

# Activity-Based Cost Systems for Management



## LEARNING OBJECTIVES

*After completing this chapter, you should be able to answer these questions:*

- 1  
What is the focus of activity-based management?
- 2  
Why do non-value-added activities cause costs to increase unnecessarily?
- 3  
Why must cost drivers be designated in an activity-based costing system?
- 4  
How does activity-based costing differ from a traditional cost accounting system?
- 5  
How does the installation of an activity-based costing system affect behavior?
- 6  
What is attribute-based costing and how does it extend activity-based costing?
- 7  
When is activity-based costing appropriate in an organization?

Carrier, a United Technologies' company, is the world's largest manufacturer of air conditioning and heating products. Competition is intense, however, and among its six largest competitors, Carrier is the only one that is not Japanese owned. The director of cost improvement for Carrier's worldwide operations notes that Carrier's customers demand "a wide range of products that have unquestionable quality and include state-of-the-art features. Further, they expect these products to be delivered when needed, at a competitive price."

As the industry leader, Carrier strives to maintain its dominant position through innovative product design (product differentiation), high-quality low-cost manufacturing (zero defects and cost leadership), and time-based competition. To achieve these objectives, Carrier has implemented a series of improvement initiatives, including just-in-time, product and process standardization, strategic outsourcing, supply chain management, target costing, and performance measurement. Complexity reduction is a common goal among each of these initiatives. These changes instituted by Carrier were in response to both internal and external challenges.

While Carrier's manufacturing environment was changing dramatically at the plant level, its parent company,

United Technologies, continued to emphasize financial reporting and control at the corporate level and placed relatively little emphasis on developing modern cost management systems for its manufacturing plants. Therefore, the manufacturing plants lacked the cost management information that was needed to support the improvement initiatives adequately and profitability suffered. "The intense competition, coupled with ever increasing customer demands, had made it difficult to maintain adequate profit margins on many products. Accordingly, Carrier's North American Operations profitability had dropped significantly below historical levels."

Carrier needed what it describes as a set of "enablers," or tools, to support the development of cost-effective product designs and manufacturing processes. Activity-based cost management (ABCM) was selected as the enabler that provides the necessary financial and activity information. Following its implementation, ABCM has been used by Carrier to quantify the benefits of redesigning plant layouts, using common parts, outsourcing, strengthening supplier and customer relationships, and developing alternative product designs. In some cases, even though management knows intuitively how to improve its operations, until the improvements are quantified they are not acted on.

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SOURCE: Dan W. Swenson, "Managing Costs through Complexity Reduction at Carrier Corporation," *Strategic Finance* (April 1998), pp. 20–28.

Carrier Corporation, like many other manufacturers, recognized that its accounting reports were not providing managers with the information and details needed to make good business decisions in a global economy. This flaw was caused, in part, by the company's traditional overhead allocation system that was in use. The traditional system discussed in Chapter 3 is geared to satisfy external reporting requirements, but often does a less than adequate job of meeting management needs. Carrier investigated its cost accounting system and found that some basic changes were necessary. Management concluded that overhead allocations using a minimal number of rates and cost drivers did not provide realistic information for managerial functions.

This chapter presents topics that are at the forefront of managerial accounting literature and result from the intensely competitive nature of the global economy. First, the chapter presents the reasons that companies now focus on value-added and non-value-added activities, and explains how activities (rather than volume measures) can be used to determine product and service costs and to measure performance. Then, basics of activity-based costing, as well as some criticisms of this technique, are discussed and illustrated.

## ACTIVITY-BASED MANAGEMENT

1

What is the focus of activity-based management?

Product cost determination, although specifically designated as an accounting function, is a major concern of all managers. For example, product costs affect decisions on corporate strategy (Is it profitable to be in this particular market?), marketing (How should this product be priced?), and finance (Should investments be made in additional plant assets to manufacture this product?). In theory, what a product or service costs to produce or perform would not matter if enough customers were willing to buy that product or service at a price high enough to cover costs and provide a reasonable profit margin. In reality, customers purchase something only if it provides acceptable value for the price being charged.

Management, then, should be concerned about whether customers perceive an equitable relationship between selling price and value. Activity-based management focuses on the activities incurred during the production or performance process as a way to improve the value received by a customer and the resulting profit achieved by providing this value. The concepts covered by activity-based management are shown in Exhibit 4–1 and are discussed in this and other chapters. These concepts help companies to produce more efficiently, determine costs more accurately, and control and evaluate performance more effectively. A primary component of activity-based management is **activity analysis**, which is the process of studying activities to classify them and to devise ways of minimizing or eliminating non-value-added activities.

### activity analysis

2

Why do non-value-added activities cause costs to increase unnecessarily?

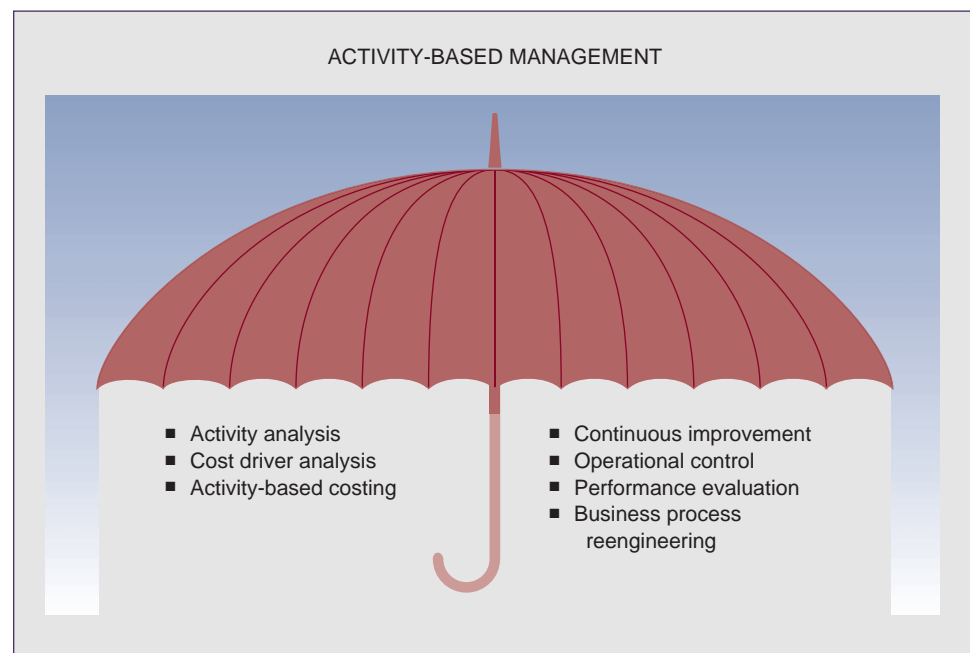
### Value-Added versus Non-Value-Added Activities

In a business context, an **activity** is defined as a repetitive action performed in fulfillment of business functions. If one takes a black-or-white perspective, activities are either value-added or non-value-added. A value-added (VA) activity increases the worth of a product or service to a customer and is one for which the customer is willing to pay. Alternatively, a non-value-added (NVA) activity increases the time spent on a product or service but does not increase its worth. Non-value-added activities are unnecessary from the perspective of the customer, which means they

### activity

#### EXHIBIT 4-1

*The Activity-Based Management Umbrella*



create costs that can be eliminated without affecting the market value or quality of the product or service.

Businesses also experience significant non-value-added time and activities. Some NVA activities are essential to business operations, but customers would not willingly choose to pay for these activities. These activities are known as **business-value-added activities**. For instance, companies must prepare invoices as documentation for sales and collections. Customers know this activity must occur, that it creates costs, and that product selling prices must be set to cover the costs of this activity. However, because invoice preparation adds no direct value to products and services, customers would prefer not to have to pay for this activity.

In striving to manage the relationship between price charged to and value received by the customer, firms are increasingly turning to their suppliers for help. The accompanying News Note indicates how electronics manufacturers depend on their suppliers not only for efficient and effective delivery of necessary components but also for the ideas that lead to new generations of products.

To help in activity analysis, managers should first identify organizational processes. "Processes include production, distribution, selling, administration, and other company functions. A company should define a process before it attempts to associate related activities to the defined process. Processes should not be forced or defined to fit activities; activities should fit processes."<sup>1</sup> Processes are commonly horizontal in nature (across organizational functions) and overlap multiple functional areas. For example, any production process also affects engineering, purchasing, warehousing, accounting, personnel, and marketing.

For each distinct process, a **process map** (or detailed flowchart) should be prepared that indicates every step that goes into making or doing something. All steps and all affected areas must be included, not just the obvious ones. For example, storing newly purchased parts would not be on a typical list of "Steps in Making Product X," but when materials and supplies are purchased, they are commonly stored until needed. Storage uses facilities that cost money and time is

**business-value-added activity**

**process map**

<http://www.ibm.com>

QUALITY



NEWS NOTE

### Sorting Suppliers for Competitive Advantage

Supplier evaluation programs have never been more important in the electronics industry. Electronics Original Equipment Manufacturers (OEMs) are relying on suppliers not only to supply parts, but to develop new technologies that OEMs will need for future products. With new product development time for some equipment being six months or less, and with life cycles being two years or less for many products, reliance on suppliers will continue to grow.

In recent years, IBM has reduced its number of suppliers, aggregating more business with fewer suppliers. To determine which suppliers to use and how much business to give each, IBM evaluates them on price, quality, delivery, and technology. However, each criterion is weighted

differently depending on the commodity that the supplier produces.

"We base the technology rating on what's going on in the supplier's lab," says Gene Richter, chief procurement officer. "Is the supplier going to be the first to be qualified on a 1 gigabit DRAM, or the last? Does the supplier offer a full breadth of memory products or only one narrow niche? Is the supplier going to be the leader in the next generation in new technology? It can be very subjective. It's hard to sort the top three, but it's easy to tell the top three from the bottom three," says Richter.

SOURCE: James Carbone, "Evaluation Programs Determine Top Suppliers," *Purchasing* (November 18, 1999), pp. 31–35.

<sup>1</sup> Charles D. Mecimore and Alice T. Bell, "Are We Ready for Fourth-Generation ABC?" *Management Accounting* (January 1995), p. 24.

**value chart****processing (service) time****inspection time****transfer time****idle time****cycle (lead) time**

required to move the items in and out, resulting in labor costs. Each process map is unique and based on the results of a management and employee team's study.

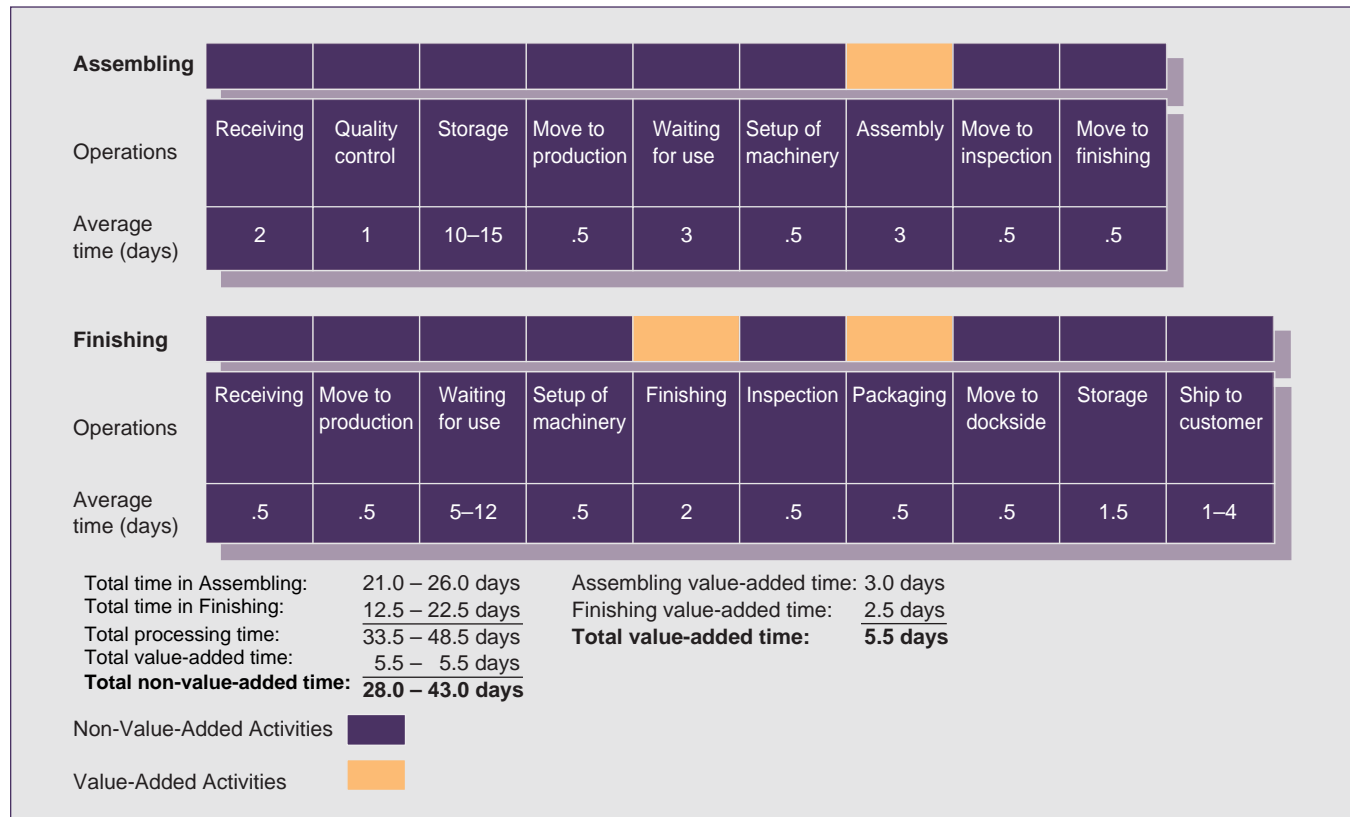
Once the process map has been developed, a **value chart** can be constructed that identifies the stages and time spent in those stages from beginning to end of a process. Time can be consumed in four general ways: processing (or service), inspection, transfer, and idle. The actual time that it takes to perform the functions necessary to manufacture the product or perform the service is the **processing (or service) time**; this quantity of time is value-added. Performing quality control results in **inspection time**, whereas moving products or components from one place to another constitutes **transfer time**. Lastly, storage time and time spent waiting at a production operation for processing are **idle time**. Inspection time, transfer time, and idle time are all non-value-added. Thus, the **cycle (or lead) time** from the receipt of an order to completion of a product or performance of a service is equal to value-added processing time plus non-value-added time.

Although viewing inspection time and transfer time as non-value-added is theoretically correct, few companies can completely eliminate all quality control functions and all transfer time. Understanding the non-value-added nature of these functions, however, should help managers strive to minimize such activities to the extent possible. Thus, companies should view value-added and non-value-added activities as occurring on a continuum and concentrate on attempting to eliminate or minimize those activities that add the most time and cost *and* the least value.

Exhibit 4–2 illustrates a value chart for a chemical product made by Titan Chemical. Note the excessive time consumed by simply storing and moving materials. Value is added to products only during the times that production actually occurs; thus, Titan Company's entire production sequence has only 5.5 days of value-added time.

**EXHIBIT 4-2**

Value Chart for Titan Chemical



In some instances, a company may question whether the time spent in packaging is value-added. Packaging is essential for some products but unnecessary for others and, because packaging takes up about a third of the U.S. landfills and creates a substantial amount of cost, companies and consumers are beginning to focus their attention on reducing or eliminating packaging.

## Manufacturing Cycle Efficiency

Dividing value-added processing time by total cycle time provides a measure of efficiency referred to as **manufacturing cycle efficiency (MCE)**. (A service company would compute service cycle efficiency by dividing actual service time by total cycle time.) If a company's production time were 3 hours and its total cycle time were 24 hours, its manufacturing cycle efficiency would be 12.5 ( $3 \div 24$ ) percent.

Although the ultimate goal of 100 percent efficiency can never be achieved, typically, value is added to the product only 10 percent of the time from receipt of the parts until shipment to the customer. Ninety percent of the cycle time is waste. A product is much like a magnet. The longer the cycle time, the more the product attracts and creates cost.<sup>2</sup>

A just-in-time manufacturing process seeks to achieve substantially higher efficiency by producing components and goods at the precise time they are needed by either the next production station or the consumer. Thus, a significant amount of idle time (especially in storage) is eliminated. Raising MCE can also be achieved by installing and using automated technology, such as flexible manufacturing systems.

In a retail environment, cycle time relates to the length of time from ordering an item to selling that item. Non-value-added activities in retail include shipping time from the supplier, receiving delays for counting merchandise, and any storage time between receipt and sale. In a service company, cycle time refers to the time between the service order and service completion. All time spent on activities that are not actual service performance or are nonactivities (such as delays in beginning a job) are considered non-value-added for that job.

Non-value-added activities can be attributed to systemic, physical, and human factors. For example, systemic causes could include a processing requirement that products be manufactured in large batches to minimize setup cost or that service jobs be taken in order of urgency. Physical factors contribute to non-value-added activities because, in many instances, plant and machine layout do not provide for the most efficient transfer of products. This factor is especially apparent in multistory buildings in which receiving and shipping are on the ground floor, but storage and production are on upper floors. People may also be responsible for non-value-added activities because of improper skills or training or the need to be sociable.

Attempts to reduce non-value-added activities should be directed at all of these causes, but it is imperative that the "Willie Sutton" rule be applied. This rule is named for the bank robber who, when asked why he robbed banks, replied, "That's where the money is." The NVA activities that create the most costs should be the ones that management concentrates its efforts on reducing or eliminating. The system must be changed to reflect a new management philosophy regarding performance measures and determination of product cost. Physical factors must be changed as much as possible to eliminate layout difficulties and machine bottlenecks, and people must accept and work toward total quality control. Focusing attention on eliminating non-value-added activities should cause product/service quality to increase, and cycle time and cost to decrease.

**manufacturing cycle  
efficiency (MCE)**

<sup>2</sup> Tom E. Pryor, "Activity Accounting: The Key to Waste Reduction," *Accounting Systems Journal* (Fall 1990), p. 38.



Although constructing value charts for every product or service would be time consuming, a few such charts can quickly indicate where a company is losing time and money through non-value-added activities. Using amounts such as depreciation on storage facilities, wages for employees who handle warehousing, and the cost of capital on working capital funds tied up in stored inventory can provide an estimate of the amount by which costs could be reduced through the elimination of non-value-added activities.

## COST DRIVER ANALYSIS

3

Why must cost drivers be designated in an activity-based costing system?

Companies engage in many activities that consume resources and, thus, cause costs to be incurred. All activities have cost drivers, defined in Chapter 3 as the factors having direct cause–effect relationships to a cost. Many cost drivers may be identified for an individual business unit. For example, cost drivers for factory insurance are number of employees; value of property, plant, and equipment; and number of accidents or claims during a specified time period. Cost drivers affecting the entire plant include inventory size, physical layout, and number of different products produced. Cost drivers are classified as volume-related (such as machine hours) and non-volume-related, which generally reflect the incurrence of specific transactions (such as setups, work orders, or distance traveled).

A greater number of cost drivers can be identified than should be used for cost accumulation or activity elimination. Management should limit the cost drivers selected to a reasonable number and ascertain that the cost of measuring a driver does not exceed the benefit of using it. A cost driver should be easy to understand, directly related to the activity being performed, and appropriate for performance measurement.

Costs have traditionally been accumulated into one or two cost pools (total factory overhead or variable and fixed factory overhead), and one or two drivers (direct labor hours and/or machine hours) have been used to assign costs to products. These procedures cause few, if any, problems for financial statement preparation. However, the use of single cost pools and single drivers may produce illogical product or service costs for internal managerial use in complex production (or service) environments.

Exhibit 4–3 indicates how activity analysis is combined with cost driver analysis to create a tool for managing costs. While cost driver analysis identifies the activities causing costs to be incurred, the activity analysis highlights activities that are not value-adding and can be targeted for elimination to reduce costs and product prices.

To reflect the more complex environments, the accounting system must first recognize that costs are created and incurred because their drivers occur at different levels.<sup>3</sup> This realization necessitates using **cost driver analysis**, which investigates, quantifies, and explains the relationships of drivers and their related costs. Traditionally, cost drivers were viewed only at the unit level; for example, how many hours of labor or machine time did it take to produce a product or render a service? These drivers create **unit-level costs**, meaning that they are caused by the production or acquisition of a single unit of product or the delivery of a single unit of service. Other drivers and their costs are incurred for broader-based categories or levels of activity. These broader-based activity levels have successively wider scopes of influence on products and product types. The categories are classified as batch, product or process, and organizational or facility levels. Examples of the kinds of costs that occur at the various levels are given in Exhibit 4–4.

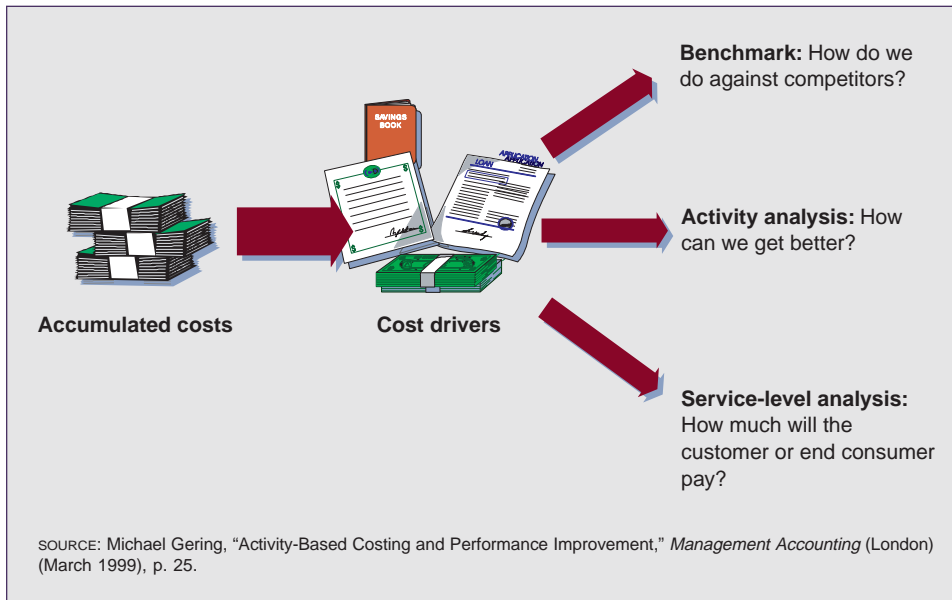
cost driver analysis

unit-level costs

<sup>3</sup> This hierarchy of costs was introduced by Robin Cooper in “Cost Classification in Unit-Based and Activity-Based Manufacturing Cost Systems,” *Journal of Cost Management* (Fall 1990), p. 6.

**EXHIBIT 4-3**

ABC Data and Cost Management



**EXHIBIT 4-4**

Levels of Costs

Classification Levels	Types of Costs	Necessity of Cost
Unit-Level Costs	<ul style="list-style-type: none"> <li>Direct material</li> <li>Direct labor</li> <li>Some machine costs, if traceable</li> </ul>	Once for each unit produced
Batch-Level Costs	<ul style="list-style-type: none"> <li>Purchase orders</li> <li>Setup</li> <li>Inspection</li> <li>Movement</li> <li>Scrap, if related to the batch</li> </ul>	Once for each batch produced
Product/Process-Level Costs	<ul style="list-style-type: none"> <li>Engineering change orders</li> <li>Equipment maintenance</li> <li>Product development</li> <li>Scrap, if related to product design</li> </ul>	Supports a product type or a process
Organizational or Facility Costs	<ul style="list-style-type: none"> <li>Building depreciation</li> <li>Plant or division manager's salary</li> <li>Organizational advertising</li> </ul>	Supports the overall production or service process



**batch-level cost**

Costs that are caused by a group of things being made, handled, or processed at a single time are referred to as **batch-level costs**. A good example of a batch-level cost is the cost of setting up a machine. Assume that setting up a machine to cast product parts costs \$900. Two different parts are to be manufactured during the day; therefore, two setups will be needed at a total cost of \$1,800. The first run will generate 3,000 Type A parts; the second run will generate 600 Type B parts. These quantities are specifically needed for production because the company is on a just-in-time production system. If a unit-based cost driver (volume) were used, the total setup cost of \$1,800 would be divided by 3,600 parts, giving a cost per part of \$0.50. This method would assign the majority of the cost to Type A parts ( $3,000 \times \$0.50 = \$1,500$ ). However, because the cost is actually created by a batch-level driver, \$900 should be spread over 3,000 Type A parts for a cost of \$0.30 per part and \$900 should be spread over 600 Type B parts for a cost of \$1.50 per part. Using a batch-level perspective indicates the commonality of the cost to the units within the batch and is more indicative of the relationship between the activity (setup) and the driver (different production runs).

**product-level (process-level) cost**

A cost caused by the development, production, or acquisition of different items is called a **product-level** (or **process-level**) **cost**. To illustrate this level of cost, assume that the engineering department of Carrier Corp. issued five engineering change orders (ECOs) during May. Of these ECOs, four related to Product R, one related to Product S, and none related to Product T. Each ECO costs \$7,500 to issue. During May, the company produced 1,000 units of Product R, 1,500 units of Product S, and 5,000 units of Product T. If ECO costs were treated as unit-level costs, the total ECO cost of \$37,500 would be spread over the 7,500 units produced at a cost per unit of \$5. However, this method inappropriately assigns \$25,000 of ECO cost to Product T, which had no engineering change orders issued for it! Using a product/process-level driver (number of ECOs) for ECO costs would assign \$30,000 of costs to Product R and \$7,500 to Product S. These amounts would be assigned to R and S, but not simply to the current month's production. The ECO cost should be allocated to all current and future R and S units produced while these ECOs are in effect because the products manufactured using the changed design benefit from the costs of the ECOs. This allocation reflects the use of a life-cycle concept.

*This plant bottles several different types of juices. The costs of the gallon of orange juice and the plastic jug are unit-level costs. The setup cost of filling the vat with orange juice is a batch-level cost. The cost of developing each juice recipe is a process-level cost. And, finally, the cost of depreciation on the equipment and building is an organizational-level cost.*



Certain costs at the organizational level are incurred for the singular purpose of supporting continuing facility operations. These **organizational-level costs** are common to many different activities and products or services and can be prorated to products only on an arbitrary basis. Although organizational-level costs theoretically should not be assigned to products at all, some companies attach them to goods produced or services rendered because the amounts are insignificant relative to all other costs.

### organizational-level cost

Accountants have traditionally (and incorrectly) assumed that if costs did not vary with changes in production at the unit level, those costs were fixed rather than variable. In reality, batch, product/process, and organizational level costs are all variable, but they vary for reasons other than changes in production volume. Therefore, to determine a valid estimate of product or service cost, costs should be accumulated at each successively higher level of costs. Because unit, batch, and product/process level costs are all associated with units of products (merely at different levels), these costs can be summed at the product level to match with the revenues generated by product sales. Organizational-level costs are not product related, thus they should only be subtracted in total from net product revenues.

Exhibit 4–5 illustrates how costs collected at the unit, batch, and product/process levels can be used to generate a total product cost. Each product cost would be multiplied by the number of units sold and that amount of cost of goods sold would be subtracted from total product revenues to obtain a product line profit or loss item. These computations would be performed for each product line and summed to determine net product income or loss from which the unassigned organizational-level costs would be subtracted to find company profit or loss for internal management use. In this model, the traditional distinction (discussed in Chapter 3) between product and period costs can be and is ignored. The emphasis is on refining product profitability analysis for internal management purposes, rather than for external financial statements. Because the product/period cost distinction required by generally accepted accounting principles is not recognized, the model presented in Exhibit 4–5 is not currently acceptable for external reporting.

Data for a sample manufacturing company with three products are presented in Exhibit 4–6 to illustrate the difference in information that would result from recognizing multiple cost levels. Before recognizing that some costs were incurred at the batch, product, and organizational level, the company accumulated and allocated its factory overhead costs among its three products on a machine hour (MH) basis. Each product requires one machine hour, but Product D is a low-volume, special-order line. As shown in the first section of Exhibit 4–6, cost information indicated that Product D was a profitable product. After analyzing its activities, the company began capturing costs at the different levels and assigning them to products based on appropriate cost drivers. The individual details for this overhead assignment are not shown, but the final assignments and resulting product profitability figures are presented in the second section of Exhibit 4–6. This more refined approach to assigning costs shows that Product D is actually unprofitable.

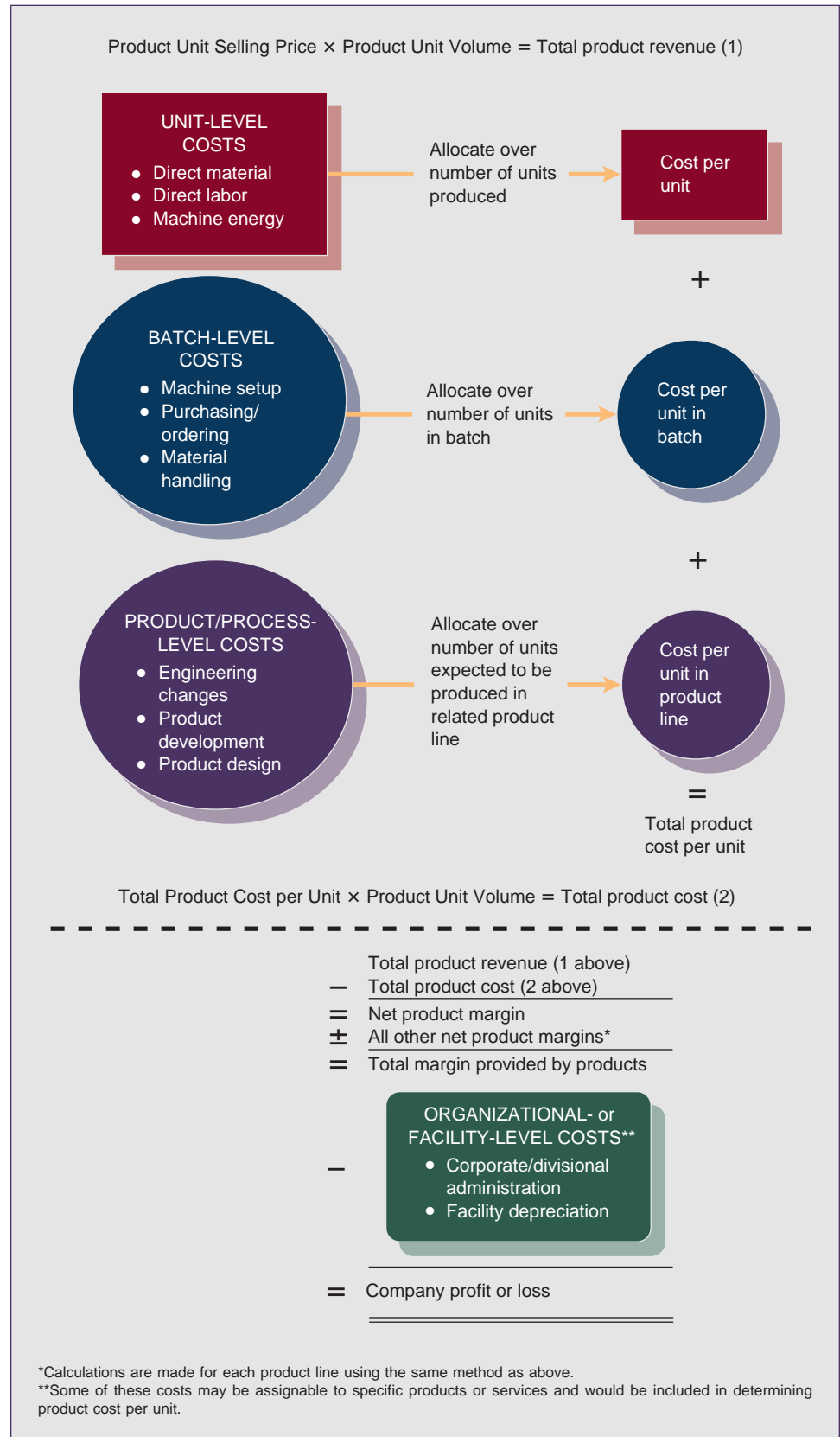
Costs are incurred because firms engage in a variety of activities, and these activities consume company resources. Accountants have traditionally used a transaction basis to accumulate costs and, additionally, have focused on the cost incurred rather than the source of the cost. However, managers now believe that the “conventional transaction-driven system is costly to administer, fails to control costs, and usually yields erroneous product cost data.”<sup>4</sup>

Traditional cost allocations tend to subsidize low-volume, specialty products by misallocating overhead to high-volume, standard products. This problem occurs because costs of the extra activities needed to make specialty products are assigned

<sup>4</sup> Richard J. Schonberger, “World-Class Performance Management,” in Peter B. B. Turney, ed., *Performance Excellence in Manufacturing and Service Organizations* (Sarasota, Fla.: American Accounting Association, 1990), p. 1.

**EXHIBIT 4-5**

Determining Product Profitability and Company Profit



Total overhead cost = \$1,505,250  
 Total machine hours = 111,500  
 Overhead rate per machine hour = \$13.50

	PRODUCT C (5,000 UNITS)		PRODUCT D (1,500 UNITS)		PRODUCT E (105,000 UNITS)		Total
	Unit	Total	Unit	Total	Unit	Total	
Product revenue	\$50.00	\$250,000	\$45.00	\$67,500	\$40.00	\$4,200,000	\$4,517,500
Product costs							
Direct	\$20.00	100,000	\$20.00	\$30,000	\$ 9.00	\$ 945,000	
OH per MH	13.50	67,500	13.50	20,250	13.50	1,417,500	
Total	<u>\$33.50</u>	<u>\$167,500</u>	<u>\$33.50</u>	<u>\$50,250</u>	<u>\$22.50</u>	<u>\$2,362,500</u>	(2,580,250)
Net income		<u>\$ 82,500</u>		<u>\$17,250</u>		<u>\$1,837,500</u>	<u>\$1,937,250</u>

	PRODUCT C (5,000 UNITS)		PRODUCT D (1,500 UNITS)		PRODUCT E (105,000 UNITS)		Total
	Unit	Total	Unit	Total	Unit	Total	
Product revenue	<u>\$50</u>	<u>\$250,000</u>	<u>\$45</u>	<u>\$ 67,500</u>	<u>\$40</u>	<u>\$4,200,000</u>	\$4,517,500
Product costs							
Direct	\$20	100,000	\$20	\$ 30,000	\$ 9	\$ 945,000	
Overhead							
Unit level	8	40,000	12	18,000	6	630,000	
Batch level	9	45,000	19	28,500	3	315,000	
Product level	<u>3</u>	<u>15,000</u>	<u>15</u>	<u>22,500</u>	<u>2</u>	<u>210,000</u>	
Total	<u>\$40</u>	<u>\$200,000</u>	<u>\$66</u>	<u>\$ 99,000</u>	<u>\$20</u>	<u>\$2,100,000</u>	(2,399,000)
Product line income or (loss)		<u>\$ 50,000</u>		<u>\$ (31,500)</u>		<u>\$2,100,000</u>	<u>\$2,118,500</u>
Organizational-level costs							(181,250)
Net income							<u>\$1,937,250</u>

**EXHIBIT 4-6***Product Profitability Analysis*

using the one or very few drivers of traditional costing—and usually these drivers are volume based. Interestingly, as long ago as 1954, William J. Vatter noted that “[j]ust as soon as cost accounting is found inadequate for the needs it is supposed to meet, just as soon as cost accounting does not provide the data which management must have, cost accounting will either change to meet those needs or it will be replaced with something else.”<sup>5</sup> The time has come for cost accounting to change by utilizing new bases on which to collect and assign costs. Those bases are the activities that drive or create the costs.

**ACTIVITY-BASED COSTING**

4

How does activity-based costing differ from a traditional cost accounting system?

Recognizing that several levels of costs exist, accumulating costs into related cost pools, and using multiple cost drivers to assign costs to products and services are the three fundamental components of activity-based costing (ABC). ABC is a cost accounting system that focuses on the various activities performed in an organization and collects costs on the basis of the underlying nature and extent of those activities. This costing method focuses on attaching costs to products and services based on the activities conducted to produce, perform, distribute, or support those products and services. The accompanying News Note illustrates use of ABC at the U.S. Postal Service.

<sup>5</sup> William J. Vatter, “Tailor-Making Cost Data for Specific Uses,” in L. S. Rosen, ed., *Topics in Managerial Accounting* (Toronto: McGraw-Hill Ryerson Ltd., 1954), p. 194.

## NEWS NOTE



## GENERAL BUSINESS

**Paying the Postman**

The U.S. Postal Service (USPS) is a unique federal entity in several respects. First, the USPS, in essence, operates in a manner similar to many private sector companies. The USPS provides a variety of services, generates revenue from these services, and incurs costs and expenses as a result of its operations. Second, the USPS is unique in that it is open to private sector competition. Competition includes companies such as Federal Express, United Parcel Service, Mail Boxes, Etc., and a host of other similar companies. Few other governmental agencies or departments operate in a similar business environment.

Retailers as well as USPS competitors have long accepted credit cards as payments for goods and services. Moreover, new technologies are beginning to lead to a “cashless” world. Customers are seeking convenience and value, while businesses are striving for increased sales and guaranteed payment. Given the competitive forces facing the USPS and the rapid pace at which new technologies are becoming available, USPS management realized that it had to use innovative business methods to maintain and increase its market share against the competition and provide increased value to its customers while ensuring cost effectiveness.

Based on this evaluation of its position in the marketplace, the USPS engaged Coopers and Lybrand (C&L)\* to conduct activity-based cost studies of its key revenue collection processes for a national credit card and debit card program. To obtain an understanding of the cash, check, and credit/debit card activities, C&L reviewed USPS data and procedure manuals, interviewed USPS headquarters staff, and conducted telephone surveys of front window supervisors and district office accounting personnel. Using an activity-based cost modeling approach, C&L defined the cash and check process in terms of the activities that link together to make the processes.

In summarizing its findings, C&L reported that, “Credit and debit card processing costs are relatively high at the moment due to the normal impact of process start-up, low initial volume and high initial implementation costs. However, as volumes continue to grow, projected credit and debit card costs can become competitive with current cash and check processing costs.

\*now PricewaterhouseCoopers

SOURCE: Terrell L. Carter, Ali M. Sedaghat, and Thomas D. Williams, “How ABC Costs Changed the Post Office,” *Strategic Finance* (February 1998), pp. 20–36.

<http://www.usps.com>  
<http://www.fedex.com>  
<http://www.ups.com>  
<http://www.mbe.com>

Managers in many manufacturing companies are concerned about the product costing information being provided by the traditional cost accounting systems. The general consensus is that product costs currently being developed are useful in preparing financial statements, but are often of limited use for management decision making. Activity-based costing, on the other hand, is useful in companies having the following characteristics:

1. the production or performance of a wide variety of products or services;
2. high overhead costs that are not proportional to the unit volume of individual products;
3. significant automation that has made it increasingly more difficult to assign overhead to products using the traditional direct labor or machine-hour bases;
4. profit margins that are difficult to explain; and
5. hard-to-make products that show big profits and easy-to-make products that show losses.<sup>6</sup>

Companies having the above characteristics may want to reevaluate their cost systems and implement activity-based costing.

**Two-Step Allocation**

After being recorded in the general ledger and subledger accounts, costs are accumulated in activity center cost pools. An **activity center** is a segment of the production or service process for which management wants a separate report of

5

How does the installation of an activity-based costing system affect behavior?

**activity center**

<sup>6</sup> Robin Cooper, “You Need a New Cost System When . . .,” *Harvard Business Review* (January–February 1989), pp. 77–82.

the costs of activities performed. In defining these centers, management should consider the following issues: geographical proximity of equipment, defined centers of managerial responsibility, magnitude of product costs, and a need to keep the number of activity centers manageable. Costs having the same driver are accumulated in pools reflecting the appropriate level of cost incurrence (unit, batch, or product/process). The fact that a relationship exists between a cost pool and a cost driver indicates that, if the cost driver can be reduced or eliminated, the related cost should also be reduced or eliminated.

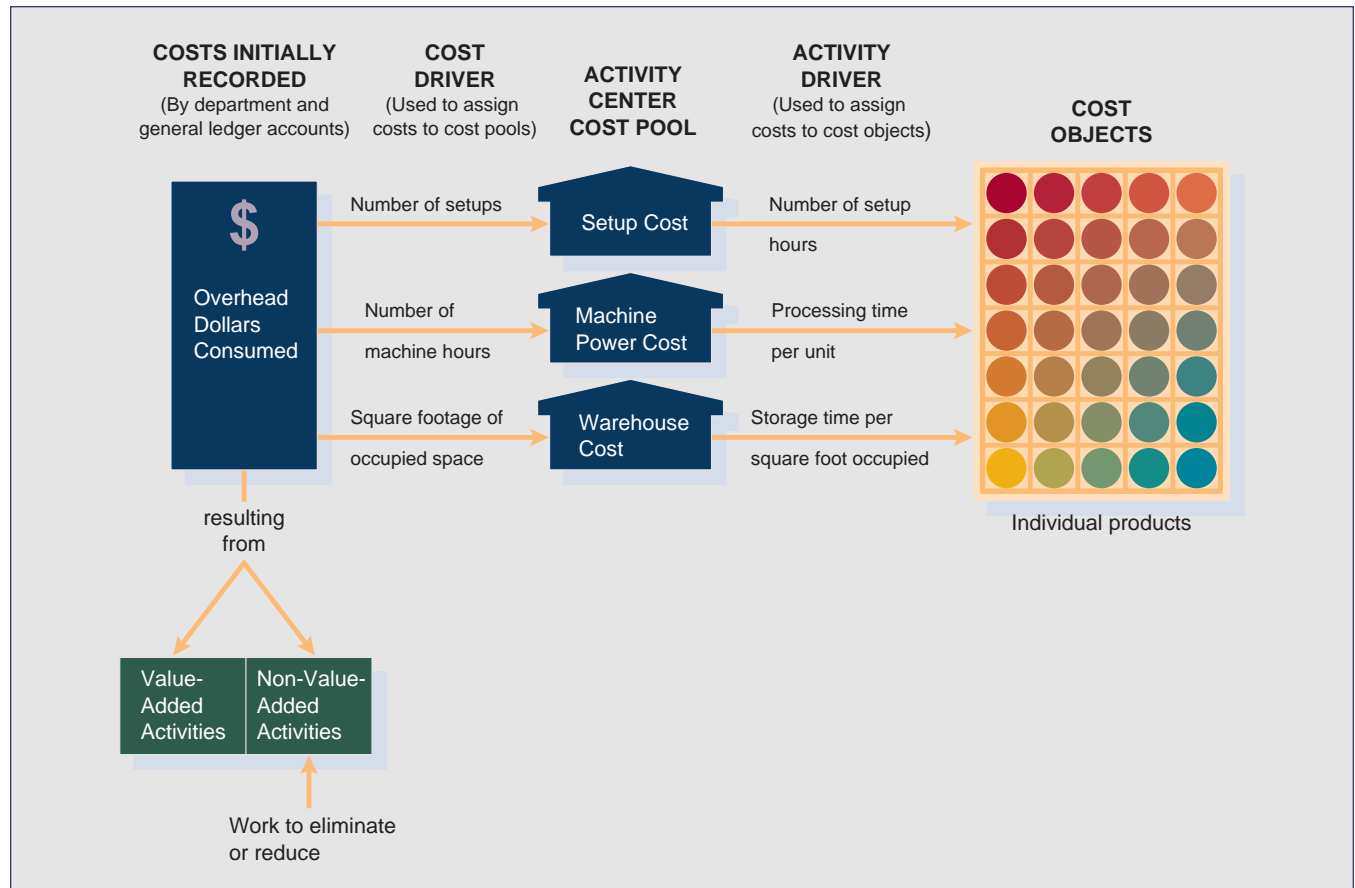
Gathering costs in pools reflecting the same cost drivers allows managers to recognize cross-functional activities in an organization. In the past, some companies may have accumulated overhead in smaller-than-plantwide pools, but this accumulation was typically performed on a department-by-department basis. Thus, the process reflected a vertical-function approach to cost accumulation. But production and service activities are horizontal by nature. A product or service flows through an organization, affecting numerous departments as it goes. Using a cost driver approach to develop cost pools allows managers to more clearly focus on the various cost impacts created in making a product or performing a service than was possible traditionally.

After accumulation, costs are allocated out of the activity center cost pools and assigned to products and services by use of a second driver. These drivers are often referred to as activity drivers. An **activity driver** measures the demands placed on activities and, thus, the resources consumed by products and services. An activity driver selected often indicates an activity's output. The process of cost assignment is the same as the overhead application process illustrated in Chapter 3. Exhibit 4-7 illustrates this two-step process of tracing costs to products and services in an ABC system.

activity driver

**EXHIBIT 4-7**

*Tracing Costs in an Activity-Based Costing System*





As noted in Exhibit 4–7, the cost drivers for the collection stage may differ from the activity drivers used for the allocation stage because some activity center costs are not traceable to lower levels of activity. Costs at the lowest (unit) level of activity should be allocated to products by use of volume- or unit-based drivers. Costs incurred at higher (batch and product/process) levels may also be allocated to products by use of volume-related drivers, but the volume measure should include only those units associated with the batch or the product/process—not total production or service volume. Exhibit 4–8 provides some common drivers for various activity centers.

### Activity-Based Costing Illustrated

An ABC example is shown in Exhibit 4–9. Information is gathered about the activities and costs for a factory maintenance department. Costs are then assigned to specific products based on activities. This department allocates its total personnel cost among the three activities performed in that department based on the number of employees in those areas. This allocation reflects the fact that occurrences of a specific activity, rather than volume of production or service, are indicative of work performed in the department.

This company manufactures Product Z, which is a rather complex unit with relatively low demand. The cost allocated to Product Z with the activity-based costing system is 132 percent higher than the cost allocated with the traditional allocation system (\$1.564 versus \$0.675)!

Discrepancies in costs between traditional and activity-based costing methods are not uncommon. Activity-based costing systems indicate that significant resources are consumed by low-volume products and complex production operations. Studies have shown that, after the implementation of activity-based costing, the costs of high-volume, standard products have often been too high and, using ABC, have declined anywhere from 10 to 30 percent. Low-volume, complex specialty product costs tend to increase from 100 to 500 percent, although in some cases these costs have risen by 1,000 to 5,000 percent!<sup>7</sup> Thus, activity-based costing typically

#### EXHIBIT 4–8

##### Activity Drivers

Activity Center	Activity Drivers
Accounting	Reports requested; dollars expended
Personnel	Job change actions; hiring actions; training hours; counseling hours
Data processing	Reports requested; transactions processed; programming hours; program change requests
Production engineering	Hours spent in each shop; job specification changes requested; product change notices processed
Quality control	Hours spent in each shop; defects discovered; samples analyzed
Plant services	Preventive maintenance cycles; hours spent in each shop; repair and maintenance actions
Material services	Dollar value of requisitions; number of transactions processed; number of personnel in direct support
Utilities	Direct usage (metered to shop); space occupied
Production shops	Fixed per-job charge; setups made; direct labor; machine hours; number of moves; material applied

SOURCE: Michael D. Woods, "Completing the Picture: Economic Choices with ABC," *Management Accounting* (December 1992), p. 54. Reprinted from *Management Accounting*. Copyright by Institute of Management Accountants, Montvale, N.J.

<sup>7</sup> Peter B. B. Turney, *An Introduction to Activity-Based Costing* (ABC Technologies, Inc., 1990), video.

Factory Maintenance Department: The company's conventional system assigns the personnel costs of this department to products using direct labor hours (DLHs); the department has 9 employees and incurred \$450,000 of personnel costs in the current year or \$50,000 per employee. Expected DLHs are 200,000.

### ABC ALLOCATION

#### Stage 1

Trace costs from general ledger and subsidiary ledger accounts to activity center pools according to number of employees:

- Regular maintenance—uses 5 employees; \$250,000 is allocated to this activity; second-stage allocation to be based on machine hours (MHs)
- Preventive maintenance—uses 2 employees; \$100,000 is allocated to this activity; second-stage allocation to be based on number of setups
- Repairs—uses 2 employees; \$100,000 is allocated to this activity; second-stage allocation is based on number of machine starts

#### Stage 2

Allocate activity center cost pools to products using cost drivers chosen for each cost pool.

2001 activity of second-stage drivers: 500,000 MHs; 5,000 setups; 100,000 machine starts

Step 1: Allocate costs per unit of activity of second-stage cost drivers.

- Regular maintenance— $\$250,000 \div 500,000 \text{ MHs} = \$0.50 \text{ per MH}$
- Preventive maintenance— $\$100,000 \div 5,000 \text{ setups} = \$20 \text{ per setup}$
- Repairs— $\$100,000 \div 100,000 \text{ machine starts} = \$1 \text{ per machine start}$

Step 2: Allocate costs to products using quantity of second-stage cost drivers consumed in making these products. The following quantities of activity are relevant to Product Z: 30,000 MHs; 30 setups; 40 machine starts; and 3,000 DLHs out of a total of 200,000 DLHs in 2001. Ten thousand units of Product Z were manufactured during 2001.

ABC Allocation to Product Z =  $(30,000 \times \$0.50) + (30 \times \$20) + (40 \times \$1) = \$15,640$  for 10,000 units or \$1.564 per unit

Traditional Allocation to Product Z =  $\$450,000 \div 200,000 \text{ DLHs} = \$2.25 \text{ per DLH}$ ;  $(3,000 \times \$2.25) = \$6,750$  for 10,000 units or \$0.675 per unit

### EXHIBIT 4-9

*Illustration of Activity-Based Costing Allocation*

shifts a substantial amount of overhead cost from standard, high-volume products to premium special-order, low-volume products, as shown in Exhibit 4-10. The ABC costs of moderate products and services (those that are neither extremely simple nor complex, nor produced in extremely low or high volumes) tend to remain approximately the same as the costs calculated using traditional costing methods.

Although the preceding discussion addresses costs normally considered product costs, activity-based costing is just as applicable to service department costs. Many companies use an activity-based costing system to allocate corporate overhead costs to their revenue-producing units based on the number of reports, documents, customers, or other reasonable measures of activity.

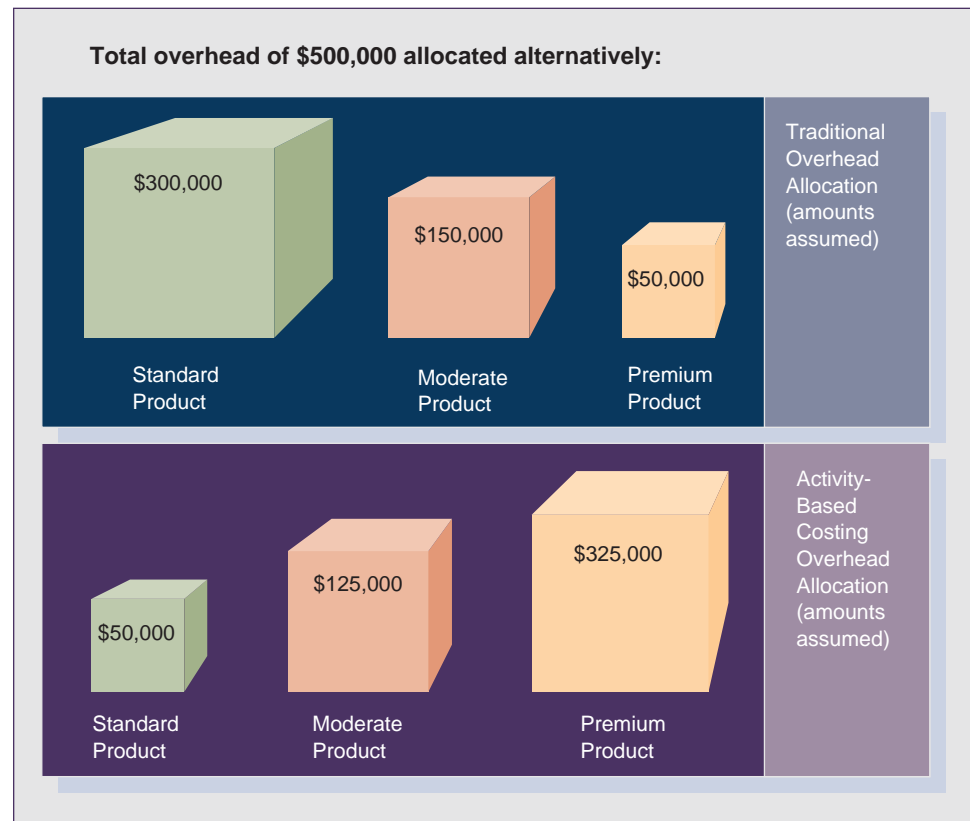
## Short-Term and Long-Term Variable Costs

Short-term variable costs increase or decrease corresponding with changes in the volume of activity. Costs that do not move in relation to volume have conventionally been accepted as fixed. "Generally [however], as a business expands, costs tend to be far more variable than they should be, and when it contracts, they are far more fixed than they should be."<sup>8</sup> Professor Robert Kaplan of Harvard University considers the ability of "fixed" costs to change under the "Rule of One," which means that possessing or using more than one unit of a resource is evidence that

<sup>8</sup> B. Charles Ames and James D. Hlavacek, "Vital Truths About Managing Your Costs," *Harvard Business Review* (January–February 1990), p. 145.

**EXHIBIT 4-10**

Traditional versus ABC  
Overhead Allocations

**long-term variable cost**

**product variety**  
**product complexity**  
**process complexity**

the resource is variable.<sup>9</sup> Because of this logic, many people have come to view fixed costs as **long-term variable costs**, for which suitable (usually non-volume-related) cost drivers simply need to be identified.

Two significant cost drivers that cause long-term variable costs to change, but which traditionally have been disregarded, are product variety and product complexity. **Product variety** refers to the number of different types of products made; **product complexity** refers to the number of components included in a product; **process complexity** refers to the number of processes through which a product flows. These items create additional overhead (such as warehousing, purchasing, setups, and inspections), so long-term variable costs tend to increase as the number and types of products increase. Therefore, managers should use these cost drivers in applying ABC.

6

What is attribute-based costing and how does it extend activity-based costing?

**attribute-based costing (ABC II)****Attribute-Based Costing**

**Attribute-based costing (ABC II)**, an extension of activity-based costing, employs detailed cost-benefit analyses relating to information on customer needs (in terms of performance attributes of a product such as reliability, durability, responsiveness, and so forth) and the costs of the incremental improvements necessary to obtain these attributes. ABC II employs planned costs rather than past costs because, as discussed earlier, such a high percentage of a product's life-cycle costs are locked in during the product's development stage. The approach focuses on satisfying customer needs by searching for the optimum enhancement of customer utility through comparisons of alternatives for attribute enhancements relative to the costs of producing those enhancements.<sup>10</sup>

<sup>9</sup> Patrick L. Romano, "Activity Accounting: An Update—Part 2," *Management Accounting* (June 1989), p. 63.

<sup>10</sup> For additional information, see Mike Walker, "Attribute Based Costing," *Australian Accountant* (March 1992), pp. 42–45.

## DETERMINING WHETHER ABC IS APPROPRIATE

7

When is activity-based costing appropriate in an organization?

A vital loss of information may occur in an accounting system that ignores activity and cost relationships. Not every accounting system using direct labor or machine hours as the cost driver is providing inadequate or inaccurate cost information. However, some general clues may alert managers to the need to review the cost data being provided by a conventional accounting system. Some of these clues are more relevant to manufacturing entities, but others are equally appropriate for both manufacturing and service businesses. Consider the following:

*For a given organization, is it likely that ABC will produce costs that are significantly different from those that are generated with conventional accounting, and does it seem likely that those costs will be “better”? The factors involved here include:*

- *the number and diversity of products or services produced,*
- *the diversity and differential degree of support services used for different products,*
- *the extent to which common processes are used,*
- *the effectiveness of current cost allocation methods,*
- *and the rate of growth of period costs.*

*If information that is considered “better” is generated by ABC, will the new information change the dependent decisions made by the management? The factors involved here are:*

- *management’s freedom to set prices,*
- *the ratio of period costs to total costs,*
- *strategic considerations,*
- *the climate and culture of cost reduction in the company,*
- *and the frequency of analysis that is desirable or necessary.*<sup>11</sup>

Two primary underlying assumptions that companies must consider before adopting ABC are that the costs in each cost pool are (1) driven by homogeneous activities and (2) strictly proportional to the activity.<sup>12</sup> If these assumptions are met, the following circumstances may indicate a need to consider using activity-based costing.

### With Product Variety and Product Complexity

Product variety is commonly associated with a need to consider activity-based costing. Products may be variations of the same product line (such as Hallmark’s different types of greeting cards), or they may be in numerous product families (such as Procter & Gamble’s detergents, diapers, fabric softeners, and shampoos). In either case, product additions cause numerous overhead costs to increase.

In the quest for product variety, many companies are striving for **mass customization** of products through the use of flexible manufacturing systems. Such personalized production can often be conducted at a relatively low cost. Although such customization may please some customers, it does have some drawbacks. First, there may simply be too many choices. For instance, at GE Fanuc (a Charlottesville, Virginia, manufacturer), customers had to look through several 4-inch-thick binders of components to design a custom-made product—an extremely time-consuming project.<sup>13</sup> Nissan reportedly had 87 different varieties of steering wheels, but customers did not want many of them and disliked having to choose from so many

<http://www.hallmark.com>

<http://www.pg.com>

**mass customization**

<http://gefanuc.com>

<http://www.nissanmotors.com>

<sup>11</sup> T. L. Estrin, Jeffrey Kantor, and David Albers, “Is ABC Suitable for Your Company?” *Management Accounting* (April 1994), p. 40.

<sup>12</sup> Harold P. Roth and A. Faye Borthick, “Are You Distorting Costs by Violating ABC Assumptions?” *Management Accounting* (November 1991), pp. 39–40.

<sup>13</sup> B. Joseph Pine, “Customers Don’t Want Choices,” *The Wall Street Journal* (April 18, 1994), p. A12.

### Pareto principle

options.<sup>14</sup> Second, mass customization creates a tremendous opportunity for errors. And third, most companies have found that customers, given the wide variety of choices, typically make selections from a rather small percentage of the total. At Toyota, investigation of purchases revealed that 20 percent of the product varieties accounted for 80 percent of the sales.<sup>15</sup> This 20:80 ratio is a fairly common one and is referred to as the **Pareto principle**, after the Italian economist Vilfredo Pareto.<sup>16</sup>

Companies with complex products, services, or processes may want to investigate ways to reduce that complexity. Management may want to review the design of the company's products and processes to standardize them and reduce the number of different components, tools, and processes required. Products should be designed to consider the Pareto principle and take advantage of commonality of parts. An analysis of components will generally reveal that 20 percent of the components are used in 80 percent of the products. If this is the case, then companies need to consider two other factors. First, are the remaining components used in key products? If so, could equal quality be achieved by using the more common parts? If not, can the products be sold for a premium price to cover the costs associated with the use of low-volume components? Second, are the parts specified for use in products purchased by important customers who are willing to pay a premium price for the products? If so, the benefits from the complexity may be worth the cost. However, would customers be equally satisfied if more common parts were used and the product price were reduced? Complexity is acceptable only if it is value-added from the customer's point of view.

Process complexity may develop over time, or it may exist because of a lack of sufficient planning in product development. Processes are complex when they create difficulties for the people attempting to perform production operations (physical straining, awkwardness of motions, or wasted motions) or for the people using manufacturing machinery (multiple and/or detailed setups, lengthy transfer time between machine processes, recalibration of instruments, and so on). Process complexity reflects numerous non-value-added activities and thus causes time delays and cost increases.

### simultaneous (concurrent) engineering

A company can employ simultaneous engineering to reduce both product and process complexity. **Simultaneous** (or **concurrent**) **engineering** refers to the continuous involvement of all primary functions and personnel contributing to a product's origination and production from the beginning of a project. Multifunctional teams design the product by considering customer expectations, vendor capabilities, parts commonality, and production process compatibility. Such an integrated design effort is referred to as a design-for-manufacturability approach. Simultaneous engineering helps companies to shorten the time-to-market for new products and minimize complexity and cost.

Many traditional cost systems are not designed to account for information such as how many different parts are used in a product, so management cannot identify products made with low-volume or unique components. Activity-based costing systems are flexible and can gather such details so that persons involved in reengineering efforts have information about relationships among activities and cost drivers. Armed with these data, reengineering efforts can be focused on the primary causes of process complexity and on the causes that create the highest levels of waste.

<sup>14</sup> B. Joseph Pine II, Bart Victor, and Andrew C. Boynton, "Making Mass Customization Work," *Harvard Business Review* (September–October 1993), p. 110.

<sup>15</sup> *Ibid.*, p. 108.

<sup>16</sup> Pareto found that about 85 percent of Milan's wealth was held by about 15 percent of the people. The term *Pareto principle* was coined by Joseph Juran in relationship to quality problems. Juran found that a high proportion of such problems were caused by a small number of process characteristics (the vital few), whereas the majority of process characteristics (the trivial many) accounted for only a small proportion of quality problems.

### With Lack of Commonality in Overhead Costs

Certain products and services create substantially more overhead costs than others. Although some of these additional overhead costs may be caused by product variety or product/process complexity, others may be related to support services. For example, some products require significant levels of advertising; some use high cost distribution channels; and some necessitate the use of high-technology machinery. “A software distribution company, for example, discovered that a supposedly profitable high-margin product was generating so many calls to its help line that it was actually a money loser. Dropping that one product improved company profitability by nearly 10%.”<sup>17</sup> If only one or two overhead pools are used, overhead related to specific products will be spread over all products. The result will be increased costs for products that are not responsible for the increased overhead.

### With Problems in Current Cost Allocations

If a company has undergone one or more significant changes in its products or processes (such as increased product variety or business process reengineering), managers and accountants need to investigate whether the existing cost system still provides a reasonable estimate of product or service cost. Many companies that have automated their production processes have experienced large reductions in labor and large increases in overhead costs. In such companies, using direct labor as an overhead allocation base produces extraordinarily high application rates. Prior to the introduction of ABC at Harris Semiconductor Sector, the overhead application rate per area ranged from 800 to 1,800 percent of the direct labor costs. This process resulted in 90 to 95 percent of all costs being allocated on a “mere 5–10 percent (i.e., direct labor costs) of the cost base.”<sup>18</sup> Products made using automated equipment tend to be charged an insufficient amount of overhead, whereas products made using high proportions of direct labor tend to be overcharged.

Traditional cost allocations also generally emphasize the assignment of product costs to products at the same time the majority of period costs are expensed as incurred. Activity-based costing recognizes that some period costs (such as R&D and distribution) may be distinctly and reasonably associated with specific products and thus should be traced and allocated to those products. This recognition changes the traditional view of product versus period cost. And, as indicated in the News Note on page 150, ABC information can be used, with diplomacy, to evaluate customer profitability.

### With Changes in Business Environment

A change in a company’s competitive environment may also require better cost information. Increased competition may occur for several reasons: (1) other companies have recognized the profit potential of a particular product or service, (2) the product or service has become cost-feasible to make or perform, or (3) an industry has been deregulated. If many new companies are competing for old business, the best estimate of product or service cost must be available to management so that profit margins and prices can be reasonably set.

Changes in management strategy can also signal a need for a new cost system. For example, if management wants to begin new operations, the cost system must be capable of providing information on how costs will change. Confirming management’s view of costs to the traditional variable versus fixed classifications may not allow such information to be effectively developed. Viewing costs as short-term

<sup>17</sup> Srikumar S. Rao, “True Cost,” *Financial World* (September 25, 1995), pp. 62–63.

<sup>18</sup> Christopher R. Dederer, “Harris Semiconductor ABC: Worldwide Implementation and Total Integration,” *Journal of Cost Management* (Spring 1996), p. 44.



## NEWS NOTE



## GENERAL BUSINESS

**Measuring Customers to Manage Profits**

Activity-based costing differs from conventional costing in that it uses cost drivers to assign costs. By understanding the overhead that a particular customer or product really uses, ABC pinpoints customer profitability in a way that conventional accounting cannot.

The first shock comes when customers or products previously believed to be profitable are shown to consume more resources than the revenue that they generate.

Take for example the owner of a chain of pharmaceutical companies who wanted to reprice his products. He focused on assigning the transaction and holding costs associated with each product and used ABC to put in place a quick but fairly accurate system. Not surprisingly many small items generated costs well out of line with the accounting system and the Christmas break was used to reprice the items in the warehouse and on his shelves. Unfortunately, the new pricing was not well received; the business underwent a shock and his management team spent the next four months back-peddling with their customers.

Big changes, whether they are performed inside or across the boundaries of the organization, require careful diplomacy. Knowing the costs of your products sets a target. Implementing that target requires careful steps.

In big companies this usually requires the input of various players, of multifunctional teams that negotiate joint solutions with suppliers and customers. Often this leads to dramatic solutions that no one party would have reached on its own—standard packaging, availability of forecasts, more frequent deliveries, cheaper materials for noncritical parts.

ABC provides the tools to negotiate these solutions. By negotiating what the customer is prepared to pay for, we are able to minimize total costs across the entire value chain and add value for the final user.

SOURCE: Michael Gering, "Activity-Based Costing and the Customer," *Management Accounting* (London) (April 1999), pp. 26–27.

**continuous improvement**

variable versus long-term variable focuses on cost drivers and on the changes the planned operations will have on activities and costs.

**Continuous improvement** recognizes the concepts of eliminating non-value-added activities to reduce cycle time, making products (or performing services) with zero defects, reducing product costs on an ongoing basis, and simplifying products and processes. Activity-based costing, by promoting an understanding of cost drivers, allows the non-value-added activities to be identified and their causes eliminated or reduced.

**CRITICISMS OF ACTIVITY-BASED COSTING**

Realistically assessing new models and accounting approaches for what they can help managers accomplish is always important. However, no currently existing accounting technique or system will provide management with exact cost information for every product or with the information needed to make consistently perfect decisions. Activity-based costing, although it typically provides better information than was generated under the traditional overhead allocation process, is not a panacea for all managerial concerns. The following are some of this method's shortcomings.

First, ABC requires a significant amount of time and, thus, cost to implement. If implementation is to be successful, substantial support is needed throughout the firm. An environment for change must be created that requires overcoming a variety of individual, organizational, and environmental barriers. Individual barriers are typically related to (1) fear of the unknown or shift in status quo, (2) potential loss of status, or (3) a necessity to learn new skills. Organizational barriers are often related to "territorial," hierarchical, or corporate culture issues. Environmental barriers are often built by employee groups (including unions), regulatory agencies, or other stakeholders of interest.

To overcome these barriers, a firm must first recognize that these barriers exist; second, investigate their causes; and, third, communicate information about the “what,” “why,” and “how” of ABC to all concerned parties. Top management must be involved with and support the implementation process. Lack of commitment or involvement by top management will make any meaningful progress slow and difficult. Additionally, employees and managers must be educated in some nontraditional techniques that include new terminology, concepts, and performance measurements. Assuming that top management supports the changes in the internal accounting system and that employees are educated about the system, additional time will be required to analyze the activities taking place in the activity centers, trace costs to those activities, and determine the cost drivers.

Another problem with ABC is that it does not conform specifically with generally accepted accounting principles (GAAP). ABC would suggest that some non-product costs (such as those in research and development) be allocated to products, whereas certain other traditionally designated product costs (such as factory building depreciation) not be allocated to products. Therefore, most companies have used ABC for internal reporting, while continuing to maintain their general and subsidiary ledger accounts and prepare their external financial statements on the basis of a more “traditional” system—requiring two product costing systems and causing even more costs to be incurred. As ABC systems become more widely accepted, more companies may choose to refine how ABC and GAAP determine product cost to make those definitions more compatible and, thereby, eliminate the need for two costing systems.

One final criticism that has been leveled at activity-based costing is that it does not promote total quality management (TQM) and continuous improvement. Dr. H. Thomas Johnson (the Retzlaff Professor of Quality Management at Portland State University) has issued the following cautions:

*The decade of the 1970s ushered in a new competitive environment—call it the global economy—in which accounting information is not capable of guiding companies toward competitiveness and long-term profitability.*

*Activity-based prescriptions for improved competitiveness usually entail steps that lead to selling more or doing less of what should not be sold or done in the first place. Indeed, activity-based cost information does nothing to change old remote-control, top-down management behavior. Simply because improved cost information becomes available, a company does not change its commitment to mass-produce output at high speed, to control costs by encouraging people to manipulate processes, and to persuade customers to buy output the company has produced to cover its costs. American businesses will not become long-term global competitors until they change the way managers think. No cost information, not even activity-based cost management information, will do that.<sup>19</sup>*

Companies attempting to implement ABC as a cure-all for product failures, volume declines, or financial losses will quickly recognize that Professor Johnson is correct. However, companies can implement ABC and its related management techniques in support of and in conjunction with TQM, JIT, or any of the other world-class methodologies. Companies doing so will provide the customer with the best variety, price, quality, service, and lead time of which they are capable. Not coincidentally, they should find their businesses booming. Activity-based costing and activity-based management are effective in supporting continuous improvement, short lead times, and flexible manufacturing by helping managers to

- identify and monitor significant technology costs;
- trace many technology costs directly to products;
- promote increase in market share;

<sup>19</sup> H. Thomas Johnson, “It’s Time to Stop Overselling Activity-Based Concepts,” *Management Accounting* (September 1992), pp. 31, 33.

- identify the cost drivers that create or influence cost;
- identify activities that do not contribute to perceived customer value (i.e., non-value-added activities or waste);
- understand the impact of new technologies on all elements of performance;
- translate company goals into activity goals;
- analyze the performance of activities across business functions;
- analyze performance problems; and
- promote standards of excellence.

In summary, ABC is an improved cost accounting tool that helps managers know how the score is kept so that they can play the game more competitively.

## REVISITING

**Carrier  
Corporation**

<http://www.carrier.com>

The American Productivity and Quality Center (APQC) and the Consortium for Advanced Manufacturing International (CAM-I) recently sponsored a study to benchmark best practices in the installation and use of activity-based cost management systems. Seven hundred and fifty manufacturing and service organizations were invited to participate in the study, and 166 responded by completing a 20-page survey instrument.

The survey results and telephone interviews were then used to select 15 “best practice” companies. The best practice companies were selected based on their ABCM system’s maturity, the breadth of their ABCM applications, the extent of their system’s integration, and their level of success with ABCM.

Carrier Corporation participated in the survey and was selected as one of the best practice companies. Carrier currently has more than a dozen manufacturing sites located throughout the world, and it was Carrier’s McMinnville, Tenn.,

manufacturing plant that was identified as the best practice site.

Carrier’s complexity reduction program along with its other improvement initiatives have combined to produce tangible results. For example, the firm has eliminated some product lines, moved subassemblies to point of use, outsourced some conversion operations, outsourced product lines, and created a greater understanding of how complexity affects costs. But more work needs to be done for Carrier to maintain its competitive edge. In the current competitive environment, Carrier is striving to better understand cost behavior and the steps the company can take to maintain its position as the world’s largest manufacturer of air conditioning and heating products. Even though Carrier’s management believes that product and process complexity hurts profitability, it needs hard financial data. ABCM provides Carrier managers the information they need to make difficult decisions.

SOURCE: Dan W. Swenson, “Managing Costs through Complexity Reduction at Carrier Corporation,” *Strategic Finance* (April 1998), pp. 20–28.

## CHAPTER SUMMARY

Significant changes have taken place in the business environment. These changes have caused concern about the reliability of cost information generated by a system primarily intended to provide product costs for external financial statements.

To make profits given the present competitive environment and consumer focus on product price and quality, businesses must find ways to minimize costs. Costs can be reduced without reducing quality by decreasing the number of non-value-added organizational activities. Process mapping can be performed to see all

the VA and NVA activities that take place in the production of a product or the performance of a service. Value is added to products only during the times when processing (manufacturing company), performance (service company), or display (retail company) is actually taking place. Inspection time, transfer time, and idle time all add to cycle time and cost, but not to value. The proportion of total cycle time spent in value-added processing is referred to as manufacturing cycle efficiency.

A third category of activities, known as business-value-added activities, also exists. Although not wanting to pay for these activities, customers know the activities are necessary expenses incurred by a business to conduct operations.

In addition to activity analysis, activity-based management is also concerned with finding and selecting activity cost pools and identifying the set of cost drivers that best represents the firm's activities and are the underlying causes of costs. Management should first investigate activities that reflect the major and most significant processes conducted by the company. These activities normally overlap several functional areas and occur horizontally across the firm's departmental lines.

A new method of cost assignment, more compatible with the increased high-technology environment in which business operates, is activity-based costing (ABC). ABC assigns costs to products on the basis of the types and quantities of activities that must be performed to create those products. This costing system accumulates costs for activity centers in multiple cost pools at a variety of levels (unit, batch, product, and organizational) and then allocates these costs using multiple cost drivers (both volume- and non-volume-related). Thus, costs are assigned more accurately, and managers can focus on controlling activities that cause costs rather than trying to control the costs that result from the activities. The use of activity-based costing should provide a more realistic picture of actual production cost than has traditionally been available.

Product variety and process complexity often cause a business's costs to increase because of increases in non-value-added activities. Simultaneous engineering (using multifunctional teams) can help firms to accelerate the time-to-market of new products and reduce the complexity and costs of these new products and the processes by which they are made.

## KEY TERMS

activity (p. 132)	mass customization (p. 147)
activity analysis (p. 132)	organizational-level cost (p. 139)
activity center (p. 142)	Pareto principle (p. 148)
activity driver (p. 143)	process complexity (p. 146)
attribute-based costing (ABC II) (p. 146)	process map (p. 133)
batch-level cost (p. 138)	processing (service) time (p. 134)
business-value-added activity (p. 133)	product complexity (p. 146)
continuous improvement (p. 150)	product-level (process-level) cost (p. 138)
cost driver analysis (p. 136)	product variety (p. 146)
cycle (lead) time (p. 134)	simultaneous (concurrent) engineering (p. 148)
idle time (p. 134)	transfer time (p. 134)
inspection time (p. 134)	unit-level cost (p. 136)
long-term variable cost (p. 146)	value chart (p. 134)
manufacturing cycle efficiency (MCE) (p. 135)	

## SOLUTION STRATEGIES

### Manufacturing Cycle Efficiency

Cycle Time = Processing Time + Inspection Time + Transfer Time + Idle Time

MCE = Value-Added Processing Time ÷ Total Cycle Time

### Activity-Based Costing

1. Determine the activity centers of the organization.
2. Determine departmental activities and efforts needed to conduct those activities, that is, the cost drivers.
3. Determine departmental resources consumed in conducting activities and allocate costs of these resources to activity centers based on the cost drivers.
4. Determine activities needed to manufacture products or provide revenue-producing services, that is, the activity drivers.
5. Allocate costs to products and services based on activities and cost drivers involved.

## DEMONSTRATION PROBLEM

Pierre Press prepares two versions of gourmet cookbooks: One is paperback and the other is hand-sewn and leather bound. Management is considering publishing only the higher quality book. The firm assigns its \$500,000 of overhead to the two types of books. The overhead is composed of \$200,000 of utilities and \$300,000 of quality control inspectors' salaries. Some additional data follow:

	Paperback	Leather Bound
Revenues	\$1,600,000	\$1,400,000
Direct costs	\$1,250,000	\$600,000
Production (units)	500,000	350,000
Machine hours	42,500	7,500
Inspections	2,500	12,500

### Required:

- a. Compute the overhead cost that should be allocated to each type of cookbook using cost drivers appropriate for each type of overhead cost.
- b. The firm has used machine hours to allocate overhead in the past. Should Pierre Press stop producing the paperback cookbooks? Explain why management was considering this action and what its decision should be.

### Solution to Demonstration Problem

a.	Paperback	Leather Bound	Total
Machine hours	42,500	7,500	50,000
Rate per MH (\$200,000 ÷ 50,000)	× \$4	× \$4	× \$4
Utility cost	<u>\$170,000</u>	<u>\$ 30,000</u>	<u>\$200,000</u>
Number of inspections	2,500	12,500	15,000
Rate per inspection (\$300,000 ÷ 15,000)	× \$20	× \$20	× \$20
Quality inspection cost	<u>\$ 50,000</u>	<u>\$250,000</u>	<u>\$300,000</u>
Total traceable overhead costs	<u>\$220,000</u>	<u>\$280,000</u>	<u>\$500,000</u>

- b. Income calculation using machine hours to allocate utilities and inspection hours to allocate inspectors' salaries to products:

Using the traditional cost driver (machine hours), the following results had been achieved, given a \$10 charge ( $\$500,000 \div 50,000$ ) per MH:

	Paperback	Leather Bound
Revenue	\$1,600,000	\$1,400,000
Direct costs	\$1,250,000	\$ 600,000
Overhead	425,000	75,000
Total costs	\$1,675,000	\$ 675,000
Margin	\$ (75,000)	\$ 725,000

The reason paperbacks were erroneously thought to be unprofitable was caused by the method of allocating overhead. The firm should continue producing paperbacks as shown in the following calculations.

	Paperback	Leather Bound
Revenue	\$1,600,000	\$1,400,000
Direct costs	\$1,250,000	\$ 600,000
Overhead	220,000	280,000
Total costs	\$1,470,000	\$ 880,000
Margin	\$ 130,000	\$ 520,000

## QUESTIONS

1. What is activity-based management (ABM) and what are the specific management tools that fall beneath the ABM umbrella?
2. Define value-added activities and non-value-added activities. Compare and give three examples of each type.
3. Why are value-added activities defined from a customer viewpoint?
4. What management opportunity is associated with identifying the non-value-added activities in a production process?
5. In a televised football game, what activities are value added? What activities are non-value-added? Would everyone agree with your choices? Why or why not?
6. How is a process map used to identify opportunities for cost savings?
7. What is manufacturing cycle efficiency? What would its value be in an optimized manufacturing environment and why?
8. What is a cost driver and how is it used? Give four examples of cost drivers.
9. Do cost drivers exist in a traditional accounting system? Are they designated as such? How, if at all, does the use of cost drivers differ between a traditional accounting system and an activity-based costing system?
10. What is activity analysis and how is it used in concert with cost driver analysis to manage costs?
11. What is activity-based costing? How does it differ from traditional product costing approaches?
12. Why do the more traditional methods of overhead assignment “overload” standard, high-volume products with overhead costs, and how does ABC improve overhead assignments?
13. What characteristics of a company would generally indicate that activity-based costing might improve product costing?
14. Why does activity-based costing require that costs be aggregated at different levels?
15. List the benefits of activity-based costing. How could these reduce costs?
16. Traditional costing systems often differentiate between fixed and variable costs. How does the ABC philosophy address fixed and variable costs?



17. How does attribute-based costing extend the concept of activity-based costing?
18. Are all companies likely to benefit to an equal extent from adopting ABC? Discuss.
19. Significant hurdles are often encountered in adopting ABC including a large time commitment. What specific activities associated with ABC adoption require large investments of time?

## EXERCISES

20. (*Terminology*) Match the following lettered terms on the left with the appropriate numbered description on the right.
 

<ol style="list-style-type: none"> <li>a. Activity driver</li> <li>b. Cost driver analysis</li> <li>c. Cycle time</li> <li>d. Idle time</li> <li>e. Long-term variable cost</li> <li>f. Mass customization</li> <li>g. Product complexity</li> <li>h. Organizational-level cost</li> <li>i. Unit-level cost</li> <li>j. Value chart</li> </ol>	<ol style="list-style-type: none"> <li>1. Non-value-added use of time</li> <li>2. Cost explained well by traditional cost drivers</li> <li>3. Driver of some costs</li> <li>4. Time from receipt of order to delivery of product</li> <li>5. Cost not usually assigned to products under ABC</li> <li>6. Personalized production</li> <li>7. Establishing cost causality</li> <li>8. Measure of activity demand</li> <li>9. Indicator of activities and their time</li> <li>10. Costs traditionally known as fixed</li> </ol>
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21. (*Terminology*) Match the following lettered terms on the left with the appropriate numbered description on the right.
 

<ol style="list-style-type: none"> <li>a. Activity analysis</li> <li>b. Activity-based costing</li> <li>c. Attribute-based costing</li> <li>d. Batch-level cost</li> <li>e. Manufacturing cycle efficiency</li> <li>f. Non-value-added activity</li> <li>g. Process map</li> <li>h. Research and development</li> <li>i. Simultaneous engineering</li> <li>j. Value-added activity</li> </ol>	<ol style="list-style-type: none"> <li>1. Setup cost</li> <li>2. A costing system that uses multiple cost drivers</li> <li>3. A process of involving all affected personnel from the beginning of a project</li> <li>4. An approach to associate costs with activities</li> <li>5. A tool to find the cost of product features</li> <li>6. A flowchart indicating all steps in producing a product or performing a service</li> <li>7. Idle time, transfer time, or storage time</li> <li>8. Actual production time divided by total cycle time</li> <li>9. Product/process level cost</li> <li>10. Something that increases worth of a product or service</li> </ol>
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22. (*Activity analysis*) Conveyance Systems is investigating the costs of schedule changes in its factory. Following is a list of the activities, estimated times, and average costs required for a single schedule change.

Activity	Estimated Time	Average Cost
Review impact of orders	30 min–2 hrs	\$ 300
Reschedule orders	15 min–24 hrs	800
Lost sales		
Unreliable customer service		
Reschedule production orders	15 min–1 hr	75
Contact production supervisor	5 min	5
Stop production and change over		
Generate paperwork to return materials		
Return and locate material (excess inventory)	20 min–6 hrs	1,500
Generate new production paperwork	15 min–4 hrs	500
Change routings		
Change bill of materials		
Change procurement schedule	10 min–8 hrs	2,100
Purchase orders		
Inventory		
Collect paperwork from the floor	15 min	75
Review new line schedule	15 min–30 min	100
Overtime premiums	3 hrs–10 hrs	1,000
Total		<u>\$6,455</u>

- Which of the above, if any, are value-added activities?
  - What is the cost driver in this situation?
  - How can the cost driver be controlled and the activities eliminated?
23. (*Cycle time and MCE*) The following functions are performed in making salad dressing at A-1 Toppings.

Function	Time (Minutes)
Receiving ingredients	45
Moving ingredients to stockroom	15
Storing ingredients in stockroom	3,600
Moving ingredients from stockroom	15
Mixing ingredients	30
Cooking ingredients	90
Bottling ingredients	90
Moving bottled dressing to warehouse	20
Storing bottled dressing in warehouse	5,040
Moving bottled dressing from warehouse to trucks	30

- Calculate the cycle time of this manufacturing process.
  - Calculate the manufacturing cycle efficiency of this process.
  - What could A-1 Toppings do to improve its MCE?
24. (*Identifying cost drivers*) The Fast Lane is a highly automated, fast-food restaurant that relies on sophisticated, computer-controlled equipment to prepare and deliver food to customers. Operationally and organizationally, the restaurant operates like other major franchise fast-food restaurants. Determine whether each of the following costs are unit level (U), batch level (B), product/process level (P), or organizational level (O).
- Store manager's salary
  - Frozen french fries
  - Napkins
  - Oil for the deep-fat fryer
  - Maintenance of the restaurant building
  - Wages of employees who clear and clean tables
  - Electricity expense for the pizza oven
  - Property taxes
  - Depreciation on kitchen equipment
  - Refrigeration of raw materials

25. (*Cost drivers*) For each of the following important costs in manufacturing companies, identify a cost driver and explain why it is appropriate.
- Equipment maintenance
  - Building utilities
  - Computer operations
  - Quality control
  - Material handling
  - Material storage
  - Factory depreciation
  - Setup cost
  - Engineering changes
  - Advertising expense
  - Freight costs for materials

26. (*Cost allocation using cost drivers*) Peterson Wholesale has an in-house legal department whose activities fall into one of three major categories. Recently, operating costs in the department have risen dramatically. Management has decided to implement an activity-based costing system to help control costs and charge in-house users for the legal services provided. The principal expense in the legal department is professional salaries, and the estimated cost of professional salaries associated with each activity follow:

Reviewing supplier or customer contracts	(Contracts)	\$400,000
Reviewing regulatory compliance issues	(Regulation)	250,000
Court actions	(Court)	350,000

Management has determined that the appropriate cost allocation base for Contracts is the number of pages in the contract reviewed; for Regulation, the allocation base is the number of reviews; and for Court, the allocation base is professional hours. For 2001, the legal department reviewed 20,000 pages of contracts, responded to 500 regulatory review requests, and logged 3,000 professional hours in court.

- Determine the allocation rate for each activity in the legal department.
  - What amount would be charged to a producing department that had 1,000 pages of contracts reviewed, made 15 regulatory review requests, and consumed 250 professional hours in court services during the year?
  - How can the developed rates be used for evaluating output relative to cost incurred in the legal department? What alternative does the firm have to maintaining an internal legal department and how might this choice affect costs?
27. (*Activity-based costing*) Management at Cooper Steel Co. has decided to institute a pilot activity-based costing project in its eight-person purchasing department. Annual departmental costs are \$790,000. Because finding the best supplier takes the majority of effort in the department, most of the costs are allocated to this area.

Activity	Allocation Measure	Number of People	Total Cost
Find best suppliers	Number of telephone calls	5	\$500,000
Issue purchase orders	Number of purchase orders	2	200,000
Review receiving reports	Number of receiving reports	1	90,000

During the year, the purchasing department made 250,000 telephone calls, issued 25,000 purchase orders, and reviewed 15,000 receiving reports. Many purchase orders are received in a single shipment.

One product manufactured by Cooper Steel required the following purchasing department activities: 235 telephone calls, 70 purchase orders, and 22 receipts.

- a. What amount of purchasing department cost should be assigned to this product?
- b. If 300 units of the product are manufactured during the year, what is the purchasing department cost per unit?
28. (*Product profitability*) Lawn Management Systems (LMS) manufactures two products: lawnmowers and garden tractors. Lawnmowers are relatively simple to produce and are made in large quantities. Garden tractors must be more customized to individual wholesale customer specifications. LMS sells 50,000 lawnmowers and 10,000 garden tractors annually. Revenues and costs incurred for each product are as follows:



	Lawnmowers	Garden Tractors
Revenue	\$8,000,000	\$8,800,000
Direct material	2,000,000	1,800,000
Direct labor	1,200,000	4,000,000
Overhead	?	?

Labor is paid \$20 per hour, manufacturing overhead totals \$2,210,000, and administrative expenses equal \$1,612,000.

- a. Calculate the profit (loss) on each product if overhead and administrative expenses are assigned to the products using a direct labor hour base.
- b. Calculate the profit (loss) on each product if overhead is assigned to products using a direct labor hour base but administrative expenses are deducted from total company income rather than being allocated to products.
- c. Does your answer in part (a) or part (b) provide the better representation of the profit contributed by each product? Explain.
29. (*Value chart*) You are the new controller of a small shop that manufactures special-order desk nameplate stands. As you review the records, you find that all the orders are shipped late, the average process time for any order is three weeks, and the time actually spent in production operations is two days. The president of the company has called you in to discuss missed delivery dates. Prepare an oral presentation for the executive officers in which you address the following:
- a. Possible causes of the problem.
- b. How a value chart could be used to address the problem.
30. (*Controlling overhead*) Industrial Paints Inc. has engaged you to help the company analyze and update its costing and pricing practices. The company product line has changed over time from general paints to specialized marine coatings. Although some large orders are received, the majority of business is now generated from products designed and produced in small lot sizes to meet specifically detailed environmental and technical requirements.
- The company has experienced tremendous overhead growth, including costs in customer service, production scheduling, inventory control, and laboratory work. Factory overhead has essentially doubled since the shift in product lines. Management believes that large orders are being penalized and small orders are receiving favorable cost (and therefore selling price) treatment.
- a. Indicate why the shift in product lines would have caused such major increases in overhead.
- b. Is it possible that management is correct in its belief about the costs of large and small orders? If so, why?
- c. Write a memo to management suggesting how it might change the cost accounting system to reflect the changes in the business.
31. (*Traditional vs. ABC methods*) Many companies now recognize that their cost systems are inadequate in the context of today's powerful global competition. Managers in companies selling multiple products are making important product

decisions based on distorted cost information, because most cost systems designed in the past focused on inventory measurement. To elevate the level of management information, current literature suggests that companies should have as many as three cost systems for (1) inventory measurement, (2) operational control, and (3) activity-based costing.

- a. Discuss why the traditional cost information system, originally developed for valuing inventory, distorts product cost information.
- b. Identify the purpose and characteristics of each of the following cost systems:
  1. Inventory measurement
  2. Activity-based costing
- c. Describe the benefits that management can obtain from using activity-based costing.
- d. List the steps that a company using a traditional cost system would take to implement activity-based costing. *(CMA adapted)*

## PROBLEMS

32. (*Identifying non-value-added activities*) Stacy Kroger is planning to build a concrete walkway for her home during her annual vacation. She has prepared the following schedule of how her time on the project will be allocated:

Purchase materials	4 hours
Obtain rental equipment	2 hours
Remove sod and level site	10 hours
Build forms for concrete	12 hours
Mix and pour concrete into forms	5 hours
Level concrete and smooth	2 hours
Let dry	24 hours
Remove forms from concrete	1 hour
Return rental tools	1 hour
Clean up	2 hours

- a. Identify the value-added activities. How much total time is value-added?
- b. Identify the non-value-added activities. How much total time is spent performing non-value-added activities?
- c. Calculate the manufacturing cycle efficiency.



33. (*Activity analysis; MCE*) Southern Living constructs log cabin vacation houses in the Tennessee mountains for customers. As the company's consultant, you developed the following value chart:

Operations	Average Number of Days
Receiving materials	2
Storing materials	4
Measuring and cutting materials	3
Handling materials	7
Setting up and moving scaffolding	6
Assembling materials	7
Building fireplace	9
Pegging logs	4
Cutting and framing doors and windows	3
Sealing joints	4
Inspecting property (county inspectors)	3

- a. What are the value-added activities and their total time?
- b. What are the non-value-added activities and their total time?

- c. Calculate the manufacturing cycle efficiency of the process.
- d. Prepare a one-minute presentation explaining the difference between value-added and non-value-added activities.

34. (*Activity-based costing*) Patio Solutions makes umbrellas, gazebos, and lawn chairs. The company uses a traditional overhead allocation scheme and assigns overhead to products at the rate of \$10 per direct labor hour. In 2000, the company produced 100,000 umbrellas, 10,000 gazebos, and 30,000 lawn chairs and incurred \$2,000,000 of manufacturing overhead costs. The cost per unit for each product group in 2000 was as follows:



	Umbrellas	Gazebos	Lawn Chairs
Direct material	\$ 4.00	\$ 40.00	\$ 4.00
Direct labor	6.00	45.00	15.00
Overhead	8.00	60.00	20.00
Total	<u>\$18.00</u>	<u>\$145.00</u>	<u>\$39.00</u>

Because profitability has been lagging and competition has been getting more keen, Patio Solutions is considering implementing an activity-based costing system for 2001. In analyzing the 2000 data, management determined that all \$2,000,000 of factory overhead could be assigned to four basic activities: quality control, setups, material handling, and equipment operation. Data from 2000 on the costs associated with each of the four activities follows:

Quality Control	Setups	Material Handling	Equipment Operation	Total Costs
\$100,000	\$100,000	\$300,000	\$1,500,000	\$2,000,000

Management determined that the following allocation bases and total 2000 volumes for each allocation base could have been used for ABC:

Activity	Base	Volume
Quality control	Number of units produced	140,000
Setups	Number of setups	1,000
Material handling	Pounds of material used	2,000,000
Equipment operation	Number of machine hours	1,000,000

Volume measures for 2000 for each product and each allocation base were as follows:

	Umbrellas	Gazebos	Lawn Chairs
Number of units	100,000	10,000	30,000
Number of setups	200	400	400
Pounds of material	400,000	1,000,000	600,000
Number of machine hours	200,000	400,000	400,000

- a. For 2000, determine the total overhead allocated to each product group using the traditional allocation based on direct labor hours.
  - b. For 2000, determine the total overhead that would have been allocated to each product group if activity-based costing were used. Compute the cost per unit for each product group.
  - c. Patio Solutions has a policy of setting selling prices based on product costs. How would the sales prices using activity-based costing differ from those obtained using the traditional overhead allocation?
35. (*Activity-based costing*) Williams Components Company manufactures two products. Following is a production and cost analysis for each product for the year 2000.



Cost Component	Product A	Product B	Both Products	Cost
Units produced	10,000	10,000	20,000	
Raw materials used (units)				
X	50,000	50,000	100,000	\$ 800,000
Y		100,000	100,000	\$ 200,000
Labor hours used				
Department 1:				\$ 681,000
Direct labor (\$375,000)	20,000	5,000	25,000	
Indirect labor				
Inspection	2,500	2,500	5,000	
Machine operations	5,000	10,000	15,000	
Setups	200	200	400	
Department 2:				\$ 462,000
Direct labor (\$200,000)	5,000	5,000	10,000	
Indirect labor				
Inspection	2,500	5,000	7,500	
Machine operations	1,000	4,000	5,000	
Setups	200	400	600	
Machine hours used				
Department 1	5,000	10,000	15,000	\$ 400,000
Department 2	5,000	20,000	25,000	\$ 800,000
Power used (kw-hours)				\$ 400,000
Department 1			1,500,000	
Department 2			8,500,000	
Other activity data:				
Building occupancy				\$1,000,000
Purchasing				\$ 100,000
Number of purchase orders				
Material X			200	
Material Y			300	
Square feet occupied				
Purchasing			10,000	
Power			40,000	
Department 1			200,000	
Department 2			250,000	

Roberto Lopez, the firm's cost accountant, has just returned from a seminar on activity-based costing. To apply the concepts he has learned, he decides to analyze the costs incurred for Products A and B from an activity basis. In doing so, he specifies the following first and second allocation processes:

#### FIRST STAGE: ALLOCATIONS TO DEPARTMENTS

Cost Pool	Cost Object	Activity Allocation Base
Power	Departments	Kilowatt-hours
Purchasing	Materials	Number of purchase orders
Building occupancy	Departments	Square feet occupied

#### SECOND STAGE: ALLOCATIONS TO PRODUCTS

Cost Pool	Cost Object	Activity Allocation Base
<b>Departments:</b>		
Indirect labor	Products	Hours worked
Power	Products	Machine hours
Machinery-related	Products	Machine hours
Building occupancy	Products	Machine hours
<b>Materials:</b>		
Purchasing	Products	Materials used

SOURCE: From Harold P. Roth and A. Faye Borthick, "Getting Closer to Real Product Costs," *Management Accounting* (May 1989), pp. 28–33. Reprinted from *Management Accounting*. Copyright by Institute of Management Accountants, Montvale, N.J.

- a. Determine the total overhead for Williams Components Company.
  - b. Determine the plantwide overhead rate for the company, assuming the use of direct labor hours.
  - c. Determine the cost per unit of Product A and Product B, using the overhead application rate found in part (b).
  - d. Using the step-down approach, determine the cost allocations to departments (first-stage allocations). Allocate in the following order: building occupancy, purchasing, and power.
  - e. Using the allocations found in part (d), determine the cost allocations to products (second-stage allocations).
  - f. Determine the cost per unit of Product A and Product B using the overhead allocations found in part (e).
36. (*Using ABC to set price*) The budgeted manufacturing overhead costs of Garage Door Company for 2001 are as follows:

Type of Cost	Cost Amount
Electric power	\$ 500,000
Work cells	3,000,000
Material handling	1,000,000
Quality control inspections	1,000,000
Product runs (machine setups)	500,000
Total budgeted overhead costs	<u>\$6,000,000</u>

For the last five years, the cost accounting department has been charging overhead production costs based on machine hours. The estimated budgeted capacity for 2001 is 1,000,000 machine hours.

Jason Tracy, president of Garage Door, recently attended a seminar on activity-based costing. He now believes that ABC results in more reliable cost data that, in turn, will give the company an edge in pricing over its competitors. On the president's request, the production manager provided the following data regarding expected 2001 activity for the cost drivers of the preceding budgeted overhead costs.

Type of Costs	Activity Drivers
Electric power	100,000 kilowatt-hours
Work cells	600,000 square feet
Material handling	200,000 material moves
Quality control inspections	100,000 inspections
Product runs (machine setups)	50,000 product runs

Linda Ryan, the VP of marketing, received an offer to sell 5,000 doors to a local construction company. Linda asks the head of cost accounting to prepare cost estimates for producing the 5,000 doors. The head of cost accounting accumulated the following data concerning production of 5,000 doors:

Direct material cost	\$100,000
Direct labor cost	\$300,000
Machine hours	10,000
Direct labor hours	15,000
Electric power—kilowatt-hours	1,000
Work cells—square feet	8,000
Number of material handling moves	100
Number of quality control inspections	50
Number of product runs (setups)	25

SOURCE: Adapted from Nabil Hassa, Herbert E. Brown, and Paul M. Saunders, "Management Accounting Case Study: Beaver Window Inc.," *Management Accounting Campus Report* (Fall 1990). Copyright Institute of Management Accountants, Montvale, N.J.

- a. What is the predetermined overhead rate if the traditional measure of machine hours is used? *(continued)*

- b. What is the manufacturing cost per door as presently accounted for?
  - c. What is the manufacturing cost per door under the proposed ABC method?
  - d. If the two cost systems will result in different cost estimates, which cost accounting system is preferable as a pricing base and why?
37. (*Activity driver analysis and decision making*) High Plains Manufacturing Products is concerned about its ability to control factory labor-related costs. The company has recently finished an analysis of these costs for 2001. Following is a summary of the major categories of labor costs identified by High Plain's accounting department:

Category	Amount
Base wages	\$42,000,000
Health care benefits	7,000,000
Payroll taxes	3,360,000
Overtime	5,800,000
Training	1,250,000
Retirement benefits	4,600,000
Workers' compensation	800,000

Listed below are some of the potential cost drivers identified by the company for labor-related costs, along with their 2001 volume levels.

Potential Activity Driver	2001 Volume Level
Average number of factory employees	1,400
Number of new hires	200
Number of regular labor hours worked	2,100,000
Number of overtime hours worked	192,000
Total factory wages	\$47,800,000
Volume of production in units	8,000,000
Number of production process changes	400
Number of production schedule changes	250

- a. For each cost pool, determine the cost per unit of the activity driver using the activity driver that you believe has the closest relationship to the cost pool.
  - b. Based on your judgments and calculations in part (a), which activity driver should receive the most attention from company managers in their efforts to control labor-related costs? How much of the total labor-related cost is attributable to this activity driver?
  - c. In the contemporary environment, many firms are asking their employees to work record levels of overtime. What activity driver does this practice suggest is a major contributor to labor-related costs? Explain.
38. (*Activity-based costing and pricing*) Covington Community Hospital has found itself under increasing pressure to be accountable for the charges it assesses its patients. Its current pricing system is ad hoc, based on pricing norms for the geographical area, and it only explicitly considers direct costs for surgery, medication, and other treatments. Covington's controller has suggested that the hospital try to improve its pricing policies by seeking a tighter relationship between costs and pricing. This approach would make prices for services less arbitrary. As a first step, the controller has determined that most costs can be assigned to one of three cost pools. The three cost pools follow along with the estimated amounts and activity drivers.

Activity Center	Amount	Activity Driver	Quantity
Professional salaries	\$900,000	Professional hours	30,000 hours
Building costs	450,000	Square feet used	15,000 sq. ft.
Risk management	320,000	Patients served	1,000 patients

The hospital provides service in three broad categories. The services are listed below with their volume measures for the activity centers.

Service	Professional Hours	Square Feet	Number of Patients
Surgery	6,000	1,200	200
Housing patients	20,000	12,000	500
Outpatient care	4,000	1,800	300

- Determine the allocation rates for each activity center cost pool.
  - Allocate the activity center costs to the three services provided by the hospital.
  - What bases might be used as cost drivers to allocate the service center costs among the patients served by the hospital? Defend your selections.
39. (*Determining product cost*) Belton Furniture Corporation has identified activity centers to which overhead costs are assigned. The cost pool amounts for these centers and their selected activity drivers for 2000 are as follows.

Activity Centers	Costs	Activity Drivers
Utilities	\$300,000	60,000 machine hours
Scheduling and setup	273,000	780 setups
Material handling	640,000	1,600,000 pounds of material

The company's products and other operating statistics follow:

	PRODUCTS		
	A	B	C
Direct costs	\$80,000	\$80,000	\$90,000
Machine hours	30,000	10,000	20,000
Number of setups	130	380	270
Pounds of material	500,000	300,000	800,000
Number of units produced	40,000	20,000	60,000
Direct labor hours	32,000	18,000	50,000

- Determine unit product cost using the appropriate cost drivers for each of the products.
- Before it installed an ABC system, the company used a conventional costing system and allocated factory overhead to products using direct labor hours. The firm operates in a competitive market and product prices were set at cost plus a 20 percent markup.
  - Calculate unit costs based on conventional costing.
  - Determine selling prices based on unit costs for conventional costing and for ABC costs.
- Discuss the problems related to setting prices based on conventional costing and explain how ABC improves the information.

## CASES

40. (*Product complexity*) Tektronix Inc. is a world leader in the production of electronic test and measurement instruments. The company experienced almost uninterrupted growth through the 1980s, but in the 1990s, the low-priced end of the Portables Division product line was challenged by an aggressive low-price strategy of several Japanese competitors. These Japanese companies set prices 25 percent below Tektronix's prevailing prices. To compete, the division

needed to reduce costs and increase customer value by increasing operational efficiency.

Steps were taken to implement just-in-time delivery and scheduling techniques, a total quality control program, and people involvement techniques that moved responsibility for problem solving down to the operating level of the division. The results of these changes were impressive: substantial reductions in cycle time, direct labor hours per unit, and inventory levels as well as increases in output dollars per person per day and operating income. The cost accounting system was providing information, however, that did not seem to support the changes.

Total overhead cost for the division was \$10,000,000; of this, part (55%) seemed to be related to materials and the remainder (45%) to conversion. Material-related costs pertain to procurement, receiving, inspection, stockroom personnel, etc. Conversion-related costs pertain to direct labor, supervision, and process-related engineering. All overhead was applied on the basis of direct labor.

The division decided to concentrate efforts on revamping the application system for material-related overhead. Managers believed the majority of material overhead (MOH) costs were related to the maintenance and handling of each different part number. Other types of MOH costs were costs due to the value of parts, absolute number of parts, and each use of a different part number.

At this time, the division used 8,000 different parts and in extremely different quantities. For example, annual usage of one part was 35,000 units; usage of another part was only 200 units. The division decided that MOH costs would decrease if a smaller number of different parts were used in the products.

SOURCE: Adapted from Michael A. Robinson, ed., *Cases from Management Accounting Practice*, No. 5 (Montvale, N.J.: National Association of Accountants, 1989), pp. 13–17. Copyright by Institute of Management Accountants (formerly National Association of Accountants), Montvale, N.J.

- a. Give some reasons that materials overhead (MOH) would decrease if parts were standardized.
  - b. Using the numbers given above, develop a cost allocation method for MOH to quantify and communicate the strategy of parts standardization.
  - c. Explain how the use of the method developed in part (b) would support the strategy of parts standardization.
  - d. Is any method that applies the entire MOH cost pool on the basis of one cost driver sufficiently accurate for complex products? Explain.
  - e. Are MOH product costing rates developed for management reporting appropriate for inventory valuation for external reporting? Why or why not?
- 41. (Activity-based costing)** Kendall 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 television (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. Kendall plans to sell 65,000 of the TV circuit boards in 2000 at a price of \$150 per unit. The second high-volume product, a personal computer (PC) circuit board, is a recent addition to Kendall's product line. Because the PC board incorporates the latest technology, it can be sold at a premium price; the 2000 plans include the sale of 40,000 PC boards at \$300 per unit.

Kendall's management group is meeting to discuss strategies for 2000, 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 Kendall'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.”

Kendall uses a standard cost system, and the following data apply to the TV and PC boards.

	TV Board	PC Board
Direct material	\$80	\$140
Direct labor	1.5 hours	4 hours
Machine time	0.5 hours	1.5 hours

Variable factory overhead is applied on the basis of direct labor hours. For 2000, variable factory overhead is budgeted at \$1,120,000, and direct labor hours are estimated at 280,000. The hourly rates for machine time and direct labor are \$10 and \$14, respectively. Kendall applies a material handling charge at 10 percent of material cost; this material handling charge is not included in variable factory overhead. Total 2000 expenditures for materials are budgeted at \$10,600,000.

Ed Welch, Kendall’s controller, believes that before the management group proceeds with the discussion about allocated sales and promotional dollars to individual products, it might be worthwhile to look at these products on the basis of the activities involved in their production. As he explained to the group, “Activity-based costing integrates the cost of all activities, known as cost drivers, into individual product costs rather than including these costs in overhead pools.” Welch has prepared the following schedule to help the management group understand this concept.

Budgeted Cost		Cost Driver	Annual Activity for Cost Driver
<b>Material overhead:</b>			
Procurement	\$ 400,000	Number of parts	4,000,000 parts
Production scheduling	220,000	Number of boards	110,000 boards
Packaging and shipping	440,000	Number of boards	110,000 boards
	<u>\$1,060,000</u>		
<b>Variable overhead:</b>			
Machine setup	\$ 446,000	Number of setups	278,750 setups
Hazardous waste disposal	48,000	Pounds of waste	16,000 pounds
Quality control	560,000	Number of inspections	160,000 inspections
General supplies	66,000	Number of boards	110,000 boards
	<u>\$1,120,000</u>		
Budgeted Cost		Cost Driver	Annual Activity for Cost Driver
<b>Manufacturing:</b>			
Machine insertion	\$1,200,000	Number of parts	3,000,000 parts
Manual insertion	4,000,000	Number of parts	1,000,000 parts
Wave soldering	132,000	Number of boards	110,000 boards
	<u>\$5,332,000</u>		

#### REQUIRED PER UNIT

	TV Board	PC Board
Parts	25	55
Machine insertions of parts	24	35
Manual insertions of parts	1	20
Machine setups	2	3
Hazardous waste	0.02 lb.	0.35 lb.
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, machine time, and overhead costs in the standard cost.”

- a. Identify at least four general advantages associated with activity-based costing.
- b. On the basis of standard costs, calculate the total contribution expected in 2000 for Kendall Corporation’s
  1. TV board.
  2. PC board.
- c. On the basis of activity-based costs, calculate the total contribution expected in 2000 for Kendall Corporation’s
  1. TV board.
  2. PC board.
- d. Explain how the comparison of the results of the two costing methods may impact the decisions made by Kendall Corporation’s management group. *(CMA adapted)*

42. *(Activity-based costing)* Miami Valley Architects Inc. provides a wide range of engineering and architectural consulting services through its three branch offices in Columbus, Cincinnati, and Dayton. The company allocates resources and bonuses to the three branches based on the net income reported for the period. The following presents the results of 2001 performance (\$ in thousands).

	Columbus	Cincinnati	Dayton	Total
Sales	\$1,500	\$1,419	\$1,067	\$ 3,986
Less: Direct labor	(382)	(317)	(317)	(1,016)
Direct material	(281)	(421)	(185)	(887)
Overhead	(710)	(589)	(589)	(1,888)
Net income	<u>\$ 127</u>	<u>\$ 92</u>	<u>\$ (24)</u>	<u>\$ 195</u>

Overhead items are accumulated in one overhead pool and allocated to the branches based on direct labor dollars. For 2001, this predetermined overhead rate was \$1.859 for every direct labor dollar incurred by an office. The overhead pool includes rent, depreciation, taxes, and so on, regardless of which office incurred the expense. This method of accumulating costs forces the offices to absorb a portion of the overhead incurred by other offices.

Management is concerned with the results of the 2001 performance reports. During a review of the overhead, it became apparent that many items of overhead are not correlated to the movement in direct labor dollars as previously assumed. Management decided that applying overhead based on activity-based costing and direct tracing, where possible, should provide a more accurate picture of the profitability of each branch.

An analysis of the overhead revealed that the following dollars for rent, utilities, depreciation, taxes, and so on, could be traced directly to the office that incurred the overhead (\$ in thousands).

	Columbus	Cincinnati	Dayton	Total
Direct overhead	\$180	\$270	\$177	\$627

Activity pools and activity drivers were determined from the accounting records and staff surveys as follows:

Activity Pools	Activity Driver	# OF ACTIVITIES BY LOCATION		
		Columbus	Cincinnati	Dayton
General Administration	Direct Labor \$	382,413	317,086	317,188
Project Costing	# of Timesheet Entries	6,000	3,800	3,500
Accounts Payable/Receiving	# of Vendor Invoices	1,020	850	400
Accounts Receivable	# of Client Invoices	588	444	96
Payroll/Mail Sort & Delivery	# of Employees	23	26	18
Personnel Recruiting	# of New Hires	8	4	7
Employee Insurance Processing	Insurance Claims Filed	230	260	180
Proposals	# of Proposals	200	250	60
Sales Meetings/Sales Aids	Contracted Sales	1,824,439	1,399,617	571,208
Shipping	# of Projects	99	124	30
Ordering	# of Purchase Orders	135	110	80
Duplicating Costs	# of Copies Duplicated	162,500	146,250	65,000
Blueprinting	# of Blueprints	39,000	31,200	16,000
		<u>\$1,261,000</u>		

- What overhead costs should be assigned to each branch based on activity-based costing concepts?
- What is the contribution of each branch before subtracting the results obtained in part (a)?
- What is the profitability of each branch office using activity-based costing?
- Evaluate the concerns of management regarding the traditional costing technique currently used. *(IMA adapted)*

43. (*Activity-based costing and pricing*) Joey Lutz owns and manages a commercial cold-storage warehouse. He stores a vast variety of perishable goods for his customers. Historically, he has charged customers using a flat rate of \$0.04 per pound per month for goods stored. His cold-storage warehouse has 100,000 cubic feet of storage capacity.

In the past two years, Lutz has become dissatisfied with the profitability of the warehouse operation. Despite the fact that the warehouse remains relatively full, revenues have not kept pace with operating costs. Recently, Lutz approached his accountant, Jill Green, about using activity-based costing to improve his understanding of the causes of costs and revise the pricing formula. Green has determined that most costs can be associated with one of four activities. Those activities and their related costs, volume measures, and volume levels for 2001 follow:

Activity	Cost	Monthly Volume Measure
Send/receive goods	\$6,000	Weight in pounds—500,000
Store goods	4,000	Volume in cubic feet—80,000
Move goods	5,000	Volume in square feet—5,000
Identify goods	2,000	Number of packages—500

SOURCE: Adapted from Harold P. Roth and Linda T. Sims, "Costing for Warehousing and Distribution," *Management Accounting* (August 1991), pp. 42–45. Reprinted from *Management Accounting*. Copyright by Institute of Management Accountants, Montvale, N.J.

- Based on the activity cost and volume data, determine the amount of cost assigned to the following customers, whose goods were all received on the first day of last month.

Customer	Weight of Order	Cubic Feet	Square Feet	Number of Packages
Jones	40,000	3,000	300	5
Hansen	40,000	2,000	200	20
Assad	40,000	1,000	1,000	80

- b. Determine the price to be charged to each customer under the existing pricing plan.
- c. Determine the price to be charged using ABC, assuming Lutz would base the price on the cost determined in part (a) plus a markup of 40 percent.
- d. How well does Lutz's existing pricing plan capture the costs incurred to provide the warehouse services? Explain.

## REALITY CHECK

44. Many manufacturers are deciding to no longer service small retailers. For example, some companies have policies to serve only customers who purchase \$10,000 or more of products from the companies annually. The companies defend such policies on the basis that they allow the companies to better serve their larger outlet, which handle more volume and more diverse product lines.
- a. Relate the concepts in the chapter to the decision of manufacturers to drop small customers.
  - b. Are there any ethical implications of eliminating groups of customers that may be less profitable than others?
  - c. Does activity-based costing adequately account for all costs that are related to a decision to eliminate a particular customer base? (*Hint: Consider opportunity costs such as those related to reputation.*)
45. *Evidence suggests that ABM implementations are more likely to succeed in more open organizations. The ground is especially fertile for companies that have a stated interest in becoming world-class competitors and have backed these ambitions up with other initiatives. ABM dovetails with these initiatives, and they reinforce each other. A clear commitment from top management is also essential.*
- SOURCE: Helen Thorne and Bruce Gurd, "Some Human Aspects of Implementing Activity-Based Management," *Journal of Cost Management* (Fall 1995), p. 51.
- a. What are some of the "other initiatives" to which the article would be referring?
  - b. How might activity-based management and activity-based costing help a company in its quest to achieve world-class status?
  - c. Would it be equally important to have top management support if a company was instituting activity-based costing rather than activity-based management? Justify your answer.
  - d. Assume you are a member of top management in a large organization. Do you think implementation of ABM or ABC would be more valuable? Explain the rationale for your answer.
46. As the chief executive officer of a large corporation, you have made a decision after discussion with production and accounting personnel to implement activity-based management concepts. Your goal is to reduce cycle time and, thus, costs. A primary way to accomplish this goal is to install highly automated equipment in your plant, which would then displace approximately 60 percent of your workforce. Your company is the major employer in the area of the country where it is located.
- a. Discuss the pros and cons of installing the equipment from the perspective of your (1) stockholders, (2) employees, and (3) customers.
  - b. How would you explain to a worker that his or her job is non-value-added?
  - c. What alternatives might you have that could accomplish the goal of reducing cycle time but not create economic havoc for the local area?