 units. From these data, we can prepare the schedule of planned production and sales. Exhibit 32 shows the first two quarters.

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### Leed Company Planned production and Sales (in units)

	Quarter 2010 March 31	Ending 2010 June 30
Beginning finished goods inventory	10,000*	15,000
Add: Planned production	25,000	25,000
Units available for sale	35,000	40,000
Less: sales forecast	20,000	35,000
Ending finished goods inventory	15,000	5,000

\* Actual on January 1

Exhibit 32: Leed Company: Planned production and sales (in units) for the first two quarters of 2010

Notice that if Leed wants to maintain a stable production of running shoes, it must allow the ending inventory to fluctuate if sales vary. Thus, the finished goods inventory is affected by the difference between production and sales. When establishing inventory policy, Leed's management has decided that it is less costly to deal with fluctuating inventories than with fluctuating production.

Sometimes we receive sales and ending inventory data described as a certain percentage of the next period's sales, and we must calculate the required level of production. Assume Leed Company wishes to have ending inventory of 15,000 units. We could use the following format to calculate planned production:

Sales forecast (units) – current quarter	20,000
Add: Planned ending finished goods inventory	15,000
Total units required for the period	35,000
Deduct: Beginning finished goods inventory	10,000
Planned production (units)	25,000

Next, Leed's management must introduce dollars into the analysis. To do this, management forecasts the expected selling price and costs. Exhibit 33, shows Leed's forecasted selling price and costs. Note that Leed's management classifies costs into variable or fixed categories and budgets accordingly. As noted earlier, **variable costs** vary in total directly with production or sales. **Fixed costs** are unaffected in total by the relative level of production or sales.

### Leed Company Budget Estimates of selling price and costs For quarters ending March 31 and 2010 June 30

Forecasted selling price	\$ 20
Manufacturing costs:	
Variable (per unit manufactured):	
Direct materials	2
Direct labor	6
Manufacturing overhead	1
Fixed overhead (total each quarter)	75,000
Selling and administrative expenses:	
Variable (per unit sold)	2
Fixed (total each quarter)	100,000

Exhibit 33: Leed Company: Budget estimate of selling price and costs

Management must now prepare a schedule to forecast cost of goods sold, the next major amount in the planned operating budget. Exhibit 34, shows this schedule. Notice that the beginning finished goods inventory amount for the quarter ending March 31 is the amount shown on the 2009 December 31, year-end balance sheet (see Exhibit 39). From the data in Exhibit 33, management calculates the cost of goods manufactured using the variable costs of production plus an allocated amount of fixed manufacturing overhead (USD 75,000/25,000 units). The amount of ending finished goods inventory is the number of units determined to be in ending inventory (from Exhibit 32) times the cost per unit manufactured during the period.

<b>Leed Company</b>		
<b>Planned cost of goods sold</b>		
	<b>Quarter 2010 March 31</b>	<b>Ending 2010 June 30</b>
Beginning finished goods inventory	\$130,000*	\$180,000
Cost of goods manufactured:		
Direct materials (25,000 x \$2)	\$ 50,000	\$ 50,000
Direct labor (25,000 x \$6)	150,000	150,000
Variable manufacturing overhead (25,000 x \$1)	25,000	25,000
Fixed manufacturing overhead (per Exhibit 33)	75,000	75,000
Cost of goods manufactured (25,000 units at \$12)	\$300,000	\$300,000
Cost of goods available for sale	\$430,000	\$480,000
Ending finished goods inventory:		
(15,000 at \$12)†	180,000	
(5,000 at 12)		60,000
Cost of goods sold	\$250,000	\$420,000

\* Actual on January 1 (10,000 at \$13);  
see balance sheet Exhibit 39.

† First in, first-out procedure assumed.

#### Exhibit 34: Leed Company: Planned cost of goods sold

After managers forecast cost of goods sold, they prepare a separate budget for all selling and administrative expenses. Several supporting schedules may be prepared for items such as advertising expense, office expense, and payroll department expense. Although we do not show the schedules to support budgeted selling and administrative expenses here, note the total selling and administrative expenses for each of the first two quarters in the planned operating budget in Exhibit 35.

Exhibit 35 shows the operating budget for Leed Company. We have discussed and explained all of the items appearing in the planned operating budget except the income tax accrual. State and federal income taxes are budgeted for Leed Company at an assumed rate of 40 per cent of income before income taxes.

If the planned operating budget does not show the desired net income, managers must formulate new operating plans and develop a new budget. The purpose of preparing a planned operating budget is to gain some knowledge of the results of a period's activities before they actually occur.

A company seldom operates at the level of operations assumed in preparing the planned operating budget. After the company knows the results of actual operations, management compares actual expenses with budgeted expenses at the actual level of operations. To facilitate adjusting the budgeted items to the actual level of operations, management sometimes prepares in advance flexible budgets for the entire operating budget or for certain expenses. The next section discusses these flexible operating budgets and shows how companies prepare budget variances.

Early in the chapter, you learned that a budget should be adjusted for changes in assumptions or variations in the level of operations. Managers use a technique known as flexible budgeting to deal with budgetary adjustments. A **flexible operating budget** is a special kind of budget that provides detailed information about budgeted expenses (and revenues) at various levels of output.

## 23. Budgeting for planning and control

### A broader perspective: Planning in a changing environment

Few industries have changed as much in the past decade as the telephone industry. The old-fashioned phone company monopoly is over; it now faces intense competition from new technologies ranging from wireless telephones to free audio and video calls over the Internet. Many people no longer have land line phones and only use wireless phones. Indeed, the industry has been transformed by rapidly changing technology and accompanying changes in consumer behavior.

Verizon Communications, Inc. provides telecommunications services. Its old approach to planning and budgeting was not dynamic and creative enough to deal with the new competitive environment. To start thinking about planning in the new environment, the company's managers met to discuss the company's basic values. These managers developed such values as respect and trust in each other, excellence, profitable growth, individual fulfillment, and integrity as the foundation for the company's goals and plans. Management then established corporate goals along the lines of these values, such as profit growth goals, and goals for achieving excellence in customer service, taking the changing competitive environment into account.

Employee participation in setting goals, planning, and budgeting has been key to Verizon Communications, Inc. in communicating corporate values and goals. To communicate the company's goals, top management wrote down the company's basic business problems and the steps they wanted to take to solve these problems. This action put Verizon's goals in terms that employees could understand. After this communication step, employees knew better how to relate their day-to-day work activities to the big picture, namely, ultimate corporate objectives.

#### **Leed Company Planned operating budgets**

	<b>Quarter 2010 March 31</b>	<b>Ending 2010 June 30</b>
Forecasted sales (20,000 and 35,000 at \$20, per Exhibit 32 and Exhibit 33)	\$400,000	\$700,000
Cost of goods sold (per Exhibit 34)	250,000	420,000
Gross margin	\$150,000	\$280,000
Selling and administrative expenses:		
Variable (20,000 and 35,000 at \$2,, per Exhibit 33)	\$ 40,000	\$ 70,000
Fixed (per Exhibit 33)	100,000	100,000
Total selling and administrative expenses	\$140,000	\$170,000
Income before income taxes	\$ 10,000	\$110,000
Deduct: Estimated income taxes (assumed to be 40%)	4,000	44,000
Net income	\$ 6,000	\$ 66,000

#### Exhibit 35: Leed Company: Planned operating budgets

Exhibit 36 shows a flexible budget for Leed Company's manufacturing overhead costs at various levels of output. To keep the example simple, we assume that the first four costs are strictly variable, starting at zero. On the other hand, the last two costs, depreciation and supervision, are fixed costs in this example because they are assumed to be constant over the entire relevant range of activity.

Leed Company Flexible budget for manufacturing overhead					
Element of manufacturing overhead	Volume (per cent Of Capacity)*				
	70%	80%	90%	100%	
Units	17,500	20,000	22,500	25,000	
Supplies	\$ 1,400	\$ 1,600	\$ 1,800	\$ 2,000	
Power	7,000	8000	9,000	10,000	<---Variable portion is \$25,000
Insurance	4,200	4,800	5,400	6,000	
Maintenance	4,900	5,600	6,300	7,000	
Depreciation	18,000	18,000	18,000	18,000	<--- Fixed portion is \$75,000
Supervision	57,000	57,000	57,000	57,000	
	\$ 92,500	\$ 95,000	\$ 97,500	\$ 100,000	

\*Capacity is 25,000 units per three-month period.

#### Exhibit 36: Leed Company: Flexible budget for manufacturing overhead

Leed's management could prepare a similar flexible budget for selling and administrative expenses with supporting schedules for each expense item. Using flexible budgeting, a company calculates variable expenses for various levels of sales volume, while fixed costs remain constant within the relevant range.

**Budget variances** When management uses a flexible budget to appraise a department's performance, it bases the evaluation on the amounts budgeted for the level of activity actually experienced. The difference between actual costs incurred and the flexible budget amount for that same level of operations is called a **budget variance**. Budget variances can indicate a department's or company's degree of efficiency, since they emerge from a comparison of what was with what should have been.

To illustrate the computation of budget variances, assume that Leed's management prepared an overhead budget based on an expected volume of 100 per cent, or 25,000 units. At this level of production, the budgeted amount for supplies is USD 2,000. By the end of the period, Leed has used USD 1,900 of supplies. Our first impression is that a favorable variance of USD 100 exists.

However, if Leed's actual production for the period was only 22,500 units (90 per cent of capacity), the company actually has an unfavorable variance of USD 100. Why? Because at 90 per cent of capacity, according to the flexible operating budget, only USD 1,800 of supplies should have been used. Consequently, it appears that Leed used supplies inefficiently.

To give another example using the data in Exhibit 36, Leed's management may have budgeted maintenance at USD 5,600 for a given period assuming the company planned to produce 20,000 units (80 per cent of operating capacity). However, Leed's actual maintenance costs may have been USD 6,200 for the period. This result does not necessarily mean that Leed had an unfavorable variance of USD 600. The variance depends on actual production volume.

Assume once again that Leed actually produced 22,500 units during the period. The company had budgeted maintenance costs at USD 6,300 for that level of production. Therefore, there would actually be a favorable variance of USD 100 (USD 6,300 - USD 6,200).

Flexible budgets often show budgeted amounts for every 10 per cent change in the level of operations, such as at the 70 per cent, 80 per cent, 90 per cent, and 100 per cent levels of capacity. However, actual production may fall

## 23. Budgeting for planning and control

between the levels shown in the flexible budget. If so, the company can find the budgeted amounts at that level of operations using the following formula:

Budgeted amount = Budgeted fixed portion of costs + [Budgeted variable portion of cost per unit X Actual units of output]

**Flexible operating budget and budget variances illustrated** As stated earlier, a flexible operating budget provides detailed information about budgeted expenses at various levels of activity. The main advantage of using a flexible operating budget along with a planned operating budget is that management can appraise performance on two levels. First, management can compare the actual results with the planned operating budget, which enables management to analyze the deviation of actual output from expected output. Second, given the actual level of operations, management can compare actual costs at actual volume with budgeted costs at actual volume. The use of flexible operating budgets gives a valid basis for comparison when actual production or sales volume differs from expectations.

Using the data from Exhibit 33, Exhibit 37 and Exhibit 38, present Leed's detailed planned operating budget and flexible operating budget for the quarter ended 2010 March 31. The planned operating budget was based on a sales forecast of 20,000 units and a production forecast of 25,000 units. Exhibit 37 and Exhibit 38 show actual sales of 19,000 units and actual production of 25,000 units. (As is typically the case, the budgeted and actual amounts are not equal.) The actual selling price was USD 20 per unit, the same price that management had forecasted.

**Leed Company**  
**Comparison of planned operating budget**  
**and actual results**  
**For quarter ended 2010 March 31**

	<b>Planned budget</b>	<b>Actual</b>
Sales (budgeted 20,000 units, actual 19,000 units)	\$400,000	\$380,000
Cost of goods sold:		
Beginning finished goods inventory	\$130,000	\$130,000
Cost of goods manufactured (25,000 units):		
Direct materials	\$ 50,000	\$ 62,500
Direct labor	150,000	143,750
Variable manufacturing overhead	25,000	31,250
Fixed manufacturing overhead	75,000	75,000
Cost of goods manufactured	\$300,000	\$312,500
Cost of goods available for sale	\$430,000	\$442,500
Ending finished goods inventory	180,000	200,000
Cost of goods sold	\$250,000	\$242,500
Gross margin	\$150,000	\$137,500
Selling and administrative expenses:		
Variable	\$ 40,000	\$ 28,500
Fixed	100,000	95,000
Total selling and administrative expenses	\$ 140,000	\$123,500
Income before income taxes	\$ 10,000	\$ 14,000
Deduct: Estimated income taxes (40%)	4,000	5,600
Net income	\$ 6,000	\$ 8,400

**Exhibit 37: Leed Company: Comparison of planned operating budget and actual results**

In Exhibit 37 we compare the actual results with the planned operating budget. Comparison of actual results with the planned operating budget yields some useful information because it shows where actual performance deviated from planned performance. For example, sales were 1,000 units lower than expected, sales revenue was USD 20,000 less than expected, gross margin was USD 12,500 less than expected, and net income was USD 2,400 more than expected.

The comparison of actual results with the planned operating budget does not provide a basis for evaluating whether or not management performed efficiently at the actual level of operations. For example, in Exhibit 37, the cost of goods sold was USD 7,500 less than expected. The meaning of this difference is not clear, however, because the actual cost of goods sold relates to the 19,000 units actually sold, while the planned cost of goods sold relates to the 20,000 units expected.

A company makes a valid analysis of expense controls by comparing actual results with a flexible operating budget based on the levels of sales and production that actually occurred. Exhibit 38 shows the comparison of Leed's flexible operating budget with the actual results. Note that the flexible budget in Exhibit 38 is made up of several pieces. The flexible budget amounts for sales revenue and selling and administrative expenses come from a flexible sales budget (not shown) for 19,000 units of sales.

<b>Leed Company</b>			
<b>Comparison of flexible operating budget and actual results</b>			
<b>For quarter ended 2010 March 31</b>			
	<b>Flexible budget</b>	<b>Actual</b>	<b>Budget variance over (under)</b>
Sales (19,000 units)	\$ 380,000	\$ 380,000	\$ -0-
Cost of goods sold:			
Beginning finished goods inventory	\$ 130,000	\$ 130,000	\$ -0-
Cost of goods manufactured (25,000 units):			
Direct materials	\$ 50,000	\$ 62,500	\$ (12,500)
Direct labor	150,000	143,750	(6,250)
Variable manufacturing overhead	25,000	31,250	6,250
Fixed manufacturing overhead	75,000	75,000	-0-
Cost of goods manufactured	\$300,000	\$312,500	\$ 12,500
Cost of goods available for sale	\$430,000	\$442,500	\$ 12,500
Ending finished goods inventory	192,000	200,000	8,000
Cost of goods sold (19,000 units)	\$238,000	\$242,500	\$ 4,500
Gross margin	\$ 142,000	\$ 137,500	\$ (4,500)
Selling and administrative expenses:			
Variable	\$ 38,000	\$ 28,500	\$ (9,500)
Fixed	100,000	95,000	(5,000)
Total selling and administrative expenses	\$138,000	\$123,500	\$ (14,500)
Income before income taxes	\$ 4,000	\$ 14,000	\$ 10,000
Deduct: estimated taxes (40%)	1,600	5,600	4,000
Net income	\$ 2,400	\$ 8,400	\$ 6,000

### Exhibit 38: Leed Company: Comparison of flexible operating budget and actual results

In comparisons such as these, if the number of units produced is equal to the number sold, many companies do not show their beginning and ending inventories in their flexible operating budgets. Instead, the flexible operating budget may show the number of units actually sold multiplied by the budgeted unit cost of direct materials, direct labor, and manufacturing overhead. This budget also shows actual costs for direct materials, direct labor, and manufacturing overhead for the number of units sold.

The comparison of the actual results with the flexible operating budget (Exhibit 38) reveals some inefficiencies for items in the cost of goods manufactured section. For instance, direct materials and variable overhead costs were considerably higher than expected. Direct labor costs, on the other hand, were somewhat lower than expected. Both variable and fixed selling and administrative expenses were lower than expected. Net income was USD 6,000 more than expected at a sales level of 19,000 units.

### 23. Budgeting for planning and control

Now that Leed's management has prepared the operating budget (or projected income statement), it can prepare its financial budget. Remember that the financial budget is a projected balance sheet.

To prepare a projected balance sheet, Leed's management must analyze each balance sheet account. Managers take the beginning balance from the balance sheet at the end of the preceding period. Look at Exhibit 39, Leed Company's balance sheet as of 2009 December 31. Management must consider the effects of planned activities on these balances. Many accounts are affected by items in the planned operating budget, by cash inflows and outflows, and by policy decisions. Management uses the planned operating budget in Exhibit 35 and the other illustrations previously given to prepare Leed Company's financial budget for the first two quarters of 2010.

<b>Leed Company</b>		
<b>Balance sheet</b>		
<b>2009 December 31</b>		
<b>Assets</b>		
Current assets:		
Cash		\$ 130,000
Accounts receivable		200,000
Inventories:		
Materials	\$ 40,000	
Finished goods	130,000	170,000
Prepaid expenses		20,000
Total current assets		\$ 520,000
<b>Property, plant, and equipment:</b>		
Land		\$ 60,000
Buildings	\$1,000,000	
Less: accumulated depreciation	400,000	600,000
Equipment	\$ 600,000	
Less: accumulated depreciation	180,000	420,000
Total property, plant, and equipment		\$ 1,080,000
Total assets		\$ 1,600,000
<b>Liabilities and stockholders' equity</b>		
Current liabilities:		
Accounts payable	\$ 80,000	
Accrued liabilities payable	160,000	
Income taxes payable	100,000	
Total current liabilities	\$ 340,000	
Stockholders' equity:		
Capital stock 100,000 shares of \$10 par value)	\$ 1,000,000	
Retained earnings	260,000	
Total stockholders' equity	\$ 1,260,000	
Total liabilities and stockholders' equity	\$ 1,600,000	

Exhibit 39: Leed Company: Balance sheet at beginning of period

**Accounts receivable** Leed must prepare several new schedules to prepare a financial budget. The first of these schedules is the accounts receivable schedule in Exhibit 40. Assume that Leed will collect 60 per cent of the current quarter's sales in that quarter, and the remaining 40 per cent will be collected in the following quarter. Thus, collections for the first quarter will be USD 440,000. The USD 440,000 equals 60 per cent of budgeted sales of USD 400,000 for the first quarter plus the uncollected sales of the previous quarter [(0.6 X USD 400,000) + USD 200,000]. Second quarter collections would be USD 580,000 [(0.6 X USD 700,000) + USD 160,000]. We have simplified the illustration by assuming all sales are on credit, and that there are no sales returns or allowances, no discounts, and no uncollectible accounts.

**Leed company  
Planned accounts receivable  
collections and balances**

	<b>Quarter 2010 March 31</b>	<b>Ending 2010 June 30</b>
Planned balance at beginning of quarter	\$200,000*	\$160,000
Planned sales for period (per Exhibit 35)	400,000	700,000
Total	\$600,000	\$860,000
Projected collections during quarter (per discussion in text)	440,000	580,000
Planned balance at end of quarter	\$160,000	\$280,000

\*Actual on January 1

Exhibit 40: Leed Company: Planned accounts receivable collections and balances

**Inventories** Leed's management must prepare a schedule of planned materials purchases and inventories. Planned usage and cost per unit of materials are from the planned cost of goods sold schedule (Exhibit 34). We assume no work in process inventories to simplify the illustration; there are only materials and finished goods inventories.

In Exhibit 41, we show a schedule of planned purchases and inventories of materials for Leed Company. Leed normally maintains its materials inventory at a level of one-half of next quarter's planned usage. The USD 40,000 beginning inventory was greater than normal because of a strike threat in the supplier company. This threat has now passed, and the materials inventory is reduced at the end of the first quarter to the normal planned level. In Exhibit 34, we calculated the planned ending finished goods inventories.

**Leed Company  
Planned materials purchases  
and inventories**

	<b>Quarter 2010 March 31</b>	<b>Ending 2010 June 30</b>
Planned usage (25,000 x \$2) (per Exhibit 34)	\$50,000	\$50,000
Planned ending inventory ( $\frac{1}{2} \times 25,000 \times 2$ ) (per discussion in text)	25,000	25,000
Planned materials available for use	\$ 75,000	\$75,000
Inventory at beginning of quarter	40,000*	25,000
Planned purchases for the quarter	\$35,000	\$50,000

\*Actual on January 1

Exhibit 41: Leed Company: Planned materials purchases and inventories

**Accounts affected by operating costs** Leed's management would prepare individual schedules for each of the accounts affected by operating costs. For illustrative purposes, however, we prepare a schedule that combines all the accounts affected by materials purchases or operating costs. We assume that:

- All purchases of materials are made on account.
- Direct labor incurred is credited to Accrued Liabilities Payable.
- Manufacturing overhead incurred is credited to the following accounts:

	<b>Quarter March 31</b>	<b>Ending June 30</b>
Accounts payable	\$ 16,000	\$ 13,000
Accrued liabilities payable	60,000	64,000
Prepaid expenses	6,000	5,000
Accumulated depreciation – Building	5,000	5,000
Accumulated depreciation – Equipment	13,000	13,000
Total	\$100,000	\$100,000

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- Selling and administrative expenses incurred are credited to the following accounts:

	<b>Quarter March 31</b>	<b>Ending June 30</b>
Accounts payable	\$ 5,000	\$ 10,000
Accrued liabilities payable	130,000	154,000
Prepaid expenses	2,000	3,000
Accumulated depreciation – Building	1,000	1,000
Accumulated depreciation – Equipment	2,000	2,000
Total	\$140,000	\$170,000

- Planned cash payments are as follows:

	<b>Quarter March 31</b>	<b>Ending June 30</b>
Accounts payable	\$ 80,000	\$ 56,000
Accrued liabilities payable	330,000	354,000
Prepaid expenses	-0-	10,000
Total	\$410,000	\$420,000

Exhibit 42, shows analyses of the accounts credited as a result of these data. The illustration provides a considerable amount of information needed in constructing financial budgets for the quarters ended 2010 March 31, and 2010 June 30. The balances on both dates for Accounts Payable, Accrued Liabilities Payable, Prepaid Expenses (the only debit balance account shown), Accumulated Depreciation—Building, and Accumulated Depreciation—Equipment are computed in the schedule.

**Income taxes payable** A separate schedule could be prepared showing the changes in the state and federal Income Taxes Payable account, but in this example, a brief discussion suffices. Balances reported in the financial budgets assume that Leed pays one-half of the USD 100,000 liability in the 2009 December 31, balance sheet in each of the first two quarters of 2010 (shown in Exhibit 45). The accrual for the current quarter is added (Exhibit 35). Thus, the balance on 2010 March 31, is USD 54,000, calculated as (USD 100,000 - USD 50,000 + USD 4,000). The balance on 2010 June 30, is USD 48,000, calculated as (USD 54,000 - USD 50,000 + USD 44,000). On June 30, the balance equals the accrual for the current year, USD 4,000 for the first quarter and USD 44,000 for the second quarter.

Analysis of accounts For quarters ending March 31 and 2010	Credited for materials Total debits	Leed Company	costs		Accumulated depreciation	
		Purchases and operating June 30 Accounts payable	Accrued liabilities payable	Prepaid expenses	Building	Equipment
Beginning balances, January 1 (per Exhibit 39)		\$ 80,000	\$ 160,000	\$ 20,000*	\$ 400,000	\$ 180,000
Purchases or operating costs, quarter ending March 31 (credits made to accounts shown at right):						
Direct materials (per Exhibit 41)	\$ 35,000*	\$ 35,000				
Direct labor (per Exhibit 34)	150,000*		\$150,000			
Manufacturing overhead (per Exhibit 34 and above schedules)	100,000*	16,000	60,000	\$ 6,000	\$ 5,000	\$ 13,000
Selling and administrative expenses (per Exhibit 35 and above schedules)	140,000*	5,000	130,000	2,000	1,000	2,000
Total	\$425,000	\$ 56,000	\$ 340,000	\$ 8,000	\$ 6,000	\$ 15,000
Total including January 1 balances		\$136,000	\$ 500,000	\$ 12,000*	\$ 406,000	\$ 195,000
Planned cash payments (debits made to accounts shown)		80,000*	330,000*			
Planned balances, March 31		\$ 56,000	\$ 170,000	\$12,000*	\$ 406,000	\$ 195,000
Purchases or operating costs, quarter ending June 30 (credits made to accounts shown at right):						
Direct materials (per Exhibit 41)	\$ 50,000*	\$ 50,000				
Direct labor (per Exhibit 34)	150,000*		\$ 150,000			
Manufacturing overhead (per Exhibit 34 and above schedules)	100,000*	13,000	64,000	\$ 5,000	\$ 5,000	\$ 13,000
Selling and administrative expenses (per Exhibit 35 and above schedules)	170,000*	10,000	154,000	3,000	1,000	2,000
Total	\$470,000	\$ 73,000	\$368,000	\$ 8,000	\$ 6,000	\$ 15,000
Total including March 31 balances		\$129,000	\$538,000	\$ 4,000*	\$412,000	\$210,000
Planned cash payments (debits made to accounts shown)		56,000*	354,000*	10,000*		
Planned balances, June 30		\$ 73,000	\$ 184,000	\$ 14,000*	\$ 412,000	\$210,000

\*Debit balance or debit to account.

Exhibit 42: Leed Company: Analyses of accounts credited for materials purchases and operating costs

**Cash budget** After the preceding analyses have been prepared, sufficient information is available to prepare the cash budget and compute the balance in the Cash account on March 31 and 2010 June 30. Preparing a cash budget requires information about cash receipts and cash disbursements.

**Cash receipts** We can prepare the cash receipts schedule from the information used to compute the accounts receivable schedule (Exhibit 40). In Exhibit 43, we show the schedule of planned cash receipts for Leed Company.

**Cash disbursements** Companies need cash to pay for purchases, wages, rent, interest, income taxes, cash dividends, and most other expenses. We can obtain the amount of each cash disbursement from other budgets or schedules. Look at Exhibit 44, the cash disbursements schedule for Leed Company. You can see where the

### 23. Budgeting for planning and control

information came from, except for the payment of income taxes and dividends. Income taxes are assumed to be 40 per cent of income before income taxes. We assume that USD 20,000 of dividends will be paid in the first quarter and USD 40,000 in the second quarter.

#### Leed Company Planned Cash receipts

	Quarter 2010 March 31	ending 2010 June 30
Collections on accounts receivable:		
From preceding quarter's sales	\$200,000	\$160,000 (0.4 x \$400,000)
From current quarter's sales	240,000 (0.6 x \$400,000)	420,000 (0.6 x \$700,000)
Total cash receipts (per Exhibit 40)	\$440,000	\$580,000

Exhibit 43: Leed Company: Planned cash receipts

#### Leed Company Planned cash disbursements

	Quarter 2010 March 31	Ending 2010 June 30
Payment of accounts payable (per Exhibit 42)	\$ 80,000	\$ 56,000
Payment of accrued liabilities payable (per Exhibit 42)	330,000	354,000
Payment of income tax liability	50,000	50,000
Payment of dividends	20,000	40,000
Expenses prepaid (per Exhibit 42)	-0-	10,000
Total cash disbursements	\$480,000	\$510,000

Exhibit 44: Leed Company: Planned cash disbursements

Once cash receipts and disbursements have been determined, we can prepare a cash budget for Leed Company, as shown in Exhibit 45. The **cash budget** is a plan indicating expected inflows and outflows of cash.

#### Leed company Planned cash flows and cash balances

	Quarter 2010 March 31	ending 2010 June 30
Planned balance at beginning of quarter	\$130,000*	\$ 90,000
Planned cash receipts:		
Collections of accounts receivable (per Exhibit 43)	440,000	580,000
	\$570,000	\$670,000
Planned cash disbursements:		
Payment of accounts payable (per Exhibit 42)	\$ 80,000	\$ 56,000
Payment of accrued liabilities payable (per Exhibit 42)	330,000	354,000
Payment of income tax liability	50,000	50,000
Payment of dividends	20,000	40,000
Expenses prepaid (per Exhibit 42)	-0-	10,000
Total cash disbursements	\$480,000	\$510,000
Planned balance at end of quarter	\$ 90,000	\$ 160,000

\*Actual on January 1.

Exhibit 45: Leed Company: Planned cash flows and cash balances

This cash budget helps management to decide whether enough cash will be available for short-term needs. If a company's cash budget indicates a cash shortage at a certain date, the company may need to borrow money on a short-term basis. If the company's cash budget indicates a cash excess, the company may wish to invest the extra funds for short periods to earn interest rather than leave the cash idle. Knowing in advance that a possible cash shortage or excess may occur allows management sufficient time to plan for such occurrences and avoid a cash crisis.

The preparation of Leed's financial budget for the quarters ending March 31 and June 30 (Exhibit 46) completes the master budget. Management now has information to help appraise the policies it has adopted before implementing them. If the master budget shows the results of these policies to be unsatisfactory, the company can change its policies before serious problems arise.

<b>Leed Company Projected balance sheet As of March 31 and 2010 June 30</b>	<b>2010 March 31    2010 June 30</b>	
<b>Assets</b>		
Current assets:		
Cash (per Exhibit 45)	\$ 90,000	\$ 160,000
Accounts receivable (per Exhibit 40)	160,000	280,000
Inventories:		
Materials (per Exhibit 41)	25,000	25,000
Finished goods (per Exhibit 34)	180,000	60,000
Prepaid expenses (per Exhibit 42)	12,000	14,000
Total current assets	\$ 467,000	539,000
Property, plant, and equipment:		
Land (per Exhibit 39)	\$ 60,000	\$ 60,000
Buildings, net (\$1,000,000 less accumulated depreciation of \$406,000 and \$412,000) (per Exhibit 39 and Exhibit 42)	594,000	588,000
Equipment, net (\$600,000 less accumulated depreciation of \$195,000 and \$210,000) (per Exhibit 39 and Exhibit 42)	405,000	390,000
Total property, plant, and equipment	\$1,059,000	\$1,038,000
Total assets	\$1,526,000	\$1,577,000
<b>Liabilities and stockholders' equity</b>		
Current liabilities:		
Accounts payable (per Exhibit 42)	\$ 56,000	\$ 73,000
Accrued liabilities payable (per Exhibit 42)	170,000	184,000
Income taxes payable (per discussion in the text)	54,000	48,000
Total current liabilities	\$ 280,000	\$ 305,000
Stockholders' equity:		
Capital stock (100,000 shares of \$10 par value) (per Exhibit 39)	\$1,000,000	\$1,000,000
Retained earnings (see footnotes below)	246,000*	272,000†
Total stockholders' equity	\$1,246,000	\$1,272,000
Total liabilities and stockholders' equity	\$1,526,000	\$ 1,577,000
*\$260,000 (per Exhibit 39) + Income of \$6,000 – Dividends of \$20,000.		
†\$246,000 + Income of \$66,000 – Dividends of \$40,000.		

Exhibit 46: Leed Company: Projected balance sheet

For example, Leed Company's management had a policy of stable production each period. The master budget shows that production can be stabilized even though sales fluctuate widely. However, the planned ending inventory at June 30 may be considered somewhat low in view of the fluctuations in sales. Management now knows this in advance and can take corrective action if necessary.

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### An accounting perspective:

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#### Uses of technology

Imagine the difficulty of coordinating budgets in companies having worldwide operations, companies such as PepsiCo and BP. BP has oil and gas exploration, production, and marketing

## 23. Budgeting for planning and control

facilities in various countries. The BP plant in Singapore, for example, has to transmit its budget information to corporate headquarters in London, where managers coordinate the budgets of various operations worldwide, request additional information, require revisions in the budgets, and otherwise interact constantly with far-flung operations. Recent advances in telecommunications networks and collaboration software have made this process much faster and easier. Managers in the Singapore plant of BP can get reactions from corporate headquarters almost immediately. Corporate headquarters can get answers to its questions fast and can coordinate the budgets from various worldwide operations quickly.

### Budgeting in merchandising companies

Budget preparation for merchandising companies and service companies is similar to budgeting for manufacturing companies. This section discusses budgeting in merchandising companies.

Throughout this chapter, we have focused on budgeting in a manufacturing company. Suppose managers in a retail merchandising business, such as a dress shop or a furniture store, prepare a budget. In this case, the company prepares a purchases budget instead of a production budget. To compute the purchases for each quarter, management must estimate the cost of the goods to be sold during the quarter and the inventory required at the end of the quarter.

Suppose Strobel Furniture Company prepared a sales budget like the one in Exhibit 47. Assume the company maintains sufficient inventory to cover one-half of the next quarter's sales. Cost of goods sold is 55 per cent of sales. The ending inventory on 2009 December 31, was USD 8,250. The purchases budget can now be prepared, as shown in Exhibit 48. For the first quarter of 2010, notice that the ending inventory is one-half of the second quarter's cost of goods sold [ $0.5 \times (0.55 \times \text{USD } 80,000) = \text{USD } 22,000$ ].

Strobel can now use the information in its purchases budget to prepare the cost of goods sold section of the operating budget, to prepare cash disbursements schedules, and to prepare the inventory and accounts payable amounts in the financial budget.

<b>Strobel Furniture Sales budget</b>		<b>Company</b>		
<b>For quarters ending through 2011 March 31</b>		<b>2010 March 31,</b>		<b>2011 March</b>
<b>2010 March 31</b>	<b>2010 June 30</b>	<b>2010 September 30</b>	<b>2010 December 31</b>	<b>31</b>
\$30,000	\$80,000	\$50,000	\$90,000	\$40,000

Exhibit 47: Strobel furniture company: Sales budget

	<b>Strobel Furniture Company</b>		<b>Purchase budget</b>	
	<b>For quarters ending</b>		<b>March 31 Through</b>	
	<b>2010 December 31</b>		<b>2010 September 30</b>	
	<b>2010 March 31</b>	<b>2010 June 30</b>	<b>2010 September 30</b>	<b>2010 December 31</b>
Ending inventory desired*	\$22,000	\$13,750	\$24,750	\$11,000
Cost of goods sold (55% of sales)	16,500	44,000	27,500	49,500
Total	\$38,500	\$57,750	\$52,520	\$60,500
Less: beginning inventory	8,250	22,000	13,750	24,750
Purchases required	\$30,250	\$35,750	\$38,500	\$35,750
*Next period's sales x 55% x 50%				

Exhibit 48: Strobel furniture company: Purchases budget

### Budgeting in service companies

The concepts discussed in this chapter are equally applicable to service companies. Service firms have service revenues and operating expenses that must be budgeted. Projected income statements and balance sheets can be prepared for service companies using the techniques described in this chapter.

### Additional concepts related to budgeting

Two additional concepts that affect budgeting are sometimes used in industry. These concepts are just-in-time inventory systems and zero-base budgeting.

Chapter 20 described **just-in-time inventory**. Recall that the just-in-time inventory system provides that materials are bought just in time to be put into the manufacturing process; small parts, or subparts, are purchased just in time to be assembled into a final product; and goods are produced and delivered just in time to be sold.

The overall purpose of the just-in-time inventory system is to decrease, or in some cases eliminate, inventories in a company. By eliminating inventory, companies reduce the buffer stock between purchasing, production, and sales. Consequently, companies using just-in-time inventory must budget purchasing, production, and sales so the goods are purchased just in time for production and produced just in time for sales.

Zero-base budgeting became popular in the 1970s, particularly when President Jimmy Carter supported it for state and federal governmental units. It has received less attention since then.

Under **zero-base budgeting**, managers in a company start each year with zero budget levels and must justify every dollar that appears in the budget. Managers do not assume any costs incurred in previous years should be incurred this year. Each manager prepares decision packages that describe the nature and cost of tasks that can be performed by that unit and the consequences of not performing each task. Top organization officials rank the decision packages and approve those that they believe are most worthy. A major drawback to the use of this concept is the massive amounts of paperwork and time needed to prepare and rank decision packages, especially in large organizations.

This chapter discussed the general concepts of budgeting. In Chapter 26, we will discuss another type of budgeting known as capital budgeting.

The next chapter discusses standard costs, which are used in budgeting and are important in controlling operations.

## 23. Budgeting for planning and control

### Understanding the learning objectives

- A budget is a plan showing the company's objectives and how management intends to acquire and use resources to attain those objectives.
- Several kinds of budgets are responsibility, capital, master, planned operating, and financial budgets.
- A budget: (1) shows management's operating plans for the coming periods; (2) formalizes management's plans in quantitative terms; (3) forces all levels of management to think ahead, anticipate results, and take action to remedy possible poor results; and (4) may motivate individuals to strive to achieve stated goals.
- Other benefits are: business activities are better coordinated; managers become aware of other managers' plans; employees may become cost conscious and try to conserve resources; the company reviews its organization plan and changes it when necessary; and managers foster a vision that might not otherwise be developed.
- Top management support: All management levels must be aware of the budget's importance to the company and must know that the budget has top management's support.
- Participation in goal setting: Employees are generally more likely to strive toward organizational goals if they participate in setting them.
- Communicating results: People should be promptly and clearly informed of their progress.
- Flexibility: The operating budget should be restated if the basic assumptions underlying the budget change during the year. For control purposes, after the actual level of operations is known, the actual revenues and expenses should be compared to the expected performance at that level of operations.
- Follow-up: Managers should check budgets continuously and correct them whenever necessary because budgets deal with projections and estimates of future operating results, cash flows, and financial position.
- Managers develop a planned operating budget in units rather than dollars. Managers forecast sales units for the year. Then, based on the sales forecast and the company's inventory policy, they forecast production requirements in units.
- Next, dollars must be introduced into the analysis. A forecast of expected selling prices must be made, and costs must be analyzed.
- Management then prepares a schedule to forecast cost of goods sold.
- After forecasting the cost of goods sold, management prepares a separate budget for all selling and administrative expenses. Several supporting schedules may be involved for other various expenses.
- The totals on the separate budgets are combined to form the planned operating budget, which shows the budgeted income after income taxes for a certain period.
- A flexible operating budget is a special kind of budget that provides detailed information about budgeted expenses (and revenues) at various levels of output.
- This budget shows the effect that different volume changes, in per cents of capacity, have on the expenses of a company.

- Preparing a financial budget involves analyzing every balance sheet account in light of the planned activities expressed in the income statement.
- Managers usually prepare a separate cash budget to show sources, uses, and net changes in cash for the period.
- Supporting budgets also may be developed for accounts receivable, inventories, accounts affected by operating costs, and federal income taxes payable.

### Demonstration problem

During January 2010, Ramos Company plans to sell 40,000 units of its product at a price of USD 30 per unit. The company estimates selling expenses to be USD 120,000 plus 2 per cent of sales revenue. Administrative expenses are estimated to be USD 90,000 plus 1 per cent of sales revenue. Federal income tax expense is estimated to be 40 per cent of income before federal income taxes.

Ramos plans to produce 50,000 units during January with estimated variable costs per unit as follows: USD 3 for material, USD 7.50 for labor, and USD 4.50 for variable overhead. Estimated fixed overhead cost is USD 60,000 per month. The finished goods inventory at 2010 January 1, is 8,000 units with a cost per unit of USD 15. The company uses FIFO inventory procedure.

Prepare a projected income statement for January 2010.

### Solution to demonstration problem

<b>Ramos Company Projected income statement For January 2010</b>		
Sales (40,000 x \$30)		\$1,200,000
Cost of goods sold (see planned cost of goods sold)		638,400
Gross margin		\$561,600
Selling expenses:		
Fixed	\$120,000	
Variable (0.02 x \$120,000)	24,000	
Administrative expenses:		
Fixed	90,000	
Variable (0.01 x \$1,200,000)	12,000	246,000
Income before federal income taxes		\$315,600
Deduct: Federal income tax expense (40%)		126,600
Net income		\$189,360

<b>Ramos Company Planned cost of goods sold</b>		
Beginning finished goods inventory (8,000 x \$15)		\$ 120,000
Cost of goods manufactured:		
Direct materials (50,000 x \$3)	\$150,000	
Direct labor (50,000 x \$7.50)	375,000	
Variable manufacturing overhead (50,000 x \$4.50)	225,000	
Fixed manufacturing overhead	60,000	
Cost of goods manufactured (50,000 x \$16,20)		810,000
Cost of goods available for sale		\$ 930,000
Ending finished goods inventory (18,000 x \$16,20)		291,600
Cost of goods sold		\$ 638,400

## 23. Budgeting for planning and control

### Key terms\*

**Budget** A plan showing a company's objectives and proposed ways of attaining the objectives. Major types of budgets are (1) master budget, (2) responsibility budget, and (3) capital budget.

**Budgeting** The coordination of financial and nonfinancial planning to satisfy an organization's goals.

**Budget variance** The difference between an actual cost incurred (or revenue earned) at a certain level of operations and the budgeted amount for the same level of operations.

**Cash budget** A plan indicating expected inflows (receipts) and outflows (disbursements) of cash; it helps management decide whether enough cash will be available for short-term needs.

**Financial budget** The projected balance sheet portion of a master budget.

**Fixed costs** Costs that are unaffected in total by the relative level of production or sales.

**Flexible operating budget** A special budget that provides detailed information about budgeted expenses (and revenues) at various levels of output.

**Just-in-time inventory system** Provides that goods are produced and delivered just in time to be sold.

**Master budget** The projected income statement (planned operating budget) and projected balance sheet (financial budget) showing the organization's objectives and proposed ways of attaining them; includes supporting budgets for various items in the master budget; also called master profit plan. The master budget is the overall plan of the enterprise and ideally consists of all of the various segmental budgets.

**Participatory budgeting** A method of preparing the budget that includes the participation of all levels of management responsible for actual performance.

**Planned operating budget** The projected income statement portion of a master budget.

**Production budget** A budget that takes into account the units in the sales budget and the company's inventory policy.

**Variable costs** Costs that vary in total directly with production or sales and are a constant dollar amount per unit of output over different levels of output or sales.

**Zero-base budgeting** Managers in a company start each year with zero budget levels and must justify every dollar that will appear in the budget.

\*Some terms listed in earlier chapters are repeated here for your convenience.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

Budgets are based on more than past results.

Cash budgets may cover a week or a month, sales and production budgets a month, a quarter, or a year, and general operating budgets may cover a quarter or a year.

The planned operating budget is developed first in units and then in dollars.

Planned operating budgets based on planned activity levels and flexible budgets are the same if planned activity levels and actual activity levels are not the same.

#### Multiple-choice

Select the best answer for each of the following questions.

Which of the following best describes some of the benefits related to the preparation and use of budgets:

- Business activities are better coordinated.
- Managers become aware of other managers' plans.
- Employees may become cost conscious and try to conserve resources.

- d. Managers may review the organizational plan and make necessary changes more often.
- e. All of the above.

When preparing a projected income statement, which of the following budgets is prepared first?

- a. Projected cost of goods sold budget.
- b. Selling and administrative budget.
- c. Sales budget.
- d. Financial budget.

Fixed costs are USD 60,000, variable cost per unit is USD 1.20, and budgeted units of output are 200,000 units. Determine the budgeted production costs.

- a. USD 300,000.
- b. USD 360,000.
- c. USD 240,000.
- d. USD 276,000.

Production costs (including USD 30,000 of fixed costs) are budgeted at USD 150,000 for an expected output of 100,000 units. Actual output was 90,000 units, while actual costs were USD 142,500. What is the budget variance and is it favorable or unfavorable?

- a. USD 5,500 unfavorable.
- b. USD 6,500 favorable.
- c. USD 6,500 unfavorable.
- d. USD 4,500 unfavorable.

Now turn to “Answers to self-test” at the end of the chapter to check your answers.

## Questions

- What are three purposes of budgeting?
- What are the purposes of a master, planned operating, and financial budget?
- How does the management by exception concept relate to budgeting?
- What are five basic principles which, if followed, should improve the probability of preparing a meaningful budget? Why is each important?
- What is the difference between an imposed budget and a participatory budget?
- Define and explain a budget variance.
- What are the two major budgets in the master budget? Which should be prepared first? Why?
- Distinguish between a master budget and a responsibility budget.

## 23. Budgeting for planning and control

- The budget established at the beginning of a given period carried an item for supplies expense in the amount of USD 40,000. At the end of the period, the supplies used amounted to USD 44,000. Can it be concluded from these data that there was an inefficient use of supplies or that care was not exercised in purchasing the supplies?
- Management must make certain assumptions about the business environment when preparing a budget. What areas should be considered?
- Why is budgeted performance better than past performance as a basis for judging actual results?
- Describe the concepts of just-in-time inventory systems and zero-base budgeting.
- **Real world question** Refer to the financial statements for a publicly traded company. An industry analyst has asked you to forecast sales for each of the next five years (after the current year). Assume sales increase each year by the same percentage. That is, the percentage increase for next year is expected to be the same as it was last year. What is your estimate of sales in each of the next five years?
- **Real world question** Refer to your forecasts of sales for the company in the previous question. Evaluate the simple forecasting method you were asked to use in that question. What additional factors should be used in forecasting sales?
- **Real world question** Do you think the sales for a particular grocery store in your neighborhood will go up, go down, or stay the same next year compared to this year? Give your answer in sales volume, then give it in sales dollars.
- **Real world question** The text refers to the benefits of participation in budgeting. Assume your college bookstore is preparing a budget for next year and wants to include employees in the budgeting process. Give examples of the people who should be included and state what information they could provide.

### Exercises

**Exercise A** Hike n' Run Company has decided to produce 288,000 pairs of socks at a uniform rate throughout 2010. The sales department of Hike n' Run has estimated sales for 2010 according to the following schedule:

	<b>Sales of pairs of socks</b>
First quarter	76,800
Second quarter	62,400
Third quarter	72,000
Fourth quarter	100,800
Total for 2007	312,000

Assume the 2009 December 31, inventory is estimated to be 38,400 pairs of socks. Prepare a schedule of planned sales and production for the first two quarters of 2010.

**Exercise B** DePaul Company projects sales of 25,000 units during May at USD 6 per unit. Production costs are USD 1.80 per unit. Variable selling and administrative expenses are USD 0.60 per unit; fixed selling and administrative expenses are USD 60,000. Compute the budgeted income before income taxes.

**Exercise C** Skaters Plus Company plans to sell 90,000 skateboards next quarter at a price of USD 36 per unit. Production costs are USD 14.40 per unit. Selling and administrative expenses are: variable, USD 7.20 per unit; and

fixed, USD 604,800 per quarter. What are the budgeted earnings for next quarter? (Do not consider federal income taxes.)

**Exercise D** Duke Corporation considers materials and labor to be completely variable costs. Expected production for the year is 50,000 units. At that level of production, direct materials cost is budgeted at USD 198,000, and direct labor cost is budgeted at USD 450,000. Prepare a flexible budget for materials and labor for possible production levels of 52,500, 60,000, and 67,500 units of product.

**Exercise E** Assume that in the previous exercise the actual production was 60,000 units, materials cost was USD 247,000, and labor cost was USD 510,000. What are the budget variances?

**Exercise F** Fixed production costs for Alexia Company are budgeted at USD 576,000, assuming 40,000 units of production. Actual sales for the period were 35,000 units, while actual production was 40,000 units. Actual fixed costs used in computing cost of goods sold amounted to USD 504,000. What is the budget variance?

**Exercise G** The shoe department of Noardstone's Department Store has prepared a sales budget for April calling for a sales volume of USD 75,000. The department expects to begin in April with a USD 50,000 inventory and to end the month with an USD 42,500 inventory. Its cost of goods sold averages 70 per cent of sales.

Prepare a purchases budget for the department showing the amount of goods to be purchased during April.

### Problems

**Problem A** Joyce Corporation prepares monthly operating and financial budgets. The operating budgets for June and July are based on the following data:

	Units produced	Units sold
June	400,000	360,000
July	360,000	400,000

All sales are at USD 30 per unit. Direct materials, direct labor, and variable manufacturing overhead are estimated at USD 3, USD 6, and USD 3 per unit, respectively. Total fixed manufacturing overhead is budgeted at USD 1,080,000 per month. Selling and administrative expenses are budgeted at USD 1,200,000 plus 10 per cent of sales, while federal income taxes are budgeted at 40 per cent of income before federal income taxes. The inventory at June 1 consists of 200,000 units with a cost of USD 17.10 each.

- Prepare monthly budget estimates of cost of goods sold assuming that FIFO inventory procedure is used.
- Prepare planned operating budgets for June and July.

**Problem B** The computation of operating income for Frisco Company for 2008 follows:

Sales		\$1,800,000
Cost of goods manufactured and sold:		
Direct materials	\$360,000	
Direct labor	240,000	
Variable manufacturing overhead	120,000	
Fixed manufacturing overhead	240,000	960,000
Gross margin		\$ 840,000
Selling expenses:		
Variable	\$132,000	
Fixed	168,000	300,000
Administrative expenses:		
Variable	\$156,000	
Fixed	192,000	348,000
Net operating income		\$ 192,000

### 23. Budgeting for planning and control

An operating budget is prepared for 2009 with sales forecasted at a 25 per cent increase in volume. Direct materials, direct labor, and all costs labeled as variable are completely variable. Fixed costs are expected to continue except for a USD 24,000 increase in fixed administrative costs. Actual operating data for 2009 are:

Sales	\$2,160,000
Direct materials	444,000
Direct labor	288,000
Variable manufacturing overhead	148,800
Fixed manufacturing overhead	246,000
Variable selling expenses	186,000
Fixed selling expenses	157,200
Variable administrative expenses	198,000
Fixed administrative expenses	218,200

- Prepare a budget report comparing the 2009 planned operating budget with actual 2009 data.
- Prepare a budget report that would be useful in appraising the performance of the various persons charged with responsibility to provide satisfactory income. (Hint: Prepare budget data on a flexible basis and use the percentage by which sales were actually experienced.)
- Comment on the differences revealed by the two reports.

**Problem C** Use the following data to prepare a planned operating budget for Hi-Lo Company for the year ending 2009 December 31:

Plant capacity	100,000 units
Expected sales volume	90,000 units
Expected production	90,000 units
Actual production	90,000 units
Forecasted selling price	\$ 12,00 per unit
Actual selling price	\$ 13,50 per unit
Manufacturing costs:	
Variable (per unit):	
Direct materials	\$3.60
Direct labor	\$1.50
Manufacturing overhead	\$2.25
Fixed manufacturing overhead	\$108,000
Selling and administrative expenses:	
Variable (per unit)	\$1.20
Fixed	\$60,000

Assume no beginning or ending inventory. Federal income taxes are budgeted at 40 per cent of income before federal income taxes.

The actual operating data for the year ending 2009 December 31, follow:

Sales		\$1,080,000
Cost of goods sold:		
Direct materials	\$337,500	
Direct labor	135,000	
Variable manufacturing overhead	202,500	
Fixed manufacturing overhead	108,000	
Total	\$783,000	
Less: Ending inventory (\$783,000 x 10/90)	87,000	696,000
Gross margin		\$384,000
Selling expenses:		
Variable	102,000	
Fixed	72,000	174,000
Income before federal income taxes		\$210,000
Deduct: Federal income taxes at 40%		84,000
Net income		\$126,000

- Prepare a planned operating budget for the year ended 2009 December 31, for part (1).

b. Using a flexible operating budget, analyze the efficiency of operations and comment on the company's sales policy for part (2).

**Problem D** Kim Company wants you to prepare a flexible budget for selling and administrative expenses. The general manager and the sales manager have met with all the department heads, who provided the following information regarding selling and administrative expenses:

The company presently employs 30 full-time salespersons with a base of USD 3,600 each per month plus commissions and 10 full-time salespersons with a salary of USD 6,000 each per month plus commissions. In addition, the company employs nine regional sales managers with a salary of USD 21,600 per month, none of whom is entitled to any commissions.

If sales volume exceeds USD 80 million per year, the company must hire four more salespersons, each at a salary of USD 3,600 per month plus commissions.

Sales commissions are either 10 per cent or 5 per cent of the selling price, depending on the product sold. Typically, a 10 per cent commission applies on 60 per cent of sales, and a 5 per cent commission applies on the remaining 40 per cent of sales.

Salespersons' travel allowances average USD 1,500 per month per salesperson (excluding managers).

Advertising expenses average USD 150,000 per month plus 3 per cent of sales.

Selling supplies expense is estimated at 1 per cent of sales.

Administrative salaries are USD 300,000 per month.

Other administrative expenses include the following:

Rent—USD 48,000 per month

Office supplies—2 per cent of sales

Other administrative expenses (telephone, etc.)—USD 12,000 per month

Prepare a flexible budget for selling and administrative expenses for sales volume of USD 36 million, USD 48 million, and USD 60 million per year.

**Problem E** Galaxy Lighting Company manufactures and sells lighting fixtures. Estimated sales for the next three months are:

September	\$350,000
October	500,000
November	400,000

Sales for August were USD 400,000. All sales are on account. Galaxy Lighting Company estimates that 60 per cent of the accounts receivable are collected in the month of sale with the remaining 40 per cent collected the following month. The units sell for USD 30 each. The cash balance for September 1 is USD 100,000.

Generally, 60 per cent of purchases are due and payable in the month of purchase with the remainder due the following month. Purchase cost per unit for materials is USD 18. The company maintains an end-of-the-month inventory of 1,000 units plus 10 per cent of next month's unit sales.

### 23. Budgeting for planning and control

Prepare a cash receipts schedule for September and October and a purchases budget for August, September, and October.

**Problem F** Refer to the previous problem. In addition to the information given, selling and administrative expenses paid in cash are USD 120,000 per month.

Prepare a monthly cash budget for September and October for Galaxy Lighting Company.

#### Alternate problems

**Alternate problem A** Cougars Company prepares monthly operating and financial budgets. Estimates of sales in units are made for each month. Production is scheduled at a level high enough to take care of current needs and to carry into each month one-half of the next month's unit sales. Direct materials, direct labor, and variable manufacturing overhead are estimated at USD 12, USD 6, and USD 4 per unit, respectively. Total fixed manufacturing overhead is budgeted at USD 480,000 per month. Sales for April, May, June, and July 2009 are estimated at 100,000, 120,000, 160,000, and 120,000 units. The inventory at 2009 April 1, consists of 50,000 units with a cost of USD 28.80 per unit.

- Prepare a schedule showing the budgeted production in units for April, May, and June 2009.
- Prepare a schedule showing the budgeted cost of goods sold for the same three months assuming that the FIFO method is used for inventories.

**Alternate problem B** Following is a summary of operating data of Bugs Company for the year 2008:

Sales		\$ 7,00,000
Cost of goods manufactured and sold:		
Direct materials	\$1,200,000	
Direct labor	1,100,000	
Variable manufacturing overhead	300,000	
Fixed manufacturing overhead	800,000	3,400,000
Gross margin		\$ 3,600,000
Selling expenses:		
Variable	\$ 300,000	
Fixed	400,000	700,000
		2,900,000
General and administrative expenses:		
Variable	\$ 100,000	
Fixed	1,200,000	1,300,000
Net operating income		\$ 1,600,000

Sales volume for 2009 is budgeted at 90 per cent of 2008 sales volume. Prices are not expected to change. The 2009 budget amounts for the various other costs and expenses differ from those reported in 2008 only for the expected volume change in the variable items. Actual operating data for 2009 follow:

Sales	\$5,800,000
Direct materials	1,300,000
Direct labor	1,100,000
Variable manufacturing overhead	300,000
Fixed manufacturing overhead	780,000
Variable selling expenses	270,000
Fixed selling expenses	290,000
Variable administrative expenses	110,000
Fixed administrative expenses	1,100,000

- Prepare a budget report comparing the planned operating budget for 2009 with the actual results for that year.

b. Prepare a budget report that would be useful in pinpointing responsibility for the poor showing in 2009. (Hint: Prepare a flexible operating budget.)

**Alternate problem C** Use the following data for Andrea Company in preparing its 2009 planned operating budget:

Plant capacity	500,000 units
Expected sales volume	450,000 units
Expected production	500,000 units
Forecasted selling price	\$72 per unit
Variable manufacturing costs per unit:	
Direct materials	\$ 27.00
Direct labor	9.00
Manufacturing overhead	6.00
Fixed manufacturing overhead per period	\$900,000
Selling and administrative expenses:	
Variable (per unit)	\$ 3.00
Fixed (per period)	\$ 750,000

Assume no beginning inventory. Federal income taxes are budgeted at 40 per cent of income before income taxes.

The actual results for Andrea Company for the year ended 2009 December 31, follow. (Note: The actual sales price was USD 80 per unit. Actual unit production was equal to actual unit sales.)

Sales (500,000 units @ \$80 per unit)		\$40,000,000
Cost of goods sold:		
Direct materials	\$12,000,000	
Direct labor	4,400,000	
Variable manufacturing overhead	4,000,000	
Fixed manufacturing overhead	1,000,000	21,400,000
Gross margin		\$18,600,000
Selling and administrative expenses:		
Variable	\$ 1,400,000	
Fixed	800,000	2,200,000
Income before federal income taxes		\$16,400,000
Deduct: Federal income taxes		6,560,000
Net income		\$ 9,840,000

a. Prepare a planned operating budget for the year ended 2009 December 31, for (1).

b. Using a flexible operating budget, analyze the efficiency of operations. Comment on the results of 2009 and on the company's sales policy in (2).

**Alternate problem D** Rocklin Company gathered the following budget information for the quarter ending 2009 September 30:

Sales	\$540,000
Purchases	450,000
Salaries and wages	194,000
Rent	10,000
Supplies	8,000
Insurance	2,000
Other cash expenses	12,000

A cash balance of USD 36,000 is planned for July 1. Accounts receivable are expected to be USD 60,000 on July 1. All but one-half of 1 per cent of the July 1 Accounts Receivable balance will be collected in the quarter ending September 30. The company's sales collection pattern is 95 per cent in the quarter of sale and 5 per cent in the quarter after sale. Accounts payable will be USD 30,000 on July 1 and will be paid during the coming quarter. The company's purchases payment pattern is 75 per cent in the quarter of purchase and 25 per cent in the quarter after purchase. Expenses are paid in the quarter in which they are incurred.

### 23. Budgeting for planning and control

Prepare a cash budget for the quarter ending 2009 September 30.

#### Beyond the numbers—Critical thinking

**Business decision case A** Golden State Company has applied at a local bank for a short-term loan of USD 150,000 starting on 2009 October 1. The bank's loan officer has requested a cash budget from the company for the quarter ending 2009 December 31. The following information is needed to prepare the cash budget:

Sales	\$600,000
Purchases	350,000
Salaries and wages to be paid	125,000
Rent payments	7,000
Supplies (payments for)	4,500
Insurance payments	1,500
Other cash payments	22,000

A cash balance of USD 24,000 is planned for October 1. Accounts receivable are expected to be USD 48,000 on October 1. All of these accounts will be collected in the quarter ending December 31. In general, sales are collected as follows: 90 per cent in the quarter of sale, and 10 per cent in the quarter after sale. Accounts payable will be USD 480,000 on October 1 and will be paid during the quarter ending December 31. All purchases are paid in the quarter after purchase.

a. Prepare a cash budget for the quarter ending 2009 December 31. Assume that the USD 150,000 loan will be made on October 1 and will be repaid with interest at 10 per cent on December 31.

b. Will the company be able to repay the loan on December 31? If the company desires a minimum cash balance of USD 18,000, will the company be able to repay the loan as planned?

**Ethics case B** The state of California, USA faced large budget deficits. Meanwhile, officials in a particular community college district were looking for ways to spend the money that had been budgeted for the district. The community college was entering the last three months of the fiscal year with excess funds because the area had experienced a mild winter resulting in lower than usual utilities and maintenance costs.

At a budget meeting, one official commented, "You know what will happen if we do not spend all of our budget. The state will claim we do not need as much money next year. What happens if we have a hard winter next year? We will need every cent we can get!"

The community college's accounting manager commented, "We are legally entitled to spend all of the money this year that has been budgeted to us. I am concerned about the memorandum that we received requesting that we cut expenditures wherever possible to help reduce the state's deficit."

The first official responded, "That deficit is the state's problem, not ours. We would not have a deficit in the first place if the state administrators were able to estimate taxes and do a better job of budgeting. Let us deal with our problems and let them deal with theirs!"

Write a response from the point of view of the taxpayers of the state of California. Should the community college spend all of the money that had been budgeted for it?

**Broader perspective C** Refer to the Broader perspective, "Planning in a changing environment". Describe and evaluate Verizon Communications, Inc.'s new approach to planning. How would you advise company management to communicate the company's values and plans to employees?

**Group project D** In groups of three, develop a budget for an organization that publishes financial statements, such as The Coca-Cola Company or Maytag Corporation. Your budget should include three different types of projected income statements for the coming month, quarter, or year. These three income statements should be for optimistic, pessimistic, and expected scenarios. Collect or develop as much information as possible to prepare the budget. For example, to prepare a budgeted income statement for a publicly traded company such as Coca-Cola, look at previous annual reports and collect whatever additional information you can from news reports. Be sure to state the assumptions used in preparing the budget in a memorandum you write as a team. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Do not forget to include the three different projected income statements.

**Group project E** The chief executive officer (CEO) of Rigid Plastics Corporation remarked to a colleague, "I do not understand why other companies waste so much time in the budgeting process. I set our company goals, and everyone strives to meet them. What is wrong with that approach?" In groups of two or three students, write a memorandum to your instructor stating whether you agree with this comment or not and explain why. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project F** Multigoal Corporation has established a bonus plan for its employees. An employee receives a bonus if his or her department meets or is below the cost levels specified in the annual budget plan. If the department's costs exceed the budget, its employees earn no bonus. In groups of two or three students, write a memorandum to your instructor stating the problems that might arise with this bonus plan. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

#### Using the Internet—A view of the real world

Visit the website for a high technology company that provides recent annual reports. Examples include Intel Corporation, IBM, and Dell. Develop a budgeted income statement (operating budget) for the coming year and include three categories for optimistic, pessimistic, and expected scenarios. Collect or develop as much information as possible to prepare the budget. For example, look at previous annual reports and collect whatever additional information you can from news reports. Be sure to state the assumptions used in preparing the budget in a memorandum. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Do not forget to include the three different projected income statements.

Visit the website for a retail company that provides recent annual reports. Develop a budgeted income statement (operating budget) for the coming year and include three categories for optimistic, pessimistic, and expected scenarios. Collect or develop as much information as possible to prepare the budget. For example, look at previous annual reports and collect whatever additional information you can from news reports. Be sure to state the assumptions used in preparing the budget in a memorandum. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Do not forget to include the three different projected income statements.

#### Comprehensive problems

Wimerick Corporation prepares annual budgets by quarters. The company's post-closing trial balance as of 2010 December 31, is as follows:

	Debits	Credits
Cash	\$138,000	

### 23. Budgeting for planning and control

Accounts receivable	360,000	
Allowance for uncollectible accounts		\$ 12,000
Inventories	156,000	
Prepaid expenses	12,000	
Furniture and equipment	180,000	
Accumulated depreciation – Furniture and equipment		12,000
Accounts payable		120,000
Accrued liabilities payable		36,000
Notes payable, 5% (due 2008)		480,000
Capital stock		300,000
Retained earnings (deficit)	114,000	
	\$960,000	\$960,000

All of the capital stock of the company was recently acquired by Juan Jackson. After the purchase, Jackson loaned substantial sums of money to the corporation, which still owes him USD 480,000 on a 5 per cent note. There are no accrued federal income taxes payable, but future earnings will be subject to income taxation.

Jackson is anxious to withdraw USD 120,000 from the corporation (as a payment on the note payable to him) but will not do so if it reduces the corporation's cash balance below USD 120,000. Thus, he is quite interested in the budgets for the quarter ending 2011 March 31.

Sales for the coming quarter ending 2011 March 31, are forecasted at USD 1,200,000; for the following quarter they are forecasted at USD 1,500,000. All sales are priced to yield a gross margin of 40 per cent. Inventory is to be maintained on hand at the end of any quarter in an amount equal to 20 per cent of the goods to be sold in the next quarter. All sales are on account, and 95 per cent of the 2010 December 31, receivables plus 70 per cent of the current quarter's sales will be collected during the quarter ending 2011 March 31.

Selling expenses are budgeted at USD 48,000 plus 6 per cent of sales; USD 24,000 will be incurred on account, USD 66,000 accrued, USD 27,000 from expiration of prepaid rent and prepaid insurance, and USD 3,000 from allocated depreciation.

Purchasing expenses are budgeted at USD 34,800 plus 5 per cent of purchases for the quarter; USD 9,000 will be incurred on account, USD 48,000 accrued, USD 13,800 from expired prepaid expenses, and USD 1,200 from allocated depreciation.

Administrative expenses are budgeted at USD 42,000 plus 2 per cent of sales; USD 3,000 will be incurred on account, USD 36,000 accrued, USD 13,200 from expired prepayments, and USD 1,800 from allocated depreciation. Uncollectible accounts are estimated at 1 per cent of sales.

Interest accrues at 5 per cent annually on the notes payable and is credited to Accrued Liabilities Payable.

All of the beginning balances in Accounts Payable and Accrued Liabilities Payable, plus 80 per cent of the current credits to Accounts Payable, and all but USD 30,000 of the current accrued liabilities will be paid during the quarter. An USD 18,000 insurance premium is to be paid prior to March 31, and a full year's rent of USD 144,000 is due on January 2.

Federal income taxes are budgeted at 40 per cent of the income before federal income taxes. The taxes should be accrued, and no payments are due in the first quarter.

a. Prepare a planned operating budget for the quarter ending 2011 March 31, including supporting schedules for planned purchases and operating expenses.

b. Prepare a financial budget for 2011 March 31. Supporting schedules should be included that (1) analyze accounts credited for purchases and operating expenses, (2) show planned accounts receivable collections and balance, and (3) show planned cash flows and cash balance.

c. Will Jackson be able to collect the USD 120,000 on his note?

Davis Corporation is a rapidly expanding company. The company's post-closing balance as of 2010 December 31, is as follows:

<b>Davis corporation</b>		
<b>Post-closing trial</b>		
<b>balance</b>		
<b>2010 December 31</b>		
	<b>Debits</b>	<b>Credits</b>
Cash	\$240,000	
Accounts receivable	480,000	
Allowance for uncollectible accounts		\$ 36,000
Inventories	600,000	
Prepaid expenses	72,000	
Land	600,000	
Buildings and equipment	1,800,000	
Accumulated depreciation – Buildings and equipment		240,000
Accounts payable		360,000
Accrued liabilities payable (including income taxes)		240,000
Capital stock		2,400,000
Retained earnings		516,000
	<b>\$3,792,000</b>	<b>\$3,792,000</b>

Sales in the last quarter of 2010 amounted to USD 2,400,000 and are projected at USD 3,000,000 and USD 4,800,000 for the first two quarters of 2011. This expansion has created a need for cash. Management is especially concerned about the probable cash balance of 2011 March 31, since a payment of USD 360,000 for some new equipment must be made on delivery on April 2. The current cash balance of USD 240,000 is considered to be the minimum workable balance.

Purchases, all on account, are to be scheduled so that the inventory at the end of any quarter is equal to one-third of the goods expected to be sold in the coming quarter. Cost of goods sold averages 60 per cent of sales.

Selling expenses are budgeted at USD 120,000 plus 8 per cent of sales; USD 24,000 is expected to be incurred on account, USD 288,000 accrued, USD 33,600 from expired prepayments, and USD 14,400 from allocated depreciation.

Purchasing expenses are budgeted at USD 84,000 plus 5 per cent of purchases; USD 12,000 will be incurred on account, USD 156,000 accrued, USD 13,200 from expired prepayments, and USD 10,800 from allocated depreciation.

Administrative expenses are budgeted at USD 150,000 plus 3 per cent of sales; USD 24,000 will be incurred on account, USD 132,000 accrued, USD 13,200 from expired prepayments, and USD 10,800 from allocated depreciation.

Federal income taxes are budgeted at 40 per cent of income before federal income taxes and are recorded as accrued liabilities. Payments on these taxes are included in the payments on accrued liabilities discussed in item 6.

### 23. Budgeting for planning and control

All 2010 December 31, accounts payable plus 80 per cent of current credits to this account will be paid in the first quarter. All of the 2010 December 31, accrued liabilities payable (except for USD 72,000) will be paid in the first quarter. Of the current quarter's accrued liabilities, all but USD 288,000 will be paid during the first quarter.

Cash outlays for various expenses normally prepaid will amount to USD 96,000 during the quarter.

All sales are made on account; 80 per cent of the sales are collected in the quarter in which made, and all of the remaining sales are collected in the following quarter, except for 2 per cent which is never collected. The Allowance for Uncollectible Accounts account shows the estimated amount of accounts receivable at 2010 December 31, arising from 2010 sales that will not be collected.

a. Prepare an operating budget for the quarter ending 2011 March 31. Supporting schedules for planned purchases and operating expenses should be included.

b. Prepare a financial budget for 2011 March 31. Include supporting schedules that (1) analyze accounts credited for purchases and expenses, (2) show planned cash flows and cash balance, and (3) show planned collections of accounts receivable and the accounts receivable balance.

c. Will sufficient cash be on hand April 2 to pay for the new equipment?

**Answers to self-test**

#### **True-false**

**True.** Budgets are estimates of the future and should consider future plans and conditions.

**True.** Cash budgets may cover a week or a month; sales and production budgets a month, a quarter, or a year; and general operating budgets may cover a quarter or a year.

**True.** The planned operating budget is developed first in units, then in dollars.

**False.** Flexible budgets are based on actual activity and planned operating budgets are based on planned activity. Planned operating budgets based on planned activity levels and flexible budgets are not the same if planned activity levels and actual activity levels are not the same.

#### **Multiple-choice**

**e.** The benefits of budgeting include a through d.

**c.** The sales budget is first. We need to know sales before we predict cost of goods sold, selling and administrative expenses, and the financial budget.

**a.** Budgeted amount = Fixed cost + (Variable cost per unit x Units of output)

= USD 60,000 + (USD 1.20 x 200,000)

= USD 60,000 + USD 240,000

= USD 300,000 budgeted amount

**d.** USD 150,000 – USD 30,000 = USD 120,000 variable cost

$\frac{\text{USD } 120,000}{100,000 \text{ units}} = \text{USD } 1.20 \text{ per unit variable cost}$

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Budgeted costs at 90,000 units:	
90,000 x USD 1.20	USD 108,000
Fixed costs	30,000
	USD 138,000
Actual costs	142,500
Unfavorable budget variance	USD 4,500

# 24. Control through standard costs

## Learning objectives

After studying this chapter, you should be able to:

- Discuss the nature of standard costs, including how standards are set.
- Define budgets and discuss how budgets are used in a standard cost system.
- Discuss the advantages and disadvantages of using standard costs.
- Calculate the six variances from standard and determine if the variance is favorable or unfavorable.
- Discuss what each of the six variances shows and prepare journal entries to record the variance.
- Discuss the three selection guidelines used to investigate variances from standard.
- Discuss theoretical and practical methods for disposing of variances from standard.

This chapter discusses the uses of standard costs, the advantages and disadvantages of using standard costs, and how to compute the difference, or variance, between an actual cost and a standard cost. We discuss how managers can improve efficiency by investigating variances and taking corrective action.

## Uses of standard costs

Whenever you have set goals that you have sought to achieve, these goals could have been called standards. Periodically, you might measure your actual performance against these standards and analyze the differences to see how close you are to your goal. Similarly, management sets goals, such as standard costs, and compares actual costs with these goals to identify possible problems.

This section begins with a discussion of the nature of standard costs. Next, we explain how managers use standard costs to establish budgets. Then we describe how management uses the concept of **management by exception** to investigate variances from standards. We also explain setting standards and how management decides whether to use ideal or practical standards. The section closes with a discussion of the other uses of standard costs.

## Nature of standard costs

A **standard cost** is a carefully predetermined measure of what a cost should be under stated conditions. Standard costs are not only estimates of what costs will be but also goals to be achieved. When standards are properly set, their achievement represents a reasonably efficient level of performance.

Usually, effective standards are the result of engineering studies and of time and motion studies undertaken to determine the amounts of materials, labor, and other services required to produce a product. Also considered in

## 24. Control through standard costs

setting standards are general economic conditions because these conditions affect the cost of materials and other services that must be purchased by a manufacturing company.

Manufacturing companies determine the standard cost of each unit of product by establishing the standard cost of direct materials, direct labor, and manufacturing overhead necessary to produce that unit. Determining the standard cost of direct materials and direct labor is less complicated than determining the standard cost of manufacturing overhead.

The standard direct materials cost per unit of a product consists of the standard amount of material required to produce the unit multiplied by the standard price of the material. You must distinguish between the terms standard price and standard cost. Standard price usually refers to the price per unit of inputs into the production process, such as the price per pound of raw materials.

Standard cost, however, is the standard quantity of an input required per unit of output times the standard price per unit of that input. For example, if the standard price of cloth is USD 3 per yard and the standard quantity of material required to produce a dress is 3 yards, the standard direct materials cost of the dress is 3 yards x USD 3 per yard = USD 9. Similarly, a company computes the standard direct labor cost per unit for a product as the standard number of hours needed to produce one unit multiplied by the standard labor or wage rate per hour.

**Standard manufacturing overhead cost** To find the standard manufacturing overhead cost of a unit, use the following steps. First, determine the expected level of output for the year. This level of output is called the **standard level of output**. Second, determine the total budgeted manufacturing overhead cost at the standard level of output. The total budgeted overhead cost includes both fixed and variable components. Total fixed cost is the same at every level of output within a relevant range. Total variable overhead varies in direct proportion to the number of units produced. Third, compute the standard manufacturing overhead cost per unit by dividing the total budgeted manufacturing overhead cost at the standard level of output by the standard level of output. The result is standard overhead cost (or rate) per unit of output.

The formula to compute the standard overhead cost per unit is:

$$\text{Standard overhead cost (rate) per unit} = \frac{\text{Total budgeted overhead cost at the standard level of output}}{\text{Standard level of output}}$$

Sometimes accountants find the standard overhead rate per unit of input, such as direct labor-hour instead of per unit. To find the standard overhead cost per unit, multiply the direct labor-hours per unit times the standard overhead cost per direct labor-hour. For instance, if the standard overhead costs per direct labor-hour is USD 5 and the standard number of direct labor-hours is two hours per unit, the standard overhead cost per unit is USD 5 x 2 hours = USD 10.

As discussed in Chapter 23, **budgets** are formal written plans that represent management's planned actions in the future and the impacts of these actions on the business. As a business incurs actual expenses and revenues, management compares them with the budgeted amounts. To control operations, management investigates any differences between the actual and budgeted amounts and takes corrective action.

When management compares actual expenses and revenues with budgeted expenses and revenues, differences—called variances—are likely to occur. The responsibility of management is to investigate significant variances.

Obviously, management must determine when a variance is significant. This process of focusing on only the most significant variances is known as **management by exception**. The process of management by exception enables management to concentrate its efforts on those variances that could have a big effect on the company, ignoring those variances that are not significant.

In developing standards, management must consider the assumed conditions under which these standards can be met. Standards generally fall into two groups—ideal and practical.

A company attains **ideal standards** under the best circumstances—with no machinery problems or worker problems. The company can attain these unrealistic standards only when it has highly efficient, skilled workers who are working at their best effort throughout the entire period needed to complete the job.

**Practical standards** are strict but attainable standards that have allowances made for machinery problems and rest periods for workers. Companies can meet these standards if average workers are efficient at their work. These standards are generally used in planning.

Generally, management does not use ideal standards because ideal standards do not allow for normal repairs to machinery or rest periods for workers. A company rarely runs its operations under ideal conditions. Since planning under ideal standards is unrealistic, managers rarely use ideal standards in budgeting. Instead, management uses practical standards in planning because these standards are more realistic, allowing for machinery repairs and rest periods for workers. Any variances that result when practical standards are used indicate abnormal or unusual problems.

In addition to developing budgets, companies use standard costs in evaluating management's performance, evaluating workers' performance, and setting appropriate selling prices.

Firms evaluate management's and workers' performances through the use of a budget. When management compares actual results with budgeted amounts, it can see how well it is performing its own duties and managing its employees. Management also can evaluate workers based on how well they performed relative to the budgeted amounts pertaining to the activities they performed.

Standard costs are useful in setting selling prices. The budget shows the expected expenses incurred by the business. By considering these expenses, management can determine how much to charge for a product so that it can produce the desired net income. As the business actually incurs these expenses, management determines if the selling prices set are still reasonable and, when necessary, considers some price adjustments after taking competition into account.

### **Advantages and disadvantages of using standard costs**

Five of the benefits that result from a business using a standard cost system are:

- Improved cost control.
- More useful information for managerial planning and decision making.
- More reasonable and easier inventory measurements.
- Cost savings in record-keeping.

## 24. Control through standard costs

- Possible reductions in production costs.

**Improved cost control** Companies can gain greater cost control by setting standards for each type of cost incurred and then highlighting exceptions or variances—instances where things did not go as planned. Variances provide a starting point for judging the effectiveness of managers in controlling the costs for which they are held responsible.

Assume, for example, that in a production center, actual direct materials costs of USD 52,015 exceeded standard costs by USD 6,015. Knowing that actual direct materials costs exceeded standard costs by USD 6,015 is more useful than merely knowing the actual direct materials costs amounted to USD 52,015. Now the firm can investigate the cause of the excess of actual costs over standard costs and take action.

Further investigation should reveal whether the exception or variance was caused by the inefficient use of materials or resulted from higher prices due to inflation or inefficient purchasing. In either case, the standard cost system acts as an early warning system by highlighting a potential hazard for management.

**More useful information for managerial planning and decision making** When management develops appropriate cost standards and succeeds in controlling production costs, future actual costs should be close to the standard. As a result, management can use standard costs in preparing more accurate budgets and in estimating costs for bidding on jobs. A standard cost system can be valuable for top management in planning and decision making.

**More reasonable and easier inventory measurements** A standard cost system provides easier inventory valuation than an actual cost system. Under an actual cost system, unit costs for batches of identical products may differ widely. For example, this variation can occur because of a machine malfunction during the production of a given batch that increases the labor and overhead charged to that batch. Under a standard cost system, the company would not include such unusual costs in inventory. Rather, it would charge these excess costs to variance accounts after comparing actual costs to standard costs.

Thus, in a standard cost system, a company assumes that all units of a given product produced during a particular time period have the same unit cost. Logically, identical physical units produced in a given time period should be recorded at the same cost.

**Cost savings in record-keeping** Although a standard cost system may seem to require more detailed record-keeping during the accounting period than an actual cost system, the reverse is true. For example, a system that accumulates only actual costs shows cost flows between inventory accounts and eventually into cost of goods sold. It records these varying amounts of actual unit costs that must be calculated during the period. In a standard cost system, a company shows the cost flows between inventory accounts and into cost of goods sold at consistent standard amounts during the period. It needs no special calculations to determine actual unit costs during the period. Instead, companies may print standard cost sheets in advance showing standard quantities and standard unit costs for the materials, labor, and overhead needed to produce a certain product.

**Possible reductions in production costs** A standard cost system may lead to cost savings. The use of standard costs may cause employees to become more cost conscious and to seek improved methods of completing

their tasks. Only when employees become active in reducing costs can companies really become successful in cost control.

Three of the disadvantages that result from a business using standard costs are:

- Controversial materiality limits for variances.
- Nonreporting of certain variances.
- Low morale for some workers.

**Controversial materiality limits for variances** Determining the materiality limits of the variances may be controversial. The management of each business has the responsibility for determining what constitutes a material or unusual variance. Because materiality involves individual judgment, many problems or conflicts may arise in setting materiality limits.

**Nonreporting of certain variances** Workers do not always report all exceptions or variances. If management only investigates unusual variances, workers may not report negative exceptions to the budget or may try to minimize these exceptions to conceal inefficiency. Workers who succeed in hiding variances diminish the effectiveness of budgeting.

**Low morale for some workers** The management by exception approach focuses on the unusual variances. Management often focuses on unfavorable variances while ignoring favorable variances. Workers might believe that poor performance gets attention while good performance is ignored. As a result, the morale of these workers may suffer.

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### An accounting perspective:

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#### Business insight

A few forward-looking companies have succeeded in allowing employees to set their own work standards. In most cases, industrial engineers shut themselves in a room and ponder how to set standards. The industrial engineers ignored the workers, who in turn ignored the standards. In the alternative scenario, workers themselves hold the stopwatches and set the standards. Worker team members time each other, looking for the most efficient and safest way to do the work. They standardize each task so everyone in the team does it the same way. The workers are more informed about how to do the work than industrial engineers, and they are more motivated to meet the standards they set.

Source: Based on the authors' research.

### Computing variances

As stated earlier, standard costs represent goals. Standard cost is the amount a cost should be under a given set of circumstances. The accounting records also contain information about actual costs.

## 24. Control through standard costs

The amount by which actual cost differs from standard cost is called a **variance**. When actual costs are less than the standard cost, a cost variance is favorable. When actual costs exceed the standard costs, a cost variance is unfavorable. Do not automatically equate favorable and unfavorable variances with good and bad. You must base such an appraisal on the causes of the variance.

The following section explains how to compute the dollar amount of variances, a process called isolating variances, using data for Beta Company. Beta manufactures and sells a single product, each unit of which has the following standard costs:

Materials – 5 sheets at \$6	\$30
Direct labor – 2 hours at \$10	20
Manufacturing overhead – 2 direct labor hours at \$5	10
Total standard cost per unit	\$60

We present additional data regarding the production activities of the company as needed.

The standard materials cost of any product is simply the standard quantity of materials that should be used multiplied by the standard price that should be paid for those materials. Actual costs may differ from standard costs for materials because the price paid for the materials and/or the quantity of materials used varied from the standard amounts management had set. These two factors are accounted for by isolating two variances for materials—a price variance and a usage variance.

Accountants isolate these two materials variances for three reasons. First, different individuals may be responsible for each variance—a purchasing agent for the price variance and a production manager for the usage variance. Second, materials might not be purchased and used in the same period. The variance associated with the purchase should be isolated in the period of purchase, and the variance associated with usage should be isolated in the period of use. As a general rule, the sooner a variance can be isolated, the greater its value in cost control. Third, it is unlikely that a single materials variance—the difference between the standard cost and the actual cost of the materials used—would be of any real value to management for effective cost control. A single variance would not show management what caused the difference, or one variance might simply offset another and make the total difference appear to be immaterial.

**Materials price variance** In a manufacturing company, the purchasing and accounting departments usually set a standard price for materials meeting certain engineering specifications. They consider factors such as market conditions, vendors' quoted prices, and the optimum size of a purchase order when setting a standard price. A **materials price variance (MPV)** occurs when a company pays a higher or lower price than the standard price set for materials. Materials price variance (MPV) is the difference between actual price paid (AP) and standard price allowed (SP) multiplied by the actual quantity of materials purchased (AQ). In equation form, the materials price variance is:

$$\text{Materials price variance} = (\text{Actual price} - \text{Standard price}) \times \text{Actual quantity purchased}$$

To illustrate, assume that a new supplier entered the market enabling Beta Company to purchase 60,000 sheets of material at a price of USD 5.90 each. Since the standard price set by management is USD 6 per sheet, the materials price variance is computed as:

$$\text{Materials price variance} = (\text{Actual price} - \text{Standard price}) \times \text{Actual quantity purchased}$$

$$\begin{aligned} &= (\text{USD } 5.90 - \text{USD } 6.00) \times 60,000 \\ &= \text{USD } -0.10 \times 60,000 \\ &= \text{USD } -6,000 \text{ (favorable)} \end{aligned}$$

The materials price variance of USD 6,000 is considered favorable since the materials were acquired for a price less than the standard price. If the actual price had exceeded the standard price, the variance would be unfavorable because the costs incurred would have exceeded the standard price. The journal entry to record the purchase of materials is:

(a) Materials inventory (+A)	360,000
Materials price variance (-A)	6,000
Accounts payable (+L)	354,000
To record the purchase of materials at less than standard cost.	

Note that the Accounts Payable account shows the actual debt owed to suppliers, while the Materials Inventory account shows the standard price of the actual quantity of materials purchased. The Materials Price Variance account shows the difference between the actual price and standard price multiplied by the actual quantity purchased.

**Materials usage variance** Because the standard quantity of materials used in making a product is largely a matter of physical requirements or product specifications, usually the engineering department sets it. But if the quality of materials used varies with price, the accounting and purchasing departments may perform special studies to find the right quality.

The **materials usage variance** occurs when more or less than the standard amount of materials is used to produce a product or complete a process. The variance shows only differences from the standard quantity caused by the quantity of materials used; it does not include any effect of variances in price. Thus, the materials usage variance (MUV) is equal to actual quantity used (AQ) minus standard quantity allowed (SQ) multiplied by standard price (SP):

$$\text{Materials usage variance} = (\text{Actual quantity used} - \text{Standard quantity allowed}) \times \text{Standard price}$$

To illustrate, assume that Beta Company used 55,500 sheets of material to produce 11,000 units of a product for which the standard quantity allowed is 55,000 sheets (5 sheets per unit allowed  $\times$  11,000 units actually produced). Since the standard price of the material is USD 6 per sheet, the materials usage variance of USD 3,000 would be computed as follows:

$$\begin{aligned} &\text{Materials usage variance} = (\text{Actual quantity used} - \text{Standard quantity allowed}) \times \text{Standard price} \\ &= (55,500 - 55,000) \times \text{USD } 6 \\ &= 500 \times \text{USD } 6 \\ &= \text{USD } 3,000 \text{ (unfavorable)} \end{aligned}$$

The variance is unfavorable because more materials were used than the standard quantity allowed to complete the job. If the standard quantity allowed had exceeded the quantity actually used, the materials usage variance would have been favorable.

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The journal entry to record the use of the materials is:

(b) Work in process inventory (+A)	330,000	
Materials usage variance (+A)	3,000	
Materials inventory (-A)		333,000

To record the use of materials and to establish the materials usage variance.

The Materials Usage Variance account shows the standard cost of the excess materials used. Note also that the Work in Process Inventory account contains both standard quantity and standard prices.

In the equations for both the materials variances, positive amounts were unfavorable variances and negative amounts were favorable variances. Unfavorable variances are debits in variance accounts because they add to the costs incurred, which are recorded as debits. Similarly, favorable variances are shown as negative amounts because they are reductions in costs. Thus, favorable variances are recorded in variance accounts as credits. We use this format in this text, but a word of caution is in order. Far greater understanding is achieved if you determine whether a variance is favorable or unfavorable by reliance on reason or logic. If more materials were used than the standard quantity, or if a price greater than the standard price was paid, the variance is unfavorable. If the reverse is true, the variance is favorable.

Exhibit 49 below shows the relationship between standard and actual materials cost and the computation of the materials variances; it is based on the following data relating to Beta Company:

Standard price per sheet of material	\$6.00
Actual price per sheet of material	\$5.90
Number of sheets of material purchased	60,000
Standard number of sheets of material per unit 5 of product	
Units of product produced in period	11,000
Actual number of sheets of material used	\$5,500

**Purchase of materials**

Actual cost of materials purchased:

Actual price X actual quantity purchased  
 5.90 X 60,000 sheets = \$354,000

Standard cost of materials purchased:

Standard price	X actual quantity purchased	<--Price variance:
\$6.00	X 60,000 sheets = \$360,000	\$354,000 - \$360,000
		= -\$6,000 (favorable)

Use of materials

Standard cost of Produce 11,000 units: materials used to

Actual number of sheets used	X standard price	
55,500	X \$6.00 = \$333,000	<--Usage variance:
Standard cost of materials allowed to	Produce 11,000 units:	\$333,000 - \$330,000
		=

Standard number of sheets allowed	X standard price	\$ 3,000 (unfavorable)
55,500*	X \$ 6.00 = \$330,000	

\*(11,000 x 5) = 55,000.

**Exhibit 49: Materials price and usage variances**

The standard labor cost of any product is equal to the standard quantity of labor time allowed multiplied by the wage rate that should be paid for this time. Here again, it follows that the actual labor cost may differ from standard labor cost because of the wages paid for labor, the quantity of labor used, or both. Thus, two labor variances exist—a rate variance and an efficiency variance.

**Labor rate variance** The **labor rate variance (LRV)** occurs when the average rate of pay is higher or lower than the standard cost to produce a product or complete a process. The labor rate variance is similar to the materials price variance.

To compute the labor rate variance (LRV), multiply the difference between the actual direct labor-hour rate paid (AR) and the standard direct labor-hour rate allowed (SR) by the actual hours of direct labor services worked (AH):

$$\text{Labor rate variance} = (\text{Actual rate} - \text{Standard rate}) \times \text{Actual hours worked}$$

To continue the Beta example, assume that the direct labor payroll of the company consisted of 22,200 hours at a total cost of USD 233,100 (an average actual hourly rate of USD 10.50). Because management has set a standard direct labor-hour rate of USD 10 per hour, the labor rate variance is:

$$\begin{aligned} \text{Labor rate variance} &= (\text{Actual rate} - \text{Standard rate}) \times \text{Actual hours worked} \\ &= (\text{USD } 10.50 - \text{USD } 10.00) \times 22,200 \\ &= \text{USD } 0.50 \times 22,200 \\ &= \text{USD } 11,100 \text{ (unfavorable)} \end{aligned}$$

## 24. Control through standard costs

The variance is positive and unfavorable because the actual rate paid exceeded the standard rate allowed. If the reverse were true, the variance would be favorable.

**Labor efficiency variance** Usually, the company's engineering department sets the standard amount of direct labor-hours needed to complete a product. Engineers may base the direct labor-hours standard on time and motion studies or on bargaining with the employees' union. The **labor efficiency variance (LEV)** occurs when employees use more or less than the standard amount of direct labor-hours to produce a product or complete a process. The labor efficiency variance is similar to the materials usage variance.

To compute the labor efficiency variance (LEV), multiply the difference between the actual direct labor-hours worked (AH) and the standard direct labor-hours allowed (SH) by the standard direct labor-hour rate per hour (SR):

$$\begin{aligned}\text{Labor efficiency variance} &= (\text{Actual rate} - \text{Standard rate}) \times \text{Actual hours worked} \\ &= (\text{USD } 10.50 - \text{USD } 10.00) \times 22,200 \\ &= \text{USD } 0.50 \times 22,200 \\ &= \text{USD } 11,100 \text{ (unfavorable)}\end{aligned}$$

The variance is positive and unfavorable because the actual rate paid exceeded the standard rate allowed. If the reverse were true, the variance would be favorable.

**Labor efficiency variance** Usually, the company's engineering department sets the standard amount of direct labor-hours needed to complete a product. Engineers may base the direct labor-hours standard on time and motion studies or on bargaining with the employees' union. The **labor efficiency variance (LEV)** occurs when employees use more or less than the standard amount of direct labor-hours to produce a product or complete a process. The labor efficiency variance is similar to the materials usage variance.

To compute the labor efficiency variance (LEV), multiply the difference between the actual direct labor-hours worked (AH) and the standard direct labor-hours allowed (SH) by the standard direct labor-hour rate per hour (SR):

$$\text{Labor efficiency variance} = (\text{Actual hours worked} - \text{Standard hours allowed}) \times \text{Standard rate}$$

To illustrate, assume that the 22,200 hours of direct labor-hours worked by Beta Company employees resulted in 11,000 units of production. Assume these units have a standard direct labor-hours of 20,000 hours (11,000 units at 2 hour unit). Since the standard direct labor rate is USD 10 per hour, the labor efficiency variance is USD 2,000, computed as follows:

$$\begin{aligned}\text{Labor efficiency variance} &= (\text{Actual hours worked} - \text{Standard hours allowed}) \times \text{Standard rate} \\ &= (22,200 - 20,000) \times \text{USD } 10 \\ &= 2,200 \times \text{USD } 10 \\ &= \text{USD } 2,000 \text{ (unfavorable)}\end{aligned}$$

The variance is unfavorable since more hours than the standard number of hours were required to complete the period's production. If the reverse were true, the variance would be favorable.

The standard direct labor-hours allowed for the period's output are 22,000 hours (11,000 units at 2 hours per unit). The standard direct labor cost is USD 10 per hour; therefore, the standard direct labor cost for the output achieved is assigned to inventory, regardless of the actual direct labor cost.

The journal entry to charge the direct labor cost to Work in Process Inventory is:

(c) Work in process inventory (+A)	220,000	
Labor rate variance (+A)	11,100	
Labor efficiency variance (+A)	2,000	
Payroll summary (+L)		233,100
To charge work in process with direct labor and to establish the two labor variances.		

With this entry, gross wages earned by direct-production employees (USD 233,100) are distributed as follows: USD 220,000 (the standard labor cost of production) to Work in Process Inventory and the balance to the two labor variance accounts. The unfavorable labor rate variance is not necessarily caused by paying employees more wages than they are entitled to receive. More probable reasons are either that more highly skilled employees with higher wage rates worked on production than originally anticipated, or that employee wage rates increased after the standard was developed and the standard was not revised. Favorable rate variances, on the other hand, could be caused by using less-skilled, cheaper labor in the production process. Typically, the hours of labor employed are more likely to be under management's control than the rates that are paid. For this reason, labor efficiency variances are generally watched more closely than labor rate variances.

In Exhibit 50, at the top of the next page, we show the relationship between standard and actual direct labor cost and the computation of the labor variances. The illustration is based on the following data relating to Beta Company:

Standard direct labor-hours per unit	2 hours
Equivalent units produced in period	11,000 units
Standard labor rate per direct labor-hour	\$ 10
Total direct labor wages paid (at actual rate of \$10.50 per hour)	\$233,100
Actual direct labor-hours worked	22,200 hours

Actual Labor Cost:		
Actual labor rate	X actual hours worked	
\$ 10.50	X 22,200 = \$233,100	
Standard cost of actual hours worked:		Labor rate variance:
		\$233,100 - \$222,000
		=
Standard labor rate	X actual hours worked	\$11,100
\$10.00	X 22,200 = \$222,000	(unfavorable)
Standard cost of hours allowed to produce 11,000 units:		Labor efficiency variance:
Standard labor rate	X standard hours allowed	\$222,000 - \$220,000
\$10.00	X 22,000* = \$220,000	=
		\$2,000 (unfavorable)

\* 2 hours x 11,000 units = 22,000.

Exhibit 50: Labor rate and efficiency variances

## 24. Control through standard costs

**Summary of labor variances** The accuracy of the two labor variances can be checked by comparing their sum with the difference between actual and standard labor cost for a period. In the Beta Company illustration, this difference was:

Actual labor cost incurred (22,200 hours x \$10.50)	\$233,100
Standard labor cost allowed (22,000 hours x \$10)	220,000
Total labor variance (unfavorable)	\$ 13,100

This USD 13,100 is made up of two labor variances, both unfavorable:

Labor rate variance (22,200 x \$0.50)	\$11,100
Labor efficiency variance (200 x \$10)	2,000
Total labor variance (unfavorable)	\$ 13,100

Labor costs are typically a major cost in service organizations. Banks, public accounting firms, law firms, hospitals, and parking enforcement agencies are just a few organizations that monitor labor costs closely. University officials developed the following standards for a university's parking enforcement people. (The university's officials explained that they do not have ticket quotas, but they expect their parking ticket writers "to be enforcing parking laws, not hanging out at the coffee house".)

Standard direct labor time per ticket	12 minutes
Number of tickets written in March	2,000 tickets
Standard labor rate per hour	\$14
Total labor costs for ticket writing (at an average rate of \$13.50 per hour)	\$5,670
Actual ticket writing hours worked	420 hours

The university has calculated labor rate and efficiency variances as follows:

$$\begin{aligned}\text{Labor rate variance} &= (\text{Actual rate} - \text{Standard rate}) \times \text{Actual hours} \\ &= (\text{USD } 13.50 - \text{USD } 14.00) \times 420 \text{ hours} \\ &= \text{USD } -0.50 \times 420 \text{ hours} \\ &= \text{USD } -210 \text{ (favorable)}\end{aligned}$$

$$\text{Labor rate variance} = (\text{Actual hours} - \text{Standard hours}) \times \text{Standard rate}$$

$$\begin{aligned}\text{Standard hours} &= \frac{12 \text{ minutes}}{60 \text{ minutes}} \times 2,000 \text{ tickets} \\ &= 0.2 \text{ hours} \times 2,000 \text{ tickets} \\ &= 400 \text{ hours}\end{aligned}$$

$$\begin{aligned}\text{Labor efficiency variance} &= (420 \text{ hours} - 400 \text{ hours}) \times \text{USD } 14 \\ &= 20 \text{ hours} \times \text{USD } 14 \\ &= \text{USD } 280 \text{ (unfavorable)}\end{aligned}$$

In a standard cost system, accountants apply the manufacturing overhead to the goods produced using a standard overhead rate. They set the rate prior to the start of the period by dividing the budgeted manufacturing overhead cost by a standard level of output or activity. Total budgeted manufacturing overhead varies at different

levels of standard output, but since some overhead costs are fixed, total budgeted manufacturing overhead does not vary in direct proportion with output.

Managers use a **flexible budget** to isolate overhead variances and to set the standard overhead rate. Flexible budgets show the budgeted amount of manufacturing overhead for various levels of output.

Look at Beta Company's flexible budget for the period in Exhibit 51 below. Note that Beta's flexible budget shows the variable and fixed manufacturing overhead costs expected to be incurred at three levels of activity: 9,000 units, 10,000 units, and 11,000 units. For product costing purposes, Beta must estimate the expected level of activity in advance and set a rate based on that level. The level chosen is called the standard volume of output. This standard volume of output (or activity) may be expressed in terms of any of the activity bases used in setting standard overhead rates. These activity bases include percentage of capacity, units of output machine-hours, and direct labor-hours, among others. In our example, standard volume is assumed to be 10,000 units produced. Management expects to use 20,000 machine-hours of services.

<b>Beta Company</b>			
<b>Flexible manufacturing overhead budget</b>			
Machine-hours	18,000	20,000	22,000
Units of output	9,000	10,000	11,000
Variable overhead:			
Indirect materials	\$ 7,200	\$ 8,000	\$ 8,800
Power	9,000	10,000	11,000
Royalties	1,800	2,000	2,200
Other	18,000	20,000	22,000
Total variable overhead	\$36,000	\$40,000	\$44,000
Fixed overhead:			
Insurance	\$4,000	\$ 4,000	\$ 4,000
Property taxes	6,000	6,000	6,000
Depreciation	20,000	20,000	20,000
Other	30,000	30,000	30,000
Total fixed overhead	\$60,000	\$60,000	\$ 60,000
Standard overhead rate (\$100,000/20,000 hours)		\$5	

Exhibit 51: Flexible manufacturing overhead budget

Assume that Beta applies manufacturing overhead using a rate based on machine-hours. According to the flexible manufacturing overhead budget, the expected manufacturing overhead cost at the standard volume (20,000 machine-hours) is USD 100,000, so the standard overhead rate is USD 5 per machine-hour (USD 100,000/20,000 machine-hours).

Knowing the separate rates for variable and fixed overhead is useful for decision making, as discussed in Chapters 21 and 22. The variable overhead rate is USD 2 per hour (USD 40,000/20,000 hours), and the fixed overhead rate is USD 3 per hour (USD 60,000/20,000 hours). If the expected volume had been 18,000 machine-hours, the standard overhead rate would have been USD 5.33 (USD 96,000/18,000 hours). If the standard volume had been 22,000 machine-hours, the standard overhead rate would have been USD 4.73 (USD 104,000/22,000 hours).

Note that the difference in rates is due solely to dividing fixed overhead by a different number of machine-hours. That is, the variable overhead cost per unit stays constant (USD 2 per machine-hour) regardless of the number of units expected to be produced, and only the fixed overhead cost per unit changes.

## 24. Control through standard costs

Continuing with the Beta Company illustration, assume that the company incurred USD 108,000 of actual manufacturing overhead costs in a period during which 11,000 units of product were produced. The actual costs would be debited to Manufacturing Overhead and credited to a variety of accounts such as Accounts Payable, Accumulated Depreciation, Prepaid Insurance, Property Taxes Payable, and so on. According to the flexible budget, the standard number of machine-hours allowed for 11,000 units of production is 22,000 hours. Therefore, USD 110,000 of manufacturing overhead is applied to production (USD 5 per machine-hour times 22,000 hours) by debiting Work in Process Inventory and crediting Manufacturing Overhead for USD 110,000. The journal entry to apply manufacturing overhead to production would be:

Work in process inventory (+A)	110,000
Manufacturing overhead (+SE)	110,000

To apply manufacturing overhead to production  
(22,000 hours at \$5 per hour).

These accounts show that manufacturing overhead has been overapplied to production by the USD 2,000 credit balance in the Manufacturing Overhead account. Because of its fixed component, manufacturing overhead tends to be over applied when actual production is greater than standard production.

Although various complex computations can be made for overhead variances, we use a simple approach in this text. In this approach, known as the two-variance approach to overhead variances, we calculate only two variances—an overhead budget variance and an overhead volume variance.

**Overhead budget variance** The **overhead budget variance (OBV)** shows in one amount how economically overhead services were purchased and how efficiently they were used. This overhead variance is similar to a combined price and usage variance for materials or labor. The overhead budget variance (OBV) is equal to the difference between total actual overhead costs (actual OH) and total budgeted overhead costs (BOH) for the actual output attained.

To calculate the total budgeted overhead costs, multiply the variable overhead rate times the standard machine-hours allowed for production achieved, plus the constant amount of fixed overhead. For Beta Company, this would be USD 2 variable overhead times 22,000 hours, or USD 44,000 variable overhead, plus USD 60,000 of fixed overhead—a total of USD 104,000. Since the total actual overhead was USD 108,000 and the total budgeted overhead was USD 104,000, the overhead budget variance is computed as follows:

$$\begin{aligned}\text{Overhead budget variance} &= \text{Actual overhead} - \text{Budgeted overhead at actual production volume level} \\ &= \text{USD } 108,000 - \text{USD } 104,000 \\ &= \text{USD } 4,000 \text{ (unfavorable)}\end{aligned}$$

The variance is unfavorable because actual overhead costs were USD 108,000, while according to the flexible budget, they should have been USD 104,000.

**Overhead volume variance** The **overhead volume variance (OVV)** is caused by producing at a level other than that used in setting the standard overhead application rate. The OVV shows whether plant assets produced more or fewer units than expected. Because fixed overhead is not constant on a per unit basis, any deviation from planned production causes the overhead application rate to be incorrect. The OVV is the difference

between the budgeted amount of overhead for the actual volume achieved (BOH) and the applied overhead (Applied OH):

$$\text{Overhead volume variance} = \text{Budgeted overhead} - \text{Applied overhead}$$

In the Beta Company illustration, the 11,000 units produced in the period have a standard allowance of 22,000 machine-hours. We calculated budgeted overhead when computing the overhead budget variance. The flexible budget in Exhibit 51, at the top of the previous page, shows that the budgeted overhead for 22,000 machine-hours is USD 104,000. Overhead is applied to work in process on the basis of standard hours allowed for a particular amount of production; in this case, 22,000 hours at USD 5 per hour. The overhead volume variance then is:

$$\begin{aligned} \text{Overhead volume variance} &= \text{Budgeted overhead} - \text{Applied overhead} \\ &= \text{USD } 104,000 - \text{USD } 110,000 \\ &= \text{USD } -6,000 \text{ (favorable)} \end{aligned}$$

Note that the amount of the overhead volume variance is related solely to fixed overhead. As we show in Exhibit 51, fixed overhead at all levels of activity is USD 60,000. Since Beta Company used 20,000 machine-hours as its standard, the fixed overhead rate is USD 3 per machine-hour. Beta worked 2,000 more standard hours (22,000 - 20,000) than was expected. Beta also can calculate the overhead volume variance as follows:

(Number of hours used in setting predetermined overhead rates	- Number of standard hours allowed for production level achieved)	X Fixed overhead rate per hour	= Overhead volume variance
(20,000	- 22,000)	X USD 3	=USD -6,000 (favorable)

The variance is favorable because the company achieved a higher level of production than was expected.

**Recording overhead variances** These journal entries are related to overhead:

(d)	Work in Process (+A)	110,000	
	Manufacturing Overhead (+SE)		110,000
	To record the application of manufacturing overhead to work in process.		
(e)	Manufacturing overhead (-SE)	108,000	
	Various accounts (Varies)		108,000
	To record actual manufacturing overhead.		
(f)	Manufacturing overhead (-SE)	2,000	
	Overhead budget variance (-SE)	4,000	
	Overhead volume variance (+SE)		6,000
	To record the variances related to overhead and close the manufacturing overhead account.		

The first entry applies manufacturing overhead to Work in Process at the rate of USD 5 per standard machine-hour. The second entry records the actual manufacturing overhead costs incurred during the period by Beta Company. The final entry reduces the Manufacturing Overhead account balance to zero and sets up the two variances calculated for overhead; these two variance accounts reveal the causes of the overapplied manufacturing overhead for the period.

**Summary of overhead variances** To easily determine the accuracy of the two overhead variances, Beta would compare the sum of the budget and volume variances with the difference between the costs of actual manufacturing overhead and applied manufacturing overhead (the amount of over- or underapplied overhead). For Beta Company, the difference between actual and applied manufacturing overhead was:

## 24. Control through standard costs

Actual manufacturing overhead incurred	\$ 108,000
Applied manufacturing overhead allowed (22,000 machine-hours x \$5 per hour)	<u>110,000</u>
Total overhead variance (favorable)	\$ -2,000

This difference is made up of the two overhead variances:

Overhead budget variance – unfavorable (\$108,000 - \$104,000)	\$ 4,000
Overhead volume variance -favorable [\$104,000 – (22,000 x \$5)]	-6,000
Total overhead variance (favorable)	\$ -2,000

For a summary of the six variances from standard discussed in this chapter, see Exhibit 52 below.

Materials price variance =	(Actual price – Standard price) x Actual quantity purchased
Materials usage variance =	(Actual quantity used – Standard quantity allowed) x Standard price
Labor rate variance =	(Actual rate – standard rate) x Actual hours worked
Labor efficiency variance =	(Actual hours worked – standard hours allowed) x Standard rate
Overhead budget variance =	Actual overhead – budgeted overhead
Overhead volume variance =	Budgeted overhead – applied overhead

Exhibit 52: Summary of variances from standard

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### An accounting perspective:

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#### Uses of technology

Although standard costing often appears more difficult than actual costing to students, standard costing is generally easier in the real world. The key to this simplicity is the computer's capability to store, retrieve, and update standards. Once a firm sets standards for a product, it is relatively simple to update these standards for changes in labor rates, product prices, and efficiency improvements.

### Goods completed and sold

To complete the standard cost system example, assume Beta Company completed and transferred 11,000 units to finished goods and sold on account 10,000 units at a price equal to 160 per cent of standard cost. Also, there were no beginning or ending work in process inventories, and no beginning finished goods inventory. Journal entry (g) transfers the standard cost of the units completed, 11,000 x USD 60 = USD 660,000, from Work in Process Inventory to Finished Goods Inventory. Entry (h) records the sales for the period, 160 per cent x USD 60 x 10,000 = USD 960,000. Entry (i) records the cost of goods sold, 10,000 x USD 60 = USD 600,000.

(g)	Finished goods inventory (+A)	660,000	
	Work in process inventory (-A)		660,000
	To record the transfer of completed units to finished goods inventory.		
(h)	Accounts receivable (+A)	960,000	
	Sales (+SE)		960,000
	To record sales for the period.		
(i)	Cost of goods sold (-SE)	600,000	
	Finished goods inventory (-A)		600,000
	To record cost of goods sold for		

the period.

Beta debits the Work in Process Inventory with the standard cost of materials, labor, and manufacturing overhead for units put into production. Therefore, the entry recording the transfer of the standard cost of the completed units,  $11,000 \times \text{USD } 60 = \text{USD } 660,000$ , reduces Work in Process Inventory to a zero balance.

Sales for the period amount to 10,000 units at USD 96 each (160 per cent of USD 60). It is fairly common practice to base selling prices at least partially on standard costs. Note that Beta debited Finished Goods Inventory with the standard cost of goods completed and credited it with the standard cost of goods sold. Thus, the ending Finished Goods Inventory consists of the units actually on hand (1,000) at their standard cost of USD 60 each, or USD 60,000.

### **Investigating variances from standard**

Once all variances have been computed, management must decide which variances should be investigated further. Because numerous variances occur, managers cannot investigate all of them. Management needs some selection guidelines. Possible guidelines include the (1) amount of the variance; (2) size of the variance relative to the cost incurred; and (3) controllability of the cost associated with the variance—that is, whether it is considered controllable or noncontrollable. Managers also may use statistical analysis in deciding which variances to investigate. For instance, they could determine the average value of actual costs for a period so that only those variances deviating from the average by more than a certain percentage would be investigated. To decide which selection guidelines are most useful, management should seek the opinions of knowledgeable operating personnel.

Any analysis of variances is likely to disclose some variances that are controllable within the company and others that are not. For instance, quantities used are generally controllable internally. Prices paid for materials purchased may or may not be controllable. Management may discover that the purchasing agent is not getting competitive bids; therefore, the price paid for materials would have been more controllable had the agents sought competitive bids. On the other hand, a raw materials shortage may exist that drives the price upward, and the price paid may be beyond the buyer's control.

Another point to remember about the analysis of variances is that separate variances are not necessarily independent. For example, an unfavorable labor rate variance may result from using higher paid employees in a certain task. However, higher paid employees may be more productive, resulting in a favorable labor efficiency variance. These employees also may be more highly skilled and may waste fewer materials, resulting in a favorable materials usage variance. Therefore, significant variances, both favorable and unfavorable, should be investigated.

At the end of a month or quarter, management may develop performance reports that compare the actual results and costs with the budgeted results and costs. These reports enable management to determine how well they and their workers were able to perform within the budget. At the bottom of the performance report, the supervisor or manager responsible for the elements mentioned in the report gives reasons for any variances. Management then investigates any variance not supported by an acceptable reason.

### **Disposing of variances from standard**

At the end of the year, variances from standard must be disposed of in the accounting records. The variances may be (1) viewed as losses due to inefficiency and closed to the Income Summary; (2) allocated as adjustments to the recorded cost of Work in Process Inventory, Finished Goods Inventory, and Cost of Goods Sold; or (3) closed to

## 24. Control through standard costs

Cost of Goods Sold. Theoretically, the alternative chosen should depend on whether the standards set were reasonably attainable and whether the variances were controllable by company employees. For instance, a firm may consider an unfavorable materials usage or labor efficiency variance caused by carelessness or inefficiency a loss and close it to the Income Summary because the standard was attainable and the variance was controllable. The business may consider an unfavorable materials price variance caused by an unexpected price change an added cost and allocate it to the inventory accounts and Cost of Goods Sold because the standard was unattainable and the variance was uncontrollable. As a practical matter, companies usually close small variances to the Cost of Goods Sold account rather than allocate them to the inventory accounts and to cost of goods sold.

Entry (j) reflects this practical disposition of Beta Company's variances by closing them to Cost of Goods Sold:

(j) Materials price variance (+A)	6,000	
Overhead volume variance (+A)	6,000	
Cost of goods sold (-SE)	8,100	
Materials usage variance (-A)		3,000
Labor rate variance (-A)		11,100
Labor efficiency variance (-A)		2,000
Overhead budget variance (-A)		4,000
To close the variance accounts.		

Companies do not report variances separately in financial statements released to the public but simply include them in the reported cost of goods sold amount. Reports prepared for internal use may list the variances separately after the cost of goods sold is shown at standard cost.

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### A broader perspective: Quality management and the Baldrige award

Many of the methods successfully used in the Japanese quality movement originated in the United States. The use of statistical controls in assessing processes originated in the United States, but Japanese managers applied the concept and had much greater employee involvement in quality improvement than US companies. Although lagging in implementing quality management programs, many US companies have jumped on the quality management bandwagon.

The US Congress created the Malcolm Baldrige National Quality Award in honor of a former secretary of commerce. The award is given to businesses that excel in major aspects of quality, such as quality planning, human resource development, and customer focus. Companies that have won this award include well-known manufacturing companies such as Motorola, Westinghouse (Commercial Nuclear Fuel Division), IBM, Texas Instruments (Defense Systems and Electronics Group), and General Motors (Cadillac Division). The award has also been given to large service organizations—Ritz-Carlton Hotels, Federal Express, and AT&T (Network Systems Group)—and to small businesses such as Granite Rock Co. in Watsonville, California, USA, and Globe Metallurgical in Cleveland, Ohio, USA. The Baldrige Award promotes sharing of information about effective quality management programs and identifies companies with role-model quality management systems.

Source: Authors' research.

## Nonfinancial performance measures

Although variances provide important measures of performance, nonfinancial performance measures are also important. Nonfinancial performance measures are particularly important for evaluating quality and customer service. Chapter 20 discussed various nonfinancial measures of performance.

Businesses measure quality by the number and type of customer complaints or by the number of product defects. If they reduce the number of product defects, firms are likely to reduce the number of customer complaints. The objective is to increase customer satisfaction with their products, increase repeat sales, reduce the costs of dealing with customer complaints, and reduce the costs of repairing products.

Managers can reduce materials waste by improving the quality of raw materials so there is less waste from defective materials. Managers also can increase employee training so workers make fewer mistakes and improve the production process. Materials waste may show up in the materials efficiency variance. Workers are generally motivated to find ways to reduce waste if companies keep track of materials waste every day. While reporting variances from standard costs is important to department heads and plant managers, workers are more likely to be motivated by immediate feedback in nonfinancial language.

## Activity-based costing, standards, and variances

Activity-based costing is commonly used with standard costing. Hewlett-Packard, a pioneer in the development of activity-based costing, uses it to develop standard costs. In our example, we applied overhead using just one cost driver—machine-hours. Using activity-based costing, a company uses multiple activity-bases, or cost drivers, as discussed in Chapter 20.

By striving to meet standards, management assumes responsibility for reducing the production costs of its products. In Chapter 25, you will learn about responsibility accounting in a broader sense. Many successful companies rely on responsibility accounting to make their business operations profitable.

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### An accounting perspective:

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#### Business insight

Managers of many companies criticize standard costing because they believe it keeps workers from continuous improvement. These managers argue that workers who achieve standards do not try to improve beyond those standards. We believe workers can beat the standards and strive for continuous improvement if they are properly motivated.

#### Understanding the learning objectives

- A standard cost is a carefully predetermined measure of what a cost should be under stated conditions.
- Engineering studies and time and motion studies are undertaken to determine the amounts of materials, labor, and other services required to produce a product.
- Budgets are formal written plans that represent management's planned actions in the future and the impacts of these actions on the business.

## 24. Control through standard costs

- Comparison of actual amounts to the budgeted amounts allows management to evaluate their own performance and that of their workers.

- Advantages of using standard costs include improved cost control, more useful information for managerial planning and decision making, more reasonable inventory measurements, cost savings in record-keeping, and possible reductions in production costs incurred.

- Disadvantages of using standard costs include controversial materiality limits for variances, nonreporting of certain variances, and low morale for some workers.

- **Materials price variance:**

$(\text{Actual price} - \text{Standard price}) \times \text{Actual quantity purchased}$  .

- **Materials usage variance:**

$(\text{Actual quantity used} - \text{Standard quantity allowed}) \times \text{Standard price}$  .

- **Labor rate variance:**

$(\text{Actual rate} - \text{Standard rate}) \times \text{Actual hours worked}$  .

- **Labor efficiency variance:**

$(\text{Actual hours worked} - \text{Standard hours allowed}) \times \text{Standard rate}$  .

- **Overhead budget variance:**

Actual overhead - Budgeted overhead.

- **Overhead volume variance:**

Budgeted overhead - Applied overhead.

- The **materials price variance**, shows whether the price paid for materials purchased was higher or lower than the standard price. This journal entry records the purchase of materials:

Materials inventory (debit)  
Materials price variance (debit or credit)  
Accounts payable (credit)

The Materials Price Variance account is debited if the variance is unfavorable and credited if the variance is favorable.

- The **materials usage variance** shows whether the actual quantity of materials used was higher or lower than the standard quantity. The journal entry to record materials usage is:

Work in process inventory (debit)  
Materials usage variance (debit or credit)  
Materials inventory (credit)

The Materials Usage Variance account is debited if unfavorable and credited if favorable.

- The **labor rate variance** shows whether the actual direct labor-hour rate paid is higher or lower than the standard rate.

- The **labor efficiency variance** shows whether the actual direct labor-hours worked were greater or less than the standard hours. This journal entry charges the direct labor cost to Work in Process Inventory:

Work in process inventory (debit)  
Labor rate variance (debit or credit)  
Labor efficiency variance (debit or credit)  
Payroll Summary (credit)

The Labor Rate Variance account is debited if the variance is unfavorable and credited if the variance is favorable. The Labor Efficiency Variance account is debited if the variance is unfavorable and credited if the variance is favorable.

- The **overhead budget variance** shows the difference between total actual overhead costs and total budgeted overhead costs.
- The **overhead volume variance** shows the difference between the budgeted amount of overhead for the actual volume achieved and the applied overhead. This journal entry records the overhead variance:

Manufacturing overhead (debit or credit)  
Overhead budget variance (debit or credit)  
Overhead volume variance (debit or credit)

The debit or credit to Manufacturing Overhead closes that account. The Overhead Budget Variance account is debited if the variance is unfavorable and credited if the variance is favorable. The Overhead Volume Variance account is credited if the variance is favorable and debited if the variance is unfavorable.

- Three possible selection guidelines are (1) amount of variance, (2) size of the variance relative to cost incurred, and (3) controllability of the cost associated with the variance.
- Significant variances, both favorable and unfavorable, should be investigated.
- Variances may be viewed as losses due to inefficiency and closed to the Income Summary account; allocated as adjustments to the recorded cost of Work in Process Inventory, Finished Goods Inventory, and Cost of Goods Sold; or closed to Cost of Goods Sold.
- Practically, variances are usually closed to Cost of Goods Sold.

### Demonstration problem

Gleim Company manufactures children's toys that are identical. The standard cost of each toy is:

#### Direct materials:

Three blocks of wood at \$0.24 \$0.72  
Direct labor (1 hour at \$6) 6.00

#### Overhead:

Fixed (\$21,600/60,000 units) 0.36  
Variable 0.48  
\$7.56

Gleim bases the standard overhead rate on a volume of 60,000 units per month. In May, it manufactured 50,000 units. Using the following detailed data relative to production, compute the six variances from standard for the month.

#### Materials purchased:

160,000 blocks of wood at \$ 0.26

#### Materials used:

152,000 blocks of wood  
Direct labor: 49,000 hours at \$ 6.12  
Fixed manufacturing overhead \$ 21,840  
Variable manufacturing overhead \$ 24,420

### Solution to demonstration problem

#### Materials price variance:

$(\$0.026 - \$0.24) \times 160,000$  \$ 3,200

## 24. Control through standard costs

	(unfavorable)
<u>Materials usage variance:</u>	
(152,000 – 150,000*) x \$0.24	480 (unfavorable)
Total materials variance	\$ 3,680 (unfavorable)
<u>Labor rate variance:</u>	
(\$6.12 - \$6.00) x 49,000	\$ 5,880 (unfavorable)
<u>Labor efficiency variance:</u>	
(49,000 – 50,000) x \$6.00	-6,000 (favorable)
Net labor variance	\$ -120 (favorable)
<u>Overhead budget variance:</u>	
Actual (\$21,840 + \$24,420)	\$46,260
Budgeted [\$21,600 x (50,000 x \$0.48)]	45,600
Overhead budget variance	\$660 (unfavorable)
<u>Overhead volume variance:</u>	
Budget – Applied [\$45,600 – (50,000 x \$ 3,600 \$0.84)]	(unfavorable)
Total overhead variance	\$ 4,260 (unfavorable)
Total variance for month	\$ 7,820 (unfavorable)

\*50,000 units x 3 blocks per unit.

### Key terms

**Budgets** Formal written plans that represent management's planned actions in the future and the impacts of these actions on the business.

**Flexible budget** A budget that shows the budgeted amount of manufacturing overhead for various levels of output; used in isolating overhead variances and setting standard overhead rates.

**Ideal standards** Standards that can be attained under the best circumstances—that is, with no machinery problems or worker problems. These unrealistic standards can only be met when the company has highly efficient, skilled workers who are working at their best effort throughout the entire period needed to complete the job.

**Labor efficiency variance (LEV)** A variance from standard caused by using more or less than the standard amount of direct labor-hours to produce a product or complete a process; computed as (Actual hours worked - Standard hours allowed) x Standard rate per hour.

**Labor rate variance (LRV)** A variance from standard caused by paying a higher or lower average rate of pay than the standard cost to produce a product or complete a process; computed as (Actual rate - Standard rate) x Actual hours worked.

**Management by exception** The process where management only investigates those variances that are unusually favorable or unfavorable or that have a material effect on the company.

**Materials price variance (MPV)** A variance from standard caused by paying a higher or lower price than the standard for materials purchased; computed as (Actual price - Standard price) x Actual quantity purchased.

**Materials usage variance (MUV)** A variance from standard caused by using more or less than the standard amount of materials to produce a product or complete a process; computed as (Actual quantity used - Standard quantity allowed) x Standard price.

**Overhead budget variance (OBV)** A variance from standard caused by incurring more or less than the standard manufacturing overhead for the actual production volume achieved, as shown by a flexible budget; computed as Actual overhead - Budgeted overhead at the actual production volume level.

**Overhead volume variance (OVV)** A variance from standard caused by producing at a level other than that used in setting the standard overhead application rates; computed as Budgeted overhead - Applied overhead.

**Practical standards** Standards that are strict but attainable. Allowances are made for machinery problems and rest periods for workers. These standards are generally used in planning.

**Standard cost** A carefully predetermined measure of what a cost should be under stated conditions.

**Standard level of output** A carefully predetermined measure of what the expected level of output should be for a specified period of time, usually one year.

**Variance** A deviation of actual costs from standard costs; may be favorable or unfavorable. That is, actual costs may be less than or more than standard costs. Variances may relate to materials, labor, or manufacturing overhead.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

Standard cost usually refers to the standard price per unit of inputs into the production process.

Standard costs are useful in evaluating management's and workers' performance.

Under a standard cost system, all units of a given product produced during a particular period are typically in inventory at the same unit cost.

This journal entry records the use of materials and establishes a Materials Usage Variance account: debit Accounts Payable and Materials Usage Variance; credit Materials Inventory.

Favorable variances are credits in variance accounts.

#### Multiple-choice

Select the best answer for each of the following questions.

Which of the following explain why accountants separate materials variances into a purchase price variance and a usage variance?

- Different individuals may be responsible for each variance.
- Materials might not be purchased and used in the same period.
- These two variances are likely to be more informative to top management than one overall materials variance.
- All of the above.

Determine the materials usage variance and materials price variance from the following data:

Materials purchased	30,000 units
Price per unit purchased	\$3.00
Standard price per unit	\$3.10
Materials used	25,000 units
Standard quantity allowed	22,000 units

a. USD 9,300 favorable (MUV)

USD 3,000 unfavorable (MPV).

b. USD 9,300 unfavorable (MUV)

USD 3,000 favorable (MPV).

c. USD 9,000 unfavorable (MUV)

USD 2,200 favorable (MPV).

d. USD 9,000 favorable (MUV)

USD 2,500 unfavorable (MPV).

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To which account would an unfavorable materials usage or labor efficiency variance caused by carelessness or inefficiency be closed?

- a. Materials Inventory.
- b. Income Summary.
- c. Work in Process.
- d. Finished Goods Inventory.

Which of the following journal entries is correct for closing out the variance accounts?

- a. Sales

Materials Usage Variance

Labor Rate Variance

Materials Price Variance

Overhead Volume Variance

Labor Efficiency Variance

Overhead Budget Variance

- b. Materials Price Variance

Overhead Volume Variance

Accounts Payable

Materials Usage Variance

Labor Rate Variance

Labor Efficiency Variance

Overhead Budget Variance

- c. Materials Price Variance

Overhead Volume Variance

Cost of Goods Sold

Materials Usage Variance

Labor Rate Variance

Labor Efficiency Variance

Overhead Budget Variance

- d. Materials Price Variance

Overhead Budget Variance

Accounts Receivable

Materials Usage Variance

Overhead Volume Variance

Labor Efficiency Variance

Labor Rate Variance

Now turn to “Answers to self-test” at the end of the chapter to check your answers.

## Questions

- Is a standard cost an estimated cost? What is the primary objective of employing standard costs in a cost system?
- What is a budget?
- What is the difference between ideal and practical standards? Which standard generally is used in planning?
- What is meant by the term management by exception?
- What are some advantages of using standard costs? What are some disadvantages?
- Describe how the materials price and usage variances would be computed from the following data:
- Standard—1 unit of material at USD 20 per unit. Purchased—1,200 units of material at USD 20.30; used—990 units. Production—1,000 units of finished goods.
- When might a given company have a substantial favorable materials price variance and a substantial unfavorable materials usage variance?
- What is the usual cause of a favorable or unfavorable labor rate variance? What other labor variance is isolated in a standard cost system? Of the two variances, which is more likely to be under the control of management? Explain.
- Identify the type of variance indicated by each of the following situations and indicate whether it is favorable or unfavorable:
  - The cutting department of a company during the week ending July 15 cut 12 size-S cogged wheels out of three sheets of 12-inch high-tempered steel. Usually three wheels of such size are cut out of each sheet.
  - A company purchased and installed an expensive new cutting machine to handle expanding orders. This purchase and the related depreciation had not been anticipated when the overhead was budgeted.
  - Edwards, the band saw operator, was on vacation last week. Lands took her place for the normal 40-hour week. Edwards' wage rate is USD 12 per hour, while Lands' is USD 10 per hour. Production was at capacity last week and the week before.

## 24. Control through standard costs

- Theoretically, how would an accountant dispose of variances from standard? How does an accountant typically dispose of variances?
- Why are variances typically isolated as soon as possible?
- Is it correct to consider favorable variances as always being desirable? Explain.
- How does the use of standard costs permit the application of the principle of management by exception?
- How do standards help in controlling production costs?
- **Real world question** Refer to the discussion of employees setting standards in "An accounting perspective: Business insight". What are the advantages and disadvantages of having employees set their own standards?
- **Real world question** Imagine you are making and selling pizzas for Domino's Pizza. How would you set standards for one pizza to be made and delivered?

### Exercises

**Exercise A** During July, the cutting department completed 8,000 units of a product that had a standard materials cost of 2 square feet per unit at USD 2.40 per square foot. The actual materials purchased consisted of 16,400 square feet at USD 2.20 per square foot, for a total cost of USD 36,080. The actual material used this period was 16,160 square feet. Compute the materials price and usage variances. Indicate whether each is favorable or unfavorable.

Direct materials – 4 pounds at \$5 per pound	\$20
Direct labor – 3 hours at \$6 per hour	18
Manufacturing overhead – 150% of direct labor	<u>27</u>
	\$65

**Exercise B** Whitewater's purchasing agent took advantage of a special offer from one of its suppliers to purchase 44,000 pounds of material at USD 4.10 per pound. Assume 5,500 units were produced and 34,100 pounds of material were used. Compute the variances for materials. Comment on the purchasing agent's decision to take the special offer.

**Exercise C** Compute the labor variances in the following situation:

Actual direct labor payroll (51,600 hours at \$18)	\$928,800
Standard direct labor allowed per unit, 4.20 hours at \$19.20	80.64
Production for month (in units)	10,000

**Exercise D** Blackman Company manufactures a product that has a standard direct labor cost of four hours per unit at USD 24 per hour. In producing 6,000 units, the foreman used a different crew than usual, which resulted in a total labor cost of USD 26 per hour for 22,000 hours. Compute the labor variances and comment on the foreman's decision to use a different crew.

**Exercise E** The following data relates to the manufacturing activities of Strauss Company for the first quarter of the current year:

Standard activity (in units)	30,000
Actual production (units)	24,000

Budgeted fixed manufacturing overhead	\$36,000
Variable overhead rate (per unit)	\$ 4.00
Actual fixed manufacturing overhead	\$37,200
Actual variable manufacturing overhead	\$88,800

Compute the overhead budget variance and the overhead volume variance. (Assume overhead is applied based on units produced.)

**Exercise F** Assume that the actual production in the previous exercise was 26,000 units rather than 24,000. What was the overhead volume variance?

**Exercise G** The standard cost variance accounts of Sun City Company at the end of its fiscal year had the following balances:

Materials price variance (unfavorable)	\$18,000
Materials usage variance (unfavorable)	14,400
Labor rate variance (favorable)	10,800
Labor efficiency variance (unfavorable)	39,600
Overhead budget variance (favorable)	2,000
Overhead volume variance (unfavorable)	21,600

Prepare one journal entry to record the closing of the variance accounts to Cost of Goods Sold.

### Problems

**Problem A** A product has a standard materials usage and cost of 4 pounds per unit at USD 7.00 per pound. During the month, 2,400 pounds of materials were purchased at USD 7.30 per pound. Production for the month totaled 550 units requiring 2,100 pounds of materials.

Compute the materials variances.

**Problem B** During December, a department completed 2,500 units of a product that has a standard materials usage and cost of 1.2 square feet per unit at USD 0.48 per square foot. The actual material used consisted of 3,050 square feet at an actual cost of USD 2,664.48. The actual purchase of this material amounted to 4,500 square feet at a total cost of USD 3,931.20.

Prepare journal entries (a) for the purchase of the materials and (b) for the issuance of materials to production.

**Problem C** Martin Company makes plastic garbage bags. One box of bags requires one hour of direct labor at an hourly rate of USD 6. The company produced 200,000 boxes of bags using 208,000 hours of direct labor at a total cost of USD 1,144,000.

Compute the labor variances.

**Problem D** The finishing department of Mozart Company produced 25,000 units during November. The standard number of direct labor-hours per unit is two hours. The standard rate per hour is USD 37.80. During the month, 51,250 direct labor-hours were worked at a cost of USD 1,742,500.

- Compute labor variances. Record the labor data in a journal entry.
- Record the journal entry to dispose of any variances (close to Cost of Goods Sold).

**Problem E** The standard amount of output for the Chicago plant of Worldworth Company is 50,000 units per month. Overhead is applied based on units produced. The flexible budget of the month for manufacturing overhead

## 24. Control through standard costs

allows USD 180,000 for fixed overhead and USD 4.80 per unit of output for variable overhead. Actual overhead for the month consisted of USD 181,440 of fixed overhead; the actual variable overhead follows.

Compute the overhead budget variance and the overhead volume variance assuming the following actual production in units and actual variable overhead in dollars:

a. 37,500 and USD 182,400.

b. 55,000 and USD 270,480.

**Problem F** Based on a standard volume of output of 96,000 units per month, the standard cost of the product manufactured by Tahoe Company consists of:

Direct materials (0.25 pounds x \$8 per pound)	\$2.00
Direct labor (0.5 hours x \$7.60 per hour)	3.80
Variable manufacturing overhead	2.50
Fixed manufacturing overhead (\$144,000 in total)	1.50
Total	\$9.80

A total of 25,200 pounds of materials was purchased at USD 8.40 per pound. During May, 98,400 units were produced with the following costs:

Direct materials used (24,000 pounds at \$8.40)	\$201,600
Direct labor (50,000 hours at \$7.80)	390,000
Variable manufacturing overhead	249,000
Fixed manufacturing overhead	145,000

Compute the materials price and usage variances, the labor rate and efficiency variances, and the overhead budget and volume variances. (Overhead is applied based on units produced.)

### Alternate problems

**Alternate problem A** The following data apply to Roseanne Company for August, when 2,500 units were produced:

Materials used: 16,000 pounds  
standard materials per unit: 6 pounds at 5 per pound  
Materials purchased: 24,000 pounds at \$4.80 per pound  
Direct labor: 5,800 hours at a total cost of \$69,600

Standard labor per unit: 2 hours at \$11 per hour.

a. Compute the materials and labor variances.

b. Prepare journal entries to record the transactions involving these variances.

**Alternate problem B** During April, Shakespeare Company produced 15,000 units of a product called Creative. Creative has a standard materials cost of two pieces per unit at USD 8 per piece. The actual materials used consisted of 30,000 pieces at a cost of USD 230,000. Actual purchases of the materials amounted to 40,000 pieces at a cost of USD 300,000.

Compute the two materials variances.

**Alternate problem C** Some of the records of Gonzaga Company's repair and maintenance division were accidentally shredded. Salvaged records indicate that actual direct labor-hours for the period were 2,000 hours. The total labor variance was USD 6,000, favorable. The standard labor rate was USD 7 per direct labor-hour, and the labor rate variance was USD 2,000, unfavorable.

Compute the actual direct labor rate per hour and prepare the journal entry to record the labor rate and the labor efficiency variances.

**Alternate problem D** All Fixed Overhead Company computes its overhead rate based on a standard level of output of 20,000 units. Fixed manufacturing overhead for the current year is budgeted at USD 30,000. Actual fixed manufacturing overhead for the current year was USD 31,000. Overhead is applied based on units produced.

Compute the amount of overhead volume variance for the year under each of the following assumptions regarding actual output:

- a. 12,500 units.
- b. 22,500 units.

**Beyond the numbers—Critical thinking**

**Business decision case A** Turn to the Sun City Company exercise in this chapter. For each of the variances listed, give a possible reason for its existence.

**Business decision case B** Diane La Hoya, the president of the Rebokk Company, has a problem that does not involve substantial dollar amounts but does involve the important question of responsibility for variances from standard costs. She has just received the following report:

Standard materials at standard price for the actual production in May	\$9,000
Unfavorable materials price variance (\$3.60 - \$3.00) x 3,450 pounds	2,070
Unfavorable materials usage variance (3,450 - 3,000 pounds) x \$3	1,350
Total actual materials cost for the month of May (3,450 pounds at \$3.60 per pound)	<u>\$12,420</u>

La Hoya has discussed the unfavorable price variance with Jim Montel, the purchasing officer. Montel agrees that under the circumstances he should be held responsible for most of the materials price variance. But he objects to the inclusion of USD 270 (450 pounds of excess materials used at USD 0.60 per pound). This, he argues, is the responsibility of the production department. If the production department had not been so inefficient in the use of materials, he would not have had to purchase the extra 450 pounds.

On the other hand, Ken Kechum, the production manager, agrees that he is basically responsible for the excess quantity of materials used. But, he does not agree that the materials usage variance should be revised to include the USD 270 of unfavorable price variance on the excess materials used. "That is Jim's responsibility," he says.

La Hoya now turns to you for help. Specifically, she wants you to tell her:

- a. Who is responsible for the USD 270 in dispute?
- b. If responsibility cannot be clearly assigned, how should the accounting department categorize the variance (price or usage)? Why?
- c. Are there likely to be other circumstances where materials variances cannot be considered the responsibility of the manager most closely involved with them? Explain.

Prepare written answers to the three questions La Hoya asked.

## 24. Control through standard costs

**A broader perspective C** Refer to "A broader perspective: Quality management and Baldrige award". The Baldrige Award has been criticized for fostering a winner-versus-loser mentality, instead of encouraging every organization to improve its quality. Further, the award has been criticized for grading on the curve by awarding companies that are the best in US industry but still do not compete well against foreign competition.

Write a response to each of these criticisms of the Baldrige Award.

**Group project D** Many workers hate standards. Some people claim standards reduce morale and productivity. Others believe standards are necessary to motivate people. Based on your own experience in school or on a job, what do you think?

In groups of three, choose an organization or business to use as an example. List all the possible standards you could set for this organization or business. Then decide whether your group favors setting standards. If the group does, decide who should set each of the standards on your list. If the group does not favor standards, discuss your reasons. Choose one member to report for your group to the class.

**Group project E** The chief executive officer (CEO) of Tax Preparation Services, Incorporated, remarked to a colleague, "Establishing standard costs and performing variance analysis is only useful for companies with inventories. As a service organization, how could we possibly benefit from implementing such a system?" In groups of two or three students, write a memorandum to your instructor stating whether you agree with this comment or not and explain why. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project F** The controller of Plastics Manufacturing, Incorporated, states: "Let us figure the materials price variances when the materials are used rather than at the time of purchase. This way we can prepare the price and usage variances at the same time and directly link the price variance to production." In groups of two or three students, write a memorandum to your instructor stating whether you agree with this suggestion or not and explain why. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

### Using the Internet—A view of the real world

Using any Internet search engine enter "standard costs" (be sure to include the quotation marks). Select an article that directly discusses standard costs and print a copy of the article. You are encouraged (but not required) to find an article that answers some of the following questions: When is the use of standard costing appropriate? How do certain industries use standard costing? How are standard costs established? How do standard costs help management in production?

Write a memorandum to your instructor summarizing the key points of the article. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to include a copy of the article used for this assignment.

Using any Internet search engine select one of the new terms at the end of the chapter and perform a key word search. Be sure to include quotation marks (for example: "Management by exception"). Select an article that directly discusses the new term used and print a copy of the article. Write a memorandum to your instructor

summarizing the key points of the article. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to include a copy of the article used for this assignment.

#### Answers to self-test

##### True-false

**False.** Standard cost is the standard quantity of an input required per unit of output times the standard price per unit of that input.

**True.** Standard costs are useful in evaluating the performance of management and workers.

**True.** Under a standard cost system all units of a given product are carried in inventory at the same unit cost.

**False.** The general journal entry to record the use of materials and establish the materials usage variance debits Work in Process Inventory (not Accounts Payable) and Materials Usage Variance and credits Materials Inventory.

**True.** Favorable variances are shown as credits.

##### Multiple-choice

**d.** All of these answers are correct. Different people are often responsible for the two variances, materials are sometimes purchased and used in different accounting periods, and the two separate variances are likely to provide more information to top management than just one materials variance.

**b.**

$$\begin{aligned}\text{Materials usage variance} &= (\text{Actual quantity used} - \text{Standard quantity allowed}) \times \text{Standard price} \\ &= (25,000 - 22,000) \times \text{USD } 3.10 \\ &= 3,000 \times \text{USD } 3.10 \\ &= \text{USD } 9,300 \text{ (unfavorable)}\end{aligned}$$

$$\begin{aligned}\text{Materials price variance} &= (\text{Actual price} - \text{Standard price}) \times \text{Actual quantity purchased} \\ &= (\text{USD } 3.00 - \text{USD } 3.10) \times 30,000 \\ &= -\text{USD } 0.10 \times 30,000 \\ &= -\text{USD } 3,000 \text{ (favorable)}\end{aligned}$$

**b.** An unfavorable materials usage or labor efficiency variance caused by carelessness or inefficiency may be considered a loss and closed to Income Summary because the standard was attainable and the variance was controllable.

**c.** The other answers incorrectly close the variance accounts. The variance accounts are closed to Cost of Goods Sold.

# 25. Responsibility accounting: Segmental analysis

## Learning objectives

After studying this chapter, you should be able to:

- Explain responsibility accounting and its use in a business entity.
- Prepare responsibility accounting reports.
- Prepare a segmental income statement using the contribution margin format.
- Calculate return on investment, margin, and turnover for a segment.
- Calculate the residual income of a segment.
- Allocate costs from service departments to operating departments (Appendix).

When a business is small, the owner usually supervises many different activities in the business. As a business grows, responsibility for some of these activities must be given to other persons. Obviously, the success of a business depends to a great extent on the persons responsible for these activities.

In this chapter, you learn about delegating authority to lower level managers for managing various business activities and holding these lower level managers responsible for the activities under their control. You also learn how to assess the performance of these managers. A company's activities are grouped into responsibility centers. The company measures the performance of each center manager in terms of the items of revenue and expense over which that manager has control.

## Responsibility accounting

The term **responsibility accounting** refers to an accounting system that collects, summarizes, and reports accounting data relating to the responsibilities of individual managers. A responsibility accounting system provides information to evaluate each manager on the revenue and expense items over which that manager has primary control (authority to influence).

A responsibility accounting report contains those items controllable by the responsible manager. When both controllable and uncontrollable items are included in the report, accountants should clearly separate the categories. The identification of controllable items is a fundamental task in responsibility accounting and reporting.

To implement responsibility accounting in a company, the business entity must be organized so that responsibility is assignable to individual managers. The various company managers and their lines of authority

## 25. Responsibility accounting: Segmental analysis

(and the resulting levels of responsibility) should be fully defined. The organization chart in Exhibit 53 demonstrates lines of authority and responsibility that could be used as a basis for responsibility reporting.

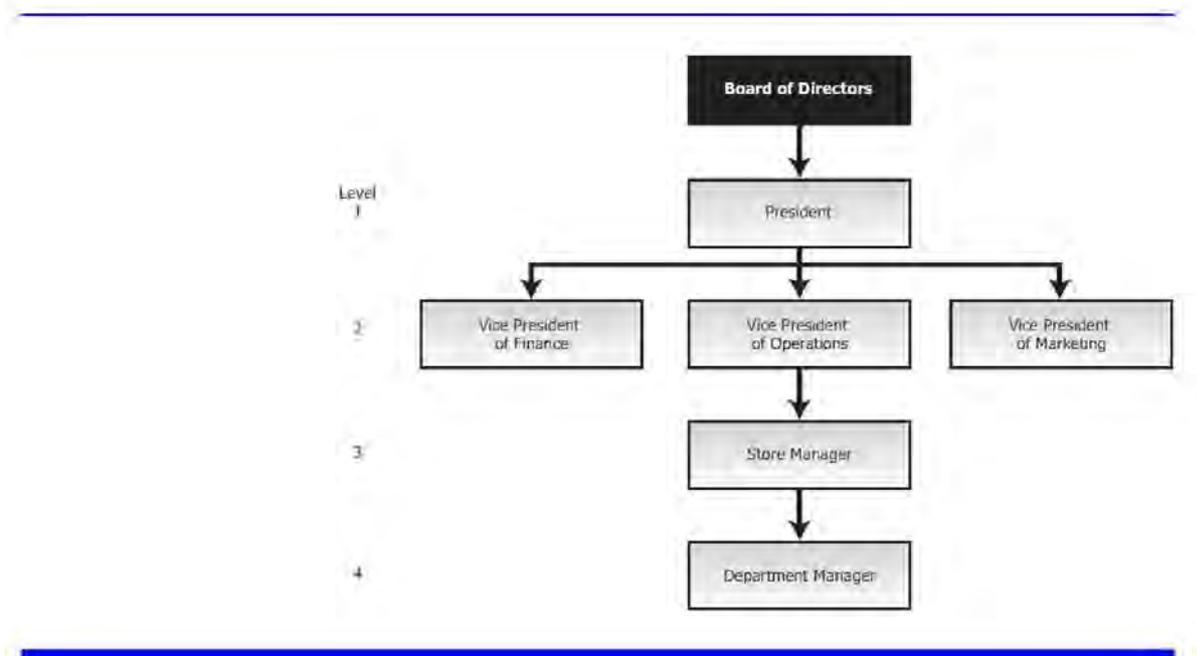


Exhibit 53: A corporate functional organization chart including four levels of management

To identify the items over which each manager has control, the lines of authority should follow a specified path. For example, in Exhibit 53 we show that a department supervisor may report to a store manager, who reports to the vice president of operations, who reports to the president. The president is ultimately responsible to stockholders or their elected representatives, the board of directors. In a sense, the president is responsible for all revenue and expense items of the company, since at the presidential level all items are controllable over some period. The president often carries the title, Chief Executive Officer (CEO) and usually delegates authority to lower level managers since one person cannot keep fully informed of the day-to-day operating details of all areas of the business.

The manager's level in the organization also affects those items over which that manager has control. The president is usually considered a first-level manager. Managers (usually vice presidents) who report directly to the president are second-level managers. Notice on the organization chart in Exhibit 53 that individuals at a specific management level are on a horizontal line across the chart. Not all managers at that level, however, necessarily have equal authority and responsibility. The degree of a manager's authority varies from company to company.

While the president may delegate much decision-making power, some revenue and expense items remain exclusively under the president's control. For example, in some companies, large capital (plant and equipment) expenditures may be approved only by the president. Therefore, depreciation, property taxes, and other related expenses should not be designated as a store manager's responsibility since these costs are not primarily under that manager's control.

The controllability criterion is crucial to the content of performance reports for each manager. For example, at the department supervisor level, perhaps only direct materials and direct labor cost control are appropriate for measuring performance. A plant manager, however, has the authority to make decisions regarding many other costs not controllable at the supervisory level, such as the salaries of department supervisors. These other costs would be included in the performance evaluation of the store manager, not the supervisor.

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### A broader perspective: Employee buyouts

Traditional organization lines of responsibility have workers reporting to supervisors or department managers, who in turn report to higher managers, who report to even higher managers, and so forth on up the organization. Top management is accountable to stockholders.

What happens when those stockholders are also employees, as in the case of many employee buyouts (such as The Chilcote Company – <http://www.chilcotecompany.com>)? Now, employees report to managers who are accountable back to the employees in their role as stockholders. Employees wear two hats: They own the company and they work for the company. In some sense, this makes each employee like a proprietor of a business. Presumably, after employees buy their company, they have greater incentives to make the company successful.

Source: Based on the authors' research.

### Responsibility reports

Responsibility accounting provides reports to different levels of management. The amount of detail varies depending on the manager's level in the organization. A performance report to a department manager of a retail store would include actual and budgeted dollar amounts of all revenue and expense items under that supervisor's control. The report issued to the store manager would show only totals from all the department supervisors' performance reports and any additional items under the store manager's control, such as the store's administrative expenses. The report to the company's president includes summary totals of all the stores' performance levels plus any additional items under the president's control. In effect, the president's report should include all revenue and expense items in summary form because the president is responsible for controlling the profitability of the entire company.

**Management by exception** is the principle that upper level management does not need to examine operating details at lower levels unless there appears to be a problem. As businesses become increasingly complex, accountants have found it necessary to filter and condense accounting data so that these data may be analyzed quickly. Most executives do not have time to study detailed accounting reports and search for problem areas. Reporting only summary totals highlights any areas needing attention and makes the most efficient use of the executive's time.

The condensation of data in successive levels of management reports is justified on the basis that the appropriate manager will take the necessary corrective action. Thus, specific performance details need not be reported to superiors.

## 25. Responsibility accounting: Segmental analysis

For example, if sales personnel costs have been excessively high in a particular department, that departmental manager should find and correct the cause of the problem. When the store manager questions the unfavorable budget variance of the department, the departmental supervisor can inform the store manager that corrective action was taken. Hence, it is not necessary to report to any higher authority that a particular department within one of the stores is not operating satisfactorily because the matter has already been resolved. Alternatively, if a manager's entire store has been performing poorly, summary totals reported to the vice president of operations discloses this situation, and an investigation of the store manager's problems may be indicated.

In preparing responsibility accounting reports, companies use two basic methods to handle revenue or expense items. In the first approach, only those items over which a manager has direct control are included in the responsibility report for that management level. Any revenue and expense items that cannot be directly controlled are not included. The second approach is to include all revenue and expense items that can be traced directly or allocated indirectly to a particular manager, whether or not they are controllable. This second method represents a full-cost approach, which means all costs of a given area are disclosed in a single report. When this approach is used, care must be taken to separate controllable from noncontrollable items to differentiate those items for which a manager can and should be held responsible.

For accounting reports to be of maximum benefit, they must be timely. That is, accountants should prepare reports as soon as possible after the end of the performance measurement period. Timely reporting allows prompt corrective action to be taken. When reports are delayed excessively, they lose their effectiveness as control devices. For example, a report on the previous month's operations that is not received until the end of the current month is virtually useless for analyzing poor performance areas and taking corrective action.

Companies also should issue reports regularly so that managers can spot trends. Then, appropriate management action can be initiated before major problems occur. Regular reporting allows managers to rely on reports and become familiar with their contents.

Firms should make the format of their responsibility reports relatively simple and easy to read. Confusing terminology should be avoided. Where appropriate, expressing results in physical units may be more familiar and understandable to some managers. To assist management in quickly spotting budget variances, companies can report both budgeted (expected) and actual amounts. A **budget variance** is the difference between the budgeted and actual amounts of an item. Because variances highlight problem areas (exceptions), they are helpful in applying the management-by-exception principle. To help management evaluate performance to date, responsibility reports often include both a current period and year-to-date analysis.

### Responsibility reports—An illustration

Exhibit 54 on the next page, shows how Macy's Corporation could relate its responsibility accounting reports. Assume Macy's has four management levels—the president, vice president of operations, store manager, and department manager. In Exhibit 54 on the next page, we show that a responsibility report would be prepared for each management level.

Note in Exhibit 55, the detailed information included in the responsibility reports for each manager. Only the individual manager's controllable expenses are contained in these reports. For example, the store manager's report includes only totals from the Men's Clothing Department manager's report. In turn, the report to the vice president

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includes only totals from the store manager's report, and so on. Detailed data from the lower levels are summarized or condensed and reported at the next higher level.

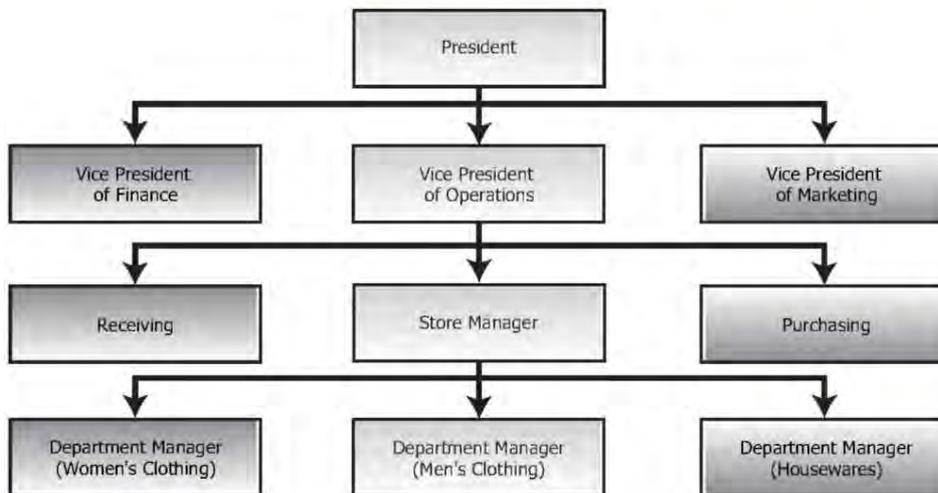
You can see that at each level, more and more costs become controllable. Also, the company introduces controllable costs not included on lower level reports into the reports for levels 3, 2, and 1. The only store cost not included at the store manager's level is the store manager's salary because it is noncontrollable by that store manager. It is, however, controllable by the store manager's supervisor, the vice president of operations.

Based on an analysis of these reports, the Men's Clothing Department manager probably would take immediate action to see why supplies and overtime were significantly over budget this month. The store manager may ask the department manager what the problems were and whether they are now under control. The vice president may ask the same question of the store manager. The president may ask each vice president why the budget was exceeded this month and what corrective action has been taken.

## 25. Responsibility accounting: Segmental analysis

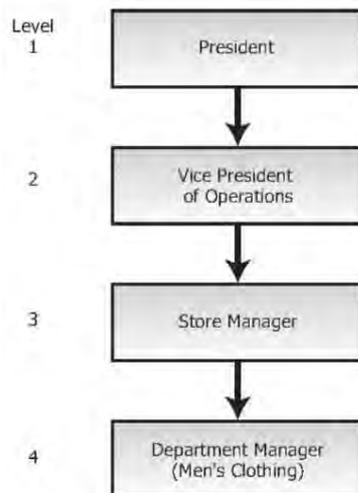
### Illustration 25.2 Organization Chart—Macy's Corporation

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### Illustration 25.3 Responsibility Reports for Macy's Corporation

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Exhibit 54: Organization chart-Macy's corporation

### Responsibility centers

A **segment** is a fairly autonomous unit or division of a company defined according to function or product line. Traditionally, owners have organized their companies along functional lines. The segments or departments organized along functional lines perform a specified function such as marketing, finance, purchasing, production, or shipping. Recently, large companies have tended to organize segments according to product lines such as an electrical products division, shoe department, or food division.

A **responsibility center** is a segment of an organization for which a particular executive is responsible. There are three types of responsibility centers—expense (or cost) centers, profit centers, and investment centers. In designing a responsibility accounting system, management must examine the characteristics of each segment and

the extent of the responsible manager's authority. Care must be taken to ensure that the basis for evaluating the performance of an expense center, profit center, or investment center matches the characteristics of the segment and the authority of the segment's manager. The following sections of the chapter discuss the characteristics of each of these centers and the appropriate bases for evaluating the performance of each type.

**First Level**

<b>Macy's Corporation President</b>				
<b>Controllable Expenses</b>	<b>Amount</b>		<b>Over or (Under) Budget</b>	
	<b>This Month</b>	<b>Year to Date</b>	<b>This Month</b>	<b>Year to Date</b>
President's office expense	\$ 11,000	\$ 55,000	\$ 1,000	\$ 2,000
Vice president of operations	128,720	700,000	6,000	8,000
Vice president of marketing	18,700	119,000	4,000	8,000
Vice president of finance	14,000	115,000	8,000	9,000
Vice presidents' salaries	29,000	145,000	-0-	-0-
<b>Total</b>	<b>\$ 201,420</b>	<b>\$ 1,134,000</b>	<b>\$ 19,000</b>	<b>\$ 27,000</b>

**Second Level**

<b>Macy's Corporation Vice President of Operations</b>				
<b>Controllable Expenses</b>	<b>Amount</b>		<b>Over or (Under) Budget</b>	
	<b>This Month</b>	<b>Year to Date</b>	<b>This Month</b>	<b>Year to Date</b>
Vice president's office expense	\$ 2,840	\$ 9,500	\$ (500)	\$ (8,000)
Store manager	88,800	490,000	2,500	5,000
Purchasing	5,300	32,500	1,000	2,000
Receiving	4,700	33,000	3,000	9,000
Salaries of store managers and heads of purchasing and receiving	27,000	135,000	-0-	-0-
<b>Total (include in report for next higher level)</b>	<b>\$ 128,720</b>	<b>\$ 700,000</b>	<b>\$ 6,000</b>	<b>\$ 8,000</b>

**Fourth Level**

**Macy's Corporation  
Manger, Men's Clothing Department**

## 25. Responsibility accounting: Segmental analysis

Controllable Expenses	Amount		Over or (Under) Budget	
	This Month	Year to Date	This Month	Year to Date
Inventory losses	\$ 2,000	\$ 10,000	\$ 100	\$ 400
Supplies	1,800	8,500	800	950
Salaries	11,000	53,000	(100)	810
Overtime	2,000	14,500	800	140
Total (include in report for next higher level)	\$ 16,800	\$ 86,000	\$ 1,600	\$ 2,300

Exhibit 55: Responsibility reports for Macy's corporation

An **expense center** is a responsibility center incurring only expense items and producing no direct revenue from the sale of goods or services. Examples of expense centers are service centers (e.g. the maintenance department or accounting department) or intermediate production facilities that produce parts for assembly into a finished product. Managers of expense centers are held responsible only for specified expense items.

The appropriate goal of an expense center is the long-run minimization of expenses. Short-run minimization of expenses may not be appropriate. For example, a production supervisor could eliminate maintenance costs for a short time, but in the long run, total costs might be higher due to more frequent machine breakdowns.

A **profit center** is a responsibility center having both revenues and expenses. Because segmental earnings equal segmental revenues minus related expenses, the manager must be able to control both of these categories. The manager must have the authority to control selling price, sales volume, and all reported expense items. To properly evaluate performance, the manager must have authority over all of these measured items. **Controllable profits of a segment** result from deducting the expenses under a manager's control from revenues under that manager's control.

Closely related to the profit center concept is an investment center. An **investment center** is a responsibility center having revenues, expenses, and an appropriate investment base. When a firm evaluates an investment center, it looks at the rate of return it can earn on its investment base. Accountants compute the **return on investment (ROI)**, also called the rate of return, by dividing segmental income by the appropriate investment base. For example, a segment that earns USD 500,000 on an investment base of USD 5,000,000 has an ROI of 10 per cent.

Determining the investment base to be used in the ROI calculation is a tricky matter. Normally, the assets available for use by the division make up its investment base. But accountants disagree on whether depreciable assets should be included in the ROI calculation at original cost, original cost less accumulated depreciation, or current replacement cost. **Original cost** is the price paid to acquire the assets. **Original cost less accumulated depreciation** is the book value of the assets—the amount paid less total depreciation taken. **Current replacement cost** is the cost of replacing the present assets with similar assets in the same condition as those now in use. A different rate of return results from each of these measures. Therefore, management must select and agree on an appropriate measure of investment base prior to making ROI calculations or interdivision comparisons.

Even after the investment base is defined, problems may still remain because many segment managers have limited control over some of the items included in the investment base of their segment. For instance, top-level management often makes capital expenditure decisions for major store assets rather than allowing the segment

managers to do so. Therefore, the segment manager may have little control over the store assets used by the segment. Another problem area may be the company's centralized credit and collection department. The segment manager may have little or no control over the amount of accounts receivable included as segment assets because the manager cannot change the credit-granting or collection policies of the company.

Usually these problems are overcome when managers realize that if all segments are treated in the same manner, the inclusion of noncontrollable items in the investment base may have negligible effects. Then, comparisons of the ROI for all segments are based on a consistent treatment of items. To avoid adverse reactions or decreased motivation, segment managers must agree to this treatment.

Companies prefer to evaluate segments as investment centers because the ROI criterion facilitates performance comparisons between segments. Segments with more resources should produce more profits than segments with fewer resources, so it is difficult to compare the performance of segments of different sizes on the basis of profits alone. However, when ROI is a performance measure, performance comparisons take into account the differences in the sizes of the segments. The segment with the highest percentage ROI is presumably the most effective in using whatever resources it has.

Typical investment centers are large, autonomous segments of large companies. The centers are often separated from one another by location, types of products, functions, and/or necessary management skills. Segments such as these often seem to be separate companies to an outside observer. But the investment center concept can be applied even in relatively small companies in which the segment managers have control over the revenues, expenses, and assets of their segments.

### Transfer prices

Profit centers and investment centers inside companies often exchange products with each other. The Pontiac, Buick, and other divisions of General Motors buy and sell automobile parts from each other, for example. No market exchange takes place, so the company sets transfer prices that represent revenue to the selling division and costs to the buying division.

A **transfer price** is an artificial price used when goods or services are transferred from one segment to another segment within the same company. Accountants record the transfer price as a revenue of the producing segment and as a cost, or expense, of the receiving segment. Usually no cash actually changes hands between the segments. Instead, the transfer price is an internal accounting transaction.

Segments are generally evaluated based on some measure of profitability. The transfer price is important because it affects the profitability of the buying and selling segments. The higher the transfer price, the better for the seller. The lower the transfer price, the better for the buyer.

Ideally, a transfer price provides incentives for segment managers to make decisions not only in their best interests but also in the interests of the entire company. For example, if the selling segment can sell everything it produces for USD 100 per unit, the buying segment should pay the market price of USD 100 per unit. A seller with excess capacity, however, should be willing to transfer a product to the buying segment for any price at or above the differential cost of producing and transferring the product to the buying segment (typically all variable costs).

## 25. Responsibility accounting: Segmental analysis

In practice, companies mostly base transfer prices on (1) the market price of the product, (2) the cost of the product, or (3) some amount negotiated by the buying and selling segment managers.

### Use of segmental analysis

So far we have described only the fundamentals of responsibility accounting. In this section we focus specifically on segmental analysis.

**Decentralization** is the dispersion of decision-making authority among individuals at lower levels of the organization. In other words, the extent of decentralization refers to the degree of control that segment managers have over the revenues, expenses, and assets of their segments. When a segment manager has control over these elements, the investment center concept can be applied to the segment. Thus, the more decentralized the decision making is in an organization, the more applicable is the investment center concept to the segments of the company. The more centralized the decision making is, the more likely responsibility centers are to be established as expense centers.

Some advantages of decentralized decision making are:

- Managing segments trains managers for high-level positions in the company. The added authority and responsibility also represent job enlargement and often increase job satisfaction and motivation.
- Top management can be more removed from day-to-day decision making at lower levels of the company and can manage by exception. When top management is not involved with routine problem solving, it can devote more time to long-range planning and to the company's most significant problem areas.
- Decisions can be made at the point where problems arise. It is often difficult for top managers to make appropriate decisions on a timely basis when they are not intimately involved with the problem they are trying to solve.
- Since decentralization permits the use of the investment center concept, performance evaluation criteria such as ROI and residual income (to be explained later) can be used.

### Concepts used in segmental analysis

To understand segmental analysis, you need to know about the concepts of variable cost, fixed cost, direct cost, indirect cost, net income of a segment, and contribution to indirect expenses. Next, we describe each concept.

Costs may be either directly or indirectly related to a particular cost object. A **cost object** is a segment, product, or other item for which costs may be accumulated. In other words, a cost is not direct or indirect in and of itself. It is only direct or indirect in relation to a given cost object.

A **direct cost (expense)** is specifically traceable to a given cost object. An **indirect cost (expense)** is not traceable to a given cost object but has been allocated to it. Accountants can designate a particular cost (expense) as direct or indirect by reference to a given cost object. Thus, a cost that is direct to one cost object may be indirect to another. For instance, the salary of a segment manager may be a direct cost of a given manufacturing segment but an indirect cost of one of the products manufactured by that segment. In this example, the segment and the product are two distinct cost objects.

Because a direct cost is traceable to a cost object, the cost is likely to be eliminated if the cost object is eliminated. For instance, if the plastics segment of a business closes down, the salary of the manager of that segment probably is eliminated. Sometimes a direct cost would remain even if the cost object were eliminated, but this is the exception rather than the rule.

An indirect cost is not traceable to a particular cost object; therefore, it only becomes an expense of the cost object through an allocation process. For example, consider the depreciation expense on the company headquarters building that is allocated to each segment of the company. The depreciation expense is a direct cost for the company headquarters, but it is an indirect cost to each segment. If a segment of the company is eliminated, the indirect cost for depreciation assigned to that segment does not disappear; the cost is simply allocated among the remaining segments. In a given situation, it may be possible to identify an indirect cost that would be eliminated if the cost object were eliminated, but this would be the exception to the general rule.

Because the direct costs of a segment are clearly identified with that segment, these costs are often controllable by the segment manager. In contrast, indirect costs become segment costs only through allocation; therefore, most indirect costs are noncontrollable by the segment manager. Be careful, however, not to equate direct costs with controllable costs. For example, the salary of a segment manager may be direct to that segment and yet is noncontrollable by that manager because managers cannot specify their own salaries.

When preparing internal reports on the performance of segments of a company, management often finds it is important to classify expenses as fixed or variable and as direct or indirect to the segment. These classifications may be more useful to management than the traditional classifications of cost of goods sold, operating expenses, and nonoperating expenses that are used for external reporting in the company's financial statements. As a result, many companies prepare an income statement for internal use with the format shown in Exhibit 56(A).

**A. All Expenses Allocated to Segments**

	<b>Segment A</b>	<b>Segment B</b>	<b>Total</b>
Sales	\$ 2,500,000	\$ 1,500,000	\$ 4,000,000
Less: Variable expenses (all of which are direct expenses)	<u>700,000</u>	<u>650,000</u>	<u>1,350,000</u>
<b>Contribution margin</b>	<b>\$ 1,800,000</b>	<b>\$ 850,000</b>	<b>\$ 2,650,000</b>
Less: Direct fixed expenses	<u>450,000</u>	<u>550,000</u>	<u>1,000,000</u>
<b>Contribution to indirect expenses</b>	<b>\$ 1,350,000</b>	<b>\$ 300,000</b>	<b>\$ 1,650,000</b>
Less: Indirect fixed expenses	<u>270,000</u>	<u>330,000</u>	<u>600,000</u>
<b>Net Income</b>	<b>\$ 1,080,000</b>	<b>\$ (30,000)</b>	<b>\$ 1,050,000</b>

**B. Indirect Expenses not allocated to Segments**

	<b>Segment A</b>	<b>Segment B</b>	<b>Total</b>
Sales	\$ 2,500,000	\$ 1,500,000	\$ 4,000,000
Less: Variable expenses	<u>700,000</u>	<u>650,000</u>	<u>1,350,000</u>
<b>Contribution margin</b>	<b>\$ 1,800,000</b>	<b>\$ 850,000</b>	<b>\$ 2,650,000</b>
Less: Direct fixed expenses	<u>450,000</u>	<u>550,000</u>	<u>1,000,000</u>
<b>Contribution to indirect expenses</b>	<b>\$ 1,350,000</b>	<b>\$ 300,000</b>	<b>\$ 1,650,000</b>
Less: Indirect fixed expenses			<u>600,000</u>
<b>Net income</b>			<b>\$ 1,050,000</b>

Exhibit 56: Contribution margin format income Statement

## 25. Responsibility accounting: Segmental analysis

This format is called the **contribution margin format** for an income statement (first introduced in Chapter 22) because it shows the contribution margin. **Contribution margin** is defined as sales revenue less variable expenses. Notice in Exhibit 56(A) that all variable expenses are direct expenses of the segment. The second subtotal in the contribution margin format income statement is the segment's contribution to indirect expenses. **Contribution to indirect expenses** is defined as sales revenue less all direct expenses of the segment (both variable direct expenses and fixed direct expenses). The final total in the income statement is **segmental net income**, defined as segmental revenues less all expenses (direct expenses and allocated indirect expenses).

Earlier we stated that the performance of a profit center is evaluated on the basis of the segment's profits. It is tempting to use segmental net income to make this evaluation since total net income is used to evaluate the performance of the entire company. The problem with using segmental net income to evaluate performance is that segmental net income includes certain indirect expenses that have been allocated to the segment but are not directly related to it or its operations. Because segmental contribution to indirect expenses includes only revenues and expenses directly related to the segment, this amount is often more appropriate for evaluation purposes.

Given the facts in Exhibit 56(A), if management relied on segmental net income to judge segmental performance, management might conclude that Segment B should be eliminated because it shows a loss of USD 30,000. But this action would reduce overall company income by USD 300,000, as shown here:

Reduction in corporate revenues		\$ 1,500,000
<u>Reduction in corporate expenses:</u>		
Variable expenses	\$ 650,000	
Direct fixed expenses	<u>550,000</u>	<u>1,200,000</u>
Reduction in corporate income		<u>\$ 300,000</u>

Notice that the elimination of Segment B would not eliminate the USD 330,000 of allocated fixed costs. These costs would need to be allocated to Segment A if Segment B no longer existed.

To stress the importance of a segment's contribution to indirect expenses, many companies prefer the contribution margin income statement format in Exhibit 56(B), over that in Exhibit 56(A). The difference is that indirect fixed costs are not allocated to individual segments in Exhibit 56(B). Indirect fixed expenses appear only in the total column for the computation of net income for the entire company. The computation for each segment stops with the segment's contribution to indirect expenses; this is the appropriate figure to use for evaluating the earnings performance of a segment. Only for the company as a whole is net income (revenues minus all expenses) computed; this is, of course, the appropriate figure to use for evaluating the company as a whole.

**Arbitrary allocations of indirect fixed expenses** As stated earlier, indirect fixed expenses, such as depreciation on the corporate administration building or on the computer facility maintained at company headquarters, can only be allocated to segments on some arbitrary basis. The two basic guidelines for allocating indirect fixed expenses are by the benefit received and by the responsibility for the incurrence of the expense.

Accountants can make an allocation on the basis of benefit received for certain indirect expenses. For instance, assume the entire company used a corporate computer for a total of 10,000 hours. If it used 4,000 hours, Segment K could be charged (allocated) with 40 per cent of the computer's depreciation for the period because it received 40 per cent of the total benefits for the period.

For certain other indirect expenses, accountants base allocation on responsibility for incurrence. For instance, assume that Segment M contracts with a magazine to run an advertisement benefiting Segment M and various

other segments of the company. Some companies would allocate the entire cost of the advertisement to Segment M because it was responsible for incurring the advertising expense.

To further illustrate the allocation of indirect expenses based on a measure of benefit or responsibility for incurrence, assume that Daily Company operates two segments, X and Y. It allocates the following indirect expenses to its two segments using the designated allocation bases:

Expense	Allocation Base
Administrative office building occupancy expense, \$ 50,000	Net sales
Insurance expense, \$ 35,000	Cost of segmental plant assets
General administrative expenses, \$ 40,000	Number of employees

The following additional data are provided:

	Segment X	Segment Y	Total
Net sales	\$ 400,000	\$ 500,000	\$ 900,000
Segmental plant assets	\$ 250,000	\$ 400,000	\$ 650,000
Number of employees	50	80	130

The following expense allocation schedule shows the allocation of indirect expenses:

	Segment X	Segment Y	Total
Administrative office building occupancy expense	\$ 22,222 <sup>a</sup>	\$ 27,778 <sup>b</sup>	\$ 50,000
Insurance expense	13,462 <sup>c</sup>	21,538 <sup>d</sup>	35,000
General administrative expenses	15,385 <sup>e</sup>	24,615 <sup>f</sup>	40,000

$$^a \$ 400,000 / \$ 900,000 \times \$ 50,000 = \$ 22,222$$

$$^d \$ 400,000 / \$ 650,000 \times \$ 35,000 = \$ 21,538$$

$$^b \$ 500,000 / \$ 900,000 \times \$ 50,000 = \$ 27,778$$

$$^e 50 / 130 \times \$ 40,000 = \$ 15,385$$

$$^c \$ 250,000 / \$ 650,000 \times \$ 35,000 = \$ 13,462$$

$$^f 80 / 130 \times \$ 40,000 = \$ 24,615$$

When it uses neither benefit nor responsibility to allocate indirect fixed expenses, a company must find some other reasonable, but arbitrary, basis. Often, for lack of a better approach, a firm may allocate indirect expenses based on net sales. For instance, if Segment X's net sales were 60 per cent of total company sales, then 60 per cent of the indirect expenses would be allocated to Segment X. Allocating expenses based on sales is not recommended because it reduces the incentive of a segment manager to increase sales because this would result in more indirect expenses being allocated to that segment.

Having covered some basic concepts essential to segmental analysis, we next present some specific procedures for performance evaluation.

### Investment center analysis

To this point, the segmental analysis discussion has concentrated on the contribution to indirect expenses and segmental net income approaches. Now we introduce the investment base concept into the analysis. Two evaluation bases that include the concept of investment base in the analysis are ROI (return on investment) and RI (residual income).

A segment that has a large amount of assets usually earns more in an absolute sense than a segment that has a small amount of assets. Therefore, a firm cannot use absolute amounts of segmental income to compare the performance of different segments. To measure the relative effectiveness of segments, a company might use **return**

## 25. Responsibility accounting: Segmental analysis

**on investment (ROI)**, which calculates the return (income) as a percentage of the assets employed (investment).

The formula for ROI is:

$$\text{ROI} = \frac{\text{Income}}{\text{Investment}}$$

To illustrate the difference between using absolute amounts and using percentages in evaluating a segment's performance, consider the data in Exhibit 57, for a company with three segments.

	Segment A	Segment B	Segment C	Total
(a) Income	\$ 250,000	\$1,000,000	\$ 500,000	\$1,750,000
(b) Investment	2,500,000	5,000,000	2,000,000	9,500,000
Return on investment (a) ÷ (b)	10 per cent	20 per cent	25 per cent	18.42 per cent

Exhibit 57: Computation of return on investment (ROI)

When using absolute dollars of income to evaluate performance, Segment B appears to be doing twice as well as Segment C. However, using ROI to evaluate the segments indicates that Segment C is really performing the best (25 per cent), Segment B is next (20 per cent), and Segment A is performing the worst (10 per cent). Therefore, ROI is a more useful indicator of the relative performance of segments than absolute income.

Although ROI appears to be a quite simple and straightforward computation, there are several alternative methods for making the calculation. These alternatives focus on what is meant by income and investment. Exhibit 58, shows various definitions and applicable situations for each type of computation.

Situation	Definition of Income	Definition of Investment
1. Evaluation of the earning power of the company. Do not use for segments or segment managers due to inclusion of non controllable expenses.	Net income of the company.*	Total assets of the company.†
2. Evaluation of rate of income contribution of segment. Do not use for segment managers due to inclusion of non controllable expenses.	Contribution to indirect expenses.	Assets directly used by and identified with the segment.
3. Evaluation of income performance of segment manager.	<i>Controllable</i> income. Begin with contribution to indirect expenses and eliminate any revenues and direct expenses not under the control of the segment manager.	Assets under the control of the segment manager.

\* Often *net operating income* is used; this term is defined as income before interest and taxes.

† *Operating assets* are often used in the calculation. This definition excludes assets not used in normal operations.

Exhibit 58: Possible definitions of income and investment

As discussed earlier in the chapter, alternative valuation bases include cost less accumulated depreciation, original cost, and current replacement cost. Each of the valuation bases has merits and drawbacks, as we discuss next. First, cost less accumulated depreciation is probably the most widely used valuation base and is easily determined. Because of the many types of depreciation methods, comparisons between segments or companies may be difficult. Also, as book value decreases, a constant income results in a steadily increasing ROI even though the segment's performance is unchanged. Second, the use of original cost eliminates the problem of decreasing book value but has its own drawback. The cost of old assets is much less than an investment in new assets, so a segment with old assets can earn less than a segment with new assets and realize a higher ROI. Third, current replacement cost is difficult to use because replacement cost figures often are not available, but this base does eliminate some of the problems caused by the other two methods. Whichever valuation basis is adopted, all ROI calculations that are to be used for comparative purposes should be made consistently.

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## An accounting perspective:

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### Business insight

Although financial performance measures such as ROI are important for providing incentives to perform well, so is the company's culture. For example, Johnson & Johnson has a culture emphasizing high ethical standards. The Johnson & Johnson Credo, published in its annual report and displayed throughout the company, is a famous example of this culture. HP is known as a people-oriented company that emphasizes personal development and long-term employment.

To encourage long-term growth, 3M requires that at least 25 per cent of each division's sales come from new products. This encourages constant innovation and new product development. In addition, the company allows employees to spend 15 per cent of their time on innovative projects, encourages sharing of technology across divisions, and provides "seed" grants for employees to develop new products. With this corporate culture, 3M has a worldwide reputation for innovation.

**Expanded form of ROI computation** The ROI formula breaks into two component parts:

$$\text{ROI} = \frac{\text{Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Investment}}$$

The first part of the formula, Income/Sales, is called margin or return on sales. The **margin** refers to the percentage relationship of income or profits to sales. This percentage shows the number of cents of profit generated by each dollar of sales. The second part of the formula, Sales/Investment, is called turnover. **Turnover** shows the number of dollars of sales generated by each dollar of investment. Turnover measures how effectively each dollar of assets was used.

A manager can increase ROI in the following three ways. In Exhibit 59, note the possible outcomes of some of these strategies to increase ROI.

- By concentrating on increasing the profit margin while holding turnover constant: Pursuing this strategy means keeping selling prices constant and making every effort to increase efficiency and thereby reduce expenses.
- By concentrating on increasing turnover by reducing the investment in assets while holding income and sales constant: For example, working capital could be decreased, thereby reducing the investment in assets.

## 25. Responsibility accounting: Segmental analysis

Past year's return on investment:

$$\text{ROI} = \text{Margin} \times \text{Turnover}$$

$$\text{ROI} = \frac{\text{Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Investment}}$$

$$\text{ROI} = \frac{\text{USD } 100,000}{\text{USD } 2,000,000} \times \frac{\text{USD } 2,000,000}{\text{USD } 1,000,000}$$

$$\text{ROI} = 5 \text{ per cent} \times 2 \text{ time}$$

ROI = 10 per cent

- Increase margin through reducing expenses by USD 40,000; no effect on sales or investment.

$$\text{ROI} = \frac{\text{USD } 140,000}{\text{USD } 2,000,000} \times \frac{\text{USD } 2,000,000}{\text{USD } 1,000,000}$$

$$\text{ROI} = 7 \text{ per cent} \times 2 \text{ time}$$

ROI = 14 per cent

- Increase turnover through reducing investment in assets by USD 200,000; no effect on sales or investment.

$$\text{ROI} = \frac{\text{USD } 100,000}{\text{USD } 2,000,000} \times \frac{\text{USD } 2,000,000}{\text{USD } 800,000}$$

$$\text{ROI} = 5 \text{ per cent} \times 2.5 \text{ time}$$

ROI = 12.5 per cent

- (a) Increase margin and turnover by disposing of nonproductive depreciable assets; income increased by USD 10,000; investment decreased by USD 200,000; no effect on sales.

$$\text{ROI} = \frac{\text{USD } 110,000}{\text{USD } 2,000,000} \times \frac{\text{USD } 2,000,000}{\text{USD } 800,000}$$

$$\text{ROI} = 5.5 \text{ per cent} \times 2.5 \text{ time}$$

ROI = 13.75 per cent

- (b) Increase margin and turnover through increased advertising; sales increased by USD 500,000 and income by USD 50,000; no effect on investment.

$$\text{ROI} = \frac{\text{USD } 150,000}{\text{USD } 2,500,000} \times \frac{\text{USD } 2,500,000}{\text{USD } 1,000,000}$$

$$\text{ROI} = 6 \text{ per cent} \times 2.5 \text{ time}$$

ROI = 15 per cent

- (c) Increase turnover through increased advertising; sales increased by USD 500,000 and income by USD 12,500; no effect on investment.

$$\text{ROI} = \frac{\text{USD } 112,500}{\text{USD } 2,500,000} \times \frac{\text{USD } 2,500,000}{\text{USD } 1,000,000}$$

$$\text{ROI} = 4.5 \% \times 2.5 \text{ times}$$

$$\text{ROI} = 11.25\%$$

Exhibit 59: Strategies for increasing return on investment (ROI)

- By taking actions that affect both margin and turnover: For example, disposing of nonproductive depreciable assets would decrease investment while also increasing income (through the reduction of depreciation expense). Thus, both margin and turnover would increase. An advertising campaign would probably increase sales and income. Turnover would increase, and margin might increase or decrease depending on the relative amounts of the increases in income and sales.

### Economic value added and residual income

When a company uses ROI to evaluate performance, managers have incentives to focus on the average returns from their segments' assets. However, the company's best interest is served if managers also focus on the marginal returns.

To illustrate, assume the manager of Segment 3 in Exhibit 60, has an opportunity to take on a project involving an investment of USD 100,000 that is estimated to return USD 22,000, or 22 per cent, on the investment. Since the segment's ROI is currently 25 per cent, or USD 250,000/USD 1,000,000, the manager may decide to reject the project because accepting the project will cause the segment's ROI to decline. Suppose however, from the company's point of view, all projects earning greater than a 10 per cent return should be accepted, even if they are lower than a particular segment's ROI.

Before acceptance of the project by Segment 3, the amounts are as follows:

	Segment 1	Segment 2	Segment 3
a. Income	\$ 100,000	\$ 500,000	\$ 250,000
b. Investment	1,000,000	2,500,000	1,000,000
c. Cost of capital	10%	10%	10%
d. Desired minimum income	\$ 100,000	\$ 250,000	\$ 100,000
e. Residual Income (RI)	-0-	250,000	150,000

With acceptance of the project by Segment 3, the amounts would be as follows:

	Segment 1	Segment 2	Segment 3
a. Income	\$ 100,000	\$ 500,000	\$ 272,000 <sup>†</sup>
b. Investment	1,000,000	2,500,000	1,100,000 <sup>‡</sup>
c. Cost of capital	10%	10%	10%
d. Desired minimum income	\$ 100,000	\$ 250,000	\$ 110,000
e. Residual Income (RI)	-0-	250,000	162,000

<sup>†</sup> \$250,000 + (22% of \$100,000).

<sup>‡</sup> \$1,000,000 original investment + \$100,000 new investment.

#### Exhibit 60: Computation of Residual Income (RI)

The rejection by a segment manager of a project that exceeds the 10 per cent desired minimum return is an example of suboptimization. **Suboptimization** occurs when a segment manager takes an action that is in the segment's best interest but is not in the best interest of the company as a whole.

To deal with this type of suboptimization, many companies use the concept of economic value added which computes the residual income of a business segment. **Residual income (RI)** is defined as the amount of income a segment has in excess of the segment's investment base times its cost of capital percentage. Each company based on debt costs establishes its cost of capital coverage and desired returns to stockholders. The formula for residual income (RI) is:

$$RI = \text{Income} - (\text{Investment} \times \text{Cost of capital percentage})$$

## 25. Responsibility accounting: Segmental analysis

When a company uses RI to evaluate performance, the segment rated as the best is the segment with the greatest amount of RI rather than the one with the highest ROI.

Returning to our example, the project opportunity for Segment 3 could earn in excess of the desired minimum ROI of 10 per cent. In fact, the project generates RI of USD 12,000, calculated as (USD 22,000 - [10 per cent X USD 100,000]). If RI were applied as the basis for evaluating segmental performance, the manager of Segment 3 would accept the project because doing so would improve the segment's performance. That choice would also be beneficial to the entire company.

Critics of the RI method complain that larger segments are likely to have the highest RI. In a given situation, it may be advisable to look at both ROI and RI in assessing performance or to scale RI for size.

A manager tends to make choices that improve the segment's performance. The challenge is to select evaluation bases for segments that result in managers making choices that benefit the entire company. When performance is evaluated using RI, choices that improve a segment's performance are more likely also to improve the entire company's performance.

When calculating RI for a segment, the income and investment definitions are contribution to indirect expenses and assets directly used by and identified with the segment. When calculating RI for a manager of a segment, the income and investment definitions should be income controllable by the manager and assets under the control of the segment manager.

In evaluating the performance of a segment or a segment manager, comparisons should be made with (1) the current budget, (2) other segments or managers within the company, (3) past performance of that segment or manager, and (4) similar segments or managers in other companies. Consideration must be given to factors such as general economic conditions and market conditions for the product being produced. A superior segment in Company A may be considered superior because it is earning a return of 12 per cent, which is above similar segments in other companies but below other segments in Company A. However, segments in Company A may be more profitable because of market conditions and the nature of the company's products rather than because of the performance of the segment managers. Top management must use careful judgment whenever performance is evaluated.

### Segmental reporting in external financial statements

In June 1997, the Financial Accounting Standards Board issued *Statement of Financial Accounting Standards No. 131*, "Disclosures about Segments of an Enterprise and Related Information". This statement requires publicly held companies to publish certain segmental information in their annual and interim financial statements. It also requires that these companies report certain information about their products and services, the geographic areas in which they operate, and their major customers. Thus, external users of financial statements of a company can (1) better understand the company's performance, (2) better assess the prospects for future net cash flows, and (3) make more informed judgments about the company.

In this chapter you learned about responsibility accounting and segmental analysis. Chapter 26 discusses capital budgeting and long-term planning.

## Understanding the learning objectives

- Responsibility accounting refers to an accounting system that collects, summarizes, and reports accounting data relating to the responsibilities of individual managers.
- Although the amount of detail varies, reports issued under a responsibility accounting system are interrelated. Totals from the report on one level of management are carried forward in the report to the management level immediately above.
- The contribution margin format for the income statement shows the contribution margin for the company.
- Contribution to indirect expenses is defined as sales revenue less all direct expenses of the segment.
- The final total in the income statement is segmental net income, defined as segmental revenues less all expenses (direct expenses and allocated indirect expenses).
- Return on investment measures the relative effectiveness of segments. The formula for return on investment is:

$$\text{Return on investment} = \frac{\text{Income}}{\text{Investment}}$$

- Alternatively, the formula for return on investment can be broken into two components:

$$\text{Return on investment} = \frac{\text{Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Investment}}$$

- Margin refers to the percentage relationship of income or profits to sales. This percentage shows the number of cents of profit generated by each dollar of sales. The formula for margin can be expressed as:

$$\text{Margin} = \frac{\text{Income}}{\text{Sales}}$$

- Turnover shows the number of dollars of sales generated by each dollar of investment. Turnover measures how effectively each dollar of assets was used. The formula for turnover can be expressed as:

$$\text{Turnover} = \frac{\text{Sales}}{\text{Investment}}$$

- Residual income is defined as the amount of income a segment has in excess of its investment base times its cost of capital percentage.
- Each company sets its cost of capital based on debt costs and desired returns to stockholders.
- The formula for residual income is:

$$\text{RI} = \text{Income} - (\text{Investment} \times \text{Cost of capital percentage})$$

- Two basic methods exist for allocating service department costs: (1) the direct method and (2) the step method.

## Appendix: Allocation of service department costs

Throughout this text, we have emphasized cost allocations only in the operating departments of a company. These operating departments perform the primary purpose of the company—to produce goods and services for

## 25. Responsibility accounting: Segmental analysis

consumers. Examples of operating departments are the assembly departments of manufacturing firms and the departments in hotels that take and confirm reservations.

The costs of service departments are allocated to the operating departments because they exist to support the operating departments. Examples of service departments are maintenance, administration, cafeterias, laundries, and receiving. Service departments aid multiple production departments at the same time, and accountants must allocate and account for all of these costs. It is crucial that these service department costs be allocated to the operating departments so that the costs of conducting business in the operating departments are clearly and accurately reflected.

Accountants allocate service department costs using some type of base. When the companies' managers choose bases to use, they consider such criteria as the types of services provided, the benefits received, and the fairness of the allocation method. Examples of bases used to allocate service department costs are number of employees, machine-hours, direct labor-hours, square footage, and electricity usage.

Two basic methods exist for allocating service department costs. The first method, the direct method, is the simplest of the two. The direct method allocates costs of each of the service departments to each operating department based on each department's share of the allocation base. Services used by other service departments are ignored. For example, if Service Department A uses some of Service Department B's services, these services would be ignored in the cost allocation process. Because these services are not allocated to other service departments, some accountants believe the direct method is not accurate.

The second method of allocating service department costs is the step method. This method allocates service costs to the operating departments and other service departments in a sequential process. The sequence of allocation generally starts with the service department that has incurred the greatest costs. After this department's costs have been allocated, the service department with the next highest costs has its costs allocated, and so forth until the service department with the lowest costs has had its costs allocated. Costs are not allocated back to a department that has already had all of its costs allocated.

To illustrate the direct method and the step method, we use the following data:

	<b>Service Maintenance</b>	<b>Department Administration</b>	<b>Operating Departments</b>	
			<b>1</b>	<b>2</b>
Costs	\$ 8,000	\$ 4,000	\$ 32,000	\$ 36,000
Machine-hours used	1,000	2,000	1,500	2,500
Number of employees	100	200	250	150

The costs of the maintenance department are allocated based on the machine-hours used. For the administration department, the cost allocation is based on the number of employees.

Using the preceding data, an example of the direct method follows:

	<b>Service Maintenance</b>	<b>Departments Administration</b>	<b>Operating 1</b>	<b>Departments 2</b>
Costs	\$ 8,000	\$ 4,000	\$ 32,000	\$ 36,000
Allocation of maintenance department's costs*	<u>(8,000)</u>		3,000	5,000
	\$ -0-			
Allocation of		<u>(4,000)</u>	<u>2,500</u>	<u>1,500</u>

administration  
department's costs†

\$ -0-                      \$ 37,500              \$ 42,500

\* Department 1's fraction is 1,500/4,000; Department 2's fraction is 2,500/4,000.

† Department 1's fraction is 250/400; Department 2's fraction is 150/400.

Using the same data, an example of the step method follows:

	<u>Service</u>	<u>Departments</u>	<u>Operating</u>	<u>Departments</u>
	<u>Maintenance</u>	<u>Administration</u>	<u>1</u>	<u>2</u>
Costs	\$ 8,000	\$ 4,000	\$ 32,000	\$ 36,000
Allocation of maintenance department's costs*	(8,000)	2,667	2,000	3,333

\$ -0-

Allocation of administration department's costs†	(6,667)	4,167	2,500
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\$ -0-                      \$ 38,167              \$ 41,833

\* Administration 1's fraction is 2,000/6,000; Department 1's fraction: 1,500/6,000; Department 2's fraction: 2,500/6,000.

† Department 1's fraction: 250/400; Department 2's fraction is 150/400.

Note in the preceding examples that the maintenance department costs were not allocated to the administration department under the direct method but were allocated under the step method. Also, to eliminate the administration department's costs, under the step method those costs allocated to the administration department from the maintenance department must be allocated to the operating departments as part of the total administration department's cost.

### Demonstration problem

The results of operations for Alan Company's two segments in 2009 follow:

	<b>Segment 1</b>	<b>Segment 2</b>	<b>Total</b>
Sales	\$ 90,000	\$ 135,000	\$ 225,000
Variable expenses	63,000	81,000	144,000
Fixed expenses:			
Direct	9,000	25,200	34,200
Indirect			12,600

The company has total operating assets of USD 315,000; USD 288,000 of these assets are identified with particular segments as follows:

	<b>Segment 1</b>	<b>Segment 2</b>
Assets directly used by and identified with the segment	\$ 108,000	\$ 180,000

- Prepare a statement showing the contribution margin, contribution to indirect expenses for each segment, and the total income for Alan Company.
- Determine the return on investment for each segment and then for the entire company.
- Comment on the results of (a) and (b).

### Solution to demonstration problem

- Alan Company**



**Residual income (RI), Economic Value Added** The amount of income a segment has in excess of the investment base times the cost of capital percentage. Residual income is equal to  $\text{Income} - (\text{Investment} \times \text{Cost of capital percentage})$ .

**Responsibility accounting** Refers to an accounting system that collects, summarizes, and reports accounting data relating to the responsibility of the individual managers. A responsibility accounting system provides information to evaluate each manager on revenue and expense items over which that manager has primary control.

**Responsibility center** A segment of an organization for which a particular executive is responsible.

**Return on investment (ROI)** Calculates the return (income) as a percentage of the assets employed (investment).

$$\text{Return on investment} = \frac{\text{Income}}{\text{Investment}} \quad \text{Or} \quad \frac{\text{Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Investment}}$$

**Segment** A fairly autonomous unit or division of a company defined according to function or product line.

**Segmental net income** The final total in the income statement; segmental revenues less all expenses (direct expenses and allocated indirect expenses).

**Suboptimization** A situation when a segment manager takes an action in the segment's best interest but not in the best interest of the company as a whole.

**Transfer price** An artificial price used when goods or services are transferred from one segment to another segment within the same company.

**Turnover (as used in ROI)** The number of dollars of sales generated by each dollar of investment.

$$\text{Turnover} = \frac{\text{Sales}}{\text{Investment}}$$

\*Some terms listed in earlier chapters are repeated here for your convenience.

### Self-test

#### True-false

Indicate whether each of the following statements is true or false.

Items that a manager has direct control over are included in responsibility accounting reports for that management level.

An appropriate goal of an expense center is the long-run minimization of expenses.

The salary of a segment manager would be considered a direct cost as well as an uncontrollable cost to that segment.

Segmental net income is the most appropriate figure to use when evaluating the performance of a segment.

When calculating RI for a segment, the income and investment definitions are income controlled by a manager, and assets directly used by and identified with the segment.

#### Multiple-choice

Select the best answer for each of the following questions.

The investment base used when determining the ROI calculation could be which of the following?

- Current replacement cost.
- Original cost.
- Original cost less accumulated depreciation.
- Any of the above.

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Which of the following actions would increase ROI?

- Reduce operating expenses with no effect on sales or assets.
- Increase investment in assets, with no change in income.
- Increase sales with no change in income or assets.
- None of the above.

Calculate ROI using the expanded form (margin times turnover) from the following data:

Sales	\$1,000,000
Investment	500,000
Income	50,000

- 20 per cent.
- 10 per cent.
- 15 per cent.
- None of the above.

In evaluating the performance of a segment or manager, comparisons should be made with:

- Other segments and managers within the company and in other companies.
- Past performance of the segment manager.
- The current budget.
- All of the above.

Calculate the ROI and RI for each of the following segments and determine if a segment should be dropped based on RI.

	<b>Segment 1</b>	<b>Segment 2</b>	<b>Segment 3</b>
Income	\$ 180,000	\$ 1,000,000	\$ 500,000
Investment	2,000,000	5,000,000	2,000,000
ROI	?	?	?
Desired minimum ROI (10%)	<u>200,000</u>	<u>500,000</u>	<u>200,000</u>
RI	?	?	?

- 9 per cent, 20 per cent, 20 per cent

USD 0, USD 500,000, USD 200,000

Consider dropping Segment 1.

- 20 per cent, 20 per cent, 20 per cent

USD 200,000, USD 500,000, USD 200,000

Do not drop any segment.

- 9 per cent, 20 per cent, 25 per cent

USD (20,000), USD 500,000, USD 300,000

Consider dropping Segment 1.

d. 20 per cent, 20 per cent, 25 per cent

USD 200,000, USD 500,000, USD 300,000

Do not drop any segment.

Now turn to “Answers to self-test” at the back of the chapter to check your answers.

## Questions

- What is the fundamental principle of responsibility accounting?
- List five important factors that should be considered in designing reports for a responsibility accounting system.
- How soon should accounting reports be prepared after the end of the performance measurement period? Explain.
- Name and describe three types of responsibility centers.
- Describe a segment of a business enterprise that is best treated as an expense center. List four indirect expenses that may be allocated to such an expense center.
- Compare and contrast an expense center and an investment center.
- What purpose is served by setting transfer prices?
- What is the advantage of using investment centers as a basis for performance evaluation?
- Which categories of items must a segment manager have control over for the investment center concept to be applicable?
- What is the connection between the extent of decentralization and the investment center concept?
- Give some of the advantages of decentralization.
- Differentiate between a direct cost and an indirect cost of a segment. What happens to these categories if the segment to which they are related is eliminated?
- Is it possible for a cost to be direct to one cost object and indirect to another cost object? Explain.
- Describe some of the methods by which indirect expenses are allocated to a segment.
- Give the general formula for return on investment (ROI). What are its two components?
- Give the three sets of definitions for income and investment that can be used in ROI calculations, and explain when each set is applicable.
- Give the various valuation bases that can be used for plant assets in investment center calculations. Discuss some of the advantages and disadvantages of these methods.
- In what way is the use of the residual income (RI) concept superior to the use of ROI?
- How is residual income (RI) determined?

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- If the RI for segment manager A is USD 50,000 while the RI for segment manager B is USD 100,000, does this necessarily mean that B is a better manager than A? Explain.
- **Real world question** Refer to the annual report of a publicly traded company. Which of the company's geographic regions performed better? Explain.
- (Based on Appendix) Briefly discuss the two methods of allocating service department costs.

### Exercises

**Exercise A** The following information refers to the inspection department of a chemical packaging plant for September:

	Amount	Over or (Under) Budget
Supplies	\$ 54,000	\$ (10,800)
Repairs and maintenance	270,000	21,600
Overtime paid to inspectors	108,000	10,800
Salary of inspection department manager	32,400	(5,400)
Salary of plant manager	43,200	-0-
Allocation of company accounting costs	32,400	10,800
Allocation of building depreciation to the inspection department	21,600	(5,400)

Using this information, prepare a responsibility report for the manager of the inspection department for September. Include those items for which you think the inspection department manager would be held responsible.

**Exercise B** Present the following information for the Hardware Division of ABC Computer Company,

Sales	\$ 1,400,000
Variable selling and administrative expenses	100,000
Fixed direct manufacturing expenses	35,000
Fixed indirect manufacturing expenses	56,000
Variable manufacturing expenses	400,000
Fixed direct selling and administrative expenses	175,000
Fixed indirect selling and administrative expenses	28,000

**Exercise C** Given the following data, prepare a schedule that shows contribution margin, contribution to indirect expenses, and net income of the Sharks Division of Hockey, Inc.:

Direct fixed expenses	\$ 324,000
Indirect fixed expenses	259,200
Sales	2,100,000
Variable expenses	1,500,000

What would be the effect on the company income if the segment were eliminated?

**Exercise D** Three segments (A, B, and C) of Trump Enterprises have net sales of USD 300,000, USD 150,000, and USD 50,000, respectively. A decision is made to allocate the pool of USD 25,000 of administrative overhead expenses of the home office to the segments, using net sales as the basis for allocation.

- a. How much of the USD 25,000 should be allocated to each segment?
- b. If Segment C is eliminated, how much of the USD 25,000 will be allocated to A and B?

**Exercise E** Two segments (Mountain Bike and Road Bike) showed the following data for the most recent year:

	<b>Mountain bike</b>	<b>Road bike</b>
Contribution to indirect expenses	\$ 840,000	\$ 504,000
Assets directly used by and identified with the segment	2,520,000	2,184,000
Sales	3,360,000	6,720,000

- Calculate return on investment for each segment in the most direct manner.
- Calculate return on investment using the margin and turnover components.

**Exercise F** Calculate the new margin, turnover, and return on investment of the Mountain Bike segment for each of the following changes. Consider each change independently of the others.

- Direct variable expenses were reduced by USD 33,600. Sales and assets were unaffected.
- Assets used by the segment were reduced by USD 540,000, while income and sales were unaffected.
- An advertising campaign increased sales by USD 336,000 and income by USD 50,000. Assets directly used by the segment were unaffected.

**Exercise G** The following data are available for Segment A of ABC Company:

Net income of the segment	\$ 50,000
Contribution to indirect expenses	40,000
Controllable income by manager	48,000
Assets directly used by the manager	360,000
Assets under the control of the segment manager	240,000

Determine the return on investment for evaluating (a) the income performance of the manager of Segment A and (b) the rate of income contribution of the segment.

**Exercise H** Travel Company has three segments: Air, Land, and Sea. Data concerning income and investment follow:

	<b>Air</b>	<b>Land</b>	<b>Sea</b>
Contribution to indirect expenses	\$ 43,200	\$ 86,400	\$ 115,200
Assets directly used by and identified with the segment	288,000	576,000	1,296,000

Assuming that the cost of capital on investment is 12 per cent, calculate the residual income of each of the segments. Do the results indicate that any of the segments should be eliminated?

## Problems

**Problem A** You are given the following information for Farflung Company for the year ended 2009 December 31. The company is organized according to functions:

<b>Controllable expenses</b>	<b>Plant Manager</b>		<b>Vice Of</b>		<b>President Manufacturing</b>		<b>President</b>	
	<b>Budget</b>	<b>Actual</b>	<b>Budget</b>	<b>Actual</b>	<b>Budget</b>	<b>Actual</b>	<b>Budget</b>	<b>Actual</b>
Office expense	\$ 7,200	\$ 9,600	\$ 12,000	\$ 16,800	\$ 24,000	\$ 16,800		
Printing	19,200	16,800						
Paging	2,400	2,160						
Binding	4,800	4,800						
Purchasing			24,000	26,400				
Receiving			12,000	14,400				
Inspection			19,200	16,800				
Vice president of marketing					192,000	168,000		
Controller					144,000	120,000		
Treasurer					96,000	72,000		

## 25. Responsibility accounting: Segmental analysis

Vice president of personnel 48,000 72,000

Prepare the responsibility accounting reports for the three levels of management—plant manager, vice president of manufacturing, and president.

**Problem B** Joey Bauer Corporation has production plants in Sacramento, Dallas, and Seattle. Following is a summary of the results for 2009:

Plant	Revenues	Expenses	Investment base (gross assets)
Sacramento	\$ 450,000	\$ 225,000	\$ 4,500,000
Dallas	450,000	180,000	3,375,000
Seattle	675,000	247,500	7,200,000

- If the plants are treated as profit centers, which plant manager appears to have done the best job?
- If the plants are treated as investment centers, which plant manager appears to have done the best job? (Assume the plant managers are evaluated by return on investment on gross assets.)
- Do the results of profit center analysis and investment center analysis give different findings? If so, why?

**Problem C** Quinn Company allocates all of its home office expenses to its two segments, A and B. Allocations are based on the following selected expense account balances and additional data:

Expenses (allocation bases)			
Home office building expense (net sales)			\$ 76,800
Buying expense (net purchases)			67,200
Uncollectible accounts (net sales)			8,000
Depreciation of home office equipment (net sales)			21,120
Advertising expense (indirect, allocated on basis of relative amounts of direct advertising)			86,400
Insurance expense (relative amounts of equipment plus average inventory in department)			23,040
	Segment A	Segment B	Total
Purchases (net)	\$ 243,200	\$ 76,800	\$ 320,000
Sales (net)	512,000	128,000	640,000
Equipment (cost)	96,000	64,000	160,000
Advertising (cost)	25,600	12,800	38,400
Average inventory	160,000	64,000	224,000

- Prepare a schedule showing the amounts of each type of expense allocable to Segments X and Y using these data and bases of allocation.
- Evaluate and criticize these allocation bases.

**Problem D** Allentown, Inc., is a company with two segments, X and Y. Its revenues and expenses for 2009 follow:

	Segment X	Segment Y	Total
Net sales	\$ 96,000	\$ 144,000	\$ 240,000
<u>Direct expenses:</u> *			
Cost of goods sold	45,000	99,000	144,000
Selling	13,680	7,200	20,880
Administrative:			
Uncollectible accounts	3,000	1,800	4,800
Insurance	2,400	1,200	3,600
Interest	480	240	720
<u>Indirect expenses (all fixed):</u>			
Selling			18,000

Administrative 25,200  
 \* All the direct expenses are variable except insurance and interest, which are fixed.

a. Prepare a schedule showing the contribution margin, the contribution to indirect expenses of each segment, and net income for the company as a whole. Do not allocate indirect expenses to the segments.

b. Assume that indirect selling expenses are to be allocated on the basis of net sales and that indirect administrative expenses are to be allocated on the basis of direct administrative expenses. Prepare a statement (starting with the contribution to indirect expenses) that shows the net income of each segment.

c. Comment on the appropriateness of the income amounts shown in parts (a) and (b) for determining the income contribution of the segments.

**Problem E** The following data pertain to the operating revenues and expenses for Golden State Company for 2009:

	<b>Los Angeles (LA) Segment</b>	<b>San Francisco (SF) Segment</b>	<b>Total</b>
Sales	\$ 180,000	\$ 360,000	\$ 540,000
Variable expenses	96,000	240,000	336,000
Direct fixed expenses	24,000	30,000	54,000
Indirect fixed expenses			72,000

Regarding the company's total operating assets of USD 900,000, the following facts exist:

	<b>Los Angeles Segment</b>	<b>San Francisco Segment</b>
Assets directly used by and identified with the segment	\$ 180,000	\$ 360,000

a. Prepare a statement showing the contribution margin of each segment, the contribution to indirect expenses of each segment, and the total income of Golden State Company.

b. Determine the return on investment for evaluating (1) the earning power of the entire company and (2) the performance of each segment.

c. Comment on the results of part (b).

**Problem F** Shaq Company operates with three segments, Louisiana, Orlando, and LA. Data regarding these segments follow:

	<b>Louisiana segment</b>	<b>Orlando segment</b>	<b>LA segment</b>
Contribution to indirect expenses	\$ 324,000	\$ 180,000	\$ 144,000
Assets directly used and identified with the segment	1,800,000	1,440,000	720,000

a. Calculate the return on investment for each segment. Rank them from highest to lowest.

b. Assume the cost of capital is 12 per cent for a segment. Calculate residual income for each segment. Rank them from highest to lowest.

c. Repeat (b), but assume the cost of capital is 17 per cent for a segment. Rank them from highest to lowest.

d. Comment on the rankings achieved.

**Problem G** The manager of the Winston Company faced the following data for the year 2009:

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Contribution to indirect expenses	\$ 1,800,000
Assets directly used by and identified with the segment	22,500,000
Sales	36,000,000

- Determine the margin, turnover, and return on investment for the segment in 2009.
- Determine the effect on margin, turnover, and return on investment of the segment in 2010 if each of the following changes were to occur. Consider each change separately and assume that any items not specifically mentioned remain the same as in 2009:

A campaign to control costs resulted in USD 180,000 of reduced expenses.

Certain nonproductive assets were eliminated. As a result, investment decreased by USD 900,000, and expenses decreased by USD 72,000.

An advertising campaign resulted in increasing sales by USD 3,600,000, cost of goods sold by USD 2,700,000, and advertising expense by USD 540,000.

An investment was made in productive assets costing USD 900,000. As a result, sales increased by USD 360,000, and expenses increased by USD 54,000.

**Problem H** For the year ended 2009 December 31, Fore Company reported the following information for the company as a whole and for the sports segment of Fore Corporation:

	<b>Fore company</b>	<b>Sports Woods Project</b>	<b>Segment Irons Project</b>	<b>Total</b>
Sales	\$ 12,000,000	\$ 1,350,000	\$ 600,000	\$ 1,950,000
Income	1,125,000	300,000	37,500	337,500
Investment	4,500,000	900,000	105,000	1,005,000

Fore Company anticipates that these relationships (return on investment, margin, and turnover) will hold true for the upcoming year. The sports segment is faced with the possibility of adding a new project in 2010, with the following projected data:

	<b>Putters Project</b>
Sales	\$ 450,000
Income	52,500
Investment	187,500

- Determine the return on investment for Fore Company, for the sports segment, and for the Woods and Irons projects separately for the year ended 2009 December 31.
- Using this information, determine the effect of adding the Putters project on the sports segment's return on investment. What problem may be encountered?

Using the data provided in the previous problem, determine the residual income (1) for all three projects and (2) for the sports segment with and without the Putters project, if the cost of capital is 25 per cent. What is the effect on the sport segment's residual income if the Putter project is added? How does this result compare with your answer to the previous problem?

### Alternate problems

**Alternate problem A** Swiss Corporation has three production plants (X, Y, and Z). Following is a summary of the results for January 2009:

Plant	Revenues	Expenses	Investment
			Base (gross assets)
X	\$ 720,000	\$ 300,000	\$ 1,440,000
Y	960,000	180,000	1,920,000
Z	5,040,000	1,920,000	13,200,000

- If the plants are treated as profit centers, which plant manager appears to have done the best job?
- If the plants are treated as investment centers, which plant manager appears to have done the best job? (Assume the plant managers are evaluated by return on investment.)
- Do the results of profit center analysis and investment center analysis give different findings? If so, why?

**Alternate problem B** Easy Loans, Inc., allocates expenses and revenues to the two segments that it operates. Easy Loans extends credit to customers under a revolving charge plan whereby all account balances not paid within 30 days are charged interest at the rate of 11/2 per cent per month.

Following are selected revenue and expense accounts and some additional data needed to complete the allocation of the one revenue amount and the expenses.

**Revenue and Expenses (allocation bases)**

Revolving charge service revenue (net sales)	\$ 600,000
Home office building occupancy expense (net sales)	45,000
Buying expenses (net purchases)	150,000
General administrative expenses (number of employees in department)	75,000
Insurance expense (relative average inventory plus cost of equipment and fixtures in each department)	18,000
Depreciation expense on home office equipment (net 30,000 sales)	

	High Risk Segment	Low Risk Segment	Total
Number of employees	3	7	10
Net sales	\$ 300,000	\$ 600,000	\$ 900,000
Net purchases	240,000	360,000	600,000
Averaging inventory	60,000	120,000	180,000
Cost of equipment fixtures	90,000	180,000	270,000

- Prepare a schedule showing allocation of these items to the High and Low Risk segments.
- Do you think these are good allocation bases? Why or why not?

**Alternate problem C** Student Painters, Inc., operates two segments, interior and exterior. The revenue and expense data for 2009 follow:

	Interior	Exterior	Total
Net sales	\$ 335,700	553,800	\$ 889,500
<u>Direct expenses:</u> *			
Cost of goods sold	186,000	282,000	468,000
Selling	31,800	27,000	58,800
Administrative	9,000	6,000	15,000
Uncollectible accounts	2,400	6,600	9,000
<u>Indirect expenses (all fixed):</u>			
Selling			126,000
Administrative			156,000

\*All the direct expenses are variable except administrative expense, which is fixed.

- Prepare a schedule showing the contribution margin, the contribution to indirect expenses of each segment, and net income for the company as a whole. Do not allocate indirect expenses to the segments.

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b. Assume that indirect selling expenses are to be allocated to segments on the basis of net sales (round to the nearest per cent) and that indirect administrative expenses are to be allocated on the basis of direct administrative expenses. Prepare a statement (starting with the contribution to indirect expenses) which shows the net income of each segment.

c. Comment on the appropriateness of the income amounts shown in parts (a) and (b) for determining the income contribution of the segments.

**Alternate problem D** Elliott Corporation has three segments. Following are the results of operations for 2009:

	<b>Segment A</b>	<b>Segment B</b>	<b>Segment C</b>	<b>Total</b>
Sales	\$36,000,000	\$ 21,600,000	\$ 14,400,000	\$ 72,000,000
Variable expenses	25,920,000	12,240,000	9,720,000	47,880,000
<u>Fixed expenses:</u>				
Direct	5,040,000	1,800,000	720,000	7,560,000
Indirect				3,600,000

For the company's total operating assets of USD 100,800,000, the following facts exist:

	<b>Segment A</b>	<b>Segment B</b>	<b>Segment C</b>
Assets directly used by and identified with the segment	\$ 50,400,000	\$ 28,800,000	\$ 14,400,000

- Prepare a statement (in thousands of dollars) showing the contribution margin, the contribution to indirect expenses for each segment, and the total income of the Elliott Corporation.
- Determine the return on investment for evaluating (1) the performance of the entire company and (2) performance of each segment.
- Comment on the results of part (a).

**Alternative problem E** Goodwin Company has three segments, 1,2, and 3. Data regarding these segments follow:

	<b>Segment 1</b>	<b>Segment 2</b>	<b>Segment 3</b>
Contribution to indirect expenses	\$ 432,000	\$ 208,800	\$ 72,000
Assets directly used by and identified with the segment	3,600,000	1,440,000	360,000

- Calculate the return on investment for each segment. Rank them from highest to lowest.
- Assume the cost of capital is 10 per cent for a segment. Calculate the residual income for each segment. Rank them from highest to lowest.
- Repeat (b), but assume the desired cost of capital is 14 per cent. Rank the segments from highest to lowest.
- Comment on the rankings achieved.

#### Beyond the numbers—Critical thinking

**Business decision case A** Texas Company manufactures skateboards. Because the company's business is seasonal, between August and December skilled manufacturing employees are laid off. To improve morale, the financial vice president suggested that 10 employees not be laid off in the future. Instead, she suggested that they work in general labor from August to December but still be paid their manufacturing wages of USD 10 per hour. General labor personnel earn USD 6.60 per hour. What are the implications of this plan for the assignment of costs to the various segments of the business?

**Business decision case B** Piero Company builds new homes. Sarah Richards is in charge of the construction department. Among other responsibilities, Sarah hires and supervises the carpenters and other workers who build the homes. Piero Company does not do its own foundation work. The construction of foundations is done by subcontractors hired by Leslie Larue of the procurement department.

To start the development of a 500-home community, Larue hired Dire Company to build the foundations for the homes. On the day construction was to begin, Dire Company went out of business. Consequently, construction was delayed six weeks while Larue hired a new subcontractor. Which department should be charged with the cost of the delay in construction? Why?

**Business decision case C** Ken Silva is the supervisor of Department 103 of Laguna Company. The annual budget for Silva's department is as follows:

<b>Annual budget for Department 103</b>	
Small tools	\$ 6,750
Set up	7,500

## 25. Responsibility accounting: Segmental analysis

Direct labor	8,250
Direct materials	15,000
Supplies	3,750
Supervision	22,500
Property taxes	3,750
Property insurance	750
Depreciation, machinery	1,500
Depreciation, building	1,500
Total	<u>\$ 71,250</u>

Silva's salary of USD 15,000 is included in supervision. The remaining USD 7,500 in supervision is the salary of the assistant supervisor directly responsible to Silva. Identify the budget items that Silva controls.

**Broader perspective – Writing experience D** Refer to "A broader perspective: Employee buyouts". Write a brief report explaining the effects of employee buyouts on employee motivation.

**Group project E** Macrofast Software, Inc., faces stiff competition in selling its products. Macrofast's top management feels considerable pressure from the company's stockholders to increase earnings.

Mac Washington, the vice president of marketing at the company's Production Software Division, received a memorandum from top management that said, in effect, "Increase your division's earnings or look for a new job".

Washington could think of only one way to increase earnings by the end of the year. The Production Software Division had several installations that should be completed early the following year, probably in February or March. For each of those jobs, he asked the customers to sign a Completed Installation document stating the job was completed to the customer's satisfaction. He did this because Macrofast's accounting department would record the revenue from the job when it received the Completed Installation document.

Several customers signed Completed Installation documents even though the jobs were not complete because Washington gave them a personally signed letter stating the Completion Installation document was not legally binding.

The scheme initially worked. Revenues were prematurely recorded for these jobs, sales and earnings for the year were up, Macrofast's top management was delighted with the results, and Washington was rewarded with a large bonus and a promotion to a vice presidency at corporate headquarters.

The following June, a staff accountant discovered the scheme when a customer called to complain that he was being billed for a job that was not yet completed. When the accountant produced the customer's Completed Installation document, the customer produced Washington's letter saying the document was not binding. The accountant did some detective work and unearthed the scheme. When she presented the results to her supervisor, the supervisor said, "This practice is unfortunate and is against company policy. But what is done is done. Do not worry about last year's financial statements. Just be sure it does not happen again."

- In teams of four, discuss what the staff accountant should do.
- Then, decide how your solution would change if all jobs had been completed to the customers' satisfaction.
- As a team, write a memorandum to your instructor describing your solutions. The heading of the memo should contain the date, to whom it is written, from whom, and the subject matter.

**Group project F** Bleak Prospects, Inc., found that its market share was slipping. Division managers were encouraged to maximize ROI and made decisions consistent with that goal. Nonetheless, there were frequent

customer complaints, with resulting loss of business. Moreover, Bleak depended on an established product line and was unable to find new products for expansion while its competitors seemed to be able to generate new products almost yearly. What would you suggest Bleak Prospects' management do to improve the situation? In groups of two or three students, write a memorandum to your instructor addressing this question. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project G** Management of Division A is evaluated based on residual income measures. The division can either rent or buy a certain asset. Will the performance evaluation technique have an impact on the rent-or-buy decision? Why or why not? In groups of three students, write a memorandum to your instructor addressing this question. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

#### Using the Internet—A view of the real world

Visit the website for PepsiCo, Incorporated.

<http://www.pepsico.com>

Go to the company's most recent annual report. Compare the performance of PepsiCo's three business segments: (1) beverages, (2) snack foods, and (3) restaurants. (You will find business segment information in the notes to the financial statements.) Which business segment had the most operating profits? Which business performed better using ROI, profit margin, and asset turnover as the performance measures? Use end-of-year "identifiable assets" to measure investment, "operating profits" to measure income, and "net sales" to measure sales. Be sure to submit a copy of PepsiCo's business segment information from the annual report.

Visit the website for PepsiCo, Incorporated.

<http://www.pepsico.com>

Go to the company's most recent annual report. Using financial information for the most recent year, which of the company's geographic areas had the highest ROI? (You will find business segment information in the notes to the financial statements, including geographic segments.) Use end-of-year "identifiable assets" to measure investment, "operating profits" to measure income, and "net sales" to measure sales. Be sure to submit a copy of PepsiCo's business segment information from the annual report.

#### Answers to self-test

##### **True-false**

**True.** Those items that a manager has direct control over are included in responsibility reports for that management level.

**True.** An appropriate goal of an expense center is the long-run minimization of expenses.

**True.** The manager's salary would be a direct cost of the segment but not controllable at that level. (The salary would be controllable by someone higher in the organization.)

**False.** Segments should be evaluated using their revenues and direct expenses.

**False.** The income and investment definitions when calculating RI for a segment are contribution to indirect expenses and assets directly used by and identified with the segment.

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**Multiple-choice**

**d.** Any of these bases—current replacement cost, original cost, or original cost less accumulated depreciation—could be used.

**a.** ROI would increase if operating expenses were reduced, all other things remaining constant.

**b.**

$$\text{ROI} = \frac{\text{Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Investment}}$$

$$\text{ROI} = \frac{50,000}{1,000,000} \times \frac{1,000,000}{500,000}$$

$$\text{ROI} = .05 \times 2$$

ROI = 10 per cent

**d.** All of these should be used to evaluate managerial performance.

**c.**

	<b>Segment 1</b>	<b>Segment 2</b>	<b>Segment 3</b>
Income	\$ 180,000	\$ 1,000,000	\$ 500,000
Investment	2,000,000	5,000,000	2,000,000
ROI	9%	20%	25%
Desired minimum			
ROI (10%)	200,000	500,000	200,000
RI	\$ (20,000)	\$ 500,000	\$ 300,000

Consider dropping Segment 1.

# 26. Capital budgeting: Long-range planning

## Learning objectives

After studying this chapter, you should be able to:

- Define capital budgeting, explain budgeting and explain the effects of making poor capital-budgeting decisions.
- Determine the net cash inflows, after taxes, for both an asset addition and an asset replacement.
- Evaluate projects using the payback period.
- Evaluate projects using the unadjusted rate of return.
- Evaluate projects using the net present value.
- Evaluate projects using the profitability index.
- Evaluate projects using the time-adjusting rate of return.
- Determine for project evaluation, the effect of an investment in working capital.

In your personal life, you make many short-run decisions, such as where to go on vacation this year, and many long-run decisions, such as whether to buy a home. The quality of these decisions determines, to a large extent, the success of your life. Businesses also face short-run and long-run decisions.

In previous chapters, you studied how accountants help management make short-run decisions, such as what prices to charge for their products this year. Accountants also play an important role in advising management on long-range decisions that will benefit the company for many years, such as investing in new buildings and equipment. Long-run decisions have a great impact on the long-run success of a company. Incorrect long-run decisions can threaten the survival of a company.

Whereas short-run decisions involve items such as selling prices, costs, volume, and profits in the current year, long-run decisions involve investments in capital assets, such as buildings and equipment, affecting the current year and many future years. Planning for these investments is referred to as capital budgeting.

This chapter introduces the general concepts behind capital budgeting. Then, it discusses and illustrates four methods for selecting the best alternatives among capital projects. Two of these methods involve the use of present value concepts. Finally, the chapter stresses the importance of the postaudit review of capital project decisions.

## Capital budgeting defined

**Capital budgeting** is the process of considering alternative capital projects and selecting those alternatives that provide the most profitable return on available funds, within the framework of company goals and objectives. A

## 26. Capital budgeting: Long-range planning

**capital project** is any available alternative to purchase, build, lease, or renovate buildings, equipment, or other long-range major items of property. The alternative selected usually involves large sums of money and brings about a large increase in fixed costs for a number of years in the future. Once a company builds a plant or undertakes some other capital expenditure, its future plans are less flexible.

Poor capital-budgeting decisions can be costly because of the large sums of money and relatively long periods involved. If a poor capital budgeting decision is implemented, the company can lose all or part of the funds originally invested in the project and not realize the expected benefits. In addition, other actions taken within the company regarding the project, such as finding suppliers of raw materials, are wasted if the capital-budgeting decision must be revoked. Poor capital-budgeting decisions may also harm the company's competitive position because the company does not have the most efficient productive assets needed to compete in world markets.

Investment of funds in a poor alternative can create other problems as well. Workers hired for the project might be laid off if the project fails, creating morale and unemployment problems. Many of the fixed costs still remain even if a plant is closed or not producing. For instance, advertising efforts would be wasted, and stock prices could be affected by the decline in income.

On the other hand, failure to invest enough funds in a good project also can be costly. Ford's Mustang is an excellent example of this problem. At the time of the original capital-budgeting decision, if Ford had correctly estimated the Mustang's popularity, the company would have expended more funds on the project. Because of an undercommitment of funds, Ford found itself short on production capacity, which caused lost and postponed sales of the automobile.

Finally, the amount of funds available for investment is limited. Thus, once a company makes a capital investment decision, alternative investment opportunities are normally lost. The benefits or returns lost by rejecting the best alternative investment are the **opportunity cost** of a given project.

For all these reasons, companies must be very careful in their analysis of capital projects. Capital expenditures do not occur as often as ordinary expenditures such as payroll or inventory purchases but involve substantial sums of money that are then committed for a long period. Therefore, the means by which companies evaluate capital expenditure decisions should be much more formal and detailed than would be necessary for ordinary purchase decisions.

### Project selection: A general view

Making capital-budgeting decisions involves analyzing cash inflows and outflows. This section shows you how to calculate the benefits and costs used in capital-budgeting decisions. Because money has a time value, these benefits and costs are adjusted for time under the last two methods covered in the chapter.

Money received today is worth more than the same amount of money received at a future date, such as a year from now. This principle is known as the time value of money. Money has time value because of investment opportunities, not because of inflation. For example, USD 100 today is worth more than USD 100 to be received one year from today because the USD 100 received today, once invested, grows to some amount greater than USD 100 in one year. Future value and present value concepts are extremely important in assessing the desirability of

long-term investments (capital budgeting). If you need to review these concepts, refer back to the appendix to Chapter 15, which covers these concepts.

The **net cash inflow** (as used in capital budgeting) is the net cash benefit expected from a project in a period. The net cash inflow is the difference between the periodic cash inflows and the periodic cash outflows for a proposed project.

**Asset acquisition** Assume, for example, that a company is considering the purchase of new equipment for USD 120,000. The equipment is expected (1) to have a useful life of 15 years and no salvage value, and (2) to produce cash inflows (revenue) of USD 75,000 per year and cash outflows (costs) of USD 50,000 per year. Ignoring depreciation and taxes, the annual net cash inflow is computed as follows:

Cash inflows	\$75,000.00
Cash outflows	50,000
Net cash inflow	\$ 25,000

**Depreciation and taxes** The computation of the net cash inflow usually includes the effects of depreciation and taxes. Although depreciation does not involve a cash outflow, it is deductible in arriving at federal taxable income. Thus, depreciation reduces the amount of cash outflow for federal income taxes. This reduction is a tax savings made possible by a depreciation tax shield. A **tax shield** is the total amount by which taxable income is reduced due to the deductibility of an item. For example, if depreciation is USD 8,000, the tax shield is USD 8,000. To simplify the illustration, we assume the use of the straight-line depreciation for tax purposes throughout the chapter. Straight-line depreciation can be elected for tax purposes, even under the new tax law.

The tax shield results in a tax savings. The amount of the tax savings can be found by multiplying the tax rate by the amount of the depreciation tax shield. The formula is:

$$\text{Tax rate} \times \text{Depreciation tax shield} = \text{Tax savings}$$

Using the data in the previous example and assuming straight-line depreciation of USD 8,000 per year and a 40 per cent tax rate, the amount of the tax savings is USD 3,200 (40 per cent x USD 8,000 depreciation tax shield). Now, considering taxes and depreciation, we compute the annual net cash inflow from the USD 120,000 of equipment as follows:

	<b>Change in net income</b>	<b>Change in cash flow</b>
Cash inflows	\$ 75,000	\$75,000
Cash outflows	50,000	50,000
Net cash inflow before taxes	\$25,000	\$25,000
Depreciation	8,000	
Income before income taxes	\$17,000	
Deduct: Income at 40%	6,800	6,800
Net income after taxes	\$10,200	
Net cash inflow (after taxes)		\$18,200

If there were no depreciation tax shield, federal income tax expense would have been USD 10,000, or (USD 25,000 x 40 per cent), and the net after-tax cash inflow from the investment would have been USD 15,000, found by (USD 25,000 - USD 10,000), or [USD 25,000 x (1 - 40 per cent)].

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The depreciation tax shield, however, reduces federal income tax expense by USD 3,200, or (USD 8,000 x 40 per cent), and increases the investment's after-tax net cash inflow by the same amount. Therefore, the following formula also can be used to determine the after-tax net cash inflow from an investment:

$$\begin{aligned} \text{Net cash inflow after taxes} &= [\text{Net cash inflow before taxes} \times (1 - \text{Tax rate})] + [\text{Depreciation expense} \times \text{Tax rate}] \\ &= (\text{USD } 25,000 \times (1 - .4)) + (\text{USD } 8,000 \times .4) = \text{USD } 18,200 \end{aligned}$$

**Asset replacement** Sometimes a company must decide whether or not it should replace existing plant assets. Such replacement decisions often occur when faster and more efficient machinery and equipment appear on the market.

The computation of the net cash inflow is more complex for a replacement decision than for an acquisition decision because cash inflows and outflows for two items (the asset being replaced and the new asset) must be considered. To illustrate, assume that a company operates two machines purchased four years ago at a cost of USD 18,000 each. The estimated useful life of each machine is 12 years (with no salvage value). Each machine will produce 40,000 units of product per year. The annual cash operating expenses (labor, repairs, etc.) for the two machines together total USD 14,000. After the old machines have been used for four years, a new machine becomes available. The new machine can be acquired for USD 28,000 and has an estimated useful life of eight years (with no salvage value). The new machine produces 60,000 units annually and entails annual cash operating expenses of USD 10,000. The USD 4,000 reduction in operating expenses (USD 14,000 - USD 10,000) is a USD 4,000 increase in net cash inflow (savings) before taxes.

The firm pays USD 28,000 in the first year to acquire the new machine. In addition to this initial outlay, the annual net cash inflow from replacement is computed as follows:

$$\text{Net cash inflow after taxes} = (\text{Annual net cash inflows (savings) before taxes} \times (1 - \text{tax rate})) + \text{Additional annual depreciation expense} \times \text{Tax rate}$$

Using these data, the following display shows how you can use this formula to find the net cash flow after taxes:

Annual cash operating expenses:

Old machines	\$ 14,000
New machines	10,000
Annual net cash inflow (savings) before taxes	\$ 4,000
1 - Tax rate	X 60%
Annual net cash inflow (savings)* after taxes ignoring depreciation (1)	\$ 2,400

Annual depreciation expense:

Old machines	\$ 3,000
New machine	3,500
Additional annual depreciation expense	\$ 500
Tax rate	X 40%
Tax savings from additional depreciation (2)	200
Net cash inflow after taxes (1) + (2)	\$ 2,600

\*Cash savings are considered to be cash inflows.

In formula format, the calculation is:

$$\text{Net cash inflow after taxes} = (\text{USD } 4,000 \times (1 - .4)) + (\text{USD } 500 \times .4) = \text{USD } 2,600$$

Notice that these figures concentrated only on the differences in costs for each of the two alternatives. Two other items also are relevant to the decision. First, the purchase of the new machine creates a USD 28,000 cash outflow immediately after acquisition. Second, the two old machines can probably be sold, and the selling price or salvage value of the old machines creates a cash inflow in the period of disposal. Also, the previous example used straight-line depreciation. If the modified Accelerated Cost Recovery System (modified ACRS) had been used, the tax shield would have been larger in the early years and smaller in the later years of the asset's life.

**Out-of-pocket and sunk costs** A distinction between out-of-pocket costs and sunk costs needs to be made for capital budgeting decisions. An **out-of-pocket cost** is a cost requiring a future outlay of resources, usually cash. Out-of-pocket costs can be avoided or changed in amount. Future labor and repair costs are examples of out-of-pocket costs.

**Sunk costs** are costs already incurred. Nothing can be done about sunk costs at the present time; they cannot be avoided or changed in amount. The price paid for a machine becomes a sunk cost the minute the purchase has been made (before that moment it was an out-of-pocket cost). The amount of that past outlay cannot be changed, regardless of whether the machine is scrapped or used. Thus, depreciation is a sunk cost because it represents a past cash outlay. Depletion and amortization of assets, such as ore deposits and patents, are also sunk costs.

A sunk cost is a past cost, while an out-of-pocket cost is a future cost. Only the out-of-pocket costs (the future cash outlays) are relevant to capital budgeting decisions. Sunk costs are not relevant, except for any effect they have on the cash outflow for taxes.

**Initial cost and salvage value** Any cash outflows necessary to acquire an asset and place it in a position and condition for its intended use are part of the **initial cost of the asset**. If an investment has a salvage value, that value is a cash inflow in the year of the asset's disposal.

**The cost of capital** The cost of capital is important in project selection. Certainly, any acceptable proposal should offer a return that exceeds the cost of the funds used to finance it. **Cost of capital**, usually expressed as a rate, is the cost of all sources of capital (debt and equity) employed by a company. For convenience, most current liabilities, such as accounts payable and federal income taxes payable, are treated as being without cost. Every other item on the right (equity) side of the balance sheet has a cost. The subject of determining the cost of capital is a controversial topic in the literature of accounting and finance and is not discussed here. We give the assumed rates for the cost of capital in this book. Next, we describe several techniques for deciding whether to invest in capital projects.

### Project selection: Payback period

The **payback period** is the time it takes for the cumulative sum of the annual net cash inflows from a project to equal the initial net cash outlay. In effect, the payback period answers the question: How long will it take the capital project to recover, or pay back, the initial investment? If the net cash inflows each year are a constant amount, the formula for the payback period is:

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$$\text{Payback period} = \frac{\text{Initial cash outlay}}{\text{Annual net cash inflow (benefit)}}$$

For the two assets discussed in the previous section, you can compute the payback period as follows. The purchase of the USD 120,000 equipment creates an annual net cash inflow after taxes of USD 18,200, so the payback period is 6.6 years, computed as follows:

$$\text{Payback period} = \frac{\text{USD } 120,000}{\text{USD } 18,200} = 6.6 \text{ years}$$

The payback period for the replacement machine with a USD 28,000 cash outflow in the first year and an annual net cash inflow of USD 2,600, is 10.8 years, computed as follows:

$$\text{Payback period} = \text{USD } 28,000 / \text{USD } 2,600 = 10.8 \text{ years}$$

Remember that the payback period indicates how long it will take the machine to pay for itself. The replacement machine being considered has a payback period of 10.8 years but a useful life of only 8 years. Therefore, because the investment cannot pay for itself within its useful life, the company should not purchase a new machine to replace the two old machines.

In each of the previous examples, the projected net cash inflow per year was uniform. When the annual returns are uneven, companies use a cumulative calculation to determine the payback period, as shown in the following situation.

Neil Company is considering a capital investment project that costs USD 40,000 and is expected to last 10 years. The projected annual net cash inflows are:

<b>Year</b>	<b>Investment</b>	<b>Annual net cash inflow</b>	<b>Cumulative net cash inflows</b>
0	\$ 40,000	-----	---
1	---	\$ 8,000	\$ 8,000
2	---	6,000	14,000
3	---	7,000	21,000
4	----	5,000	26,000
5	---	8,000	34,000
6	---	6,000	40,000
7	---	3,000	43,000
8	---	2,000	45,000
10	---	1,000	49,000

The payback period in this example is six years—the time it takes to recover the USD 40,000 original investment.

When using payback period analysis to evaluate investment proposals, management may choose one of these rules to decide on project selection:

- Select the investments with the shortest payback periods.
- Select only those investments that have a payback period of less than a specified number of years.

Both decision rules focus on the rapid return of invested capital. If capital can be recovered rapidly, a firm can invest it in other projects, thereby generating more cash inflows or profits.

Some managers use payback period analysis in capital budgeting decisions due to its simplicity. However, this type of analysis has two important limitations:

- Payback period analysis ignores the time period beyond the payback period. For example, assume Allen Company is considering two alternative investments; each requires an initial outlay of USD 30,000. Proposal Y returns USD 6,000 per year for five years, while proposal Z returns USD 5,000 per year for eight years. The payback period for Y is five years (USD 30,000/USD 6,000) and for Z is six years (USD 30,000/USD 5,000). But, if the goal is to maximize income, proposal Z should be selected rather than proposal Y, even though Z has a longer payback period. This is because Z returns a total of USD 40,000, while Y simply recovers the initial USD 30,000 outlay.
- Payback analysis also ignores the time value of money. For example, assume the following net cash inflows are expected in the first three years from two capital projects:

	<b>Net Cash Inflows</b>	
	<b>Project A</b>	<b>Project B</b>
First year	\$ 15,000	\$ 9,000
Second year	12,000	12,000
Third year	9,000	15,000
Total	\$ 36,000	\$ 36,000

Assume that both projects have the same net cash inflow each year beyond the third year. If the cost of each project is USD 36,000, each has a payback period of three years. But common sense indicates that the projects are not equal because money has time value and can be reinvested to increase income. Because larger amounts of cash are received earlier under Project A, it is the preferable project.

### Project selection: Unadjusted rate of return

Another method of evaluating investment projects that you are likely to encounter in practice is the **unadjusted rate of return** method. To compute the unadjusted rate of return, divide the average annual income after taxes by the average amount of investment in the project. The average investment is the (Beginning balance + Ending balance)/2. If the ending balance is zero (as we assume), the average investment equals the original cash investment divided by 2. The formula for the unadjusted rate of return is:

$$\text{Unadjusted rate of return} = \frac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$$

Notice that this calculation uses annual income rather than net cash inflow.<sup>5</sup>

To illustrate the use of the unadjusted rate of return, assume Thomas Company is considering two capital project proposals, each having a useful life of three years. The company does not have enough funds to undertake both projects. Information relating to the projects follows:

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<sup>5</sup> Some formulas use the initial investment in the denominator instead of the average investment. We prefer the average investment because it approximates the use of assets throughout the year not just at the beginning of the year.

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Proposal	Initial cost	Salvage Value	Average annual Before-tax Net cash inflow	Average Annual depreciation
1	\$ 76,000	\$ 4,000	\$ 45,000	\$ 24,000
2	95,000	5,000	55,000	30,000

Assuming a 40 per cent tax rate, Thomas Company can determine the unadjusted rate of return for each project as follows:

		Proposal 1	Proposal 2
Average investment: (original outlay + Salvage value)/2	(1)	\$ 40,000	\$ 50,000
Annual net cash inflow (before income taxes)		\$ 45,000	\$ 55,000
Annual depreciation		24,000	30,000
Annual income (before income taxes)		\$ 21,000	\$ 25,000
Deduct: Income taxes at 40%		8,400	10,000
Average annual net income from investment	(2)	\$ 12,600	\$ 15,000
Rate of return (2)/(1)		31.5%	30%

From these calculations, if Thomas Company makes an investment decision solely on the basis of the unadjusted rate of return, it would select Proposal 1 since it has a higher rate.

Also, the company could compute the unadjusted rate of return with the following formula:

$$\text{Rate of return} = \frac{(\text{Average annual before-tax net cash inflow} - \text{Average annual depreciation}) \times (1 - \text{Tax rate})}{\text{Average investment}}$$

For Proposal 1, the computation is as follows:

$$\begin{aligned} \text{Rate of return} &= \frac{(\text{USD } 45,000 - \text{USD } 24,000) \times (1 - 0.4)}{(\text{USD } 76,000 + \text{USD } 4,000) / 2} \\ &= \frac{\text{USD } 21,000 \times 0.6}{\text{USD } 40,000} = \frac{\text{USD } 12,600}{\text{USD } 50,000} = 30 \text{ per cent} \end{aligned}$$

For Proposal 2, the computation is as follows:

$$\begin{aligned} \text{Rate of return} &= \frac{(\text{USD } 55,000 - \text{USD } 30,000) \times (1 - 0.4)}{(\text{USD } 95,000 + \text{USD } 5,000) / 2} \\ &= \frac{\text{USD } 25,000 \times 0.6}{\text{USD } 50,000} = \frac{\text{USD } 15,000}{\text{USD } 50,000} = 30 \text{ per cent} \end{aligned}$$

Sometimes companies receive information on the average annual after-tax net cash inflow. Average annual after-tax net cash inflow is equal to annual before-tax cash inflow minus taxes. Given this information, the firms could deduct the depreciation to arrive at average net income. For instance, for Proposal 2, Thomas Company would compute average net income as follows:

After-tax net cash inflow (\$55,000- \$10,000)	\$ 45,000
Less: Depreciation	30,000
Average net income	\$ 15,000

The unadjusted rate of return, like payback period analysis, has several limitations:

- The length of time over which the return is earned is not considered.
- The rate allows a sunk cost, depreciation, to enter into the calculation. Since depreciation can be calculated in so many different ways, the rate of return can be manipulated by simply changing the method of depreciation used for the project.
- The timing of cash flows is not considered. Thus, the time value of money is ignored.

Unlike the two project selection methods just illustrated, the remaining two methods—net present value and time-adjusted rate of return—take into account the time value of money in the analysis. In both of these methods, we assume that all net cash inflows occur at the end of the year. Often used in capital budgeting analysis, this assumption makes the calculation of present values less complicated than if we assume the cash flows occurred at some other time.

### Project selection: Net present value method

In this section, you learn to calculate the net present value of capital projects. Then you learn how to use the profitability index to evaluate projects costing different amounts. The profitability index is a refinement of the net present value method.

The **net present value** method uses the company's required minimum rate of return as a discount rate and discounts all expected after-tax cash inflows and outflows from the proposed investment back to their present values. The net present value of the proposed investment is the difference between the present value of the annual net cash inflows and the present value of the required cash outflows.

In many projects, the only cash outflow is the initial investment, and since it occurs immediately, the initial investment does not need to be discounted. Therefore, in such projects, a company may compute the net present value of the proposed project as the present value of the annual net cash inflows minus the initial investment. Other types of projects require that additional investments, such as a major repair, be made at later dates in the life of the project. In those cases, the company must discount the cash outflows to their present value before comparing them to the present value of the net cash inflows.

A major issue in acknowledging the time value of money in the net present value method is determining an appropriate discount rate to use in computing the present value of cash flows. Management requires some minimum rate of return on its investments. This rate should be the company's cost of capital, but that rate is difficult to determine. Therefore, under the net present value method, management often selects a target rate that it believes to be at or above the company's cost of capital, and then uses that rate as a basis for present value calculations.

To illustrate the net present value method, assume Morris Company is considering a capital investment project that will cost USD 25,000. Morris expects net cash inflows after taxes for the next four years to be USD 8,000, USD 7,500, USD 8,000, and USD 7,500, respectively. Management requires a minimum rate of return of 14 per cent and wants to know if the project is acceptable. The following analysis uses the tables in the Appendix at the end of this text:

Annual net	Present value of	Total
Cash inflow (after taxes)	\$ 1 at 14% (from table	Present value

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		<b>A.3)</b>	
First year	\$ 8,000	.87719	\$ 7,018
Second year	7,500	.76947	5,771
Third year	8,000	.67497	5,400
Fourth year	7,500	.59208	4,441
Present value of net cash inflows			\$22,630
Cost of investment			25,000
Net present value			\$ (2,370)

Because the present value of the net cash inflows, USD 22,630, is less than the initial outlay of USD 25,000, the project is not acceptable. The net present value for the project is equal to the present value of its net cash inflows less the present value of its cost (the investment amount), which in this instance is -USD 2,370, calculated as (USD 22,630 - USD 25,000).

When a company uses the net present value method to screen alternative projects, it considers the project with the higher net present value to be more desirable. In general, a proposed capital investment is acceptable if it has a positive net present value. In the previous example, if the expected net cash inflows from the investment had been USD 10,000 per year for four years, the present value of the benefits would have been (from Table A.4 in the Appendix):

$$\text{USD } 10,000 \times 2.9137 = \text{USD } 29,137$$

This calculation yields a net present value of USD 4,137, or USD 29,137 - USD 25,000. Since the net present value is positive, the investment proposal is acceptable. However, a competing project may have an even higher net present value.

When comparing investment projects costing different amounts, the net present value method does not provide a valid means by which to rank the projects in order of desirability assuming limited financial resources. A profitability index provides this additional information to management.

### Profitability index

A **profitability index** is the ratio of the present value of the expected net cash inflows (after taxes) divided by the initial cash outlay (or present value of cash outlays if future outlays are required). The profitability index formula is:

$$\text{Profitability index} = \frac{\text{Present value of net cash inflows}}{\text{Initial cash outlay (present value of cash outlays if future outlays are required)}}$$

Management should consider only those proposals having a profitability index greater than or equal to 1.00. Proposals with a profitability index of less than 1.00 cannot yield the minimum rate of return because the present value of the projected cash inflows is less than the initial cost.

To illustrate use of the profitability index, assume that a company is considering two alternative capital outlay proposals that have the following initial costs and expected net cash inflows after taxes:

	<b>Proposal X</b>	<b>Proposal Y</b>
Initial outlay	\$ 7,000	\$ 9,500
Expected net cash inflow (after taxes):		

Year 1	\$ 5,000	\$ 9,000
Year 2	4,000	6,000
Year 3	6,000	3,000

Management's minimum desired rate of return is 20 per cent.

The net present values and profitability indexes can be computed as follows, using Table A.3 in the Appendix at the end of this book:

	<b>Present value</b>	
	<b>Proposal X</b>	<b>Proposal Y</b>
Year 1 (net cash inflow in year 1 x 0.83333)	\$ 4,167	\$ 7,500
Year 2 (net cash inflow in year 2 x 0.69444)	2,778	4,167
Year 3 (net cash inflow in year 3 x 0.57870)	3,472	1,736
Present value of net cash inflows	\$ 10,417	\$ 13,403
Initial outlay	7,000	9,500
Net present value	\$ 3,417	\$ 3,903
	<b>Proposal X</b>	<b>Proposal Y</b>
Profitability index	\$ 10,417 = 1.49	\$ 13,403 = 1.41
	\$ 7,000	\$ 9,500

When the net present values are compared, Proposal Y appears to be more favorable than Proposal X because its net present value is higher. However, the profitability indexes indicate Proposal X is the more desirable investment because it has the higher profitability index. The higher the profitability index, the more profitable the project per dollar of investment. Proposal X earns a higher rate of return on a smaller investment than Proposal Y.

Another technique for evaluating capital projects that accounts for the time value of money is the time-adjusted rate of return method. The next section discusses this method.

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### An accounting perspective:

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### Business insight

Like US managers, Japanese managers incorporate the cost of capital into their capital investment decisions. However, Japanese managers tend to rely more on consensus decision making, less on the numbers. Discount rates in Japan are generally lower than in the United States.

### Project selection: The time-adjusted rate of return (or internal rate of return)

The **time-adjusted rate of return**, also called the internal rate of return, equates the present value of expected after-tax net cash inflows from an investment with the cost of the investment. It does this by finding the rate at which the net present value of the project is zero. If the time-adjusted rate of return equals or exceeds the cost of capital or target rate of return, a firm should consider the investment further. If the proposal's time-adjusted rate of return is less than the minimum rate, the firm should reject the proposal. Ignoring other considerations, the higher the time-adjusted rate of return, the more desirable the project.

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Calculators and computer software with time-adjusted rate of return functions are readily available. Present value tables also can approximate the time-adjusted rate of return. To illustrate, assume Young Company is considering a USD 90,000 investment expected to last 25 years with no salvage value. The investment yields a USD 15,000 annual after-tax net cash inflow. This USD 15,000 is referred to as an **annuity**, which is a series of equal cash inflows.

The first step in computing the rate of return is to determine the payback period. In this case, the payback period is six years (USD 90,000/USD 15,000). The second step is to examine Table A.4 in the Appendix (present value of an annuity) to find the present value factor that is nearest in amount to the payback period of 6. Since the investment is expected to yield returns for 25 years, look at that row in the table. In that row, the factor nearest to 6 is 5.92745, which appears under the 16.5 per cent interest column. The third step is to multiply the annual return of USD 15,000 by the 5.92745 factor; the result is USD 88,912, which is just below the USD 90,000 cost of the project. Thus, the actual rate of return is slightly less than 16.5 per cent. The rate of return is less than 16.5 per cent but more than 16 per cent because as interest rates increase, present values decrease because less investment is needed to generate the same income.

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### A broader perspective: Caterpillar, Inc.

Caterpillar, Inc., invested USD 1.5 billion in a worldwide factory modernization program. Caterpillar's management realized it must continually monitor the performance of this modernization if the project was to realize its potential.

At Caterpillar, the projects are grouped into "bundles" of related projects. For example, all of the new assets used for a new product would be bundled together. "Each bundle is monitored every six months at Caterpillar, although a few key characteristics of some bundles are monitored monthly" [p. 32]. Characteristics used in monitoring performance include the amount of money projected versus the amount actually spent on the projects, the number of people expected to be used on the projects versus the number actually used, and the estimated reduction in product cost versus the reduction in product cost actually achieved.

Many firms believe their evaluation of project performance leaves much to be desired. Caterpillar's idea of "bundling" similar projects should be helpful to other firms making significant changes in their production processes and product lines.

Source: Based on the article by James A. Hendricks, Robert C. Bastian, and Thomas L. Sexton, "Bundle Monitoring of Strategic Projects," *Management Accounting*, February 1992, pp. 31-35.

The preceding example involves uniform net cash inflows from year to year. But what happens when net cash inflows are not uniform? In such instances, a trial and error procedure is necessary if present value tables are used. For example, assume that Young Company is considering a USD 200,000 project that will last four years and yield the following returns:

**Net cash inflow**

<b>Year</b>	<b>(after taxes)</b>
1	\$ 20,000
2	40,000
3	80,000
4	150,000
Total	\$ 290,000

The average annual cash inflow is  $\text{USD } 290,000/4 = \text{USD } 72,500$ . Based on this average net cash inflow, the payback period is  $\text{USD } 200,000/\text{USD } 72,500 = 2.76$  years. Looking in the four-year row of Table A.4 in the Appendix, we find that the factor 2.77048 is nearest to the payback period of 2.76. In this case, however, cash flows are not uniform. The largest returns occur in the later years of the asset's life. Since the early returns have the largest present value, the rate of return is likely to be less than the 16.5 per cent rate that corresponds to the present value factor 2.77048. If the returns had been greater during the earlier years of the asset's life, the correct rate of return would have been higher than 16.5 per cent. To find the specific discount rate that yields a present value closest to the initial outlay of USD 200,000, we try out several interest rates less than 16 per cent. The rate of return is found by trial and error. The following computation reveals the rate to be slightly higher than 12 per cent:

<b>Year</b>	<b>Return</b>	<b>Present value Factor at 12%</b>	<b>Present value of net Cash inflows</b>
1	\$ 20,000	0.89286	\$ 17,857
2	40,000	0.79719	31,888
3	80,000	0.71178	56,942
4	150,000	0.63553	95,330
			\$ 202,017

Since the cost of capital is not a precise percentage, some financial theorists argue that the time-adjusted rate of return method is preferable to the net present value method. Under the time-adjusted rate of return method, the cost of capital is used only as a cutoff point in deciding which projects are acceptable and should be given more consideration.

No matter which time value of money concept is considered better, these methods are both theoretically superior to the payback period and the unadjusted rate of return methods. However, the time value of money methods are more difficult to compute unless you use a business calculator or a microcomputer spreadsheet program. In reality, no single method should be used by itself to make capital-budgeting decisions. Managers should consider all aspects of the investment, including such nonquantitative factors as employee morale (layoff of workers due to higher efficiency of a new machine) and company flexibility (versatility of production of one machine over another). The company commits itself to its investment in a capital project for a long time and should use the best selection techniques and judgment available.

Too often, in capital project selection decisions, investments in working capital are ignored. The next section shows how to incorporate this factor into the analysis.

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An accounting perspective:

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Use of technology

People use PC spreadsheets extensively in evaluating capital projects. Decisions about investing in capital projects require a lot of thinking about the future. Because no one can predict the future with certainty, people often make numerous estimates of future cash flows—some optimistic, some pessimistic, and some simply best guesses. PC spreadsheets make the preparation of numerous forecasts (scenarios) feasible, and even fun.

**Investments in working capital**

An investment in a capital asset usually must be supported by an investment in working capital, such as accounts receivable and inventory. For example, companies often invest in a capital project expecting to increase sales. Increased sales usually bring about an increase in accounts receivable from customers and an increase in inventory to support the higher sales level. The increases in current assets—accounts receivable and inventory—are investments in working capital that usually are recovered in full at the end of a capital project's life. Such working capital investments should be considered in capital-budgeting decisions.

To illustrate, assume that a company is considering a capital project involving a USD 50,000 investment in machinery and a USD 40,000 investment in working capital. The machine, which will produce a new product, has an estimated useful life of eight years and no salvage value. The annual cash inflows (before taxes) are estimated at USD 25,000, with annual cash outflows (before taxes) of USD 5,000. The annual net cash inflow from the project is computed as follows (assuming straight-line depreciation and a 40 per cent tax rate):

Cash inflows	\$ 25,000
Cash outflows	5,000
Net cash inflow before taxes	\$ 20,000
1 – Tax rate	X 60%
Net cash inflow after taxes (ignoring depreciation) (1)	\$ 12,000
Depreciation tax shield (\$ 50,000/8 years)	\$ 6,250
Income tax rate	X 40%
Depreciation tax savings (2)	\$ 2,500
Annual net cash inflow, years 1-8 (1) + (2)	\$ 14,500

The annual net cash inflow from the machine is USD 14,500 each year for eight years. However, the working capital investment must be considered. The investment of USD 40,000 in working capital at the start of the project is an additional outlay that must be made when the project is started. The USD 40,000 would be tied up every year until the project is finished, or in this case, until the end of the life of the machine. At that point, the working capital would be released, and the USD 40,000 could be used for other investments. Therefore, the USD 40,000 is a cash outlay at the start of the project and a cash inflow at the end of the project.

The net present value of the project is computed as follows (assuming a 14 per cent minimum desired rate of return):

Net cash inflow, years 1-8 ( $\$ 14,500 \times 4.63886$ )	\$ 67,263
Recovery of investment in working capital ( $\$ 40,000 \times 0.35056$ )	14,022
Present value of net cash inflows	\$ 81,285
Initial cash outlay ( $\$ 50,000 + \$ 40,000$ )	90,000
Net present value	\$ (8,715)

The discount factor for the cash inflows, 4.63886, comes from Table A.4 in the Appendix at the end of the book, because the cash inflows in this example are a series of equal payments—an annuity. The recovery of the investment in working capital is assumed to represent a single lump sum received at the end of the project's life. As such, it is discounted using a factor (0.35056) that comes from Table A.3 in the Appendix.

The investment is not acceptable because it has a negative net present value. If the working capital investment had been ignored, the proposal would have had a rather large positive net present value of USD 17,263 (USD 67,263 - USD 50,000). Thus, it should be obvious that investments in working capital must be considered if correct capital-budgeting decisions are to be made.

The next topic discussed in the chapter is the postaudit. This important step improves the chances that future capital project selection decisions are based on realistic projections of benefits and costs.

### The postaudit

The last step in the capital-budgeting process is a postaudit review that should be performed by a person not involved in the capital-budgeting decision-making process. Such a person can provide an impartial judgment on the project's worthiness. This step should be performed early in the project's life, but enough time should have passed for any operational bugs to have been worked out. Actual operating costs and revenues should be determined and compared with those estimated when the project was originally reviewed and accepted. The postaudit review performs these functions:

- Let management know if the projections were accurate and if the particular project is performing as expected regarding cash inflows and outflows.
- May identify additional factors for management to consider in upcoming capital-budgeting decisions, such as cash outflows that were forgotten in a particular project.
- Provides a review of the capital-budgeting process to determine how effectively and efficiently it is working. The postaudit provides information that allows management to compare the actual results of decisions with the expectations it had during the planning and selection phases of the capital-budgeting process.

### Investing in high technology projects

Many companies have found it hard to justify high technology investments. A US auto manufacturer, for example, found it difficult to justify investing in a new computer-based flexible manufacturing system because its cost savings occurred so far in the future. When discounted, the present value of these savings did not justify the initial outlay. The president of the company was convinced, however, that the new system had benefits not

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quantified in the cash flow estimates, so he approved the investment even though it had a negative net present value.

Companies have difficulty in justifying an investment in high technology projects for several reasons. First, often several years pass before companies see the cash inflows from the investment. Even if the cash inflows are high, their net present value is low if they come several years in the future.

Second, management has difficulty identifying and measuring all of the benefits of new technology. When personal computers replaced typewriters, for example, people learned many new ways of creating and storing documents by using the computer. These benefits occurred because people used computers and experimented with them. These benefits would have been difficult to predict, much less measure, back when companies were trying to justify investment in personal computers. Managers believe that sometimes they just have to have faith that the investment is a good one, even though they cannot justify it on quantifiable economic grounds.

### Capital budgeting in not-for-profit organizations

The concepts discussed in this chapter also apply to not-for-profit organizations, such as universities, school districts, cities, and not-for-profit hospitals. Since these organizations are not subject to as many taxes as profit-making organizations, the cash flows related to taxes are usually zero or near zero.

### Epilogue

You have now completed the last chapter in this text. Thank you for using our textbook. The knowledge you have gained will serve you well in any career you choose. Good luck!

### Understanding the learning objectives

- Capital budgeting is the process of considering alternative capital projects and selecting those alternatives that provide the most profitable return on available funds, within the framework of company goals and objectives.
- Poor capital budgeting decisions can cause a company to lose all or part of the funds originally invested in a project and can harm the company's competitive position in world markets.
- Asset addition:

Net cash inflow after taxes = (Net cash inflow before taxes  $\times$  (1 - Tax rate)) + (Depreciation expense  $\times$  Tax rate)

- Asset replacement:

Net cash inflow after taxes = (Annual net cash inflows (savings) before taxes  $\times$  (1 - Tax rate)) + (Additional annual depreciation expense  $\times$  Tax rate)

- Payback period = 
$$\frac{\text{Initial cash outlay}}{\text{Annual net cash inflows (benefits)}}$$
- Unadjusted rate of return = 
$$\frac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$$

- All expected after-tax cash inflows and outflows from the proposed investment are discounted to their present values using the company's required minimum rate of return as a discount rate. The net present value of the proposed investment is the difference between the present value of the annual net cash in flows and the present value of the required cash outflows

• Profitability index = 
$$\frac{\text{Present value of net cash inflows}}{\text{Initial cash outlay (present value of cash outlays if future outlays are required)}}$$

• The time-adjusted rate of return equates the present value of expected after-tax net cash inflows from an investment with the cost of the investment by finding the rate at which the net present value of the project is zero. If the time-adjusted rate of return equals or exceeds the cost of capital or the target rate of return, the project should be considered. If the rate is less than the minimum rate, the project should be rejected.

• The investment in working capital causes the net present value to be lower than it would be if the working capital investment is ignored. Therefore, the required return of a project must be higher to account for the investment in working capital.

### Demonstration problem

Barkley Company is considering three different investments; the following data relate to these investments:

Investment	Initial cash outlay	Expected Before-Tax Net	Expected after-tax net	Expected life
		Cash inflow per year	Cash inflow per year	Of proposals* (years)
A	\$ 50,000	\$ 13,333	\$ 10,000	10
B	60,000	12,000	8,800	15
C	75,000	15,000	10,500	20

\*No estimated salvage value. Use straight-line depreciation.

The income tax rate is 40 per cent. The salvage value of each investment is zero. Management requires a minimum return on investments of 14 per cent.

Rank these proposals using the following selection techniques:

- Payback period.
- Unadjusted rate of return.
- Profitability index.
- Time-adjusted rate of return.

### Solution to demonstration problem

a. Payback period:

Proposal	(a) Investment	(b) Annual after-tax Cash inflow	(a)/(b) Payback period (years)
A	\$ 50,000	\$ 10,000	5.00
B	60,000	8,800	6.82
C	75,000	10,500	7.14

b. Unadjusted rate of return:

(a)	(b)	(c)	(d)=[(b - c) x (1 - 4)]	(d)/(a)
Investment	Average annual before -tax net	Average	Average	Rate

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Proposal	Average investment	Cash inflow	Depreciation	Annual income	Of Return
A	\$ 25,000	\$ 13,333	\$ 5,000	\$ 5,000	20%
B	30,000	12,000	4,000	4,800	16%
C	37,500	15,000	3,750	6,750	18%

The proposals in order of desirability are A, C, and B.

c. Profitability index:

Proposal	(a) Annual after-tax net Cash inflow	(b) Present Value factor at 14%	(c) = (a) x (b) Present value of Annual Net cash inflow	(d) Initial cash Outlay	(c) x (d) Profitability Index
A	\$ 10,000*	5.21612	\$ 52,161	\$ 50,000	1.04
B	8,800	6.14217	54,051	60,000	0.90
C	10,500	6.62313	69,543	75,000	0.93

\*This amount was given. However, the amount can also be calculated as follows:

Expected before-tax net cash inflow	\$ 13,333
Less depreciation	5,000
Taxable income	\$ 8,333
1 – Tax rate	<u>X 60%</u>
After-tax annual income	\$ 5,000
Add back depreciation	5,000
Annual after-tax net cash inflow	\$ 10,000

The proposals in order of desirability are A, C, and B. (But neither B nor C should be considered acceptable since each has a profitability index of less than one.)

d. Time-adjusted rate of return:

Proposal	Rate	How found
A	15% (slightly above)	$(\$ 50,000 / \$ 10,000) =$ Factor of 5 in 10 period row
B	12% (slightly below)	$(\$ 60,000 / \$ 8,800) =$ Factor of 6.82 in 15 period row
C	13% (slightly below)	$(\$ 75,000 / \$ 10,500) =$ Factor of 7.14 in 20 period row

The proposals in order of desirability are A, C, and B. (But neither B nor C earns the minimum rate of return.)

### Key terms\*

**Annuity** A series of equal cash inflows.

**Capital budgeting** The process of considering alternative capital projects and selecting those alternatives that provide the most profitable return on available funds, within the framework of company goals and objectives.

**Capital project** Any available alternative to purchase, build, lease, or renovate equipment, buildings, property, or other long-term assets.

**Cost of capital** The cost of all sources of capital (debt and equity) employed by a company.

**Initial cost of an asset** Any cash outflows necessary to acquire an asset and place it in a position and condition for its intended use.

**Net cash inflow** The periodic cash inflows from a project less the periodic cash outflows related to the project.

**Net present value** A project selection technique that discounts all expected after-tax cash inflows and outflows from the proposed investment to their present values using the company's minimum rate of return

as a discount rate. If the amount obtained by this process exceeds or equals the investment amount, the proposal is considered acceptable for further consideration.

**Opportunity cost** The benefits or returns lost by rejecting the best alternative investment.

**Out-of-pocket cost** A cost requiring a future outlay of resources, usually cash.

**Payback period** The period of time it takes for the cumulative sum of the annual net cash inflows from a project to equal the initial net cash outlay.

**Profitability index** The ratio of the present value of the expected net cash inflows (after taxes) divided by the initial cash outlay (or present value of cash outlays if future outlays are required).

**Sunk costs** Costs that have already been incurred. Nothing can be done about sunk costs at the present time; they cannot be avoided or changed in amount.

**Tax shield** The total amount by which taxable income is reduced due to the deductibility of an item.

**Time-adjusted rate of return** A project selection technique that finds a rate of return that will equate the present value of future expected net cash inflows (after taxes) from an investment with the cost of the investment; also called internal rate of return.

**Unadjusted rate of return** The rate of return computed by dividing average annual income after taxes from a project by the average amount of the investment.

\*Some terms listed in earlier chapters are repeated here for your convenience.

### Self-test

#### True-false

Indicate whether each of the following is true or false.

Depreciation does not involve a cash outflow; it is deductible in arriving at federal taxable income.

The price a company is going to pay for a machine is an out-of-pocket cost.

Sunk costs and out-of-pocket costs are relevant to capital-budgeting decisions.

A formula for unadjusted rate of return is as follows:

Unadjusted rate of return = Average annual income after taxes/Average amount of investment

When investment projects cost different amounts are being compared, the net present value does not provide a valid means by which to rank projects in order of contribution to income or desirability assuming limited financial resources.

#### Multiple-choice

Choose the best answer for each of the following questions.

Which of the following is incorrect regarding the payback period method?

- The payback period ignores the time period beyond the payback period.
- When using payback analysis for investment decisions, one rule is to select the shortest payback period investment.
- The formula for the payback period is:

Payback period = Initial cash outlay/Annual amount of investment

- Payback analysis ignores the time value of money.

## 26. Capital budgeting: Long-range planning

When using time value of money concepts, all aspects of the investment should be considered including which of the following?

- a. Employee morale.
- b. No single time value of money method should be used by itself to make capital budgeting decisions.
- c. Company flexibility.
- d. All of the above.

Which of the following correctly describe(s) the limitations when using the unadjusted rate of return.

- a. Timing of cash flows is not considered.
- b. It allows a sunk cost, depreciation, to enter into the calculation.
- c. The length of time over which the return will be earned is not considered.
- d. All of the above.

Which of the following statements is (are) true regarding the profitability index?

- a. Only proposals with profitability indexes greater than 1.00 should be considered.
- b. Only proposals with profitability indexes less than 1.00 should be considered.
- c. The profitability index is the ratio of the initial cash outlay divided by the present value of cash benefits (before taxes).
- d. b and c.

Which of the following statements is (are) true regarding net present value?

- a. When determining an appropriate discount rate, management uses net cash outflow.
- b. With projects that require an investment at a later date, management must discount the cash outflow to its present value before it is compared to the present value of cash inflows.
- c. When using the net present value to screen alternative projects, as long as the project's net present value is equal to the investment the project is desirable.
- d. b and c.

Which of the following statements is (are) true regarding the time-adjusted rate of return?

- a. The first step in computing the rate of return is determining the payback period.
- b. The annual after-tax net cash inflow also is called an annuity.
- c. The cost of capital is used only as a cutoff point in deciding which projects should be considered further.
- d. All of the above.

Now turn to "Answers to self-test" at the back of the chapter to check your answers.

## Questions

- How do capital expenditures differ from ordinary expenditures?
- What effects can capital-budgeting decisions have on a company?
- What effect does depreciation have on cash flow?
- Give an example of an out-of-pocket cost and a sunk cost by describing a situation in which both are encountered.
- A machine is being considered for purchase. The salesperson attempting to sell the machine says that it will pay for itself in five years. What is meant by this statement?
- Discuss the limitations of the payback period method.
- What is the profitability index, and of what value is it?
- What is the time-adjusted rate of return on a capital investment?
- What role does the cost of capital play in the time-adjusted rate of return method and in the net present value method?
- What is the purpose of a postaudit? When should a postaudit be performed?
- A friend who knows nothing about the concepts in this chapter is considering purchasing a house for rental to students. In just a few words, what would you tell your friend to think about in making this decision?

## Exercises

**Exercise A** Diane Manufacturing Company is considering investing USD 600,000 in new equipment with an estimated useful life of 10 years and no salvage value. The equipment is expected to produce USD 240,000 in cash inflows and USD 160,000 in cash outflows annually. The company uses straight-line depreciation, and has a 40 per cent tax rate. Determine the annual estimated net income and net cash inflow.

**Exercise B** Zen Manufacturing Company is considering replacing a four-year-old machine with a new, advanced model. The old machine was purchased for USD 60,000, has an estimated useful life of 10 years with no salvage value, and has annual maintenance costs of USD 15,000. The new machine would cost USD 45,000, but annual maintenance costs would be only USD 6,000. The new machine would have an estimated useful life of 10 years with no salvage value. Using straight-line depreciation and an assumed 40 per cent tax rate, compute the additional annual cash inflow if the old machine is replaced.

**Exercise C** Given the following annual costs, compute the payback period for the new machine if its initial cost is USD 420,000.

	<b>Old machine</b>	<b>New machine</b>
Depreciation	\$ 18,000	\$ 42,000
Labor	72,000	63,000
Repairs	21,000	4,500
Other costs	12,000	3,600
	\$ 123,000	\$ 113,100

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**Exercise D** Jefferson Company is considering investing USD 33,000 in a new machine. The machine is expected to last five years and to have a salvage value of USD 8,000. Annual before-tax net cash inflow from the machine is expected to be USD 7,000. Calculate the unadjusted rate of return. The income tax rate is 40 per cent.

**Exercise E** Compute the profitability index for each of the following two proposals assuming the desired minimum rate of return is 20 per cent. Based on the profitability indexes, which proposal is better?

	<b>Proposal 1</b>	<b>Proposal 2</b>
Initial cash outlay	\$ 16,000	\$ 10,300
Net cash inflow (after taxes):		
First year	10,000	6,000
Second year	9,000	6,000
Third year	6,000	4,000
Fourth year	-0-	2,500

**Exercise F** Ross Company is considering three alternative investment proposals. Using the following information, rank the proposals in order of desirability using the payback period method.

	<b>Proposal</b>		
	<b>A</b>	<b>B</b>	<b>C</b>
Initial outlay	\$ 360,000	\$ 360,000	\$ 360,000
Net cash inflow (after taxes):			
First year	\$ -0-	\$ 90,000	\$ 90,000
Second year	180,000	270,000	180,000
Third year	180,000	90,000	270,000
Fourth year	90,000	180,000	450,000
	\$ 450,000	\$ 630,000	\$ 990,000

**Exercise G** Simone Company is considering the purchase of a new machine costing USD 50,000. It is expected to save USD 9,000 cash per year for 10 years, has an estimated useful life of 10 years, and no salvage value. Management will not make any investment unless at least an 18 per cent rate of return can be earned. Using the net present value method, determine if the proposal is acceptable. Assume all tax effects are included in these numbers.

**Exercise H** Refer to the data in previous exercise. Calculate the time-adjusted rate of return.

**Exercise I** Rank the following investments for Renate Company in order of their desirability using the (a) payback period method, (b) net present value method, and (c) time-adjusted rate of return method. Management requires a minimum rate of return of 14 per cent.

	<b>Initial</b>	<b>Expected after-tax net cash</b>	<b>Expected life of proposal</b>
<b>Investment</b>	<b>Cash outlay</b>	<b>Inflow per year</b>	<b>(years)</b>
A	\$ 120,000	\$ 15,000	8
B	150,000	26,000	20
C	240,000	48,000	10

### Problems

**Problem A** Hamlet Company is considering the purchase of a new machine that would cost USD 300,000 and would have an estimated useful life of 10 years with no salvage value. The new machine is expected to have annual before-tax cash inflows of USD 100,000 and annual before-tax cash outflows of USD 40,000. The company will depreciate the machine using straight-line depreciation, and the assumed tax rate is 40 per cent.

a. Determine the net after-tax cash inflow for the new machine.

b. Determine the payback period for the new machine.

**Problem B** Graham Company currently uses four machines to produce 400,000 units annually. The machines were bought three years ago for USD 50,000 each and have an expected useful life of 10 years with no salvage value. These machines cost a total of USD 30,000 per year to repair and maintain.

The company is considering replacing the four machines with one technologically superior machine capable of producing 400,000 units annually by itself. The machine would cost USD 140,000 and have an estimated useful life of seven years with no salvage value. Annual repair and maintenance costs are estimated at USD 14,000.

Assuming straight-line depreciation and a 40 per cent tax rate, determine the annual additional after-tax net cash inflow if the new machine is acquired.

**Problem C** Macro Company owns five machines that it uses in its manufacturing operations. Each of the machines was purchased four years ago at a cost of USD 120,000. Each machine has an estimated life of 10 years with no expected salvage value. A new machine has become available. One new machine has the same productive capacity as the five old machines combined; it can produce 800,000 units each year. The new machine will cost USD 648,000, is estimated to last six years, and will have a salvage value of USD 72,000. A trade-in allowance of USD 24,000 is available for each of the old machines. These are the operating costs per unit:

	<b>Five old Machines</b>	<b>New Machines</b>
Repairs	\$ 0.6796	\$ 0.0856
Depreciation	0.1500	0.2400
Power	0.1890	0.1036
Other operating costs	0.1620	0.0496
	\$ 1.1806	\$ 0.4788

Ignore federal income taxes. Use the payback period method for (a) and (b).

a. Do you recommend replacing the old machines? Support your answer with computations. Disregard all factors except those reflected in the data just given.

b. If the old machines were already fully depreciated, would your answer be different? Why?

c. Using the net present value method with a discount rate of 20 per cent, present a schedule showing whether or not the new machine should be acquired.

**Problem D** Span Fruit Company has used a particular canning machine for several years. The machine has a zero salvage value. The company is considering buying a technologically improved machine at a cost of USD 232,000. The new machine will save USD 50,000 per year after taxes in cash operating costs. If the company decides not to buy the new machine, it can use the old machine for an indefinite time by incurring heavy repair costs. The new machine would have an estimated useful life of eight years.

a. Compute the time-adjusted rate of return for the new machine.

b. Management thinks the estimated useful life of the new machine may be more or less than eight years. Compute the time-adjusted rate of return for the new machine if its useful life is (1) 5 years and (2) 12 years, instead of 8 years.

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c. Suppose the new machine's useful life is eight years, but the annual after-tax cost savings are only USD 45,000. Compute the time-adjusted rate of return.

d. Assume the annual after-tax cost savings from the new machine will be USD 35,000 and its useful life will be 10 years. Compute the time-adjusted rate of return.

**Problem E** Merryll, Inc., is considering three different investments involving depreciable assets with no salvage value. The following data relate to these investments:

	<b>Initial cash</b>	<b>Expected before-tax net</b>	<b>Expected after-tax net</b>	<b>Life of proposal</b>
<b>Investment</b>	<b>Outlay</b>	<b>Cash inflow per year</b>	<b>Cash inflow per year</b>	<b>(years)</b>
1	\$ 140,000	\$ 37,333	\$ 28,000	10
2	240,000	72,000	48,000	20
3	360,000	89,333	68,000	10

The income tax rate is 40 per cent. Management requires a minimum return on investment of 12 per cent.

Rank these proposals using the following selection techniques:

- Payback period.
- Unadjusted rate of return.
- Profitability index.
- Time-adjusted rate of return.

**Problem F** Slow to Change Company has decided to computerize its accounting system. The company has two alternatives—it can lease a computer under a three-year contract or purchase a computer outright.

If the computer is leased, the lease payment will be USD 5,000 each year. The first lease payment will be due on the day the lease contract is signed. The other two payments will be due at the end of the first and second years. The lessor will provide all repairs and maintenance.

If the company purchases the computer outright, it will incur the following costs:

Acquisition cost	\$ 10,500
Repairs and maintenance:	
First year	300
Second year	250
Third year	350

The computer is expected to have only a three-year useful life because of obsolescence and technological advancements. The computer will have no salvage value and be depreciated on a double-declining-balance basis. Slow to Change Company's cost of capital is 16 per cent.

- Calculate the net present value of out-of-pocket costs for the lease alternative.
- Calculate the net present value of out-of-pocket costs for the purchase alternative.
- Do you recommend that the company purchase or lease the machine?

**Problem G** Van Gogh Sports Company is trying to decide whether to add tennis equipment to its existing line of football, baseball, and basketball equipment. Market research studies and cost analyses have provided the following information:

Van Gogh will need additional machinery and equipment to manufacture the tennis equipment. The machines and equipment will cost USD 450,000, have an estimated 10-year useful life, and have a USD 10,000 salvage value.

Sales of tennis equipment for the next 10 years have been projected as follows:

Years	Sales in dollars
1	\$ 75,000
2	112,500
3	168,750
4	187,500
5	206,250
6 – 10 (each year)	225,000

Variable costs are 60 per cent of selling price, and fixed costs (including straight-line depreciation) will total USD 88,500 per year.

The company must advertise its new product line to gain rapid entry into the market. Its advertising campaign costs will be:

Years	Annual advertising cost
1 – 3	\$ 75,000
4 – 10	37,500

The company requires a 14 per cent minimum rate of return on investments.

Using the net present value method, decide whether or not Van Gogh Sports Company should add the tennis equipment to its line of products. (Ignore federal income taxes.) Round to the nearest dollar.

**Problem H** Jordan Company is considering purchasing new equipment costing USD 2,400,000. Jordan estimates that the useful life of the equipment will be five years and that it will have a salvage value of USD 600,000. The company uses straight-line depreciation. The new equipment is expected to have a net cash inflow (before taxes) of USD 258,000 annually. Assume that the tax rate is 40 per cent and that management requires a minimum return of 14 per cent.

Using the net present value method, determine whether the equipment is an acceptable investment.

**Problem I** Penny Company has an opportunity to sell some equipment for USD 40,000. Such a sale will result in a tax-deductible loss of USD 4,000. If the equipment is not sold, it is expected to produce net cash inflows after taxes of USD 8,000 for the next 10 years. After 10 years, the equipment can be sold for its book value of USD 4,000. Assume a 40 per cent federal income tax rate.

Management currently has other opportunities that will yield 18 per cent. Using the net present value method, show whether the company should sell the equipment. Prepare a schedule to support your conclusion.

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### Alternate problems

**Alternate problem A** Mark's Manufacturing Company is currently using three machines that it bought seven years ago to manufacture its product. Each machine produces 10,000 units annually. Each machine originally cost USD 25,500 and has an estimated useful life of 17 years with no salvage value.

The new assistant manager of Mark's Manufacturing Company suggests that the company replace the three old machines with two technically superior machines for USD 22,500 each. Each new machine would produce 15,000 units annually and would have an estimated useful life of 10 years with no salvage value.

The new assistant manager points out that the cost of maintaining the new machines would be much lower. Each old machine costs USD 2,500 per year to maintain; each new machine would cost only USD 1,500 a year to maintain.

Compute the increase in after-tax annual net cash inflow that would result from replacing the old machines; use straight-line depreciation and an assumed tax rate of 40 per cent.

**Alternate problem B** Fed Extra Company is considering replacing 10 of its delivery vans that originally cost USD 30,000 each; depreciation of USD 18,750 has already been taken on each van. The vans were originally estimated to have useful lives of eight years and no salvage value. Each van travels an average of 150,000 miles per year. The 10 new vans, if purchased, will cost USD 36,000 each. Each van will be driven 150,000 miles per year and will have no salvage value at the end of its three-year estimated useful life. A trade-in allowance of USD 3,000 is available for each of the old vans. Following is a comparison of costs of operation per mile:

	Old vans	New vans
Fuel, lubricants, etc.	\$ 0.152	\$ 0.119
Tires	0.067	0.067
Repairs	0.110	0.087
Depreciation	0.025	0.080
Other operating costs	0.051	0.043
Operating costs per mile	\$ 0.405	\$ 0.396

Use the payback period method for (a) and (b).

a. Do you recommend replacing the old vans? Support your answer with computations and disregard all factors not related to the preceding data.

b. If the old vans were already fully depreciated, would your answer be different? Why?

c. Assume that all cost flows for operating costs fall at the end of each year and that 18 per cent is an appropriate rate for discounting purposes. Using the net present value method, present a schedule showing whether or not the new vans should be acquired.

**Alternate problem C** Mesa Company has been using an old-fashioned computer for many years. The computer has no salvage value. The company is considering buying a computer system at a cost of USD 35,000. The new computer system will save USD 7,000 per year after taxes in cash (including tax effects of depreciation). If the company decides not to buy the new computer system, it can use the old one for an indefinite time. The new computer system will have an estimated useful life of 10 years.

a. Compute the time-adjusted rate of return for the new computer system.

b. The company is uncertain about the new computer system's 10-year useful life. Compute the time-adjusted rate of return for the new computer system if its useful life is (1) 6 years and (2) 15 years, instead of 10 years.

c. Suppose the computer system has a useful life of 10 years, but the annual after-tax cost savings are only USD 4,500. Compute the time-adjusted rate of return.

d. Assume the annual after-tax cost savings will be USD 7,500 and the useful life will be eight years. Compute the time-adjusted rate of return.

**Alternate problem D** Ott's Fresh Produce Company has always purchased its trucks outright and sold them after three years. The company is ready to sell its present fleet of trucks and is trying to decide whether it should continue to purchase trucks or whether it should lease trucks. If the trucks are purchased, the company will incur the following costs:

	<b>Costs per fleet</b>
Acquisition cost	\$ 312,000
Repairs:	
First year	3,600
Second year	6,600
Third year	9,000
Other annual costs	9,600

At the end of three years, the trucks could be sold for a total of USD 96,000. Another fleet of trucks would then be purchased. The costs just listed, including the same acquisition cost, also would be incurred with respect to the second fleet of trucks. The second fleet also could be sold for USD 96,000 at the end of three years.

If the company leases the trucks, the lease contract will run for six years. One fleet of trucks will be provided immediately, and a second fleet of trucks will be provided at the end of three years. The company will pay USD 126,000 per year under the lease contract. The first lease payment will be due on the day the lease contract is signed. The lessor bears the cost of all repairs.

Using the net present value method, determine if the company should buy or lease the trucks. Assume the company's cost of capital is 18 per cent. (Ignore federal income taxes.)

#### Beyond the numbers—Critical thinking

**Business decision case A** Lloyd's Company wishes to invest USD 750,000 in capital projects that have a minimum expected rate of return of 14 per cent. The company is evaluating five proposals. Acceptance of one proposal does not preclude acceptance of any of the other proposals. The company's criterion is to select proposals that meet its 14 per cent minimum required rate of return. The relevant information related to the five proposals is as follows:

<b>Investment</b>	<b>Initial cash Outlay</b>	<b>Expected after-tax net Cash inflow per year</b>	<b>Expected life of Proposal (years)</b>
A	\$ 150,000	\$ 45,000	5
B	300,000	60,000	8
C	375,000	82,500	10
D	450,000	78,000	12
E	150,000	31,500	10

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- a. Compute the net present value of each of the five proposals.
- b. Which projects should be undertaken? Why? Rank them in order of desirability.

**Business decision case B** Slick Company is considering a capital project involving a USD 225,000 investment in machinery and a USD 45,000 investment in working capital. The machine has an expected useful life of 10 years and no salvage value. The annual cash inflows (before taxes) are estimated at USD 90,000 with annual cash outflows (before taxes) of USD 30,000. The company uses straight-line depreciation. Assume the federal income tax rate is 40 per cent.

The company's new accountant computed the net present value of the project using a minimum required rate of return of 16 per cent (the company's cost of capital). The accountant's computations follow:

Cash inflows	\$ 90,000
Cash outflows	30,000
Net cash inflow	\$ 60,000
Present value of net cash at 16%	X 4.833
Present value of net cash inflow	\$283,980
Initial cash outlay	225,000
Net present value	\$ 64,980

- a. Are the accountant's computations correct? If not, compute the correct net present value.
- b. Is this capital project acceptable to the company? Why or why not?

**An accounting perspective – Writing experience C** Refer to "An accounting perspective: Business insight". Write a brief paper explaining why managers in Japan might use lower measures of the cost of capital than US managers.

**Ethics case – Writing experience D** Rebecca Peters just learned that First Bank's investment review committee rejected her pet project, a new computerized method of storing data that would enable customers to have instant access to their bank records. Peters' software consulting firm specializes in working with financial institutions. This project for First Bank was her first as project manager.

Following up, Peters learned that First Bank's investment review committee liked the idea but were not convinced that the new software's financial benefits would justify the cost of the software. When she told a colleague about the rejection at First Bank, the colleague said, "Why not tell the committee this software will increase the bank's profits? After we installed the software in the bank in Indianapolis, Indiana, USA their profits increased substantially. We even have data from that bank that you could present."

Peters thought about the suggestion. She knew First Bank would be pleased with the software if they installed it, and she wanted to make the sale. She also knew that the situation in Indianapolis, Indiana, USA was different; profits there had increased primarily because of other software that had reduced the bank's operating costs.

What should Rebecca Peters do? Write her a letter telling what you would do.

**Group assignment E** For summer employment, a friend is considering investing in a coffee stand on a busy street near office buildings. Being unfamiliar with the concepts in this chapter, your friend does not know how to make the decision. In teams of four, help your friend get started by providing a framework and questions that your friend should answer. (For example, how much will the investment be? How much are the estimated cash flows

from sales?) Prepare a memorandum from the group to your instructor; list your questions and suggestions for your friend. In the heading, include the date, to whom it is written, from whom, and the subject matter.

**Group project F** You have the option of choosing between two projects with equal total cash flows over five years but different annual cash flows. In groups of two or three students, determine which project should be selected for investment. Write a memorandum to your instructor addressing this issue. Be sure to provide examples to reinforce your answer. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

**Group project G** A manager comments to her superior, "There is no need to perform a postaudit. The project was justified based on our initial projections and we were given the green light to proceed. It has been a year since we started the project, a postaudit would be a waste of time." In groups of two or three students, respond to this comment. Do you agree? Do you disagree? If this manager is right, why bother with a postaudit? Write a memorandum to your instructor addressing these questions. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

#### Using the Internet—A view of the real world

Using any Internet search engine enter "budgeting" . Select an article that directly discusses budgeting in an organization or industry and print a copy of the article. You are encouraged (but not required) to find an article that answers some of the following questions: What is the purpose of budgeting? How are budgets developed? How is budgeting used to motivate employees? How might budgeting create ethical dilemmas?

Write a memorandum to your instructor summarizing the key points of the article. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to include a copy of the article used for this assignment.

Using any Internet search engine select one of the new terms at the end of the chapter and perform a key word search. Be sure to include quotation marks (for example: "Payback period"). Select an article that directly discusses the new term used, and print a copy of the article. Write a memorandum to your instructor summarizing the key points of the article. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to include a copy of the article used for this assignment.

#### Answers to self-test

##### True-false

**True.** Depreciation does not involve a cash outflow; it is deductible in arriving at federal taxable income.

**True.** The price paid for a machine becomes a sunk cost the minute the purchase has been made.

**False.** Only the out-of-pocket costs (the future cash outlays) are relevant to capital-budgeting decisions.

**True.** Unadjusted rate of return =  $\frac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$

**True.** The profitability index should be used to rank these projects.

##### Multiple-choice

**c.** The correct formula is:

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$$\text{Payback period} = \frac{\text{Initial cash outlay}}{\text{Annual net cash inflow (benefit)}}$$

- d.** All of the above choices are correct answers.
- d.** All of the above choices are correct answers.
- a.** A profitability index is the ratio of the present value of the expected net cash inflows (after taxes) divided by the initial cash outlay (or present value of cash outlays if future outlays are required).
- b.** With projects that require an investment at a later date, management must discount the cash outflow to its present value before it is compared to the present value of cash inflows.
- d.** All of the choices are correct answers.