

# Cost Management

**A Strategic Emphasis**

*Fourth Edition*

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# Cost Allocation: Service Departments and Joint Product Costs

After studying the chapter, you should be able to . . .

1. Identify the strategic role of cost allocation
2. Explain the ethical issue of cost allocation
3. Use the three steps of departmental cost allocation
4. Explain the problems in implementing the different departmental cost allocation methods
5. Explain the use of cost allocation in service firms
6. Use the three joint product costing methods
7. (Appendix) Use the four by-product costing methods

In keeping with their firms' mission of continual improvement and superiority in their products and services, General Electric (GE) and many other firms such as Ford Motor Company, Johnson & Johnson, IBM, and Marriott have sought improved methods of providing administrative services within their firms. These administrative services are often called *shared services* because they are shared among the company's operating units. Shared services generally include such transaction-processing services as payroll processing, claims processing, human resources, and many accounting services, among others. The firms named have studied the cost to provide the services and have been alarmed at the relatively high costs, such as \$10 or more to process a single vendor invoice. Some firms have chosen to outsource these services or to have the operating units provide the services locally, but, like GE, most firms are centralizing these services to reduce cost, provide a high and standardized level of service quality, and provide a single base of technology for easy use, communication, and future modification.<sup>1</sup>

With the growth of these centralized services, the need for effective methods to allocate the shared costs to the operating units has increased. Generally, the allocation issue arises when cost is shared because of a shared facility, program, production process, or service. The methods used to allocate these common costs to products are explained in this chapter.

This chapter explains methods for allocating common costs to products for two broad types of common costs: (1) the costs of production and service departments shared by two or more individual products and (2) the joint manufacturing costs for products that are not separately identifiable until later in the manufacturing process. An example of the latter is the cost of refining crude oil (the joint cost) into the individual products: gasoline, heating oil, and other products.

We take a strategic perspective in developing these allocation methods and ask key strategic questions. How do the allocation methods we have chosen affect the motivations and behaviors of those in the operating units as well as the service units? Can we use ABC costing principles to develop more accurate methods of cost allocation? Does this service add value or should it be outsourced? The firm's answers to these questions can have a significant impact on its competitiveness and success.

<sup>1</sup> For more information on company practices, see Ann Triplett and Jon Scheumann, "Managing Shared Services with ABM," *Strategic Finance*, February 2000, pp. 40–45.



Recording artists Courtney Love, LeAnn Rimes, Beck, Clint Black, and others have sued the music industry for millions of dollars of unpaid royalties. The artists claim that the music industry unfairly cut into their royalties by improperly accounting for expenses. At issue lies the often complex recording contracts between the artists and the record companies that contain the details of how the expenses of producing and distributing the artist's work are to be calculated and charged to the artist's account. The artists think they are being cheated, while an industry spokesman says that the contracts reflect

a "complex business relationship where both the artists and the label understandably angle to secure the best possible contract—in negotiations or renegotiations—while still preserving a mutually beneficial relationship." In other words, both sides should be well represented by management accountants who understand how the costs are to be calculated and allocated.

**Source:** Jennifer Ordonez, "Rockers vs. Bean Counters," *The Wall Street Journal*, September 24, 2002, p. B1.

## The Strategic Role of Cost Allocation

The strategic role of cost allocation has four objectives:

1. Determine *accurate departmental and product costs* as a basis for evaluating the cost efficiency of departments and the profitability of different products.
2. *Motivate* managers to exert a high level of effort to achieve the goals of top management.
3. Provide the right *incentive* for managers to make decisions that are consistent with the goals of top management.
4. *Fairly determine the rewards* earned by the managers for their effort and skill and for the effectiveness of their decision making.

### LEARNING OBJECTIVE 1

Identify the strategic role of cost allocation.

The first and most important objective requires the cost allocation method to be sufficiently accurate to support effective management decision making about products and departments.

The second objective, motivating managers, means that, to be effective, the cost allocation used must reward department managers for reducing costs as desired. A key motivation issue is whether the manager *controls* the allocated cost. For example, when a department's cost allocation for equipment maintenance is based on the number of the department's machine breakdowns, the manager has an incentive to reduce them and therefore reduce the maintenance costs. On the other hand, when the cost of maintenance is allocated on the basis of a department's square feet of floor space, the manager—who cannot affect the amount of floor space—is not motivated.

The third objective, providing the incentive for decision making, is achieved when cost allocation effectively provides the incentives for the individual manager to act autonomously in a manner that is consistent with top management's goals. For example, a major advantage of cost allocation methods is that they draw managers' attention to shared facilities. The cost allocation provides an incentive for individual and joint efforts to manage these costs and to encourage the managers to use these facilities to improve the performance of their units.

The fourth objective, fairness, is met when the cost allocation is clear, objective, and consistently applied. The most objective basis for cost allocation exists when a *cause-and-effect relationship* can be determined. For example, the allocation of maintenance costs on the basis of the number of equipment breakdowns is more objective and fair than an allocation based on square feet, the number of products produced, or labor costs in the department. The reason is that a cause-and-effect relationship exists between maintenance costs and the number of breakdowns; square feet or labor costs, however, do not have a clear relationship to maintenance costs.

In some situations, cause-and-effect bases are not available and alternative concepts of fairness are used. One such concept is *ability-to-bear*, which is commonly employed with bases related to size, such as total sales, total assets, or the profitability of the user departments. Other concepts of fairness are based on equity perceived in the circumstance, such as *benefit received*, which often is measured in a nonquantitative way. For example, the cost of a firm's computer services might be allocated largely or entirely to the research and development department because the computer is more critical to this department's functioning and this department uses it more than other departments.



## The Ethical Issues of Cost Allocation

### LEARNING OBJECTIVE 2

Explain the ethical issues of cost allocation.

A number of ethical issues are important in cost allocation. First, ethical issues arise when costs are allocated to products or services that are produced for both a competitive market and a public agency or government department. Although government agencies very often purchase on a cost-plus basis, products sold competitively are subject to price competition. The incentive in these situations is for the manufacturer, using cost allocation methods, to shift manufacturing costs from the competitive products to the cost-plus products.

A second ethical issue in implementing cost allocation methods is the equity or fair share issue that arises when a governmental unit reimburses the costs of a private institution or when it provides a service for a fee to the public. In both cases, cost allocation methods are used to determine the proper price or reimbursement amount. Although no single measure of equity exists in these cases, the objectives of cost allocation identified at the beginning of the chapter are a useful guide.

A third important ethical issue is the effect of the chosen allocation method on the costs of products sold to or from foreign subsidiaries. The cost allocation method usually affects the cost of products traded internationally and therefore the amount of taxes paid in the domestic and the foreign countries. Firms can reduce their worldwide tax liability by increasing the costs of products purchased in high-tax countries or in countries where the firm does not have favorable tax treatment. For this reason, international tax authorities closely watch the cost allocation methods used by multinational firms. The methods most acceptable to these authorities are based on sales and/or labor costs.<sup>2</sup>

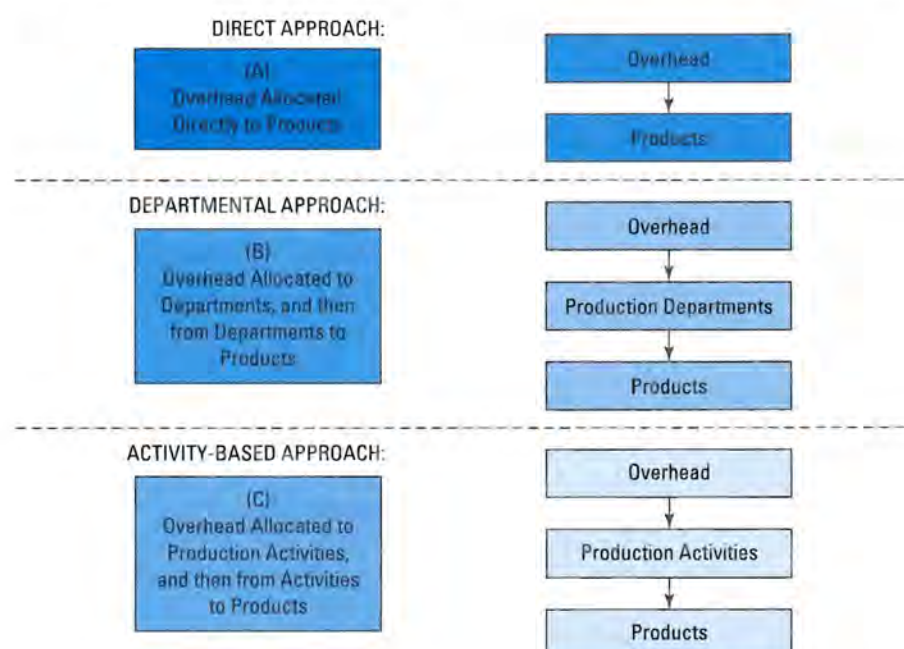
## Cost Allocation to Service and Production Departments

### LEARNING OBJECTIVE 3

Use the three steps of departmental cost allocation.

The preceding chapters on job costing (Chapter 4), activity-based costing (Chapter 5), and process costing (Chapter 11) provide a useful context for introducing cost allocation. The processes discussed in those chapters allocated overhead costs either *directly* to products (job costing) or *indirectly* in an allocation first to production departments and then to the products (process costing) or by using production activities (activity-based costing), as illustrated in Exhibit 12.1. Direct allocation pools all overhead into a single amount and allocates overhead using a single rate. In contrast, the departmental approach pools overhead costs in departmental cost pools and allocates overhead from each department to the products using a separate

**EXHIBIT 12.1**  
Three Types of Overhead Allocation



<sup>2</sup> Eric G. Tomsett, "Allocation of Central Costs in an International Group," *World Tax* (a publication of Deloitte & Touche International), January 1992.



**FEDERAL RESERVE BANKS REALLOCATE COMMON COSTS TO LESS COMPETITIVE SERVICES**

The Monetary Control Act of 1980 required the Federal Reserve (FED) to charge explicitly for certain services, in effect placing Federal Reserve banks in direct competition with large commercial banks for these services. The act also required the FED to price these services based on full cost, including allocated indirect costs. Recent research indicates that the FED responded to the act by both improving the efficiency with which it provides these services and reallocating indirect costs to the less price-competitive services. In this manner, the FED was able to lower the full cost and, therefore, the price of its most price-competitive services.

**COST ALLOCATION AND TAXATION OF UNRELATED BUSINESS INCOME AT NONPROFIT ORGANIZATIONS**

Nonprofit organizations are exempt from federal income tax except for income from any activities that are unrelated to the nonprofit's exempt purpose. An example is the use of a laboratory for both tax-exempt basic medical research and testing a taxable product for commercial pharmaceutical firms. A concern in these cases is that the tax-exempt nonprofit organization will be able to compete unfairly

with for-profit firms because of their tax-exempt status. The key argument is that common costs for the nonprofit's exempt and business activities will be used to "subsidize" the for-profit business (in this case, the taxable product testing). The nonprofit clearly has an incentive to allocate a relatively large portion of the common costs to the business activity to reduce taxes, but current Treasury regulations require that the cost allocation be reasonable. This has led some to argue that common costs should not be allocated in these cases. However, a recent analytical study (using economic models) of the economic productivity of for-profit and not-for-profit firms competing in the same business shows that failure to allocate common costs would lead to economic inefficiency by deterring the nonprofit manager from engaging in economically efficient unrelated businesses. The study supports the Treasury stance, which allows "reasonable" cost allocations.

Based on information in Ken S. Cavalluzzo, Christopher D. Ittner, and David F. Larcker, "Competition, Efficiency, and Cost Allocation in Government Agencies: Evidence on the Federal Reserve System," *Journal of Accounting Research*, Spring 1998, pp. 1–32; and Richard Sansing, "The Unrelated Business Income Tax, Cost Allocation, and Productive Efficiency," *National Tax Journal*, June 1998, pp. 291–302.

rate, one for each department. The departmental approach is preferred because it more accurately traces overhead costs to the products when different products require different amounts of resources in the various production departments.

The activity-based approach is generally preferred of the three approaches because it identifies cost behavior at the activity level, a much more detailed level of analysis than either the department level, as used in the departmental allocation approach, or plant level, as used in the direct approach.<sup>3</sup> The activity-based costing approach is explained in Chapter 5. In the following section, we explain the application of the departmental approach.

**Departmental Approach**

The departmental approach recognizes that the typical manufacturing operation involves two types of manufacturing departments: production departments and service departments. Service departments provide human resources, maintenance, engineering, and other support to the production departments; production departments directly assemble and complete the product. The departmental approach has three phases: (1) trace all direct costs and allocate overhead costs to both the service departments and the production departments, (2) allocate the service department costs to the production departments, and finally (3) allocate the production department costs to the products. These phases are illustrated in Exhibit 12.2.

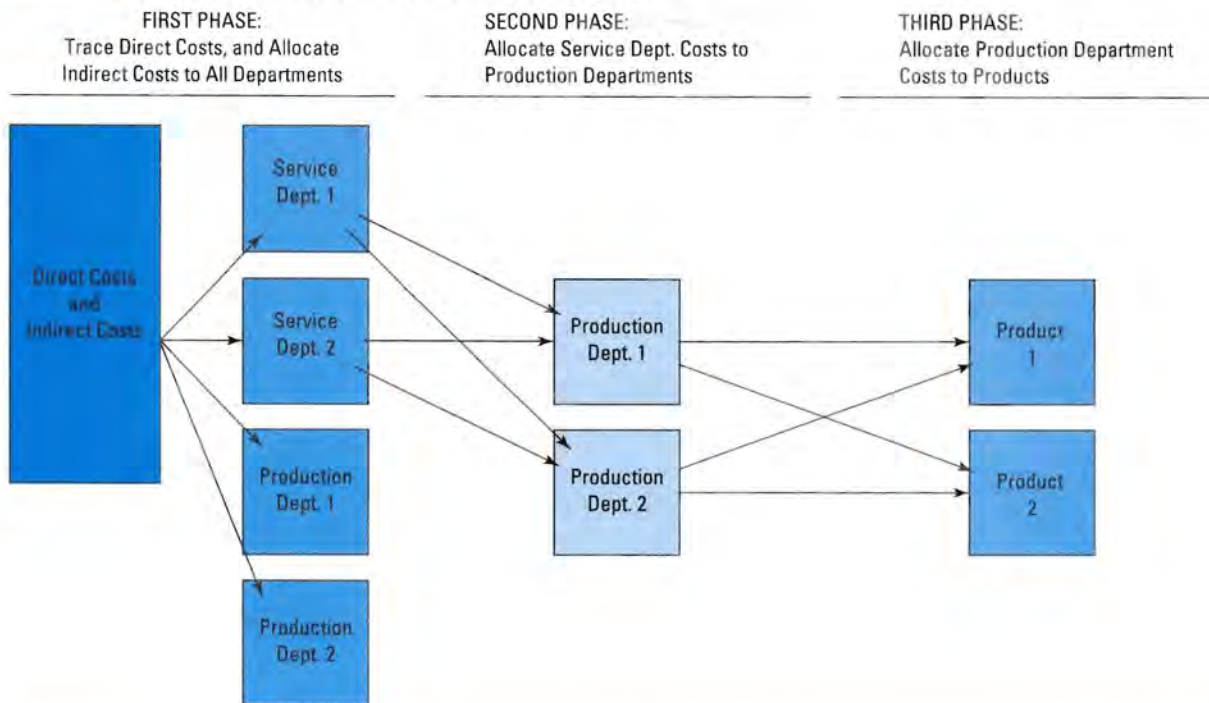
**First Phase: Trace Direct Costs and Allocate Overhead Costs to Departments**

The first phase in the departmental allocation approach traces the direct and indirect manufacturing costs in the plant to each service and production department that used them and identifies the overhead costs in the plant and allocates them to each of the service and production departments.

For the first-phase allocation, see the information for Beary Company in Exhibit 12.3. Beary manufactures two products and has two manufacturing departments and two service departments. \$36,000 direct cost can be traced to each department, and an indirect cost of \$30,000 (\$25,000 labor and \$5,000 materials) is common to all departments but cannot be traced directly to the departments. Beary uses both labor-hours and machine-hours for allocating the indirect costs.

<sup>3</sup> For a survey of the use of activity-based costing in the allocation of shared facility costs, see Ann Triplett and Jon Scheumann, "Managing Shared Services with ABM," *Strategic Finance*, February 2000, pp. 40–45.



**EXHIBIT 12.2** The Three Phases in Departmental Cost Allocation**EXHIBIT 12.3**

Data for Beary Company

	Service Department 1	Service Department 2	Production Department 1	Production Department 2	Total Hours	Total Amount
Labor-hours	1,800	1,200	3,600	5,400	12,000	
Machine-hours	320	160	1,120	1,600	3,200	
Direct costs	\$1,600	\$5,500	\$15,500	\$13,400		\$36,000
Indirect labor	Not Traceable					25,000
Indirect materials	Not Traceable					5,000
						<u>\$66,000</u>

The first-phase allocation for Beary Company is shown in Exhibit 12.4. Total direct costs of \$36,000 are traced to the four departments, and the overhead costs are allocated using labor-hours (for indirect labor) and machine-hours (for indirect materials). The exhibit presents the allocation base information for labor-hour and machine-hour usage. The \$25,000 of indirect labor is allocated to the four departments using the labor-hours allocation base. For example, the amount of indirect labor allocated to service department 1 is \$3,750 (service department 1's share of total indirect labor, or  $15\% \times \$25,000$ ). The allocations of indirect labor costs to the other departments are made in the same way. Similarly, the \$5,000 of indirect materials cost is allocated to the four departments using machine-hours. The amount of indirect materials allocated to service department 1 is \$500 ( $10\% \times \$5,000$ ). The totals for direct costs and allocated indirect costs are \$66,000, the same as the total cost to allocate (from Exhibit 12.3).

Service department 1	\$ 5,850
Service department 2	8,250
Production department 1	24,750
Production department 2	<u>27,150</u>
Total	\$66,000

**Second Phase: Allocate Service Department Costs to Production Departments**

The second phase allocates service department costs to the producing departments. This is the most complex of the allocation phases because services flow back and forth between the service

**EXHIBIT 12.4** Departmental Allocation, First Phase: Beary Company

Departmental Allocation Bases	Departments				Total
	Service 1	Service 2	Production 1	Production 2	
Direct labor-hours (DLH)	1,800	1,200	3,600	5,400	12,000
Percent	15%	10%	30%	45%	100%
Machine-hours (MH)	320	160	1,120	1,600	3,200
Percent	10%	5%	35%	50%	100%
<b>First Phase: Trace Direct Costs and Allocate Overhead Costs to Departments</b>					
Direct costs	\$1,600	\$5,500	\$15,500	\$13,400	\$36,000
Overhead Costs to Departments					
Indirect Labor DLH	3,750	2,500	7,500	11,250	\$25,000
	= 15% × \$25,000	= 10% × \$25,000	= 30% × \$25,000	= 45% × \$25,000	
Indirect Materials MH	500	250	1,750	2,500	\$ 5,000
	= 10% × \$5,000	= 5% × \$5,000	= 35% × \$5,000	= 50% × \$5,000	
Totals for all departments	<b>\$5,850</b>	<b>\$8,250</b>	<b>\$24,750</b>	<b>\$27,150</b>	<b>\$66,000</b>

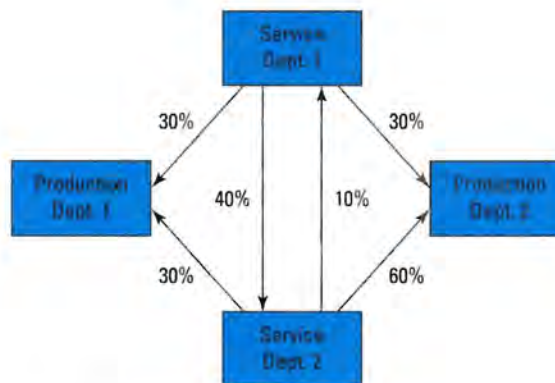
**Reciprocal flows**

represent the movement of services back and forth between service departments.

departments. These are often called **reciprocal flows**. For example, assume that 40 percent (720 hours) of service department 1's 1,800 labor-hours are spent serving service department 2. Also assume that 10 percent of service department 2's time is spent serving service department 1. You can see these two reciprocal flows for Beary Company in Exhibit 12.5.

The percentage of service relationships is commonly determined by reference to labor-hours, units processed, or some other allocation base that best reflects the service provided in the departments. At Beary Company, the service flow percentages for each service department are determined according to the labor-hours used for services provided to the other service department and to the production departments. Beary's first service department spends 40 percent of its labor time serving the service department 2 and 30 percent serving each of the two production departments. Service department 2 serves the service department 1 approximately 10 percent of the time, the first production department 30 percent of the time, and the second production department 60 percent of the time.

Accountants use three common methods to allocate costs under the departmental approach: (1) the direct method, (2) the step method, and (3) the reciprocal method.

**EXHIBIT 12.5****Reciprocal Relationships in Beary Company****The direct method**

of departmental cost allocation is accomplished by using the service flows *only to production departments* and determining each production department's share of that service.

**The Direct Method**

The **direct method** of departmental cost allocation is the simplest of the three methods because it ignores the reciprocal flows. The cost allocation is accomplished by using the service flows *only to production departments* and determining each production department's share of that service. For example, for service department 1, the share of time for each production department is 50 percent of the total production department service, determined as follows.



For service department 1:

Net service to both production departments from service department 1:	
=100% – Time of service to second service department	
=100% – 40% = 60%	
Production department 1's share: 30 percent/60 percent =	<u>50 percent</u>
Production department 2's share: 30 percent/60 percent =	<u>50 percent</u>

For service department 2:

Net service to both production departments from service department 2:	
100 percent – 10 percent = 90 percent	
Production department 1's share: 30 percent/90 percent =	<u>33.33%</u>
Production department 2's share: 60 percent/90 percent =	<u>66.67%</u>

These percentage shares are used to allocate the costs from service departments to production departments, as shown in the second-phase section at the top of Exhibit 12.6. In that panel, for example, \$5,850 of service department 1's costs are allocated equally to the production departments; 50 percent each is \$2,925. The \$8,250 of service department 2's costs are allocated 33.33 percent or \$2,750 to production department 1 and 66.67 percent or \$5,500 to production department 2. Total costs in production departments 1 and 2 at the end of the second phase allocations are \$30,425 and \$35,575, respectively.

The third and final phase is much like the first phase. The allocation from production departments to products typically is based on the number of labor-hours or machine-hours used in the production departments that produce the products. For Beary Company, using the direct method, costs are allocated to production department 1 on the basis of labor-hours and to production department 2 on the basis of machine-hours; see the third-phase panel of Exhibit 12.6.

#### EXHIBIT 12.6 Departmental Allocation Second and Third Phases, Using the Direct Method: Beary Company

Second Phase: Allocate Service Department Costs to Production Departments			
Direct Method	Production 1	Production 2	Total
Service 1 Service percent to producing departments	30%	30%	
Allocation percent per direct method	50% = 30/(30 + 30)	50% = 30/(30 + 30)	
Allocation amount	<u>\$2,925</u>	<u>\$2,925</u>	
	=50% × \$5,850	=50% × \$5,850	
Service 2 Service percent to producing departments	30%	60%	
Allocation percent per direct method	33.33% = 30/(30 + 60)	66.67% = 60/(30 + 60)	
Allocation amount	<u>2,750</u>	<u>5,500</u>	
	= 33.33% × \$8,250	= 66.67% × \$8,250	
Plus: First-phase allocation	<u>24,750</u>	<u>27,150</u>	
Totals for Production Departments	<u>\$30,425</u>	<u>\$35,575</u>	<u>\$66,000</u>
Third Phase: Allocate Production Department Costs to Products			
	Product 1	Product 2	
Base: labor-hours			
Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	
Production 1 (labor-hour basis)	<u>\$15,212.50</u>	<u>\$15,212.50</u>	
	= 50% × \$30,425	= 50% × \$30,425	
Production 2 (machine-hour basis)	<u>\$8,893.75</u>	<u>\$26,681.25</u>	
	= 25% × \$35,575	= 75% × \$35,575	
Totals for each product	<u>\$24,106.25</u>	<u>\$41,893.75</u>	<u>\$66,000</u>



### COST ALLOCATION AND MEDICARE REIMBURSEMENT IN HOSPITALS

A recent study of 105 hospitals found evidence of bias in their cost allocation practices. Since 1983, Medicare has reimbursed hospitals for inpatient services on the basis of specific, prospective rates and for outpatient services on the basis of cost. This reimbursement plan motivates hospitals to allocate as much common cost as possible to outpatient departments instead of inpatient services. The study examined the ratio of cost allocated to outpatient departments relative to total allocated cost for the period 1977 to 1991. Using regression analysis and data for each hospital, the study found a significant upward shift in costs allocated to outpatient departments after 1983.

### COST ALLOCATION AND THE FINANCIAL PERFORMANCE OF HMOs

The financial performance of HMOs is under increasing scrutiny by state and federal regulators. Two key performance measures are the *medical loss ratio* (MLR), a statistic that measures the percentage of total HMO premium revenue that is spent on medical care, and the *administrative expense ratio* (AER), which measures the proportion of HMO revenues that are used for administrative costs. Many states require that HMOs report these ratios to potential enrollees. In addition,

Massachusetts has established a minimum MLR of 80 percent for Medicare plans, and Connecticut has established a requirement that the AER be no higher than 20 percent. Faced with these requirements, HMOs are sometimes accused of using cost allocation as a way to achieve the desired ratios. A recent study of the issue included five large HMOs that had widely different MLR and AER values. The study found a large difference in the treatment of allocated costs, especially in the treatment of medical management costs (the cost of the medical director, case managers, and utilization management nurses) and in areas where the cost accounting was unique, such as arrangements with vendors to share certain administrative expenses and arrangements with provider groups (physicians and hospitals) to share certain administrative expenses. All participating HMOs agreed that more detailed and consistent guidance in the area of cost allocation is needed.

Based on information in: Leslie Eldenburg and Sanjay Kallapur, "Changes in Hospital Service Mix and Cost Allocations in Response to Changes in Medicare Reimbursement Schemes," *Journal of Accounting and Economics*, May 1997, pp. 31–51; and Nancy Turnbull and Nancy M. Kane, "The Impact of Accounting and Actuarial Practice Differences on Medical Loss Ratios: An Exploratory Study with Five HMOs," *Inquiry*, The Blue Cross and Blue Shield Association, Chicago, Fall 1999, pp. 343–52.

Assume that the production of product 1 required 1,800 hours of production department 1's total labor time of 3,600 hours, and thus is allocated 50 percent ( $1,800/3,600$ ) of the total cost in production department 1. Similarly, assume that product 1 required 400 of the 1,600 machine-hours used in production department 2, it is allocated 25 percent ( $400/1,600$ ) of the costs of production department 2. Product 2's costs are determined in a similar manner, as shown in Exhibit 12.6. The total cost of \$66,000 is allocated as \$24,106.25 to product 1 and \$41,893.75 to product 2.

#### The step method

uses a sequence of steps in the allocating service department costs to production departments.

**The Step Method** The second method to allocate service department costs is the **step method**, so-called because it uses a sequence of steps in allocating service department costs to production departments. In the first step, one service department is selected to be allocated fully, that is, to the other service department as well as to each production department. The department to be allocated fully usually is chosen because it provides the most service to other service departments. At Beary Company, service department 1 provides more service (40%) and it goes first in the allocation. Service department 2 is allocated only to the production departments, in the same manner as the direct method. Overall, this means that the step method may provide more accurate allocations because one of the reciprocal flows between the two service departments (the one in the first step) is considered in the allocation, unlike the direct method that ignores all reciprocal flows.

The first phase of the step method (tracing direct costs and initial allocation of indirect costs) is the same as for the direct method as shown in Exhibit 12.4. However, in the second phase (Exhibit 12.7), service department 1, which is in the first step, is allocated to service department 2 and the two production departments. The allocation to service department 2 is \$2,340 (40 percent  $\times$  \$5,850). The allocations for the two production departments are determined in a similar manner. Then, in the second step, service department 2 is allocated to the two production departments using the direct method in the same manner as in Exhibit 12.6. The only difference is that the total cost in service department 2 (\$10,590) now includes the original cost in service department 2 (\$8,250) plus the cost allocated from service department 1 in the first step (\$2,340).

The third phase of the step method is completed in the same manner as in Exhibit 12.6. Using the step method, the total cost allocated to product 1 is \$24,008.75 and the total cost allocated to product 2 is \$41,991.25, for a total of \$66,000.



**EXHIBIT 12.7** Departmental Allocation, Second and Third Phases Using the Step Method

<b>Second Phase: Allocate Service Department Costs to Production Departments: Using the Step Method</b>				
	<b>Service 2</b>	<b>Production 1</b>	<b>Production 2</b>	<b>Total</b>
<b>First Step</b>				
Service 1				
Service percent	40%	30%	30%	
Amount	<b>\$2,340</b>	<b>\$1,755</b>	<b>\$1,755</b>	
	= 40% × \$5,850	= 30% × \$5,850	= 30% × \$5,850	
<b>Second Step</b>				
Service 2				
Service percent		30%	60%	
Allocation percent per direct method		33.33	66.67	
Amount	<b>10,590</b>	<b>3,530</b>	<b>7,060</b>	
	= \$8,250 + \$2,340	= 33.33% × \$10,590	= 66.67% × \$10,590	
Plus: First-phase allocation		<b>24,750</b>	<b>27,150</b>	
Totals for production departments		<b>30,035</b>	<b>35,965</b>	<b>\$66,000</b>
<b>Third Phase: Allocate Production Department Costs to Products</b>				
Labor-hours				
Hours		1,800	1,800	3,600
Percentage		50%	50%	
Machine-hours				
Hours		400	1,200	1,600
Percentage		25%	75%	
Production 1 (labor-hour basis)		<b>\$15,017.50</b>	<b>\$15,017.50</b>	
		= 50% × \$30,035	= 50% × \$30,035	
Production 2 (machine-hour basis)		<b>\$8,991.25</b>	<b>\$26,973.75</b>	
		= 25% × \$35,965	= 75% × \$35,965	
Totals for each product		<b>\$24,008.75</b>	<b>\$41,991.25</b>	<b>\$66,000</b>

The **reciprocal method** considers *all* reciprocal flows between service departments through simultaneous equations.

**The Reciprocal Method** The **reciprocal method** is the preferred of the three methods because, unlike the others, it considers *all* reciprocal flows between the service departments. This is accomplished by using simultaneous equations; the reciprocal flows are simultaneously determined in a system of equations.

An equation for each service department represents the cost to be allocated, consisting of the first-phase allocation costs plus the cost allocated from the other department. For Beary Company, the equation for service department 1 is as follows, using the symbol S1 to represent service department 1 costs and the symbol S2 to represent costs in service department 2.

$$\text{Allocated S1 Costs} = \text{Initial allocation} + \text{Cost allocated from S2}$$

$$S1 = \$5,850 + 10\% \times S2$$

Similarly, the equation for the second service department is as follows:

$$\text{Allocated S2 Costs} = \text{Initial allocation} + \text{Cost allocated from S1}$$

$$S2 = \$8,250 + 40\% \times S1$$

These two equations can be solved for S1 and S2 by substituting the second equation into the first as follows:

$$S1 = \$5,850 + 10\% \times (\$8,250 + 40\% \times S1)$$

$$S1 = \$6,953.13$$

And substituting S1 back into the second equation:

$$S2 = \$11,031.25$$

These values for S1 and S2 are allocated to the producing departments using the percentage service amounts for each department. We illustrate the process for Beary Company in Exhibit 12.8. Note that since the reciprocal method has considered all reciprocal service department activities, the allocation is based on the actual service percentages for each



# Cost Management in Action

## Health Care Providers Allocate Cost for Medicare Reimbursement

Since the advent of Medicare in 1966 to cover medical expenses of aged, blind, and disabled individuals, health care providers have been required to use cost allocation methods to receive reimbursement from the federal government for services covered by Medicare. The costs of health care service activities are allocated to the patient revenue-generating services. Some examples of service activities and patient revenue-generating services in a hospital follow.

How do hospitals respond to Medicare requirements and allocate the costs of service activities to the patient revenue-generating services? What methods are likely to be preferred?

(Refer to comments on Cost Management in Action at end of chapter.)

### Patient Revenue-Generating Services

Intensive care unit	Laboratory
Psychiatric care	Radiology
Coronary care	Emergency Room
Surgery	Pharmacy
Anesthesia	

### Service Activities

Dietary	Operation of hospital buildings
Laundry and linen	Administrative and general
Admissions	Housekeeping
Social services	
Nursing administration	

production department. For example, production department 1, which receives 30 percent of service department 1's work, is allocated 30 percent of service department 1's cost, \$2,086 ( $30\% \times \$6,953.13$ ). The allocations are made in a similar manner to the allocation of service department 2's costs and to production department 2.

The third phase analysis in Exhibit 12.8 is done in the same manner as in Exhibits 12.6 and 12.7. The total cost allocated to product 1 is \$24,036.25 and for product 2, \$41,963.75.

### EXHIBIT 12.8 Departmental Allocation Second and Third Phases, Using the Reciprocal Method

#### Second Phase: Allocate Service Department Costs to Production Departments Using the Reciprocal Method

First: Solve the simultaneous equations for Service 1 and Service 2 (see text):

Amount allocated from service 1	\$ 6,953.13
Amount allocated from service 2	\$11,031.25

	Production 1	Production 2	Total
Second: Allocate to producing departments			
Service 1			
Service %	30%	30%	
Allocated amount	<u>\$2,086</u>	<u>\$2,086</u>	
	= $30\% \times \$6,953$	= $30\% \times \$6,953$	
Service 2			
Service %	30%	60%	
Allocated amount	<u>3,309</u>	<u>6,619</u>	
	= $30\% \times \$11,031$	= $60\% \times \$11,031$	
Plus: Costs allocated in first phase	<u>24,750</u>	<u>27,150</u>	
Totals for Production Departments	<u>\$30,145</u>	<u>\$35,855</u>	<u>\$66,000</u>

#### Third Phase: Allocate Production Department Costs to Products

Base: Direct labor-hours

Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	
Production 1 (direct labor-hour basis)	<u>\$15,072.50</u>	<u>\$15,072.50</u>	
	= $50\% \times \$30,145$	= $50\% \times \$30,145$	
Production 2 (machine-hour basis)	<u>\$8,963.75</u>	<u>\$26,891.25</u>	
	= $25\% \times \$35,855$	= $75\% \times \$35,855$	
Totals for each product	<u>\$24,036.25</u>	<u>\$41,963.75</u>	<u>\$66,000</u>



### Implementation Issues

The key implementation issue is the choice of the most accurate allocation method. Briefly review Exhibits 12.6, 12.7, and 12.8. Note that although total costs are the same (\$66,000), the amounts allocated to the two products vary. Although these amounts do not vary greatly for Beary Company, wide variations can occur in practice. When significant differences exist, a management accountant should consider the value of the reciprocal method, which is more complete and accurate than the others because it fully considers the reciprocal flows between service departments.

#### EXHIBIT 12.9 Solving for the Reciprocal Allocation Method Using the Solver Function in Microsoft Excel

Solving reciprocal departmental allocation problems can become tedious if three or more departments are involved. In this case, we suggest the use of software programs such as the Solver tool in Excel. The following screen capture illustrates how the Solver tool can be used to solve the Beary Company example in the text. The column for "Allocated Cost" in the spreadsheet contains the cost in each service department, while the columns for "Service Rates" contain the reciprocal service rates. The column for "Initial Allocation to" contains the product of the "Allocated Cost" and "Service Rates" columns, using cell-based formulas.

Cells E7 and F7 contain the formula-based sums of these columns. After selecting "Solver" from the Tools menu, the Dialog Box in Exhibit 12.9, panel A appears and must be completed as shown. For example, the Target Cell (E7) must be set to a value of \$5,850 (the cost of the first service department). When the dialog box is complete, select Solve, and the solution will appear in cells B5 and B6 (overwriting the amounts originally entered in the Allocated Cost column). The solution is \$6,953.13 in cell B5 and \$11,031.25 in cell B6. The solution is shown in panel B.

Panel A: Solver Dialog Box

The screenshot shows the Microsoft Excel - Beary Solver window. The background spreadsheet, titled "Reciprocal Cost Allocations for the Beary Company", has the following data:

Service Department	Allocated Cost	Service Rates to...		Initial Allocation to...	
		S1	S2	S1	S2
S1	\$ 5,850.00	1.00	(0.40)	\$ 5,850.00	\$ (2,340.00)
S2	\$ 8,250.00	(0.10)	1.00	\$ (825.00)	\$ 8,250.00
				\$ 5,025.00	\$ 5,910.00

The Solver Parameters dialog box is open, showing the following settings:

- Set Target Cell:** \$E\$7
- Equal To:** ☒ Max ☐ Min ☐ Value of: 5850
- By Changing Cells:** \$B\$5:\$B\$6
- Subject to the Constraints:**
  - \$B\$5 >= 0
  - \$B\$6 >= 0
  - \$F\$7 = 8250

The dialog box includes buttons for Solve, Close, Options, Reset All, and Help.

(Continued)



**EXHIBIT 12.9** Continued**Panel B: Solver Solution for Beary Example**

Reciprocal Cost Allocations for the Beary Company					
Service Department	Allocated Cost	Service Rates to...		Initial Allocation to...	
		S1	S2	S1	S2
S1	\$ 6,953.13	1.00	(0.40)	\$ 6,953.13	\$ (2,781.25)
S2	\$ 11,031.25	(0.10)	1.00	\$ (1,103.13)	\$ 11,031.25
				\$ 5,850.00	\$ 8,250.00

Excel can be used to solve the reciprocal allocation method using the Solver tool. The solution technique is illustrated in Exhibit 12.9.

**LEARNING OBJECTIVE 4**

Explain the problems in implementing the different departmental cost allocation methods.

Four additional issues to consider when implementing the departmental allocation approach are (1) difficulty in determining an appropriate allocation base, (2) separation of variable and fixed costs (called *dual allocation*), (3) use of budgeted rather than actual amounts, and (4) allocated costs exceeding the outside purchase price.

**Difficulty in Determining the Allocation Base** Determining an appropriate allocation base and a percentage amount for service provided by the service departments is often difficult. For example, using labor hours could be inappropriate in an automated plant where labor is a small part of total cost. Similarly, square feet of floor space could be inappropriate to allocate certain costs when a great deal of idle space exists. Furthermore, the use of square feet of floor space can have undesirable motivational consequences. For example, if we are allocating plantwide maintenance costs to production departments using floor space as a base, a department has inadequate incentive to limit its use of maintenance expense. Since the actual use of maintenance is unrelated to floor space, if a given department increases its use of maintenance, then the other departments pay for the increase as well, as illustrated in Exhibit 12.10. Here, department A increases its use of maintenance by \$60,000 (from panel 2 to panel 3 in Exhibit 12.10), while department B's usage stays the same. The effect of department A's increased usage (when allocation is based on square feet) is that department B pays one-half of the increased cost. A preferred approach in this example would be to allocate on the basis of maintenance requests in order to achieve the desired objectives of motivation and fairness. Exhibit 12.11 provides some suggested allocation bases that can address some of these difficulties.

**Distinguish Fixed and Variable Costs: Dual Allocation**

A preferred departmental allocation approach is dual allocation, which separates variable and fixed costs and traces the variable costs directly to the departments that caused the cost. Tracing variable costs in this way satisfies the allocation objectives of motivation and fairness. However, firms sometimes find that separating the variable and fixed costs of the departments is difficult or uneconomical. The firm then allocates the total costs (both variable and fixed) in the same manner. Because variable costs are not traced, the latter approach based on total cost does not meet the allocation objectives as well as dual allocation.



**EXHIBIT 12.10****Disincentive Effects of Certain Allocation Methods**

	Department A	Department B	Total Maintenance Cost
<b>Panel 1: Basic information</b>			
Square feet of floor space	5,000	5,000	
Average number of maintenance requests	50	50	
Total maintenance costs			\$200,000
<b>Panel 2: Maintenance cost allocation in an average month using square feet of floor space</b>			
Allocated maintenance cost	\$100,000	\$100,000	\$200,000
<b>Panel 3: Maintenance cost allocation based on square feet for a month when department A increases usage of maintenance from 50 to 80 maintenance requests, while department B's usage remains the same at 50 requests. Here we assume that maintenance costs are variable with the number of maintenance requests, or \$2,000 per request [<math>\\$200,000 / (50 + 50)</math>], so that total maintenance costs increase to \$260,000 [<math>\\$2,000 \times (50 + 80)</math>].</b>			
Allocated maintenance cost:	\$130,000	\$130,000	\$260,000

**EXHIBIT 12.11****Allocation Bases for Selected Types of Costs**

Source: Institute of Management Accountants, "Allocation of Service and Administrative Costs," *Statement Number 4B* (Montvale, NJ, 1985).

Personnel-related costs—number of employees
Payroll-related costs (pensions, fringe benefits, payroll taxes)—labor cost
Materials-related costs—materials cost or quantity used
Space-related costs—square feet or cubic feet
Energy-related costs—motor capacity
Research and development costs—estimated time, sales, or assets employed
Public relations costs—sales
Executives' salaries costs—sales, assets employed
Property taxes costs—square feet, real estate or insurance valuation, market value of assets

**Budgeted versus Actual Amounts** When the allocation base is determined from actual amounts (for example, labor-hours incurred in the current period), each department's cost allocation affects the other departments' actual usage of the allocation base. The reason is that each department's actual usage affects total actual usage. Unfavorable incentives arise because one department's usage now affects the amount allocated to the other departments. Exhibit 12.12

**EXHIBIT 12.12****Disincentive Effects of Actual Usage-Based Allocation Methods**

	Department A	Department B	Total Maintenance Cost
<b>Panel 1: Basic information</b>			
Actual number of direct labor-hours	10,000	10,000	
Budgeted number of direct labor-hours	10,000	10,000	
Average number of maintenance requests	50	50	
Total maintenance costs			\$200,000
<b>Panel 2: Maintenance cost allocation in an average month using the number of direct labor-hours</b>			
Allocated maintenance cost	\$100,000	\$100,000	\$200,000
<b>Panel 3: Maintenance cost allocation based on direct labor-hours for a month when department A decreases usage of direct labor-hours from 10,000 to 6,000 hours while department B's usage remains the same at 10,000 hours. Here we assume that maintenance costs have both a variable (\$5 per direct labor-hour) and a fixed (\$100,000) component. Total maintenance costs decrease to \$180,000 [<math>\\$100,000 + \\$5 \times (6,000 + 10,000)</math>] and cost/hr is \$180,000/16,000 = \$11.25</b>			
Allocated maintenance cost:	\$ 67,500	\$112,500	\$180,000
	= 6,000 hrs	= 10,000 hrs	
	× \$11.25	× \$11.25	



**EXHIBIT 12.13** Cost Allocation Using External Prices

(A)	(B)	(C)	(D)	(E)	(F)	(G)
User Department	Direct Labor-Hours	Direct Labor-Hour Allocation Base	Cost Allocation Based on Labor-Hours	Outside Price	Allocation Base for Outside Price	Allocation Based on Outside Price
A	3,000	30% (3,000/10,000)	\$ 300	\$ 360	30% (360/1,200)	\$ 300
B	4,000	40% (4,000/10,000)	400	600	50% (600/1,200)	500
C	1,000	10% (1,000/10,000)	100	120	10% (120/1,200)	100
D	<u>2,000</u>	20% (2,000/10,000)	<u>200</u>	<u>120</u>	10% (120/1,200)	<u>100</u>
Total	10,000		\$1,000	\$1,200		\$1,000

continues the example of allocating maintenance costs used in Exhibit 12.10 except that maintenance is allocated on the basis of direct labor-hours. Also, we assume that maintenance costs are both variable and fixed relative to direct labor-hours; there are \$100,000 in total fixed costs and a \$5 per direct labor-hour variable cost. Exhibit 12.12 shows that department B's allocated costs increased from \$100,000 (panel 2) to \$112,500 (panel 3) even though department B did not increase its usage of direct labor-hours or of maintenance requests. The reason for this is that department A reduced its usage of direct labor from 10,000 hours to 6,000 hours. As a result, the \$100,000 *total fixed costs in maintenance are allocated over a smaller number of total labor-hours*, thus increasing department B's total cost allocation. The direct labor-hours-based allocation is unfair and unmotivating for department B.

For this reason, using budgeted or predetermined amounts rather than actual amounts for allocating fixed costs is preferable. When budgeted direct labor-hours are used, each department's fixed cost allocation is predictable and is not influenced by the usage in other departments. In contrast, allocating variable costs on the basis of actual usage is preferable, since variable costs can be directly traced to the different users. This is another reason that it is important to separate variable and fixed costs using dual allocation. An important limitation of the use of budgeted rates is that sometimes the budget information could be difficult to obtain. For example, budgeted rates would be difficult to implement when the allocation base varies significantly from period to period or is difficult to predict accurately.

**Allocated Costs Exceed External Purchase Cost** Another limitation of the three departmental methods is that they can allocate to a department a higher cost than the cost of the service that the department could purchase from an outside supplier. Should the department pay more for a service internally than an outside vendor would charge? To motivate managers to be efficient and to make the right decisions, the allocation should be based on the cost as if each department had to obtain the service outside the firm. Consider the data in Exhibit 12.13 for a firm with four departments that share a common data processing service costing \$1,000. Data processing costs are allocated using direct labor-hours in each department as shown in columns (B), (C), and (D) of Exhibit 12.13. The data processing service can also be obtained from an outside firm at the cost shown in column (E).

The direct labor-hours allocation base in this example penalizes department D, which can obtain the service outside the firm for \$80 less than the inside cost (\$200 – \$120), perhaps because of the simplified nature of the requirements in department D. In contrast, department B can obtain the service outside only at a much higher price (\$600 versus \$400 inside), perhaps because of the specialized nature of the service. In this case, the allocation based on the *outside price* (column G in Exhibit 12.13) is fair to both departments B and D. It is a better reflection of the competitive cost of the service. The question of whether, and under what conditions, the department should be allowed to purchase outside the firm is a different issue, which is addressed in the coverage of management control in Chapters 17 and 18.



## Cost Allocation in Service Industries

### LEARNING OBJECTIVE 5

Explain the use of cost allocation in service firms.

The concepts presented in this chapter apply equally well to manufacturing, service, or not-for-profit organizations that incur joint costs. For example, financial institutions such as commercial banks also use cost allocation. To illustrate, we use the Community General Bank (CGB), which provides a variety of banking services, including deposit accounts, mortgage loans, installment loans, investment services, and other services. Currently, CGB is analyzing the profitability of its mortgage loan department, which has two main businesses, commercial construction loans and residential construction loans. An important part of the analysis of these loan businesses is determining how to trace or allocate costs to the two businesses.

The cost allocation begins by identifying which departments directly support the two mortgage loan businesses, the loan operations department and the marketing department. The *operations department* handles the processing of loan applications, safekeeping of appropriate documents, billing, and maintaining accounts for both commercial and residential loans. The *marketing department* provides direct advertising, promotions, and customer service for both types of loans.

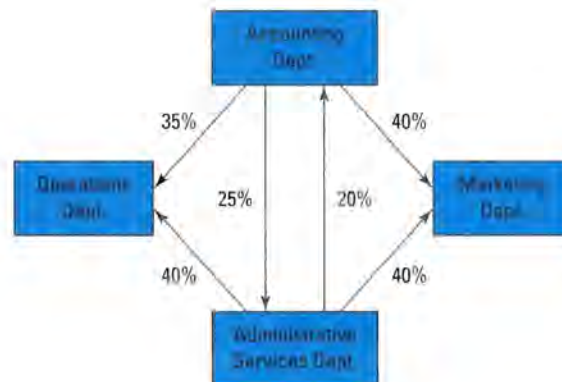
Other departments support the two loan businesses indirectly by supporting the operations and marketing departments. Two important support departments are the administrative services department and the accounting department. The *administrative services department* provides legal and technical support. The *accounting department* provides financial services, including regular financial reports and the maintenance of customer records. The administrative services and accounting departments provide services to each other as well as to the operations and marketing departments, as illustrated in Exhibit 12.14. Each of the four departments has labor and certain supplies costs that can be traced directly to it. In addition, CGB's human resources department and computer services department provide services to all four departments.

CGB uses the step method to allocate costs from support departments to the loan businesses. See the step method in Exhibit 12.15, which follows the same approach as for Beary Company in Exhibit 12.7. The top of Exhibit 12.15 shows the allocation bases that CGB uses to allocate human resources costs and computer services costs to each department. The allocation base for human resources costs is the number of employees, or the head count, in each department, and the allocation of computer services costs is based on the number of computers in each department. The number of employees and the number of computers in each department are given.

The first phase of the allocation in Exhibit 12.15 shows tracing the totals of \$1,560,000 of direct labor and \$33,000 for supplies costs to each department as well as the allocation of the human resources costs (\$80,000) and computer services costs (\$66,000), using the allocation bases head count and number of computers, respectively. The result is that the total cost of \$1,739,000 is allocated as follows,

### EXHIBIT 12.14

Cost Flows in Community General Bank





Accounting department	\$ 253,700
Administrative services department	381,500
Operations department	623,700
Marketing department	480,100
Total cost	<u>\$1,739,000</u>

In the second phase, the accounting and administrative service department costs are allocated to the operations and marketing departments using the step method and the service percentages in Exhibit 12.14. The result is that the \$1,739,000 of total cost is now allocated to the operations department (\$934,957.50) and the marketing department (\$804,042.50).

**EXHIBIT 12.15** Use of the Step Method for Cost Allocation at Community General Bank

Departmental Allocation Bases	Departments				Total
	Accounting	Administrative Services	Operations	Marketing	
Human Resources Headcount	80 20.0%	100 25.0%	160 40.0%	60 15.0%	400 100.0%
Computer Services Number of computers	60 20.0%	60 20.0%	150 50.0%	30 10.0%	300 100.0%
<b>First Phase: Trace Direct Costs and Allocate Overhead Costs to Departments</b>					
Direct costs (given)					
Labor	\$221,000	\$339,500	\$554,500	\$445,000	\$1,560,000
Supplies	3,500	8,800	4,200	16,500	33,000
Indirect costs					
Human Resources	16,000	20,000	32,000	12,000 (e.g., \$12,000 = 15% × \$80,000)	80,000
Computer Services	13,200	13,200	33,000	6,600 (e.g., \$ 6,600 = 10% × \$66,000)	66,000
Totals for all departments	<u>\$253,700</u>	<u>\$381,500</u>	<u>\$623,700</u>	<u>\$480,100</u>	<u>\$1,739,000</u>
<b>Second Phase: Allocate Service Department Costs to Operations and Marketing, Using the Step Method</b>					
First step					
Accounting Department	Service percent Amount	25% \$63,425	35% \$88,795	40% \$101,480 (e.g., \$101,480 = 40% × \$253,700)	
Second step					
Administrative services	Service percent Allocation percent (per direct method) Amount		40% 50% \$222,462.50	40% 50% \$222,462.50 (e.g., \$222,462.50 = 50% × (\$381,500 + \$63,425))	
Totals for production departments			<u>\$934,957.50</u>	<u>\$804,042.50</u>	<u>\$1,739,000</u>
<b>Third Phase: Allocate Operations and Marketing Costs to Commercial and Residential Loans</b>					
			<b>Commercial Loans</b>	<b>Residential Loans</b>	
Base: Number of banking transactions			15,000	10,000	25,000
Percent			60%	40%	
Number of loans			900	3,600	4,500
Percent			20%	80%	
Operations (Number of transactions)			\$560,974.50	\$ 373,983	
Marketing (Number of loans)			<u>\$160,808.50</u>	<u>\$ 643,234</u>	
Totals for commercial and residential loans			<u>\$ 721,783</u>	<u>\$1,017,217</u>	<u>\$1,739,000</u>



**EXHIBIT 12.16****Profitability Analysis of  
Mortgage Loans Community  
General Bank**

	Commercial Loans	Residential Loans
Revenues	\$2,755,455	\$2,998,465
Less expenses		
Cost of funds	1,200,736	1,387,432
Allocated operating costs	721,783	1,017,217
Contribution	\$ 832,936	\$ 593,816
Key ratios		
Contribution/revenue	30.23%	19.80%
Cost of funds/revenues	43.58%	46.27%

In the third and final phase, the costs from the operations and marketing departments are allocated to the two businesses, commercial and residential loans. The base that CGB uses to allocate operations department costs is the number of banking transactions handled within operations (15,000 for commercial loans and 10,000 for residential loans) and to allocate marketing costs is the number of loans of either type (900 commercial loans and 3,600 residential loans). The result of the final allocation is that the total cost of \$1,739,000 is allocated to the commercial loans department (\$721,783) and the residential loans department (\$1,017,217), as illustrated for the third phase in Exhibit 12.15.

Cost allocation provides CGB a basis for evaluating the cost and profitability of its services. By taking the allocated operating costs just determined, the cost of funds provided, and the revenue produced by both commercial and residential loans, a profitability analysis of mortgage loans can be completed. Assume that the commercial and residential loan departments have revenues of \$2,755,455 and \$2,998,465, respectively, and direct cost of funds of \$1,200,736 and \$1,387,432, respectively.

The profitability analysis in Exhibit 12.16 shows that the relatively high allocated operating costs of the residential loan department are an important factor in its overall poor performance (only 19.8 percent contribution per dollar of revenue in contrast to more than 30 percent for the commercial loan area). In contrast, the cost of funds appears to be comparable for both types of loans (43.58 percent of revenues for commercial loans and 46.27 percent of revenues for residential loans). The analysis indicates that the bank should investigate the profitability of residential loans and, in particular, the cost of operations and marketing for these loans.

## Joint Product Costing

**LEARNING OBJECTIVE 6**

Use the three joint product costing methods.

**Joint products**

are products from the same production process that have relatively substantial sales value.

**By-products**

are products whose total sales values are minor in comparison with the sales value of the joint products.

**The split-off point**

is the first point in a joint production process at which individual products can be identified.

Many manufacturing plants yield more than one product from a joint manufacturing process. For example, the petroleum industry processes crude oil into multiple products: gasoline, naphtha, kerosene, fuel oils, and residual heavy oils. Similarly, the semiconductor industry processes silicon wafers into a variety of computer memory chips with different speeds, temperature tolerances, and life expectancies. Beef and hides are products linked in the meat-packing process; neither of these items can be produced without producing the other. Other industries that yield joint products include lumber production, food processing, soap making, grain milling, dairy farming, and fishing.

Joint products and by-products are derived from processing a single input or a common set of inputs. **Joint products** are products from the same production process that have relatively substantial sales values. Products whose total sales values are minor in comparison to the sales value of the joint products are classified as **by-products**.

Joint products and by-products both start their manufacturing life as part of the same raw material. Until a certain point in the production process, no distinction can be made between the products. The point in a joint production process at which individual products can be identified for the first time is called the **split-off point**. Thereafter, separate production processes can be applied to the individual products. At the split-off point, joint products or by-products might be salable or require further processing to be salable, depending on their nature.

Joint costs include all manufacturing costs incurred prior to the split-off point (including direct materials, direct labor, and factory overhead). For financial reporting purposes, these