CHAPTER 7

Allocating Costs of Support Departments and Joint Products

AFTER STUDYING THIS CHAPTER, YOU SHOULD BE ABLE TO:

1. Describe the difference between support departments and producing departments.
2. Calculate charging rates, and distinguish between single and dual charging rates.
3. Allocate support center costs to producing departments using the direct method, the sequential method, and the reciprocal method.
4. Calculate departmental overhead rates.
5. Identify the characteristics of the joint production process, and allocate joint costs to products.

Mutually beneficial costs, which occur when the same resource is used in the output of two or more services or products, are known as **common costs**. These common costs may pertain to periods of time, individual responsibilities, sales territories, and classes of customers. A special case of common costs is that of the joint production process. This chapter will first focus on the costs common to departments and to products, and then on the common costs of the joint production process.

An Overview of Cost Allocation

The complexity of many modern firms leads the accountant to allocate costs of support departments to producing departments and individual product lines. Allocation is simply a means of dividing a pool of

OBJECTIVE 1

Describe the difference between support departments and producing departments.

costs and assigning those costs to various subunits. It is important to realize that allocation does not affect the total cost. Total cost is neither reduced nor increased by allocation. However, the amounts of cost assigned to the subunits can be affected by the allocation procedure chosen. Because cost allocation can affect bid prices, the profitability of individual products, and the behavior of managers, it is an important topic. For example, the wages paid to security guards at a factory are a common cost of all of the different products manufactured there. The benefits of security are applicable to each product, yet the assignment of security cost to the individual products is an arbitrary process. In other words, while it is clear that the products (or services) require the common resource and that the resource cost should be assigned to these cost objects, it is often not clear how best to go about assigning the cost. Usually, common cost assignment is made through a series of consistent allocation procedures.

Types of Departments

The first step in cost allocation is to determine just what the cost objects are. Usually, they are departments. There are two categories of departments: producing departments and support departments. **Producing departments** are directly responsible for creating the products or services sold to customers. In a large public accounting firm, examples of producing departments are auditing, tax, and management advisory services (computer systems services). In a manufacturing setting such as **Volkswagen (VW)**, producing departments are those that work directly on the products being manufactured (e.g., assembly and painting). **Support departments** provide essential services for producing departments. These departments are indirectly connected with an organization's services or products. At VW, those departments might include engineering, maintenance, personnel, and building and grounds.

Once the producing and support departments have been identified, the overhead costs incurred by each department can be determined. Note that this involves tracing costs to the departments, not allocating costs, because the costs are directly associated with the individual department. A factory cafeteria, for example, would have food costs, wages of cooks and servers, depreciation on dishwashers and stoves, and supplies (e.g., napkins and plastic forks). Overhead directly associated with a producing department such as assembly in a furniture-making plant would include utilities (if measured in that department), supervisory salaries, and depreciation on equipment used in that department. Overhead that cannot be easily assigned to a producing or support department is assigned to a catchall department such as general factory. General factory might include depreciation on the factory building, rental of a Santa Claus suit for the factory Christmas party, the cost of restriping the parking lot, the plant manager's salary, and telephone service. In this way, all costs are assigned to a department.

Exhibit 7-1, on the following page, shows how a manufacturing firm and a service firm can be divided into producing and support departments. The manufacturing plant, which makes furniture, may be departmentalized into two producing departments (assembly and finishing) and four support departments (materials storeroom, cafeteria, maintenance, and general factory). The service firm, a bank, might be departmentalized into three producing departments (auto loans, commercial lending, and personal banking) and three support departments (drive through, data processing, and bank administration). Overhead costs are traced to each department. Note that each factory or service company overhead cost must be assigned to one, and only one, department.

Once the company has been departmentalized and all overhead costs have been traced to the individual departments, support department costs are assigned to producing departments, and overhead rates are developed to cost products. Although support departments do not work directly on the products or services that are sold, the costs of providing these support services are part of the total product cost and must be assigned to the products. This assignment of costs consists of a two-stage allocation: (1) allocation of support department costs to producing departments and (2) assignment

EXHIBIT 7-1 Examples of Departmentalization for a Manufacturing Firm and a Service Firm

Manufacturing Firm: Furniture Maker

Producing Departments	Support Departments
Assembly:	Materials Storeroom:
Supervisors' salaries	Clerk's salary
Small tools	Depreciation on forklift
Indirect materials	Cafeteria:
Depreciation on machinery	Food
Finishing:	Cooks' salaries
Sandpaper	Depreciation on stoves
Depreciation on sanders and buffers	Maintenance:
	Janitors' salaries
	Cleaning supplies
	Machine oil and lubricants
	General Factory:
	Depreciation on building
	Security
	Utilities

Service Firm: Bank

Producing Departments	Support Departments
Auto Loans:	Drive Through:
Loan processors' salaries	Tellers' salaries
Forms and supplies	Depreciation on equipment
Commercial Lending:	Data Processing:
Lending officers' salaries	Personnel salaries
Depreciation on office equipment	Software
Bankruptcy prediction software	Depreciation on hardware
Personal Banking:	Bank Administration:
Supplies and postage for statements	Salary of CEO
	Receptionist's salary
	Telephone costs
	Depreciation on bank and vault

of these allocated costs to individual products. The second-stage allocation, achieved through the use of departmental overhead rates, is necessary because there are multiple products being worked on in each producing department. If there were only one product within a producing department, all the support costs allocated to that department would belong to that product. Recall that a predetermined overhead rate is computed by taking total estimated overhead for a department and dividing it by an estimate of an appropriate base. Now we see that a producing department's overhead consists of two parts: overhead directly associated with a producing department and overhead allocated to the producing department from the support departments. A support department cannot have an overhead rate that assigns overhead costs to units produced, because it does not make a salable product. That is, products do not pass through support departments. The nature of support departments is to service producing departments, not the products that pass through the producing departments. For example, maintenance personnel repair and maintain the equipment in the assembly department,

not the furniture that is assembled in that department. Exhibit 7-2 summarizes the steps involved.

EXHIBIT 7-2 Steps in Allocating Support Department Costs to Producing Departments

1. Departmentalize the firm.
2. Classify each department as a support department or a producing department.
3. Trace all overhead costs in the firm to a support or producing department.
4. Allocate support department costs to the producing departments.
5. Calculate predetermined overhead rates for producing departments.
6. Allocate overhead costs to the units of individual product through the predetermined overhead rates.

Types of Allocation Bases

In effect, producing departments *cause* support activities; therefore, the costs of support departments are also caused by the activities of the producing departments. **Causal factors** are variables or activities within a producing department that provoke the incurrence of support costs. In choosing a basis for allocating support department costs, every effort should be made to identify appropriate causal factors (activity drivers). Using causal factors results in product costs being more accurate. Furthermore, if the causal factors are known, managers are more able to control the consumption of services.

COST MANAGEMENT Technology in Action

Did you get my order? Did you ship it? If not, when are you going to? These are the three big questions that **Mott's** North America customers want answered—and they want them answered in real time. Mott's, which sells juices and processed fruit products (including applesauce, Clamato, Mr. and Mrs. T drink mixer, and Rose's Holland House) to food brokers, uses SAP R/3 integrated applications to provide customer service and support. While many companies assign customer service to a support department, Mott's believes that customer service is the most critical issue in their business. The company wants to provide more timely information about order status, the availability of products, and production schedules and delivery. This requires integration across order taking, billing, accounts receivable, production, and shipping.

"Orders come in through EDI, telephone, or fax," says Jeff Morgan, vice president of information technology. "Customer service takes the order and checks availability to confirm delivery date. If there is insufficient product in inventory, the service representative checks the production plan. This automatically calculates lead times to determine delivery of the entire order or partial shipment and balance delivery date. The order is launched, financials are updated as it works its way through the system, and an invoice is generated. As soon as any data are entered into the system, they are immediately available for access by other users throughout the system."

Further benefits are gained through the elimination of duplicate data entry and the need to reconcile transactions between the formerly "siloed" support departments. The end results are a reduction in cost, improvement in customer service, and better understanding of the relationship between production and support costs.

Source: Taken from SAP materials and the Web site: http://www.sap.com/usa.

To illustrate the types of causal factors, or activity drivers, that can be used, consider the following three support departments: power, personnel, and materials handling. For power costs, a logical allocation base is kilowatt-hours, which can be measured by separate meters for each department. If separate meters do not exist, perhaps machine hours used by each department would provide a good proxy, or a means of approximating power

usage. For personnel costs, both the number of producing department employees and the labor turnover (e.g., number of new hires) are possible activity drivers. For materials handling, the number of material moves, the hours of materials handling used, and the quantity of material moved are all possible activity drivers. Exhibit 7-3 lists some possible activity drivers that can be used to allocate support department costs. When competing activity drivers exist, managers need to assess which factor provides the most convincing relationship.

EXHIBIT 7-3 Examples of Possible Activity Drivers for Support Departments

Accounting:
- Number of transactions

Cafeteria:
- Number of employees

Data Processing:
- Number of lines entered
- Number of hours of service

Engineering:
- Number of change orders
- Number of hours

Maintenance:
- Machine hours
- Maintenance hours

Materials Storeroom:
- Number of material moves
- Pounds of material moved
- Number of different parts

Payroll:
- Number of employees

Personnel:
- Number of employees
- Number of firings or layoffs
- Number of new hires
- Direct labor cost

Power:
- Kilowatt-hours
- Machine hours

Purchasing:
- Number of orders
- Cost of orders

Shipping:
- Number of orders

While the use of a causal factor to allocate common cost is the best solution, sometimes an easily measured causal factor cannot be found. In that case, the accountant looks for a good proxy. For example, the common cost of plant depreciation may be allocated to producing departments on the basis of square footage. Though square footage does not cause depreciation, it can be argued that the number of square feet a department occupies is a good proxy for the services provided to it by the factory building. The choice of a good proxy to guide allocation is dependent upon the company's objectives for allocation.

Objectives of Allocation

A number of important objectives are associated with the allocation of support department costs to producing departments and ultimately to specific products. The following major objectives have been identified by the IMA:[1]

1. To obtain a mutually agreeable price
2. To compute product-line profitability
3. To predict the economic effects of planning and control
4. To value inventory
5. To motivate managers

1. *Statements of Management Accounting (Statement 4B)*, "Allocation of Service and Administrative Costs" (Montvale, NJ: NAA, 1985). The NAA is now known as the Institute of Management Accountants (IMA).

Competitive pricing requires an understanding of costs. Only by knowing the costs of each service or product can the firm create meaningful bids. If costs are not accurately allocated, some costs could be overstated, resulting in bids that are too high and a loss of potential business. Alternatively, if the costs are understated, bids could be too low, producing losses on these products.

Good estimates of individual product costs also allow a manager to assess the profitability of individual products and services. Multiproduct companies need to be sure that all products are profitable and that the overall profitability of the firm is not disguising the poor performance of individual products. This meets the profitability objective identified by the IMA.

By assessing the profitability of various support services, a manager may evaluate the mix of support services offered by the firm. From this evaluation, executives may decide to drop some support services, reallocate resources from one to another, reprice certain support services, or exercise greater cost control in some areas. These steps would meet the IMA's planning and control objective. The validity of any evaluation, however, depends to a great extent on the accuracy of the cost assignments made to individual products.

For a service organization such as a hospital, the IMA objective of inventory valuation is not relevant. For manufacturing organizations, however, this objective must be given special attention. Rules of financial reporting (GAAP) require that all direct and indirect manufacturing costs be assigned to the products produced. Since support department costs are indirect manufacturing costs, they must be assigned to products. This is accomplished through support department cost allocation. Inventories and cost of goods sold, then, include direct materials, direct labor, and all manufacturing overhead, including the cost of support departments.

Allocations also can be used to motivate managers. If the costs of support departments are not allocated to producing departments, managers may tend to overconsume these services. Consumption of a support service may continue until the marginal benefit of the service equals zero. In reality, the marginal cost of a service is, of course, greater than zero. By allocating the costs and holding managers of producing departments responsible for the economic performance of their units, the organization ensures that managers will use a support service until the marginal benefit of the service equals its marginal cost. Thus, allocation of support department costs helps each producing department select the correct level of support service consumption.

There are other behavioral benefits. Allocation of support department costs to producing departments encourages managers of those departments to monitor the performance of support departments. Since the costs of the support departments affect the economic performance of their own departments, those managers have an incentive to control these costs through means other than simple usage of the support service. For instance, the managers can compare the internal costs of the support service with the costs of acquiring it externally. If a support department is not as cost effective as an outside source, perhaps the company should not continue to supply the service internally. Many university libraries, for example, are moving toward the use of outside contractors for photocopying services. They have found that these contractors are more cost efficient and provide a higher level of service to library users than did the previous method of using professional librarians to make change, keep the copy machines supplied with paper, fix paper jams, etc. This possibility of comparison should result in a more efficient internal support department. Monitoring by managers of producing departments will also encourage managers of support departments to be more sensitive to the needs of the producing departments.

Clearly, then, there are good reasons for allocating support department costs. The validity of these reasons depends, however, on the accuracy and fairness of the cost assignments made. Although it may not be possible to identify a single method of allocation that simultaneously satisfies all of these objectives, several guidelines have been developed to assist in determining the best allocation method. These guidelines are

cause and effect, benefits received, fairness, and ability to bear. Another guideline to be used in conjunction with any of the others is cost-benefit. That is, the method used must provide sufficient benefits to justify any effort involved.

Cause and effect requires the determination of causal factors to guide allocation. For example, a corporate legal department may track the number of hours spent on legal work for its various divisions (e.g., handling patent applications, lawsuits, etc.). The number of hours worked by lawyers and paralegals has a clear cause-and-effect relationship with the overall cost of the legal department and may be used to allocate the cost of the corporate legal department to the various company divisions.

The benefits-received guideline associates the cost with perceived benefits. Research and development (R&D) costs, for example, may be allocated on the basis of the sales of each division. Although some R&D efforts may be unsuccessful and while the successful efforts may happen to benefit one division in one year, all divisions have a stake in corporate R&D and will at some point have increased sales because of it.

Fairness or equity is a guideline often mentioned in government contracting. In the case of cost allocation methods, fairness usually means that the government contract should be costed in a method similar to nongovernmental contracts. For example, an airplane engine manufacturer may allocate a portion of corporate legal department costs to the government contract if these costs are usually allocated to private contracts.

Ability to bear is the least desirable guideline. It tends to "penalize" the most profitable division by allocating to it the largest proportion of a support department cost—regardless of whether the profitable division receives any services from the allocated department. As a result, no motivational benefits of allocation are realized.

In determining how to allocate support department costs, the guideline of cost-benefit must be considered. In other words, the costs of implementing a particular allocation scheme must be compared to the benefits expected to be derived. As a result, companies try to use easily measured and understood bases for allocation.

Allocating One Department's Costs to Another Department

OBJECTIVE 2

Calculate charging rates, and distinguish between single and dual charging rates.

Frequently, the costs of a support department are allocated to another department through the use of a charging rate. In this case, we focus on the allocation of one department's costs to other departments. For example, a company's data processing department may serve various other departments. The cost of operating the data processing department is then allocated to the user departments. While this seems simple and straightforward, a number of considerations go into determining an appropriate charging rate. The two major factors are (1) the choice of a single or a dual charging rate and (2) the use of budgeted versus actual support department costs.

A Single Charging Rate

Some companies prefer to develop a single charging rate. Suppose, for example, that Hamish and Barton, a large regional public accounting firm, develops an in-house photocopying department to serve its three producing departments (audit, tax, and management advisory systems, or MAS). The costs of the photocopying department include fixed costs of $26,190 per year (salaries and machine rental) and variable costs of $0.023 per page copied (paper and toner). Estimated usage (in pages) by the three producing departments is as follows:

Audit department	94,500
Tax department	67,500
MAS department	108,000
Total	270,000

If a single charging rate is used, the fixed costs of $26,190 will be combined with estimated variable costs of $6,210 (270,000 × $0.023). Total costs of $32,400 are divided by the estimated 270,000 pages to be copied to yield a rate of $0.12 per page.

The amount charged to the producing departments is solely a function of the number of pages copied. Suppose that the actual usage for audit is 92,000 pages, 65,000 pages for tax, and 115,000 pages for MAS. The total photocopying department charges would be as shown:

	Number of Pages × *Charge per Page* =		*Total Charges*
Audit	92,000	$0.12	$11,040
Tax	65,000	0.12	7,800
MAS	115,000	0.12	13,800
Total	272,000		$32,640

Notice that the use of a single rate treats the fixed cost as if it were variable. In fact, to the producing departments, photocopying is strictly variable. Did the photocopying department need $32,640 to copy 272,000 pages? No, it needed only $32,446 [$26,190 + (272,000 × $0.023)]. The extra amount charged is due to the treatment of a fixed cost in a variable manner.[2]

Dual Charging Rates

While the use of a single rate is simple, it ignores the differential impact of changes in usage on costs. The variable costs of a support department increase as the level of service increases. For example, the costs of paper and toner for the photocopying department increase as the number of pages copied increases. Fixed costs, on the other hand, do not vary with the level of service. For example, the rental payment for photocopying machines does not change as the number of pages increases or decreases. We can avoid the treatment of fixed costs as variable by developing two rates: one for fixed costs and one for variable costs. The development of dual charging rates (which are used as the basis for pricing) is particularly important in companies such as public utilities.

Developing a Fixed Rate

Fixed service costs can be considered capacity costs; they are incurred to provide the capacity necessary to deliver the service units required by the producing departments. When the support department was established, its delivery capability was designed to serve the long-term needs of the producing departments. Since the original support needs caused the creation of the support service capacity, it seems reasonable to allocate fixed costs based on those needs.

Either the normal or peak activity of the producing departments provides a reasonable measure of original support service needs. Normal capacity is the average capacity achieved over more than one fiscal period. If service is required uniformly over the time period, normal capacity is a good measure of activity. Peak capacity allows for variation in the need for the support department, and the size of the department is structured to allow for maximum need. In our example, the tax department may need much more photocopying during the first four months of the year, and its usage may be based on that need. The choice of normal or peak capacity in allocating budgeted fixed service costs depends on the needs of the individual firm. Budgeted fixed costs are allocated in this way regardless of whether the purpose is product costing or performance evaluation.

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2. Note that the photocopying department would have charged out less than the cost needed if the number of pages copied had been less than the budgeted number of pages. You might calculate the total cost charged for a total of 268,000 pages ($0.12 × 268,000 = $32,160) and compare it with the cost incurred of $32,354 [$26,190 + (268,000 × $0.023)].

The allocation of fixed costs follows a 3-step procedure:

1. *Determination of budgeted fixed support service costs.* The fixed support service costs that should be incurred for a period need to be identified.
2. *Computation of the allocation ratio.* Using the practical or normal capacity of each producing department, it is necessary to compute an allocation ratio. The allocation ratio simply gives a producing department's share or percentage of the total capacity of all producing departments.

$$\text{Allocation ratio} = \text{Producing department capacity}/\text{Total capacity}$$

3. *Allocation.* The fixed support service costs are then allocated in proportion to each producing department's original support service needs.

$$\text{Allocation} = \text{Allocation ratio} \times \text{Budgeted fixed support service costs}$$

Let's assume that the three departments in our example originally decided that they would need the number of photocopies equal to the budgeted number given earlier:

	Original Number of Copies	*Percent*	*Budgeted Fixed Cost*	*Allocated Fixed Cost*
Audit	94,500	35%	$26,190	$ 9,166.50
Tax	67,500	25	26,190	6,547.50
MAS	108,000	40	26,190	10,476.00
Total	270,000	100%		$26,190.00

The fixed costs allocated, then, are the relevant percentages for each department multiplied by the support department's budgeted fixed costs.

Developing a Variable Rate

The variable rate depends on the costs that change as the activity driver changes. In the photocopying department, the activity driver is the number of pages copied. As the number of pages increases, more paper and toner are used. Since these materials average $0.023 per page, the variable rate is $0.023. This variable rate is used in conjunction with the fixed amount allocated to determine total charges. In our example, the audit department would be allocated 35 percent of fixed cost plus $0.023 per page copied. The tax department would be allocated 25 percent of fixed cost plus $0.023 per page copied. MAS would be allocated 40 percent of fixed cost plus $0.023 per page copied. Let's see how variable photocopying costs are allocated under the dual-rate method.

	Actual Number of Copies	×	*Variable Rate*	=	*Variable Amount*	+	*Fixed Amount*	=	*Total Charge*
Audit	92,000		$0.023		$2,116		$ 9,167		$11,283
Tax	65,000		0.023		1,495		6,548		8,043
MAS	115,000		0.023		2,645		10,476		13,121
Total	272,000				$6,256		$26,191		$32,447

Total Allocation

Under the dual charging rates, the fixed photocopying rates are charged to the departments in accordance with their original capacity needs. Especially in a case like this one, in which fixed costs are such a high proportion of total costs, the additional effort needed to develop the dual rates may be worthwhile.

The dual-rate method has the benefit of sending the correct signal regarding increased usage of the support department. Suppose that the tax department wants to have several research articles on tax law changes photocopied for clients. Should this be

done "in house" by the photocopying department or sent to a private photocopying firm that charges $0.06 per page? Under the single-rate method, the in-house cost charged would be too high because it wrongly assumes that fixed cost will increase as pages copied increase. However, under the dual-rate method, the additional cost would be only $0.023 per page, which correctly approximates the additional cost of the job.

COST MANAGEMENT

Technology in Action

Over the past 10 to 15 years, companies such as **Hewlett-Packard**, **IBM**, and **Dow Chemical**, have taken certain support departments and formed shared services centers (SSCs). The SSC performs activities that are used across a wide array of the company's divisions and departments. For example, payroll, receiving, and customer billing and accounts receivable processing have each formed the basis of an SSC. The company reaps the savings that accrue to economies of scale and standardized process design. Tools to measure performance are also incorporated into the SSC design. The SSC is faced with three important cost questions:

1. What causes costs in our operation?
2. How much should be charged back to the customers/producing departments?
3. How do our costs compare with those of outsourcing firms that perform the same service?

Activity-based costing and activity-based management are a natural fit for the SSCs. The drivers used to develop charging rates are seldom unit-based drivers (based on production). Instead, they might include the number of transactions processed and the percentage of errors in customer-provided information. Because ABC provides a better understanding of costs and their related drivers, it provides a better framework for managing SSC costs than traditional cost accounting systems.

Source: Taken from Ann Triplett and Jon Scheumann, "Managing Shared Services with ABM," *Strategic Finance* (February 2000): 40–45.

Budgeted versus Actual Usage

The second factor to be considered in charging costs from a single service department to other departments is whether actual usage or budgeted usage should be the basis for allocating costs. In truth, this factor only has an impact on allocated costs when fixed costs are involved. As a result, we need to consider it in the case of a single charging rate (which combines fixed with variable costs to generate a rate) and of the fixed portion of the dual charging rate.

When we allocate support department costs to the producing departments, should we allocate actual or budgeted costs? The answer is budgeted costs. There are two basic reasons for allocating support department costs. One reason is to cost the units produced. In this case, the budgeted support department costs are allocated to producing departments as a preliminary step in forming the overhead rate. Recall that the overhead rate is calculated at the beginning of the period, when actual costs are unknown. Thus, budgeted costs must be used. The second usage of allocated support department costs is for performance evaluation. In this case, too, budgeted support department costs are allocated to producing departments.

Managers of support and producing departments usually are held accountable for the performance of their departments. Their ability to control costs is an important factor in their performance evaluations. This ability is usually measured by comparing actual costs with planned or budgeted costs. If actual costs exceed budgeted costs, the department may be operating inefficiently, with the difference between the two costs serving as the measure of that inefficiency. Similarly, if actual costs are less than budgeted costs, the department may be operating efficiently.

A general principle of performance evaluation is that managers should not be held responsible for costs or activities over which they have no control. Since managers of producing departments have significant input regarding the level of support service consumed, they should be held responsible for their share of support service costs. This

statement, however, has an important qualification: A department's evaluation should not be affected by the degree of efficiency achieved by another department.

This qualifying statement has an important implication for the allocation of support department costs. *Actual* costs of a support department should not be allocated to producing departments because they include efficiencies or inefficiencies achieved by the support department. Managers of producing departments have no control over the degree of efficiency achieved by a support department manager. By allocating *budgeted* costs instead of actual costs, no inefficiencies or efficiencies are transferred from one department to another.

Whether budgeted usage or actual usage is used depends on the purpose of the allocation. For *product costing*, the allocation is done at the beginning of the year on the basis of budgeted usage so that a predetermined overhead rate can be computed. If the purpose is *performance evaluation*, however, the allocation is done at the end of the period and is based on actual usage. The use of cost information for performance evaluation is covered in more detail in Chapter 9.

Let's return to our photocopying example. Recall that annual budgeted fixed costs were $26,190 and the budgeted variable cost per page was $0.023. The three producing departments—audit, tax, and MAS—estimated usage at 94,500 copies, 67,500 copies, and 108,000 copies, respectively. Given these data, the costs allocated to each department at the *beginning* of the year are shown in Exhibit 7-4.

EXHIBIT 7-4 Use of Budgeted Data for Product Costing: Comparison of Single- and Dual-Rate Methods

Single-Rate Method

	Number of Copies	×	Total Rate	=	Allocated Cost
Audit	94,500		$0.12		$11,340
Tax	67,500		0.12		8,100
MAS	108,000		0.12		12,960
Total	270,000				$32,400

Dual-Rate Method

	Number of Copies	×	Variable Rate	+	Fixed Allocation	=	Allocated Cost
Audit	94,500		$0.023		$ 9,167		$11,340*
Tax	67,500		0.023		6,548		8,100*
MAS	108,000		0.023		10,476		12,960
Total	270,000						$32,400

*Rounded down.

Note that the single-rate method produces the same allocation as does the dual-rate method when budgeted figures are used. This is because budgeted fixed cost is just absorbed by the number of budgeted pages.

When the allocation is done for the purpose of budgeting the producing departments' costs, then, of course, the budgeted support department costs are used. The photocopying costs allocated to each department would be added to other producing department costs—including those directly traceable to each department plus other

support department allocations—to compute each department's anticipated spending. In a manufacturing plant, the allocation of budgeted support department costs to the producing departments would precede the calculation of the predetermined overhead rate.

During the year, each producing department would also be responsible for actual charges incurred based on the actual number of pages copied. Going back to the actual usage assumed previously, a second allocation is now made to measure the actual performance of each department against its budget. The actual photocopying costs allocated to each department for performance evaluation purposes are shown in Exhibit 7-5.

EXHIBIT 7-5 Use of Actual Data for Performance Evaluation Purposes: Comparison of Single- and Dual-Rate Methods

Single-Rate Method

	Number of Copies	×	Total Rate	=	Allocated Cost
Audit	92,000		$0.12		$11,040
Tax	65,000		0.12		7,800
MAS	115,000		0.12		13,800
Total	272,000				$32,640

Dual-Rate Method

	Number of Copies	×	Variable Rate	+	Fixed Allocation	=	Allocated Cost
Audit	92,000		$0.023		$ 9,167		$11,283
Tax	65,000		0.023		6,548		8,043
MAS	115,000		0.023		10,476		13,121
Total	272,000						$32,447

Fixed versus Variable Bases: A Note of Caution

Using normal or practical capacity to allocate fixed support service costs provides a *fixed* base. As long as the capacities of the producing departments remain at the level originally anticipated, there is no reason to change the allocation ratios. Thus, each year, the audit department receives 35 percent of the budgeted fixed photocopying costs, the tax department 25 percent, and the MAS department 40 percent, no matter what their actual usage is. If the capacities of the departments change, the ratios should be recalculated.

In practice, some companies choose to allocate fixed costs in proportion to actual usage or expected actual usage. Since usage may vary from year to year, allocation of fixed costs would then use a variable base. Variable bases, however, have a significant drawback: they allow the actions of one department to affect the amount of cost allocated to another department.

To see how this is demonstrated, let's return to Hamish and Barton's photocopying department and assume that fixed costs are allocated on the basis of anticipated usage for the coming year. The audit and tax departments budget the same number of copies as before. However, the MAS department anticipates much less activity due to a regional recession, which will cut down the number of new clients served; the anticipated number of photocopies for this department falls to 68,000. The adjusted fixed

cost allocation ratios and allocated fixed cost based on the newly budgeted usage are as follows.

	Number of Copies	*Percent*	*Allocated Fixed Cost*
Audit	94,500	41.1%	$10,764
Tax	67,500	29.3	7,674
MAS	68,000	29.6	7,752
Total	230,000	100.0%	$26,190

Notice that both the audit and tax departments' allocation of fixed costs increased even though the fixed costs of the photocopying department remained unchanged. This increase is caused by a decrease in the MAS department's use of photocopying. In effect, the audit and tax departments are being penalized because of MAS's decision to reduce the number of pages copied for the MAS department. Imagine the feelings of the first two managers when they realize that their copying charges have increased due to the increase in allocated fixed costs! The penalty occurs because a variable base is used to allocate fixed support service costs; it can be avoided by using a fixed base.

Choosing a Support Department Cost Allocation Method

OBJECTIVE 3

Allocate support center costs to producing departments using the direct method, the sequential method, and the reciprocal method.

So far, we have considered cost allocation from a single support department to several producing departments. We used the direct method of support department cost allocation, in which support department costs are allocated only to producing departments. This was appropriate in the earlier example because no other support departments existed. This would also be appropriate when there is no possibility of interaction among support departments. Many companies do have multiple support departments, and they frequently interact. For example, in a factory, personnel and cafeteria serve each other, other support departments, and the producing departments.

Ignoring these interactions and allocating support costs directly to producing departments may produce unfair and inaccurate cost assignments. For example, power, although a support department, may use 30 percent of the services of the maintenance department. The maintenance costs caused by the power department belong to the power department. By not assigning these costs to the power department, its costs are understated. In effect, some of the costs caused by power are "hidden" in the maintenance department because maintenance costs would be lower if the power department did not exist. As a result, a producing department that is a heavy user of power and an average or below-average user of maintenance may then receive, under the direct method, a cost allocation that is understated.

In determining which support department cost allocation method to use, companies must determine the extent of support department interaction. In addition, they must weigh the costs and benefits associated with the three methods described and illustrated in the following sections: the direct, sequential, and reciprocal methods.

Direct Method of Allocation

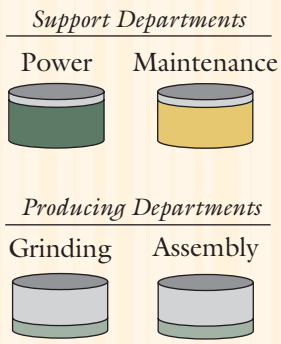
When companies allocate support department costs only to the producing departments, they are using the **direct method** of allocation. The direct method is the simplest and most straightforward way to allocate support department costs. Variable service costs are allocated directly to producing departments in proportion to each department's usage of the service. Fixed costs are also allocated directly to the producing department, but in proportion to the producing department's normal or practical capacity.

Exhibit 7-6 illustrates the lack of support department reciprocity on cost allocation in using the direct method. In Exhibit 7-6, we see that by using the direct method, support department cost is allocated to producing departments only. No cost from one support department is allocated to another support department. Thus, no support department interaction is recognized.

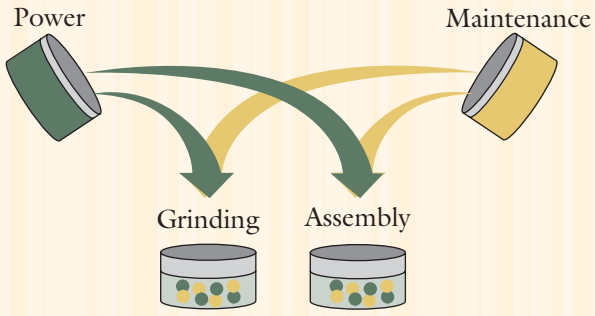
EXHIBIT 7-6 Allocation of Support Department Costs to Producing Departments Using the Direct Method

Suppose there are two support departments, power and maintenance, and two producing departments, grinding and assembly, each with a "bucket" of directly traceable overhead cost.

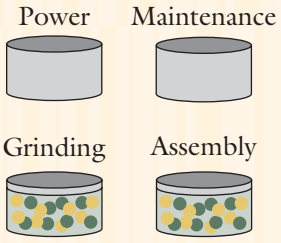
Objective: Distribute all power and maintenance costs to grinding and assembly using the direct method.



Direct Method—Allocate power and maintenance costs only to grinding and assembly.



After allocation—Zero cost in power and maintenance; all overhead cost in grinding and assembly.



To illustrate the direct method, consider the data in Exhibit 7-7 on the following page. The data show the budgeted activity and budgeted costs of two support departments and two producing departments. (Note that the same data are used to illustrate the sequential method; for the time being, ignore the allocation ratios at the bottom of Exhibit 7-7 that correspond to the sequential method.) Assume that the causal factor for power costs is kilowatt-hours, and the causal factor for maintenance costs is maintenance hours. These causal factors are used as the bases for allocation. In the direct

method, only the kilowatt-hours and the maintenance hours in the producing departments are used to compute the allocation ratios. The direct allocations based on the data given in Exhibit 7-7 are shown in Exhibit 7-8. (To simplify the illustration, no distinction is made between fixed and variable costs.)

EXHIBIT 7-7 Data for Illustrating Allocation Methods

	Support Departments		Producing Departments	
	Power	Maintenance	Grinding	Assembly
Direct costs*	$250,000	$160,000	$100,000	$60,000
Normal activity:				
Kilowatt-hours	—	200,000	600,000	200,000
Maintenance hours	1,000	—	4,500	4,500
Allocation ratios:				
Direct method:				
Kilowatt-hours	—	—	0.75	0.25
Maintenance hours	—	—	0.50	0.50
Sequential method:				
Kilowatt-hours	—	0.20	0.60	0.20
Maintenance hours	—	—	0.50	0.50

*For a producing department, direct costs refer only to overhead costs that are directly traceable to the department.

EXHIBIT 7-8 Direct Allocation Illustrated

	Support Departments		Producing Departments	
	Power	Maintenance	Grinding	Assembly
Direct costs	$ 250,000	$ 160,000	$100,000	$ 60,000
Power[a]	(250,000)	—	187,500	62,500
Maintenance[b]	—	(160,000)	80,000	80,000
Total	$ 0	$ 0	$367,500	$202,500

[a]Allocation of power based on ratios from Exhibit 7-7: 0.75 × $250,000; 0.25 × $250,000.
[b]Allocation of maintenance based on ratios from Exhibit 7-7: 0.50 × $160,000; 0.50 × $160,000.

Sequential Method of Allocation

The **sequential (or step) method** of allocation recognizes that interactions among the support departments do occur. However, the sequential method does not fully recognize support department interaction. Cost allocations are performed in step-down fashion, following a predetermined ranking procedure. This ranking can be performed in various ways. For example, a company could rank the support departments in order of the percentage of service they render to other support departments. Usually, however, the sequence is defined by ranking the support departments in order of the amount of

service rendered, from the greatest to the least. Degree of support service is usually measured by the direct costs of each support department; the department with the highest cost is seen as rendering the greatest service.

Exhibit 7-9, on the following page, illustrates the sequential method. First, the support departments are ranked, usually in accordance with direct costs; here power is first, then maintenance. Next, power costs are allocated to maintenance and the two producing departments. Then, the costs of maintenance are allocated only to producing departments.

The costs of the support department rendering the greatest support service are allocated first. They are distributed to all support departments below it in the sequence and to all producing departments. Then, the costs of the support department next in sequence are similarly allocated, and so on. In the sequential method, once a support department's costs are allocated, it never receives a subsequent allocation from another support department. In other words, costs of a support department are never allocated to support departments *above* it in the sequence. Also note that the costs allocated from a support department are its direct costs *plus* any costs it receives in allocations from other support departments. The direct costs of a department are those that are directly traceable to the department.

To illustrate the sequential method, consider the data provided in Exhibit 7-7. Using cost as a measure of service, the support department rendering more service is power. Thus, its costs will be allocated first, followed by those for maintenance. The allocation ratios shown in Exhibit 7-7 will be used to execute the allocation. Note that the allocation ratios for the maintenance department ignore the usage by the power department, since its costs cannot be allocated to a support department above it in the allocation sequence.

The allocations obtained with the sequential method are shown in Exhibit 7-10 on page 293. Notice that $50,000 of the power department's costs are allocated to the maintenance department. This reflects the fact that the maintenance department uses 20 percent of the power department's output. As a result, the cost of operating the maintenance department increases from $160,000 to $210,000. Also notice that when the costs of the maintenance department are allocated, no costs are allocated back to the power department, even though it uses 1,000 hours of the output of the maintenance department.

The sequential method may be more accurate than the direct method because it recognizes some interactions among the support departments. It does not recognize all interactions, however; no maintenance costs were assigned to the power department even though it used 10 percent of the maintenance department's output. The reciprocal method corrects this deficiency.

Reciprocal Method of Allocation

The **reciprocal method** of allocation recognizes all interactions of support departments. Under the reciprocal method, the usage of one support department by another is used to determine the total cost of each support department, where the total cost reflects interactions among the support departments. Then, the new total of support department costs is allocated to the producing departments. This method fully accounts for support department interaction.

Total Cost of Support Departments

To determine the total cost of a support department so that this total cost reflects interactions with other support departments, a system of simultaneous linear equations must be solved. Each equation, which is a cost equation for a support department, is the sum of the department's direct costs plus the proportion of service received from other support departments.

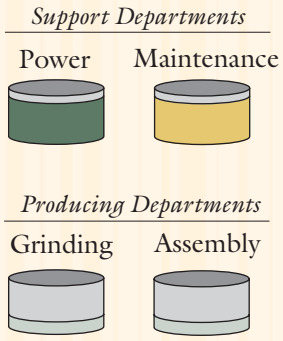
$$\text{Total cost} = \text{Direct costs} + \text{Allocated costs}$$

The method is best described using an example. The same data used to illustrate the direct and sequential methods will be used to illustrate the reciprocal method in

EXHIBIT 7-9 Allocation of Support Department Costs to Producing Departments Using the Sequential Method

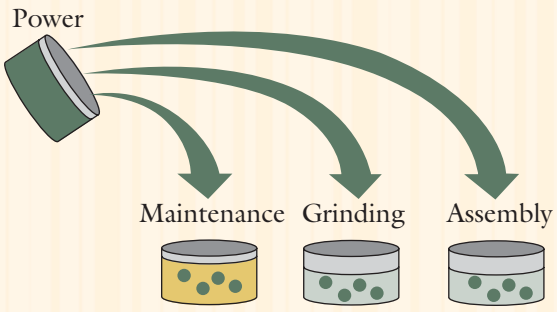
Suppose there are two support departments, power and maintenance, and two producing departments, grinding and assembly, each with a "bucket" of directly traceable overhead cost.

Objective: Distribute all power and maintenance costs to grinding and assembly using the sequential method.

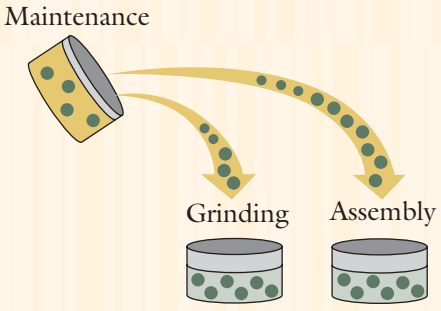


Step 1: Rank support departments—#1 power, #2 maintenance.

Step 2: Distribute power to maintenance, grinding, and assembly.



Then, distribute maintenance to grinding and assembly.



After allocation—Zero cost in power and maintenance; all overhead cost in grinding and assembly.

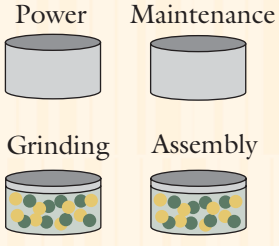


EXHIBIT 7-10 Sequential Allocation Illustrated

	Support Departments		Producing Departments	
	Power	Maintenance	Grinding	Assembly
Direct costs	$ 250,000	$ 160,000	$100,000	$ 60,000
Power[a]	(250,000)	50,000	150,000	50,000
Maintenance[b]	—	(210,000)	105,000	105,000
Total	$ 0	$ 0	$355,000	$215,000

[a]Allocation of power based on ratios from Exhibit 7-7: 0.20 × $250,000; 0.60 × $250,000; 0.20 × $250,000.
[b]Allocation of maintenance costs based on ratios from Exhibit 7-7: 0.50 × $210,000; 0.50 × $210,000.

EXHIBIT 7-11 Data for Illustrating Reciprocal Method

	Support Departments		Producing Departments	
	Power	Maintenance	Grinding	Assembly
Direct costs:*				
Fixed	$200,000	$100,000	$ 80,000	$50,000
Variable	50,000	60,000	20,000	10,000
Total	$250,000	$160,000	$100,000	$60,000
Normal activity:				
Kilowatt-hours	—	200,000	600,000	200,000
Maintenance hours	1,000	—	4,500	4,500

	Proportion of Output Used by			
	Power	Maintenance	Grinding	Assembly
Allocation ratios:				
Power	—	0.20	0.60	0.20
Maintenance	0.10	—	0.45	0.45

*For a producing department, direct costs are defined as overhead costs that are directly traceable to the department.

Exhibit 7-11. The allocation ratios needed for the simultaneous equations are interpreted as follows: maintenance receives 20 percent of power's output, and power receives 10 percent of maintenance's output.

Now let P equal the total cost of the power department and M equal the total cost of the maintenance department. As indicated previously, the total cost of a support department is the sum of its direct costs plus the proportion of service received from other support departments. Using the data and allocation ratios from Exhibit 7-11, the cost equation for each support department can be expressed as follows:

$$P = \text{Direct costs} + \text{Share of maintenance's cost} \quad (7.1)$$
$$= \$250{,}000 + 0.1M \text{ (maintenance's cost equation)}$$

$$M = \text{Direct costs} + \text{Share of power's costs} \quad (7.2)$$
$$= \$160{,}000 + 0.2P \text{ (power's cost equation)}$$

The direct-cost components of each equation are taken from Exhibit 7-11, as are the allocation ratios.

The power cost equation (Equation 7.1) and the maintenance cost equation (Equation 7.2) can be solved simultaneously to yield the total cost for each support department. Substituting Equation 7.1 into Equation 7.2 gives the following:

$$\begin{aligned} M &= \$160{,}000 + 0.2(\$250{,}000 + 0.1M) \\ M &= \$160{,}000 + \$50{,}000 + 0.02M \\ 0.98M &= \$210{,}000 \\ M &= \$214{,}286 \end{aligned}$$

Substituting this value for M into Equation 7.1 yields the total cost for power:

$$\begin{aligned} P &= \$250{,}000 + 0.1(\$214{,}286) \\ &= \$250{,}000 + \$21{,}429 \\ &= \$271{,}429 \end{aligned}$$

After the equations are solved, the total costs of each support department are known. These total costs, unlike the direct or sequential methods, reflect all interactions between support departments.

Allocation to Producing Departments

Once the total costs of each support department are known, the allocations to the producing departments can be made. These allocations, based on the proportion of output used by each producing department, are shown in Exhibit 7-12. Notice that the total costs allocated to the producing departments equal $410,000, the total direct costs of the two support departments ($250,000 + $160,000).

EXHIBIT 7-12 Reciprocal Allocation Illustrated

		Allocated to	
	Total Cost	Grinding[a]	Assembly[b]
Power	$271,429	$162,857	$ 54,285*
Maintenance	214,286	96,429	96,429
Total		$259,286	$150,714

[a]Power: 0.60 × $271,429; Maintenance: 0.45 × $214,286.
[b]Power: 0.20 × $271,429; Maintenance: 0.45 × $214,286.
*Rounded down.

Comparison of the Three Methods

Exhibit 7-13 gives the cost allocations from the power and maintenance departments to the grinding and assembly departments using the three support department cost allocation methods. How different are the results? Does it really matter which method is used? Depending on the degree of interaction of the support departments, the three allocation methods can give radically different results. In this particular example, the di-

EXHIBIT 7-13 **Comparison of Support Department Cost Allocations Using the Direct, Sequential, and Reciprocal Methods**

	Direct Method		Sequential Method		Reciprocal Method	
	Grinding	Assembly	Grinding	Assembly	Grinding	Assembly
Direct costs	$100,000	$ 60,000	$100,000	$ 60,000	$100,000	$ 60,000
Allocated from power	187,500	62,500	150,000	50,000	162,857	54,285
Allocated from maintenance	80,000	80,000	105,000	105,000	96,429	96,429
Total cost	$367,500	$202,500	$355,000	$215,000	$359,286	$210,714

rect method (as compared to the sequential method) allocated $12,500 more to the grinding department (and $12,500 less to the assembly department). Surely, the manager of the assembly department would prefer the direct method and the manager of the grinding department would prefer the sequential method. Because allocation methods do affect the cost responsibilities of managers, it is important for the accountant to understand the consequences of the different methods and to have good reasons for the eventual choice.

It is important to keep a cost-benefit perspective in choosing an allocation method. The accountant must weigh the advantages of better allocation against the increased cost using a more theoretically preferred method, such as the reciprocal method. For example, about 20 years ago, the controller for the IBM Poughkeepsie plant decided that the reciprocal method of cost allocation would do a better job of allocating support department costs. He identified over 700 support departments and solved the system of equations using a computer. Computationally, he had no problems. However, the producing department managers did not understand the reciprocal method. They were sure that extra cost was being allocated to their departments, but they were not sure just how. After months of meetings with the line managers, the controller threw in the towel and returned to the sequential method—which everyone did understand.

Another factor to be considered in allocating support department cost is the rapid change in technology. Many firms currently find that support department cost allocation is useful for them. However, the move toward activity-based costing and just-in-time manufacturing can virtually eliminate the need for support department cost allocation. In the case of the JIT factory with manufacturing cells, much of the service (e.g., maintenance, materials handling, and setups) is performed by cell workers. Allocation is not necessary.

OBJECTIVE 4

Calculate departmental overhead rates.

Departmental Overhead Rates and Product Costing

Upon allocating all support service costs to producing departments, an overhead rate can be computed for each department. This rate is computed by adding the allocated service costs to the overhead costs that are directly traceable to the producing department and dividing this total by some measure of activity, such as direct labor hours or machine hours.

For example, from Exhibit 7-10, the total overhead costs for the grinding department after allocation of support service costs are $355,000. Assume that machine hours are the base for assigning overhead costs to products passing through the grinding department and that the normal level of activity is 71,000 machine hours. The overhead rate for the grinding department is computed as follows:

$$\text{Overhead rate} = \$355{,}000/71{,}000 \text{ machine hours} = \$5 \text{ per machine hour}$$

Similarly, assume that the assembly department uses direct labor hours to assign its overhead. With a normal level of activity of 107,500 direct labor hours, the overhead rate for the assembly department is as follows:

$$\text{Overhead rate} = \$215{,}000/107{,}500 \text{ direct labor hours} = \$2 \text{ per direct labor hour}$$

Using these rates, the product's unit cost can be determined. To illustrate, suppose a product requires two machine hours of grinding per unit produced and one hour of assembly. The overhead cost assigned to one unit of this product would be \$12 [(2 × \$5) + (1 × \$2)]. If the same product uses \$15 of materials and \$6 of labor (totalled from grinding and assembly), then its unit cost is \$33 (\$12 + \$15 + \$6).

One might wonder, however, just how accurate this \$33 cost is. Is this amount really what it costs to produce the product in question? Since materials and labor are directly traceable to products, the accuracy of product costs depends largely on the accuracy of the assignment of overhead costs. This in turn depends on the degree of correlation between the factors used to allocate support service costs to departments and the factors used to allocate the department's overhead costs to the products. For example, if power costs are highly correlated with kilowatt-hours and machine hours are highly correlated with a product's consumption of the grinding department's overhead costs, then we can have some confidence that the \$5 overhead rate accurately assigns costs to individual products. However, if the allocation of support service costs to the grinding department or the use of machine hours is faulty—or both—then product costs will be distorted. The same reasoning can be applied to the assembly department. To ensure accurate product costs, great care should be used in identifying and using causal factors for both stages of overhead assignment. More will be said about this in a later chapter.

Accounting for Joint Production Processes

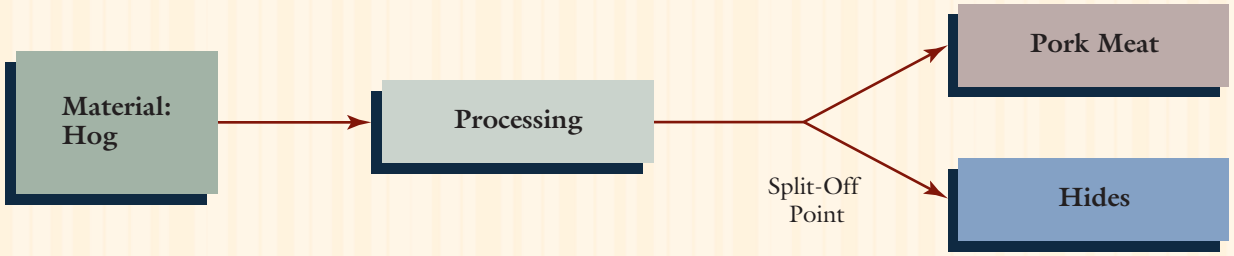
OBJECTIVE 5

Identify the characteristics of the joint production process, and allocate joint costs to products.

Joint products are two or more products produced simultaneously by the same process up to a "split-off" point. The **split-off point** is the point at which the joint products become separate and identifiable. For example, oil and natural gas are joint products. When a company drills for oil, it gets natural gas as well. As a result, the costs of exploration, acquisition of mineral rights, and drilling are incurred to the initial split-off point. Such costs are necessary to bring crude oil and natural gas out of the ground, and they are common costs to both products. Of course, some joint products may require processing beyond the split-off point. For example, crude oil can be processed further into aviation fuel, gasoline, kerosine, naptha, and other petrochemicals. The key point, however, is that the direct materials, direct labor, and overhead costs incurred up to the initial split-off point are joint costs that can be allocated to the final product only in some arbitrary manner. Joint products are so enmeshed that once the decision to produce has been made, management decision has little effect on the output, at least to the initial split-off point. Exhibit 7-14 depicts the joint production process. Exhibit 7-15 depicts the usual production process in which two products are manufactured independently from a common material. For example, a Taurus and a Mustang require steel, but the purchase of steel by **Ford Motor Company** does not require the manufacture of either model of car.

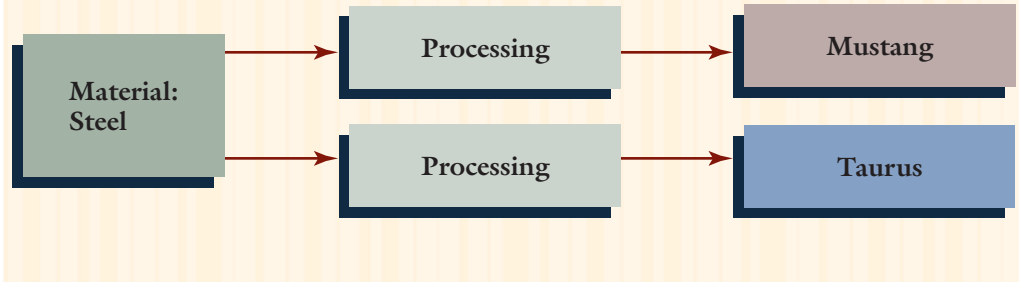
Joint products are related to each other such that an increase in the output of one increases the output of the others, although not necessarily in the same ratio. Up to the split-off point, you cannot get more of one product without getting more of the other(s). Whether considering the direct materials and conversion costs incurred prior to the initial split-off point as depicted in Exhibit 7-14, or the costs of heat, fuel, and

EXHIBIT 7-14 Joint Production Process



depreciation incurred in the type of multiple-product production depicted in Exhibit 7-15, one characteristic stands out. They are all indirect costs in the sense that allocation among the various products is necessary: that is, such costs cannot be traced directly to the ultimate products they benefit.

EXHIBIT 7-15 Independent Multiple-Product Production Using the Same Material



Cost Separability and the Need for Allocation

Costs are either separable or not. **Separable costs** are easily traced to individual products and offer no particular problem. If not separable, they must be allocated to various products for various reasons. Cost allocations are arbitrary. That is, there is no well-accepted theoretical way to determine which product incurs what part of the joint cost. In reality, all joint products benefit from the entire joint cost. The objective in joint cost allocation is to determine the most appropriate way to allocate a cost that is not really separable.The primary reason for joint cost allocation is that financial reporting (GAAP) and federal income tax law require it. In addition, these product costs are somewhat useful in calculating the cost of special lots or orders including government cost-type contracts and in justifying prices for legislative or administrative regulations. It is important to note that the allocation of joint costs is not appropriate for certain types of management decisions. The impact of joint costs on decision making is reserved for Chapter 18.

There are two important differences between costs incurred up to the split-off point in joint product situations and those indirect costs incurred for products that are produced independently. First, certain costs such as direct materials and direct labor, which are directly traceable to products when two or more products are separately produced,

become indirect and indivisible when used prior to the split-off point to produce joint products. For example, if ore contains both iron and zinc, the direct material itself is a joint product. Since neither zinc nor iron can be produced alone prior to the split-off point, the related processing costs of mining, crushing, and splitting the ore are also joint costs. Second, manufacturing overhead becomes even more indirect in joint product situations. Consider the purchase of pineapples. A pineapple, in and of itself, is not a joint product. However, when pineapples are purchased for canning, the initial processing or trimming of the fruit results in a variety of products (skin for animal feed, trimmed core for further slicing and dicing, and juice). The processing (conversion) costs to the point of split-off, as well as the cost of the original pineapples, are mutually beneficial to all products produced to that point. Both of these phenomena are caused either because the material itself is a joint product or because processing results in the simultaneous output of more than one product. Or the differences could be due to some combination of both. As a result, joint processing may limit the extent to which activity drivers in an activity-based costing system can effectively indicate a cause-and-effect relationship between overhead costs and joint products.

Distinction and Similarity between Joint Products and By-Products

The distinction between joint products and by-products rests solely on the relative importance of their sales value. A **by-product** is a secondary product recovered in the course of manufacturing a primary product. It is a product whose total sales value is relatively minor in comparison with the sales value of the main product(s). This is not a sharp distinction, but rather one of degree. Thus, the first distinction that a manufacturer must make is whether the operation is characterized by joint production. Then any by-products must be distinguished from main or joint products. By-products can be characterized by their relationship to the main products in the following manner:

1. By-product resulting from scrap, trimmings, and so forth, of the main products in essentially nonjoint product types of undertakings (e.g., fabric trimmings from clothing pieces)
2. Scrap and other residue from essentially joint product types of processes (e.g., fat trimmed from beef carcasses)
3. A minor joint product situation (fruit skins and trimmings used as animal feed)

Relationships between joint products and by-products change, as do the classes of products within each of these classifications. When the relative importance of the individual products changes, the products need to be reclassified and the costing procedures changed. In fact, many by-products began as waste materials, became economically significant (and thus become by-products), and grow in importance to finally become full-fledged joint products. For example, sawdust and chips in sawmill operations were originally waste, but over the years, they have gained value as a major component of particle board. The various methods of accounting for by-products reflect this development. Generally, accounting for by-products began as an extension of accounting for waste material. Revenue from the sale of the by-products is recorded as separate income, when the amount of income is so small that it has little impact on either overall cost or sales. As the value of by-product revenues becomes more significant, the cost of the main product is reduced by recoveries, and finally the by-products achieve near main product status and are allocated a share of the joint cost incurred prior to split-off.

There are a number of ways to account for by-products. Typically, joint costs are not allocated to by-products because the products themselves are considered to be immaterial. Instead, revenue for the sale of the by-product is accounted for as "revenue from by-products" or as "other income." Any further processing costs needed (beyond the split-off point) are deducted from revenue. On occasion, net revenue from the sale of the by-product is accounted for as a deduction from the cost of goods sold of the joint products.

Accounting for Joint Product Costs

The accounting for overall joint costs of production (direct materials, direct labor, and overhead) is no different from the accounting for product costs in general. It is the *allocation* of joint costs to the individual products that is the source of difficulty. Still, the allocation must be done for financial reporting purposes—to value inventory carried on the balance sheet and to determine income. Thus, an allocation method must be found that, though arbitrary, allocates the costs on as reasonable a basis as possible. Because judgment is involved, equally competent accountants can arrive at different costs for the same product. There are a variety of methods for allocating joint costs. These methods include the physical units method, the weighted average method, the sales-value-at-split-off method, the net realizable value method, and the constant gross margin percentage method. These are covered in the following sections.

Physical Units Method

Under the **physical units method**, joint costs are distributed to products on the basis of some physical measure. These physical measures may be expressed in units such as pounds, tons, gallons, board feet, atomic weight, or heat units. If the joint products do not share the same physical measure (e.g., one product is measured in gallons, another in pounds), some common denominator may be used. For example, a producer of fuels may take gallons, barrels, and tons and convert each one into BTUs (British thermal units) of energy.

Computationally, the physical units method allocates to each joint product the same proportion of joint cost as the underlying proportion of units. So, if a joint process yields 300 pounds of Product A and 700 pounds of Product B, Product A receives 30 percent of the joint cost and Product B receives 70 percent. An alternative computation is to divide total joint costs by total output to find an average unit cost. The average unit cost is then multiplied by the number of units of each product. Although the method is not wholly satisfactory, it has a measure of logic behind it. Since all products are manufactured by the same process, it is impossible to say that one costs more per unit to produce than the other.

For example, suppose that a sawmill processes logs into four grades of lumber totaling 3,000,000 board feet as follows.

Grades	*Board Feet*
First and second	450,000
No. 1 common	1,200,000
No. 2 common	600,000
No. 3 common	750,000
Total	3,000,000

Total joint cost is $186,000. Using the physical units method, how much joint cost is allocated to each grade of lumber? First, we find the proportion of the total units for each grade; then, we assign each grade its proportion of joint cost.

Grades	*Board Feet*	*Percent of Units*	*Joint Cost Allocation*
First and second	450,000	0.15	$ 27,900
No. 1 common	1,200,000	0.40	74,400
No. 2 common	600,000	0.20	37,200
No. 3 common	750,000	0.25	46,500
Totals	3,000,000		$186,000

We could also calculate the average unit cost of $0.062 ($186,000/3,000,000) and multiply it by the board feet for each grade.

For example, manufacturers of forest products may add the average cost of logs entering the mill to the average conversion cost to arrive at an average finished product cost. This cost is applied to all finished products, no matter their type, grade, or market value. This method serves the purpose of product costing.

The physical units method may be used in any industry that processes joint products of differing grades (e.g., flour milling, tobacco, and lumber). However, a disadvantage of the physical units method is that high profits may be reflected from the sale of the high grades, with low profits or losses reflected on the sale of lower grades. This may result in incorrect managerial decisions if the data are not properly interpreted.

The physical units method presumes that each unit of material in the final product costs just as much to produce as any other. This is especially true where the dominant element can be traced to the product. Many feel this method often is unsatisfactory because it ignores the fact that not all costs are directly related to physical quantities. Also, the product might not have been handled at all if it had been physically separable before the split-off point from the part desired.

Weighted Average Method

In an attempt to overcome the difficulties encountered under the physical units method, weight factors can be assigned. These weight factors may include such diverse elements as amount of material used, difficulty to manufacture, time consumed, difference in type of labor used, and size of unit. These factors and their relative weights are usually combined in a single value, which we might call the **weight factor**. In the canning industry, the weight factor is used in the calculation of a basic case.

An example of the use of weight factors is found in the canning industry.[3] One type of weight factor is used to convert different-size cases of peaches into a uniform size for purposes of allocating joint costs to each case. Thus, if a basic case contains 24 cans of peaches in size 2½ cans, that case is assigned a weight factor of 1.0. A case with 24 cans in size 303 (a can roughly half the size 2½ can) receives a weight of 0.57, and so on. Once all types of cases have been converted into basic cases using the weight factors, joint costs can be allocated according to the physical units method. Peaches can also be assigned weight factors according to grade (e.g., fancy, choice, standard, and pie). If the standard grade is weighted at 1.00, then the better grades are weighted more heavily and the pie grade less heavily.

For example, suppose that a peach-canning factory purchases $5,000 of peaches; grades them into fancy, choice, standard, and pie quality; and then cans each grade. The following data on grade, number of cases, and weight factor apply.

Grades	*Number of Cases*	*Weight Factor*	*Weighted Number of Cases*	*Percent*	*Allocated Joint Cost*
Fancy	100	1.30	130	0.21667	$1,083
Choice	120	1.10	132	0.22000	1,100
Standard	303	1.00	303	0.50500	2,525
Pie	70	0.50	35	0.05833	292
			600		$5,000

By multiplying the number of cases by the weight factor, we obtain the weighted number of cases. Then, the physical units method can be applied as the percentage of weighted

3. The peach-canning example is adapted from K. E. Jankowski, "Cost and Sales Control in the Canning Industry," *N.A.C.A. Bulletin* 36 (November 1954): 376.

cases for each grade is obtained and multiplied by the joint cost to yield the allocated joint cost. The effect is to allocate relatively more of the joint cost to the fancy and choice grades because they represent more desirable peaches. The pie grade peaches, the good bits and pieces from bruised peaches, are relatively less desirable and are assigned a lower weight.

Frequently, weight factors are predetermined and set up as part of either an estimated cost or a standard cost system. The use of carefully constructed weight factors enables the cost accountant to give more attention to several influences and, therefore, results in more reasonable allocations. The real danger, of course, is that weights may be used that are either inappropriate in the first place or become so through the passage of time. Obviously, if arbitrary rates are used, the resulting costs of individual products will be arbitrary.

Allocation Based on Relative Market Value

Many accountants believe that joint costs should be allocated to individual products according to their ability to absorb joint costs. The advantage of this approach is that joint cost allocation will not produce consistently profitable or unprofitable items. The rationale for using ability to bear is the assumption that costs would not be incurred unless the jointly produced products together would yield enough revenue to cover all costs plus a reasonable return. The reverse also would be consistent with this theory; that is, a derived cost that the purchaser of materials and other joint costs is willing to incur for any individual product could be obtained by relating costs to sales values. On the other hand, fluctuations in the market value of any one or more of the end products automatically change the apportionment of the joint costs, though actually it costs no more or no less to produce than before.

The relative market value approach to joint cost allocation is better than the physical units approach if two conditions hold: (1) the physical mix of output can be altered by incurring more (less) total joint costs and (2) this alteration produces more (less) total market value.[4] Several variants of the relative market value method are found in practice.

Sales-Value-at-Split-Off Method

The **sales-value-at-split-off method** allocates joint cost based on each product's proportionate share of market or sales value at the split-off point. Under this method, the higher the market value, the greater the share of joint cost charged against the product. As long as the prices at split-off are stable, or the fluctuations in prices of the various products are synchronized (not necessarily in amount, but in the rate of change), their respective allocated costs remain constant.

Using the same example of lumber mill costs given in the preceding discussion of the physical units method, the joint cost of $186,000 is distributed to the various grades on the basis of their market value at split-off.

Grades	*Quantity Produced (board ft.)*	*Price at Split-Off (per 1,000 board ft.)*	*Sales Value at Split-Off*	*Percent of Total Market Value*	*Allocated Joint Cost*
First and second	450,000	$300	$135,000	0.2699	$ 50,201
No. 1 common	1,200,000	200	240,000	0.4799	89,261
No. 2 common	600,000	121	72,600	0.1452	27,007
No. 3 common	750,000	70	52,500	0.1050	19,530
Totals	3,000,000		$500,100		$185,999*

*Does not sum to $186,000 due to rounding.

4. William Cats-Baril, James F. Gatti, and D. Jacque Grinnell, "Joint Product Costing in the Semiconductor Industry," *Management Accounting* (February 1986): 29.

Note that the joint cost is allocated in proportion to sales value at the split-off point. No. 1 common, for example, is valued at $240,000 at split-off, and that amount is 47.99 percent of the total sales value. Therefore, 47.99 percent of total joint cost is assigned to the No. 1 common grade.

The sales-value-at-split-off method can be approximated through the use of weighting factors based on price. The advantage is that the price-based weights do not change as market prices do. An example of this method is found in the glue industry. Material is put into process in the cooking department. The products resulting from the cooking operations are the several "runs of glue." The first run is of the highest grade, has the highest market value, and costs the least. Successive runs require higher temperatures, cost more, and produce lower grades of products. Glue factories do not attempt to determine the actual cost of each skimming because the effect would be to show the lowest cost on the first grade of product and the highest cost on the lowest grade. Instead, the cost of all glue produced is determined, and this total cost is spread over the various grades on the basis of their respective tests of purity. The relative degree of purity is an indicator of the quality and, therefore, of the market value of each run or grade produced. Hence, multiplying the yield for each run by its relative purity is equivalent to multiplying it by the market value. The amounts weighted by purity are used to allocate the joint costs to each run. Additional runs would be undertaken, of course, only as long as the incremental revenue of the additional run is equal to or exceeds the incremental costs incurred.

The weighting factor based on market value at split-off is conceptually the same as the weighting factor method under physical units. However, in this case, the weighting factor is based on sales value, while the weighting factor described in the physical units section could be based on various other considerations such as processing difficulty, size, and so on. These other considerations may or may not be related to market value.

Net Realizable Value Method

When market value is used to allocate joint costs, we are talking about market value *at the split-off point*. However, on occasion, there is no ready market price for the individual products at the split-off point. In this case, the net realizable value method can be used. First, we obtain a **hypothetical sales value** for each joint product by subtracting all separable (or further) processing costs from the eventual market value. This approximates the sales value at split-off. Then, the **net realizable value method** can be used to prorate the joint costs based on each product's share of hypothetical sales value.

Suppose that a company manufactures two products, Alpha and Beta, from a joint process. One production run costs $5,750 and results in 1,000 gallons of Alpha and 3,000 gallons of Beta. Neither product is salable at split-off, but must be further processed such that the separable cost for Alpha is $1 per gallon and for Beta is $2 per gallon. The eventual market price for Alpha is $5 and for Beta, $4. Joint cost allocation using the net realizable value method is as follows:

	Market Price	*Further Processing Cost*	*Hypothetical Market Price*	*Number of Units*	*Hypothetical Market Value*	*Allocated Joint Cost*
Alpha	$5	$1	$4	1,000	$ 4,000	$2,300
Beta	4	2	2	3,000	6,000	3,450
					$10,000	$5,750

Note that joint cost is allocated on the basis of each product's share of hypothetical market value. Thus, Alpha receives 40 percent of the joint cost ($2,300) because it accounts for 40 percent of the hypothetical market value. The net realizable value method is particularly useful when one or more products cannot be sold at the split-off point but must be processed further.

Constant Gross Margin Percentage Method

The net realizable value method is easy to apply. However, it assigns all profit to the hypothetical market value. In other words, the further processing costs are assumed to have no profit value even though they are critical to selling the products. The **constant gross margin percentage method** corrects for this by recognizing that costs incurred after the split-off point are part of the cost total on which profit is expected to be earned, and it allocates joint cost such that the gross margin percentage is the same for each product.

Using the data for Alpha and Beta, we can allocate the $5,750 joint cost using the constant gross margin percentage method. First, total revenues and costs are calculated to determine overall gross margin and the gross margin percentage. Then, revenues for the individual products are adjusted for gross margin, separable costs are deducted, and the resulting figure is the allocated joint cost.

		Percent
Revenue [($5 × 1,000) + ($4 × 3,000)]	$17,000	100%
Costs [$5,750 + ($1 × 1,000) + ($2 × 3,000)]	12,750	75
Gross margin	$ 4,250	25%

	Alpha	*Beta*
Eventual market value	$5,000	$12,000
Less: Gross margin at 25% of market value	1,250	3,000
Cost of goods sold	$3,750	$ 9,000
Less: Separable costs	1,000	6,000
Allocated joint costs	$2,750	$ 3,000

The constant gross margin percentage method allocates more joint cost to Alpha than did the net realizable value method. This is due to the assumption of a relationship between cost and the cost-created value. That is, the net realizable value assumed no gross margin attributable to further processing costs, while the constant gross margin percentage method assumed not only that further processing yields profit but also that it yields an identical profit percentage across products. Which assumption is correct? There are two important questions: first, whether there is a "direct relationship" between cost and value and, second, whether the relationship is necessarily the same for all products jointly produced before and after the split-off point. The practice of product-line pricing to meet competition tends to make such assumptions invalid. Although exceptions exist, many companies do not try to maintain more-or-less equal margins between prices and full costs on their various products.

SUMMARY

Producing departments create the products or services that the firm is in business to manufacture and sell. Support departments serve producing departments but do not themselves create a salable product. Because support departments exist to support a variety of producing departments, the costs of the support departments are common to all producing departments and must be allocated to them to satisfy a number of important objectives. These objectives include inventory valuation, product-line profitability, pricing, and planning and control. Allocation can also be used to encourage favorable managerial behavior.

When the costs of one support department are allocated to other departments, a charging rate must be developed. A single rate combines variable and fixed costs of the support department to generate a charging rate. A dual rate separates the fixed and variable costs. Fixed support department costs are allocated on the basis of original capacity, and a variable rate is developed on the basis of budgeted usage.

Budgeted costs, not actual costs, should be allocated so that the efficiencies or inefficiencies of the support departments themselves are not passed on to the producing departments. Because the causal factors can differ for fixed and variable costs, these types of cost should be allocated separately.

Three methods can be used to allocate support service costs to producing departments: the direct method, the sequential method, and the reciprocal method. These methods differ in the degree of support department interaction considered. By noting support department interactions, more accurate product costing is achieved. The result can be improved planning, control, and decision making. Two methods of allocation recognize interactions among support departments: the sequential (or step) method and the reciprocal method. These methods allocate support service costs among some (or all) interacting support departments before allocating costs to the producing departments.

Departmental overhead rates are calculated by adding direct departmental overhead costs to those costs allocated from the support departments and dividing the sum by the budgeted departmental base.

Joint production processes result in the output of two or more products which are produced simultaneously. Joint or main products have relatively significant sales value. By-products have relatively less significant sales value. Joint costs must be allocated to the individual products for purposes of financial reporting. Several methods have been developed to allocate joint costs. These include the physical units method, the weighted average method, the sales-value-at-split-off method, the net realizable value method, and the constant gross margin method.

Typically, by-products are not allocated any of the joint product costs. Instead, by-product sales are listed as "Other income" on the income statement, or they are treated as a credit to Work In Process of the main product(s).

Joint cost allocation may interfere with management decision making because the joint costs must be incurred to produce all of the products. Thus, allocated costs are not useful for output and pricing decisions. Further processing costs, or separable costs, are used in management decision making.

The arbitrary nature of joint cost allocation has led to a dizzying array of accounting methods. These methods are meant to respond to each company's individual circumstances. A few of the more widely used methods have been covered in this chapter.

REVIEW PROBLEMS AND SOLUTIONS

1 Allocation: Direct, Sequential, and Reciprocal Methods

Antioch Manufacturing produces machine parts on a job-order basis. Most business is obtained through bidding. Most firms competing with Antioch bid full cost plus a 20 percent markup. Recently, with the expectation of gaining more sales, Antioch reduced its markup from 25 percent to 20 percent. The company operates two service departments and two producing departments. The budgeted costs and the normal activity levels for each department are as follows:

	Service Departments		*Producing Departments*	
	A	*B*	*C*	*D*
Overhead costs	$100,000	$200,000	$100,000	$50,000
Number of employees	8	7	30	30
Maintenance hours	2,000	200	6,400	1,600
Machine hours	—	—	10,000	1,000
Labor hours	—	—	1,000	10,000

The direct costs of department A are allocated on the basis of employees; those of department B are allocated on the basis of maintenance hours. Departmental overhead rates are used to assign costs to products. Department C uses machine hours, and department D uses labor hours.

The firm is preparing to bid on a job (Job K) that requires three machine hours per unit produced in department C and no time in department D. The expected prime costs per unit are $67.

Required:

1. Allocate the service costs to the producing departments using the direct method.
2. What will the bid be for Job K if the direct method of allocation is used?
3. Allocate the service costs to the producing departments using the sequential method.
4. What will the bid be for Job K if the sequential method is used?
5. Allocate the service costs to the producing departments using the reciprocal method.
6. What will the bid be for Job K if the reciprocal method is used?

SOLUTION

1.

	Service Departments		*Producing Departments*	
	A	*B*	*C*	*D*
Direct costs	$ 100,000	$ 200,000	$100,000	$ 50,000
Department A[a]	(100,000)	—	50,000	50,000
Department B[b]	—	(200,000)	160,000	40,000
Total	$ 0	$ 0	$310,000	$140,000

[a]Department A costs are allocated on the basis of the number of employees in the producing departments, departments C and D. The percentage of department A cost allocated to department C = 30/(30 + 30) = 0.50. Cost of department A allocated to department C = 0.50 × $100,000 = $50,000. The percentage of department A cost allocated to department D = 30/(30 + 30) = 0.50. Cost of department A allocated to department D = 0.50 × $100,000 = $50,000.

[b]Department B costs are allocated on the basis of maintenance hours used in the producing departments, departments C and D. The percentage of department B cost allocated to department C = 6,400/(6,400 + 1,600) = 0.80. Cost of department B allocated to department C = 0.80 × $200,000 = $160,000. The percentage of department B cost allocated to department D = 1,600/(6,400 + 1,600) = 0.20. Cost of department B allocated to department D = 0.20 × $200,000 = $40,000.

2. Department C: Overhead rate = $310,000/10,000 = $31 per machine hour. Product cost and bid price:

Prime cost	$ 67
Overhead (3 × $31)	93
Total unit cost	$160
Bid price ($160 × 1.2)	$192

3.

	Service Departments		*Producing Departments*	
	A	*B*	*C*	*D*
Direct costs	$ 100,000	$ 200,000	$100,000	$ 50,000
Department B[a]	40,000	(200,000)	128,000	32,000
Department A[b]	(140,000)	—	70,000	70,000
Total	$ 0	$ 0	$298,000	$152,000

[a]Department B is ranked first because its direct costs are higher than those of department A. Department B costs are allocated on the basis of maintenance hours used in the lower ranking support department, department A, and the producing departments, departments C and D. The percentage of department B cost allocated to department A = 2,000/(2,000 + 6,400 + 1,600) = 0.20. Cost of department B allocated to department A = 0.20 × $200,000 = $40,000. The percentage of department B cost allocated to department C = 6,400/(2,000 + 6,400 + 1,600) = 0.64. Cost of department B allocated to department C = 0.64 × $200,000 = $128,000. The percentage of department B cost allocated to department D = 1,600/(2,000 + 6,400 + 1,600) = 0.16. Cost of department B allocated to department D = 0.16 × $200,000 = $32,000.

[b]Department A costs are allocated on the basis of number of employees in the producing departments, departments C and D. The percentage of department A cost allocated to department C = 30/(30 + 30) = 0.50. Cost of department A allocated to department C = 0.50 × $140,000 = $70,000. The percentage of department A cost allocated to department D = 30/(30 + 30) = 0.50. Cost of department A allocated to department D = 0.50 × $140,000 = $70,000. (*Note:* Department A cost is no longer $100,000. It is $140,000 due to the $40,000 that was allocated from department B.)

4. Department C: Overhead rate = $298,000/10,000 = $29.80 per machine hour. Product cost and bid price:

Prime cost	$ 67.00
Overhead (3 × $29.80)	89.40
Total unit cost	$156.40
Bid price ($156.40 × 1.2)	$187.68

5. Allocation ratios:

	Proportion of Output Used by			
	A	*B*	*C*	*D*
A	—	0.1045	0.44775	0.44775
B	0.2000	—	0.6400	0.1600

$$A = \$100{,}000 + 0.2000B$$
$$B = \$200{,}000 + 0.1045A$$
$$A = \$100{,}000 + 0.2(\$200{,}000 + 0.1045A)$$
$$A = \$100{,}000 + \$40{,}000 + 0.0209A$$
$$0.9791A = \$140{,}000$$
$$A = \$142{,}988$$
$$B = \$200{,}000 + 0.1045(\$142{,}988)$$
$$B = \$214{,}942$$

	Service Departments		*Producing Departments*	
	A	*B*	*C*	*D*
Direct costs	$ 100,000	$ 200,000	$100,000	$ 50,000
Department B	42,988	(214,942)	137,563	34,391
Department A	(142,988)	14,942	64,023	64,023
Total	$ (0)	$ 0	$301,586	$148,414

6. Department C: Overhead rate = $301,586/10,000 = $30.16 per machine hour. Product cost and bid price:

Prime cost	$ 67.00
Overhead (3 × $30.16)	90.48
Total unit cost	$157.48
Bid price ($157.48 × 1.2)	$188.98

2 Joint Cost Allocation, Further Processing

Sanders Pharmaceutical Company purchases a material which is then processed to yield three chemicals: anarol, estyl, and betryl. In June, Sanders purchased 10,000 gallons of the material at a cost of $250,000, and the company incurred joint conversion costs of $70,000. June sales and production information are as follows:

	Gallons Produced	*Price at Split-Off*	*Further Processing Cost per Gallon*	*Eventual Sales Price*
Anarol	2,000	$55	—	—
Estyl	3,000	40	—	—
Betryl	5,000	30	$5	$60

Anarol and estyl are sold to other pharmaceutical companies at the split-off point. Betryl can be sold at the split-off point or processed further and packaged for sale as an asthma medication.

Required:

1. Allocate the joint costs to the three products using the physical units method, the sales-value-at-split-off method, the net realizable value method, and the constant gross margin percentage method.
2. Suppose that half of June's production of estyl could be purified and mixed with all of the anarol to produce a veterinary grade anesthetic. All further processing costs amount to $35,000. The selling price for the veterinary grade anarol is $112 per gallon. Should Sanders further process the estyl into the anarol anesthetic?

SOLUTION

1. Total joint cost to be allocated = $250,000 + $70,000 = $320,000

Physical Units Method:

	Gallons Produced	*Percent of Gallons Produced*	×	*Joint Cost*	*Joint Cost Allocation*
Anarol	2,000	(2,000/10,000) = 0.20		$320,000	$ 64,000
Estyl	3,000	(3,000/10,000) = 0.30		320,000	96,000
Betryl	5,000	(5,000/10,000) = 0.50		320,000	160,000
Total	10,000				$320,000

Sales-Value-at-Split-Off Method:

	Gallons Produced	*Price at Split-Off*	*Revenue at Split-Off*	*Percent of Revenue*	×	*Joint Cost*	*Joint Cost Allocation*
Anarol	2,000	$55	$110,000	0.28947		$320,000	$ 92,630
Estyl	3,000	40	120,000	0.31579		320,000	101,053
Betryl	5,000	30	150,000	0.39474		320,000	126,317
Total			$380,000				$320,000

Net Realizable Value Method:

Step 1: Determine hypothetical sales revenue.

	Eventual Price	−	*Further Processing Cost per Gallon*	=	*Hypothetical Sales Price*	× *Gallons*	= *Hypothetical Revenue*
Anarol	$55		—		$55	2,000	$110,000
Estyl	40		—		40	3,000	120,000
Betryl	60		$5		55	5,000	275,000
Total							$505,000

Step 2: Allocate joint cost as a proportion of hypothetical sales revenue.

	Hypothetical Sales Revenue	*Percent*	×	*Joint Cost*	=	*Joint Cost Allocation*
Anarol	$110,000	0.21782		$320,000		$ 69,702
Estyl	120,000	0.23762		320,000		76,039*
Betryl	275,000	0.54456*		320,000		174,259
Total margin	$505,000					$320,000

*Rounded up.

Constant Gross Margin Percentage Method:

	Dollars	*Percent*
Revenue [($55 × 2,000) + ($40 × 3,000) + ($60 × 5,000)]	$530,000	100.00%
Costs [$320,000 + ($5 × 5,000)]	345,000	65.09
Gross margin	$185,000	34.91%

	Anarol	*Estyl*	*Betryl*
Eventual market value	$110,000	$120,000	$300,000
Less: Gross margin at 34.91%	38,401	41,892	104,730
Cost of goods sold	$ 71,599	$ 78,108	$195,270
Less: Separable costs	—	—	(25,000)
Joint cost allocation	$ 71,599	$ 78,108	$170,270

Note: $71,599 + $78,108 + $170,270 = $319,977; there is a rounding error of $23.

2. Joint costs are irrelevant to this decision. Instead, further processing costs and the opportunity cost of lost contribution margin on the estyl diverted to anarol purification must be considered.

Added revenue ($112 − $55)(2,000)	$114,000
Less: Further processing of anarol mixture	(35,000)
Less: Lost contribution margin on estyl (1,500 × $40)	(60,000)
Increased operating income	$ 19,000

KEY TERMS

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QUESTIONS FOR WRITING AND DISCUSSION

1. Describe the two-stage allocation process for assigning support service costs to products in a traditional manufacturing environment.
2. Why must support service costs be assigned to products for purposes of inventory valuation?
3. Explain how allocation of support service costs is useful for planning and control and in making pricing decisions.
4. Assume that a company has decided not to allocate any support service costs to producing departments. Describe the likely behavior of the managers of the producing departments. Would this be good or bad? Explain why allocation would correct this type of behavior.
5. Explain how allocating support service costs will encourage service departments to operate more efficiently.
6. Why is it important to identify and use causal factors to allocate support service costs?
7. Explain why it is better to allocate budgeted support service costs rather than actual support service costs.
8. Why is it desirable to allocate variable costs and fixed costs separately?
9. Explain why either normal or peak capacity of the producing (or user) departments should be used to allocate the fixed costs of support departments.
10. Explain why variable bases should not be used to allocate fixed costs.
11. Why is the dual-rate charging method better than the single-rate method? In what circumstances would it not matter whether dual or single rates were used?
12. Explain the difference between the direct method and the sequential method.
13. The reciprocal method of allocation is more accurate than either the direct or sequential methods. Do you agree or disagree? Explain.
14. What is a joint cost? How does it relate to by-products?
15. How do joint costs differ from other common costs?

EXERCISES

7-1 Classifying Departments as Producing or Support—Manufacturing Firm

LO1 Classify each of the following departments in a factory that produces crème-filled snack cakes as a producing department or a support department.

a. Janitorial
b. Baking
c. Inspection
d. Mixing
e. Engineering
f. Grounds
g. Purchasing
h. Packaging
i. Icing (frosts top of snack cakes and adds decorative squiggle)
j. Filling (injects crème mixture into baked snack cakes)
k. Personnel
l. Cafeteria
m. General factory
n. Machine maintenance
o. Bookkeeping

7-2 Classifying Departments as Producing or Support—Service Firm

LO1 Classify each of the following departments in a large metropolitan law firm as a producing department or a support department.

a. Copying
b. WESTLAW computer research
c. Tax planning
d. Environmental law
e. Oil and gas law
f. Custodians
g. Word processing
h. Corporate law
i. Small business law
j. Personnel

7-3 Identifying Causal Factors for Support Department Cost Allocation

LO1 Identify some possible causal factors for the following support departments:

a. Cafeteria
b. Custodial services
c. Laundry
d. Receiving, shipping, and stores
e. Maintenance
f. Personnel
g. Accounting
h. Power
i. Building and grounds

7-4 Objectives of Cost Allocation

LO1 Dr. Fred Poston, "Dermatologist to the Stars," has a practice in southern California. The practice includes three dermatologists, three medical assistants, an office manager, and a receptionist. The office space, which is rented for $5,000 per month, is large enough to accommodate four dermatologists, but Dr. Poston has not yet found the right physician to fill the fourth spot. Dr. Poston developed a skin cleanser for his patients that is nongreasy and does not irritate skin that is still recovering from the effects of chemical peels and dermabrasion. The cleanser requires $0.50 worth of ingredients

per 8-ounce bottle. A medical assistant mixes up several bottles at a time during lulls in her schedule. She waits until she has about 15 minutes free and then mixes 10 bottles of cleanser. She is paid $2,250 per month. Dr. Poston charges $5.00 per bottle and sells approximately 5,000 bottles annually. His accountant is considering various ways of costing the skin cleanser.

Required:

1. Give two reasons for allocating overhead cost to the cleanser. How should the cost of the office space and the medical assistant's salary be allocated to the cleanser? Explain.
2. Suppose that *Healthy You* magazine runs an article on Dr. Poston and his skin cleanser, which causes demand to skyrocket. Consumers across the country buy the cleanser via phone or mail order. Now, Dr. Poston believes that he can sell about 40,000 bottles annually. He can hire someone part time, for $1,000 per month, to mix and bottle the cleanser and to handle the financial business of the cleanser. An unused office and examining room can be dedicated to the production of the cleanser. Would your allocation choice for Requirement 1 change in this case? Explain.

7-5 Objectives of Allocation

LO1 Leanne and Janine are planning a trip to Padre Island, Texas, during spring break. Members of the varsity volleyball team, they are looking forward to five days of beach volleyball and parasailing. They will drive Leanne's car and estimate that they will pay the following costs during the trip:

Motel	$625
Food (each)	75
Gas (total)	50
Parasailing & equipment rental	125

They have reservations at the Beach-Vue Motel, which charges $95 per night for a single, $125 per night for a double, and an additional $20 per night if a rollaway bed is added to a double room.

Leanne's little sister, Cher, wants to go along. She isn't into sports but thinks that five days of partying and relaxing on the beach would be a great way to unwind from the rigors of school. She figures that she could ride with Leanne and Janine and share their room.

Required:

1. Using incremental costs only, what would it cost Cher to accompany Leanne and Janine?
2. Using the benefits-received method, what would it cost Cher to go on the trip?

7-6 Single and Dual Charging Rates

LO2 Barry Alexander owns a block of shops on a street just off Rodeo Drive. Of the 10 store spaces in the building, seven are rented by boutique owners, and three are vacant. Barry has decided that offering more services to stores in the mall would enable him to increase occupancy. He has decided to use one of the vacant spaces to provide, at cost, a gift-wrapping service to shops in the mall. The boutiques are enthusiastic about the new service. Most of them are staffed minimally, which means that every time they have to wrap a gift, phones go unanswered and other customers in line grow impatient. Barry figured that the gift-wrapping service would incur the following costs: The store space would normally rent for $2,000 per month; part-time gift wrappers could be hired for

$1,000 per month; and wrapping paper and ribbon would average $1.50 per gift. The boutique owners estimated the following number of gifts to be wrapped per month.

Store	*Number of Gifts Wrapped per Month*
The Paper Chase	175
Reservation Art	400
Kid-Sports	100
Sugar Shack	75
Designer Shoes	20
Boutique de Donatessa	130
Alan's Drug and Sundries	100

After the service had been in effect for six months, Barry calculated the following actual average monthly number of gifts wrapped for each of the stores.

Store	*Actual Average Number of Gifts Wrapped per Month*
The Paper Chase	170
Reservation Art	310
Kid-Sports	240
Sugar Shack	10
Designer Shoes	50
Boutique de Donatessa	200
Alan's Drug and Sundries	450

Required:

1. Calculate a single charging rate, on a per-gift basis, to be charged to the shops. Based on the shops' actual number of gifts wrapped, how much would be charged to each shop using the single charging rate?
2. Based on the shops' actual number of gifts wrapped, how much would be charged to each shop using the dual charging rate?
3. Which shops would prefer the single charging rate? Why? Which would prefer the dual charging rate, and why?
4. Several of the shop owners were angry about their bill for the gift-wrapping service. They pointed out that they were to be charged only for the cost of the service. How could you make a case for them?

7-7 Actual versus Budgeted Costs

LO2

Kumar, Inc., evaluates managers of producing departments on their ability to control costs. In addition to the costs directly traceable to their departments, each production manager is held responsible for a share of the costs of a support center, the human resources (HR) department. The total costs of HR are allocated on the basis of actual direct labor hours used. The total costs of HR and the actual direct labor hours worked by each producing department are as follows:

	Year 1	*Year 2*
Direct labor hours worked:		
Department A	24,000	25,000
Department B	36,000	25,000
Total hours	60,000	50,000
Actual HR cost	$120,000	$120,000
Budgeted HR cost	115,000*	112,500*

*$0.25 per direct labor hour plus $100,000.

Required:

1. Allocate the HR costs to each producing department for Year 1 and Year 2 using the direct method with actual direct labor hours and actual HR costs.
2. Discuss the following statement: "The costs of human resource-related matters increased by 25 percent for department A and decreased by over 16 percent for department B. Thus, the manager of department B must be controlling HR costs better than the manager of department A."
3. Can you think of a way to allocate HR costs so that a more reasonable and fair assessment of cost control can be made? Explain.

7-8 Fixed and Variable Cost Allocation

LO2

Refer to the data in **Exercise 7-7**. When the capacity of the HR department was originally established, the normal usage expected for each department was 20,000 direct labor hours. This usage is also the amount of activity planned for the two departments in Year 1 and Year 2.

Required:

1. Allocate the costs of the HR department using the direct method and assuming that the purpose is product costing.
2. Allocate the costs of the HR department using the direct method and assuming that the purpose is to evaluate performance.

7-9 Direct Method and Overhead Rates

LO3

Pagilla Company manufactures both sunscreen and tubes of lip balm, with each product manufactured in separate departments. Three support departments support the production departments: power, general factory, and purchasing. Budgeted data on the five departments are as follows:

	Support Departments			*Producing Departments*	
	Power	*General Factory*	*Purchasing*	*Sunscreen*	*Lip Balm*
Overhead	$120,000	$540,000	$220,000	$137,500	$222,500
Square feet	3,000	—	3,000	9,600	8,400
Machine hours	—	1,403	1,345	8,000	24,000
Purchase orders	20	40	7	60	120

The company does not break overhead into fixed and variable components. The bases for allocation are: power—machine hours, general factory—square feet, and purchasing—purchase orders.

Required:

1. Allocate the overhead costs to the producing departments using the direct method. (Take allocation ratios out to four significant digits.)
2. Using machine hours, compute departmental overhead rates. (Round the overhead rates to the nearest cent.)

7-10 Sequential Method

LO3

Refer to the data in **Exercise 7-9**. The company has decided to use the sequential method of allocation instead of the direct method.

Required:

1. Allocate the overhead costs to the producing departments using the sequential method. (Take allocation ratios out to four significant digits.)
2. Using machine hours, compute departmental overhead rates. (Round the overhead rates to the nearest cent.)

7-11 Reciprocal Method

LO3

Stubing Company has two producing departments and two support centers. The following budgeted data pertain to these four departments:

	Support Departments		*Producing Departments*	
	Maintenance	*Personnel*	*Assembly*	*Painting*
Overhead	$200,000	$60,000	$43,000	$74,000
Square footage	—	2,700	5,400	5,400
Number of employees	30	—	72	198
Direct labor hours	—	—	25,000	40,000

Required:

1. Allocate the overhead costs of the support departments to the producing departments using the reciprocal method.
2. Using direct labor hours, compute departmental overhead rates.

7-12 Direct Method

LO3

Refer to the data in **Exercise 7-11**. The company has decided to simplify its method of allocating support service costs by switching to the direct method.

Required:

1. Allocate the costs of the support departments to the producing departments using the direct method.
2. Using direct labor hours, compute departmental overhead rates.

7-13 Sequential Method

LO3

Refer to the data in **Exercise 7-11**.

Required:

1. Allocate the costs of the support departments using the sequential method.
2. Using direct labor hours, compute departmental overhead rates.

7-14 Physical Units Method

LO5

Alomar Company manufactures four products from a joint production process: andol, incol, ordol, and exsol. The joint costs for one batch are as follows:

Direct materials	$56,300
Direct labor	28,000
Overhead	15,700

At the split-off point, a batch yields 1,000 andol, 1,500 incol, 2,500 ordol, and 3,000 exsol. All products are sold at the split-off point: andol sells for $20 per unit; incol sells for $75 per unit; ordol sells for $64 per unit, and exsol sells for $22.50 per unit.

Required:

1. Allocate the joint costs using the physical units method.
2. Suppose that the products are weighted as follows:

Andol	3.0
Incol	2.0
Ordol	0.4
Exsol	1.0

Allocate the joint costs using the weighted average method.

7-15 Sales-Value-at-Split-Off Method

LO5 Refer to **Exercise 7-14** and allocate the joint costs using the sales-value-at-split-off method.

7-16 Net Realizable Value Method, Decision to Sell at Split-Off or Process Further

LO5 Presley, Inc., produces two products, ups and downs, in a single process. The joint costs of this process were $42,000, and 39,000 units of ups and 21,000 units of downs were produced. Separable processing costs beyond the split-off point were as follows: ups, $18,000; downs, $5,780. Ups sell for $2.00 per unit; downs sell for $2.18 per unit.

Required:

1. Allocate the $42,000 joint costs using the estimated net realizable value method.
2. Suppose that ups could be sold at the split-off point for $1.80 per unit. Should Presley sell ups at split-off or process them further? Show supporting computations.

PROBLEMS

7-17 Allocation: Fixed and Variable Costs, Budgeted Fixed and Variable Costs

LO2 Biotechtron, Inc., has two research laboratories in the Midwest, one in Tulsa, Oklahoma, and one in Ames, Iowa. The owner of Biotechtron centralized the legal services function in the Tulsa office and had both laboratories send any legal questions or issues to the Tulsa office. The legal services support center has budgeted fixed costs of $60,000 per year and a budgeted variable rate of $40 per hour of professional time. The normal usage of the legal services center is 1,625 hours per year for the Tulsa office and 875 hours per year for the Ames office. This corresponds to the expected usage for the coming year.

Required:

1. Determine the amount of legal services support center costs that should be assigned to each office.
2. Since the offices produce services, not tangible products, what purpose is served by allocating the budgeted costs?
3. Now, assume that during the year, the legal services center incurred actual fixed costs of $59,000 and actual variable costs of $91,500. It delivered 2,300 hours of professional time—1,200 hours to Tulsa and 1,100 hours to Ames. Determine the amount of the legal services center's costs that should be allocated to each office. Explain the purposes of this allocation.

4. Did the costs allocated differ from the costs incurred by the legal services center? If so, why?

7-18 Direct Method, Variable versus Fixed, Costing and Performance Evaluation

LO2, LO3

AirBorne is a small airline operating out of Boise, Idaho. Its three flights travel to Salt Lake City, Reno, and Portland. The owner of the airline wants to assess the full cost of operating each flight. As part of this assessment, the costs of two support departments (maintenance and baggage) must be allocated to the three flights. The two support departments that support all three flights are located in Boise (any maintenance or baggage costs at the destination airports are directly traceable to the individual flights). Budgeted and actual data for the year are as follows for the support departments and the three flights:

	Support Centers		*Flights*		
	Maintenance	*Baggage*	*Salt Lake City*	*Reno*	*Portland*
Budgeted data:					
Fixed overhead	$240,000	$150,000	$20,000	$18,000	$30,000
Variable overhead	$30,000	$64,000	$5,000	$10,000	$6,000
Hours of flight time*	—	—	2,000	4,000	2,000
Number of passengers*	—	—	10,000	15,000	5,000
Actual data:					
Fixed overhead	$235,000	$156,000	$22,000	$17,000	$29,500
Variable overhead	$80,000	$33,000	$6,200	$11,000	$5,800
Hours of flight time	—	—	1,800	4,200	2,500
Number of passengers	—	—	8,000	16,000	6,000

*Normal activity levels.

Required:

1. Using the direct method, allocate the support service costs to each flight, assuming that the objective is to determine the cost of operating each flight.
2. Using the direct method, allocate the support service costs to each flight, assuming that the objective is to evaluate performance. Do any costs remain in the two support departments after the allocation? If so, how much? Explain.

7-19 Comparison of Methods of Allocation

LO3

Homestead Pottery, Inc., is divided into two operating divisions: pottery and retail. The company allocates power and human resources department costs to each operating division. Power costs are allocated on the basis of the number of machine hours and human resources costs on the basis of the number of employees. No effort is made to separate fixed and variable costs; however, only budgeted costs are allocated. Allocations for the coming year are based on the following data:

	Support Departments		*Operating Divisions*	
	Power	*Human Resources*	*Pottery*	*Retail*
Overhead costs	$100,000	$205,000	$80,000	$50,000
Machine hours	2,000	2,000	3,000	5,000
Number of employees	20	60	60	80

Required:

1. Allocate the support service costs using the direct method.
2. Allocate the support service costs using the sequential method.
3. Allocate the support service costs using the reciprocal method.

7-20 Direct Method, Reciprocal Method, Overhead Rates

LO3, LO4

CMA

Barrylou Corporation is developing departmental overhead rates based on direct labor hours for its two production departments—molding and assembly. The molding department employs 20 people, and the assembly department employs 80 people. Each person in these two departments works 2,000 hours per year. The production-related overhead costs for the molding department are budgeted at $200,000, and the assembly department costs are budgeted at $320,000. Two support departments—repair and power—directly support the two production departments and have budgeted costs of $48,000 and $250,000, respectively. The production departments' overhead rates cannot be determined until the support departments' costs are properly allocated. The following schedule reflects the use of the repair department's and power department's output by the various departments.

	Repair	*Power*	*Molding*	*Assembly*
Repair hours	—	1,000	1,000	8,000
Kilowatt-hours	240,000	—	840,000	120,000

Required:

1. Calculate the overhead rates per direct labor hour for the molding department and the assembly department using the direct allocation method to charge the production departments for support department costs.
2. Calculate the overhead rates per direct labor hour for the molding department and the assembly department using the reciprocal method to charge support department costs to each other and to the production departments.
3. Explain the difference between the methods, and indicate the arguments generally presented to support the reciprocal method over the direct allocation method. *(CMA adapted)*

7-21 Physical Units Method, Relative Sales Value Method

LO5

Petro-Chem, Inc., is a small company that acquires high-grade crude oil from low-volume production wells owned by individuals and small partnerships. The crude oil is processed in a single refinery into Two Oil, Six Oil, and impure distillates. Petro-Chem does not have the technology or capacity to process these products further and sells most of its output each month to major refineries. There were no beginning finished goods or work-in-process inventories on November 1. The production costs and output of Petro-Chem for November are as follows:

Crude oil acquired and placed into production	$5,000,000
Direct labor and related costs	2,000,000
Manufacturing overhead	3,000,000

Production and sales:
Two Oil, 300,000 barrels produced; 80,000 barrels sold at $20 each.
Six Oil, 240,000 barrels produced; 120,000 barrels sold at $30 each.
Distillates, 120,000 barrels produced and sold at $15 per barrel.

Required:

1. Calculate the amount of joint production cost that Petro-Chem would allocate to each of the three joint products by using the physical units method. (Carry out the ratio calculation to four decimal places.)
2. Calculate the amount of joint production cost that Petro-Chem would allocate to each of the three joint products by using the relative sales value method.

7-22 Fixed and Variable Cost Allocation

LO2

Welcome Inns is a chain of motels serving business travelers in Arizona and southern Nevada. The chain has grown from one motel in 2004 to five motels. In 2007, the owner of the company decided to set up an internal accounting department to centralize control of financial information. (Previously, local CPAs handled each motel's bookkeeping and financial reporting.) The accounting office was opened in January 2007 by renting space adjacent to corporate headquarters in Glendale, Arizona. All motels have been supplied with personal computers and modems by which to transfer information to central accounting on a weekly basis.

The accounting department has budgeted fixed costs of $85,000 per year. Variable costs are budgeted at $26 per hour. In 2007, actual cost for the accounting department was $182,500. Further information is as follows:

	Actual Revenues		*Actual Hours of Accounting*
	2006	*2007*	*2007*
Henderson	$337,500	$431,800	1,475
Boulder City	450,000	508,000	400
Kingman	360,000	381,000	938
Flagstaff	540,000	635,000	562
Glendale	562,500	584,200	375

Required:

1. Suppose the total costs of the accounting department are allocated on the basis of 2007 sales revenue. How much will be allocated to each motel?
2. Suppose that Welcome Inns views 2006 sales figures as a proxy for budgeted capacity of the motels. Thus, fixed accounting department costs are allocated on the basis of 2006 sales, and variable costs are allocated according to 2007 usage multiplied by the variable rate. How much accounting department cost will be allocated to each motel?
3. Comment on the two allocation schemes. Which motels would prefer the method in Requirement 1? The method in Requirement 2? Explain.

7-23 Physical Units Method, Relative Sales-Value-at-Split-Off Method, Net Realizable Value Method, Decision Making

LO5

CMA

Sonimad Sawmill, Inc., (SSI) purchases logs from independent timber contractors and processes them into the following three types of lumber products.

1. Studs for residential construction (e.g., walls and ceilings)
2. Decorative pieces (e.g., fireplace mantels and beams for cathedral ceilings)
3. Posts used as support braces (e.g., mine support braces and braces for exterior fences around ranch properties)

These products are the result of a joint sawmill process that involves removing bark from the logs, cutting the logs into a workable size (ranging from 8 to 16 feet in length),

and then cutting the individual products from the logs, depending upon the type of wood (pine, oak, walnut, or maple) and the size (diameter) of the log.

The joint process results in the following costs and output of products during a typical month:

Joint production costs	
Materials (rough timber logs)	$ 500,000
Debarking (labor and overhead)	50,000
Sizing (labor and overhead)	200,000
Product cutting (labor and overhead)	250,000
Total joint costs	$1,000,000

Product yield and average sales value on a per-unit basis from the joint process are as follows:

Product	*Monthly Output*	*Fully Processed Sales Price*
Studs	75,000	$ 8
Decorative pieces	5,000	100
Posts	20,000	20

The studs are sold as rough-cut lumber after emerging from the sawmill operation without further processing by SSI. Also, the posts require no further processing. The decorative pieces must be planed and further sized after emerging from the SSI sawmill. This additional processing costs SSI $100,000 per month and normally results in a loss of 10 percent of the units entering the process. Without this planing and sizing process, there is still an active intermediate market for the unfinished decorative pieces where the sales price averages $60 per unit.

Required:

1. Based on the information given for Sonimad Sawmill, Inc., allocate the joint processing costs of $1,000,000 to each of the three product lines using the:
   a. Relative sales-value-at-split-off method
   b. Physical units method at split-off
   c. Estimated net realizable value method
2. Prepare an analysis for Sonimad Sawmill, Inc., to compare processing the decorative pieces further as it presently does, with selling the rough-cut product immediately at split-off. Be sure to provide all calculations.
3. Assume Sonimad Sawmill, Inc., announced that in six months it will sell the rough-cut product at split-off due to increasing competitive pressure. Identify at least three types of likely behavior that will be demonstrated by the skilled labor in the planing and sizing process as a result of this announcement. Explain how this behavior could be improved by management. *(CMA adapted)*

7-24 Single Charging Rates

LO2

House Corporation Board (HCB) of Tri-Gamma Sorority is responsible for the operation of a two-story sorority house on the State University campus. HCB has set a normal capacity of 60 women. At any given point in time, there are 100 members of the chapter: 60 living in the house and 40 living elsewhere (e.g., in the freshman dorms on campus). HCB needs to set rates for the use of the house for the coming year. The following costs are budgeted: $240,000 fixed and $34,800 variable. The fixed costs are fairly insensitive to the number of women living in the house. Food is budgeted at $40,000 and is included in the fixed costs; food does not seem to vary greatly given the stated capacity. The variable expenses consist of telephone bills and some of the

utilities. HCB is not responsible for chapter dues, party fees, pledging and initiation fees, and other social expenditures. Women living in the house eat 20 meals per week there and live in a 2-person room. (All in-house members' rooms, bathroom facilities, etc., are on the second floor.) All members eat Monday dinner at the house and have full use of house facilities (e.g., the two TV lounges, kitchens, access to milk and cereal at any time, study facilities, and so on).

HCB has traditionally set two rates: one for in-house members and one for out-of-house members. There are 32 weeks in a school year.

Required:

1. Discuss the factors that might go into determining the charging rate for the two types of sorority members.
2. Set charging rates for the in-house and out-of-house members.

7-25 Case Using a Hospital Setting, Allocation Methods, Unit-Cost Determination and Pricing Decisions

LO2, LO3

Paula Barneck, the newly appointed director of the Lambert Medical Center (LMC), a large metropolitan hospital, was reviewing the financial report for the most recent quarter. The hospital had again shown a loss. For the past several years, it had been struggling financially. The financial problems had begun with the introduction of the federal government's new diagnostic-related group (DRG) reimbursement system. Under this system, the government mandated fixed fees for specific treatments or illnesses. The fixed fees were supposed to represent what the procedures should cost and differed from the traditional cost objective of the patient day of prior years. Although no formal assessment had been made, the general feeling of hospital management was that the DRG reimbursement was hurting LMC's financial state.

The increasing popularity of health maintenance organizations (HMOs) and physician provider organizations (PPOs) was also harming the hospital's financial well-being. In HMOs, physicians, who are employed full time, are usually located in a clinic owned by the HMO, and subscribers must use these physicians. In PPOs, hospitals provide contracts with a group of physicians in private practice. These physicians usually serve non-PPO patients as well as PPO patients. The PPO patient can select any physician from the list of physicians under contract with the particular PPO. The PPO approach usually offers a greater selection of physicians and tends to preserve the patient's traditional freedom of choice. More and more of the hospital's potential patients were joining HMOs and PPOs, and, unfortunately, LMC was not capturing its fair share of the HMO and PPO business. HMOs and PPOs routinely asked for bids on hospital services and provided their business to the lowest bidder. In too many cases, LMC had not won that work.

Paula had accepted the position of hospital administrator knowing that she was expected to produce dramatic improvements in LMC's financial state. She was convinced that she needed more information about the hospital's product costing methods. Only by having accurate cost information for the various procedures offered by the hospital could she evaluate the effects of DRG reimbursement and the hospital's bidding strategy.

Paula requested a meeting with Eric Rose, the hospital's controller. Their conversation follows:

PAULA: Eric, as you know, we recently lost a bid on some laboratory tests that would be performed on a regular basis for a local HMO. In fact, I was told by the director of the HMO that we had the highest bid of the three submitted. I know the identity of the other two hospitals that submitted bids, and I have a hard time

believing that their costs for these tests are any lower than ours. Describe exactly how we determine the cost of these lab procedures.

ERIC: First, we classify all departments as either revenue-producing centers or service centers. Next, the costs of the service centers are allocated to the revenue-producing centers. The costs directly traceable to the revenue-producing centers are then added to the allocated costs to obtain the total cost of operating the revenue-producing center. This total cost is divided by the total revenues of the revenue-producing center to obtain a cost-to-charges ratio. Finally, the cost of a particular procedure is computed by multiplying the charge for that procedure by the cost-to-charges ratio.

PAULA: Let me see if I understand. The costs of laundry, housekeeping, maintenance, and other service departments are allocated to all of the revenue-producing departments. Let's assume that the lab receives $100,000 as its share of these allocated costs. The $100,000 is then added to the direct costs—let's assume these are also $100,000—to obtain total operating costs of $200,000. If the laboratory earns revenues of $250,000, the cost-to-charges ratio is 0.80 ($200,000/$250,000). Finally, if I want to know the cost of a particular lab procedure, say a blood test for which we normally charge $20, then all I do is multiply the cost-to-charges ratio of 0.8 by $20 to obtain the cost of $16. Am I right?

ERIC: Absolutely. In the laboratory testing bid that we just lost, our bid was at cost, as computed using our cost-to-charges formula. Perhaps the other hospitals are bidding below their cost to capture the business.

PAULA: Eric, I don't agree. The cost-to-charges ratio is a traditional approach for costing hospital products, but I'm afraid that it is no longer useful. Given the new environment in which we're operating, we need more accurate product costing information. We need accuracy to improve our bidding, to help us assess and deal with the new DRG reimbursement system, and to evaluate the mix of services we offer. The cost-to-charges ratio approach backs into the product cost. It is indirect and inaccurate. Some procedures require more labor, more materials, and more expensive equipment than others. The cost-to-charges approach doesn't reflect these potential differences.

ERIC: Well, I'm willing to change the cost accounting system so that it meets our needs. Do you have any suggestions?

PAULA: Yes. I'm in favor of a more direct computation of product costs. Allocating support service costs to the revenue-producing departments is only the first stage in product costing. We do need to allocate these support service costs to the producing departments—but we need to be certain that we are allocating them in the right way. We also need to go a step further and assign the costs accumulated in the revenue-producing departments to individual products. The costs directly traceable to each product should be identified and assigned directly to those products; indirect costs can be assigned through one or more overhead rates. The base for assigning the overhead costs should be associated with their incurrence. If at all possible, allocations should reflect the usage of support services by the revenue-producing departments; moreover, the same criterion should govern the assignment of overhead costs to the products within the department.

ERIC: Sounds like an interesting challenge. With over 30,000 products, a job-order costing system would be too burdensome and costly. I think some system can be developed, however, that will do essentially what you want.

PAULA: Good. Listen, for our next meeting, come prepared to brief me on why and how you allocate these service department costs to the revenue-producing departments. I think this is a critical step in accurate product costing. I also want to know how you propose to assign the costs accumulated in each revenue-producing department to that department's products.

As Eric mentally reviewed his meeting with Paula, he realized that the failure of bids could be attributable to inaccurate cost assignments. Because of this possibility, Eric decided to do some additional investigation to see if the cost-to-charges ratio method of costing services was responsible.

Eric pulled the current year's budgeted data from his files. He found the following data. The number of departments and the budget have been reduced for purposes of simplification.

	Support Departments			*Revenue Departments*	
	Administrative	*Laundry*	*Janitorial*	*Laboratory*	*Nursing*
Overhead	$20,000	$75,000	$50,000	$43,000	$150,000
Employees	1	4	7	8	20
Pounds of laundry	50	200	400	1,000	4,000
Square feet	1,000	1,200	500	5,000	20,000

Support department costs are allocated using the direct method.

Eric decided to compute the costs of three different lab tests using the cost-to-charges ratio and then recompute them using a more direct method, as suggested by Paula. By comparing the unit costs under each approach, he could evaluate the cost-estimating ability of the cost-to-charges ratio. The three tests selected for study were the blood count test (Test B), cholesterol test (Test C), and a chemical blood analysis (Test CB).

After careful observation of the three tests, Eric concluded that the consumption of the resources of the laboratory could be associated with the relative amount of time taken by each test. Based on the amount of time needed to perform each test, Eric developed relative value units (RVUs) and associated the consumption of materials and labor with these units. The RVUs for each test and the cost per RVU for materials and labor are as follows:

Test	*RVUs*	*Material per RVU*	*Labor per RVU*
B	1	$2.00	$2.00
C	2	2.50	2.00
CB	3	1.00	2.00

Eric also concluded that the pool of overhead costs collected within the laboratory should be applied using RVUs. (He was convinced that RVU was a good activity driver for overhead.) The laboratory's expected RVUs for the year were 22,500. The laboratory usually performs an equal number of the three tests over a year. This year was no exception.

Eric also noted that the hospital usually priced its services so that revenues exceeded costs by a specified percentage. Based on the past total costs of the laboratory, this pricing strategy had led to the following fees for the three blood tests:

	Test B	*Test C*	*Test CB*
Fees charged	$5.00	$19.33	$22.00

Required:

1. Allocate the costs of the support departments to the two revenue-producing departments using the direct method.
2. Assuming that the three blood tests are the only tests performed in the laboratory, compute the cost-to-charges ratio (total costs of the laboratory divided by the laboratory's total revenues).

3. Using the cost-to-charges ratio computed in Requirement 2, estimate the cost per test for each blood test.
4. Compute the cost per test for each test using RVUs.
5. Which unit cost—the one using the cost-to-charges ratio or the one using RVUs—do you think is the most accurate? Explain.
6. Assume that Lambert Medical Center has been requested by an HMO to bid on Test CB. Using a 5 percent markup, prepare the bid using the cost computed in Requirement 3. Repeat, using the cost prepared in Requirement 4. Suppose that anyone who bids $20 or less will win the bid. Discuss the implications of costing accuracy on the hospital's problems with its bidding practices.

7-26 Collaborative Learning Exercise: Comparison of Methods of Allocation

LO3, LO4

Divide the class into groups of six. Within each group, form pairs. One pair works Requirement 1(a); another pair works Requirement 1(b); and the remaining pair works Requirement 1(c). When the pairs have completed their work, they reform their group, and each pair teaches the other how to complete Requirement 1. Then, the groups discuss Requirement 2.

Kare Foods Company specializes in the production of frozen dinners. The first of the two operating departments cooks the food. The second is responsible for packaging and freezing the dinners. The dinners are sold by the case, each case containing 25 dinners.

Two support departments provide support for Kare's operating units: maintenance and power. Budgeted data for the coming quarter follow. The company does not separate fixed and variable costs.

	Support Departments		*Producing Departments*	
	Maintenance	*Power*	*Cooking*	*Packaging and Freezing*
Overhead costs	$340,000	$200,000	$ 75,000	$55,000
Machine hours	—	40,000	40,000	20,000
Kilowatt-hours	20,000	—	100,000	80,000
Direct labor hours	—	—	5,000	30,000

The predetermined overhead rate for cooking is computed on the basis of machine hours; direct labor hours are used for packaging and freezing. The prime costs for one case of standard dinners total $16. It takes two machine hours to produce a case of dinners in the cooking department and 0.5 direct labor hour to process a case of standard dinners in the packaging and freezing department.

Recently, the Air Force has requested a bid on a 3-year contract that would supply standard frozen dinners to Minuteman missile officers and staff on duty in the field. The locations of the missile sites were remote, and the Air Force had decided that frozen dinners were the most economical means of supplying food to personnel on duty.

The bidding policy of Kare Foods is full manufacturing cost plus 20 percent. Assume that the lowest bid of other competitors is $48.80 per case.

Required:

1. Prepare bids for Kare Foods using each of the following allocation methods:
   a. Direct method
   b. Sequential method
   c. Reciprocal method

2. Refer to Requirement 1. Did all three methods produce winning bids? If not, explain why. Which method most accurately reflects the cost of producing the cases of dinners? Why?

7-27 Cyber Research Case

Have each student find the Web sites of four companies—two service companies and two manufacturing companies. By reviewing the description of each company's operations, determine what types of support departments are needed. Do the Web sites refer to these support departments?