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## Chapter 3

# How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?

Cindy Hall is the owner and chief executive officer of SailRite Company. SailRite builds two models of sailboats that are sold at hundreds of retail boat showrooms throughout the world. At its inception several years ago, the company produced only the Basic model, which is 12 feet long and designed for two sailors. Very few options are available for this model, and the production process is relatively simple. Because many owners of the Basic model wanted to move to a bigger, more sophisticated boat, SailRite developed the Deluxe model two years ago. The Deluxe model is 14 feet long and designed for three sailors. Many additional features are available for this model, and the production process is more complex than for the Basic model. Last year, SailRite sold 5,000 units of the Basic and 1,000 units of the Deluxe.



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Although sales of both models increased last year over the year before, company profits have steadily declined. Cindy, the CEO, is concerned about this trend and discusses her concerns with John Lester, the company's accountant; Mary McCann, the vice president of marketing; and Bob Schuler, the vice president of production.

Cindy (CEO):	<i>Ever since we introduced the Deluxe model our profits have taken a beating. I need some input on what we should do to get this turned around.</i>
Mary (Marketing Vice President):	<i>I'm not sure you can blame our salespeople. We've asked them to push the Deluxe model because of the high profit margins, and our sales force has really responded. Sales have steadily increased over the last couple of years, and customers seem to love our sailboats.</i>
Bob (Production Vice President):	<i>I don't think the problem is with our products, and using our current costing system, we make \$320 in profit for each Basic model and \$850 for each Deluxe model. We need to take a close look at how the cost of each boat is determined. Overhead costs have increased significantly</i>

	<i>since we started producing the Deluxe boat—to about 45 percent of total production costs—and yet we use only one overhead rate based on direct labor hours to allocate these costs. I don't see how this can lead to an accurate cost, and I assume we set the price based on the cost of each boat.</i>
<i>Cindy:</i>	<i>We certainly considered the cost in our pricing structure. Are you telling me the cost information I have isn't accurate?</i>
<i>John (Accountant):</i>	<i>No, the cost information you have is fine for financial reporting, but not for pricing products. When we were producing only the Basic model, overhead allocation wasn't an issue. All overhead costs were simply assigned to the one product. Now that we have two products, overhead is allocated based on direct labor hours as Bob stated. We are required to allocate overhead for financial reporting purposes, but I wouldn't use this cost information for internal pricing purposes.</i>
<i>Bob:</i>	<i>I can tell you that the production process for the Deluxe model is much more complicated than the one for the Basic model, so I would expect to see significantly higher costs attached to the Deluxe boat.</i>
<i>John:</i>	<i>What I'm hearing is that we need better cost information. I think it's time we move to a more sophisticated costing system called activity-based costing. Give me time to do some research. Let's meet next week.</i>

This dialogue between the accountant and top management emphasizes the importance of having accurate cost information for decision-making purposes. Very few costing systems provide “perfect” product cost information. Overhead (indirect manufacturing costs) can be allocated in a number of different ways and result in a number of different costs for the same product. The goal is to find a system of allocation that best approximates the amount of overhead costs caused by each product. Sophisticated costing systems are expensive, however. Organizations like SailRite must continually ask the question: Will the benefits of having improved cost information outweigh the costs of obtaining the information?

Several options are available to allocate overhead costs. Before we discuss these options, it is important to understand why overhead costs are allocated at all.

## 3.1 Why Allocate Overhead Costs?

### LEARNING OBJECTIVE

1. Understand why organizations allocate overhead costs to products.

*Question: Recall that costs for direct labor and direct materials are easily traced to products. When SailRite produces a sailboat, the direct materials include items such as fiberglass to build the hull, mast, sails, and rope. Direct labor includes the employees building the boat. Accounting for these costs is fairly simple. Indirect manufacturing costs (also called manufacturing overhead or overhead) include electricity to run the factory, rent for the factory building, and factory maintenance. These costs are not easily traced to products and pose a much more complicated challenge for SailRite. Accounting for indirect manufacturing costs typically requires allocating overhead using predetermined overhead rates. Why do managers insist on allocating overhead costs to products?*

*Answer: Three important reasons that managers allocate overhead costs to products are described in the following:*

- **Provide information for decision making.** Setting prices for products is one example of a decision that must be made by management. Prices are often established based on the cost of products. It is not enough to simply include direct materials and direct labor. Overhead must be considered as well.
- **Promote efficient use of resources.** Several different activities are performed to produce a product, such as purchasing raw materials, setting up production machinery, inspecting the final product, and repairing defective products. All of these activities consume resources (consuming resources is another way of stating that a cost is associated with each of these activities). If products are charged for the use of these activities, managers will have an incentive to be efficient in utilizing the activities.
- **Comply with U.S. Generally Accepted Accounting Principles (U.S. GAAP).** U.S. GAAP requires that all manufacturing costs—direct materials, direct labor, and overhead—be assigned to products for inventory costing purposes. This requires the allocation of overhead costs to products.

### KEY TAKEAWAY

- Overhead costs are allocated to products to provide information for internal decision making, to promote the efficient use of resources, and to comply with U.S. Generally Accepted Accounting Principles.

### REVIEW PROBLEM 3.1

For each scenario listed as follows, identify which of the three important reasons presented in this section best explains why managers choose to allocate overhead costs to products.

- a. Financial statements are prepared for the annual report that is provided to shareholders.
- b. Management is considering the addition of a new product line.
- c. The production manager decides to decrease the frequency of raw materials purchases to reduce the allocated portion of the purchasing department's costs.
- d. Profits are calculated for each product so management can decide which products to promote.
- e. Quality control inspections are reduced to cut down on the allocated portion of the quality control department's costs.
- f. Financial statements are prepared for the company's bondholders.
- g. Management asks for cost information to assist in bidding for a contract.

Solutions to Review Problem 3.1

- a. Comply with U.S. GAAP
- b. Provide information for decision making
- c. Promote efficient use of resources
- d. Provide information for decision making
- e. Promote efficient use of resources
- f. Comply with U.S. GAAP
- g. Provide information for decision making

## 3.2 Approaches to Allocating Overhead Costs

### LEARNING OBJECTIVE

1. Compare and contrast allocating overhead costs using a plantwide rate, department rates, and activity-based costing.

*Question: Managers at companies such as Hewlett-Packard often look for better ways to figure out the cost of their products. When Hewlett-Packard produces printers, the company has three possible methods that can be used to allocate overhead costs to products—plantwide allocation, department allocation, and activity-based allocation (called activity-based costing). How do managers decide which allocation method to use?*

*Answer: The choice of an allocation method depends on how managers decide to group overhead costs and the desired accuracy of product cost information. Groups of overhead costs are called **cost pools**<sup>1</sup>. For example, **Hewlett Packard's** printer production division may choose to collect all factory overhead costs in one cost pool and allocate those costs from the cost pool to each product using one predetermined overhead rate. Or **Hewlett Packard** may choose to have several cost pools (perhaps for each department, such as assembly, packaging, and quality control) and allocate overhead costs from each department cost pool to products using a separate predetermined overhead rate for each department. In general, the more cost pools used, the more accurate the allocation process.*

### Plantwide Allocation

*Question: Let's look at SailRite Company, which was presented at the beginning of the chapter. The managers at SailRite like the idea of using the plantwide allocation method to allocate overhead to the two sailboat models produced by the company. How would SailRite implement the plantwide allocation method?*

1. A collection of overhead costs, typically organized by department or activity.
2. A method of allocating costs that uses one cost pool, and therefore one predetermined overhead rate, to allocate overhead costs.

*Answer: The **plantwide allocation**<sup>2</sup> method uses one predetermined overhead rate to allocate overhead costs. Regardless of the approach used to allocate overhead, a predetermined overhead rate is established for each cost pool. The predetermined*

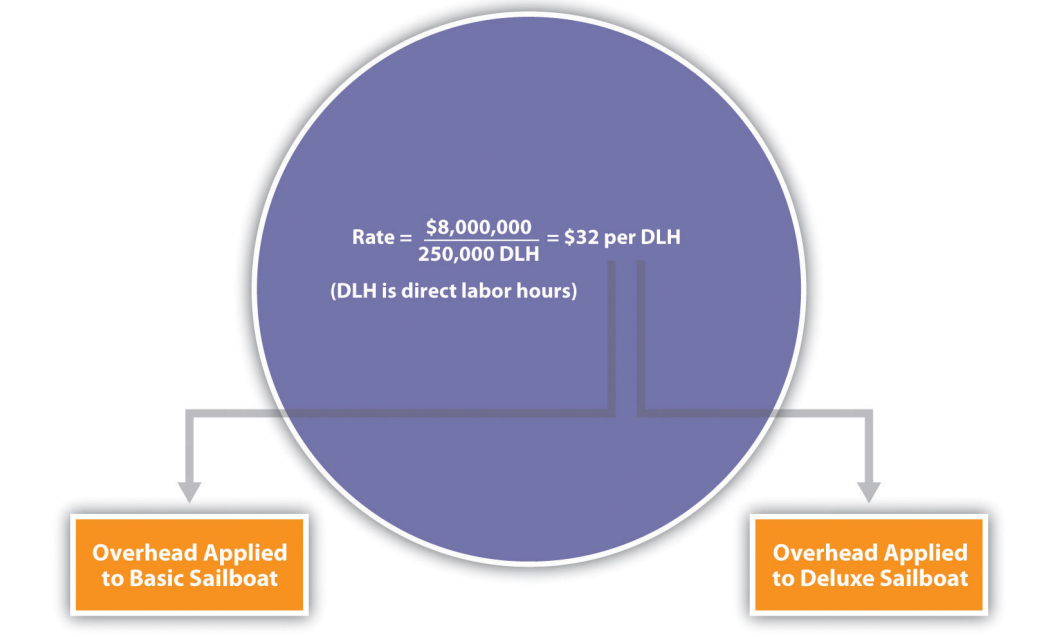
overhead rate is calculated as follows (from [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#)):

$$\text{Predetermined overhead rate} = \frac{\text{Estimated overhead costs}}{\text{Estimated activity in allocation base}}$$

When activity-based costing is used, the denominator can also be called *estimated cost driver activity*. One cost pool accounts for all overhead costs, and therefore one predetermined overhead rate is used to apply overhead costs to products. You learned about this approach in [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) where one predetermined rate—typically based on direct labor hours, direct labor costs, or machine hours—was used to allocate overhead costs. (Remember, the focus here is on the allocation of overhead costs. Direct materials and direct labor are easily traced to the product and therefore are not a part of the overhead allocation process.)

Using SailRite Company as an example, assume annual overhead costs are estimated to be \$8,000,000 and direct labor hours are used for the plantwide allocation base. Management estimates that a total of 250,000 direct labor hours are worked annually. These estimates are based on the previous year's overhead costs and direct labor hours and are adjusted for expected increases in demand the coming year. The predetermined overhead rate is \$32 per direct labor hour (= \$8,000,000 ÷ 250,000 direct labor hours). Thus, as shown in [Figure 3.1 "Using One Plantwide Rate to Allocate SailRite Company's Overhead"](#), products are charged \$32 in overhead costs for each direct labor hour worked.

Figure 3.1 Using One Plantwide Rate to Allocate SailRite Company's Overhead



### Product Costs Using the Plantwide Allocation Approach at SailRite

*Question: Assume SailRite uses one plantwide rate to allocate overhead based on direct labor hours. What is SailRite's product cost per unit and resulting profit using the plantwide approach to allocate overhead?*

*Answer:* The calculation of a product's cost involves three components—direct materials, direct labor, and manufacturing overhead. Assume direct materials cost \$1,000 for one unit of the Basic sailboat and \$1,300 for the Deluxe. Direct labor costs are \$600 for one unit of the Basic sailboat and \$750 for the Deluxe. This information, combined with the overhead cost per unit, gives us what we need to determine the product cost per unit for each model.

Given the predetermined overhead rate of \$32 per direct labor hour calculated in the previous section, and assuming it takes 40 hours of direct labor to build one Basic sailboat and 50 hours to build one Deluxe sailboat, we can calculate the manufacturing overhead cost per unit. Manufacturing overhead cost per unit is \$1,280 (= \$32 × 40 direct labor hours) for the Basic boat and \$1,600 (= \$32 × 50 direct labor hours) for the Deluxe boat. Combine the manufacturing overhead with direct materials and direct labor, as shown in [Figure 3.2 "SailRite Company Product Costs](#)



Using One Plantwide Rate Based on Direct Labor Hours", and we are able to calculate the product cost per unit.

Figure 3.2 SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours

	Basic Sailboat (cost per unit)	Deluxe Sailboat (cost per unit)
Direct materials	\$ 1,000	\$ 1,300
Direct labor	600	750
Overhead	1,280*	1,600**
Total product cost per unit	<u>\$ 2,880</u>	<u>\$ 3,650</u>

\*\$1,280 = 40 direct labor hours per unit × \$32 rate.

\*\*\$1,600 = 50 direct labor hours per unit × \$32 rate.

The average sales price is \$3,200 for the Basic model and \$4,500 for the Deluxe. Using the product cost information in Figure 3.2 "SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours", the profit per unit is \$320 (= \$3,200 price – \$2,880 cost) for the Basic model and \$850 (= \$4,500 price – \$3,650 cost) for the Deluxe. Recall from the opening dialogue that SailRite’s overall profit has declined ever since it introduced the Deluxe model even though the data shows both products are profitable.

*Question: The managers at SailRite like the idea of using the plantwide allocation approach, but they are concerned that this approach will not provide accurate product cost information. Although the plantwide allocation method is the simplest and least expensive approach, it also tends to be the least accurate. In spite of this weakness, why do some organizations prefer to use one plantwide overhead rate to allocate overhead to products?*

*Answer: Organizations that use a plantwide allocation approach typically have simple operations with a few similar products. Management may not want more accurate product cost information or may not have the resources to implement a more complex accounting system. As we move on to more complex costing systems, remember that these systems are more expensive to implement. Thus the benefits*

of having improved cost information must outweigh the costs of obtaining the information.

## Department Allocation

*Question: Assume the managers at SailRite Company prefer a more accurate approach to allocating overhead costs to its two products. As a result, they are considering using the department allocation approach. How would SailRite form cost pools for the department allocation approach?*

Answer: The **department allocation**<sup>3</sup> approach is similar to the plantwide approach except that cost pools are formed for each department rather than for the entire plant, and a separate predetermined overhead rate is established for each department. Remember, total estimated overhead costs will not change. Instead, they will be broken out into various department cost pools. This approach allows for the use of different allocation bases for different departments depending on what drives overhead costs for each department. For example, the Hull Fabrication department at SailRite Company may find that overhead costs are driven more by the use of machinery than by labor, and therefore decides to use machine hours as the allocation base. The Assembly department may find that overhead costs are driven more by labor activity than by machine use and therefore decides to use labor hours or labor costs as the allocation base.

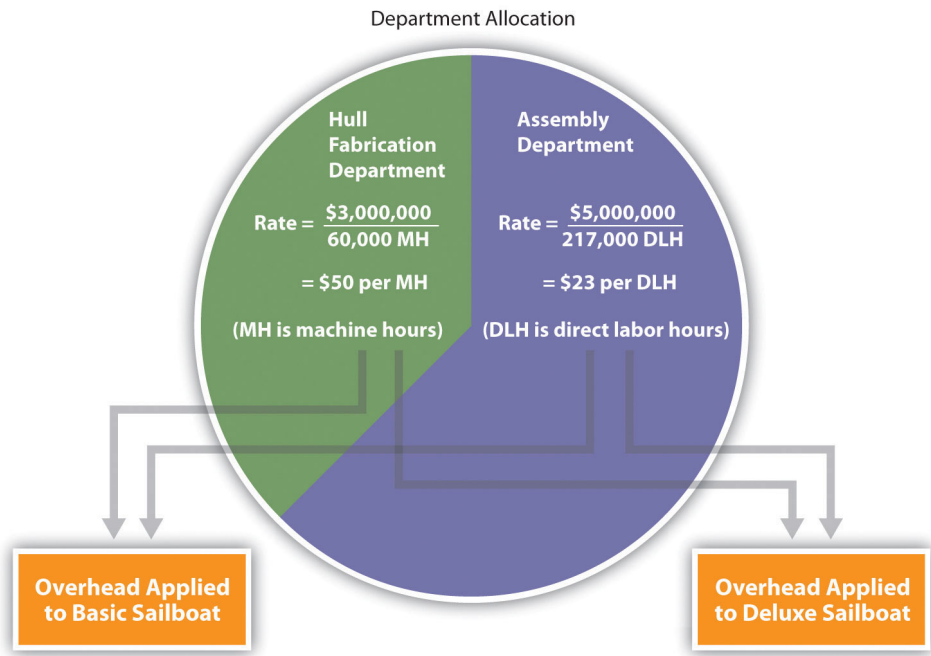
Assume that SailRite is considering using the department approach rather than the plantwide approach for allocating overhead. The cost pool in the Hull Fabrication department is estimated to be \$3,000,000 for the year, and the cost pool in the Assembly department is estimated at \$5,000,000. Note that total estimated overhead cost is still \$8,000,000 (= \$3,000,000 + \$5,000,000). Machine hours (estimated at 60,000 hours) will be used as the allocation base for Hull Fabrication, and direct labor hours (estimated at 217,000 hours) will be used as the allocation base for Assembly. Thus two rates are used to allocate overhead (rounded to the nearest dollar) as follows:

1. Hull Fabrication department rate: \$50 per machine hour (= \$3,000,000 ÷ 60,000 hours)
2. Assembly department rate: \$23 per direct labor hour (= \$5,000,000 ÷ 217,000 hours)

3. A method of allocating costs that uses a separate cost pool, and therefore a separate predetermined overhead rate, for each department.

As shown in [Figure 3.3 "Using Department Rates to Allocate SailRite Company's Overhead"](#), products going through the Hull Fabrication department are charged \$50 in overhead costs for each *machine hour* used. Products going through the Assembly department are charged \$23 in overhead costs for each *direct labor hour* used.

Figure 3.3 Using Department Rates to Allocate SailRite Company's Overhead



The department allocation approach allows cost pools to be formed for each department and provides for flexibility in the selection of an allocation base. Although [Figure 3.3 "Using Department Rates to Allocate SailRite Company's Overhead"](#) shows just two rates, many companies have more than two departments and therefore more than two rates. Organizations that use this approach tend to have simple operations within each department but different activities across departments. One department may use machinery, while another department may use labor, as is the case with SailRite's two departments. This approach typically provides more accurate cost information than simply using one plantwide rate but still relies on the assumption that overhead costs are driven by direct labor hours, direct labor costs, or machine hours. This assumption of a causal relationship is increasingly less realistic as production processes become more complex.

The plantwide and department allocation methods are "traditional" approaches because both typically use direct labor hours, direct labor costs, or machine hours

as the allocation base, and both were used prior to the creation of activity-based costing in the 1980s.

#### KEY TAKEAWAY

- Regardless of the approach used to allocate overhead, a predetermined overhead rate is established for each cost pool. The plantwide allocation approach uses one cost pool to collect and apply overhead costs and therefore uses one predetermined overhead rate for the entire company. The department allocation approach uses several cost pools (one for each department) and therefore uses several predetermined overhead rates.

## REVIEW PROBLEM 3.2

Kline Company expects to incur \$800,000 in overhead costs this coming year—\$200,000 in the Cut and Polish department and \$600,000 in the Quality Control department. Total annual direct labor costs are expected to be \$160,000. The Cut and Polish department expects to use 25,000 machine hours, and the Quality Control department plans to utilize 50,000 hours of direct labor time for the year.

*Required:*

1. Assume Kline Company allocates overhead costs with the plantwide approach, and direct labor cost is the allocation base. Calculate the rate used by the company to allocate overhead costs.
2. Assume Kline Company allocates overhead costs with the department approach. Calculate the rate used by each department to allocate overhead costs.

Solutions to Review Problem 3.2

1. The plantwide rate is calculated as follows:

$$\begin{aligned} \text{Predetermined overhead rate} &= \frac{\text{Estimated overhead costs}}{\text{Estimated activity in allocation base}} \\ &= \frac{\$800,000}{\$160,000} \\ &= \$5 \text{ per } \$1 \text{ in direct labor cost (or 5\%)} \end{aligned}$$

2. The department rates are calculated using the same formula as the plantwide rate. However, overhead costs and activity levels are estimated for each department rather than for the entire company, and two separate rates are calculated:

$$\text{Cut and Polish department} = \frac{\$200,000}{25,000 \text{ machine hours}} = \$8 \text{ per machine hour}$$

$$\text{Quality Control department} = \frac{\$600,000}{50,000 \text{ direct labor hours}} = \$12 \text{ per direct labor hour}$$

### 3.3 Using Activity-Based Costing to Allocate Overhead Costs

#### LEARNING OBJECTIVE

1. Understand how to use the five steps of activity-based costing to determine product costs.

*Question: Suppose the managers at SailRite Company decide that the benefits of implementing an activity-based costing system would exceed the cost, and thus the company should use activity-based costing to allocate overhead. What are the five steps of activity-based costing, and how would this method work for SailRite?*

**Answer: Activity-based costing (ABC)**<sup>4</sup> uses several cost pools, organized by *activity*, to allocate overhead costs. (Remember that plantwide allocation uses one cost pool for the whole plant, and department allocation uses one cost pool for each department.) The idea is that activities are required to produce products—activities such as purchasing materials, setting up machinery, assembling products, and inspecting finished products. These activities can be costly. Thus the cost of activities should be allocated to products based on the products' use of the activities.

#### ABC in Action at SailRite Company

Five steps are required to implement activity-based costing. As you work through the example for SailRite Company, once again note that total estimated overhead costs remain at \$8,000,000. However, the total is broken out into different *activities* rather than *departments*, and an overhead rate is established for each activity. The five steps are as follows:

4. A method of costing that uses several cost pools, and therefore several predetermined overhead rates, organized by activity to allocate overhead costs.

5. Any process or procedure that consumes overhead resources.

#### Step 1. Identify costly activities required to complete products.

An **activity**<sup>5</sup> is any process or procedure that consumes overhead resources. The goal is to understand all the activities required to make the company's products.

This requires interviewing and meeting with personnel throughout the organization. Companies that use activity-based costing, such as **Hewlett Packard** and **IBM**, may identify hundreds of activities required to make their products. The most challenging part of this step is narrowing down the activities to those that have the biggest impact on overhead costs.

After meeting with personnel throughout the company, SailRite’s accountant identified the following activities as having the biggest impact on overhead costs:

- Purchasing materials
- Setting up machines
- Running machines
- Assembling products
- Inspecting finished products

**Step 2. Assign overhead costs to the activities identified in step 1.**

This step requires that overhead costs associated with each activity be assigned to the activity (i.e., a cost pool is formed for each activity). For SailRite, the cost pool for the purchasing materials activity will include costs for items such as salaries of purchasing personnel, rent for purchasing department office space, and depreciation of purchasing office equipment.

The accountant at SailRite developed the following allocations after careful review of all overhead costs (remember, these are *overhead* costs, not direct materials or direct labor costs):

<u>Activity</u>	<u>Estimated Annual Overhead Cost</u>
Purchasing materials	\$1,200,000
Setting up machines	1,600,000
Running machines	2,700,000
Assembling products*	1,500,000
Inspecting finished products	1,000,000
Total	<u>\$8,000,000</u>

*\*We should note that this is not the direct labor cost. Instead, this represents overhead costs associated with assembling products, such as supplies and the factory space being used for assembly.*

At this point, we have identified the most important and costly activities required to make products, and we have assigned overhead costs to each of these activities. The next step is to find an allocation base that drives the cost of each activity.

**Step 3. Identify the cost driver for each activity.**

A **cost driver**<sup>6</sup> is the action that causes (or “drives”) the costs associated with the activity. Identifying cost drivers requires gathering information and interviewing key personnel in various areas of the organization, such as purchasing, production, quality control, and accounting. After careful scrutiny of the process required for each activity, SailRite established the following cost drivers:

Activity	Cost Driver	Estimated Annual Cost Driver Activity
Purchasing materials	Purchase requisitions	10,000 requisitions
Setting up machines	Machine setups	2,000 setups
Running machines	Machine hours	90,000 hours
Assembling products	Direct labor hours	250,000 hours
Inspecting finished products	Inspection hours	20,000 hours

Notice that this information includes an estimate of the level of activity for each cost driver, which is needed to calculate a predetermined rate for each activity in step 4.

**Step 4. Calculate a predetermined overhead rate for each activity.**

This is done by dividing the estimated overhead costs (from step 2) by the estimated level of cost driver activity (from step 3). Figure 3.4 "Predetermined Overhead Rates for SailRite Company" provides the overhead rate calculations for SailRite Company based on the information shown in the previous three steps. It shows that products will be charged \$120 in overhead costs for each purchase requisition processed,

6. The action that causes the costs associated with an activity.



\$800 for each machine setup, \$30 for each machine hour used, \$6 for each direct labor hour worked, and \$50 for each hour of inspection time.

Figure 3.4 Predetermined Overhead Rates for SailRite Company

Activity	Cost Driver	(a) Estimated Overhead Costs	(b) Estimated Cost Driver Activity	(a) + (b) Predetermined Overhead Rate
Purchasing materials	Purchase requisitions	\$1,200,000	10,000	\$120 per requisition
Setting up machines	Machine setups	1,600,000	2,000	800 per setup
Running machines	Machine hours	2,700,000	90,000	30 per machine hour
Assembling products	Direct labor hours	1,500,000	250,000	6 per direct labor hour
Inspecting finished products	Inspection hours	1,000,000	20,000	50 per inspection hour
Total		<u>\$8,000,000</u>		

**Step 5. Allocate overhead costs to products.**

Overhead costs are allocated to products by multiplying the predetermined overhead rate for each activity (calculated in step 4) by the level of cost driver activity used by the product. The term *applied overhead* is often used to describe this process.

Assume the following annual cost driver activity takes place at SailRite for the Basic and Deluxe sailboats: Notice that the total activity levels presented here match the estimated activity levels presented in step 4. This was done to avoid complicating the example with overapplied and underapplied overhead. However, a more realistic scenario would provide *actual* activity levels that are different than *estimated* activity levels, thereby creating overapplied and underapplied overhead for each activity. We described the disposition of overapplied and underapplied overhead in [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#).

Activity	Basic Sailboat	Deluxe Sailboat	Total
Purchasing materials	7,000 requisitions	3,000 requisitions	10,000 requisitions
Setting up machines	1,100 setups	900 setups	2,000 setups
Running machines	50,000 hours	40,000 hours	90,000 machine hours

Assembling products	200,000 hours	50,000 hours	250,000 direct labor hours
Inspecting finished products	12,000 hours	8,000 hours	20,000 inspection hours

Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company" shows the allocation of overhead using the cost driver activity just presented and the overhead rates calculated in Figure 3.4 "Predetermined Overhead Rates for SailRite Company". Notice that allocated overhead costs total \$8,000,000. This is the same cost figure used for the plantwide and department allocation methods we discussed earlier. Activity-based costing simply provides a more refined way to allocate the same overhead costs to products.

Figure 3.5 Allocation of Overhead Costs to Products at SailRite Company

Activity	Predetermined Overhead Rate	Cost Driver Activity	Basic Sailboat		Deluxe Sailboat	
			Overhead Allocated*	Cost Driver Activity	Overhead Allocated*	
Purchasing materials	\$ 120 per requisition	7,000	\$ 840,000	3,000	\$ 360,000	
Setting up machines	800 per setup	1,100	880,000	900	720,000	
Running machines	30 per machine hour	50,000	1,500,000	40,000	1,200,000	
Assembling products	6 per direct labor hour	200,000	1,200,000	50,000	300,000	
Inspecting finished products	50 per inspection hour	12,000	600,000	8,000	400,000	
Total overhead costs allocated			\$ 5,020,000		\$ 2,980,000	
Total companywide overhead costs			\$ 8,000,000			
Overhead cost per unit for each product**			\$ 1,004		\$ 2,980	

\*Overhead allocated equals the predetermined overhead rate times the cost driver activity.

\*\*Overhead cost per unit for the Basic model equals \$5,020,000 (overhead allocated) ÷ 5,000 units produced, and for the Deluxe model, it equals \$2,980,000 ÷ 1,000 units produced.

The bottom of Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company" shows the overhead cost per unit for each product assuming SailRite produces 5,000 units of the Basic sailboat and 1,000 units of the Deluxe sailboat. This information is needed to calculate the product cost for each unit of product, which we discuss next.

### Product Costs Using the Activity-Based Costing Approach at SailRite

Question: As shown in Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company", SailRite knows the overhead cost per unit using activity-based costing is \$1,004

for the Basic model and \$2,980 for the Deluxe. Now that SailRite has the overhead cost per unit, how will the company find the total product cost per unit and resulting profit?

Answer: Recall from our discussion earlier that the calculation of a product’s cost involves three components—direct materials, direct labor, and manufacturing overhead. Assume direct materials cost \$1,000 for the Basic sailboat and \$1,300 for the Deluxe. Direct labor costs are \$600 for the Basic sailboat and \$750 for the Deluxe. This information, combined with the overhead cost per unit calculated at the bottom of [Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company"](#), gives us what we need to determine the product cost per unit for each model, which is presented in [Figure 3.6 "SailRite Company Product Costs Using Activity-Based Costing"](#). The average sales price is \$3,200 for the Basic model and \$4,500 for the Deluxe. Using the product cost information in [Figure 3.6 "SailRite Company Product Costs Using Activity-Based Costing"](#), the Basic model yields a profit of \$596 (= \$3,200 price – \$2,604 cost) per unit and the Deluxe model yields a loss of \$530 (= \$4,500 price – \$5,030 cost) per unit.

Figure 3.6 *SailRite Company Product Costs Using Activity-Based Costing*

	Basic Sailboat (cost per unit)	Deluxe Sailboat (cost per unit)
Direct materials	\$ 1,000	\$ 1,300
Direct labor	600	750
Overhead	1,004	2,980
Total product cost per unit	<u>\$ 2,604</u>	<u>\$ 5,030</u>

As you can see in [Figure 3.6 "SailRite Company Product Costs Using Activity-Based Costing"](#), overhead is a significant component of total product costs. This explains the need for a refined overhead allocation system such as activity-based costing.

### Comparison of ABC to Plantwide Costing at SailRite

After going through the process of allocating overhead using activity-based costing, John Lester (the company accountant) called a meeting with the same management group introduced at the beginning of the chapter: Cindy Hall (CEO), Mary McCann (vice president of marketing), and Bob Schuler (vice president of production). As you read the following dialogue, refer to [Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company"](#), which summarizes John’s findings.

Cindy:	<i>What do you have for us, John?</i>
John:	<i>I think you'll find the results of our most recent costing analysis very interesting. We used an approach called activity-based costing to allocate overhead to products.</i>
Bob:	<i>I recall being interviewed last week about the activities involved in the production process.</i>
John:	<i>Yes, here's what we found. The old allocation approach indicates that the Basic boat costs \$2,880 to build and the Deluxe boat costs \$3,650 to build. Our average sales price for the Basic is \$3,200 and \$4,500 for the Deluxe. You can see why we pushed sales of the Deluxe boat—it has a profit of \$850 per boat.</i>
Cindy:	<i>John, from your analysis, it looks as if we were wrong about the Deluxe boat being the most profitable.</i>
John:	<i>We do have some startling results. Using activity-based costing, an approach I think is much more accurate, the Deluxe boat is not profitable at all. In fact, we lose \$530 for each Deluxe boat sold, and the profits from the Basic boat are much higher than we thought at \$596 per unit.</i>
Cindy:	<i>I see direct materials and direct labor are the same no matter which costing system we use. Why is there such a large variation in overhead costs?</i>
John:	<i>Good question! When we used our old approach of one plantwide rate based on direct labor hours, the Deluxe process consumed 20 percent of all direct labor hours worked—that is, 50,000 Deluxe hours divided by 250,000 total hours. Therefore the Deluxe model was allocated 20 percent of all overhead costs. Using activity-based costing, we identified five key activities and assigned overhead costs based on the use of these activities. The Deluxe process consumed more than 20 percent of the resources provided for every activity. For example, running machines is one of the most costly activities, and the Deluxe model used about 44 percent of the resources provided by this activity. This is significantly higher than the 20 percent allocated using direct labor hours under the old approach.</i>
Bob:	<i>This certainly makes sense! Each Deluxe boat takes a whole lot more machine hours to produce than the Basic boat.</i>
Cindy:	<i>Thanks for this analysis, John. Now we know why company profits have been declining even though sales have increased. Either the Deluxe sales price must go up or costs must go down—or a combination of both!</i>

Figure 3.7 Activity-Based Costing Versus Plantwide Costing at SailRite Company

Plantwide Costing (direct labor hours as allocation base)		
	Basic Sailboat	Deluxe Sailboat
Direct materials	\$ 1,000	\$ 1,300
Direct labor	600	750
Overhead*	1,280	1,600
Total product cost per unit (a)	<u>\$ 2,880</u>	<u>\$ 3,650</u>
Sales price (b)	<u>\$ 3,200</u>	<u>\$ 4,500</u>
<b>Profit = (b) – (a)</b>	<b>\$ 320</b>	<b>\$ 850</b>

Activity-Based Costing (several different allocation bases)		
	Basic Sailboat	Deluxe Sailboat
Direct materials	\$ 1,000	\$ 1,300
Direct labor	600	750
Overhead**	1,004	2,980
Total product cost per unit (c)	<u>\$ 2,604</u>	<u>\$ 5,030</u>
Sales price (d)	<u>\$ 3,200</u>	<u>\$ 4,500</u>
<b>Profit (loss) = (d) – (c)</b>	<b>\$ 596</b>	<b>\$ (530)</b>

\*From Figure 3.2 "SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours".

\*\*From Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company".

Question: SailRite has more accurate product cost information using activity-based costing to allocate overhead. Why is the overhead cost per unit so different using activity-based costing?

Answer: Figure 3.8 "Detailed Analysis of Overhead Allocations at SailRite Company" provides a more thorough look at how the Deluxe product consumes a significant share of overhead resources—much higher than the 20 percent that was being allocated based on direct labor hours. Let's look at Figure 3.8 "Detailed Analysis of Overhead Allocations at SailRite Company" in detail:

- The ABC column represents overhead costs allocated using the activity-based costing shown back in [Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company"](#).
- The DLH (direct labor hours) column represents overhead costs allocated using direct labor hours as the allocation base where 80 percent was allocated to the Basic boat (= 200,000 hours ÷ 250,000 total hours) and 20 percent allocated to the Deluxe boat (= 50,000 hours ÷ 250,000 total hours).
- The Diff. (difference) column shows the difference between one allocation method and the other. Notice the shift in the allocation of overhead costs using activity-based costing. A total of \$1,380,000 in overhead costs shifts to the Deluxe sailboat, which amounts to \$1,380 per boat (= \$1,380,000 ÷ 1,000 boats).

Figure 3.8 Detailed Analysis of Overhead Allocations at SailRite Company

Activity	Basic Sailboat			Deluxe Sailboat		
	(a) ABC*	(b) DLH**	(a) – (b) Diff.	(c) ABC*	(d) DLH**	(c) – (d) Diff.
Purchasing materials	\$ 840,000	\$ 960,000	\$ (120,000)	\$ 360,000	\$ 240,000	\$ 120,000
Setting up machines	880,000	1,280,000	(400,000)	720,000	320,000	400,000
Running machines	1,500,000	2,160,000	(660,000)	1,200,000	540,000	660,000
Assembling products	1,200,000	1,200,000	–	300,000	300,000	–
Inspecting finished products	600,000	800,000	(200,000)	400,000	200,000	200,000
Total	<u>\$ 5,020,000</u>	<u>\$ 6,400,000</u>	<u>\$ (1,380,000)</u>	<u>\$ 2,980,000</u>	<u>\$ 1,600,000</u>	<u>\$ 1,380,000</u>

\*Amounts in this column come from [Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company"](#).

\*\*Amounts in this column are calculated by multiplying 80 percent for the Basic boat (20 percent for the Deluxe) by the total overhead cost for the activity. For example, the total overhead cost for purchasing materials is \$1,200,000 (see [Figure 3.4 "Predetermined Overhead Rates for SailRite Company"](#)) and  $\$1,200,000 \times 80 \text{ percent} = \$960,000$ . Using the plantwide approach (one plantwide rate based on direct labor hours), \$960,000 is the amount allocated to the Basic sailboat for this activity, and \$240,000 is the amount allocated to the Deluxe boat.

The primary reason that using activity-based costing shifted overhead costs to the Deluxe sailboat is that producing each Deluxe boat requires more resources than the Basic boat. For example, the Basic boat requires 50,000 machine hours to produce 5,000 boats, and the Deluxe boat requires 40,000 machine hours to produce 1,000 boats. The number of machine hours required per boat produced is as follows:

	<u>Basic</u>	<u>Deluxe</u>
Total machine hours (a)	50,000	40,000
Total boats produced (b)	÷ 5,000	÷ 1,000
Machine hours per boat (a) ÷ (b)	<u>10</u>	<u>40</u>

You can see from this analysis that the Deluxe boat consumes four times the machine hours of the Basic boat. At a rate of \$30 per machine hour, the Deluxe boat is assigned \$1,200 per boat for this activity (\$30 rate × 40 machine hours) while the Basic boat is assigned \$300 per boat (\$30 rate × 10 machine hours).

### Advantages and Disadvantages of ABC

*Question: Activity-based costing undoubtedly provides better cost information than most traditional costing methods, such as plantwide and department allocation methods. However, ABC has its limitations. What are the advantages and disadvantages of using activity-based costing?*

Answer: The advantages and disadvantages of ABC are as follows:

#### Advantages

**More accurate cost information leads to better decisions.** The cost information provided by ABC is generally regarded as more accurate than the information provided by most traditional costing methods. This allows management to make better decisions in areas such as product pricing, product line changes (adding products or eliminating products), and product mix decisions (how much of each product to produce and sell).

**Increased knowledge of production activities leads to process improvements and reduced costs.** ABC requires identifying the activities involved in the production process (step 1) and assigning costs to these activities (step 2). This provides management with a better view of the detailed activities involved (purchasing materials, machine setups, inspections, and so forth) and the cost of each activity. Managers are more likely to focus on improving efficiency in the most costly activities, thereby reducing costs.

### Disadvantages

**ABC systems can be costly to implement.** ABC systems require teamwork across the organization and therefore require employees to take time out from their day-to-day activities to assist in the ABC process (e.g., to identify costly activities). Assigning costs to activities takes time, as does identifying and tracking cost drivers. And assigning costs to products requires a significant amount of time in the accounting department. Imagine having 15 cost pools (activities), each with a predetermined overhead rate used to assign overhead costs to the company's 80 products—not an unrealistic example for a large company. The accounting costs incurred to maintain such a system can be prohibitively high.

**Unitizing fixed costs can be misleading.** Product costing involves allocating costs from activity centers to products and calculating a product cost per unit. The problem with this approach is that fixed costs are often a large part of the overhead costs being allocated (e.g., building and machinery depreciation and supervisor salaries). Recall that fixed costs are costs that *do not change in total* with changes in activity.

Looking back to the SailRite example using activity-based costing, the Deluxe sailboat cost \$5,030 per unit to produce based on production of 1,000 units (as shown in [Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company"](#)). If SailRite produces 2,000 units of the Deluxe boat, will the unit cost remain at \$5,030? Probably not. A significant portion of overhead costs are fixed and will be spread out over more units, thereby reducing the cost per unit. We address this issue at length in later chapters. The point here is that managers must beware of using per unit cost information blindly for decision making, particularly if a significant change in the level of production is anticipated.

**The benefits may not outweigh the costs.** Companies with one or two products that require very little variation in production may not benefit from an ABC system. Suppose a company produces one product. The overhead costs can be divided into as many cost pools as you like, but all overhead costs will still be assigned to the one product. (We should mention, however, that management would benefit from understanding the activities involved in the process and the costs associated with each activity. It's the allocation to the one product—steps 4 and 5 of ABC—that would provide little useful information in this scenario.)

Companies that produce several different products may believe that the benefits of implementing ABC will outweigh the costs. However, management must be willing to use the ABC information to benefit the company. Companies like **Chrysler Group LLC** have been known to try ABC, only to meet resistance from their managers.



Until managers are willing to use the ABC information to make improvements in the organization, there is no point in implementing such a system.

### **Business in Action 3.1**

#### Characteristics of Companies That Use Activity-Based Costing

A survey of 130 U.S. manufacturing companies yielded some interesting results. The companies that used activity-based costing (ABC) had higher overhead costs as a percent of total product costs than companies that used traditional costing. Those using ABC also had a higher level of automation. The complexity of production processes and products tended to be higher for those using ABC, and ABC companies operated at capacity more frequently.

It is important to note that the differences between companies using ABC and companies using traditional costing systems in all these areas—overhead costs, automation, complexity of production, and frequency of capacity—were relatively small. However, users of ABC indicated their systems were more adequate than traditional systems in providing useful information for performance evaluation and cost reduction.

Source: Susan B. Hughes and Kathy A. Paulson Gjerde, “Do Different Cost Systems Make a Difference?” *Management Accounting Quarterly*, Fall 2003.

### **ABC Cost Flows**

*Question: How are overhead costs recorded when using activity-based costing?*

*Answer:* We presented the flow of costs for a job costing system in [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#), including how to track actual overhead costs and how to track overhead applied using a separate manufacturing overhead account. The cost flows are the same for an activity-based costing system, with one exception. Instead of using one plantwide overhead rate to allocate (or apply) overhead to products, an ABC system uses several overhead rates to allocate overhead. The entry to record this allocation—whether it involves one rate or

multiple rates—is the same as the entry in [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#). Simply debit work-in-process inventory and credit manufacturing overhead for the amount of overhead applied. (Some companies use separate work-in-process inventory and manufacturing overhead accounts for each activity. For the sake of simplicity, we do not use separate accounts.)

For example, assume production of SailRite’s Basic sailboats has the following cost driver activity for one week of operations:

(a) Activity for the Week	(b) Rate*	(a) × (b) Amount of Overhead Applied
10 purchase requisitions	\$120 per requisition	\$ 1,200
15 machine setups	800 per setup	12,000
35 machine hours	30 per machine hour	1,050
150 direct labor hours	6 per direct labor hour	900
60 inspection hours	50 per inspection hour	<u>3,000</u>
Total overhead applied to the Basic Sailboat		<u>\$ 18,150</u>

\*From [Figure 3.4 "Predetermined Overhead Rates for SailRite Company"](#).

The entry to record overhead applied to the Basic sailboats for the week is as follows:

Dr. WIP Inventory	18,150	
Cr. Manufacturing overhead		18,150

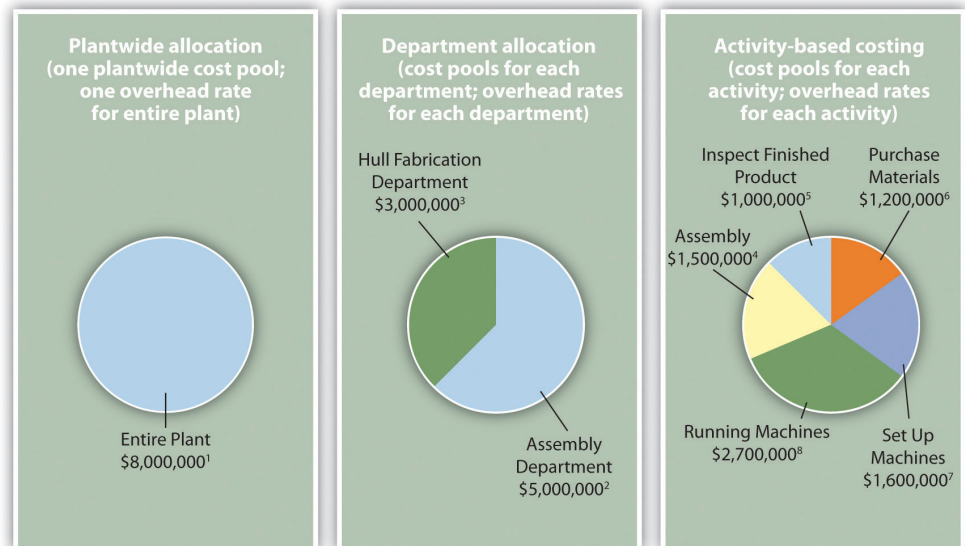
Recall from [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) that the manufacturing overhead account is closed to cost of goods sold at the end of the period. If actual overhead costs are higher than applied overhead, the resulting *underapplied* overhead is closed with a debit to cost of goods sold and a credit to manufacturing overhead. If actual overhead costs are lower than applied overhead, the resulting *overapplied* overhead is closed with a debit to manufacturing overhead and a credit to cost of goods sold.

## Recap of Three Allocation Methods

We have discussed three different methods of allocating overhead to products—plantwide allocation, department allocation, and activity-based costing. Remember, total overhead costs will not change in the short run, but the way total overhead costs are allocated to products will change depending on the method used.

**Figure 3.9 "The Three Methods of Overhead Allocation"** presents the three allocation methods, using SailRite as an example. Notice that the three pie charts in the illustration are of equal size, representing the \$8,000,000 total overhead costs incurred by SailRite.

Figure 3.9 The Three Methods of Overhead Allocation



Overhead Rates:

<sup>1</sup> Allocated based on direct labor hours (DLH):  $\$8,000,000 \div 250,000 \text{ DLH} = \$32 \text{ per DLH}$ .

<sup>2</sup> Allocated based on direct labor hours (DLH):  $\$5,000,000 \div 217,000 \text{ DLH} = \$23 \text{ per DLH}$ .

<sup>3</sup> Allocated based on machine hours (MH):  $\$3,000,000 \div 60,000 \text{ MH} = \$50 \text{ per MH}$ .

<sup>4</sup> Allocated based on direct labor hours (DLH):  $\$1,500,000 \div 250,000 \text{ DLH} = \$6 \text{ per DLH}$ .

<sup>5</sup> Allocated based on inspection hours (IH):  $\$1,000,000 \div 20,000 \text{ IH} = \$50 \text{ per IH}$ .

<sup>6</sup> Allocated based on purchase requisitions (PR):  $\$1,200,000 \div 10,000 \text{ PR} = \$120 \text{ per PR}$ .

<sup>7</sup> Allocated based on machine setups (MS):  $\$1,600,000 \div 2,000 \text{ MS} = \$800 \text{ per MS}$ .

<sup>8</sup> Allocated based on machine hours (MH):  $\$2,700,000 \div 90,000 \text{ MH} = \$30 \text{ per MH}$ .

### KEY TAKEAWAY

- Activity-based costing focuses on identifying the activities required to make products, on forming cost pools for each activity, and on allocating overhead costs to the products based on their use of each activity. ABC systems and traditional systems often result in vastly different product costs. But even if the resulting product costs are not much different, ABC provides managers with a better understanding of the production activities required for each activity and the associated costs, which often leads to improved efficiency and reduced costs.

## Business in Action 3.2

### Using Activity-Based Costing to Argue Predatory Pricing

**BuyGasCo Corporation**, a privately owned chain of gas stations based in Florida, was taken to court for selling regular grade gasoline below cost, and an injunction was issued. Florida law prohibits selling gasoline below refinery cost if doing so injures competition. Using a plantwide approach of allocating costs to products, the plaintiff's costing expert was able to support the allegation of predatory pricing. The defendant's expert witness, an accounting professor, used activity-based costing to dispute the allegation.

Both costing experts had to allocate costs to each of the three grades of gasoline (regular, plus, and premium) to determine a total cost per grade of fuel and a cost per gallon for each grade. Sales of regular grade fuel were significantly higher (63 percent of total sales) than the other two grades. Using the plantwide approach, the plaintiff's expert allocated all costs based on gallons of gas sold. Using the activity-based costing approach, the defendant's expert formed three activity cost pools—labor, kiosk, and gas dispensing. The first two cost pools allocated costs using gallons of gas sold and therefore were allocated as they would be with the plantwide approach (63 percent for regular grade, 20 percent for plus, and 17 percent for premium). The third cost pool (gas dispensing) allocated costs equally to each grade of fuel (i.e., one-third of costs to each grade of fuel). The gas dispensing pool included costs for storage tanks, all of which were the same size, as well as gas pumps and signs.

Compared with the plantwide approach, activity-based costing showed a lower cost per gallon for regular gas and a higher cost per gallon for the other two grades of fuel. Once the ABC information was presented, the case was settled, and the initial injunction was lifted.

Sources: Thomas L. Barton and John B. MacArthur, "Activity-Based Costing and Predatory Pricing: The Case of the Petroleum Retail Industry," *Management Accounting*, Spring 2003; All Business, "Home Page," <http://www.allbusiness.com>.

## REVIEW PROBLEM 3.3

Parker Company produces an inkjet printer that sells for \$150 and a laser printer that sells for \$350. Last year, total overhead costs of \$1,050,000 were allocated based on direct labor hours. A total of 15,000 direct labor hours were required last year to build 12,000 inkjet printers (1.25 hours per unit), and 10,000 direct labor hours were required to build 4,000 laser printers (2.50 hours per unit). Total direct labor and direct materials costs for the year were as follows:

	Inkjet Printer	Laser Printer
Direct materials	\$540,000	\$320,000
Direct labor	\$600,000	\$400,000

The management of Parker Company would like to use activity-based costing to allocate overhead rather than use one plantwide rate based on direct labor hours. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

Activity	Cost Driver	Estimated Overhead Costs	Estimated Cost Driver Activity		
			Inkjet	Laser	Total
Production runs	Number of production runs	\$ 400,000	40	10	50
Quality inspections	Inspection hours	250,000	1,200	2,800	4,000
Packaging and shipping	Number of units shipped	400,000	12,000	4,000	16,000
Total		<u>\$1,050,000</u>			

Required:

1. Calculate the direct materials cost per unit and direct labor cost per unit for each product.
2.
  1. Using the plantwide allocation method, calculate the predetermined overhead rate and determine the overhead cost per unit for the inkjet and laser products.
  2. What is the cost per unit for the inkjet and laser products?
- 3.

1. Using the activity-based costing allocation method, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)
2. Using the activity-based costing allocation method, allocate overhead to each product. (Hint: This is step 5 in the activity-based costing process.) Determine the overhead cost per unit. Round amounts to the nearest dollar.
3. What is the product cost per unit for the inkjet and laser products?
4. Calculate the per unit profit for each product using the plantwide approach and the activity-based costing approach. Comment on the differences between the results of the two approaches.

Solutions to Review Problem 3.3

1. The cost per unit for direct materials is as follows:

	Inkjet Printer	Laser Printer
Total direct material costs (a)	\$ 540,000	\$ 320,000
Units produced (b)	12,000 units	4,000 units
Direct material cost per unit (a) ÷ (b)	<u>\$ 45 per unit</u>	<u>\$ 80 per unit</u>

The cost per unit for direct labor is as follows:

	Inkjet Printer	Laser Printer
Total direct labor costs (c)	\$ 600,000	\$ 400,000
Units produced (d)	12,000 units	4,000 units
Direct labor cost per unit (c) ÷ (d)	<u>\$ 50 per unit</u>	<u>\$ 100 per unit</u>

- 2.

1. The plantwide allocation used by Parker Company is based on direct labor hours. The predetermined overhead rate is calculated as follows:

$$\frac{\text{Estimated overhead cost}}{\text{Estimated activity in allocation base}} = \frac{\$1,050,000}{25,000 \text{ hours}} = \$42 \text{ per direct labor hour}$$

Because the inkjet printer requires 1.25 direct labor hours to build and the laser printer takes 2.50 direct labor hours to build (both figures are provided in the problem data), \$52.50 in overhead is allocated to 1 unit of the inkjet product (= \$42 rate × 1.25 hours) and \$105 in overhead is allocated to 1 unit of the laser product (\$42 rate × 2.50 direct labor hours).

2. Per unit product costs are as follows:

	Inkjet Printer	Laser Printer
Direct materials	\$ 45.00	\$ 80.00
Direct labor	50.00	100.00
Overhead	52.50*	105.00**
Total product cost per unit	<u>\$ 147.50</u>	<u>\$ 285.00</u>

*Direct materials and direct labor determined from Question 1.*

*\*\$52.50 = 1.25 direct labor hours per unit × \$42 rate.*

*\*\*\$105 = 2.50 direct labor hours per unit × \$42 rate.*

3.

1. Predetermined overhead rates are calculated for each activity as follows:



## Chapter 3 How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?

Activity	Cost Driver	(a) Estimated Overhead Costs	(b) Estimated Cost Driver Activity	(a) ÷ (b) Predetermined Overhead Rate
Production runs	Number of production runs	\$ 400,000	50 runs	\$ 8,000.00 per run
Quality inspections	Inspection hours	250,000	4,000 hours	62.50 per inspection hr.
Packaging and shipping	Number of units shipped	400,000	16,000 units	25.00 per unit shipped
Total		<u>\$1,050,000</u>		

2. Overhead costs are allocated as follows:

Activity	Predetermined Overhead Rate	Inkjet Printer		Laser Printer	
		Cost Driver Activity	Overhead Allocated*	Cost Driver Activity	Overhead Allocated*
Production runs	\$8,000.00 per run	40	\$ 320,000	10	\$ 80,000
Quality inspections	62.50 per inspection	1,200	75,000	2,800	175,000
Packaging and shipping	25.00 per unit shipped	12,000	300,000	4,000	100,000
Total overhead costs allocated			<u>\$ 695,000</u>		<u>\$ 355,000</u>
Total companywide overhead costs			<u>\$ 1,050,000</u>		
Overhead cost per unit for each product**			<u>\$ 58</u>		<u>\$ 89</u>

\*Overhead allocated equals the predetermined overhead rate times the cost driver activity.

\*\*Overhead cost per unit for the inkjet printer equals \$695,000 (overhead allocated) ÷ 12,000 units produced, and for the laser printer, \$355,000 ÷ 4,000 units produced. Amounts are rounded to the nearest dollar.

3. Per unit product costs are as follows:

	Inkjet Printer	Laser Printer
Direct materials	\$ 45	\$ 80
Direct labor	50	100
Overhead	58	89
Total product cost per unit	<u>\$ 153</u>	<u>\$ 269</u>

Direct materials and direct labor determined from Question 1. Overhead determined from Question 3b.

4.

Plantwide Allocation (direct labor hours as the allocation base)		
	Inkjet Printer	Laser Printer
Direct materials	\$ 45.00	\$ 80.00
Direct labor	50.00	100.00
Overhead	52.50	105.00
Total product cost per unit (a)	<u>\$147.50</u>	<u>\$285.00</u>
Sales price (b)	<u>\$150.00</u>	<u>\$350.00</u>
<b>Profit = (b) – (a)</b>	<b><u>\$ 2.50</u></b>	<b><u>\$ 65.00</u></b>

Activity-Based Costing (several different allocation bases)		
	Inkjet Printer	Laser Printer
Direct materials	\$ 45.00	\$ 80.00
Direct labor	50.00	100.00
Overhead	58.00	89.00
Total product cost per unit (c)	<u>\$153.00</u>	<u>\$269.00</u>
Sales price (d)	<u>\$150.00</u>	<u>\$350.00</u>
<b>Profit (loss) = (d) – (c)</b>	<b><u>\$ (3.00)</u></b>	<b><u>\$ 81.00</u></b>

Although unit product costs do not change significantly for the inkjet printer when activity-based costing is used (from \$147.50 to \$153), the cost increases enough to result in a \$3 loss for each unit. Conversely, the laser printer costs decrease significantly from \$285 to \$269 per unit when using activity-based costing, resulting in a profit of \$81 per unit.

The shift in overhead costs to the inkjet printer is primarily a result of the inkjet printer using 80 percent of the production run resources and thus being assigned 80 percent of the overhead costs associated with production runs. The plantwide rate approach only assigned 60 percent of all overhead costs to the inkjet printer, including those related to production runs (60 percent = 15,000 inkjet direct labor hours ÷ 25,000 total direct labor hours).

### 3.4 Using Activity-Based Management to Improve Operations

#### LEARNING OBJECTIVE

1. Understand the concept of activity-based management.

*Question: Activity-based costing is helpful in providing relatively accurate product cost information. However, the value of activity-based costing information goes beyond accurate product costing. When activity-based costing is used in conjunction with activity-based management, organizations are often able to make dramatic improvements to operations. How does activity-based management help an organization reduce costs and become more efficient?*

**Answer: Activity-based management (ABM)**<sup>7</sup> provides three steps for managers to use that lead to improved efficiency and profitability of operations.

#### Step 1. Identify activities required to complete products.

This involves interviewing personnel throughout the company. Recall that activity-based costing also requires the identification of key activities. However, ABM allows for a more detailed analysis because the estimation of costs and related overhead rates are not required when using ABM.

7. A management tool that uses cost information obtained from an ABC system to improve the efficiency and profitability of operations.

8. Activities that add to a product's quality and performance.

9. Activities that do not add to a product's quality and performance.

#### Step 2. Determine whether activities are value-added or non-value-added.

Activities that add to the product's quality and performance are called **value-added activities**<sup>8</sup>. Activities that do not add to the product's quality and performance are called **non-value-added activities**<sup>9</sup>. Examples of value-added activities at SailRite include using materials and machines to produce hulls and assembling each

sailboat. Examples of non-value-added activities include storing parts in a warehouse and letting machinery sit idle.

**Step 3. Continuously improve the value-added activities and minimize or eliminate the non-value-added activities.**

Even if an activity is identified as value-added, ABM requires the continuous improvement of the activity. For example, SailRite's assembly process (a value-added activity) may require workers to shift back and forth between Basic and Deluxe sailboats throughout the day, each of which uses different parts and requires different tools. Perhaps the efficiency of this process could be improved by assembling the boats in batches—one day working on Basic boats, another day working on Deluxe boats.

Activities that are non-value-added should be minimized or eliminated. For example, storing parts in a warehouse at SailRite (a non-value-added activity) might be minimized by moving to a just-in-time system that requires suppliers to deliver parts immediately before they are needed for production.

The next time you visit a fast-food restaurant, go to a clothing store, or stand in line at a college bookstore, try to identify value-added and non-value-added activities. Think about ways the organization can eliminate non-value-added activities and improve value-added activities.

**KEY TAKEAWAY**

- Activity-based management provides a three step process that shows management how to use the cost information obtained from an activity-based costing system to improve the efficiency and profitability of operations.

### **Business in Action 3.3**

Why Use Activity-Based Costing (ABC) and Activity-Based Management (ABM)?

A survey of 296 users of activity-based costing and activity-based management showed that the top four objectives of using ABC and ABM were as follows:

1. To provide product costing (58 percent)
2. To analyze processes (51 percent)
3. To evaluate performance (49 percent)
4. To assess profitability (38 percent)

All these objectives are important to most organizations and can be achieved with the help of ABC and ABM systems.

Source: Mohan Nair, "Activity-Based Costing: Who's Using It and Why?" *Management Accounting Quarterly*, Spring 2000.

### REVIEW PROBLEM 3.4

Label each of the following activities as value-added or non-value-added:

- a. Placing customers who call to order a pizza on hold
- b. Assembling desks to be sold to customers
- c. Storing raw materials to be used in production the next month
- d. Designing a car to maximize comfort
- e. Scrapping defective production materials
- f. Waiting for a phone call from a customer
- g. Moving raw materials from one end of a factory to the other

Solutions to Review Problem 3.4

- a. Non-value-added activity
- b. Value-added activity
- c. Non-value-added activity
- d. Value-added activity
- e. Non-value-added activity
- f. Non-value-added activity
- g. Non-value-added activity

## 3.5 Using Activity-Based Costing (ABC) and Activity-Based Management (ABM) in Service Organizations

### LEARNING OBJECTIVE

1. Apply activity-based costing and activity-based management to service organizations.

*Question: To this point, we have presented ABC and ABM examples in a manufacturing setting. However, service organizations, such as banks, hospitals, airlines, and government agencies, also use ABC and ABM. Some specialists refer to activity-based costing and activity-based management as activity-based costing and management, or ABCM. In fact, a recent survey indicates that 75 percent of companies that use ABC are in the public sector, a service industry, or a consulting industry. Mohan Nair, "Activity-Based Costing: Who's Using It and Why?" Management Accounting Quarterly, Spring 2000, 29–33. How can ABC help service organizations get better product cost information?*

*Answer: The same five steps used in manufacturing organizations can also be used in service organizations. To understand how ABC could be used in a service organization, let's look at how ABC can be used to determine the cost of loan products at a financial institution.*

### Service Organization Example of ABC

Imagine you are the chief financial officer of Five Star Bank. You are interested in implementing an activity-based costing system to evaluate the cost of different loan products, such as auto loans and home equity loans, offered by the bank. The five steps of activity-based costing we presented earlier still apply. Let's look at how these steps might work when evaluating the cost of bank loans.

#### Step 1. Identify costly activities.

Processing loans includes activities such as meeting with customers, reviewing customer applications, and running credit reports.

**Step 2. Assign overhead costs to the activities identified in step 1.**

Costs assigned to the activity of *reviewing customer applications* include items such as wages of personnel reviewing applications, depreciation of computer equipment used to review online applications, and supplies needed for the review process.

**Step 3. Identify the cost driver for each activity.**

Activity cost drivers are shown as follows:

Activity	Cost Driver
Meeting with customers	Hours of meeting time
Reviewing customer applications	Number of applications reviewed
Running credit reports	Number of credit reports run

**Step 4. Calculate a predetermined overhead rate for each activity.**

This is done by dividing estimated overhead costs for each activity by the estimated cost driver activity. For the activity *meeting with customers*, this calculation results in a rate per hour of meeting time. For the activity *reviewing customer applications*, the calculation results in a rate per application reviewed, and for *running credit reports*, a rate per credit report run.

**Step 5. Allocate overhead costs to products.**



Overhead is allocated, or *applied*, to products (auto loans and home equity loans in this example) based on the use of each activity's cost driver. If a loan officer reviews 30 auto loan applications, an amount equal to the *rate per application reviewed* times *30 applications* is allocated to the auto loans product.

### Service Organization Example of ABM

*Question: Managers at Five Star Bank are not only interested in product cost information; they would also like to scrutinize the activities involved in processing loans and make the process more efficient. How can the management of Five Star Bank use activity-based management to become more efficient?*

*Answer: Managers and accountants can apply the three steps of activity-based management to Five Star Bank as follows:*

1. **Identify activities required to complete the product.** This involves interviewing personnel throughout the company to capture all the activities involved in processing loans.
2. **Determine whether activities are value-added or non-value-added.** An example of a value-added activity is the quick approval of a loan. An example of a non-value-added activity is time spent waiting for credit reports.
3. **Continuously improve the value-added activities and minimize, or eliminate, the non-value-added activities.** Five Star Bank should continually strive to improve its ability to approve loans quickly (a value-added activity). While waiting for credit reports (a non-value-added activity), perhaps the bank can find other value-added activities that bank personnel can perform (e.g., responding to customer questions or processing other loan applications).

### Business in Action 3.4

#### Activity-Based Costing at **Blue Cross and Blue Shield of Florida (BCBSF)**

Management at **Blue Cross and Blue Shield of Florida** realized it needed more sophisticated cost information to make better decisions. Given the highly competitive nature of the health care insurance industry and the need to minimize costs, **BCBSF's** management decided to implement an activity-based costing system. Management's primary concern was how to allocate administrative costs totaling \$588,000,000 (21 percent of revenue) to the products and services the organization provides.

The benefits of implementing an activity-based costing and management system at **BCBSF** are as follows:

- Product pricing is improved as a result of having better cost information (prices are based on cost).
- Regional management is able to identify the cost of services provided by headquarters and make more efficient use of costly services.
- Product managers use the cost information to design products in a way that is most cost-effective.

As stated by the product director and cost accounting manager at **BCBSF**, "The goal is to provide the right information at the right time to the right people in a cost-efficient way."

Source: Kenneth L. Thurston, Dennis M. Kelemen, and John B. MacArthur, "Cost for Pricing at Blue Cross and Blue Shield of Florida," *Management Accounting Quarterly*, Spring 2000.

**KEY TAKEAWAY**

- Activity-based costing and activity-based management techniques are not limited to manufacturing companies. Virtually all organizations—including service, nonprofit, retail, and governmental—can benefit from implementing some form of ABC and ABM.

## REVIEW PROBLEM 3.5

Menzies and Associates provides two products to its clients—tax services and audit services. Last year, total overhead costs of \$1,000,000 were allocated based on direct labor hours. A total of 10,000 direct labor hours were required last year for tax clients at a cost of \$350,000, and 30,000 direct labor hours were required for audit clients at a cost of \$1,200,000. Direct materials used were negligible and are included in overhead costs. Sales revenue totaled \$720,000 for tax services and \$2,200,000 for audit services.

Management of Menzies and Associates would like to use activity-based costing to allocate overhead rather than use one plantwide rate based on direct labor hours (perhaps the term “officewide” rate would be more appropriate here). The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

Estimated Cost Driver Activity					
Activity	Cost Driver	Estimated Overhead Costs	Tax	Audit	Total
Scheduling and data entry	Number of clients	\$ 400,000	150	100	250
Advertising in journals	Number of ads	100,000	45	5	50
Computer usage	Computer hours	500,000	2,500	2,500	5,000
Total		<u>\$1,000,000</u>			

*Required:*

1.

- Using the plantwide allocation method, calculate the total cost for each product. (Hint: Product costs for this company include overhead and direct labor.)
- Calculate the profit for each product using this approach. Also calculate profit as a percent of sales revenue for each product.

2.

- Using activity-based costing, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)

2. Using activity-based costing, calculate the amount of overhead assigned to each product. (Hint: This is step 5 in the activity-based costing process.)
  3. Calculate the profit for each product using this approach. Also calculate profit as a percent of sales revenue for each product.
3. Comment on the results of using activity-based costing compared to plantwide allocation.

Solutions to Review Problem 3.5

1.

1. The plantwide allocation used by Menzies and Associates is based on direct labor hours. The rate is calculated as follows:

$$\frac{\text{Estimated overhead cost}}{\text{Estimated activity in allocation base}} = \frac{\$1,000,000}{40,000 \text{ hours}} = \$25 \text{ per direct labor hour}$$

Total product costs are as follows:

	Tax	Audit
Direct labor (given)	\$ 350,000	\$ 1,200,000
Overhead	250,000*	750,000**
Total product cost	<u>\$ 600,000</u>	<u>\$ 1,950,000</u>

\*\$250,000 = 10,000 direct labor hours × \$25 rate.

\*\*\$750,000 = 30,000 direct labor hours per unit × \$25 rate.

2.

## Chapter 3 How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?

	Tax	Audit
Direct labor	\$ 350,000	\$1,200,000
Overhead	250,000	750,000
Total product cost (a)	<u>\$ 600,000</u>	<u>\$1,950,000</u>
Sales revenue (b)	720,000	2,200,000
Profit (c) = (b) – (a)	<u>120,000</u>	<u>250,000</u>
Profit as percent of revenue (c) ÷ (b)	17% (rounded)	11% (rounded)

2.

1. Predetermined overhead rates are calculated for each activity as follows:

Activity	Cost Driver	(a) Estimated Overhead Costs	(b) Estimated Cost Driver Activity	(a) ÷ (b) Predetermined Overhead Rate
Scheduling and data entry	Number of clients	\$ 400,000	250 clients	\$ 1,600 per client
Advertising in journals	Inspection ads	100,000	50 ads	2,000 per ad
Computer usage	Computer hours	500,000	5,000 hours	100 per hour
Total		<u>\$1,000,000</u>		

2. Overhead costs are allocated as follows:

Activity	Predetermined Overhead Rate	Cost Driver Activity	Tax		Audit	
			Overhead Allocated*	Cost Driver Activity	Overhead Allocated*	Cost Driver Activity
Scheduling and data entry	\$ 1,600 per client	150	\$ 240,000	100	\$ 160,000	100
Advertising in journals	2,000 per ad	45	90,000	5	10,000	5
Computer usage	100 per hour	2,500	250,000	2,500	250,000	2,500
Total overhead costs allocated			<u>\$ 580,000</u>		<u>\$ 420,000</u>	
Total companywide overhead costs			<u>\$ 1,000,000</u>		<u>\$ 1,000,000</u>	

\*Overhead allocated equals the predetermined overhead rate times the cost driver activity.

3. The profit and profit as a percent of sales revenue are calculated as follows:

	Tax	Audit
Direct labor	\$ 350,000	\$ 1,200,000
Overhead	580,000	420,000
Total product cost (d)	<u>\$ 930,000</u>	<u>\$ 1,620,000</u>
Sales revenue (e)	<u>\$ 720,000</u>	<u>\$ 2,200,000</u>
Profit (loss) (f) = (e) – (d)	<u>\$(210,000)</u>	<u>\$ 580,000</u>
Profit (loss) as percent of revenue (f) ÷ (e)	(29)% (rounded)	26% (rounded)

3. Activity-based costing results in a significant increase of overhead costs allocated to the tax product and a decrease of overhead costs allocated to the audit product. The plantwide allocation approach allocates overhead based on direct labor hours, which results in 25 percent of all overhead costs being allocated to tax (= 10,000 direct labor hours in tax ÷ 40,000 total direct labor hours) and 75 percent to audit. However, ABC shows that tax uses 60 percent of scheduling and data entry resources (= 150 tax clients ÷ 250 total clients), 90 percent of advertising resources (= 45 tax ads ÷ 50 total ads), and 50 percent of computer resources (= 2,500 tax computer hours ÷ 5,000 total computer hours). Thus tax is allocated more overhead costs using ABC than using one plantwide rate based on direct labor hours. Note that total profit of \$370,000 is the same regardless of the overhead cost allocation approach used. Using the plantwide allocation approach, \$370,000 = \$120,000 + \$250,000. Using the ABC approach, \$370,000 = (\$210,000) + \$580,000.

Management must use this information to make improvements to the company's operations. It would probably be unwise to eliminate tax services because of the connection they have with audit services (i.e., audit clients may appreciate the convenience of also having tax services available to them). However, management can look for ways to make the process more efficient by focusing on costly activities identified in the ABC analysis.

Note that when calculating product costs for service organizations, it is difficult, if not impossible, to calculate a product cost *per unit*. Most service organizations do not have an easily defined unit of measure because services vary so much from one customer to another. One alternative is to calculate

total profit as a percent of total sales revenue. This allows for a comparison of profitability between different types of services, similar to comparing the profitability for units of product.



## 3.6 Variations of Activity-Based Costing (ABC)

### LEARNING OBJECTIVE

1. Expand the use of activity-based costing.

*Question: The primary focus of activity-based costing thus far has been on allocating manufacturing overhead costs to products. Although this is important for external reporting purposes, we can expand ABC to include costs beyond manufacturing overhead. Also, we can organize costs in different ways to help managers evaluate performance. What different approaches can be used to organize cost data in a way that helps managers make better decisions?*

*Answer: Cost data can be organized in a number of ways to help managers make decisions. Four common approaches are addressed in this section:*

1. Expanding ABC to include nonmanufacturing costs
2. Allocating service department costs to production departments
3. Using the hierarchy of costs to organize cost information
4. Measuring the costs of controlling and failing to control quality

### External Reporting and Internal Decision Making

*Question: U.S. Generally Accepted Accounting Principles require the allocation of all manufacturing costs to products for inventory costing purposes. The choice of an allocation method is not critical to this process. Companies that use direct labor hours, machine hours, activity-based costing, or some other method to allocate overhead costs to products are likely to be in compliance with U.S. GAAP. Throughout this chapter, we have illustrated how ABC is used to allocate manufacturing overhead costs. However, organizations often use ABC for purposes that go beyond allocating costs solely for external reporting. How might ABC be used to help companies in areas other than external reporting?*

Answer: Commissions paid to sales people for the sale of specific products (often called *selling, general, and administrative*) are included as an operating expense in financial reports prepared for external users as required by U.S. GAAP. However, many organizations may assign commission costs to specific products for internal decision-making purposes. This treatment is not in compliance with U.S. GAAP, but it is perfectly acceptable for internal reporting purposes and may be done using activity-based costing. It is important to understand that managers have ultimate control over which costs should be allocated to products for internal reporting purposes, and this allocation often involves going beyond overhead costs.

**Table 3.1 "Examples of Costs Allocated to Products"** provides examples of costs that could be allocated to products. It also includes cost categories—product, selling, and general and administrative (G&A)—and indicates whether the cost allocation complies with U.S. GAAP for *external* reporting. As you can see in the far right column, all costs can be allocated to products for *internal* reporting purposes.

Table 3.1 Examples of Costs Allocated to Products

Cost	Cost Category*	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Direct materials	Product	Yes	Yes
Direct labor	Product	Yes	Yes
Manufacturing overhead**	Product	Yes	Yes
Sales commissions	Selling	No	Yes
Shipping products to customers	Selling	No	Yes

\*See [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) for information about category definitions.

\*\*Includes all manufacturing costs other than direct labor and direct materials, such as factory related costs for supervisors, building rent, machine maintenance, utilities, and indirect materials. See [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) for more detail.

Cost	Cost Category*	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Product advertising	Selling	No	Yes
Legal costs for product lawsuit	G&A	No	Yes
Processing payroll for production personnel	G&A	No	Yes
Company president's salary	G&A	No	Yes
Costs of implementing ABC	G&A	No	Yes

\*See [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) for information about category definitions.

\*\*Includes all manufacturing costs other than direct labor and direct materials, such as factory related costs for supervisors, building rent, machine maintenance, utilities, and indirect materials. See [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) for more detail.

### Allocating Service Department Costs Using the Direct Method

*Question: Most companies have departments that are classified as either service departments or production departments. **Service departments**<sup>10</sup> provide services to other departments within the company and include such functions as accounting, human resources, legal, maintenance, and computer support. **Production departments**<sup>11</sup> are directly involved with producing goods or providing services for customers and include such functions as ordering materials, assembling products, and performing quality inspections. Why do companies often allocate a share of service department costs to production departments for internal reporting purposes even though U.S. GAAP generally does not allow it for external reporting?*

10. Departments that provide services to other departments within a company.

11. Departments directly involved with producing goods or providing services for customers.

Answer: Companies allocate service department costs to production departments for several reasons:

- The services provided by departments within a company are not free, and they should be used as efficiently as possible. Managers of production departments that use these services thus have an incentive to minimize their use.
- To minimize costs, **Hewlett Packard** and other large companies often “outsource” services like building maintenance and legal support (i.e., they have other companies provide the services for them). This creates an incentive for the company’s service departments to provide services at a reasonable cost.
- Organizations often include service department costs when determining product costs for internal decision-making purposes, as described earlier (refer to Table 3.1 "Examples of Costs Allocated to Products" for examples).

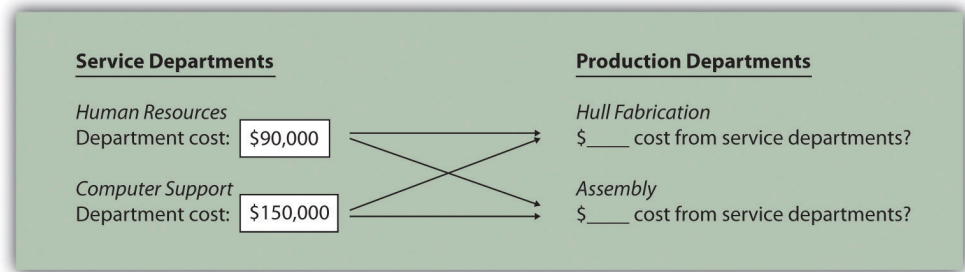
*Question: How do companies allocate service department costs to production departments and how might this be done at SailRite?*

Answer: Several methods of allocating service department costs to production departments are available. We introduce the simplest approach—the *direct method*—here (complex approaches are presented in more advanced cost accounting texts). The **direct method**<sup>12</sup> allocates service department costs directly to production departments but not to other service departments.

For example, assume that SailRite Company has two service departments—Human Resources and Computer Support. Costs associated with Human Resources and Computer Support total \$90,000 and \$150,000, respectively. Recall that SailRite has two production departments—Hull Fabrication and Assembly. The goal is to allocate service department costs to the two production departments, as shown in Figure 3.10 "Allocating Service Department Costs to Production Departments at SailRite Company: Direct Method (Before Allocations)".

12. A method of allocating costs that allocates service department costs directly to production departments but not to other service departments.

Figure 3.10 *Allocating Service Department Costs to Production Departments at SailRite Company: Direct Method (Before Allocations)*



SailRite would like to allocate service department costs using an allocation base that drives these costs. Assume management decides to use the *number of employees* as the allocation base to allocate Human Resources costs, and the *number of computers* as the allocation base to allocate Computer Support costs. Allocation base activity for each production department is as follows:

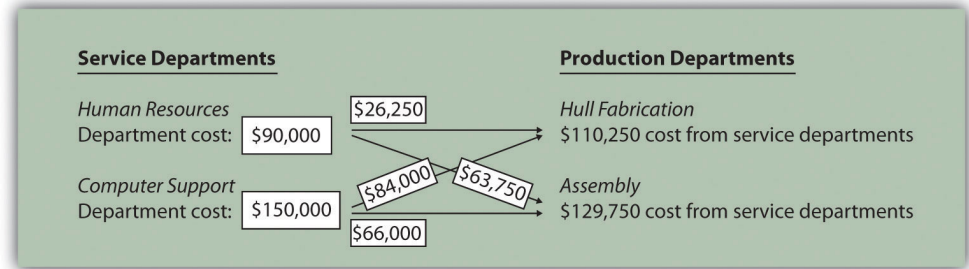
	Hull Fabrication	Assembly	Total
Number of employees	35	85	120
Number of computers	42	33	75

The allocation rate for human resource services is \$750 per employee (= \$90,000 department costs ÷ 120 employees). The allocation rate for computer support services is \$2,000 per computer (= \$150,000 ÷ 75 computers). Thus the Hull Fabrication department receives an allocation of \$26,250 in human resource costs (= 35 employees × \$750 rate) and \$84,000 in computer support costs (= 42 computers × \$2,000 rate). The Assembly department receives an allocation of \$63,750 in human resource costs (= 85 employees × \$750 rate) and \$66,000 in computer support costs (= 33 computers × \$2,000 rate).

The allocations to production departments are shown in Figure 3.11 "Allocating Service Department Costs to SailRite's Production Departments: Direct Method (After Allocations)". If management chooses to allocate service department costs to production departments as described here, there must be some benefit to going through the process. Should these costs be assigned to activity cost pools for the purpose of costing products (activity-based costing)? Should production department managers be evaluated based on the use of these services? Should actual service department usage be compared to budgeted usage for each production department? The answers to these questions vary from one

organization to the next. However, one point is certain—the benefits of implementing this allocation system must outweigh the costs!

Figure 3.11 Allocating Service Department Costs to SailRite’s Production Departments: Direct Method (After Allocations)



### The Hierarchy of Costs

Question: Some organizations group activities into four cost categories, called the hierarchy of costs, to help managers form cost pools for activity-based costing purposes. The **cost hierarchy**<sup>13</sup> Credit for developing the cost hierarchy is generally given to R. Cooper and R. S. Kaplan, “Profit Priorities from Activity-Based Costing,” *Harvard Business Review*, May 1991, 130–35. groups costs based on whether the activity is at the facility level, product or customer level, batch level, or unit level. What is the difference between each of these categories, and how does this information help managers?

Answer: Each category within the cost hierarchy is described as follows:

13. A method of costing that groups costs based on whether the activity is at the facility level, product or customer level, batch level, or unit level.
14. Activities required to sustain facility operations and include items such as building rent and management of the factory.
15. Activities required to develop, produce, and sell specific types of products.
16. Activities required to produce batches (or groups) of products.

- **Facility-level activities**<sup>14</sup> (or costs) are required to sustain facility operations and include items such as building rent and management of the factory. These costs are generally changed over long time horizons and are incurred regardless of how many product-, batch-, or unit-level activities take place.
- **Product-level activities**<sup>15</sup> (or customer-level activities) are required to develop, produce, and sell specific types of products. This category includes items such as product development and product advertising. These costs can be changed over a shorter time horizon than facility-level activities and are incurred regardless of the number of batches run or units produced.
- **Batch-level activities**<sup>16</sup> are required to produce batches (or groups) of products and include items such as machine setups and quality

inspections. These costs can be changed over a shorter time horizon than product- and facility-level activities and are driven by the number of batches run rather than the number of units produced. For example, a batch can consist of producing 5 units or 10,000 units. The costs in this category are driven by the number of batches, not the number of units in each batch.

- **Unit-level activities**<sup>17</sup> are required to produce individual units of product and include items such as energy to run machines, direct labor, and direct materials. These costs can be changed over a short time horizon based on how many units management chooses to produce.

The cost hierarchy serves as a framework for managers to establish cost pools and determine what drives the change in costs for each cost pool. It also provides a sense of how quickly (or slowly) costs change based on decisions made by management. Examples of activities often identified by companies using activity-based costing, and how these activities fit in the cost hierarchy, appear in [Table 3.2 "Cost Hierarchy Examples"](#).

Table 3.2 Cost Hierarchy Examples

Cost Hierarchy Category	Activity/Cost
Facility-level	Plant depreciation
	Building rent
	Management of facility
Product/customer-level	New product development
	Product engineering
	Product marketing and advertising
	Maintaining customer records
Batch-level	Machine setups
	Processing purchase orders
	Batch quality inspections
Unit-level	Energy to run production machines
	Direct labor
	Direct materials

17. Activities required to produce individual units of product, such as direct materials and direct labor.

## Measuring the Costs of Controlling and Improving Quality

*Question: The hierarchy of costs is not the only approach organizations use to group costs. Managers are also concerned about measuring the costs associated with quality. Quality-related costs can be organized into four categories. The first two categories—prevention and appraisal—are costs incurred to control and improve quality. The final two categories—internal failure and external failure—are costs incurred as a result of failing to control and improve quality. What is the difference between these cost categories, and how does this information help managers improve quality?*

- **Prevention costs**<sup>18</sup> are costs incurred to prevent defects in products and services. Examples include designing production processes that minimize defects, providing quality training to employees, and inspecting raw materials before they are placed in production.
- **Appraisal costs**<sup>19</sup> (often called *detection costs*) are costs incurred to detect defective products before they are delivered to customers. The cost of finished goods inspections falls in this category.
- **Internal failure costs**<sup>20</sup> are the costs incurred as a result of detecting defective products before they are delivered to customers. Examples include the reworking of defective products, the scrapping of defective products, and the machine downtime resulting from process problems that cause defects.
- **External failure costs**<sup>21</sup> are the costs incurred as a result of delivering defective products to customers. Examples include warranty repairs, warranty replacements, and product liability resulting from unsafe defective products.

Companies that measure these costs of quality typically calculate the costs in each category as a percent of total revenue. The goal is to steadily shift costs toward the prevention and appraisal categories and away from the internal and external failure categories. As organizations concentrate more on preventing defects, total quality costs as a percent of revenue tends to decline and product quality improves. **Table 3.3 "Summary of Quality Costs"** provides a summary of the four classifications of quality-related costs.

Table 3.3 Summary of Quality Costs

Quality Cost Category	Description
Prevention cost	Cost of activities that prevent defects in products, such as quality training and raw materials inspections

18. Costs for activities that prevent defects in products and services.

19. Costs for activities that detect defective products before they are delivered to customers.

20. Costs incurred as a result of detecting defective products before they are delivered to customers.

21. Costs for activities that result from delivering defective products to customers.



Quality Cost Category	Description
Appraisal cost	Cost of activities that detect defective products before they are delivered to customers, such as finished goods inspections and field inspections
Internal failure cost	Cost of activities that result from detecting defective products before they are delivered to customers, such as rework and scrap
External failure cost	Cost of activities that result from delivering defective products to customers, such as warranty repairs and warranty replacements

### KEY TAKEAWAY

- Activity-based costing is not simply used to allocate manufacturing overhead costs to products for external reporting purposes; it is also often used to allocate selling, general, and administrative costs to products for internal decision-making purposes. A number of methods can be used to assist in the cost allocation process. For example, the cost of service departments can be allocated to production departments using the direct method. Also the cost hierarchy can be used to help establish cost pools and identify cost drivers used to allocate costs. Organizations are also concerned with measuring and reducing the cost of quality by categorizing quality costs into four categories—prevention, appraisal, internal failure, and external failure.

### REVIEW PROBLEM 3.6

Fill in the following table to identify if the cost item can be included in the cost of products for external reporting purposes and/or internal reporting purposes. The first item is completed for you.

Cost	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Direct materials	Yes	Yes
Salaries of sales people		
Indirect materials used in production		
Rent for headquarters building		
Product promotions		
Direct labor		
Legal costs for patent applications		
Processing payroll for human resource personnel		
Depreciation of factory equipment		
Marketing vice president's salary		
Depreciation of administrative department equipment		

Solution to Review Problem 3.6

Cost	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Direct materials	Yes	Yes

Salaries of sales people	No	Yes
Indirect materials used in production	Yes	Yes
Rent for headquarters building	No	Yes
Product promotions	No	Yes
Direct labor	Yes	Yes
Legal costs for patent applications	No	Yes
Processing payroll for human resource personnel	No	Yes
Depreciation of factory equipment	Yes	Yes
Marketing vice president's salary	No	Yes
Depreciation of administrative department equipment	No	Yes

## END-OF-CHAPTER EXERCISES

### Questions

1. Why do managers allocate overhead costs to products?
2. Describe the three methods of allocating overhead costs.
3. What is a cost pool, and how does it relate to allocating overhead to products?
4. What is the difference between an activity and a cost driver?
5. How do cost flows using activity-based costing differ from cost flows using one plantwide rate?
6. Describe the five steps required to implement activity-based costing.
7. What are some advantages of using an activity-based costing system?
8. What are some disadvantages of using an activity-based costing system?
9. Review [Note 3.14 "Business in Action 3.1"](#) What were the two common characteristics of the 130 U.S. manufacturing companies that used activity-based costing?
10. Explain how to record the application of overhead to products using activity-based costing.
11. Describe the three steps required to implement activity-based management.
12. How does activity-based management differ from activity-based costing?
13. What is the difference between a value-added activity and a non-value-added activity? Provide two examples of non-value-added activities for each of the following:
  1. Fast-food restaurant
  2. Clothing store
  3. College bookstore
14. Review [Note 3.16 "Business in Action 3.2"](#) How did activity-based costing help **BuyGasCo Corporation** settle its predatory pricing case?
15. Review [Note 3.23 "Business in Action 3.3"](#) What did the survey of 296 users of ABC and ABM show were the top two objectives in using these systems?
16. Review [Note 3.26 "Business in Action 3.4"](#) What was management's primary concern in deciding to implement an activity-based costing system?
17. What selling costs and general and administrative costs might be allocated to products using activity-based costing? Why do some managers prefer allocating these costs to products?

18. What are service departments? Why do some managers allocate service department costs to production departments?
19. Describe the four categories included in the hierarchy of costs.
20. What is the difference between a facility-level cost and a unit-level cost?
21. How does the hierarchy of costs help managers allocate overhead costs?
22. Describe the four categories related to the costs of quality. How might the allocation of quality costs to these four categories help managers?

Brief Exercises

23. **Product Costing at SailRite.** Refer to the dialogue presented at the beginning of the chapter and the follow-up dialogue before Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company".

*Required:*

- a. In the opening dialogue, why was the owner concerned about the product costs for each of the company's boats?
- b. In the follow-up dialogue before Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company", what did the company's accountant discover about the profitability of each boat using activity-based costing? (Refer to Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company" as you prepare your answer.)

24. **Calculating Plantwide Predetermined Overhead Rate.** Manufacturing overhead costs totaling \$5,000,000 are expected for this coming year. The company also expects to use 50,000 direct labor hours and 20,000 machine hours.

*Required:*

- a. Calculate the plantwide predetermined overhead rate using direct labor hours as the base. Provide a one-sentence description of how the rate will be used to allocate overhead costs to products.
- b. Calculate the plantwide predetermined overhead rate using machine hours as the base. Provide a one-sentence description of how the rate will be used to allocate overhead costs to products.

**25. Calculating Department Predetermined Overhead Rates.**

Manufacturing overhead costs totaling \$1,000,000 are expected for this coming year—\$400,000 in the Assembly department and \$600,000 in the Finishing department. The Assembly department expects to use 4,000 machine hours, and the Finishing department expects to use 30,000 direct labor hours.

*Required:*

- a. Assume this company uses the department approach for allocating overhead costs. Calculate the predetermined overhead rate for each department, and explain how these rates will be used to allocate overhead costs to products.
- b. Why do different departments use different allocation bases (e.g., direct labor hours or machine hours)?

**26. Identifying Cost Drivers.** Ehrman Company identified the activities listed in the following as being most important (step 1 and step 2 of activity-based costing), and it formed cost pools for each activity.

1. Purchasing raw materials
2. Inspecting raw materials
3. Storing raw materials
4. Maintaining production equipment
5. Setting up machines to produce batches of product
6. Testing finished products

*Required:*

Perform step 3 of the activity-based costing process by identifying a possible cost driver for each activity.

**27. Identifying Cost Drivers: Service Company.** McHale Architects, Inc., designs, engineers, and supervises the construction of custom homes. The following activities were identified as being most important (step 1 and step 2 of activity-based costing), and cost pools were formed for each activity.

1. Meeting with customers
2. Coordinating inspections with the building department

3. Consulting with contractors
4. Maintaining office equipment
5. Processing customer billings (invoices)

*Required:*

Perform step 3 of the activity-based costing process by identifying a possible cost driver for each activity.

28. **Value-Added and Non-Value-Added Activities.** Novak Corporation manufactures custom-made kayaks and accessories. The company performs the following activities.

1. Storing parts and materials
2. Queuing orders before beginning production
3. Assembling kayaks
4. Waiting for materials to arrive to continue production
5. Painting kayaks
6. Designing kayaks to maximize comfort
7. Scrapping defective materials

*Required:*

Label each activity as value-added or non-value-added.

29. **Allocation Base for Service Departments.** Valencia Company has 15 production departments and produces hundreds of products. Service department costs are allocated to production departments using the direct method. Five service departments provide the following services to the production departments.

1. The Computer Technology department provides computer support.
2. The Personnel department posts job openings, hires employees, and coordinates employee benefits.
3. The Accounting department processes accounting data, provides financial reports, and performs general accounting duties.
4. The Maintenance department maintains buildings and equipment.
5. The Legal department provides legal services.

*Required:*

- a. For each service department, provide a possible allocation base. Explain why the base you chose for each service department is reasonable.
- b. Does the direct method provide for allocations from one service department to another? Explain.

Exercises: Set A

30. **Plantwide Versus Department Allocations of Overhead.** San Juan Company expects to incur \$600,000 in overhead costs this coming year—\$100,000 in the Cutting department, \$300,000 in the Assembly department, and \$200,000 in the Finishing department. Direct labor hours worked in all departments are expected to total 40,000 (used for the plantwide rate). The Cutting department expects to use 20,000 machine hours, the Assembly department expects to use 25,000 direct labor hours, and the Finishing department expects to incur \$100,000 in direct labor costs (this information will be used for department rates).

*Required:*

- a. Assume San Juan Company uses the plantwide approach for allocating overhead costs and direct labor hours as the allocation base. Calculate the predetermined overhead rate, and explain how this rate will be used to allocate overhead costs.
  - b. Assume San Juan Company uses the department approach for allocating overhead costs. Calculate the predetermined overhead rate for each department, and explain how these rates will be used to allocate overhead costs.
31. **Computing Product Costs Using Activity-Based Costing.** Stillwater Company identified the following activities, estimated costs for each activity, and identified cost drivers for each activity for this coming year. (These are the first three steps of activity-based costing.)



## Chapter 3 How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Ordering parts	Number of purchase requisitions	\$ 400,000	5,000 purchase requisitions
Tracking inventory of parts	Number of parts purchased	560,000	80,000 parts purchased
Running machines	Machine hours	350,000	7,000 machine hours
Inspecting finished products	Inspections hours	200,000	1,000 inspection hours
Total		<u>\$1,510,000</u>	

The company produces three products, Z1, Z2, and Z3. Information about these products for the month of January follows:

	Z1	Z2	Z3
Direct materials cost per unit	\$ 100	\$ 75	\$ 200
Direct labor cost per unit	35	25	70
Overhead cost per unit	?	?	?
Product cost per unit	<u>\$ ?</u>	<u>\$ ?</u>	<u>\$ ?</u>
Units produced	250 units	500 units	700 units

Actual cost driver activity levels for the month of January are as follows:

	Z1	Z2	Z3
Number of purchase requisitions	50	70	100
Number of parts purchased	4,000	3,300	3,600
Machine hours	330	240	310
Inspections hours	10	50	30

*Required:*

- Using the estimates for the year, compute the predetermined overhead rate for each activity (this is step 4 of the activity-based costing process).
- Using the activity rates calculated in requirement **a** and the actual cost driver activity levels shown for January, allocate overhead to the three products for the month of January (this is step 5 of the activity-based costing process).
- For each product, calculate the overhead cost per unit for the month of January. Round results to the nearest cent.
- For each product, calculate the product cost per unit for the month of January. Round results to the nearest cent.

32. **Journal Entry to Apply Overhead.** Caspian Company is deciding which of three approaches it should use to apply overhead to products. Information for each approach is provided in the following.

- **One plantwide rate.** The predetermined overhead rate is 150 percent of direct labor cost.
- **Department rates.** The Machining department uses a rate of \$55 per machine hour, and the Assembly department uses a rate of \$35 per direct labor hour.
- **Activity-based costing rates.** Three activities were identified and rates were calculated for each activity.

Purchase requisitions	\$15 per requisition processed
Production setup	\$50 per setup
Quality control	\$70 per inspection

*Required:*

- a. Direct labor costs for the year totaled \$80,000. Using the plantwide method, calculate the amount of overhead applied to products and make the appropriate journal entry.
  - b. During the year, the Machining department used 1,000 machine hours, and the Assembly department used 1,200 direct labor hours. Using the department method, calculate the amount of overhead applied to products and make the appropriate journal entry.
  - c. During the year, 900 purchase requisitions were processed, 1,300 production setups were performed, and 400 products were inspected. Using the activity-based costing approach, calculate the amount of overhead applied to products, and make the appropriate journal entry.
33. **Allocating Service Department Costs.** Crandall Company has two production departments (P1 and P2) and three service departments (S1, S2, and S3). Service department costs are allocated to production departments using the direct method. The \$400,000 costs of department S1 are allocated based on the

number of employees in each production department. The \$600,000 costs of department S2 are allocated based on the square footage of space occupied by each production department. The \$300,000 costs of department S3 are allocated based on hours of computer support used by each production department. Information for each production department follows.

Production Department	Number of Employees	Square Feet Occupied	Computer Support Hours
P1	20	3,000	10,000
P2	80	6,000	15,000
Total	<u>100</u>	<u>9,000</u>	<u>25,000</u>

*Required:*

- a. Calculate the service department costs allocated to each production department.
  - b. In general, do U.S. Generally Accepted Accounting Principles allow for the allocation of service department costs to production departments for the purpose of valuing inventory?
34. **Cost Hierarchy.** The following activities and costs are for Tanaka Company.
1. Direct materials used by workers to assemble products
  2. Purchase requisitions issued for raw materials
  3. Machines set up to produce groups of products
  4. New product research and development
  5. Maintenance performed on the factory building
  6. Direct labor assembling products
  7. Product designed for a specific customer
  8. Factory building rent

*Required:*

- a. Determine whether each item is a facility-level, product- or customer-level, batch-level, or unit-level cost.

- b. Provide one example of an appropriate allocation base for each item. (For instance, an appropriate allocation base for item 1 is the quantity of direct materials used.)

Exercises: Set B

35. **Plantwide Versus Department Allocations of Overhead:**

**Service Company.** Chan and Associates provides wetlands design and maintenance services for its customers, most of whom are developers. Billing is based on costs plus a 30 percent markup. Thus costs are allocated to customers rather than to products.

Total overhead costs this coming year are expected to be \$2,000,000 (\$600,000 in the Design department and \$1,400,000 in the Wetlands Maintenance department). Direct labor costs are expected to total \$800,000 (used for the plantwide rate). The Design department expects to incur direct labor costs of \$500,000, and the Wetlands Maintenance department expects to work 30,000 direct labor hours (this information is used for the department rates).

*Required:*

- a. Assume Chan and Associates uses the plantwide approach to allocating overhead costs and direct labor costs as the allocation base. Calculate the predetermined overhead rate, and explain how this rate will be used to allocate overhead costs. Round results to the nearest cent.
  - b. Assume Chan and Associates uses the department approach for allocating overhead costs. Calculate the predetermined overhead rate for each department, and explain how these rates will be used to allocate overhead costs. Round results to the nearest cent.
  - c. What are two possible interpretations of the term *costs* in the following statement? “Customers are billed based on costs plus a 30 percent markup.”
36. **Computing Product Costs Using Activity-Based Costing.** Petrov Company identified the following activities, estimated costs for each activity, and identified cost drivers for each

activity for this coming year. (These are the first three steps of activity-based costing.)

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Production setup	Number of production runs	\$ 60,000	100 production runs
Materials handling	Yards of material purchased	140,000	10,000 yards purchased
Quality control	Number of inspections	80,000	800 inspections
Total		<u>\$ 280,000</u>	

The company produces two products, MX1 and MX2. Information about these products for the month of March follows:

	MX1	MX2
Direct materials cost per unit	\$ 20	\$ 30
Direct labor cost per unit	15	45
Overhead cost per unit	?	?
Product cost per unit	<u>\$ ?</u>	<u>\$ ?</u>
Units produced	\$ 1,000 units	\$ 700 units

Actual cost driver activity levels for the month of March are as follows:

	MX1	MX2
Number of production runs	3	6
Yards of material purchased	550	230
Number of inspections	40	10

*Required:*

- Using the estimates for the year, compute the predetermined overhead rate for each activity (this is step 4 of the activity-based costing process).
- Using the activity rates calculated in requirement **a** and the actual cost driver activity levels shown for March, allocate overhead to the three products for the month of March (this is step 5 of the activity-based costing process).
- For each product, calculate the overhead cost per unit for the month of March. Round results to the nearest cent.
- For each product, calculate the product cost per unit for the month of March. Round results to the nearest cent.

37. **Journal Entry to Apply Overhead, Closing Overhead Account.** Premium Products, Inc., is deciding which of three approaches it should use to apply overhead to products. Information for each approach is provided as follows.

- **One plantwide rate.** The predetermined overhead rate is \$130 per direct labor hour.
- **Department rates.** The Cutting department uses a rate of 200 percent of direct labor cost, and the Finishing department uses a rate of \$50 per machine hour.
- **Activity-based costing rates.** Three activities were identified, and rates were calculated for each activity.

Materials handling	\$8 per pound of material purchased
Production setup	\$60 per setup
Quality control	\$110 per batch inspected

*Required:*

- a. Direct labor hours totaled 2,000 for the year. Using the plantwide method, calculate the amount of overhead applied to products, and make the appropriate journal entry.
- b. During the year, the Cutting department incurred \$80,000 in direct labor costs, and the Finishing department used 1,800 machine hours. Using the department method, calculate the amount of overhead applied to products, and make the appropriate journal entry.
- c. During the year, 6,000 pounds of material were purchased, 1,600 production setups were performed, and 1,300 batches of products were inspected. Using the activity-based costing approach, calculate the amount of overhead applied to products, and make the appropriate journal entry.
- d. Premium Products, Inc., closes overapplied or underapplied overhead to the cost of goods sold account at the end of each year. Prepare the journal entry to close the manufacturing overhead account at

the end of the year for each of the following independent scenarios assuming the company made the journal entry to apply overhead in requirement c.

1. The company recorded \$302,500 in actual overhead costs for the year.
2. The company recorded \$243,000 in actual overhead costs for the year.

38. **Allocating Service Department Costs.** Southwest, Inc., has two production departments (P1 and P2) and three service departments (S1, S2, and S3). Service department costs are allocated to production departments using the direct method. The \$800,000 costs of department S1 are allocated based on the number of employees in each production department. The \$300,000 costs of department S2 are allocated based on the square footage of space occupied by each production department. The \$600,000 costs of department S3 are allocated based on hours of computer support used by each production department. Information for each production department follows.

Production Department	Number of Employees	Square Feet Occupied	Computer Support Hours
P1	40	3,000	30,000
P2	160	9,000	70,000
Total	<u>200</u>	<u>12,000</u>	<u>100,000</u>

*Required:*

- a. Calculate the service department costs allocated to each production department.
  - b. In general, do U.S. Generally Accepted Accounting Principles allow for the allocation of service department costs to production departments for the purpose of valuing inventory?
39. **Cost Hierarchy.** The following activities and costs are for Rios Corporation.

1. Salary of a supervisor responsible for one product line
2. Moving groups of products to the finished goods warehouse upon completion
3. New product design
4. Factory building depreciation
5. Direct materials used by workers to assemble products
6. Machines set up to produce groups of products
7. Product designed for a specific customer
8. Maintenance performed on the factory building

*Required:*

- a. Determine whether each item is a facility-level, product- or customer-level, batch-level, or unit-level cost.
- b. Provide one example of an appropriate allocation base for each item.

#### Problems

40. **Activity-Based Costing Versus Traditional Approach.** Techno Company produces a regular computer monitor that sells for \$175 and a flat panel computer monitor that sells for \$300. Last year, total overhead costs of \$3,675,000 were allocated based on direct labor hours. A total of 63,000 direct labor hours were required last year to build 36,000 regular monitors (1.75 hours per unit), and 42,000 direct labor hours were required to build 12,000 flat panel monitors (3.50 hours per unit). Total direct labor and direct materials costs for last year were as follows:

	Regular Monitor	Flat Panel Monitor
Direct materials	\$1,908,000	\$ 900,000
Direct labor	\$1,728,000	\$1,200,000

The management of Techno Company would like to use activity-based costing to allocate overhead rather than one plantwide rate based on direct labor hours. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.



Estimated Cost Driver Activity					
Activity	Cost Driver	Estimated Overhead Costs	Regular	Flat Panel	Total
Purchase orders	Number of purchase orders	\$1,200,000	400	600	1,000
Production setups	Number of setups	1,125,000	120	30	150
Quality inspections	Inspection hours	750,000	3,600	8,400	12,000
Packaging and shipping	Number of units shipped	\$ 600,000	36,000	12,000	48,000
Total		<u>\$3,675,000</u>			

*Required:*

- a. Calculate the direct materials cost per unit and direct labor cost per unit for each product.
  
- b.
  1. Using the plantwide allocation method, calculate the predetermined overhead rate and determine the overhead cost per unit allocated to the regular and flat panel products.
  2. Using the plantwide allocation method, calculate the product cost per unit for the regular and flat panel products. Round results to the nearest cent.
  
- c.
  1. Using the activity-based costing allocation method, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)
  2. Using the activity-based costing allocation method, allocate overhead to each product. (Hint: This is step 5 in the activity-based costing process.) Determine the overhead cost per unit. Round results to the nearest cent.
  3. What is the product cost per unit for the regular and flat panel products?
  
- d. Calculate the per unit profit for each product using the plantwide approach and the activity-based costing approach.

- e. How much did the profit per unit change for each product when moving from the plantwide approach to the activity-based costing approach? What caused this change?

41. **Activity-Based Costing Versus Traditional Approach, Activity-Based Management.** Quality Furniture, Inc., produces a wood desk that sells for \$500 and a wood table that sells for \$900. Last year, total overhead costs of \$6,000,000 were allocated based on direct labor costs. Direct labor costs totaled \$2,000,000 last year, and Quality Furniture produced 15,000 desks and 5,000 tables. Total direct labor and direct materials costs by product for last year were as follows:

	Desk	Table
Direct materials	\$1,575,000	\$950,000
Direct labor	\$1,200,000	\$800,000

The management of Quality Furniture would like to use activity-based costing to allocate overhead rather than one plantwide rate based on direct labor costs. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

Estimated Cost Driver Activity					
Activity	Cost Driver	Estimated Overhead Costs	Desk	Table	Total
Purchase orders	Number of purchase orders	\$ 800,000	900	100	1,000
Machine setups	Number of setups	1,600,000	240	260	500
Machine maintenance	Machine hours	2,400,000	42,000	18,000	60,000
Quality inspections	Number of inspections	1,200,000	15,000	5,000	20,000
Total		<u>\$6,000,000</u>			

Required:

- a. Calculate the direct materials cost per unit and direct labor cost per unit for each product.
- b.

1. Using the plantwide allocation method, calculate the predetermined overhead rate and determine the overhead cost per unit allocated to the desk and table products.
  2. Using the plantwide allocation method, calculate the product cost per unit for the desk and table products. Round results to the nearest cent.
- c.
1. Using the activity-based costing allocation method, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)
  2. Using the activity-based costing allocation method, allocate overhead to each product. (Hint: This is step 5 in the activity-based costing process.) Determine the overhead cost per unit. Round results to the nearest cent.
  3. What is the product cost per unit for the desk and table products?
- d. Calculate the per unit profit for each product using the plantwide approach and the activity-based costing approach. How much did the per unit profit change when moving from one approach to the other?
- e. Refer to the estimated cost driver activity provided. Calculate the percent of each activity consumed by each product (e.g., the desk product issued 900 of the 1,000 purchase orders issued in total and therefore consumes 90 percent of this activity). These percentages represent the amount of overhead costs allocated to each product using activity-based costing. Using the plantwide approach, 60 percent of all overhead costs are allocated to the desk and 40 percent to the table. Compare the activity-based costing percentages to the percentage of overhead allocated to each product using the plantwide approach. Use this information to explain what caused the shift in overhead costs to the desk product using activity-based costing.

42. **Calculating and Recording Overhead Applied.** Assume Quality Furniture, Inc., discussed in Problem 41, uses activity-based costing.

*Required:*

- a. Using the data presented at the beginning of Problem 41, calculate the predetermined overhead rate for each activity.
- b. The following activity associated with the desk product was reported for the month of March.

Number of purchase orders processed	40
Number of machine setups	22
Number of machine hours	2,425
Number of quality inspections	890

Using the predetermined overhead rates calculated in requirement **a**, determine the amount of overhead applied to the desk product for the month of March.

- c. Make the journal entry to record overhead applied to the desk product for the month of March.
  - d. Assume you are the manager of the desk product line and would like to reduce the amount of overhead costs being applied to your products. Which activity would you focus on first? Why?
43. **Computing Product Costs Using Activity-Based Costing, Service Company.** Roseville Community Bank uses activity-based costing to assign overhead costs to two different loan products—student loans and auto loans. The bank identified the following activities, estimated costs for each activity, and identified cost drivers for each activity for this coming year. (These are the first three steps of activity-based costing.)

Chapter 3 How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Meeting with customers	Hours of meeting time	\$ 400,000	20,000 hours
Reviewing applications	Number of applications reviewed	120,000	8,000 applications
Running credit reports	Number of credit reports run	420,000	6,000 credit reports
Total		<u>\$ 940,000</u>	

The following information for the two loan products offered by Roseville Community Bank is for the month of July:

	Student Loans	Auto Loans
Direct labor cost per loan	\$ 250	\$ 150
Overhead cost per loan	?	?
Total cost per loan	<u>\$ ?</u>	<u>\$ ?</u>
Loans approved	100 loans	300 loans

Actual cost driver activity levels for the month of July are as follows:

	Student Loans	Auto Loans
Hours of meeting time	400	350
Number of applications reviewed	175	700
Number of credit reports run	150	550

Required:

- Using the estimates for the year, compute the predetermined overhead rate for each activity (this is step 4 of the activity-based costing process).
- Using the activity rates calculated in requirement **a** and the actual cost driver activity levels shown for July, allocate overhead to the two products for the month of July.
- For each loan product, calculate the overhead cost per loan approved for the month of July. Round results to the nearest cent.
- For each loan product, calculate the total cost per loan approved for the month of July. Round results to the nearest cent.
- Assume you are the manager of the auto loans product line and would like to reduce the amount of overhead costs being

applied to your products. Which activity would you focus on first? Why?

44. **Activity-Based Costing Versus Traditional Approach: Service Company, Activity-Based Management.** Hodges and Associates is a small firm that provides structural engineering services for its clients. The company performs structural engineering services for both residential and commercial buildings. Last year, total overhead costs of \$330,000 were allocated based on direct labor costs. A total of \$300,000 in direct labor costs were incurred in the following areas: \$120,000 in the residential segment and \$180,000 in the commercial segment. Direct materials used were negligible and are included in overhead costs. Sales revenue totaled \$450,000 for residential services and \$330,000 for commercial services.

The management of Hodges and Associates would like to use activity-based costing to allocate overhead rather than a plantwide rate based on direct labor costs. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

Activity	Cost Driver	Estimated Overhead Costs	Estimated Cost Driver Activity		
			Residential	Commercial	Total
Scheduling and data entry	Direct labor hours	\$ 100,000	4,500	3,500	8,000
Computer maintenance	Number of computer hours	70,000	8,000	12,000	20,000
Processing permit applications	Number of applications	160,000	400	400	800
Total		<u>\$330,000</u>			

Required:

- a.
  1. Using the plantwide allocation method, calculate the total cost for each product. (Hint: Product costs for this company include overhead and direct labor.)
  2. Using the plantwide approach, calculate the profit for each product. Also calculate profit as a

percent of sales revenue for each product (round to the nearest tenth of a percent).

b.

1. Using activity-based costing, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.) Round results to the nearest cent.
2. Using activity-based costing, calculate the amount of overhead assigned to each product. (Hint: This is step 5 in the activity-based costing process.)
3. Using activity-based costing, calculate the profit for each product. Also calculate profit as a percent of sales revenue for each product (round to the nearest tenth of a percent).

c. What caused the shift of overhead costs to the residential product using activity-based costing? How might management use this information to make improvements within the company?

45. **Calculating and Recording Overhead Applied: Service Company.** Assume Hodges and Associates, discussed in Problem 44, uses activity-based costing.

*Required:*

- a. Using the data presented at the beginning of Problem 44, calculate the predetermined overhead rate for each activity. Round results to the nearest cent.
- b. The following activity associated with the commercial product was reported for the month of September.

Number of direct labor hours	350
Number of computer hours	960

Number of applications	50
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Using the predetermined overhead rates calculated in requirement **a**, determine the amount of overhead applied to the commercial product for the month of September.

- c. Make the journal entry to record overhead applied to the commercial product for the month of September.
  - d. Assume you are manager of the commercial product line and would like to reduce the amount of overhead costs being applied to your products. Which activity would you focus on first? Why?
46. **Allocating Service Department Costs.** Szabo Industries has two production departments (Finishing and Painting) and three service departments (Maintenance, Computer Support, and Personnel). Service department costs are allocated to production departments using the direct method. Maintenance allocates costs totaling \$3,000,000 based on the square footage of space occupied by each production department. Computer Support allocates costs totaling \$4,000,000 based on hours of computer support used by each production department. Personnel allocates costs totaling \$2,500,000 based on number of employees in each production department. Information for each production department follows.

<u>Production Department</u>	<u>Square Feet Occupied</u>	<u>Computer Support Hours</u>	<u>Number of Employees</u>
Finishing	10,000	21,000	70
Painting	30,000	39,000	180
Total	40,000	60,000	250

*Required:*

- a. Calculate the service department costs allocated to each production department.
- b. Why do companies allocate service department costs to production departments?



47. **Selecting an Allocation Base for Service Costs.** Winstead, Inc., is looking for an appropriate allocation base to allocate personnel costs totaling \$5,000,000. Service department costs are allocated to three production departments: Assembly, Sanding, and Finishing. Management is considering two allocation bases.

Possible Allocation Base	Assembly	Sanding	Finishing
Number of employees	30	20	50
Square feet of space occupied	25,000	15,000	10,000

*Required:*

- a. Calculate the amount of personnel department costs allocated to production departments using each allocation base.
- b. Which allocation base do you think is most reasonable? Why?

One Step Further: Skill-Building Cases

48. **Overhead Allocation.** Do you agree with the following statement? Explain your answer.

*Total estimated overhead costs will vary depending on whether we use the plantwide method, department method, or activity-based costing to allocate overhead.*

49. **Cost Allocation Issues.** Assume you rent a house with two friends. The total monthly rent is \$1,500. Your bedroom is the smallest of the three bedrooms, and each of the others has a bathroom attached. You and your friends are trying to decide how to divide up the rent. Two possibilities are being discussed.
1. Share the cost equally among the three of you.
  2. Determine rent based on square feet occupied (the attached bathrooms would be part of the square footage measurement).

*Required:*

- a. Which approach do you think is most fair for all involved? Why?
  - b. Which approach is easiest? Why?
  - c. Suggest another approach to dividing up the cost of rent.
50. **Activity-Based Costing and Activity-Based Management.** A colleague states, “We produce one product, and our operations are relatively simple. Activity-based costing and activity-based management would be a waste of time for our company!” Do you agree with this statement? Explain.
51. **Product Costs.** The company president makes the following statement: “Product costs are straightforward. Whatever costs are incurred to produce a product are assigned to that product.” Do you agree with this statement? Explain.
52. **Changing Plantwide Allocation Rate at SailRite.** Recall from the chapter discussion that SailRite uses one plantwide rate based on direct labor hours to allocate manufacturing overhead costs to the company’s two sailboat products—Basic and Deluxe. Management was concerned about the inaccuracy of overhead costs being assigned to each product and decided to calculate product costs using activity-based costing. Product cost and profit results are summarized in the following for the plantwide allocation approach (based on direct labor hours) and activity-based costing approach. This information was presented in the chapter in Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company".

Plantwide Allocation (direct labor hours as allocation base)		
	Basic Sailboat	Deluxe Sailboat
Direct materials	\$ 1,000	\$ 1,300
Direct labor	600	750
Overhead*	1,280	1,600
Total product cost per unit (a)	\$ 2,880	\$ 3,650
Sales price (b)	\$ 3,200	\$ 4,500
<b>Profit = (b) – (a)</b>	<b>\$ 320</b>	<b>\$ 850</b>

Activity-Based Costing (several different allocation bases)		
	Basic Sailboat	Deluxe Sailboat
Direct materials	\$ 1,000	\$ 1,300
Direct labor	600	750
Overhead**	1,004	2,980
Total product cost per unit (c)	\$ 2,604	\$ 5,030
Sales price (d)	\$ 3,200	\$ 4,500
<b>Profit (loss) = (d) – (c)</b>	<b>\$ 596</b>	<b>\$ (530)</b>

\*Overhead taken from Figure 3.2 "SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours".

\*\*Overhead taken from Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company".

Although management of SailRite prefers the accuracy of activity-based costing, the cost of maintaining such an accounting system for the long term is prohibitive. John, the accountant, has proposed going back to using one plantwide rate, but he would like to allocate overhead costs using machine hours rather than direct labor hours.

Recall that overhead costs totaled \$8,000,000. A total of 90,000 machine hours were used for the period: 50,000 for Basic sailboats and 40,000 for Deluxe sailboats. The company produced 5,000 units of the Basic model and 1,000 units of the Deluxe model. Thus the Basic model uses 10 machine hours per unit (= 50,000 machine hours ÷ 5,000 units) and the Deluxe model uses 40 machine hours per unit (= 40,000 machine hours ÷ 1,000 units).

*Required:*

- a. Calculate the predetermined overhead rate using machine hours as the allocation base, and determine the overhead cost per unit allocated to the Basic and Deluxe sailboats. Round results to the nearest cent.
  - b. For each product, calculate the unit product cost and profit using the same format presented previously. Round results to the nearest cent.
  - c. Compare your results in requirement **b** to the results using direct labor hours as the allocation base and activity-based costing.
  - d. Provide at least two reasons why management might prefer machine hours as the overhead allocation base rather than direct labor hours or activity-based costing.
53. **Service Department Cost Allocation.** Biotech, Inc., recently began providing cafeteria services to its employees. Because revenue from the sale of food at the cafeteria does not fully cover cafeteria expenses, Biotech must pay for the shortfall. These costs are allocated to production departments based on employee usage. That is, the company tracks which employees use the cafeteria and allocates costs to production departments accordingly.

Sarah Kolster, manager of the quality testing department, is not happy with receiving cafeteria cost allocations. She is evaluated based on meeting a cost budget established at the beginning of the fiscal year, which does not include the cafeteria allocation, and she clearly has an incentive to minimize costs.

When Sarah met with the company's accountant, Dan, regarding this issue, she said, "Dan, I like the idea of providing cafeteria service to our employees, but the costs allocated to my department are killing my budget. Last month alone, I was allocated \$3,000 in costs related to the new cafeteria. I have no choice but to require my employees to go elsewhere for food."

Dan responded, "I understand your concern, Sarah. Management's intent was to provide a service to our employees that would improve productivity and reward employees for their hard work. If you tell your employees to stop using the cafeteria, more costs will be allocated to other departments, and the other

departments might also stop using the cafeteria. My belief is that the cafeteria will be self-sufficient within a year if more employees are encouraged to use it. This translates into no more cost allocations to departments within a year. I'll discuss your concerns with top management later this week."

*Required:*

- a. Why does Biotech, Inc., allocate cafeteria costs to departments?
- b. What recommendations would you make to top management regarding the way cafeteria costs are allocated to departments?

**Comprehensive Case**

54. **Activity-Based Costing, Journal Entries, T-Accounts, and Preparing an Income Statement.** This problem is an adaptation of the example presented at the end of [Chapter 2 "How Is Job Costing Used to Track Production Costs?"](#) for Custom Furniture Company. The only difference is that this problem uses activity-based costing to allocate overhead costs rather than one plantwide rate. Recall that inventory beginning balances were \$25,000 for raw materials inventory, \$35,000 for work-in-process inventory, and \$90,000 for finished goods inventory.

Management of Custom Furniture Company would like to use activity-based costing to allocate overhead costs totaling \$1,140,000 rather than one plantwide rate based on direct labor hours. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Purchase orders	Number of purchase orders	\$ 260,000	800 orders
Machine setups	Number of setups	360,000	1,000 setups
Machine maintenance	Machine hours	140,000	20,000 machine hours
Misc. production activities	Direct labor hours	380,000	38,000 direct labor hours
Total		<u>\$1,140,000</u>	

Transactions for the month of May are shown as follows:

1. Raw materials were purchased during the month for \$15,000 on account.
2. Raw materials totaling \$21,000 were placed in production: \$3,000 for indirect materials (glue, screws, nails, and the like) and \$18,000 for direct materials (wood planks, hardware, etc.).
3. Timesheets from the direct labor workforce show total costs of \$40,000, to be paid the next month.
4. Production supervisors and other indirect labor working in the factory are owed wages totaling \$27,000.
5. The following costs were incurred related to the factory: building depreciation of \$29,000, insurance of \$11,000 (originally recorded as prepaid insurance), utilities of \$4,000 (to be paid the next month), and maintenance costs of \$22,000 (paid immediately).
6. Manufacturing overhead is applied to products based on the following cost driver activity for the month:

Number of purchase orders	75
Number of machine setups	120
Machine hours	1,850
Direct labor hours	3,240

7. The following selling costs were incurred: wages of \$5,000 (to be paid the next month), building rent of \$3,000 (originally recorded as prepaid rent), and advertising totaling \$10,000 (to be paid the next month).
8. The following general and administrative (G&A) costs were incurred: wages of \$13,000 (to be paid the next month), equipment depreciation of \$6,000, and building rent of \$7,000 (originally recorded as prepaid rent).
9. Completed goods costing \$155,000 were transferred out of work-in-process inventory.
10. Sold goods for \$100,000 on account and \$90,000 cash.
11. The goods sold in the previous transaction had a cost of \$129,000.

12. Closed the manufacturing overhead account to cost of goods sold.

*Required:*

- a. Calculate the predetermined overhead rate for each activity.
- b. Prepare T-accounts for the following accounts: cash, accounts receivable, prepaid insurance, prepaid rent, raw materials inventory, work-in-process inventory, finished goods inventory, accumulated depreciation (building and equipment), accounts payable, wages payable, manufacturing overhead, sales, cost of goods sold, advertising expense (selling), rent expense (selling), wages expense (selling), depreciation expense (G&A), rent expense (G&A), and wages expense (G&A). Enter beginning balances in T-accounts for the inventory accounts (raw materials, work in process, and finished goods).
- c. Prepare a journal entry for each of the transactions **1** through **11**, and post each entry to the T-accounts set up in requirement **b**. Label each entry in the T-accounts by transaction number, and total each T-account.
- d. Is overhead underapplied or overapplied for the month of May? Based on the balance in the manufacturing overhead T-account prepared in requirement **c**, prepare a journal entry for transaction **12**.
- e. Prepare an income statement for the month of May. (Hint: Be sure to include the adjustment made to cost of goods sold in requirement **d**.)