Chapter 5

Activity-Based Cost Systems

After completing this chapter, you will be able to:

1. Understand how volume-based cost systems distort product costs.
2. Describe why companies producing a more varied and complex mix of products have higher costs than companies producing only a narrow range of products.
3. Design an activity-based cost system that directly traces resource costs to products.
4. Use the information from an activity-based cost system to improve operations and make better decisions about products.
5. Understand the importance of measuring the practical capacity of resources and the cost of unused capacity.
6. Appreciate the role for activity-based cost systems for service companies.
7. Discuss the barriers for implementing activity-based cost systems and how these might be overcome.

Madison Dairy

Christine Lee, the controller of Madison Dairy, was concerned about the company's decline in profitability. In recent years, Madison had diversified into new lines of business yet profits had not kept pace with sales volume increases. Many costs, which Lee thought would be fixed, were turning out not to be; in fact, categories such as factory overhead, warehousing, distribution, and administrative expenses had been increasing faster than sales. She was puzzled with the continual increase in the company's indirect and support expenses.

During the 1990s, Madison Dairy had experienced a major consolidation in its customer base, as small independent retailers became absorbed or put out of business by giants such as Wal-Mart, SuperValu, Target, and Sysco. The buying power from these large distributors and retailers put suppliers' margins under heavy pressure.

Madison had also introduced more specialized packaging, distribution, warehousing, and just-in-time replenishment services in response to demands from its wholesale and retail customers. Madison operated a complex transportation system that offered its customers multiple delivery options. Trucks delivered full loads to supermarkets and their distribution centers, and made direct deliveries of less-than-truckload quantities to convenience outlets and other small retail stores. It also used double-stacked containers to ship frozen loads of ice cream to distribution centers across the United States. And it still made home deliveries of small quantities of milk, cream, and yogurt to insulated boxes outside consumers' homes and apartments.

Madison's plants, responding to customer and consumer demand for high product variety, operated complex production processes. They produced high-volume, standard products in large production runs as well as small runs of special recipes of ice cream, yogurt, and milk.

Madison's standard cost system had excellent data about materials costs and plant operating expenses at the department level. The system allocated factory overhead as a percentage of direct manufacturing costs. The standard costs, however, did not reflect the effects of run size since the system did not incorporate information about the setups or tear downs as machines shifted between flavors, products, and packaging. The unit costs were the same whether the production run lasted for 10 minutes or 10 hours.

Changeovers were costly since some product was lost at the start of each production run until the process stabilized, and also lost at the end

As at Ericson Ice Cream, setups are done between jobs at the manufacturing company pictured here, and are sometimes time-consuming and therefore, costly. Many production and operations-management techniques can reduce setup times. Data about the cost of such labor form part of an activity-based costing system.
Will & Deni McInture/Photo Researchers, Inc.

of each run when the machine had to be stopped and cleaned to prepare for the next product. In addition to the material losses at the beginning and end of each production run, the company incurred a high opportunity cost during changeovers, as expensive machines were not producing salable product. On the filling line, changeovers occurred when personnel had to set up for customers' special labels and containers.

Lee realized that the cost system, which had been developed when the company had a much simpler product line and many fewer delivery and packaging options, no longer reflected the cost of producing its diverse product line, storing and picking the products in the warehouse, and delivering them, through multiple mechanisms, to its highly diverse customer base ranging from a family using one quart of milk per week up through giant customers such as Wal-Mart and Target. She wondered how to obtain accurate cost and profit information for the far more complex environment that Madison now faced. She believed the company could make much better decisions about its product mix, pricing, and operating processes if it had a more accurate understanding of the company's cost structure.

Traditional Manufacturing Costing Systems

Chapters 3 and 4 described fundamental concepts in costing. In Chapter 3, you learned about incremental, avoidable, sunk, and opportunity costs and how to use these concepts to make better decisions. Chapter 4 discussed cost system design, how to accumulate expenses in various cost buckets, both production and support, and how to assign service department costs to production departments to calculate cost rates for products and services that are processed through the cost centers.

In this chapter, we discuss systems that assign production costs to products. Product costing systems are important because product volume and mix explain a large percentage of the costs that companies incur. If companies want to influence their costs, they must understand the relationship between the volume and mix of the products they produce and the expenses they incur. Product costs provide the bridge between operating expenses and production output. If poorly designed product costing systems report inaccurate product costs, companies can make poor decisions on resource supply, product mix, pricing, order acceptance, and customer relationships.

Product costing systems start by assigning direct labor and direct materials costs to products. This aspect is straightforward and has been done reasonably well for about a century. For both materials and labor, cost accountants or industrial engineers perform the following computations:

1. Calculate the cost per unit (pound, kilogram, or square meter) of each material used by a product and the cost per hour of each type of direct labor that processes the product.
2. For each unit of product made, determine the quantity (number of pounds, kilograms, or square meters) of each type of material used and the quantity (number of hours) required for each type of labor.

3. For each labor and material type, multiply the cost per unit (or hour) by the quantities used per product, as shown by the following equations:

$$\text{Materials cost/unit} = \text{Quantity of materials/unit of output} \times \text{Cost per materials unit}$$
$$\text{Labor cost/unit} = \text{Quantity of labor hours/unit of output} \times \text{Cost per labor hour}$$

4. Add up all of the individual materials and labor costs to obtain the total labor and materials cost of each product unit.

As long as accurate records are maintained about labor time and material usage standards, and about the standard or actual prices of each material and labor type, the company will have good knowledge about the costs of its direct labor and materials inputs for each product it produces.

The main focus of our attention in this chapter is on the assignment of indirect expenses to products. Indirect expenses include the costs of operating machines, scheduling, quality control, purchasing, maintenance, supervision, and general factory support (including building depreciation, insurance, utilities, and housekeeping). Indirect expenses are also called shared or common costs since they support the production of all products and they are not easily traced to individual products in the simple way that direct materials and direct labor costs are.

Historically, manufacturing companies assigned indirect costs, which they often called "overhead," to production departments in simple proportion to the direct labor hours worked in each department, or sometimes through more accurate allocation schemes as discussed in Chapter 4. The manufacturing cost system then divided the indirect costs assigned to each production department by a simple measure of the volume of activity in the department, such as total direct labor hours or total machine hours worked, to calculate an overhead allocation rate for the department. The system used this department-specific overhead cost rate to allocate indirect expenses to the products that were processed through each department.

As an example of a simple product cost accounting system, consider one ice cream manufacturing plant at Madison Dairy. The plant originally produced just two products, vanilla and chocolate ice cream, and enjoyed profit margins in excess of 15% of sales. Several years ago, the plant manager had seen opportunities to expand the business by extending the product line into new flavors that earned premium selling prices. Madison had introduced strawberry ice cream, which required the same basic production technology but could be sold at prices that were 10% higher than vanilla and chocolate. Last year, the company introduced mocha-almond ice cream, which it sold at an even higher price premium. With the increase in product variety came an increase in the plant's overhead costs. These costs were allocated to products based on their direct labor content. Currently, the rate was 240% of direct labor dollars.

Christine Lee, Madison's controller, was disappointed with the recent financial performance of the plant. Exhibit 5-1 shows the product line income statement for a recent and representative month for the plant's operations. The new strawberry and mocha flavors were profitable but the high-volume vanilla and chocolate flavors had just broken even and the overall profit margin was now less than 2% of sales. After subtracting plant general and administrative expenses (not shown), the plant had operated at a loss. Lee wondered whether the company should de-emphasize the commodity vanilla and chocolate products and keep introducing new specialty flavors, which at least had positive operating profits.

Madison's manufacturing manager commented on how the introduction of the new flavors had changed his production environment:

> Five years ago, life was a lot simpler. We produced just vanilla and chocolate ice cream in long production runs, and everything ran smoothly,

Exhibit 5-1
Madison Dairy Ice Cream Plant (March 2010): Total and Product Profitability

	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total
Production and sales volume (gallons)	10,000	8,000	1,200	800	20,000
Unit selling price	$3.00	$3.00	$3.30	$3.50	
Sales	$30,000	$24,000	$3,960	$2,800	$60,760
Direct materials	6,000	4,800	720	520	12,040
Direct labor	7,000	5,600	840	560	14,000
Overhead at 240%	16,800	13,440	2,016	1,344	33,600
Total factory expenses	29,800	3,840	3,576	2,424	59,640
Gross profit	$200	$160	$384	$376	$1,120
Gross profit (% of sales)	0.7%	0.7%	9.7%	13.4%	1.8%

without much intervention. Difficulties started when we introduced the strawberry flavor. We had to make more changeovers to stop production of vanilla or chocolate, empty the vats, clean out all remnants of the previous flavor, and then start the production of the strawberry flavor. Making chocolate was simple—we didn't even have to clean out the residual from the previous run if we just dumped in enough chocolate syrup to cover it up. For strawberry, however, even small traces of other flavors create quality problems. And because mocha-almond contains nuts, to which many people have severe allergic reactions, we have to do a complete sterilization of the vat after every mocha production run.

We are also spending a lot more time on purchasing and scheduling activities and just keeping track of where we stand on existing, backlogged, and future orders. I am concerned about rumors that even more new flavors may be introduced in the near future. I don't think we have any more capability to handle additional confusion and complexity in our operations.

Ice cream production at the Madison ice cream plant involved preparing and mixing the ingredients for each flavor in large vats. In a subsequent stage, the ice cream mix was packaged into containers using semiautomatic machines. A final packing and shipping stage was performed manually.

Each product had a bill of materials that identified the quantity and cost of direct materials and labor required for the product. From this information, it was easy to calculate the direct materials costs and direct labor costs for each flavor. Madison's monthly indirect expenses (about $34,000 per month) at the plant were comprised of the following:

Expense Category	Expense
Indirect labor	$12,068
Fringe benefits	6,517
Machinery	15,400
Total	$33,985

Madison's cost system assigned the plant's indirect expenses to products on the basis of each product's direct labor cost. The cost system's current overhead rate was 240% of direct labor cost. Most people in the plant recalled that not too many years ago, before the new specialty flavors (strawberry and mocha-almond) had been introduced, the overhead rate was less than 140% of direct labor cost.[1]

Limitations of Madison's Existing Standard Cost System

Madison's standard cost system is adequate for the financial reporting role of inventory valuation. It is simple, easy to use and understand, and applied consistently from year to year. When Madison's accountants designed the system years ago, production operations were mostly manual, and total indirect costs were less than direct labor costs. Madison's two high-volume products had similar production volumes and batch sizes. Given the high cost of measuring and recording information, the accountants judged correctly that a complex costing system would be more expensive to operate than the company could recoup in benefits from a more detailed assignment of costs.

Madison's production environment, however, had changed. Because of automation, direct labor costs had decreased and indirect expenses increased. As the plant added custom, low-volume flavors, it needed more people to perform scheduling, setup, and quality control and to maintain product specifications. The cost system that was adequate when indirect expenses were low and product variety was limited could now be giving distorted signals about the relative profitability of Madison's different products.

The distortions arise because of the way Madison's existing cost system allocated production costs to products. Many manufacturing companies, like Madison, use only drivers that vary directly with the volume of products produced—such as direct labor dollars, direct labor hours, or machine hours—for allocating production expenses to products. In an environment of high product variety, however, the exclusive use of volume drivers to allocate overhead costs leads to product cost distortion, as illustrated in the following example.

Vanilla Factory and Multiflavor Factory

The Vanilla Factory produces 1 million gallons of ice cream, all the same flavor (vanilla, of course) and all packed in half-gallon containers. The Multiflavor Factory also produces 1 million gallons of ice cream but of many different flavors, recipes, brand names, and package sizes (half-pint, pint, quart, half-gallon, gallon, and two-gallon containers). Multiflavor Factory treats each combination of flavor, recipe, brand name, and package size as a different product (called a stockkeeping unit [SKU]). In a typical year, the Multiflavor Factory produces about 2,500 different SKUs, ranging from specialty flavors and packages, with annual production volumes as low as 50 to 100 gallons per year, up to high-volume standard flavors such as vanilla or chocolate in standard half-gallon packages whose annual production volumes are each about 200,000 gallons per year.

[1] The small difference between the budgeted overhead expenses of $33,985 in the table on the previous page, and the overhead assigned to products ($33,600) occurred because Madison used an approximate overhead rate of 240% when assigning costs to products rather than the actual ratio of 242.75%.

Even though both factories make the same basic product, the Multiflavor Factory requires many more resources to support its highly varied mix. It has a much larger production support staff than the Vanilla Factory because it requires more people to schedule machine and production runs; perform changeovers and setups between production runs in the blending and the packaging line; inspect items at the beginning of each production run; move materials; ship and expedite orders; develop new flavor recipes; improve existing products; negotiate with vendors; schedule materials receipts; order, receive, and inspect incoming materials and parts; and update and maintain the much larger computer-based information system. It also operates with considerably higher levels of idle time, setup time, overtime, inventory, rework, and scrap. Because both factories have the same physical output, both have roughly the same cost of materials (ignoring Multiflavor's slightly higher acquisition costs for smaller orders of specialty ingredients and flavors and other materials). For actual production, because all gallons of ice cream are about the same complexity, both the Vanilla Factory and the Multiflavor Factory require the same number of direct labor hours and machine hours for actual production (not counting the higher idle time and setup times in Multiflavor). The Multiflavor Factory also has about the same property taxes, security costs, and heating bills as the Vanilla Factory, but it has much higher indirect and support costs because of its more varied product mix and complex production tasks.

Consider now the operation of a traditional cost system, like the one used at Madison Dairy, in these two plants. The Vanilla Factory has little need for a cost system to calculate the cost of a half-gallon of vanilla ice cream. The financial manager, in any single period, simply divides total expenses by total production volume to get the cost per half-gallon package produced. For a year, divide the factory expenses by the million-gallon capacity to get the cost per gallon (or divide by 2 million to get the cost per half-gallon container produced). For the Multiflavor Factory, the traditional cost system first allocates indirect and support expenses to production cost pools, as described in Chapter 4. Once the traceable and allocated support expenses have been accumulated within each production cost pool, the system allocates the pool's costs to products on the basis of the volume cost driver for that cost center: direct labor, machine hours, units produced, or materials quantity processed. On a per-unit basis, high-volume standard half-gallon containers of vanilla and chocolate ice cream require about the same quantity of each cost driver (labor and machine time, number of units, materials quantity) as the very low volume SKUs, consisting of specialty flavors and recipes packaged in a specialty size. Therefore, Multiflavor's overhead costs would be applied to products on the basis of their production volumes. Chocolate and vanilla half-gallon containers, each representing about 20% of the plant's output, would have about 20% of the plant's overhead applied to them. A low-volume product, representing only 0.01% of the plant's output (100 gallons per year), would have about 0.01% of the plant's overhead allocated to it. The traditional costing system reports, on a per gallon basis, essentially identical product costs for all products, standard and specialty, regardless of the relative production volumes of their flavor, recipe, and packaging SKU combination.

Clearly, however, considerably more of the Multiflavor Factory's indirect resources are required (on a per gallon basis) for the low-volume, specialty, newly designed products than for the mature, high-volume, standard vanilla and chocolate products. Traditional cost systems, even those with multiple production cost centers, systematically and grossly underestimate the cost of resources required for specialty, low-volume products and overestimate the resource cost of producing high-volume, standard products, such as the half-gallon vanilla and chocolate ice cream SKUs.

Activity-Based Costing

Christine Lee of Madison Dairy wondered why she could not assign indirect expense costs to products in the same way that standard cost systems assign materials and labor costs to products. That is, why couldn't she obtain the cost of using each unit of overhead or indirect resource, and the quantity of each indirect resource used by each product the plant produced?

After doing some research, she learned that such an approach had recently been introduced, under the name **time-driven activity-based costing** (**TDABC**, or time-driven ABC).[2] The new cost system required estimating two parameters, just like for labor and materials:

1. The first parameter is the cost rate for each type of indirect resource. First, identify all costs incurred to supply that resource (such as a machine, an indirect production employee, the computer system, factory space, a warehouse, or a truck). Second, identify the capacity supplied by that resource. The capacity would be the hours of work provided by the machine or production employee, or the space provided by the warehouse or truck. For most resources (people, equipment, and machines), capacity is measured by the time supplied. The resource's cost rate is calculated by dividing its cost by the capacity it supplies, usually expressed as a cost per hour or cost per minute. For warehouses, production space, and trucks, the cost rate would be measured by cost per square foot (or square meter) of usable space. For computer memory, the resource cost rate would be the cost per megabyte or gigabyte.
2. The second parameter is an estimate of how much of each resource's capacity (such as time or space) is used by the activities performed to produce the various products and services (and customers, as we will discuss in the next chapter).

With estimates of these two parameters for each resource and product, the cost assignment can be done simply and similarly to that performed for direct materials and labor costs:

$$\begin{aligned}\text{Cost of using resource } i \text{ by product } j &= \text{Capacity cost rate of resource } i\\ &\quad \times \text{Quantity of capacity of resource } i \text{ used by product } j\end{aligned}$$

For example, take an indirect production employee who specializes in changing over machines from one product to the other. The employee's total compensation is \$4,800 per month. The employee has about 120 hours available to perform changeovers each month. This figure is obtained from showing up for work about 20 days per month, being paid for 7½ hours per day, less 90 minutes per day used for breaks, training, quality meetings, and routine machine maintenance. This leaves 6 hours per day available for setting up machines for the next production run. The setup employee's **capacity cost rate** is \$40 per hour (\$4,800 per month/120 hours per month). Consider now a product that is produced three times during the month, with the setup time for each production run taking 1.5 hours. The product uses 4.5 hours of this indirect production employee's time and would be assigned \$180 of cost (\$40/hour × 4.5 hours) this month for use of this indirect employee's time.[3]

Lee decided to implement this approach at Madison Dairy's ice cream factory.

[2] The new approach was described in R. S. Kaplan and S. R. Anderson, *Time-Driven Activity-Based Costing* (Boston: Harvard Business Press, 2007).

[3] Whereas direct materials and direct labor cost can be calculated for each unit produced of the product, indirect expenses will get assigned to the total production of the product in a given time period.

Calculating Resource Capacity Cost Rates

Fringe Benefits

Lee started with fringe benefits and immediately realized that these were really part of the cost of the direct and indirect labor resources. The fringe benefits of $6,517 represented 25% of the $26,068 in wages paid for direct and indirect labor. She decided to apply the fringe benefit costs as a simple 25% markup to all direct and indirect labor costs.

Indirect Labor

Lee next turned to the indirect labor expense. Madison had seven production employees who did both the actual work of producing the ice cream as well as all of the production support work. The standard cost accounting system treated the employees as "direct labor" when they ran the production process and "indirect" when they did everything else, such as changing a machine line from one production run to the next, scheduling production runs, ordering and receiving raw materials, and maintaining records on the various products. The plant's cost accounting system estimated the direct labor times required each month for the actual volume and mix of products produced and treated all the remaining time as "indirect."

Madison paid production employees a fixed salary per month of $3,724. Lee added the fringe benefits of 25% (equal to $931) to obtain the total monthly compensation of $4,655 per production employee. For an average month, she estimated that an employee came to work on about 19 days.[4] Employees were paid for 8 hours of work per day, but not all that time was available for productive work. Breaks, training, and meetings consumed about 1 hour per day of employees' time, leaving 7 hours per day available for work. Thus, each employee was available for 133 hours of work each month, leading to the following calculation:

$$\begin{aligned}\text{Cost rate per employee} &= \$4{,}655 \text{ per month}/133 \text{ hours per month}\\ &= \$35 \text{ per hour}\end{aligned}$$

Machinery ($15,400)

The ice cream factory had two identical production lines. It leased all of the machinery on the lines from an outside supplier, and had total current monthly lease payments of $15,400. The production machines were available every working day of the month, or about 22 days per month. The company operated with one daily eight-hour shift. Normal preventive maintenance and minor repairs were performed for one hour each day, leaving seven hours available for productive work on each production line. Thus the total available capacity per machine line was 22 days × 7 hours per day or 154 hours per month.[5] With two machine lines, the plant had machine time available for 308 hours each month.[6] Thus,

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[4] The estimate of number of days per month came from the following calculation. Employees worked about 228 days per year [365 days in a year less 104 weekend days (52 × 2) when employees did not work, 28 days for holidays and vacation and 5 days for sick days and personal leave]. Dividing 228 days per year by 12 months in a year yields the 19 days per month estimate.

[5] Subtracting 1.0 hour for maintenance from each 8-hour shift per day = 7 hours available per day per production line. Multiply 22 days per month times 7 hours per day times 2 production lines = 308 machine hours available per month.

[6] Calculation of practical capacity can be somewhat more complex than the Madison Dairy ice cream plant situation illustrates. For example, the capacity of Madison's machines could be increased if the company worked a second or third shift. A general rule is to estimate machine capacity based on the number of shifts per week that the company typically works. If the company decides to add shifts, it would increase the production line's quantity of productive hours. Another complication is the existence of peak load or seasonal capacity. More discussion on how to deal with advanced issues in estimating practical capacity can be found in R. S. Kaplan and R. Cooper, *Cost & Effect* (Boston: Harvard Business Press, 1997): 126–132.

$$\text{Cost rate for machines} = \$15{,}400 \text{ per month}/308 \text{ hours per month}$$
$$= \$50 \text{ per machine hour}$$

Calculating Resource Time Usage per Product

Lee now needed to determine the quantity of time that each product used of each production resource (indirect labor and machines).

Indirect Labor Time

The demand for indirect labor time came from three sources. First, indirect labor scheduled production runs, did the purchasing for a production run, prepared the materials and brought materials to the production line just before a production run. They also inspected the initial output from the production run to ensure that it met the product specifications. Lee assigned an industrial engineer to observe this process over a period of several weeks; he reported back that the time required to order materials, schedule, and prepare for a production run was about four hours, and this time was independent of which flavor was being produced or the size of the production run.

Employees also performed the changeovers from one product to another. Industrial engineers had already established time standards for these changeovers so this information was readily available:

Product	Changeover Time
Vanilla	2.0 hours
Chocolate	1.0 hour
Strawberry	2.5 hours
Mocha-almond	4.0 hours

The time for changing over to chocolate was short since the previous flavor did not have to be completely washed out. Vanilla and strawberry demanded more careful preparation, and mocha-almond required the longest changeover time because of the demanding quality standards for the flavor's special taste and because of the need to flush out all traces of the allergen (nuts) after a production run. Three employees worked as a team to perform each changeover so the setup time for a new batch of vanilla ice cream required six hours of indirect labor time (three employees working for two hours on the setup).

Employees also performed product-sustaining activities each month for each flavor. These activities included maintaining and updating the product's bill of materials and production process on the computer system, monitoring and maintaining a minimum supply of raw materials and finished goods inventory for each product, improving the production process, and performing recipe changes based on customer feedback. This activity took about nine hours per month for each product.

Lee summarized the demand for indirect labor by each product with the following time equation:

$$\text{Indirect labor time/product} = (4 \text{ hours} + \text{product changeover time})$$
$$\times \text{ Number of production runs} + 9$$

For example, if the Vanilla flavor had 10 production runs in a month, its total usage of indirect labor time would be:

$$\text{Vanilla indirect labor time} = (4 + 6) \times 10 + 9 = 109 \text{ hours}$$

The total demands for indirect labor are summarized in Exhibit 5-2.

Exhibit 5-2
Indirect Labor Hours by Product

	Vanilla	Chocolate	Strawberry	Mocha-Almond
Indirect labor hours—Schedule production runs	4.0	4.0	4.0	4.0
Setup time per run (hours)	2.0	1.0	2.5	4.0
Number employees per setup	3.0	3.0	3.0	3.0
Indirect labor hours per setup	6.0	3.0	7.5	12.0
Indirect labor hours per run: schedule and setup	10.0	7.0	11.5	16.0
Indirect labor—sustain products	9.0	9.0	9.0	9.0

Machinery Time

It was easy to develop the estimates of machine time by product. Machines were either producing products or being set up to produce the next batch of products. The time equation to estimate machine usage was:

$$\begin{aligned}\text{Machine time per product} &= \text{Product run time} + \text{Product changeover time}\\ &= \text{Product volume (gallons)} \times \text{Run time/gallon}\\ &\quad + \text{Product changeover time} \times \text{Number of runs}\end{aligned}$$

For example, if Vanilla had 10 production runs producing 8,000 gallons in a month, with processing time of 26 machine hours per 1,000 gallons, its hours of machine usage were:

$$\text{Vanilla machine time} = 8 \times 26 + 2 \times 10 = 228 \text{ hours}$$

Calculating Product Cost and Profitability

Lee had now developed all of the information—capacity cost rates for each resource and capacity demands on resources by each product—that she needed to calculate accurate product costs. She summarized the production data for the four products from the recent month as shown in Exhibit 5-3.

Lee next entered the production data into the two time equations for indirect production labor time and machine time to obtain the resource demand for the four products, as shown in Exhibit 5-4.

Exhibit 5-3
Madison Dairy Ice Cream Plant Production Data (March 2010)

Production Statistics (March 2010)	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total
Production and sales volume	10,000	8,000	1,200	800	20,000
Direct labor hours per gallon	0.025	0.025	0.025	0.025	
Total direct labor hours	250	200	30	20	500
Machine hours per 1,000 gallons	11	11	11	11	
Total machine run time	110	88	13	9	220
Number of production runs	12	12	8	6	38
Setup time per run (hours)	2.00	1.00	2.50	4.00	
Total setup time (hours)	24	12	20	24	80
Total machine hours	134	100	33	3	300

Exhibit 5-4
Resource Demands by Product (March 2010)

Hours of Resource Usage	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total	Cost per Hour
Direct labor	250	200	30	20	500	$35
Indirect labor	129	93	101	105	428	$35
Machines	134	100	33.2	32.8	300	$50

For example, the indirect labor time for vanilla had the following components:

Purchasing and schedule time per run	4 hours
Machine setup time per run	6 hours (2 hours of setup × 3 setup employees)
Indirect labor time per run	10 hours
Number of production runs	12
Production runs indirect labor	120
Product-sustaining time per product	9
Total indirect labor time for vanilla	129 hours

Lee calculated the costs for each product by multiplying the resource usage times in Exhibit 5-4 by each resource's capacity cost rate, shown in the last column in Exhibit 5-4. She summarized the results in the product profit and loss statements shown in Exhibit 5-5.

Lee was initially surprised by the results reported in Exhibit 5-5. She saw that the products previously thought to be the most profitable, strawberry and mocha-almond, were actually the least profitable and in fact had enormous losses as a percentage of sales. Conversely, vanilla and chocolate, previously thought to be breakeven, were actually profitable with profit margins greater than 10% of sales. On further reflection, Lee could see the reasons for the reversals in profit rankings. Vanilla and chocolate were produced in long production runs, so their use of indirect labor and machine setup time were small compared to actual production volumes. Mocha-almond, a specialty product, had small production runs; she noted that its use of indirect labor and machine setup time exceeded the quantity of direct labor and machine run time for the product (see data in Exhibit 5-2). Despite mocha-almond having a unit price that was more than 15% higher than vanilla or chocolate, its price failed, by a large amount, to pay for the cost of its use of indirect labor and machine setup time. In general, the new costing approach clearly revealed that the revenues

Exhibit 5-5
Madison Dairy's Ice Cream Revised Product Profitability (March 2010)

Product Profit or Loss	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total
Sales	$30,000	$24,000	$3,960	$2,800	$60,760
Direct materials	6,000	4,800	720	520	12,040
Direct labor (including fringes)	8,750	7,000	1,050	700	17,500
Indirect labor usage	4,515	3,255	3,535	3,675	14,980
Machine usage	6,700	5,000	1,660	1,640	15,000
Gross profit (loss)	$4,035	$3,945	($3,005)	($3,735)	$1,240
Gross profit (loss) (% of sales)	13%	16%	–76%	–133%	2%

from sales of the specialty strawberry and mocha-almond flavors failed to cover all of the expenses associated with their production.

Madison's previous standard costing system, which allocated overhead costs proportional to direct labor costs, assigned too much overhead cost to vanilla and chocolate, the high-volume simple products, and too few costs to strawberry and mocha-almond, the lower volume and more complex products. In general, not just in the simple example of the Madison Dairy ice cream plant, a company's production of complex, low-volume products requires many more resources per unit to perform setups, handle production runs, and design and support.

We can actually predict when standard costing systems will lead to high errors in estimating product costs. Cost systems that allocate overhead (indirect and support expenses) to products based on the direct labor hours (or any production volume measure) of each product produced will lead to the overcosting of high-volume products and undercosting of low-volume products when the following two situations exist:

1. Indirect and support expenses are high, especially when they exceed the cost of the allocation base itself (such as direct labor cost); and
2. Product diversity is high: the plant produces both high-volume and low-volume products, standard and custom products, and complex and simple products.

With high indirect costs and high product diversity, standard cost systems will always lead to highly distorted product costs, as the Madison Dairy ice cream plant example illustrates.

Possible Actions as a Result of the More Accurate Costing

The more accurate resource consumption and cost information in Exhibits 5-3 and 5-4 provides Madison Dairy's ice cream plant managers with numerous insights about how to increase the plant's profitability. They could attempt to raise prices for the unprofitable specialty flavors to cover their higher per unit production and sustaining costs. Currently, the costs for handling production runs and setting up machines for these two flavors are higher than their direct materials and labor costs. If customers truly value these specialty flavors, they might be willing to pay even higher prices for them. Alternatively, Madison's sales manager could consider imposing a minimum order size for Madison's retail customers so that the specialty products would be produced in larger production runs, thereby reducing the quantity of indirect resources they required. Of course, now that vanilla and chocolate are seen to be profitable, more effort might be devoted to increasing their sales volumes, an action that would not have been encouraged by the profit report in Exhibit 5-1, which showed these to be barely breakeven products for the company. Thus, this more accurate product profitability data signals that Madison Dairy's managers should be considering immediate actions in terms of pricing, product mix, and minimum order size.

Other actions could be directed at improving processes, particularly the processes for indirect and support activities. In the previous standard cost system, the costs of activities to purchase materials, schedule production runs, perform setups, and maintain products was buried in the large overhead pool and, hence, were not visible for improvement opportunities. The main focus had been to reduce direct labor and materials costs since these were the main levers affecting the standard costs. Now Christine Lee could encourage Madison's manufacturing people to redirect their attention to learning how to reduce setup times so that small batches of the specialty flavors would be less expensive (require fewer resources) to produce. They could also search for ways to reduce the times required to do purchasing and scheduling for production orders and to perform the ongoing maintenance of products each month. These would all reduce the demands for indirect labor.

The combined impact of process improvements, repricing, and product volume and mix changes will enable Madison's managers to significantly improve profitability without compromising its ability to offer customers both high-volume standard and low-volume specialty flavor products. The new and more accurate costing system provides Madison's managers with many insights that can be exploited to transform currently unprofitable operations into profitable growth.

IN PRACTICE

Using Activity-Based Costing to Increase Bank Profitability

ATB Financial, a commercial bank based in Alberta, Canada, was offering 200 products and processing more than 12 million transactions per month for its 2 million customer accounts in 160 branches. The Personal Services business offered credit card products, mortgage services, Internet banking, travel protection, loans, and retirement products. The Business Services group offered investment products, tax filing services, merchant processing services, brokerage services, foreign correspondence, and debt financing. A newly formed Investor Services group offered mutual funds, fixed-date deposits, and educational and retirement savings plans.

ATB supported these products with regional and centralized resources, such as call centers and information technology centers. But its existing cost system could not assign the costs of these regional and corporate resources to transactions, products, and customers. The chief operating officer believed that the bank's emphasis on revenue growth in a booming economy had blurred its focus on the bottom line: "When the top line is growing fast, it is easy to hide a ton of sins—we run the risk of overbuilding and giving away profitability."

An ATB project team developed and installed a time-driven ABC system that could accurately calculate branch and product profitability each month. The new system stimulated numerous cost and revenue improvement actions, including the following:

- The time equations in the TDABC model revealed how call-center process times varied by type of call. For example, calls to reset passwords were expensive and frequent. The team developed new procedures to address the root cause for these calls, and the volume and cost for this type of call soon plummeted.
- Responding to customers' requests to trace items they didn't recognize was a surprisingly high cost process. These costs were often more than the charge for this service and often more than the amount in dispute. The bank established a procedure to either increase the service fee or authorize an adjustment in lieu of handling a trace request on small items.
- The TDABC model enabled the team to discover that differences in capacity utilization explained much of the variation in branch efficiency. The model identified where excess capacity existed by process within each branch. Management could then downsize its branch service and delivery platform to expected demands.
- The project team noticed a marked difference across branches in the cost of human-handled transactions compared with electronic transactions. One human-handled transaction in a branch often led to another as customers who had already waited in line to make a bill payment were likely to make a deposit or withdrawal at the same time. The most efficient branches used "greeters" to direct customers to banking machines or Internet terminals for routine transactions.

Within a year of the ABC project launch, the bank had identified nearly $2 million in annualized profit improvement through revenue enhancement and cost reductions. A senior executive observed, "ABC is now part of our evolution to build a rigorous commercial capability to drive and manage profitability, helping us make the right decisions to drive performance."

Source: "ATB Financial: Guiding Profitable Growth," Chapter 11 in R. S. Kaplan and S. R. Anderson, *Time-Driven Activity-Based Costing: A Simpler and More Powerful Path to Higher Profits* (Boston: Harvard Business Press, 2007): 197–208.

Measuring the Cost of Unused Resource Capacity

Christine Lee noticed that the total profits shown in Exhibit 5-5 ($1,240) were higher than the $1,120 calculated in Exhibit 5-1 by the traditional standard cost system. The time-driven ABC results in Exhibit 5-5 used resource capacity rates calculated from the capacity of the resources (labor and machinery) provided each month. But Madison had operated slightly under capacity during the month of March 2010 as shown in Exhibit 5-6.

With time-driven ABC, the **cost of unused capacity** is not assigned to products—but it should not be ignored. The unused capacity remains someone's or some department's responsibility. Usually one can assign unused capacity after analyzing the decision that authorized the level of capacity supplied. For example, if the capacity was acquired to meet anticipated demands from a particular customer or a particular market segment, the costs of unused capacity due to lower-than-expected demands can be assigned to the person or organizational unit responsible for that customer or segment. Such an assignment is done on a lump-sum basis to the organizational unit; it should not be driven down to the products actually produced during the period in the unit.

Managers can often assign the cost of unused capacity to a product line, a department, or an executive. For example, if the unused capacity relates to a particular product line—as when certain production resources are dedicated to individual product lines—the cost of unused capacity is assigned to that product line where the demand failed to materialize. Suppose a division manager knew in advance that resource supply would exceed resource demand but wanted to retain the amount of current unused resources for future growth and expansion. Then that unused capacity could be a division-sustaining cost, assigned to the division making the decision to retain the unused capacity. In making such assignment of unused capacity costs, we trace the costs at the level in the organization where decisions are made that affect the supply of capacity resources and the demand for those resources. The lump-sum assignment of unused capacity costs provides feedback to managers on their supply and demand decisions.

Fixed Costs and Variable Costs in Activity-Based Cost Systems

We have seen how an activity-based cost system assigns indirect and support costs to products. Some people believe that such a full cost assignment treats indirect and support costs as "variable," in the sense that they will increase or decrease with short-term changes in the quantity produced of a product or in the number of setups or production runs. This is an erroneous inference as Madison Dairy's ice cream plant clearly shows. All of the production workers are paid whether they are doing production runs and setups or not. And the machine lease payments occur each month whether the machines are producing ice cream or not. If the company does one less setup or one fewer production run, its overall costs will not change, which is why

Exhibit 5-6
Resource Capacity Utilization at Madison Ice Cream Plant (March 2010)

Resource	# Units	Hours Supplied/Unit per Month	Total Hours Supplied	Hours Used (March 2010)	Unused Capacity (Hrs)	Cost per Hour	Unused Capacity ($)
Production labor	7	133	931	928	3	$35	$105
Machines	2	154	308	300	8	$50	$400

many refer to indirect and support costs as "fixed costs." We prefer, however, to refer to such costs as committed, not fixed.

Most expenses assigned by an ABC system are committed because managers have made a decision to supply these resources in advance of knowing exactly what the production volumes and mix will be. Thus the costs of these resources will not vary with actual production volume and mix during the month. But managers can adjust their resource costs by supplying a different quantity of resources for future months. The costs remain fixed only if managers fail to react to changes in demand and capacity utilization. Thus whether a cost is fixed or variable is not an attribute of the cost itself. It is determined by the alertness and willingness of managers to adjust the supply of resources, either up or down, in response to changes in the demands for the work performed by the resource. Committed costs can change (or vary) through the following process:

1. Demands for the capacity resources change, either because of changes in the quantity of activities performed (e.g., changes in number of production runs or products supported) or because of changes in the efficiency of performing activities. For example, if setup times get reduced, fewer resources—employees and machines time—are required to perform the same quantity of setups.
2. Managers make decisions to change the supply of committed resources, either up or down, to meet the new level of demand for the activities performed by these resources.

If the quantity of demands for a resource exceeds its capacity, the result is bottlenecks, pressure to work faster, delays, or poor-quality work. Such capacity shortages occur often on machines, but the ABC approach makes clear that shortages can also occur for human resources who perform support activities, such as designing, scheduling, ordering, purchasing, maintaining, and handling products and customers. Companies facing such shortages increase their committed costs by spending more to increase the supply of resources to perform work, which is why many indirect costs increase over time.

Demands for indirect and support resources also can decline, either intentionally through managerial actions, such as imposing minimum order sizes and reducing setup times, or because of competitive or economy-wide forces that lead to declines in sales. Should the demands for resources decrease, few immediate spending reductions will be noticed. People have been hired, space has been rented, and equipment, computers, telephones, and furniture have been acquired. The expenses for these resources continue even though there is less work for the resources to perform. The reduced demand for organizational resources does lower the cost of resources *used* by products, services, and customers, but this decrease is offset by an equivalent increase in the cost of unused capacity.

After unused capacity has been created, committed costs will vary downward if and only if managers actively reduce the supply of unused resources. What enables a resource cost to be adjusted downward is not inherent in the nature of the resource; it is a function of management decisions—first to reduce the demands for the resource and second to lower the spending on it.

Organizations often create unused capacity through actions, such as process improvement, repricing to modify the product mix, and imposing minimum order sizes on customers. They keep existing resources in place, however, even though the demands for the activities performed by the resources have diminished substantially. They also fail to find new activities that could be done by the resources already in place but not being used. In this case, the organization receives no benefits from its decisions that reduced the demands on its resources. The failure to capture benefits from the actions, however, is not because costs are fixed. Rather, the failure occurs because managers are unwilling or unable to take advantage of the unused capacity they have created, such as by spending less on capacity resources or increasing the volume of work processed by the capacity resources. The costs of these resources are fixed only if managers do not exploit the opportunities from the unused capacity they helped to create.

Thus, making decisions, such as to reduce product variety, solely on the basis of resource usage (the ABC system), may not increase profits if managers are not prepared to reduce spending to align resource supply with the future lower levels of demand. For example, if an action causes the number of production runs to decrease by 10%, no economic benefit will be achieved unless some of the resources previously supplied to perform production runs are eliminated or redeployed to higher revenue uses. Consequently, before making decisions on the basis of an ABC model, managers should determine the resource supply implications of their decisions. We can illustrate this with decisions made by the managers of Madison Dairy's ice cream plant.

Using the ABC Model to Forecast Resource Capacity

Christine Lee formed a small interdepartmental task force, which included representatives of sales, marketing, production, industrial engineering, and human resources, to make recommendations about how to improve profitability at Madison Dairy's ice cream plant. Production people and industrial engineers felt that significant improvements could be made in the setup process and also in the time required to prepare for production runs and maintain product information. They believed that new work procedures would enable the plant to reduce the setup work crew from three to two employees. Similarly, rigorous application of quality management tools would reduce the setup times for both strawberry and mocha-almond by 20%. The production and industrial engineers also committed to process improvements that would reduce the time to prepare for a production run from 4 hours to 2.5 hours, and the time required to maintain a product from 9 hours to 8 hours per month. They summarized all of their process improvement commitments in the following table:

	Vanilla	Chocolate	Strawberry	Mocha-Almond
Setup time per run (hours)	2.0	1.0	2.0	3.2
Indirect labor setup time (hours per run)	4.0	2.0	4.0	6.4
Handle production run (hours per run)	2.5	2.5	2.5	2.5
Sustaining products (hours per month)	8.0	8.0	8.0	8.0

The production people pointed out that in addition to making substantial improvements in performing setups and preparing for a production run, the plant would run more efficiently if it could produce at least 350 gallons in each production run. The sales and marketing members on the task force agreed that they could require customers to either order a minimum of at least 350 gallons of a flavor or else be willing to wait until a batch of small orders could be accumulated to allow a production run of at least 350 gallons.

Sales people suggested that there was considerable price elasticity for the commodity vanilla and chocolate products. They thought that a small $0.10 per gallon price decrease would lead to a 15% to 20% sales volume increase. They also felt that demand would not fall too precipitously for the specialty flavors if a small price increase were imposed. Given the pricing flexibility, they committed to delivering sales that would not require a large number of small production runs. After considerable discussion, the task force agreed on the sales and production plan shown below:

	VANILLA	CHOCOLATE	STRAWBERRY	MOCHA-ALMOND	TOTAL
Selling price	$2.90	$2.90	$3.40	$4.00	$2.96
Sales volume (gallons)	12,000	9,200	1,100	700	23,000
Revenues	$34,800	$26,680	$3,740	$2,800	$68,020
# production runs	15	12	3	2	32

The new sales forecast reflected a 15% increase in gallons sold, and a 12% increase in revenues, from $60,760 (in March 2010) to $68,020. The price reductions and volume increases for the high-volume products would reduce the average selling price per gallon to $2.96 (from the March 2010 average selling price of $3.04 per gallon).

Everyone was excited about the projected sales volume increases and the potential cost savings from the process improvements. But Lee was unsure whether the 15% higher production volume could be handled by the existing two machine lines in the factory. She also wondered how the process improvements would translate into actual cost reductions, especially if the plant ended up needing additional personnel and equipment to handle the higher production volumes. Fortunately, she now had a time-driven ABC model for the plant that she could use to forecast the resource capacity that would be needed with the new sales and production plan.

Lee estimated the quantity of direct labor time required for the new production plan:

	VANILLA	CHOCOLATE	STRAWBERRY	MOCHA-ALMOND	TOTAL
Production and sales volume (gallons)	12,000	9,200	1,100	700	23,000
Direct labor hours per gallon	0.025	0.025	0.025	0.025	
Total direct labor hours	**300.0**	**230.0**	**27.5**	**17.5**	**575.0**

Next she estimated the demand for indirect production labor time.

	VANILLA	CHOCOLATE	STRAWBERRY	MOCHA-ALMOND	TOTAL
# production runs	15	12	3	2	
Handle production run (hours/run)	2.5	2.5	2.5	2.5	
Indirect labor—handle runs	**37.5**	**30.0**	**7.5**	**5.0**	**80.0**
Setup time per run (hours)	2.0	1.0	2.0	3.2	
Indirect labor hours per run	4.0	2.0	4.0	6.4	
Indirect labor—total setup hours	**60.0**	**24.0**	**12.0**	**12.8**	**108.8**
Indirect labor—maintain products	**8.0**	**8.0**	**8.0**	**8.0**	**32.0**
Total indirect labor hours	**105.5**	**62.0**	**27.5**	**25.8**	**220.8**

The total demand for production labor to fulfill the new production plan was 795.8 hours. Lee noted that six employees have a capacity of 798 hours available for work (133 hours per employee × 6 employees). She was surprised and pleased to learn that the new production plan, with a 15% increase in gallons produced, actually required one fewer production worker. The combination of fewer and larger production runs, plus the efficiencies gained from shifting to two-person setup crews and other process improvements, enabled the higher production volumes to be achieved with fewer resources.

Lee had one final calculation to perform: Would the company need another production line, or would it need to operate the existing machines on overtime or add a second shift to obtain additional machine capacity for the higher production volumes? She performed the following calculations to estimate the machine times required for the new production plan:

	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total
Production volume	12,000	9,200	1,100	700	23,000
Machine hours per 1000 gallon	11	11	11	11	
Total machine run time (hours)	**132**	**101.2**	**12.1**	**7.7**	**253**
Number of production runs	15	12	3	2	
Setup time per run (hours)	2.0	1.0	2.0	3.2	
Machine setup time (hours)	**30.0**	**12.0**	**6.0**	**6.4**	**54.4**
Total machine hours	**162.0**	**113.2**	**18.1**	**14.1**	**307.4**

With two production lines, each with a capacity of 154 hours per month, Lee could see that the existing production capacity would be adequate to handle the 15% increase in production volume. The savings from fewer production runs and the 20% reduction in setup times for the strawberry and mocha-almond flavors produced enough new machine capacity to produce the higher production volumes without adding another machine line or requiring overtime or a second shift. This was a vivid example of how process improvements can allow a company to produce more without requiring any increase in total production costs (other than direct materials) and, in fact, allow for a decrease in costs through having one fewer production employee.

Lee quickly generated a pro forma (forecasted) monthly product profit and loss statement by multiplying the planned resource consumption of each product by the cost rate for each resource (right-hand column in Exhibit 5-3) as shown in Exhibit 5-7. All products would be profitable, and the overall profit margin now exceeded 16% of sales, a major improvement from the less than 2% margin earned in March 2010.

Exhibit 5-7
Madison Dairy's Ice Cream Pro Forma Product Profitability

	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total
Selling price	$2.90	$2.90	$3.40	$4.00	$2.96
Sales volume	12,000	9,200	1,100	700	23,000
Revenues	$34,800	$26,680	$3,740	$2,800	$68,020
Direct materials	7,200	5,520	660	455	13,835
Direct labor (including fringes)	10,500	8,050	963	613	20,125
Indirect labor	3,693	2,170	963	903	7,728
Machinery	8,100	5,660	905	705	15,370
Gross profit	$5,308	$5,280	$250	$125	$10,962
Gross profit (% of sales)	15.3%	19.8%	6.7%	4.5%	16.1%

All products would be profitable, and vanilla and chocolate would be achieving the company's targeted rate of 15% of sales.

Lee also noted that a monthly overall income statement for Madison's ice cream plant, shown below, would differ slightly from the last column in Exhibit 5-7:

Sales	$68,020
Direct Materials	13,835
Production Labor: 6 @ $4,655	27,930
Machines: 2 @ 7,700	15,400
Operating Profit	$10,855

The $107 difference is due to the small quantities of unused capacity for the labor and machine resources, as summarized below:

	Hours Supplied	Hours Used	Unused Capacity	Cost Rate	Cost of Unused Capacity
Production labor hours	798.0	795.8	2.2	$35	$77
Machine hours	308.0	307.4	0.6	$50	$30
Total					$107

The cost of this unused capacity is not the cost of the products actually produced during the period. It is a period cost caused by having slightly more capacity than was actually required for the volume and mix of products produced during the period. In this case, the plant is operating at more than 99% of capacity. In other circumstances, the cost of unused capacity could be quite high. If the company were not careful about segregating the cost of unused capacity from product costs, it could get confused by having products report a loss that was caused by an arbitrary allocation of excess capacity costs, not because of inefficient production or lack of adequate margins over production costs. A manager might attempt to raise prices to cover the apparently higher costs at just the wrong time, when the company already has unused capacity, indicating some demand softness in the economy or a weak competitive position. Such a price increase would likely lead to even lower sales volumes in future periods, and higher quantities of unused capacity, in effect the death spiral described in Chapter 4.

Updating the ABC Model

An important issue for any costing model is how to update it, as needed, to keep current with changes in the company's operations. Time-driven ABC models can be modified easily to reflect such changes. For example, Madison's managers may learn that production labor performs activities, such as packaging and shipping products or receiving orders directly from customers, that were not identified for the original model. These additions can easily be incorporated by estimating the time required each time an employee performs the new activity, such as the time required to package a carton of ice cream, or the time required to receive and process a customer

IN PRACTICE

W.S. Industries Uses ABC Information for Continuous Improvement

W.S. Industries, headquartered in Chennai, India, supplies equipment such as insulators, lightning arrestors, transformers, capacitors, and circuit breakers to companies that transmit and distribute electrical power. As competition intensified in the 1990s, the company could no longer pass on cost increases in the form of higher prices. It had to hold its prices constant or even reduce them. W.S. Industries wanted to protect its strong market position in India, where it was among the top three in market share, while expanding aggressively into international markets in Asia, Europe, Africa, and the United States. Among its primary goals for success was to achieve a "quantum improvement in productivity." It turned to ABC as the primary tool to achieve this business objective.

It formed an ABC project team consisting of middle managers from operations, research and development, quality, information systems, and only one finance representative. W.S. wanted operating people to have ownership of the new system, not to feel that it was developed and mandated by finance. The team mapped all process and activities into a database, classifying each as either value added or non–value added (a non–value-added activity, such as moving parts back and forth into inventory, was one that could be eliminated with no deterioration of product attributes).

Employee teams used the new ABC information to suggest continuous improvement projects (CIPs) that would either eliminate nonvalue adding activities or reduce the cost of performing value-adding activities. For example, one team received approval to break down a wall that was causing excessive quantities of internal movement. The team saw from the ABC analysis that the benefits from reduced material movement costs exceeded the cost of the renovation.

The highly unionized workforce was initially concerned about job loss due to successful improvement projects. The company guaranteed that the benefits from the CIPs would be captured by higher sales growth, not job losses. To reinforce the culture of employee empowerment and informed continuous improvement, the company instituted the following reward program:

- A CIP would be eligible for a reward only if it were successfully implemented by a team and the savings were realized without any adverse side effects.
- Expenses to implement the project would be deducted when calculating the actual savings achieved.
- Employees would receive a fixed proportion of the savings either one time or annually if savings continued to occur.
- All rewards would be disbursed equally to all team members in an open forum of all employees.

In the first three years, the company completed 56 CIPs yielding savings of Rs. 13.62 million (about U.S. $300,000). More significantly, factory capacity had increased from 9,000 metric tons of product to 11,700 metric tons per year. Material movements dropped by 15,200 metric ton-meters per day; reductions in waste, scrap, and inventory yielded savings of Rs. 10 million per year; and the available time on bottleneck machines increased from less than 85% to more than 95%. On-time delivery to customers had also improved dramatically.

Source: V. G. Narayanan, "Activity-Based Management at W.S. Industries (A)," HBS No. 101-062 (Boston: Harvard Business School Publishing, 2001).

order. The capacity cost rate for the production employees has already been determined so the system can quickly calculate the cost of the new activity by multiplying the time estimates by the capacity cost rate.

Managers can also easily update the capacity cost rates. Several factors cause a cost rate to change. First, changes in the prices of resources supplied affect the hourly cost rate. If production employees receive an 8% compensation increase, their hourly cost rate increases from $35.00 per supplied hour to $37.80 per hour. If new machines are substituted or added to a process, the cost rate is modified to reflect the change in operating expense associated with introducing the new equipment.

Capacity cost rates also change when the denominator, **practical capacity**, changes. If working conditions change, such as by increasing the number of holidays, vacation days, or sick and personal leave days or by changing the number of hours worked per day or the time taken for training, meeting, and breaks, then the person maintaining the cost system would recalculate the number of hours available for productive work each month. This is not a difficult calculation to perform.

We have already seen from the Madison Dairy ice cream plant example how employees' quality and continuous improvement efforts enable the same activity to be done in less time or with fewer resources. When permanent, sustainable improvements in a process have been made, the manager of the cost system reduces the unit time estimates—and, hence, the resource requirements—to reflect the process improvements.

Following this procedure, a time-driven ABC model update is triggered by events that require the estimates in the model to be modified. Whenever analysts learn about a significant shift in the costs of resources supplied or about changes in the resources required for the activity, they update the cost rate estimates. Whenever they learn of a significant and permanent shift in the efficiency with which an activity is performed, they update the unit time estimate.

Time Equations

We have already seen how the time estimate to perform an activity, such as changing a machine over for a new production run, can vary based on the product that has just been produced (e.g., mocha-almond to eliminate all traces of allergens) or is about to be produced. Thus processing times can vary based on the specific characteristics of a particular order and task. Time-driven ABC accommodates the complexity of real-world operations with **time equations**, a feature that enables the model to reflect how particular order and activity characteristics cause processing times to vary.

Consider, as an example, processing a customer's order. Some customer orders arrive over the telephone, others may be faxed in, while many arrive electronically on an automated web page. Each of these may involve different amounts of time for the company personnel to process. For the ice cream plant, suppose that part of the nine, soon to be eight, hours required for each production run includes the time required to receive and process a specific customer order. The ABC project team might estimate the following time equation for the time required to process a customer's order to reflect how the order arrived at the plant:

$$\begin{aligned}\text{Indirect labor time to receive a customer order} = {} & 1 \text{ hour} + 2 \text{ hours (if telephone order)} \\ & + 1 \text{ hour (if fax order)} \\ & + 0.2 \text{ hours (if electronic order)}\end{aligned}$$

The time equation allows the details of particular orders to be captured simply and incorporated within the model.

As another example, consider the activity of getting orders ready for shipment. If the item is already a standard one in a standard package, the operation may take only 0.5 minute to prepare it for shipment. If the item requires a special package, then an additional 6.5 minutes is required. And if the item is to be shipped by air, an additional 0.2 minute is required to place it in a special bag. The time equation for the packaging process can be represented as follows:

$$\begin{aligned}\text{Packaging time} = {} & 0.5 + 6.5 \text{ (if special handling required)} \\ & + 0.2 \text{ (if shipping by air)}\end{aligned}$$

The data for the time equations—order types, method of shipment, and all other production characteristics—are typically already in the company's enterprise resource planning system where the order has been entered. Order-specific data enable the particular time demands for any given order to be quickly calculated with a simple algorithm that tests for the existence of each characteristic affecting resource processing time. In this way, the time-driven ABC model can accurately and simply reflect the variety and complexity in orders, products, and customers.

Service Companies

Although ABC had its origins in manufacturing companies, today many service organizations are obtaining great benefits from this approach. In practice, the actual construction of an ABC model is nearly identical for both types of companies. This should not be surprising since even in manufacturing companies the ABC system focuses on the service component, not on the direct materials and direct labor costs of manufacturing operations. ABC addresses the support resources that serve the manufacturing process—purchasing, scheduling, inspecting, designing, supporting products and processes, and handling customers and their orders.

Service companies in general are ideal candidates for ABC, even more than manufacturing companies. First, virtually all of the costs for a service company are indirect and appear to be fixed. Manufacturing companies can trace important components of costs, such as direct material and direct labor costs, to individual products. Service companies have few or no direct materials, and many of their personnel provide indirect, not direct, support to products and customers. Consequently, service companies do not have direct, traceable costs to serve as convenient allocation bases.

The large component of apparently fixed costs in service companies arises because, unlike manufacturing companies, service companies have virtually no material costs—the prime source of short-term variable costs. Service companies must supply virtually all of their resources in advance to provide the capacity to perform work for customers during each period. Fluctuations during the period of demand by individual products and customers for the activities performed by these resources do not influence short-term spending to supply the resources.

Consequently, the *variable cost* (defined as the increase in spending resulting from an incremental transaction or customer) for many service industries is close to zero. For example, a transaction at a bank's automatic teller machine requires an additional consumption of a small piece of paper to print the receipt—but no additional outlay. For a bank to add an additional customer may require a monthly statement to be mailed, involving the cost of the paper, an envelope, and a stamp—but little more. Carrying an extra passenger on an airplane requires an extra can of soda pop, perhaps, a small snack (for most coach-class U.S. flights these days!), and a minor increase in fuel consumption—but nothing else. For a telecommunications company, handling one more phone call from a customer or one more data transfer involves no incremental spending. Therefore, service companies making decisions about products and customers on the basis of short-term variable costs might provide a full range of all products and services to customers at prices that could range down to near zero. In such cases, of course, the companies would receive virtually no recovery of the costs of all of the committed resources they supplied to enable the service to be delivered to the customer.

An activity-based cost system for a service company would be developed in the same way as that for a manufacturing company. We will illustrate with a simple example but not go through an extended example, as we did for Madison's ice cream plant. (*Note:* There will be an exercise in the problems at the end of the chapter for you to practice on.) Consider a retail brokerage company that performs stock and mutual fund trades, account management, and financial planning for its customers.

AFP/Getty Images

Its resources include various types of employees: brokers, account managers, and financial planners, information technology and telecommunications equipment and support staff, and office space and furniture. Let's focus on one resource, one of the company's 225 brokers. Remember that we need to calculate two parameters:

1. The broker's capacity cost rate.
2. How much of the broker's capacity is used by each of the various activities she performs for products and customers.

Capacity Cost Rate

The numerator in the capacity cost rate includes the broker's total compensation and the costs of all other resources deployed to support her. The broker's annual compensation is $65,000, including fringe benefits. The broker works in an 80-square-foot office and the cost of supplying space in that location has been estimated at $125 per square foot per year. Finally, the broker has a leased personal computer, rights to several financial planning and analysis software packages, real-time access to stock pricing and stock research, and support from the company's internal information technology group. The total cost of computer hardware, software, and internal consulting support is about $6,120 per year. This yields the following fully loaded cost for the broker:

Annual compensation	$65,000
Occupancy (80 sq ft @ $125/sq ft)	10,000
Computer technology and support	6,120
Total annual cost	$81,120
Monthly cost	$ 6,760

The denominator of the capacity cost rate equals the time the broker has available for work with customers. She shows up for work on 240 days per year, or 20 days per month. The workday is 7½ hours per day, with 1 hour used for breaks, training, research, and internal staff meetings. Thus the broker has about 130 hours per month (20 days per month × 6.5 hours per day) available for productive work. The broker's capacity cost rate can now be calculated:

$$\begin{aligned}\text{Broker capacity cost rate} &= (\$6{,}760 \text{ per month})/(130 \text{ hours/month}) \\ &= \$52 \text{ per hour (or, approximately,} \\ &\quad \$0.87 \text{ per minute)}\end{aligned}$$

Calculating the Time Equation for the Consumption of Broker's Capacity

The broker performs three different activities: performing a stock trade at a customer's request, opening an account for a new customer, and meeting with customers, either over the phone or in person to talk about financial plans and account management. Studies have indicated the typical times required each time one of these activities is performed:

Performing a stock trade transaction	5 minutes
Opening a new account	60 minutes
Meeting with a customer	20 minutes

During a recent month, the broker performed 912 stock trades, opened 4 new stock trading accounts, and had 6 meetings with customers. The total time of the broker associated with the stock trading product line would be calculated as:

$$\begin{aligned}\text{Broker's time used for stock trading} &= (912 \times 5 + 4 \times 60 + 6 \times 20)\\ &= 4{,}920 \text{ minutes}\\ &= 82 \text{ hours}\\ \text{Cost of broker for stock trading product line} &= 82 \times 52 = \$4{,}264\end{aligned}$$

Stock trading used 82 of the broker's 130 available hours of time during the month. Some of the broker's remaining time might have been used for other product lines, such as mutual fund sales and redemptions, and some might represent unused capacity during the month. This will be determined when the more complete model of resource consumption and costing across all product lines is built.

The preceding calculation for the single broker would be replicated for all of the company's 225 brokers, and a similar set of calculations performed for each of the company's other resources involved in supporting stock trading. The costs of all resources would then be accumulated and matched with the revenues, typically brokerage commissions, earned by trading stocks for customers, to determine the profit or loss from this product line.

Once a complete costing and profitability report has been built, the managers of a service company can contemplate the same set of actions as their counterparts in manufacturing companies: pricing, product mix, process improvements, minimum level of customer transaction volumes, etc. Companies in financial services (banks, insurance companies, and money managers), transportation (airlines, trucking, and railroads), telecommunications, wholesale and retail, health care, and even many government agencies are now using such ABC analysis to understand and improve the economics of their operations.

Implementation Issues

Although ABC has provided managers in many companies with valuable information about the cost of their activities, processes, products, services, and customers, not all ABC systems have been sustained or have contributed to higher profitability for the company. Companies have experienced difficulties and frustrations in building and using ABC and profitability models. We can identify several common pitfalls that have occurred and suggest ways to avoid them.

Lack of Clear Business Purpose

Often, the ABC project is initiated out of the finance or accounting department and is touted as "a more accurate cost system." The project team gets resources for the project, builds an initial ABC model, and then becomes disappointed and disillusioned when no one else looks at or acts on the new ABC cost and profitability information.

To avoid this syndrome, all ABC projects should be launched with a specific business purpose in mind. The purpose could be to redesign or improve processes, to influence product design decisions, to rationalize the product mix, or to provide better baselines for pricing decisions. By defining the business purpose at the start, the team will identify the line manager or department whose behavior and decisions are expected to change as a consequence of the information. The decision maker could be the manufacturing or operations manager (for process improvement), the engineering manager (for product design decisions), the sales organization (for managing customer relationships), or the marketing department (for decisions about pricing and product mix).

It is also important not to oversell what the ABC system is capable of doing. Some project teams, carried away by their enthusiasm, promise that ABC will solve all of the company's costing and financial problems. ABC is a strategic costing system that highlights the costs of processes, and the cost and profitability of products, and customers. It is not a good system for providing short-term feedback on process and departmental efficiencies and improvements.

Lack of Senior Management Commitment

A pitfall related to the first problem arises when the finance department undertakes the project without gaining senior management support and buy-in. When this happens, the rest of the organization views the project as done by and for finance people; as a result, no one outside the finance department pays attention to it. Because the finance department is not empowered to make decisions about processes, product designs, product mix, pricing, and customer relationships, no useful actions are taken that lead to increased profitability.

The most successful ABC projects occur when a clear business purpose exists for building the ABC model and when this purpose is led (or at least understood and fully supported) by senior line managers in the organization. A steering committee of senior managers from various functional groups and business units provides guidance and oversight, meeting monthly to review project progress, make suggestions on how to enhance the model, and prepare for the decisions that will be made once the model has been completed.

Even when the ABC project is initiated from the finance group, a multifunctional project team should be formed. The team should include, in addition to a cost analyst or other finance group representative, members from operations, marketing/sales, engineering, and systems. In this way, the expertise from diverse groups can be incorporated into the model design, and each team member can build support for the project within his or her department and group.

Delegating the Project to Consultants

Some projects have failed when they were outsourced to an external consulting company. Consultants may have considerable experience with ABC but not the needed familiarity with a company's operations and business problems. Nor can they build management consensus and support within the organization either to make decisions with the ABC information or to maintain and update the model. Even worse, some companies think they can get an ABC system by buying an ABC software package. The software provides a template to enter, process, and report information, but it cannot provide the thinking required to build a cost-effective ABC model.

ABC consultants and ABC software can play valuable roles for many companies, but they are not substitutes for overcoming the first two pitfalls. Successful ABC projects require top management leadership and sponsorship and a dedicated, multifunctional internal project team. These functions cannot be bypassed just because external consultants and prepackaged software have also been purchased.

Poor ABC Model Design

Sometimes, even with strong management support and sponsorship, the project team gets lost in the details and develops an ABC model that is both too complicated to build and maintain and too complex for managers to understand and act on. In other cases, the model uses arbitrary allocations—frequently percentages, not capacity utilization estimates—to map costs from resources to products and customers. The arbitrary allocations create distortions in the model and destroy its credibility among line managers. Often, the model requires other organizational functions to provide new data and information on a regular basis, increasing their workload without providing corresponding benefits. Under the burden of poor design, the ABC system soon collapses under its own weight and neglect.

As noted, ABC model design should be like any design or engineering project. The project team can start out with a simple high-level prototype, Version 1.0. After various people within the company have a chance to review the output from the model and study the assumptions made in its building, the project team can do more detailed analysis and model extension where Version 1.0 was too simplistic. Over time, the model's design will improve and gain credibility throughout the company. As one vice president of sales insisted, while serving on an advisory committee to the ABC project team:

> We absolutely need credible, valid numbers if we are to have frank discussions with our least profitable customers. Good cost numbers will also help us grow and enhance relationships with our most profitable customers.

The ABC project team should keep end users clearly in mind, get good advice from its senior management steering committee, and make good cost-effective design decisions along the way. These decisions can help avoid the problem of having an overcomplex or nontransparent costing system.

Individual and Organizational Resistance to Change

Not all managers welcome technically superior solutions. Individuals often resist new ideas and change, and organizations have great inertia. The resistance to a new ABC model may not be overt. Managers can politely sit through an ABC presentation about product and customer profitability but continue to behave just as they have in the past; or they will ask the project team to reestimate the model, using a more recent period or at another company site. Sometimes, however, the resistance is more overt. Managers may argue that the company has been successful in the past with its existing cost system; why does it need a new approach? Or, if it has been a finance-led project, they may accuse the finance people of wanting to run the company or not understanding the complexity of the business.

People Feel Threatened

Individual and organizational resistance arises because people feel threatened by the suggestion that their work could be improved. We might not think that a cost model could generate such resistance, but in fact, a more accurate costing model could reveal the following:

- Unprofitable products.
- Inefficient activities and processes.
- Substantial unused capacity.

Managers responsible for these problems could be embarrassed and threatened by the revelation of apparent bad management during their watch. Rather than accept the validity of the ABC model and attempt to rectify the problems (which likely occurred because of inadequacies in the previous cost system, not their own negligence or ineptitude), they may deny the validity of the new approach and question the motives of the people attempting to lead the change. Such defensive behavior will inhibit any effective action.

Chapter 9 includes a discussion of the behavioral issues that arise when implementing new cost control, performance measurement, and management control systems. Resistance is not unique to ABC. It can arise from the introduction of any new measurement or management system or, indeed, any management change initiative. However, as a costing innovation, ABC systems are prime candidates for triggering individuals' and organizations' negative responses to change initiatives. Dealing with such responses requires skills for recognizing and overcoming defensive behavior, skills that managers may not have been taught in their academic studies or in their early job assignments.

Epilogue to Madison Dairy

Madison Dairy extended the time-driven ABC system from its single ice cream plant to its entire operations. It was able to track the costs of changeovers in producing and packaging all of its products and the costs of picking, loading, and delivering products to its diverse customer base. The model captured differences in how it entered orders from customers (customer phone call, salesperson call, fax, truck-driver entry, electronic data interchange, or Internet), how it packaged orders (full stacks of six cases, individual cases, or partial break-pack cases for small orders), how it delivered orders (commercial carriers or its own fleet including route miles), and time spent by the driver at each customer location. The model also captured the extra packaging costs for special promotions and customer-specific labels and promotions.

Madison used its time-driven ABC model proactively to become the leading dairy supplier to a national customer. Madison demonstrated that it could identify the specific manufacturing, distribution, and order handling costs associated with serving this customer on the basis of actual order characteristics: DSD (direct store delivery) or shipments to distribution centers, gallon versus pint deliveries, and volume and mix of products. The ABC model facilitated an open, trusting relationship between supplier and customer that differentiated Madison from its competitors.

Madison also became aware that one of its convenience store customers had been overordering and returning product when the date code had expired. To save the high cost of these rebates and returns, Madison offered these retailers a 2% discount if the retailer would manage its own inventory without the return option. In this way, Madison eliminated 95% of out-of-code returns, generating a net saving of $120,000 per year.

Source: The Madison Dairy case was based on an actual company case study; see "Kemps LLC: Introducing Time-Driven ABC," HBS No. 106-001 (Boston: Harvard Business School Publishing, 2006).

Summary

This chapter introduced activity-based cost systems, including why ABC systems produce more accurate costs than standard cost systems, which allocate production overhead proportional to quantities produced. ABC systems drive the cost of indirect and support resources—manufacturing resources in factories and marketing, selling, distribution, and administrative resources—more directly to products by modeling how each product and production run makes demands on the organization's various resources.

An ABC model consists of two fundamental parameters: the costs of supplying each resource's capacity and the demands that each product and production order make on each resource's capacity. The model's developers make appropriate trade-offs in the design of the model, balancing the cost of more accurate measurement for more complex models with the benefits from the greater accuracy.

Managers use the information on activity costs to improve profitability. They can identify high-cost and inefficient processes that are prime candidates for operational improvement projects. Managers also learn about the profitable and unprofitable products and use that information to make better decisions on pricing, product mix, product design, and process improvements that transform unprofitable products into profitable ones.

Despite the apparent attraction of increased accuracy and managerial relevance as a result of using an ABC system, individual and organizational resistance can arise to block their effective use. Finance managers must be sensitive to the conditions that cause such resistance to arise and devise good countermeasures to overcome them.

Appendix 5-1

Historical Origins of Activity-Based Costing

The costing approach described in this chapter is a contemporary version of the original activity-based costing (ABC) method introduced in the 1980s.[7] The original version used a two-stage estimation approach. In the first stage, the project team interviewed and surveyed employees to identify all of the principal activities they performed and asked the employees to estimate the percentages of their time spent on each principal activity. The team used these percentages to assign the cost of the employees to the activities they performed (hence, the origin of the name "activity-based costing"). In a second stage, the project team assigned the activity costs to products based on estimates of the quantity of each activity used in the production of each product.

We illustrate the original ABC approach by applying it to the Madison Dairy ice cream plant example. First, a project team asks the indirect labor employees what activities they perform. They reply with the following three activities: schedule production runs, set up for production runs, and maintain products. They next ask about the percentages of time spent on these three activities, and receive the following estimates:

Schedule production runs	30%
Set up for production runs	60%
Maintain products	10%

The cost of indirect labor plus fringes during March 2010 was about $15,000.[8] So the team estimates the cost of the three activities as follows:

Schedule production runs	$4,500
Set up for production runs	9,000
Maintain products	1,500

[7] R. Cooper and R. S. Kaplan, "Measure Costs Right: Make the Right Decisions," *Harvard Business Review* (September–October 1988), 96–103.

[8] Indirect labor wages were about $12,000, plus 25% for fringe benefits; the $15,000 estimate could also be obtained from Exhibit 5-5, which shows the cost of indirect labor used as just under $15,000, and this excludes a small amount of unused labor capacity costs.

This calculation, driving resource costs to activities through estimated percentages of times for each activity, completes the first stage of the cost system. In the second stage, the project team drives the activity costs down to products, using activity cost drivers for each activity. A cost driver represents the output of each activity, such as the following for the three activities performed by indirect labor:

Activity	Cost Driver	Cost Driver Quantity
Schedule production runs	Number of production runs	38
Set up for production runs	Number of set up hours	240
Maintain products	Number of products	4

The team calculates activity cost driver rates by dividing each activity cost by its cost driver quantity. The activity cost driver rate represents the costs of the resources used each time the activity is performed.

Activity	Activity Cost Driver Rate
Schedule production runs	$118.42 per production run
Set up for production runs	$37.50 per setup hour
Maintain products	$375 per product maintained

In a final step, the project team multiplies the quantity of cost drivers for each product with its activity cost driver rate to obtain the assignment of indirect costs to individual products. The calculations are summarized on the next page[9]:

This cost assignment of indirect labor cost to products is quite close to that obtained by the time-driven ABC approach used in the chapter (see data in Exhibit 5-4)

[9] Recall that three indirect labor people are used during setups; also all costs are rounded to the nearest dollar.

Indirect Labor Usage	Vanilla	Chocolate	Strawberry	Mocha-Almond	Total	Activity Cost Driver Rate
Number of production runs	12	12	8	6	38	$118.42
Number of setup hours	72	36	60	72	240	$37.50
Number of products	1	1	1	1	4	$375.00
Cost of production runs	$1,421	$1,421	$947	$711	$4,500	
Cost of setups	2,700	1,350	2,250	2,700	9,000	
Cost to sustain products	375	375	375	375	1,500	
Product cost: indirect labor	$4,496	$3,146	$3,572	$3,786	$15,000	

because the employees' estimates of the time they spent on the three activities (30%, 60%, 10%) were remarkably close to the actual percentages of time (which can be calculated as 36%, 56%, 8%) and because the indirect labor employees were operating at nearly full capacity. This example indicates that under the proper conditions, original and time-driven ABC can lead to the same assignment of indirect costs to products. But the original ABC formulation was highly sensitive to employees' subjective estimates of the percentage of time they spent on their various activities and did not handle well the estimate of unused capacity; most employees estimated activity percentages that added up to 100%.

Limitations of Original Activity-Based Costing

Original ABC, while essentially equivalent to time-driven ABC models when time percentages, including unused capacity, are estimated correctly, encountered numerous problems as companies attempted to implement on an enterprise level, the approximate method, based on employees' subjective estimates of time allocations. First, the process to interview and survey employees to obtain their time allocations was time consuming and costly. At one large money center bank's brokerage operation, the ABC model required 70,000 employees at more than 100 facilities to submit monthly surveys of their time. The company had to provide 14 full-time people just to manage ABC data collection, processing, and reporting. A $20 billion distributor required several months and about a dozen employees to update its internal ABC model. Employees also found it intrusive and annoying to continually estimate how much time they spent on various activities. The high time and cost to estimate an ABC model and to maintain it—by conducting interviews and surveys again—became a major barrier to widespread ABC adoption. Also, because of the high cost of continually updating the ABC model, many ABC systems were infrequently updated, leading to out-of-date activity cost driver rates and inaccurate estimates of process, product, and customer costs.

Managers also doubted the accuracy of a system based on individuals' subjective estimates of how they spend their time. Apart from the measurement error introduced by employees' best attempts to recall their time allocations, the people supplying the data—anticipating how it might be used—could bias or distort their responses. At many companies, managers spent more time arguing about the accuracy of the model's estimated costs and profitability than addressing how to improve the inefficient processes, unprofitable products and customers, and considerable excess capacity that the model had revealed.

With original ABC, managers found it difficult to add new activities or add more detail to an existing activity. For example, consider the complexity in an activity, "ship order to customer." Rather than assume a constant cost per order shipped, a company might have wanted to recognize the cost differences when an order was shipped in a full truck or in a less-than-truckload (LTL) shipment, using overnight express or a commercial carrier. In addition, the shipping order could have been entered either manually or electronically, or required either a standard or an expedited transaction. To allow for the significant variation in resources required by each different shipping arrangement, new activities had to be added to the ABC model, and personnel reinterviewed to get their time allocations for reassigning aggregate shipping expenses to all the different shipping activity types.

Such expansion caused many original ABC systems to exceed the capacity of their generic spreadsheet tools, such as Microsoft Excel®, or even commercial ABC software packages. The systems often took days to process one month of data, assuming the solution converged at all. For example, the automated ABC model for a $12 million manufacturer took three days to calculate costs for its 40 departments, 150 activities, 10,000 orders, and 45,000 line items.

Finally, when employees estimated how much time they spent on a list of activities handed to them, invariably they reported percentages adding up to 100%. Few individuals reported that a significant percentage of their time is idle or unused. Therefore, cost driver rates were calculated assuming that resources were working at full capacity. But, of course, operations at practical capacity were more the exception than the rule. When unused capacity was assigned to products, and managers took the normal actions to improve profitability—decrease the production of loss or expensive products, increase production run sizes, and improve process efficiencies—they increased unused capacity even more. But unless the cost of the newly created unused capacity was excluded from future cost assignment to products, the apparent gains from these apparently desirable actions got reallocated back to the remaining products, raising their costs and lowering their reported profitability.

In summary, the process of calculating activity expenses through interviews, observation, and surveys required a time-consuming, error-prone, and costly process to collect the data, an expensive information system to run the model, and a difficult process to update the model in light of changing circumstances. It was also theoretically incorrect in that it included the cost of unused capacity when calculating cost driver rates. All of these difficulties were overcome with the introduction of the time-driven ABC model, which offered the following advantages:

1. It is easy and fast to build an accurate model even for large enterprises.
2. It exploits the detailed transactions data that are available from ERP systems.
3. It drives costs to transactions and orders with time equations that use specific characteristics of particular orders, processes, suppliers, and customers.
4. It provides visibility to capacity utilization and the cost of unused capacity.
5. It enables managers to forecast future resource demands, allowing them to budget for resource capacity on the basis of predicted order quantities and complexity.
6. It is easy to update the model as resource costs and process efficiencies change.

Key Terms

capacity cost rate, 172
cost of unused capacity, 179
practical capacity, 186
time-driven activity-based costing (TDABC), 172
time equations, 186

Assignment Materials

Questions

5-1 Why are traditional volume-based cost allocation systems likely to systematically distort product costs? **(LO 1, 2)**

5-2 Under what two conditions are volume-based traditional product costing systems most likely to distort product costs? How do activity-based costing systems provide more accurate costs when these two conditions hold? **(LO 1, 2)**

5-3 "When a company produces both high-volume products and low-volume products, traditional product costing systems are likely to overcost high-volume products." Do you agree with this statement? Explain. **(LO 1, 2, 3)**

5-4 Why do companies producing a varied and complex mix of products have higher costs than companies producing only a narrow range of products? **(LO 2)**

5-5 How is a time-driven ABC system updated as resource costs increase or changes in operations occur? **(LO 3)**

5-6 What two sets of parameters must be estimated in time-driven ABC? **(LO 3)**

5-7 How can the information from an activity-based costing system guide improvements in operations and decisions about products and customers? **(LO 4)**

5-8 Why is practical capacity recommended in calculating capacity cost rates? **(LO 5)**

5-9 Why might an organization not experience financial improvement even after using activity-based costing to identify and take action on promising opportunities for process improvements and cost reductions? (LO 5)

5-10 Why are service organizations often ideally suited for activity-based costing? (LO 6)

5-11 What are some special considerations in the design of cost accounting systems for service organizations? (LO 6)

5-12 Why might individuals resist implementation of activity-based costing? (LO 7)

5-13 What advantages does time-driven ABC have over original activity-based costing? (Appendix)

Exercises

LO 1, 2, 4 **5-14** ***Product costing systems and product profitability*** Potter Corporation has gained considerable market share in recent years for its specialty, low-volume, complex line of products, but the gain has been offset by a loss in market share for its high-volume, simple line of products. This has resulted in a net decline in its overall profitability. Advise management about specific changes that may be required in its cost accounting system and explain why the existing system may be inadequate.

LO 3 **5-15** ***Revising a time-driven activity-based cost system, adding products*** Refer to the Madison Dairy ice cream plant example described in this chapter.

Required

(a) Suppose that production-related computer resource expenses of $18,000 per month have been inadvertently overlooked for inclusion in the cost system. Explain how the time-driven ABC model should be updated to reflect this cost.

(b) Suppose that energy costs of $4,000 per month to run the machinery have also been inadvertently overlooked for inclusion in the cost system. How should the activity-based cost model be updated to include this cost, and what will be the effect on the machine hour rate?

(c) If the company wishes to introduce a new flavor, what information is needed in order to determine the cost of producing this new flavor?

LO 3 **5-16** ***Revising a time-driven ABC system, cost increases, and process changes*** Refer to the time-driven ABC analysis of the Madison Dairy ice cream plant example in the chapter.

Required

(a) Suppose indirect labor costs have increased by 10% from the original setting but all other information remains the same. Determine the total time-driven activity-based costs assigned to each of the four products (flavors) after incorporating the 10% increase in indirect labor costs and prepare an income statement similar to that shown in Exhibit 5-5.

(b) Suppose that in addition to the change in part a, the unit time for scheduling a production run decreased from four hours per run to three hours per run. Determine the new total time-driven activity-based costs assigned to each of the four products (flavors) and prepare an income statement similar to that shown in Exhibit 5-5 but also showing the total cost of unused capacity.

LO 3, 5 **5-17** ***Assigning activity-based costs in manufacturing, unused capacity, income*** Halifax Brass Company manufactures pumps and valves and uses a time-driven activity-based cost (TDABC) system. Last year, Halifax recorded the following data for assigning manufacturing overhead costs to its products:

	Unit Cost Estimates (Rates per Hour)	Total Unit Time Estimates (Hours Assigned to Products)		Practical Capacity Not Assigned to Products (Hours)
		Pumps	Valves	
Machine setups and run time	$20.00 per machine hour	1,500	1,800	300
Labor for setups, receiving, and packing	$30.00 per labor hour	5,000	6,000	200
Engineering (for specializing products)	$80.00 per engineering hour	200	400	50

Halifax also developed the following information on revenues and costs other than manufacturing overhead:

Total revenues	$890,000
Total direct labor cost	$120,000
Total direct materials cost	$90,000
SG&A expenses	$100,000

Required

(a) Using the company's TDABC system, how much manufacturing overhead cost will be assigned to pumps? How much will be assigned to valves?

(b) What is the company's net income? (Assume the company sells the entire amount of the products it produces.)

LO 5 **5-18** ***Capacity costs*** Ken's Cornerspot, a popular university eatery in a competitive market, has seating and staff capacity to serve about 600 lunch customers every day. For the past two months, demand has fallen from its previous near-capacity level. Concerned about his declining profit, Ken decided to take a closer look at his costs. He concluded that food was the primary cost that varied with meals served; the remaining costs of $3,300 per day were fixed. With demand averaging 550 lunches per day for the past two months, Ken thought it was reasonable to divide the $3,300 fixed costs by the current average demand of 550 lunches to arrive at an estimate of $6 of support costs per meal served. Noting that his support costs per meal had now increased, he contemplated raising his meal prices.

Required

(a) What is likely to happen if Ken continues to recompute his costs using the same approach if demand decreases further?

(b) Advise Ken on choosing a cost driver quantity for computing support costs per meal and explain why you advocate your choice of quantity.

Problems

LO 3, 5 **5-19** ***Assigning corporate support costs, activity-based costing*** Zeta Department Store has developed the following information in order to develop a time-driven ABC model for its Accounts Receivable Department:

Activity	Estimated Worker Time to Perform Activities
Manual processing of invoice and cash receipt	1.0 hour
Electronic processing of invoice and electronic funds transfer	0.1 hour
Maintain customer file	0.5 hour

The time to process payments of customer invoices depends on whether the customer pays the bill manually or electronically, as shown above. The time to maintain each customer file is the same for all customers. The annual cost of the Accounts Receivable Department is $500,000 and the associated practical capacity of accounts receivable labor is 10,000 hours. The Accounts Receivable Department has six employees.

Required

(a) What is the capacity cost rate for the Accounts Receivable Department?
(b) Zeta's Division 1 has 1,000 small- to medium-sized customers who annually generate a total of $10 million in sales, resulting in 4,000 invoices. These customers pay all their invoices manually. What is the annual activity-based cost associated with Division 1's customers?
(c) Zeta's Division 2 has 200 large customers who annually generate a total of $10 million in sales, resulting in 400 invoices. These customers pay all of their invoices electronically. What is the annual activity-based cost associated with Division 2's customers?
(d) Suppose half of Zeta's Division 1 customers change their method of payment to electronic next year. How many hours of accounts receivable labor will it require for 1,000 customers, 2,000 manual invoices, and 2,000 electronic invoices? How much will Division 1 be charged for the accounts receivable function? Will Zeta's costs decrease because of the shift to 50% electronic invoicing in Division 1?

LO 3, 5 **5-20** ***Compute activity-based cost rate, time equations*** CAN Company sells multiple products and uses a time-driven ABC system. The company's products must be wrapped individually before shipping. The packaging and shipping department employs 24 people. Each person works 20 days per month on average. Employees in this department work an eight-hour shift that includes a total of 75 minutes for breaks and a meal. The full compensation, including fringe benefits, for each packaging and shipping employee is $4,050 per month.

Required

(a) Using the principles discussed in this chapter and time-driven ABC, what is the rate per hour for each packaging and shipping employee at CAN?
(b) On average, it takes one packaging and shipping employee 15 minutes to prepare a package and label, independent of the number or types of items in the shipment, plus 6 minutes per item to bubble wrap and pack it in the carton. Using CAN's time-driven ABC system, what is the packaging and shipping cost assigned to Order 705, which consisted of 40 items?

LO 3, 4, 5 **5-21** ***Forecasting resource capacity using a time-driven ABC system*** Refer to the time-driven ABC analysis of forecasting resource capacity for the Madison Dairy ice cream plant example on pages 181–184 of this chapter. Suppose that all the information is the same except for the following:

	Vanilla	Chocolate	Strawberry	Mocha-almond	Total
Sales volume (gallons)	15,500	13,000	1,600	1,200	31,300
# production runs	18	16	4	3	41

Required

(a) Assuming that only full-time employees can be hired, determine the number of production employees required to meet this production plan. Also, determine the number of machines required for this production plan.
(b) Prepare a pro forma monthly product line income statement similar to that shown in Exhibit 5-7.
(c) What are the company's gross profit and the ratio of gross profit to sales after incorporating the cost of unused capacity?

LO 4 **5-22** ***Relationship of the Balanced Scorecard to activity-based costing*** Explain how an activity-based costing model can be linked to a Balanced Scorecard approach.

LO 4 **5-23** ***Balanced Scorecard or activity-based costing*** Suppose an organization has not implemented either activity-based costing or a Balanced Scorecard but believes both would be valuable for the organization. However, management is currently willing to undertake only one major change initiative. Advise management on the decision between implementing an activity-based costing model or a Balanced Scorecard.

LO 5 **5-24** ***Cost rates for peak- and non–peak-hour capacity usage*** XZ Discount Brokerage is trying to determine the cost of supplying computing resources in order to determine how much to charge for trades. The company's cost analyst is perplexed because XZ has acquired 80 servers to meet peak capacity needs, which occur between 9 A.M. and 5 P.M. local time, but only needs the capacity of 20 servers during the remaining time. The costs associated with each server are $3,696 per month and each server is available for use for 24 hours per day for an average of 22 days per month.

Required

(a) What cost per hour would you advise for peak-hour capacity consumption? Explain why you think this cost rate is appropriate.
(b) What cost per hour would you advise for non–peak-hour capacity consumption? Explain why you think this cost rate is appropriate.

LO 3, 5, 6 **(Appendix)** **5-25** ***Original activity-based costing and time-driven activity-based costing*** Garber Company uses a traditional activity-based costing system to assign $600,000 of committed resource costs for customer service on the basis of the following information gathered from interviews with customer service personnel:

Activity	Time Percentage	Estimated Cost Driver Quantity
Handle customer orders	75%	8,000 customer orders
Process customer complaints	10%	400 customer complaints
Perform customer credit checks	15%	450 credit checks
	100%	

Required

(a) Compute the activity cost driver rates using this system.

(b) Suppose instead that Garber uses time-driven ABC to assign the $600,000 of committed resource costs to the three activities. Compute the time-driven activity cost driver rates, assuming 10,000 hours of useful work and the unit time estimates that follow:

Activity	Unit Time (Hours)
Handle customer orders	0.75
Process customer complaints	3.50
Perform customer credit checks	3.00

(c) Suppose that the quantities of activities this period are 8,000 customer orders, 400 customer complaints, and 450 credit checks. Using the information and activity cost driver rates developed in part b, determine the cost assigned to each of the activities and the estimated hours of unused capacity as well as the associated cost. What actions might managers take after evaluating such information?

(d) Suppose that in the next time period, the quantities of activities change to 8,500 customer orders, 350 customer complaints, and 500 credit checks. Using the information and activity cost driver rates developed in part b, determine the cost assigned to each of the activities and the estimated hours of unused capacity as well as the associated cost.

(e) Explain why the activity cost driver rates computed in part a are different from the rates computed in part b.

LO 3, 6 **5-26** ***Activity-based costing in a health care organization*** Riverdale Bone and Joint Surgery specializes in treating injuries related to bones and joints, as well as surgeries such as knee replacements and hip replacements. In addition to performing surgeries, Riverdale offers post-operation treatment. Riverdale would like to develop an activity-based costing system in order to obtain accurate costs regarding the variety of patients that it serves.

Required

(a) What resource units would you advise using to build an activity-based costing system for Riverdale?

(b) After identifying the resource units, what other steps are required to determine the cost of a particular patient?

LO 1, 3 **5-27** ***Manufacturing support cost driver rates*** (Adapted from CMA, December 1990) Moss Manufacturing has just completed a major change in its quality control (QC) process. Previously, products had been reviewed by QC inspectors at the end of each major process, and the company's 10 QC inspectors were charged as direct labor to the operation or job. In an effort to improve efficiency and quality, a computer video QC system was purchased for $250,000. The system consists of a minicomputer, 15 video cameras, other peripheral hardware, and software.

The new system uses cameras stationed by QC engineers at key points in the production process. Each time an operation changes or there is a new operation, the cameras are moved, and a new master picture is loaded into the computer by a QC engineer. The camera takes pictures of the units in process, and the computer compares them to the picture of a good unit. Any differences are sent to a QC engineer who removes the bad units and discusses the flaws with the production supervisors. The new system has replaced the 10 QC inspectors with two QC engineers.

The operating costs of the new QC system, including the salaries of the QC engineers, have been included as manufacturing support in calculating the company's plantwide manufacturing support cost rate, which is based on direct labor dollars.

Josephine Gugliemo, the company's president, is confused. Her vice president of production has told her how efficient the new system is, yet there is a large increase in the manufacturing support cost driver rate. The computation of the rate before and after automation is shown here:

Item	Before	After
Budgeted support costs	$1,900,000	$2,100,000
Budgeted direct labor costs	1,000,000	700,000
Budgeted cost driver rate	190%	300%

"Three hundred percent," lamented the president. "How can we compete with such a high manufacturing support cost driver rate?"

Required

(a) Define manufacturing support costs and cite three examples of typical costs that would be included in this category. Explain why companies develop manufacturing support cost driver rates.

(b) Explain why the increase in the cost driver rate should not have a negative financial impact on Moss Manufacturing.

(c) Explain, in great detail, how Moss Manufacturing could change its accounting system to eliminate confusion over product costs.

(d) Discuss how an activity-based costing system may benefit Moss Manufacturing.

LO 1, 3, 4, 6 **(Appendix)** **5-28** ***Original activity-based costing for shared services, outsourcing, implementation issues*** Smithers, Inc., manufactures and sells a wide variety of consumer products. The products are viewed as sufficiently profitable, but recently some product-line managers have complained about the charges for the call center that handles phone calls from customers about the products. Product lines are currently charged for call center support costs on the basis of product sales revenues. The manager of product X is particularly upset because he has just obtained a report that includes the following information for last year:

	Product X	Product Y
Number of calls for information	2,000	4,000
Average length of calls for information	3 minutes	5 minutes
Number of calls registering complaints	200	1,000
Average length of complaint calls	5 minutes	10 minutes
Sales volume	$400,000	$100,000

Product X is simple to use and consumers have little concern about adverse health effects. Product Y is more complex to use and has many health hazard warnings on its label. Smithers currently allocates call center support costs using a rate of 5% of net sales dollars. The manager of product X argues that the current system does not trace call center resource usage to specific products. For example, product X bears four times the call center costs that product Y does, although fewer calls are related to product X, and the calls consume far less time.

Required

(a) What activity cost driver would you recommend to improve the current system of assigning call center support costs to product lines? Why is your method an improvement?

(b) Suppose Smithers announces that it will now assign call center support costs on the basis of an activity-based cost system that uses minutes of calls (calls for information and calls for complaints) as the activity cost driver. Suppose also that the rate is 70 cents per minute. Compare the call center cost assignments to product X and product Y under the previous system and the new activity-based cost system.

(c) What actions can the product managers take to reduce the center costs assigned to their product lines under the previous system and the new system? What other functional areas might help reduce the number of minutes of calls for product Y?

(d) Who might resist implementation of the new activity-based cost system? In your response, discuss possible reactions of the call center staff and other staff who might be affected by efforts to reduce minutes of calls.

(e) From the company's point of view, how might the activity-based costing system help in the assessment of whether to outsource the call center activities?

LO 1, 3, 4 **(Appendix)** **5-29** ***Cost distortions, original activity-based costs*** At its manufacturing plant in Duluth, Minnesota, Endo Electronics Company manufactures two products, X21 and Y37. For many years, the company has used a simple plantwide manufacturing support cost rate based on direct labor hours. A new plant accountant suggested that the company may be able to assign support costs to products more accurately by using an activity-based costing system that relies on a separate rate for each manufacturing activity that causes support costs.

After studying the plant's manufacturing activities and costs, the plant accountant has collected the following data for last year:

Item	X21	Y37
Units produced and sold	50,000	100,000
Direct labor hours used	100,000	300,000
Direct labor cost	$1,000,000	$4,500,000
Number of times handled	40,000	20,000
Number of parts	12,000	8,000
Number of design changes	2,000	1,000
Number of product setups	8,000	6,000

The accountant has also determined that actual manufacturing support costs incurred last year were as follows:

Cost Pool	Activity Costs
Handling	$3,000,000
Number of parts	2,400,000
Design changes	3,300,000
Setups	2,800,000
Total	$11,500,000

The direct materials cost for product X21 is $120 per unit, while for product Y37 it is $140 per unit.

Required

(a) Determine the unit cost of each product using direct labor hours to allocate all manufacturing support costs.

(b) Determine the unit cost of each product using activity-based costing.

(c) Which of the two methods from parts a and b produces more accurate estimates of job costs? Explain.

(d) Suppose Endo has been determining its product prices by adding a 25% markup to its reported product cost. Compute the product prices on the basis of the costs computed in parts a and b. What do you recommend to Endo regarding its pricing?

(e) What product-level changes do you suggest on the basis of the activity-based cost analysis? Who would be involved in bringing about your suggested changes?

LO 1, 3, 4 **(Appendix)** **5-30** ***Product cost distortions with traditional costing, original activity-based costing analysis*** The Manhattan Company manufactures two models of compact disc players: a deluxe model and a regular model. The company has manufactured the regular model for years; the deluxe model was introduced recently to tap a new segment of the market. Since the introduction of the deluxe model, the company's profits have steadily declined, and management has become increasingly concerned about the accuracy of its costing system. Sales of the deluxe model have been increasing rapidly.

The current cost accounting system allocates manufacturing support costs to the two products on the basis of direct labor hours. The company has estimated that this year it will incur $1 million in manufacturing support costs and will produce 5,000 units of the deluxe model and 40,000 units of the regular model. The deluxe model requires 2 hours of direct labor, and the regular model requires 1 hour. Material and labor costs per unit and selling price per unit are as follows:

Item	Deluxe	Regular
Direct materials cost	$45	$30
Direct labor cost	20	10
Selling price	140	80

Required

(a) Compute the manufacturing support cost driver rate for this year.

(b) Determine the cost to manufacture one unit of each model.

(c) The company has decided to trace manufacturing support costs to four activities. Following are the amount of manufacturing support costs traceable to the four activities this year:

			Cost Driver Units Demanded		
Activity	Cost Driver	Cost	Total	Deluxe	Regular
Purchase orders	Number of orders	$180,000	600	200	400
Quality control	Number of inspections	250,000	2,000	1,000	1,000
Product setups	Number of setups	220,000	200	100	100
Machine maintenance	Machine hours	350,000	35,000	20,000	15,000
		$1,000,000			

Compute the total cost to manufacture one unit of each model.

(d) Compare the manufacturing activity resources demanded per unit of the regular model and per unit of the deluxe model. Why did the old costing system undercost the deluxe model?

(e) Is the deluxe model as profitable as the company thinks it is under the old costing system? Explain.

(f) What should the Manhattan Company do to improve its profitability? Consider pricing and product-level changes among your suggestions. Who should be involved in implementing your recommendations?

LO 1, 3, 4 (Appendix) **5-31** ***Original activity-based costing, activity-based management*** (Adapted from CMA, June 1992) Alaire Corporation manufactures several different types of printed-circuit boards; however, two of the boards account for the majority of the company's sales. The first of these boards, a TV circuit board, has been a standard in the industry for several years. The market for this type of board is competitive and, therefore, price sensitive. Alaire plans to sell 65,000 of the TV boards this year at a price of $150 per unit. The second high-volume product, a PC circuit board, is a recent addition to Alaire's product line. Because the PC board incorporates the latest technology, it can be sold at a premium price; this year's plans include the sale of 40,000 PC boards at $300 per unit.

Alaire's management group is meeting to discuss strategies for this year, and the current topic of conversation is how to spend the sales and promotion dollars for next year. The sales manager believes that the market share for the TV board could be expanded by concentrating Alaire's promotional efforts in this area. In response to this suggestion, the production manager said, "Why don't you go after a bigger market for the PC board? The cost sheets that I get show that the contribution from the PC board is more than double the contribution from the TV board. I know we get a premium price for the PC board. Selling it should help overall profitability."

Alaire uses a standard cost system, and the following data apply to the TV and PC boards:

	Per Unit	
Item	TV Board	PC Board
Direct materials	$80	$140
Direct labor	1.5 hours	4 hours
Machine time	0.5 hour	1.5 hours

Direct labor cost is $14 per hour. Variable manufacturing support costs are applied on the basis of direct labor hours. This year's variable manufacturing support costs are budgeted at $1,120,000, and direct labor hours are estimated at 280,000. Other manufacturing support is applied at $10 per machine hour. Alaire applies a materials handling charge of 10% of materials cost; this materials handling charge is not included in variable manufacturing support costs. Total expenditures for materials this year are budgeted at $10,800,000.

Ed Welch, Alaire's controller, believes that before the management group proceeds with the discussion about allocating sales and promotional dollars to individual products, it may be worthwhile to look at these products on the basis of the activities involved in their production. Welch has prepared the following schedules for the management group:

Costs	Budgeted Cost	Cost Driver	Annual Activity for Cost Driver
Material support costs:			
Procurement	$400,000	Number of parts	4,000,000
Production scheduling	220,000	Number of boards	110,000
Packaging and shipping	440,000	Number of boards	110,000
Total costs	$1,060,000		

(*continued*)

Costs	Budgeted Cost	Cost Driver	Annual Activity for Cost Driver
Variable support costs:			
Machine setup	$446,000	Number of setups	278,750
Hazardous waste disposal	48,000	Pounds of waste	16,000
Quality control	560,000	Number of inspections	160,000
General supplies	66,000	Number of boards	110,000
Total costs	$1,120,000		
Other manufacturing support costs:			
Machine insertion	$1,200,000	Number of machine insertions	3,000,000
Manual insertion	4,000,000	Number of manual insertions	1,000,000
Wave soldering	132,000	Number of boards	110,000
Total costs	$5,332,000		

Required per Unit	TV Board	PC Board
Parts	25	55
Machine insertions	24	35
Manual insertions	1	20
Machine setups	2	3
Hazardous waste	0.02 pound	0.35 pound
Inspections	1	2

"Using this information," Welch explained, "we can calculate an activity-based cost for each TV board and each PC board and then compare it to the standard cost we have been using. The only cost that remains the same for both cost methods is the cost of direct materials. The cost drivers will replace the direct labor and support costs in the standard cost."

Required

(a) Identify at least four general advantages that are associated with activity-based costing.
(b) On the basis of standard costs, calculate the total contribution expected this year for Alaire Corporation's products: the TV board and the PC board.
(c) On the basis of activity-based costs, calculate the total contribution expected this year for Alaire Corporation's two products.
(d) Explain how the comparison of the results of the two costing methods may impact the decisions made by Alaire Corporation's management group.

Cases

LO 1, 2, 4 **5-32** ***Part proliferation: role for activity-based costing*** An article in the *Wall Street Journal* by Neal Templin and Joseph B. White (June 23, 1993) reported on the major changes occurring at General Motors. Its new chief executive officer, John Smith, had been installed after the board of directors requested the resignation of Robert Stempel, the previous chief.

John Smith's North American Strategy Board identified 30 components that could be simplified for 1994 models. GM had 64 different versions of the cruise control/turn signal mechanism. It planned to reduce that to 24 versions the next year and the following year to just 8. The tooling for each one cost GM's A. C. Rochester division about $250,000. Smith said, "We've been talking about too many parts doing the same job for 25 years, but we weren't focused on it." (Note that the tooling cost is only one component of the cost of proliferating components. Other costs include the design and engineering costs for each different component, purchasing costs, setup and scheduling costs, plus the stocking and service costs for every individual component in each GM dealership around the United States.)

GM's proliferation of parts was mind-boggling. GM made or bought 139 different hood hinges, compared with one for Ford. Saginaw's Plant Six juggled parts for 167 different steering columns—down from 250 the previous year but still far from the goal of fewer than 40 by decade's end.

This approach increased GM's costs exponentially. Not only did the company pay far more engineers than competitors did to design steering columns, but it also needed extra tools and extra people to move parts around, and it suffered from quality glitches when workers confused one steering column with another.

Required

(a) How could an inaccurate and distorted product costing system have contributed to the overproliferation of parts and components at General Motors?
(b) What characteristics should a new cost system have that would enable it to signal accurately to product designers and market researchers about the cost of customization and variety?

LO 3, 4 **5-33** ***Role for activity-based cost systems in implementing strategy*** Consider the case of the Cott Corporation, a Canadian private-label producer of high-quality cola beverages. Cott is attempting to get grocery retailers to stock its cola beverages as a lower price alternative to the more well-known brands of Coca-Cola and Pepsi-Cola. The international brands deliver directly to the retailer's store and stock their products on the retailer's shelves. Cott, in contrast, delivers to the retailer's warehouse or distribution center, leaving the retailer to move the product to the shelves of its various retail outlets. Cott offers substantially lower prices to the retailers and, in addition, is willing to work with the grocery retailer to customize the cola beverage to the retailer's specification; develop special packaging for the retailer, including labeling the beverage with the retailer's name (a practice known as *retailer branding,* such as Safeway Select Cola); offer a full variety of carbonated beverages (diet, caffeine free, multiple flavors, multiple sizes, and packaging options); and develop a marketing and merchandising strategy for the retailer for the private-label beverage.

Required

Consider how Cott might measure and manage activities and processes and relationships with suppliers and customers. How can Cott build cost systems to help it implement its strategy successfully?

LO 4, 6 **5-34** ***Financial versus management accounting: role for activity-based cost systems in privatization of government services*** The mayor of Gotham City is dissatisfied with the rising costs and deteriorating quality of the services provided by the city's municipal workers, particularly in the transportation department: paving roads, repairing potholes, and cleaning the streets. He is contemplating privatizing these services by outsourcing the business to independent, private contractors. The mayor has demanded that his staff develop an activity-based cost system for municipal services before he proceeds with his privatization initiative, declaring, "Introducing competition and privatization to government services requires real cost information. You can't compete if you are using fake money." Currently, the accounting and financial systems of Gotham City report only how much is being spent in each department by type of expenditure: payroll, benefits, materials, vehicles, equipment (including computers and telephones), and supplies.

Required

(a) Before outsourcing to the private sector, why does the mayor want to develop activity-based cost estimates of the current cost of performing these municipal services?
(b) How should the staff estimate capacity cost rates and time demands that are required for an activity-based cost system?
(c) After building activity-based cost models, should this information be shared with the municipal workers? Why or why not? How might the workers use the activity-based cost information?

LO 1, 3, 4, 7 **(Appendix)** **5-35** ***Comparison of two costing systems, original activity-based costs, implementing change*** The Redwood City plant of Crimson Components Company makes two types of rotators for automobile engines: R361 and R572. The old cost accounting system at the plant traced support costs to four cost pools:

Cost Pool	Support Costs	Cost Driver
S1	$1,176,000	Direct labor cost
S2	1,120,000	Machine hours
P1	480,000	—
P2	780,000	—
	$3,556,000	

Pool S1 included service activity costs related to setups, production scheduling, plant administration, janitorial services, materials handling, and shipping. Pool S2 included activity costs related to machine maintenance and repair, rent, insurance, power, and utilities. Pools P1 and P2 included supervisors' wages, idle time, and indirect materials for the two production departments, casting and machining, respectively.

The old accounting system allocated support costs in pools S1 and S2 to the two production departments using direct labor cost and machine hours, respectively, as the cost drivers. Then the accumulated support costs in pools P1 and P2 were applied to the products on the basis of direct labor hours. A separate rate was determined for each of the two production departments. The direct labor wage rate is $15 per hour in casting and $18 per hour in machining.

	Direct Labor Hours (DLH)			
Department	R361	R572	Total	Direct Labor Costs
Casting (P1)	60,000	20,000	80,000	$1,200,000
Machining (P2)	72,000	48,000	120,000	2,160,000
Total	132,000	68,000	200,000	$3,360,000

	Machine Hours (MH)		
Department	R361	R572	Total
Casting (P1)	30,000	10,000	40,000
Machining (P2)	72,000	48,000	120,000
Total	102,000	58,000	160,000

Item	R361	R572
Sales price per unit	$19	$20
Sales and production units	500,000	400,000
Number of orders	1,000	1,000
Number of setups	2,000	4,000
Materials cost per unit	$8	$10

Now the plant has implemented an activity-based costing system. The following table presents the amounts from the old cost pools that are traced to each of the new activity cost pools:

	Old Cost Pools				
Activity Cost Drivers	S1	S2	P1	P2	Total
P1-DLH	$120,000	$0	$120,000	$0	$240,000
P2-DLH	240,000	0	0	120,000	360,000
Setup hours	816,000	80,000	240,000	540,000	1,676,000
P1-MH	0	260,000	120,000	0	380,000
P2-MH	0	780,000	0	120,000	900,000
Total	$1,176,000	$1,120,000	$480,000	$780,000	$3,556,000

Setups for R572 are 50% more complex than those for R361; that is, each R572 setup takes 1.5 times as long as one R361 setup.

Required

(a) Determine the product costs per unit using the old system. Show all intermediate steps for allocations, including departmental cost driver rates and a breakdown of product costs into each of their components.
(b) Determine the product costs per unit using the new system.
(c) Explain the intuitive reason that the product costs differ under the two accounting systems.
(d) What should Crimson Components do to improve the profitability of its Redwood City plant? Include marketing and product-related changes among your recommendations.
(e) Describe how experienced production and sales managers are likely to react to the new product costs.

LO 1, 2, 3, 4, 5, 7 **5-36** ***Time-driven ABC, activity-based management*** Sippican Corporation (A)[10]

The decline in our profits has become intolerable. The severe price cutting in pumps has dropped our pre-tax margin to less than 2%, far below our historical 15% margins. Fortunately, our competitors are overlooking the opportunities for profit in flow controllers. Our recent 10% price increase in that line has been implemented without losing any business.
Robert Parker, President of Sippican Corporation

Robert Parker was discussing operating results in the latest month with Peggy Knight, his controller, and John Scott, his manufacturing manager. The meeting among the three was taking place in an atmosphere tinged with apprehension because competitors had been reducing prices on pumps, Sippican's major product line. Since pumps were a commodity product, Parker had seen no alternative but to match the reduced prices to maintain volume. But the price cuts had led to declining company profits, especially in the pump line (summary operating results for the previous month, March 2006, are shown in Exhibits 5-8 and 5-9).

Exhibit 5-8
Sippican Corporation: Operating Results (March 2006)

Sales		$1,847,500	100%
Direct labor expense		351,000	
Direct materials expense		458,000	
Contribution margin		$1,038,500	56%
Manufacturing overhead			
Machine related expenses	$334,800		
Setup labor	117,000		
Receiving and production control	15,600		
Engineering	78,000		
Packaging and shipping	109,200		
Total manufacturing overhead		654,600	35%
Gross margin		383,900	21%
General, selling and administrative expenses		350,000	19%
Operating income (pretax)		$33,900	1.8%

Source: Robert S. Kaplan.

Exhibit 5-9
Product Profitability Analysis (March 2006)

	Valves	Pumps	Flow Controllers
Direct labor cost[a]	$12.35	$16.25	$13.00
Direct material cost	16.00	20.00	22.00
Manufacturing overhead (at 185%)	22.85	30.06	24.05
Standard unit costs	$51.20	$66.31	$59.05
Target selling price	$78.77	$102.02	$90.85
Planned gross margin (%)	35%	35%	35%
Actual selling price	$79.00	$70.00	$95.00
Actual gross margin	$27.80	$3.69	$35.95
Actual gross margin (%)	35%	5%	38%

[a]Direct labor costs were charged at $32.50 per hour. The average daily compensation for days worked was $195 per day ($3,900 per month divided by 20 working days per month). The hourly rate was calculated by dividing $195 by the 6 hours per day available for productive work.

Source: Robert S. Kaplan.

Sippican supplied products to manufacturers of water purification equipment. The company had started with a unique design for valves that it could produce to tolerances that were better than any in the industry. Parker quickly established a loyal customer base because of the high quality of its manufactured valves. He and Scott realized that Sippican's existing labor skills and machining equipment could also be used to produce pumps and flow controllers, products that were also purchased by its customers. They soon established a major presence in the high-volume pump product line and the more customized flow controller line.

Sippican's production process started with the purchase of semifinished components from several suppliers. It machined these parts to the required tolerances and assembled them in the company's modern manufacturing facility. The same equipment and labor were used for all three product lines, and production runs were scheduled to match customer shipping requirements. Suppliers and customers had agreed to just-in-time deliveries, and products were packed and shipped as completed.

Valves were produced by assembling four different machined components. Scott had designed machines that held components in fixtures so that they could be machined automatically. The valves were standard products and could be produced and shipped in large lots. Although Scott felt several competitors could now match Parker's quality in valves, none had tried to gain market share by cutting price, and gross margins had been maintained at a standard 35%.

The manufacturing process for pumps was practically identical to that for valves. Five components were machined and then assembled into the final product. The pumps were shipped to industrial product distributors after assembly. Recently, it seemed as if each month brought new reports of reduced prices for pumps. Sippican had matched the lower prices so that it would not give up its place as a major pump supplier. Gross margins on pump sales in the latest month had fallen to about 5%, well below the company's planned gross margin of 35%.

Flow controllers were devices that controlled the rate and direction of flow of chemicals. They required more components and more labor, than pumps or valves, for each finished unit. Also, there was much more variety in the types of flow controllers used in industry, so many more production runs and shipments were performed for this product line than for valves. Sippican had recently raised flow controller prices by more than 10% with no apparent effect on demand.

Sippican had always used a simple cost accounting system. Each unit of product was charged for direct material and labor cost. Material cost was based on the prices paid for components under annual purchasing agreements. Labor rates, including fringe benefits, were $32.50 per hour,[11] and were charged

[11] The full compensation, including fringe benefits, for direct and indirect employees (other than engineers) was $3,900 per month. Employees worked an average of 20 days per month (holidays and vacations accounted for the remaining 2 to 3 days per month).

Exhibit 5-10
Product Data

Product Lines	Valves	Pumps	Flow Controllers
Materials per unit	4 components	5 components	10 components
	2 at $2 = $4	3 at $2 = $6	4 at $1 = $4
	2 at $6 = 12	2 at $7 = 14	5 at $2 = 10
			1 at $8 = $8
Materials cost per unit	$16	$20	$22
Direct labor per unit	0.38 DL hours	0.50 DL hours	0.40 DL hours
Machine hours per unit	0.5	0.5	0.3
Setup hours per run	5	6	12

Source: Robert S. Kaplan.

to products based on the standard run times for each product (see Exhibit 5-10). The company had only one producing department, in which components were both machined and assembled into finished products. The overhead costs in this department were allocated to products as a percentage of production-run direct labor cost. Currently, the rate was 185%. Since direct labor cost had to be recorded anyway to prepare factory payroll, this was an inexpensive way to allocate overhead costs to products.

Knight noted that some companies did not allocate any overhead costs to products, treating them as period, not product, expenses. For these companies, product profitability was measured at the contribution margin level—price less all variable costs. Sippican's variable costs were only its direct material and direct labor costs. On that basis, all products, including pumps, would be generating substantial contribution to overhead and profits. She thought that perhaps some of Sippican's competitors were following this procedure and pricing to cover variable costs.

Knight had recently led a small task force to study Sippican's overhead costs since they had now become much larger than the direct labor expenses. The study had revealed the following information:

1. A setup had to be performed each time a batch of components had to be machined in a production run. Each component in a product required a separate production machine to run the raw material or purchased part to the specifications for the product. Workers often operated several of the machines simultaneously once they had set up the machine. Because of the large number of setups, Sippican had dedicated about 25% of its production workforce to focus exclusively on setups. Some production workers did not operate any machines; they performed only manual assembly work. Their assembly time per product was included in the direct labor hour estimates for each product.

   Sippican operated two 7½-hour shifts each weekday. Each shift employed 45 production and assembly workers, plus 15 setup workers. Workers received two 15-minute breaks each day. They received an average of 30 minutes per day for training and education activities, and all workers—production, assembly, and setup—spent 30 minutes each shift on doing preventive maintenance and minor repairs to the machines.
2. The company had 62 machines for component processing. These machines were generally available for the six hours per shift that production workers were actively engaged in production or setup activities on the machines. Sippican leased the machines. Each machine's operating expenses were about $5,400 per month, including lease payments, supplies, utilities, and maintenance and repairs.
3. The receiving and production control departments employed four people over the two shifts. These personnel ordered, processed, inspected, and moved each batch of components for a production run. It took a total of 75 minutes for all of the activities required to get one batch of components ordered, received, and moved to a machine for processing. This time was independent of whether the components were for a long or a short production run, or whether the components were expensive or inexpensive.

4. The work in the packaging and shipping area had increased during the past couple of years as Sippican increased the number of customers it served. Each shipment took 50 minutes to prepare the packages and labels, independent of the number or types of items in the shipment, plus 8 minutes per item to bubble wrap and pack in the carton, whether the item was a valve, pump, or flow controller. The packaging and shipping area employed 14 people in each of the two shifts (28 in total).

   Employees in the receiving, production control, packaging, and shipping departments worked a 7½-hour shift that included two 15-minute breaks per day, and 30 minutes, on average, for training and education.
5. Sippican employed eight engineers for designing and developing new product varieties. Engineers' total compensation was $9,750 per month. Much of their time was spent modifying flow control products to conform to customer requests. Engineers worked 7½-hour shifts. After breaks, training, education, and professional activities, engineers supplied about 6 hours of productive work per shift.

Knight's team had collected the data shown in Exhibit 5-11 based on operations in March 2006. The team felt that this month was typical of ongoing operations.

Required

(a) Calculate the practical capacity and the capacity cost rates for each of Towerton's personnel resources: brokers, account managers, financial planners, principals, and customer service representatives.
(b) Calculate the practical capacity and the capacity cost rates for each of Sippican's resources: production and setup employees, machines, receiving and production control employees, shipping and packaging employees, and engineers.
(c) Using these capacity cost rates and the production data in Exhibits 5-10 and 5-11, calculate revised costs and profits for Sippican's three product lines. What difference does your cost assignment have on reported product costs and profitability? What causes any shifts in cost and profitability?
(d) Could this approach be extended to service companies and to companies much larger and more complex than Sippican? What would be the barriers and difficulties with implementing time-driven ABC in practice?
(e) On the basis of the revised cost and profitability estimates, what actions should Sippican's management team take to improve the company's profitability?

LO 3, 5, 7 **5-37** ***Activity-based budgeting, Balanced Scorecard, and strategy*** Sippican Corporation (B)[12]

Exhibit 5-11
Monthly Production and Operating Statistics (March 2006)

	Valves	Pumps	Flow Controllers	Total
Production (units)	7,500	12,500	4,000	24,000
Machine hours (run time)	3,750	6,250	1,200	11,200
Production runs	20	100	225	345
Setup hours (labor and machines)	100	600	2,700	3,400
Number of shipments	40	100	200	340
Hours of engineering work	60	240	600	900

Source: Robert S. Kaplan.

Refer to Case 5-36, the Sippican Corporation (A) case, which required time-driven ABC analysis.

Sippican's senior executive committee met to consider the implications from its time-driven ABC model. Frankly all had been shocked to learn that their apparently highest margin product line, flow controllers, could actually be losing money because of its many shipments, short production runs, and heavy use of engineering time. The team contemplated action steps to restore profitability.

After some deliberation, the executive team crafted a new strategy that involved the following principles:

Improve Revenue Quality: Product Focus and Menu-Based Pricing

- Focus on core products: valves and pumps.
- Increase market share in valves by offering discounts for large orders.
- Reduce discounting for pumps, especially in small order sizes.
- Aggressively raise prices for small orders of flow controllers.

Productivity

- Reduce set-up times.

Based on the new strategy, Peggy Knight developed the forecasted monthly sales and production plan shown in Exhibit 5-12. She wondered whether the shift in product mix, new pricing model, and forecasted productivity improvement in setup times would be sufficient to restore Sippican's historic margins. Sippican's machines were leased monthly and had staggered expiration times; Knight believed she could, on short notice, make 10% to 15% adjustments up or down to accommodate changes in demand for machine capacity. Also, Knight felt that she had some flexibility with the size and composition of the labor force as well. The company had recently hired quite a few production employees on short-term contracts to meet the expanded demand for the newly introduced flow controller line.

Required

(a) Estimate the resource demands from Knight's forecasted sales production plan in Exhibit 5-12.
(b) Prepare a pro forma product line income statement based on the new plan.
(c) Comment on the magnitude of the change in profit with the new plan in relation to the change in production and sales under the previous plan.

Exhibit 5-12
Forecasted Monthly Sales and Production Plan

	Valves	Pumps	Flow Controllers	Total
Forecasted price	$75	$80	$110	
Forecasted sales (units)	10,000	12,000	2,500	24,500
Number of production runs	40	40	50	130
Number of shipments	40	70	100	210
Total direct labor hours	3,800	6,000	1,000	10,800
Setup labor hours per run	4.0	4.8	9.6	
Total setup hours	160	192	480	832
Machine hours: run + setup	5,160	6,192	1,230	12,582
Engineering hours	60	240	400	700

Source: Robert S. Kaplan.

Exhibit 5-13
Towerton Monthly Income Statement (000)

Sales	$4,024
Professional staff	
Brokers	1,246
Account managers	136
Financial planners	141
Support personnel	
Principals	325
Customer service representatives	146
Space	300
Computer server expenses	241
Other information technology	169
Total costs	2,704
Margin	1,320
Margin %	32.8%
S, G & A (unallocated corporate expenses)	1,300
Operating income	20
Operating margin	0.5%

Source: Robert S. Kaplan.

LO 3, 4, 5, 6 **5-38** ***Activity-based costing, service company*** Towerton Financial Services[13]
Towerton Financial Services, a brokerage firm, started with a focus on stock trading and mutual funds. As the business grew, Towerton diversified into two new product lines, investment account management and financial planning. Although revenue has grown with the new product lines, Towerton's management is disappointed with the firm's profitability. (See Exhibit 5-13 for the most recent monthly income statement, which is typical for the company.)

Towerton's three groups of professional staff deal directly with customers across the four product and service lines. *Brokers* execute stock trades and mutual fund transactions and provide advice and recommendations. However, Towerton's brokerage customers make their own buy and sell decisions. Towerton charges a flat fee per stock trade that depends on the total amount of assets a customer has on deposit with the company. Last month, these fees averaged $8.80 per transaction. For mutual fund transactions, Towerton charges 1.5% of the value of the mutual fund shares purchased. This fee averaged $41.45 per mutual fund transaction last month. There is no charge when customers later sell their shares.

Investment account managers actively manage customers' investments by buying and selling stocks to meet customer objectives. These managers meet initially with customers to learn about their investment goals, interests, and risk tolerance. Thereafter, the parties meet quarterly to review account performance and investment strategy. Towerton charges each customer an annual asset management fee of 1.5% of the customer's assets under management.

Financial planners prepare financial plans for customers. The planners help customers develop a budget and determine how much to save and how much insurance to purchase. Towerton charges $1,200 for the first financial plan and $125 per hour thereafter for ongoing advice. Planners typically meet quarterly with customers to discuss any needed changes in plans.

Among the support personnel, *principals* manage and supervise brokers, investment account managers, and financial planners. *Customer service representatives* handle customer requests over the telephone for sales and account services.

Towerton uses two types of computer equipment: servers and desktop computers. Servers, in centralized clusters, process customer transactions, maintain customer accounts, and perform various administrative functions. Server capacity is measured in millions of computer instructions processed (MIPS). Towerton also leases a desktop computer for every employee.

[13] *Source:* Robert S. Kaplan.

Towerton's remaining expenses include office space rental and miscellaneous corporate expenses. Office space consists of individual offices for each of the professional staff and support personnel, as well as conference rooms for face-to-face meetings with customers to open accounts or service existing accounts. Miscellaneous expenses include administrative expenses for finance, human resources, audits, taxes, professional fees, and compliance.

Because of management's concern about the company's profitability, Towerton's accountants have gathered the following information:

1. After taking into account weekends, holidays, and vacations, the professional staff and support personnel work about 20 days per month on average.
2. Brokers, account managers, financial planners, and principals show up for 8 hours of work per day, but spend an average of 1.5 hours per day on breaks, training, education, and professional activities, with the remaining workday spent interacting with customers.
3. Like the other personnel, customer service representatives show up for 8 hours of work per day, but they spend an average of 1 hour per day on breaks, training, and education.
4. Each server costs $3,168 per month and operates 24 hours per day for 22 days each month. The cost per server hour is therefore $6. The server processing capacity is 50 MIPS per hour. Peak server usage occurs for 8 hours each day; during these hours, all 76 servers are operated. During the nonpeak hours, only 19 of the servers are operated. Towerton has computed the cost per MIPS as $0.12 for nonpeak hours and $0.30 for peak hours.
5. The costs per month in Exhibit 5-14 include compensation, fringe benefits, and the costs of space assigned on the basis of square feet of space occupied and individual information technology resources used for other than for customer-related activities.

Towerton's enterprise resource planning (ERP) system provided the activity report, average time utilizations, and peak and nonpeak transactions detailed in Exhibits 5-15, 5-16, and 5-17, respectively.

Required

(a) Calculate the practical capacity and the capacity cost rates for each of Towerton's personnel resources: brokers, account managers, financial planners, principals, and customer service representatives.
(b) Using the data in Exhibits 5-15, and 5-16, calculate the time utilization for each category of personnel for each of the four product lines.
(c) Using the data in Exhibit 5-17, calculate the MIPS during peak usage for each of the product lines and the MIPS during nonpeak usage for each of the product lines.
(d) Assume that the average price per mutual fund trade is $41.45. Prepare an income statement showing costs and profits for each of Towerton's four product lines, as well as the cost of unused capacity. What are reasons for the large differences in profits across the product lines?
(e) What actions might Towerton's management team take to improve the company's profitability?

Exhibit 5-14
Monthly Resources and Costs per Person

	Number of People	Cost per Person per Month
Professional staff		
Brokers	230	$6,787
Account managers	18	$8,954
Financial planners	20	$8,828
Support personnel		
Principals	30	$12,932
Customer service representatives	42	$4,192

Source: Robert S. Kaplan.

Exhibit 5-15
Activity Levels per Month

	Stock Trading	Mutual Fund Trading	Account Management	Financial Planning
Number of transactions	305,288	26,325	5,400	
Average account balance maintained			$60,000	
Number of new accounts opened	595	255	175	130
Number of total accounts maintained	29,750	12,750	1,200	900
Number of calls to customer service center (other than new product sales)	47,600	11,475	1,320	540
Number of customer meetings servicing existing accounts	3,570	765	480	569

Source: Robert S. Kaplan.

Exhibit 5-16
Time Utilization: Contact Minutes

	Stock Trading	Mutual Fund Trading	Account Management	Financial Planning
Brokers				
New accounts (minutes per new account opened)	60	60		
Existing accounts (minutes per transaction)	5	5		
Meetings with existing accounts (minutes per meeting)	20	20		
Account Managers				
New accounts (minutes per new account opened)			240	
Existing accounts (minutes per transaction)			10	
Meetings with existing accounts (minutes per meeting)			60	
Financial Planners				
New accounts (minutes per new account opened)				600
Existing accounts (minutes per transaction)				
Meetings with existing accounts (minutes per meeting)				90
Principals				
New accounts (minutes/new account opened)	10	10	20	60
Existing accounts (minutes/transaction or account)	0.5	0.5	4	
Customer Service				
New accounts (minutes per new account opened)	12	12	18	18
Existing accounts (minutes per call)	5	5	7	10

Source: Robert S. Kaplan.

Exhibit 5-17

Number of Transactions Processed by Servers

Transactions	MIPS per Transaction	Stock Trading		Mutual Fund Trading		Investment Account Management Services		Financial Planning		Total	
		Peak	Non-Peak	Peak	Non-Peak	Peak	Non-Peak	Peak	Non-Peak	Peak	Non-Peak
Order placements, trades and order clearing and settlement activities	1.4	305,288	0	0	26,325	54,750	31,000	0	0	360,038	57,325
Account balance inquiries	0.1	52,695	23,730	52,695	23,730	35,130	15,820	35,130	15,820	175,650	79,100
Quotation requests	0.1	332,400	177,100	249,300	132,825	166,200	88,550	83,100	44,275	831,000	442,750
Balance transfers	0.7	0	75,000	0	60,000	0	15,000	0	0	0	150,000
Account statement preparation	0.9	0	29,750	0	12,750	0	8,750	0	6,500	0	57,750
Total		690,383	305,580	301,995	255,630	256,080	159,120	118,230	66,595	1,366,688	786,925

Source: Robert S. Kaplan.