

## Chapter 16

# Support Activity and Dual-Rate Allocations

**SILVERMAN & ABBAS CONSULTING (SAC) SPECIALIZES IN designing multistory office complexes. At any given point in time, SAC works on dozens of contracts. Each contract uses activities such as structural engineering, electrical engineering, and plumbing. In addition to these *line activities*, SAC also has *support activities* such as human resources (HR), information technology (IT), purchasing, and administration.**

**SAC needs to track the costs for each contract for the purposes of billing and cost control. The firm has no difficulty in assigning the cost of line activities to individual contracts. Each person executing a line activity keeps a time sheet to record the time spent on the various contracts, and SAC traces the cost of materials used. However, SAC finds it difficult to deal with the cost of the support activities. For instance, only some of the purchasing activity relates directly to contracts. The purchasing activity also supports other line (plumbing) and support (IT) activities. In turn, the IT activity services both plumbing (line) and purchasing (support).**

**Ultimately, SAC knows that all of the activities benefit the contracts, meaning that all of the costs must be allocated to contracts. SAC seeks your help in disentangling the flow of costs to better estimate the cost of each contract.**



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*Silverman & Abbas Consulting, which specializes in designing multistory office complexes, has support activities such as human resources (HR), information technology (IT), purchasing, and administration. The company wants to know how to allocate the cost of the support activities to individual building contracts.*

## LEARNING OBJECTIVES

*After studying this chapter, you will be able to:*

- 1 Distinguish between line activities and support activities.
- 2 Explain three methods used to allocate the costs of support activities to products.
- 3 Discuss the need for dual-rate allocations.

As we learned in Chapters 9 and 10, both traditional and activity-based costing systems have two stages of allocation. In the first stage, we group costs into cost pools that correspond to individual departments or activities. In the second stage, we allocate all costs from each cost pool directly to products. In this chapter, we consider settings in which we cannot justify allocating all costs directly to products because of interactions among the cost pools. These complex settings, of which SAC is an example, are quite common in practice.

We begin by distinguishing between line activities and support activities. We highlight the need for maintaining separate cost pools for these two different types of activities. We then discuss the flow of costs through these cost pools to the final product, and the complexities that arise because of *reciprocity of consumption* among support activities. We present three methods that firms commonly use in these situations, and discuss their relative merits and weaknesses. Finally, we discuss how dual-rate allocations can further aid decision making when allocating costs.



## CHAPTER CONNECTIONS

The refinements we consider in this chapter are an extension of the product-costing systems we studied in Chapters 8 and 9.

## Line and Support Activities

### LEARNING OBJECTIVE 1

Distinguish between line activities and support activities.

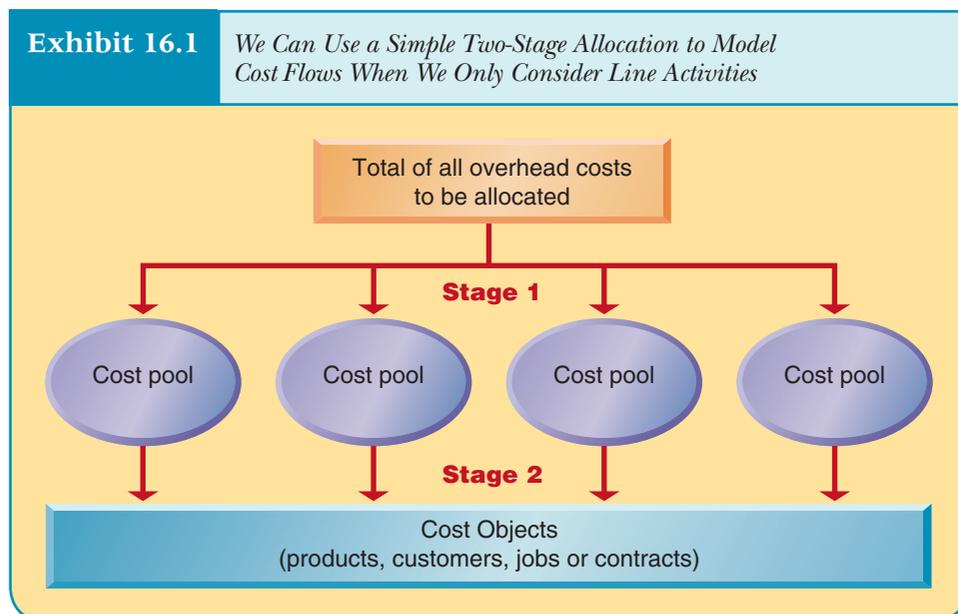
A **line activity** directly relates to producing services or products. (The associated departments are often called line departments.) Structural and electrical engineering are line activities at SAC. Costs incurred in these departments are almost *fully* traceable to contracts undertaken. In manufacturing, the activities of production departments such as machining, assembly, and shipping are line activities. In merchandising, the sales force and store management execute line activities. A **support activity** is not directly related to making or selling a product or service but is needed to run the business. All firms need someone to handle payroll even if payroll processing does not directly relate to the firm's products or services.

For simplicity, we only considered line activities in our discussions in Chapters 9 and 10. Exhibit 16.1 shows such a two-stage allocation system, with four cost pools for four distinct activities. Recall that in the first stage of the allocation process in such systems, we group into cost pools all of the costs that we wish to allocate. These cost pools may correspond to departments in a traditional system or activities in an ABC system. In the second stage, we identify appropriate cost drivers for each pool, determine the denominator volume, and calculate the allocation rate. Using this rate, we allocate costs to individual products or jobs. We represent this second-stage allocation by the arrows linking cost pools and cost objects.

The flow of costs shown in Exhibit 16.1 implicitly assumes that products or contracts account for the *entire* activity volume corresponding to *all* cost pools. In practice, this assumption is only valid for cost pools that correspond to line activities.

### Exhibit 16.1

We Can Use a Simple Two-Stage Allocation to Model Cost Flows When We Only Consider Line Activities



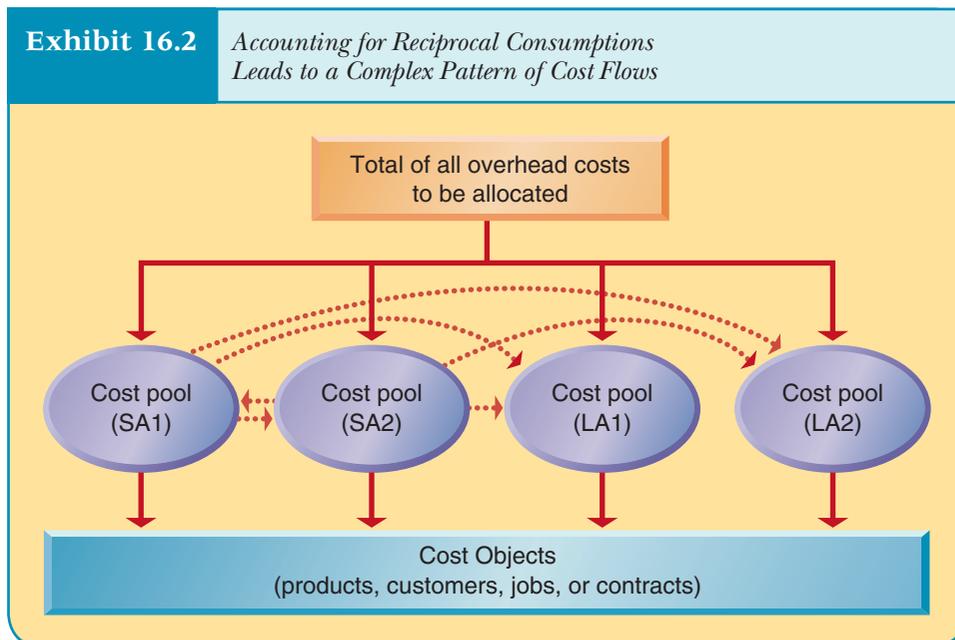
Cost flows for support activities do not follow this simple pattern because the final cost objects (products, customers, jobs, or contracts) do not account for all of the support provided. Consider purchasing. In SAC, the Purchasing Department acquires the direct materials required for individual contracts. This department is also responsible for acquiring the supplies required by other line departments such as structural engineering *and* the supplies required by support departments such as HR, IT, and administration. In such instances, it is inappropriate to allocate all costs incurred by the Purchasing Department directly to the contracts. Some of the costs should surely be allocated directly to contracts. But some should be allocated to line departments and others to other support departments. That is, some of the costs of purchasing, itself a support activity, must flow through other line and support activities before being allocated to contracts.

When modeling this cost flow, **reciprocity in consumption** among support activities (departments) complicates cost allocation procedures. To see why, consider a second support activity. Like purchasing, HR supports both line activities such as plumbing, and support activities such as purchasing. As with purchasing, we need to allocate HR costs in proportion to use. But doing so creates a circularity. The cost of purchasing (some of which we must allocate to HR) includes an allocation from HR (which includes some costs from purchasing).

Exhibit 16.2 shows the consumption of activities and flow of costs when there is reciprocity in consumption. In this exhibit, we represent the flows among cost pools by the dotted lines. We label the support activity pools as SA1 and SA2, and the line activity pools LA1 and LA2. Notice that the costs in the pool for support activity 1 (SA1) benefit the final cost objects such as products, the activity in SA2, and the activities in the two line departments (LA1 and LA2). Likewise, costs in the pool for support activity 2 (SA2) benefit products, the support activity in SA1, and the two line activities (LA1 and LA2). However, costs in the pools for line activities are all allocated to the cost objects.

Accounting for reciprocity among support activities is important for two reasons. First, it increases the accuracy of cost estimates. SAC can therefore make more effective decisions. Second, allocating the cost of support departments helps line managers become aware of the costs of the services they consume. In decentralized firms, different managers likely oversee the activities connected with the different cost

**Exhibit 16.2** *Accounting for Reciprocal Consumptions Leads to a Complex Pattern of Cost Flows*





## CHAPTER CONNECTIONS

*Understanding the costs of support departments is similar to the transfer-pricing problem we studied in Chapter 12. The key difference is that we view most support departments as cost centers, meaning that there is no demand for a markup over cost. Consistent with tradition, we employ the term transfer price only for transfers among profit or investment centers, in which case the manager of the selling division demands a profit markup.*

pools. Cost allocation rates serve as the implicit “price” for the services line managers obtain from other support departments. Pricing such internal services correctly is critical because too high a price can lead managers to economize too much on a support resource and too low a price can lead to wasteful consumption.

## Methods for Allocating Support Activity Costs

### LEARNING OBJECTIVE 2

**Explain three methods used to allocate the costs of support activities to products.**

Firms can use one of three methods to allocate support activity costs to the other cost pools and to final cost objects: the direct method, the step-down method, and the reciprocal method. We illustrate these three methods in the context of SAC. The individual allocations in each of the three methods follow the general framework we developed in Chapter 9. Key differences relate to the sequence in which we allocate costs and the extent to which the method accounts for the reciprocity in consumption.

Let us begin by collecting some data. Consider the pattern of cost flows at SAC, restricting attention to only two pools for support activities (purchasing and administration), two pools for line activities (structural and plumbing), and one generic pool for the final cost objects (contracts). Suppose SAC uses the number of purchase orders as the cost driver for allocating purchasing costs. SAC knows that it issues 1,050 purchase orders each year, including 50 for supplies used by purchasing itself. Of the remainder, administration consumes 150 orders, plumbing 255 orders, and structural accounts 425 orders, with 170 orders directly traceable to contracts. Using this data, a useful first step for *all three methods* is to convert these activity volumes into the percentages of activities consumed.

One complication that arises is how to deal with the orders used by purchasing itself. When computing percentages for allocating costs, we ignore such **self-consumption** of a support function. Ignoring self-consumption does not affect the accuracy of allocations.

For SAC, ignoring the self-consumption of 50 orders reduces the denominator volume for purchase orders to 1,000 orders. We then calculate the consumption percentages as  $150/1,000 = 15\%$ ,  $255/1,000 = 25.5\%$ ,  $425/1,000 = 42.5\%$  and  $170/1,000 = 17\%$  for administration, structural, plumbing, and contracts. Exhibit 16.3 presents the data, in terms of percentage consumption, for other activities. (Later, we show the computations using cost drivers and allocation rates.)

Exhibit 16.3 informs us that the Structural Department consumes 28% of the services offered by administration. Recall that this means that, if SAC uses head count as the driver for allocating administration costs, the Structural Engineering Department accounts for 28% of the number of people serviced by administration.

**Exhibit 16.3** *Silverman & Abbas Consulting: Consumption Patterns for Activities*

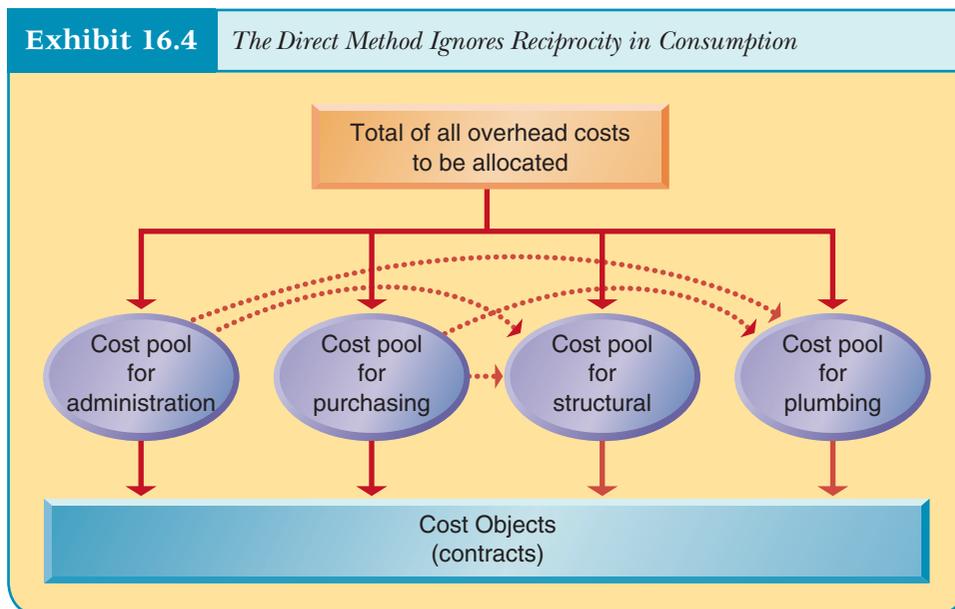
	Cost Pools for Support Activities		Cost Pools for Line Activities		Final Cost Objects
	Administration	Purchasing	Structural	Plumbing	
Costs in pools	\$650,000	\$250,000	\$1,015,000	\$1,258,750	
<i>Consumption pattern</i>					
From Administration		30.00%	28.00%	28.00%	14.00%
From Purchasing	15.00%		25.50%	42.50%	17.00%
From Structural					100.00%
From Plumbing					100.00%

Exhibit 16.3 also indicates that there is reciprocity in consumption. The purchasing function consumes 30% of services offered by administration, while administration consumes 15% of the services offered by purchasing. Both support pools also provide services to the two line production departments: structural and plumbing. Finally, contracts directly account for some of the output from both support pools and for all of the output from the two line pools.

### DIRECT METHOD

The **direct method** simplifies the allocation problem depicted in Exhibit 16.2 by ignoring reciprocity in consumption. Thus, the method assumes that the costs from support activities flow either directly to cost objects (products, jobs, contracts) or to the pools for line activities. We do not allocate costs from one support activity to another support activity. Exhibit 16.4 illustrates cost flows under the direct method.

Exhibit 16.5 presents the computations for SAC using the direct method. The first step is to re-compute the consumption percentages for the cost pools for support activities, ignoring reciprocal consumption. Consider administration costs. Purchasing, a support activity, consumes 30% of the services offered by administration.



		Cost Pools for Support Activities		Cost Pools for Line Activities		Final Cost Objects
		Administration	Purchasing	Structural	Plumbing	Products/Jobs
<u>Consumption Pattern for Activities</u>						
From Administration				40.00%	40.00%	20.00%
From Purchasing			30.00%		50.00%	20.00%
From Structural						100.00%
From Plumbing						100.00%
<u>Cost Allocation</u>						
Initial cost in pool	\$650,000	\$250,000	\$1,015,000	\$1,258,750	\$348,750	
From Administration	(\$650,000)		260,000	260,000	130,000	
From Purchasing		(\$250,000)	75,000	125,000	50,000	
Total costs in pools	\$0	\$0	\$1,350,000	\$1,643,750	\$528,750	

However, the direct method ignores this consumption and only considers the remaining 70% of the consumption when allocating administration costs. Thus, we recalculate the (revised) consumption percentages as  $28\%/70\% = 40\%$  for both structural and plumbing, and  $14\%/70\% = 20\%$  for the portion directly allocated to products. *Check It! Exercise #1* allows you to verify the computations for the purchasing cost pool.

The last four rows of Exhibit 16.5 contain the allocations. The first row shows the costs in the different cost pools. The next row allocates the cost from the administration cost pool (“from administration”) to the other cost pools and jobs. As we calculated, the structural activity consumes 40% of the output from administration. Thus, we allocate  $\$650,000 \times 0.40 = \$260,000$  from the administration pool to the pool for structural engineering. Similarly, we allocate 40% of the cost of administration to the cost pool for plumbing. Finally, because we can link 20% of the administration consumption directly to contracts, we allocate \$130,000 of administration costs to individual contracts.

After allocating the \$650,000 in administration costs, we follow the same steps to allocate the \$250,000 in purchasing costs. For example, 50% of purchasing activity pertains to plumbing (this is the revised estimate after ignoring the orders for administration). Therefore, we allocate  $\$250,000 \times 0.50 = \$125,000$  to plumbing.



## Check It! Exercise #1

Verify that under the direct method, the Structural and Plumbing departments would be allocated 30% and 50%, respectively, of the purchasing activity cost.

	Admin	Structural	Plumbing	Jobs	Total
Original consumption pattern	15.00%	25.50%	42.50%	17.00%	100.00%
Eliminate support activities	0	25.50%	_____	17.00%	85.00%
Revised percentages	0	_____	_____	20.00%	100.00%
		=	=	= 0.17/0.85	

Solution at end of chapter.

The last row shows that when all the costs for support activities have been allocated, \$1,350,000 have been allocated to structural costs, \$1,643,750 to plumbing costs, and \$528,750 directly to contracts. This completes the allocation of support costs to line activities. We can then allocate costs from line activities to jobs as we learned in Chapters 9 and 10.

### Performing the Allocation Using Rates

For simplicity in presentation, Exhibit 16.5 uses the percentage of the service consumed to calculate the amounts allocated to each cost pool. Firms often also use overhead rates for these allocations. Let us see how.

Under the direct method, we ignore any consumption by other support departments. We know that administration consumes 150 of the 1,000 purchase orders. Ignoring this consumption reduces the denominator volume for purchase orders from 1,000 orders to 850 orders. (This step achieves the same purpose as recalculating consumption percentages.) The cost in the purchasing pool is \$250,000. We therefore calculate a rate of  $\$250,000/850 \text{ orders} = \$294.12$  (rounded) per purchase order. Using this rate, we allocate 255 orders  $\times$  \$294.12 per order = \$75,000 to structural, 425 orders  $\times$  \$294.12 per order = \$125,000 to plumbing, and 170 orders  $\times$  \$294.12 per order = \$50,000 directly to contracts. These numbers, of course, are the same as the amounts we calculated in Exhibit 16.5 (see row “from Purchasing”).

Why might a firm use overhead rates, a harder method to visualize, rather than percentages to perform these allocations? Firms do so to communicate the cost of support activities to managers of line activities. The allocation informs the managers of structural and plumbing that each purchase order they request increases the firm’s long-run cost by \$294.12. This cost information might induce them to be more careful in the use of purchase orders.

For simplicity in presenting calculations, we illustrate the step-down and reciprocal methods using percentage allocations only.

## STEP-DOWN METHOD

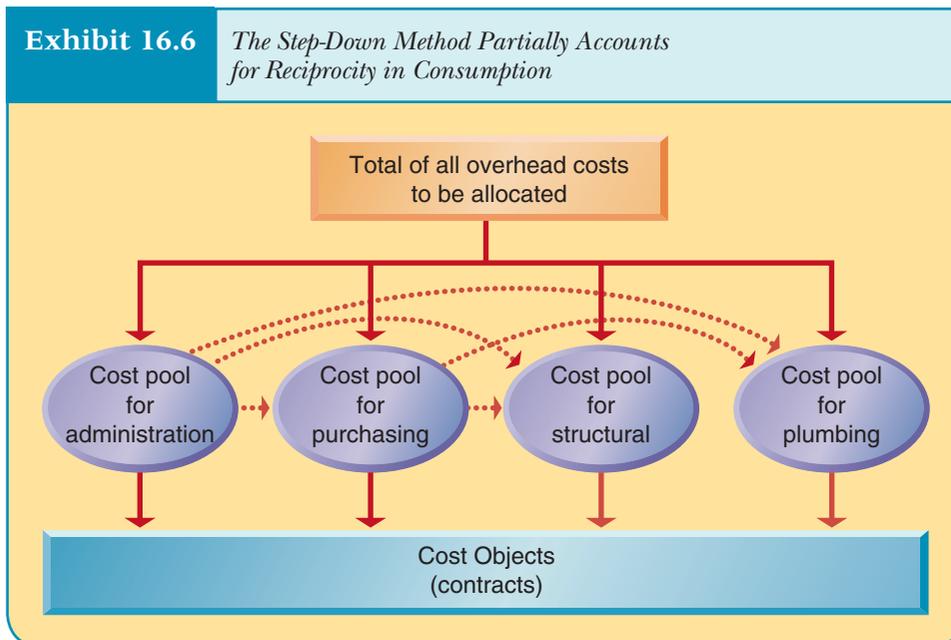
The **step-down method** improves on the direct method by considering the reciprocity in consumption partially. We begin by rank-ordering support activity cost pools according to some criterion. Frequently, organizations use the size of the cost pool as the criterion. However, we could use other criteria such as the proportion of consumption by other support activities. SAC has chosen to allocate administration costs (with \$650,000 of costs) before allocating the cost connected with the purchasing activity (\$250,000).

We allocate the costs in the highest-ranked support activity pool to all other cost pools, including the *lower*-ranked support activity pools. For SAC, we would allocate the costs in the administration pool to purchasing, as well as to structural, plumbing, and directly to jobs. This allocation differs from the direct method, because under the direct method we would allocate zero costs from one support



### CHAPTER CONNECTIONS

*The two-step process is the detailed method for allocating costs. However, as you learned in Chapter 3, the percent of the cost allocated to a cost object equals the percent of driver units in that cost object. Thus, rather than use the two-step process for allocations, in Exhibit 16.5, we directly used the percentage data to calculate the amounts allocated.*



activity pool to another support activity pool (i.e., no costs flow from administration to purchasing).

As Exhibit 16.6 indicates, under the step-down method, we first allocate administration costs to the lower-ranked support activity (purchasing), to the two line activities, and to contracts. In this case, Exhibit 16.3 provides the data we use for this allocation of administration costs: 30% will go to purchasing, 28% to structural, 28% to plumbing, and 14% directly to contracts.

Next, we allocate the costs for the purchasing activity. Realize that these costs now comprise the costs originally traced as well as the costs allocated from the administration pool. Thus we allocate  $\$250,000 + \$195,000 = \$445,000$  in costs from purchasing. Where should we allocate these costs? If there were other lower-ranked support activity pools, we would allocate the purchasing costs to those pools, as well as to the line activity pools, and directly to contracts. However, we would not allocate any purchasing costs *back* to the higher-ranked administration pool. In this way, at each step, we deal with one less cost pool for support activities. We repeat the steps for the remaining cost pools until we exhaust all of the cost pools for support activities. At that point, we complete the allocation process the way we described in Chapter 9 and used to complete the direct method.

Notice that the step-down method sequentially allocates the costs of support activities. Naturally, some refer to this method as the **sequential method**.

Exhibit 16.7 provides the computations for the step-down method for SAC. Notice that the consumption pattern for administration includes the consumption of this service by purchasing, a lower-ranked support activity. However, in the row for purchasing, we re-compute the percentages for purchasing because we ignore the Administration Department's consumption of the purchasing activity. This recalculation is the same that we saw using the direct method.

As for the costs, we first allocate the \$650,000 of costs contained in the cost pool to administration. Of this cost, we allocate 30%, or \$195,000, to the cost pool for purchasing, increasing the costs for the purchasing activity from \$250,000 to \$445,000. We then allocate 28% of \$650,000 to the Structural Department, 28% to plumbing and the remaining 14% directly to contracts.

We next allocate \$445,000 of costs from the purchasing cost pool. Of this amount, 30% goes to structural, 50% to plumbing, and the remainder directly to contracts.

**Exhibit 16.7** *Silverman & Abbas Consulting: Step-Down Method*

	Cost Pools for Support Activities		Cost Pools for Line Activities		Final Cost Objects
	Administration	Purchasing	Structural	Plumbing	Products/Jobs
<u>Consumption Pattern</u>					
From Administration		30.00%	28.00%	28.00%	14.00%
From Purchasing			30.00%	50.00%	20.00%
From Structural					100.00%
From Plumbing					100.00%
<u>Cost Allocation</u>					
Initial cost in pool	\$650,000	\$250,000	\$1,015,000	\$1,258,750	\$348,750
From Administration	(\$650,000)	195,000	182,000	182,000	91,000
From Purchasing		(\$445,000)	133,500	222,500	89,000
Total costs in pools	\$0	\$0	\$1,330,500	\$1,663,250	\$528,750

### Changing the Order of Allocations

A key step in performing a step-down allocation is to rank the support cost pools according to some criterion. However, there is no absolute criterion. The choice is often strategic because managerial incentives frequently play a role. Changing the order of allocation could change the amount of costs allocated to the cost pools and contracts. As we know from Chapter 12, managers of cost centers strive to minimize the costs of achieving a planned level of output (as specified in budgets). They would prefer a criterion that results in less support costs being allocated to cost pools under their control. Managers of profit centers act to maximize profit. They, too, would prefer a ranking scheme that would yield less allocation than more. In large organizations with multiple responsibility centers, different managers are likely to prefer different ranking criteria. It is rare that any one criterion will satisfy all managers. Moreover, the choice of a particular criterion can influence consumption patterns. Managers of cost pools receiving higher allocations of a support resource will tend to use less of the resource and vice versa.

Given these considerations, most organizations that use the step-down method follow an intuitive and a consistent criterion over time. They do not depend on consensus for their choice. The size of the support department (measured in costs) and head count are some of the commonly used ranking criteria.

In the foregoing example, we allocated the cost pool for administration activities before the purchasing cost pool. *Check It! Exercise #2* allows you to verify how the amounts allocated to the cost pools for the line activities change if SAC allocates the purchasing activity cost pool before allocating the costs for administration.

### RECIPROCAL METHOD

The **reciprocal method** is conceptually the most appealing method because it takes into account *all* of the reciprocity in consumption (as depicted in Exhibit 16.2). It is convenient to represent the reciprocal method in two steps. First, we write the reciprocal relation as a system of simultaneous equations. That is, letting A and P stand for the cost of the administration and purchasing activity respectively, we have:

$$\begin{aligned} A &= \$650,000 + 0.15 \times P \\ P &= \$250,000 + 0.30 \times A \end{aligned}$$

## Check It! Exercise #2

	<i>Support Activities</i>		<i>Line Activities</i>		<i>Cost Objects</i>
	<i>Adminis- tration</i>	<i>Purchasing</i>	<i>Structural</i>	<i>Plumbing</i>	<i>Products/ Jobs</i>
<u>Original consumption pattern</u>					
From Administration	0%	30.00%	28.00%	28.00%	14.00%
From Purchasing	15.00%	0%	25.50%	42.50%	17.00%
From Structural					100.00%
From Plumbing					100.00%
<u>Revised consumption pattern</u>					
From Purchasing	15.00%	0	25.50%	42.50%	17.00%
From Administration	0	0	40.00%	_____	_____
			(= 28%/70%)		
Initial cost in pool	\$650,000	\$250,000	\$1,015,000	\$1,258,750	\$348,750
From Purchasing	_____	(250,000)	63,750	_____	_____
From Administration	(687,500)	0	_____	275,000	_____
Remainder in pool	\$0	\$0	\$_____	\$_____	\$_____

Solution at end of chapter.

## Connecting to Practice



*Utility companies rely on elaborate cost allocations to justify their rates to regulators. (Genesee 3—co-owned by EPCOR Utilities Inc. and TransAlta Corporation—is Canada’s cleanest coal-fired power generator. The facility is situated in Alberta, where the electricity industry is deregulated and power generation is a commercial venture.)*  
 (Courtesy of EPCOR)

### UTILITIES AND COST ALLOCATIONS

**EPCOR** is a major power and water utility in Alberta, Canada. **EPCOR** operates in regulated and unregulated markets. For its regulated business, **EPCOR** applies to the Alberta Utilities Commission for approval of revisions to its general tariffs (prices). In order to justify changes to its tariffs, **EPCOR** provides a detailed cost justification as part of its general tariff applications.

**COMMENTARY:** The **Alberta Utilities Commission** (formerly the **Alberta Energy and Utilities Board**) recognizes the incentive of rate-regulated companies to overestimate applicable costs to support tariff revisions. Accordingly, the commission requires detailed cost justification for any cost forecasts (estimates). Such estimates often include complex cost allocations including numerous interdepartmental/interunit allocations. **EPCOR** utilizes the services of accounting firms such as **KPMG** to certify its methods.

The first equation yields the total cost to be allocated, A, from the administration cost pool. It consists of \$650,000 directly traced to administration plus the cost of 15% of the services of the purchasing function that the Administration Department utilizes. Similarly, the second equation yields the total cost to be allocated, P, from the purchasing cost pool. It consists of \$250,000 directly traced to purchasing plus the cost of 30% of the services of the administration function that the Purchasing Department utilizes. Thus, the two equations, taken together, fully consider the reciprocal relation between administration and purchasing.

We solve this system of equations by substituting the second equation into the first equation:

$$A = \$650,000 + 0.15 \times (\$250,000 + 0.30 \times A)$$

We simplify to obtain:

$$0.955 A = \$687,500, \text{ or } A = \$719,895 \text{ (rounded)}$$

We substitute this value into the second equation and calculate:

$$P = \$250,000 + 0.30 \times \$719,895 = \$465,968 \text{ (rounded)}$$

In the second step, we use these values for A and P as the costs in the administration and purchasing activity cost pools, and we allocate using the utilization percentages from Exhibit 16.3. For example, from the adjusted administration pool of \$719,895, we allocate 30% or \$215,968 to purchasing, 28% or \$201,571 to both structural and plumbing, and 14% or \$100,785 to contracts. Exhibit 16.8 shows these computations.

While the reciprocal method is conceptually the most appealing method for allocating support costs, it is also the most complex. However, spreadsheet programs such as Excel greatly help in performing the numerous calculations involved. They also help us in readily extending the approach to more than two support pools. Nevertheless, many firms continue to employ the direct and step-down methods, which are computationally easier but yield only approximate answers.

## INTEGRATION WITH PREDETERMINED OVERHEAD RATES

From an implementation perspective, an organization performs support activity (support department) allocations at the same time it computes predetermined overhead rates, a topic we studied in Chapter 14. Suppose that SAC decides to use the reciprocal method. In this case, referring to Exhibit 16.8, we allocate \$719,895 and \$465,968, respectively, from the administration and purchasing cost pools. Furthermore, assume SAC allocates administration costs based on head count and there are 292 persons employed at SAC (excluding administration personnel). Dividing \$719,895 by 292, SAC would charge the other departments \$2,465 per person for administration costs.

*Check it!* Exercise #3 allows you to verify the charge for each purchasing order. From the perspective of the managers of line activities (structural, plumbing), the allocations are an “overhead” charge based on their individual head count and the number of purchase orders they issue.

	Cost Pools for Support Activities		Cost Pools for Line Activities		Final Cost Objects
	Administration	Purchasing	Structural	Plumbing	
<u>Consumption pattern for activities</u>					
From Administration		30.00%	28.00%	28.00%	14.00%
From Purchasing	15.00%		25.50%	42.50%	17.00%
From Structural					100.00%
From Plumbing					100.00%
Initial cost in pool	\$650,000	\$250,000	\$1,015,000	\$1,258,750	\$348,750
From Administration	(719,895)	215,968	201,571	201,571	100,785
From Purchasing	69,895	(465,968)	118,822	198,036	79,215
Remaining costs in pool	\$0	\$0	\$1,335,393	\$1,658,357	\$528,750

**Exhibit 16.8** *Silverman & Abbas Consulting: Reciprocal Method*

 **Check It! Exercise #3**

Calculate the overhead rate for a purchase order under the three methods. Recall that SAC has 1,000 purchase orders in total: 150 to administration, 255 to structural, 425 to plumbing, and 170 to contracts. Refer to Exhibits 16.5, 16.7, and 16.8 for the costs to be allocated under the different methods.

	<u>Direct</u>	<u>Step-down</u>	<u>Reciprocal</u>
Cost to be allocated for purchasing	_____	\$445,000	_____
Denominator volume	850 orders	_____	_____
Allocation rate per order	_____	_____	\$465.97

**Solution at end of chapter.**

*Check It! Exercise #3* emphasizes the effect of considering the reciprocity in consumption. Under the direct method, which ignores reciprocal consumption, SAC estimates that each order costs \$294.12. The rate per order (an estimate of the long-run cost effect) jumps to \$465.97 when we fully consider the interaction using the reciprocal method.

Just as we calculated the overhead rates for the support departments, we can calculate them for the line departments as well. Referring back to Exhibit 16.8, we find that the Structural Department has \$1,335,393 of costs in its cost pool, after the allocations from the support activities. Suppose the Structural Department expects to bill out 12,000 hours. Its hourly cost then is \$111.28.

**Dual-Rate Allocations**

**LEARNING OBJECTIVE 3**

**Discuss the need for dual-rate allocations.**



*Printing facilities have a mixture of fixed and variable costs; their costs are best allocated using dual rates. (Tim Fan/iStockphoto)*

In the previous section, we discussed three methods to incorporate the cost impact of the reciprocal relations among a firm’s various line and support activities. Notice that all the three methods employ a single cost driver to allocate costs. In essence, we are assuming that all the costs in each cost pool exhibit the same level of controllability over time.

This assumption is likely not valid. Some of the costs in the cost pool for purchasing, such as the cost of traveling to meet with suppliers, are controllable in the short term. Other costs, such as the salaries paid to personnel, may only be controllable over a longer horizon. Managers of departments that use the purchasing department must understand this variation in costs. When making decisions that place demands on the purchasing function, these managers should consider only costs that are controllable over the relevant time horizon for the decision.

Consider the Printing Department at SAC. This department operates specialized equipment for printing large drawings and blueprints required during the process of planning a building. All of the line departments—structural, plumbing, and so on—use these prints, though with varying intensity. Let the number of prints be the allocation basis, and assume that the rate, using the reciprocal method, is \$125 per print.

Now, consider the problem from the perspective of the Plumbing Department’s manager. Her department is charged \$125 for every print she orders, meaning that she will order a new print only when she believes the benefits exceed \$125. From her perspective, the cost of ordering prints is:

$$\text{Total cost of prints} = \$125 \times \text{actual number of prints}$$

Decisions made with this view of costs, however, could find the Plumbing Department underutilizing the Printing Department. Not all of the costs included in the \$125 rate per print are controllable in the short term. Suppose that \$50 of the \$125 represents variable costs, which are controllable in the short term, while the remaining \$75 is a charge for the long-term costs of acquiring and maintaining the printing machines. From SAC's perspective, as long as additional capacity is available in the printing machines, the manager of the Plumbing Department ought to order a print if the benefits exceed \$50 and not \$125.

How can SAC communicate differences in the controllability of the underlying costs to the manager of the Plumbing Department? One answer is to use many rates. For example, we could employ two cost pools—one for long-term or fixed costs, and one for short-term variable costs—to allocate the costs from printing. Of course, we then need to compute two rates to perform the allocation and determine the charge to plumbing. Splitting the rate into two then helps inform the plumbing manager about the different levels of controllability of these costs. Naturally, we refer to the allocation as a **dual-rate** or **two-factor** allocation. (In theory, we could use many rates, with each rate corresponding to a level in the cost hierarchy. In practice, firms employ two rates only.)

### Choice of Allocation Basis

When discussing ABC systems in Chapter 10, we argued that the driver we use to allocate costs should bear an economic relation with the cost we allocate. The same logic applies in the context of dual-rate allocations. Consider the cost pool for variable costs. These costs change with the volume of activity or with the number of prints made. Consequently, it is appropriate to allocate the costs in the variable cost pool using the number of prints as the driver.

Next, consider the cost pool for fixed costs. Fixed costs are the results of capacity decisions that span a longer horizon. Consequently, we need to tie the allocation to the factors that influence the long-term decision about capacity levels. The firm would have decided on capacity levels based on demand projections from the user departments. Accordingly, these long-term projections or expected demand are the appropriate basis for allocating fixed capacity costs.

In the context of SAC, assume that the Structural Engineering Department expects to use 1,500 prints during an average year, although it only used 1,300 prints during the current year. Then, the allocation to this department contains two amounts. The first amount is a lump-sum charge of \$112,500, obtained by multiplying the expected 1,500 prints  $\times$  \$75 per print. This amount is for the fixed costs incurred by the Printing Department, where \$75 per print is a charge for the long-term costs of acquiring and maintaining the printing machines. This amount is a lump-sum charge because both the long-term usage and the rate are *fixed* amounts, and do not change from year to year.

The second part is an allocation of \$65,000 for the variable costs. Here we multiply the actual number of prints (1,300) by the variable rate of \$50 per print. The Printing Department's variable costs are proportional to the actual number of prints made. Summing up, the following equation represents the structural engineering manager's costs for printing:

$$\begin{aligned} \text{Total allocated to structural engineering department from printing} \\ = \$112,500 + (\$50 \times \text{actual number of prints}) \end{aligned}$$

Such an allocation procedure communicates the differing controllability of costs in the Printing Department. The lump-sum charge is a committed cost that is the outcome of a long-term decision, and the variable portion is the outcome of shorter-term decisions.

## SUMMARY

In this chapter, we examined two refinements to the allocation systems that we considered in Chapters 9 and 10. The first refinement is to recognize the reciprocity in consumption among support activities. We discussed three methods that firms could use to model this consumption pattern: the direct method, the step-down method, and the reciprocal method. Second, we discussed the likelihood that a single driver (or equivalently, a single rate) is not enough to fully capture the controllability of costs contained in a cost pool. Accordingly, it may be more appropriate for firms to employ long-term expected demand to allocate fixed capacity costs and to use actual demand to allocate short-term variable costs.

## RAPID REVIEW

### LEARNING OBJECTIVE 1

#### Distinguish between line activities and support activities.

- In the two-stage allocation systems we studied in Chapters 8 and 9, we first group costs into cost pools that correspond to individual departments or activities. In the second stage, we allocate *all* costs from any given cost pool directly to products.
- In the standard two-stage allocation system, we implicitly assume that products account for the *entire* activity volume corresponding to all cost pools. While this assumption is reasonable for line activities, it does not accurately depict support activities. When a firm has support activities, we need to account for the interactions that exist among cost pools.

### LEARNING OBJECTIVE 2

#### Explain three methods used to allocate the costs of support activities to products.

- The three methods used to account for reciprocity in consumption are the direct method, the step-down method, and the reciprocal method.
- The direct method is computationally easy, but it ignores all interactions among support departments.
- The step-down method partially accounts for the reciprocity in consumption among support activities. The first step is to rank-order support departments as per some criterion, such as size. We then allocate the cost of support activities in sequence, eliminating one support activity with each allocation, eventually allocating all costs to line activities and to products.

- The reciprocal method is conceptually the most accurate method because it fully accounts for the reciprocity in consumption. We first model the allocation as a system of equations to obtain the fully loaded cost in each support activity. We then allocate this fully loaded cost to all other support and line activities.

### LEARNING OBJECTIVE 3

#### Discuss the need for dual-rate allocations.

- Because a cost pool accumulates costs from multiple sources, the costs in a pool often exhibit differing levels of controllability. Users of a support activity should be aware of this variation when they make decisions about their consumption levels.
- A single rate is not enough to capture the differences in controllability across different cost pools. From a user's perspective, a single rate implies that all costs are variable in the short term. We can partially address this problem by grouping costs within a cost pool into smaller pools, corresponding to the controllability of the underlying costs.
- We usually employ two subpools: one for long-term capacity costs and one for short-term variable costs. We allocate long-term costs using expected or long-term demand as the driver. This allocation is a lump-sum allocation because long-term demand is constant within an accounting period. We allocate short-term costs using the actual volume of service. We term this allocation procedure the dual-rate or the two-factor method to reflect its usage of two separate drivers.

## ANSWERS TO CHECK IT! EXERCISES

**Exercise #1:** After eliminating consumption by administration, plumbing consumes  $42.5\% / 85.0\% = 50\%$  of the purchasing activity and the Structural Department consumes  $25.5\% / 85.0\% = 30\%$  of the purchasing activity. Direct consumption by contracts accounts for the remainder of 20%.

**Exercise #2:** There is no need to revise the pattern for purchasing as we allocate costs to all units that consume this activity. The revised consumption pattern from administration =  $(28\% / 70\%) = 40\%$  for plumbing and  $(14\% / 70\%) = 20\%$  for contracts.

Costs allocated from purchasing are  $(0.15 \times \$250,000) = \$37,500$  to administration,  $\$106,250 (= \$250,000 \times 0.425)$  to plumbing, and  $\$42,500 (= \$250,000 \times 0.17)$  directly to contracts. The total cost in administration is now  $\$37,500 + \$650,000 = \$687,500$ .

From administration, we therefore allocate  $0.4 \times \$687,500 = \$275,000$  each to structural and plumbing, and  $(0.20 \times \$687,500) = \$137,500$  directly to contracts. The final totals are  $\$1,353,750$  for structural,  $\$1,640,000$  for plumbing, and  $\$528,750$  for contracts.

**Exercise #3:** Under the direct method, total cost is  $\$250,000$  (Exhibit 16.5) and the denominator volume is 850 orders ( $1,050 - 50$  for self-consumption  $- 150$  for administration). Thus, the rate per order is  $\$294.12$  (rounded). For the step-down method, the cost in the pool is  $\$445,000$  (Exhibit 16.7). Because we only allocate these costs to structural, plumbing, and contracts, the denominator volume is  $255 + 425 + 170 = 850$  orders. Thus, the rate is  $\$523.53$  per order (rounded). The denominator volume for the reciprocal method is 1,000 orders (we include the 150 orders from administration as we allocate costs back to administration). The rate is  $\$465,968 / 1,000$  orders =  $\$465.97$  per order.

## SELF-STUDY PROBLEMS

Popov and Company make tappets, used in engines, in a small manufacturing firm in Moscow, Russia. The firm's owner, Vladimir Popov, provides you with the data shown in Exhibit 16.9.

Vladimir has requested your help in allocating the costs of the power and the maintenance activities to the line activities, machining and assembly.

a. Perform the required allocation using the direct method.

Under the direct method, we ignore the consumption of support activities by other support activities. Thus, as shown in the top part of Exhibit 16.10, we first re-compute the consumption percentages for the support activities. For instance, consider the row "From Power." Eliminating the 20% consumed by maintenance (see Exhibit 16.9), we obtain the consumption percentage for machining as  $40\% / (40\% + 40\%) = 50\%$ . We follow a similar procedure to obtain the other consumption percentages.

**Exhibit 16.9** *Popov & Company: Consumption Pattern for Activities*

	Cost Pools for Support Activities		Cost Pools for Line Activities	
	<i>Power</i>	<i>Maintenance</i>	<i>Machining</i>	<i>Assembly</i>
Costs in pools	\$288,000	\$261,000	\$100,000	\$160,000
<u>Consumption pattern for activities</u>				
From Power		20.00%	40.00%	40.00%
From Maintenance	25.00%		50.00%	25.00%

<b>Exhibit 16.10</b> <i>Popov &amp; Company: Direct Method</i>				
	<b>Cost Pools for Support Activities</b>		<b>Cost Pools for Line Activities</b>	
	<i>Power</i>	<i>Maintenance</i>	<i>Machining</i>	<i>Assembly</i>
<u>Consumption pattern (re-computed)</u>				
From Power			50.00%	50.00%
From Maintenance			66.67%	33.33%
<u>Cost allocation</u>				
Cost in pool after stage 1	\$288,000	\$261,000	\$100,000	\$160,000
From Power	(288,000)		144,000	144,000
From Maintenance		(261,000)	174,000	87,000
Total after allocations	\$0	\$0	\$418,000	\$391,000

Next, we use these percentages to allocate costs from the support activities to the line activities. Thus, referring to the allocation for power, we allocate  $0.5 \times \$288,000 = \$144,000$  to machining and an equal amount to assembly.

- b. *Perform the required allocation using the step-down method. Allocate the cost of power before allocating the cost of maintenance.*

We are given the ranking of the support activities for the allocation. (Size could be the criterion used here.) Thus, we allocate costs from the Power Department to the maintenance activity, but not vice versa.

First, let us recompute the allocation percentages shown in Exhibit 16.11. There is no need to revise the allocation percentages for power because we allocate the costs to all other support and line activities. However, we ignore consumption by the Power Department when allocating maintenance (a lower ranked department). Thus, we recompute the percentages as  $50/75 = 66.67\%$  and  $25/75 = 33.33\%$ .

The next two lines show the actual allocation. From power, we allocate  $0.20 \times \$288,000 = \$57,600$  to maintenance and  $0.40 \times \$288,000 = \$115,200$  each to machining and assembly. The row "From Power" shows that we allocate 66.67% of the cost to machining and 33.33% to assembly.

- c. *Suppose the Maintenance Department allocates its costs using maintenance hours. Further, Popov expects to consume 21,240 maintenance hours (which includes 5,310 hours by power). Compute the cost rates per maintenance hour under the step-down method.*

Referring back to Exhibit 16.11, we know that the maintenance cost pool has \$318,600 of costs. Next, under the step-down method we exclude the consumption by power as this method does not consider this link. Thus, the appropriate denominator volume is  $21,240 - 5,310 = 15,930$  hours. Accordingly, we have:

$$\text{Rate per maintenance hour} = \$318,600 / 15,930 \text{ hours} = \$20 \text{ per maintenance hour}$$

<b>Exhibit 16.11</b> <i>Popov &amp; Company: Step-Down Method</i>				
	<b>Cost Pools for Support Activities</b>		<b>Cost Pools for Line Activities</b>	
	<i>Power</i>	<i>Maintenance</i>	<i>Machining</i>	<i>Assembly</i>
<u>Consumption pattern (re-computed)</u>				
From Power		20.00%	40.00%	40.00%
From Maintenance			66.67%	33.33%
<u>Cost allocation</u>				
Cost in pool after stage 1	\$288,000	\$261,000	\$100,000	\$160,000
From Power	(288,000)	57,600	115,200	115,200
From Maintenance		(318,600)	212,400	106,200
Total after allocations	\$0	\$0	\$427,600	\$381,400

d. Perform the required allocation using the reciprocal method.

The first step in the reciprocal method is to represent the consumption patterns as a system of equations. Representing power and maintenance by P and M, respectively, we have:

$$P = \$288,000 + (0.25 \times M)$$

$$M = \$261,000 + (0.20 \times P)$$

Plug in the second equation into the first equation to get:

$$P = \$288,000 + 0.25 \times (\$261,000 + 0.20 \times P)$$

Simplifying, we get:

$$P - 0.05 P = \$288,000 + 65,250, \text{ or } P = \$371,842 \text{ (rounded)}$$

Plugging in the value into the second equation, we calculate  $M = \$335,368$  (rounded).

Using these estimates, Exhibit 16.12 shows the required allocations. Notice that we allocate costs from the Power Department to the maintenance activity and vice versa.

e. Suppose the Machining Department allocates its costs using machining hours. Further, suppose that Popov expects to consume 20,000 machine hours. Compute the cost rates per machining hour under the step-down and reciprocal methods. Comment on why the rates differ.

Referring back to Exhibit 16.11, we know that the machining cost pool has \$427,600 of costs under the step-down method. Accordingly, we have:

$$\begin{aligned} &\text{Rate per machine hour (step-down)} \\ &= \$427,600 / 20,000 \text{ hours} = \$21.38 \text{ per machine hour} \end{aligned}$$

Likewise, referring back to Exhibit 16.12, we obtain the cost for machining as \$416,421 under the reciprocal method. We therefore obtain:

$$\begin{aligned} &\text{Rate per machine hour (reciprocal)} \\ &= \$416,421 / 20,000 \text{ hours} = \$20.82 \text{ per machine hour} \end{aligned}$$

The two rates differ because the methods differ in the extent to which they account for reciprocity of consumption. Unlike the step-down method, the reciprocal method fully considers the relations and is therefore more accurate.

	Cost Pools for Support Activities		Cost Pools for Line Activities	
	Power	Maintenance	Machining	Assembly
<u>Consumption pattern</u>				
From Power		20.00%	40.00%	40.00%
From Maintenance	25.00%		50.00%	25.00%
<u>Cost allocation</u>				
Cost in pool after stage 1	\$288,000	\$261,000	\$100,000	\$160,000
From Power	(371,842)	74,368	148,737	148,737
From Maintenance	83,842	(335,368)	167,684	83,842
Total after allocations	\$0	\$0	\$416,421	\$392,579

**GLOSSARY**

**Direct method** An allocation procedure that ignores the relationship among support activities and focuses instead on the relationship between support and line activities.

**Dual-rate allocations** A procedure that employs two separate drivers to allocate fixed and variable costs in a cost pool.

**Line activity** An activity that is directly related to making and selling the firm's products and services.

**Reciprocal method** An allocation procedure that fully accounts for the relationship among support activities.

**Reciprocity in consumption** A consumption pattern in which two departments provide services to each other.

**Self-consumption** A support department consuming its own output.

**Sequential allocation** See Step-down method.

**Step-down method** An allocation procedure that partially accounts for the relationship among support activities.

**Support activity** An activity that is not a line activity. These activities help the firm execute the line activity.

**Two-factor allocation** See Dual-rate allocation.

## REVIEW QUESTIONS

- 16.1 **LO1.** What is the distinction between a line activity and a support activity? Give two examples of each.
- 16.2 **LO1.** What complicates the allocation of support activity costs?
- 16.3 **LO2.** What are the three methods for allocating the costs of support activities?
- 16.4 **LO2.** Name one important difference between the step-down method and the direct method?
- 16.5 **LO2.** Does changing the order in which we allocate the costs of support activities matter under the step-down method? Does it matter for the direct or reciprocal methods?
- 16.6 **LO2.** How do we account for the self-consumption of resources (e.g., the power consumed by the Power

Generation Department, or the Payroll Department processing checks for the employees in human resources) when we perform a step-down allocation?

- 16.7 **LO2.** Name one important difference between the reciprocal method and the step-down method.
- 16.8 **LO3.** Describe the dual-rate allocation method.
- 16.9 **LO3.** In a dual-rate allocation, what is the allocation basis for allocating capacity costs? for operating costs?
- 16.10 **LO3.** What is the advantage of using budgeted instead of actual costs when determining the overhead rates to employ for allocating the costs of support activities?

## DISCUSSION QUESTIONS

- 16.11 **LO1.** What is the implicit time horizon that we assume when we allocate support activity costs to other cost objects such as products and other activities?
- 16.12 **LO2.** We rank support departments when using the step-down method. Alternate ranking criteria include department size, number of other departments serviced, and arbitrary ranking. Which method will usually produce the smallest errors, relative to the answers obtained from the conceptually accurate reciprocal method?
- 16.13 **LO3.** Why do we prefer to use predetermined rates to charge out support department costs to other departments?
- 16.14 **LO1 (Advanced).** What is the key difference between an allocation from a support department and a transfer price? Does this distinction matter for pricing the service? For evaluating responsibility center managers?
- 16.15 **LO3 (Advanced).** Suppose a support activity allocated all of its costs based on actual usage of its

services and use of actual rates. In this scenario, how does the activity volume in one department affect the costs allocated to other activities? Why is such dependence undesirable?

- 16.16 **LO3.** Would the issue in the above question become moot if we employed predetermined overhead rates? Why does the answer depend on whether the decline in volume was predictable?
- 16.17 **LO3.** How does the use of practical capacity (see Chapter 10) further alleviate the issue identified in Question 16.15?
- 16.18 **LO3.** Under the dual-rate system, expected long-term demand is the allocation basis for allocating the capacity costs of support activities. What incentives does this provide to managers of line activities?
- 16.19 **LO3.** How could we accommodate the use of batch- and product-level costs in a dual-rate allocation system?
- 16.20 **LO3.** Would a dual-rate allocation make sense for allocating facility level costs? Why or why not?

## EXERCISES

**16.21 Direct method (LO2).** The City of Pleasantville has two departments—Parks and Recreation (P&R) and Facility Maintenance (FM)—that provide services to its citizens. The P&R Department offers many programs in art, culture, and athletics, while the FM Department maintains all of the streets, buildings, and other public facilities. Behind the scenes, Pleasantville has two departments that support the activities of the P&R and FM departments. The Human Resources Department processes payroll and oversees all hiring, development, and training. The General Administration Department provides overall coordination and managerial support.



The following table provides data regarding the consumption of services by the various activity pools/departments, as well as the amount of costs traced to each activity pool.

		Human Resources	General Administration	Parks and Recreation	Facilities Maintenance
<b>Traced costs</b>		\$100,000	\$60,000	\$360,000	\$450,000
<b>Service consumption pattern</b>					
		<i>Services consumed by</i>			
		Human Resou	General Administration	Parks and Recreation	Facilities Maintenance
<i>Services provided by</i>	Human Resources		40%	30%	30%
	General Administration	20%		60%	20%

*Required:*

Allocate the costs of the two support departments to the line departments, using the direct method. Compute the total costs in the cost pool for the P&R and FM departments.

**16.22 Step-down method (LO2).** Consider the data in Exercise 16.21

*Required:*

- Compute the total costs in the cost pool for the P&R and FM departments, using the step-down method to allocate the costs of the two support departments to the line departments. Allocate the costs of Human Resources before allocating the costs for General Administration.
- Repeat requirement (a), but allocate the costs of General Administration before allocating the costs for Human Resources.
- Comment on why you obtain different results for requirements (a) and (b).

**16.23 Reciprocal method (LO2).** Consider the data in Exercise 16.21.

*Required:*

- Compute the total costs in the cost pool for the P&R and FM departments, using the reciprocal method to allocate the costs of the two support departments to the line departments.
- Comment on which of the answers from Exercises 16.21, 16.22, and 16.23 provides the most accurate estimate of the cost of the support services consumed by the P&R and FM departments.

**16.24 Allocations and decision making (LO2).** Refer to Exercise 16.21. You have allocated the costs from the Human Resources and General Administration departments to the P&R and FM departments. Suppose you have determined that the cost pool for the P&R Department contains \$473,200 in costs and the pool for the FM Department contains \$506,800 in costs after these allocations. (These numbers may or may not be the answers to the requirement for Exercise 16.21.)

*Required:*

- The P&R Department offered a total of 18,200 hours of instruction. What is the City's total cost per instruction hour provided by the P&R department?
- How might the City use this information in its decision making?



**16.25 Role for interactions (LO2).** Sriram Motor Works manufactures scooters and other two-wheelers for sale in Asia. The firm has divided its operations into two main factories: one in Pune, India, and the other in Malaysia. The firm is contemplating the best way to allocate the support costs in the head office to the two divisions. The following data are available.

		<i>Human Resources</i>	<i>General Administration</i>	<i>Indian Division</i>	<i>Malaysian Division</i>
<b>Traced costs</b>		\$760,000	\$1,460,000	n/a	n/a
<b>Service consumption pattern</b>		<i>Services consumed by</i>			
		<i>Human Resources</i>	<i>General Administration</i>	<i>Indian Division</i>	<i>Malaysian Division</i>
<i>Services provided by</i>	Human Resources			40%	60%
	General Administration			50%	50%

*Required:*

- Determine the costs allocated to the Indian and the Malaysian divisions using the direct method.
- Repeat the requirement using the step-down method.
- Why do your answers not depend on the method you use?



**16.26 Direct method (LO2).** T<sup>3</sup> Technology Services provides consulting services to government and corporate clients. Because of security concerns, the firm has a separate staff servicing the two kinds of clients. However, one information systems group services the two groups of consultants. Likewise, a single administrative department provides all needed secretarial and administrative support.

T<sup>3</sup> wishes to base its billing rates on the cost per hour of consulting provided by its staff. Assume that each person in the Government and Corporate consulting group provides 1,500 hours of billable support per year. The following table provides relevant data.

		<i>IS</i>	<i>AS</i>	<i>Government</i>	<i>Corporate</i>
<b>Traced costs</b>		\$500,000	\$300,000	\$2,400,000	\$3,240,000
<b>Service consumption pattern</b>		<i>Services consumed by</i>			
		<i>IS</i>	<i>AS</i>	<i>Government</i>	<i>Corporate</i>
<i>Services provided by</i>	IS (hours)		4,000 hours	2,000 hours	4,000 hours
	AS (Persons)	5		20	25

T<sup>3</sup> Technologies allocates the costs of the IS Department using the hours of support provided and the AS Department costs by the head count in the user departments.

*Required:*

Determine the costs per hour of consulting provided by the Government and Corporate groups after using the direct method to allocate support department costs to the Government and Corporate groups.

**16.27 Step-down method (LO2).** Refer to Exercise 16.26. Suppose that Government regulations require T<sup>3</sup> Technologies to use the step-down method to allocate the costs of support departments and activities to line departments. However, these regulations do not dictate the order in which to allocate the cost of support activities. The Government would then reimburse T<sup>3</sup> Technologies at 115% of allowable cost, assuming 1,500 billable hours per person. The corporate clients, of course, do not care about T<sup>3</sup> Technology's cost. They would simply refuse to hire T<sup>3</sup> Technology's services if it charged more than the market rate of \$100 per billable hour.

*Required:*

Advise T<sup>3</sup> Technology's management on how it could refine its allocation procedures to maximize its reported profit.

**16.28 Reciprocal method (LO2).** Refer to Exercise 16.26. Suppose that government regulations require T<sup>3</sup> Technologies to use the reciprocal method to allocate the costs of support departments and activities to line departments.

*Required:*

- a. Determine the cost per hour billed to the Government.
- b. Comment on whether T<sup>3</sup> Technologies could boost reported profit by changing the order in which it allocates the costs of support departments to line departments.

**16.29 Reciprocal method (LO2).** Consider the following data pertaining to two support and two line departments.

		<i>S1</i>	<i>S2</i>	<i>P1</i>	<i>P2</i>
<b>Traced costs</b>		\$16,000	\$25,000		
<i>Services provided by</i>	<i>S1</i> (in hours)		200	400	400 hours
	<i>S2</i> (in persons)	10		30	60 persons

*Required:* Use the reciprocal method to determine the costs allocated to P1 and P2.

**16.30 Dual-rate method (LO3).** Suppose a firm’s secretarial pool incurs \$40,000 in fixed costs plus \$15 in variable costs for each hour of service. This amount of fixed costs allows the pool to accommodate an average volume of 5,000 hours of support per month.

The following data pertain to usage patterns (in hours used) for the three departments that are the only users of the secretarial pool.

	<i>Average Planned Usage (hours)</i>	<i>Actual Usage (in hours)</i>		
		<i>April</i>	<i>May</i>	<i>June</i>
Department 1	2,000	2,000	2,000	2,000
Department 2	2,000	1,500	2,500	2,000
Department 3	1,000	700	700	800
Total	5,000	4,200	5,200	4,800

Actual secretarial costs for April, May, and June amounted to \$110,000, \$123,000, and \$112,000, respectively.

*Required:*

- a. Determine the cost allocated to each of the three departments if the firm used a single rate, based on actual costs and usage, to allocate secretarial costs to the user departments.
- b. Repeat the allocation assuming that the firm uses a single rate to allocate costs but it employs costs (as determined by a flexible budget that we discussed in Chapter 8) to compute the rates.
- c. Repeat the allocation assuming that the firm employs separate rates for allocating fixed and variable costs. Assume that long-run usage is the denominator volume for allocating fixed costs.
- d. Which of these mechanisms would you recommend? Why?

## PROBLEMS

**16.31 Support department allocations (LO2).** Montclair, Inc., has three support departments: Cafeteria, Janitorial, and Administration. It also has two line departments: Machining and Assembly. The following data pertain to operations for the most recent year.



		<i>Cafeteria</i>	<i>Janitorial</i>	<i>Administration</i>	<i>Machining</i>	<i>Assembly</i>
<b>Traced costs</b>		\$100,000	\$60,000	\$360,000	\$450,000	\$560,000
		<i>Services provided to</i>				
		<i>Cafeteria</i>	<i>Janitorial</i>	<i>Administration</i>	<i>Machining</i>	<i>Assembly</i>
<i>Services provided</i>	<i>Cafeteria</i>		20%	20%	30%	30%
	<i>Janitorial</i>	25%		10%	35%	30%
	<i>Administration</i>	20%	10%		20%	50%

*Required:*

- Allocate the costs traced to the support activities (departments) to the line activities (departments), using the direct method.
- Allocate the costs traced to the support activities (departments) to the line activities (departments), using the step-down method. Rank support departments by size to determine the order of allocation.
- Continue with your answer to part (b) above. Suppose the Machining Department expects to incur 10,000 machine hours for the month and the Assembly Department expects to incur 25,000 labor hours. Determine the overhead rate per machine hour in the Machining Department and per labor hour in the Assembly Department.



**16.32 Support department allocations (LO2).** Pickoff and Dropoff Co. run a limousine firm. The firm has both luxury limousines rented by time and a shuttle bus support to the airport. Two separate managers, evaluated as profit centers, oversee each service. Pickoff and Dropoff also have two cost pools for support activities: maintenance and administration. The following table provides relevant data:

		Maintenance	Administration	Limo	Shuttle
<b>Traced costs</b>		\$75,000	\$30,000	\$240,000	\$324,000
<b>Service consumption pattern</b>					
		<i>Services consumed by</i>			
		Maintenance	Administration	Limo	Shuttle
<i>Services provided</i>	Maintenance		4,000 hours	2,000 hours	4,000 hours
	Administration	5 persons		20 persons	25 persons

The limousine expects to offer 10,000 hours of service, and the shuttle expects to provide 25,000 hours.

*Required:*

- Allocate the costs of the support activities (departments) to the line activities (departments) using the direct method. Calculate the hourly cost rates for the limousine and shuttle services.
- Allocate the costs of the support activities (departments) to the line activities (departments), using the step-down method. Rank support departments by size to determine the order of allocation.
- Allocate the costs of the support activities (departments) to the line activities (departments), using the reciprocal method.
- Which of the rates do you think is most accurate? Why?

**16.33 Support department allocations (LO2).** James and Quigley, LLC, is a CPA firm that offers both tax and audit services to its clients. The firm bills clients for cost plus 10%. It is straightforward to trace the direct costs associated with a particular client or engagement. However, the firm also incurs about \$45,000 in support costs (or overhead) each month. Currently, the firm accumulates this overhead costs into three pools. The tax-related pool contains the cost of subscribing to tax journals, tax-related training, and so on. Likewise, the audit pool contains costs related to maintaining audit expertise. The final pool, administration, pertains to costs such as maintaining the office and secretarial support.

The firm wishes to explore alternative ways of allocating this overhead to clients so that each client is charged for its fair share of the CPA firm's overhead costs. The following table provides relevant data.

		Audit	Tax	Adminis- tration	Client 1	Client 2
<b>Traced costs</b>		\$15,000	\$7,500	\$22,500		
<i>Services provided by</i>	Audit				40%	60%
	Tax				70%	30%
	Administration	10%	20%		40%	30%

*Required:*

- Using the step-down method, what is the overhead cost allocated to each client? Allocate administration costs first.

- b. Recall that there are three methods—the direct method, the step-down method, and the reciprocal method—for allocating support department costs. Would your answer to part (a) differ if you employed the direct method? Why or why not?
- c. Would your answer to part (a) hold regardless of the order in which we allocated support activities for the step-down allocation?
- d. Using logic rather than numbers, argue why your answer to part (a) would not differ if you employed the reciprocal method?

**16.34 Dual-rate allocation (LO3, Advanced).** The Consummate Consulting Company (CCC) offers a range of consulting services, grouped into Strategic, Technology, Cost, Marketing, and Personnel. The company allocates the cost of supporting personnel (e.g., the cost to process payroll, maintain HR policies, and so on) to user groups based on head count (i.e., the number of persons employed in the consulting group). The following data pertain to the most recent year.

Group	Strategic Management	Technology Management	Cost Management	Marketing Management	Personnel Management
Staffing	25	45	12	50	18

At the current staffing level of 150 employees, CCC estimates that providing staff services costs \$12,250 per month. CCC expects personnel administration costs to increase to \$12,875 if staff size increases to 175 persons; likewise, costs would decrease to \$11,625 if employment were to drop to 125 persons only.

*Required:*

- a. Allocate the current costs to the five consulting groups in proportion to their current staffing levels.
- b. The Cost Management group recently lost a subgroup that focused on Business Process Outsourcing. The group previously had 20 persons instead of the 12 persons now employed. Compute the cost prior to the drop-off in staffing. Compute the costs allocated to the Strategic Management group (which had no change in staffing levels) before and after the change in staffing levels for the Cost Management group. (*Hint:* Use the high-low method to figure out the fixed and variable costs for staffing.)
- c. How could CCC modify its allocation procedures to reduce the effect of actions in one group affecting the costs allocated to other groups?

**16.35 Support department allocations and make or buy (LO2, Advanced).** The Grand Mogul is a 5-star hotel in Mumbai, India. The hotel has installed its own electrical generators to supplement the normal power supply and to ensure uninterrupted power to its demanding clientele. The Power Department now generates 1,200,000 KWh of energy per year. The hotel also has a large Maintenance Department that keeps the hotel's facilities and equipment in excellent working condition. The following data are available (Rs. denotes Indian currency).

		Maintenance	Power Generation	All Other Hotel Operations
<b>Traced costs</b>		Rs. 1,750,000	Rs. 3,000,000	Not relevant
<b>Service consumption pattern</b>				
		Maintenance	Power	Hotel Operations
Services provided by	Maintenance		30%	70%
	Power	20%		80%

A local firm, with independent power generation capabilities, approaches the Grand Mogul and offers to sell it all needed power for Rs.3.00 per KWh. If it chooses to buy needed power, the Grand Mogul would eliminate the power generation equipment and all associated staff, and put the freed space to other uses. Hotel management is confident of support quality, and so; the decision will turn on monetary considerations alone.

*Required:*

- a. Evaluate the monetary benefits of outsourcing power generation to the local firm. Be sure to consider the effects of eliminating the Power Department on the costs incurred in the Maintenance Department.

- b. What other information would you like in order to improve the confidence in your estimated monetary benefit? How will this information help improve your decision?

**16.36 Dual-rate allocations (LO3).** The Waterworks Department of the City of Pleasantville provides services to both the Parks and Recreation Department and the citizens of Pleasantville. Recently, a citizen has approached you to complain (nicely) about the wide variations in her water bills. The citizen's household had consumed exactly 2,500 gallons of water each month, but the actual bill varied quite a bit. Looking into the matter, you discover the following:

1. March: As per normal patterns, the residents consumed 1.75 million gallons of water, and the P&R Department consumed 0.25 million gallons.
2. May: The city filled several large outdoor swimming pools with water in preparation for the summer. Thus the P&R Department consumed 750,000 gallons of water, raising total consumption to 3 million gallons. Usage by residents was also higher than normal at 2.25 million. You know that maximum usage almost never exceeds these levels.
3. December: The P&R Department was mostly shut down, reducing its usage to only 0.10 million gallons of water. Overall use by residents also dipped to 1.4 million gallons, perhaps because they were traveling for the holidays.

You discover that the City's Water Department anticipates a periodic surge in demand (to fill pools, skating rinks, fight fires, and so on). Consequently, the City has installed capacity to process 3 million gallons of water per month. The City anticipates that residents would consume 1.75 million gallons on average, with a low of 1.4 million gallons and a high of 2.25 million gallons per month. Likewise, the P&R Department could consume anywhere from 0.1 to 0.8 million gallons per month.

The water treatment plant budgets for fixed costs of \$30,000 per month and variable cost of 0.015 per gallon of water.

*Required:*

- a. Calculate the resident's bill for March, May, and December using actual usage and budgeted costs.
- b. Repeat requirement (a) using dual rates. That is, allocate fixed costs based on maximum usage and variable costs based on actual usage.
- c. Comment on the costs and benefits of using dual rates to determine the water bill mailed out to individual residents.

**16.37 Dual-rate allocations (LO3).** Drs. Steven Wolf and Robert Brown are partners in an orthopedic clinic located in suburban Detroit. Recently, the clinic acquired an X-ray machine. The two physicians have approached you for help in equitably allocating the machine's cost between themselves. They provide the following data:

	<i>Dr. Brown</i>	<i>Dr. Wolf</i>
Expected use per month	300 exposures	200 exposures
Actual use for March	240 films	240 films

They also tell you that their actual variable cost of \$10,720 was \$1,120 higher than their expected cost of \$9,600, or \$20 per film. The expected fixed cost (machine, amortizing room modification, salary for technician, and so on) was \$7,500 for the month. Actual cost was \$8,000.

*Required:*

- a. Determine the cost allocated to each physician under the following schemes:
  - Total actual cost allocated in proportion to actual use.
  - Total expected cost (per flexible budget) allocated in proportion to budgeted use.
  - Expected fixed cost allocated in proportion to expected use, expected variable cost allocated in proportion to actual use.
- b. Which of the above allocations do you think is most equitable? Why?

**16.38 Dual-rate allocations (LO3).** Prestige U.'s world-renowned management school offers MBA programs to three audiences: daytime students, evening students, and executives. The school prides itself on student support, meaning that the students get numerous handouts each class. These handouts cover lecture outlines, assignments, suggested

solutions, articles from the academic and practitioner press, and so on.

A different administrator operates each program. The administrator's charge is to reduce the costs of operating the program while maintaining adequate quality. The following dispute has arisen over the allocation of the costs of the copy center: \$24,000 + 0.03 cents per copy.

The following data are available:

	<i>Program</i>			<i>Total</i>
	<i>Daytime</i>	<i>Evening</i>	<i>Executive</i>	
<u>Most recent quarter</u>				
# of copies	600,000	500,000	400,000	1,500,000
# of students	300	600	100	1,000
<u>Long-term average</u>				
# of copies	720,000	450,000	330,000	1,500,000
# of students	400	500	100	1,000

*Required:*

- Suppose all costs were allocated to the programs based on the actual number of students. Determine the cost allocated to each program.
- Comment on the allocation in part (a). Suggest a superior driver, keeping in mind that the university wishes to use a single number (one rate) to charge out copy center costs.
- How would you improve the allocation procedure to reflect the consumption of copy center resources by the various programs? Be sure to consider the drivers of fixed and variable costs in your answer.

**16.39 Dual-rate allocations (LO3, Advanced).** Kevin DenAdel is the chief executive officer of a biotechnology firm that specializes in developing disease- and drought-resistant strains of wheat, corn, and soybeans. The firm is organized into three divisions, with separate staff, facilities, and equipment. However, because the underlying science is similar, all three divisions use the same technology, albeit with differing intensity. The current debate centers on the cost of the DNA sequencing machine.

*Wheat Division:* We currently sequence about 1,000,000 base pairs each year at a cost of \$0.45 per base pair. We looked into getting our own machine. We found one that has enough capacity. Its annual fixed cost is \$400,000. As per industry standards, variable costs would be \$0.10 per base pair, regardless of scale. So, we are still getting the sequencing done by a reliable vendor.

*Corn Division:* We are in the same boat, although our volume is only 500,000 base pairs a year. We can get a small machine, but it is not cost-effective. It will cost us close to \$0.55 per pair when we can get it done outside for \$0.45 per pair. When our volume increases, as we anticipate, we may revisit this issue.

*Soybean Division:* We are probably the least intensive users of sequencing. Maybe we make 100,000 pairs in a year, and it is simply not viable for us to get a machine. The smallest machine will give us five times the capacity we need.

Knowing that the firm is currently paying \$720,000 for DNA sequencing, Kevin is looking into buying a machine to satisfy the needs of all three divisions. He has found a machine that has a capacity of 2 million base pairs a year. This machine will trigger annual fixed costs of \$550,000.

*Required:*

- Calculate the change in the firm's profit if Kevin decides to buy the machine and has all sequencing done internally.
- What other factors should Kevin consider in his decision?
- Suppose Kevin acquires the machine and instructs all divisions to do their sequencing in-house. How much cost should be allocated to each division?
- The head of the Soybean Division argues that none of the fixed cost should be allocated to her division. She argues that the firm would have likely bought the machine whether her division wanted it or not, and that she is merely using the capacity that would otherwise go to waste. Evaluate the merits of this argument.