chapter 5

Activity-Based Costing and Just-In-Time Costing

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Learning Objectives

After studying Chapter 5, you will be able to:

- Explain the interrelationships among cost drivers, activities, and products in an activity-based cost system.
- Describe the key components and cost flows in an activity-based cost system.
- Distinguish between the two stages of cost allocation in an activity-based cost system.
- Apply activity-based costing in a manufacturing setting.
- Understand how activity-based costing is extended to nonmanufacturing settings.
- Relate activity-based management to activity-based costing.
- Describe the key elements of a just-in-time cost system.

Chapter Outline

Testing . . . Testing

Cortell Laboratories was formed in 1993 and began its operations in testing various electrical characteristics of integrated circuits sent to it by manufacturers on the west coast. Cortell focused on a strategy of providing quicker turnaround times than had been offered by manufacturers' labs or other outside labs. The strategy was successful and was marketed well. Within ten years, Cortell had annual revenues of over $30 million. Profit and cash flow, also highly positive, allowed Cortell to self-fund all expansion.

In 2010, Cortell began offering tests for transformers. Within one year, transformer testing was so successful that the lab was now running on three full shifts. In the midst of all this success, Harriet Cortell, the company president, is now faced with a dilemma. The marketing manager, Beth Jacobs, has come to her and argued that testing transformers is much more profitable than testing integrated circuits, and therefore, the lab should concentrate more of its resources on marketing and performing transformer tests. To support her argument, Jacobs compiled costs and profit margins for each testing service. These figures showed that transformer testing was over 40 percent more profitable than testing integrated circuits. Cortell looked at the overhead allocated to the two types of tests and could hardly believe that each test was assigned the same amount of overhead per test. She knew that testing transformers involved more job orders and required more setups than testing integrated circuits. "Our costing system is not reflecting the complexity of these tests," claimed Cortell.

Several months earlier, Cortell had heard about an activity-based cost approach for assigning overhead costs. She immediately contacted the controller, Bill Kelector, and asked him to do an activity-based cost analysis.

Introduction

Two major forces have combined to put great pressure on managerial accountants like Bill Kelector to provide improved cost information about their firms' products and services. These are global competition and automation in the workplace.

1. **Global competitiveness**. Most companies in nearly every industry face increased competition from direct competitors, whether from across the street or halfway around the world. Whether the technology is old (making iron and steel) or new (making high-definition televisions), the needs for accurate and relevant product cost data have grown dramatically. Competitiveness also means knowing the costs of product quality, reliable delivery, and waste (unproductive effort). Cost control takes on new meaning if a competitor can sell an item at a price that is 10 percent lower than another company's production cost and still make money on the sale. Increasingly, companies are realizing that traditional volume-based cost systems are not using the "right" variables or collecting cost data in enough detail.
2. **Automation of the workplace**. Dramatic changes in production have also taken place. Another "industrial revolution" is what some people have called it. Computer power has introduced concepts like computer-aided design (CAD), computer-aided manufacturing (CAM), flexible manufacturing systems (FMS), and robotics. Computer power has allowed precise tasks to be programmed and machines to be designed to do those tasks. Likewise, computer power has enabled production managers to coordinate thousands of events, transactions, and possible courses of action. One outcome is a shift from heavy dependence on labor to technology. Direct labor costs were often a major product cost, and labor activity often reflected general activity in the plant. Now, in many companies, direct labor is a minor portion of a product's total cost. Other production costs have grown tremendously because of equipment costs and support personnel needed to coordinate production. New activity measures are needed to link resources used with production activities. The traditional approach of allocating overhead costs using direct labor hours or direct labor cost is no longer relevant in companies that are highly automated.

Competition and automation have focused attention on getting more accurate, timely, and relevant costs for products and services. The concepts are very simple and have always been at the heart of cost accounting: Link the cost of resources used to the activity using the resources, and link the activity to the product being produced. Traditionally, the activity measure used most often has been a volume measure: direct labor hours (or dollars). In recent years, there has been a recognition that the complexity of production, rather than volume, is the most important determinant of overhead costs. Cost systems known as activity-based costing reflect this new orientation.

Consider the following example of a company that manufactures ball-point pens in two different plants. In one plant, plant A, 30,000 identical pens are produced—all with black ink and black casings. In the other plant, plant B, 30,000 similar pens are also produced, but 10,000 have black ink, another 10,000 have blue ink, and the remaining 10,000 contain red ink. Likewise, those in plant B have a variety of casing colors: 8,000 are black, 12,000 are gold, and 10,000 are silver. Since each plant manufactures 30,000 pens, the amount of direct labor hours worked would be expected to be virtually the same in each plant. Therefore, using direct labor to allocate overhead costs to the two plants would result in

the same amount of overhead costs assigned to each plant. Yet, plant B clearly consumes more overhead costs such as indirect labor costs relating to more machine change-overs, time spent on purchasing materials, and inventory management time. In other words, plant B manufactures more complex products, but traditional costing that uses direct labor to allocate overhead costs ignores this complexity. Activity-based costing not only considers volume when assigning overhead costs, but does so in ways that reflect the complexity of the various products.

This chapter presents the conceptual foundation for activity-based costing as a means of improving the accuracy of assigning costs to cost objectives—primarily to products and services. Many companies that have adopted activity-based cost systems have also instituted just-in-time inventory systems. Later in the chapter, we discuss how adoption of just-in-time inventory systems has affected product costing.

5.1 Activity-Based Costing

Activity-based costing focuses on finding the cost of producing a product or service. In Chapter 1, we introduced cost of goods manufactured and the three traditional groups of costs: direct materials, direct labor, and factory overhead. In past years, direct materials and direct labor were linked with products because of their obvious direct relationships; all other manufacturing costs were traditionally lumped together as overhead. One activity measure, often direct labor, was used to attach all overhead costs to products. Many different overhead costs were combined and included:

1. Plant supervision salaries.
2. Materials handling costs.
3. Plant engineering costs.
4. Setup or changeover costs.
5. Supplies and indirect materials.
6. Depreciation, taxes, and insurance on equipment.
7. Energy and other utility costs.
8. Repair and maintenance costs.

Ideally, every overhead cost item could be traced directly to specific products. This is just not possible. If we produce a million units of different types and sizes of batteries in a factory, can the manager's $100,000 salary be traced to the different batteries? No. Can we link the manager's salary to certain factory activities, then link the activity costs to the different batteries? Yes, but only with careful analysis and application. Activity-based costing focuses on distributing costs that managers are unable to clearly identify with specific jobs or products (i.e., indirect costs).

Issues Influencing Cost Management Systems Design

Product costs are so critical to managerial decisions that greater precision and accuracy are needed today than were demanded in the past. Thus, a major effort is under way in many companies to upgrade their cost systems.

The level of detail that a cost system needs is based on the following considerations:

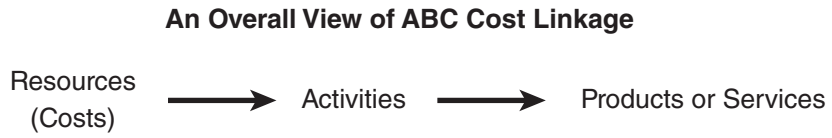
1. The competitive environment, which will impact the degree of accuracy needed and the toleration of costing errors.
2. The homogeneity or heterogeneity of the products or services.
3. The complexity of the production process.
4. The volumes of each product or service produced.
5. The costs of measuring and collecting activity and cost data.
6. The impacts that more accurate and relevant data will have on managerial behavior.

Detailed cost systems are expensive to design and to operate. Yet the value of better cost information can also be extremely high.

Definition of Activity-Based Costing

Activity-based costing (ABC) is a system of accounting that focuses on activities performed to produce products or services. Activities become the fundamental cost accumulation points. This is because it is activities such as purchasing, moving materials, and machine set-up that cause overhead costs to be incurred. Costs are traced to activities, and activities are traced to products based on each product's use of the activities. We show these relationships for allocating costs in Figure 5.1.

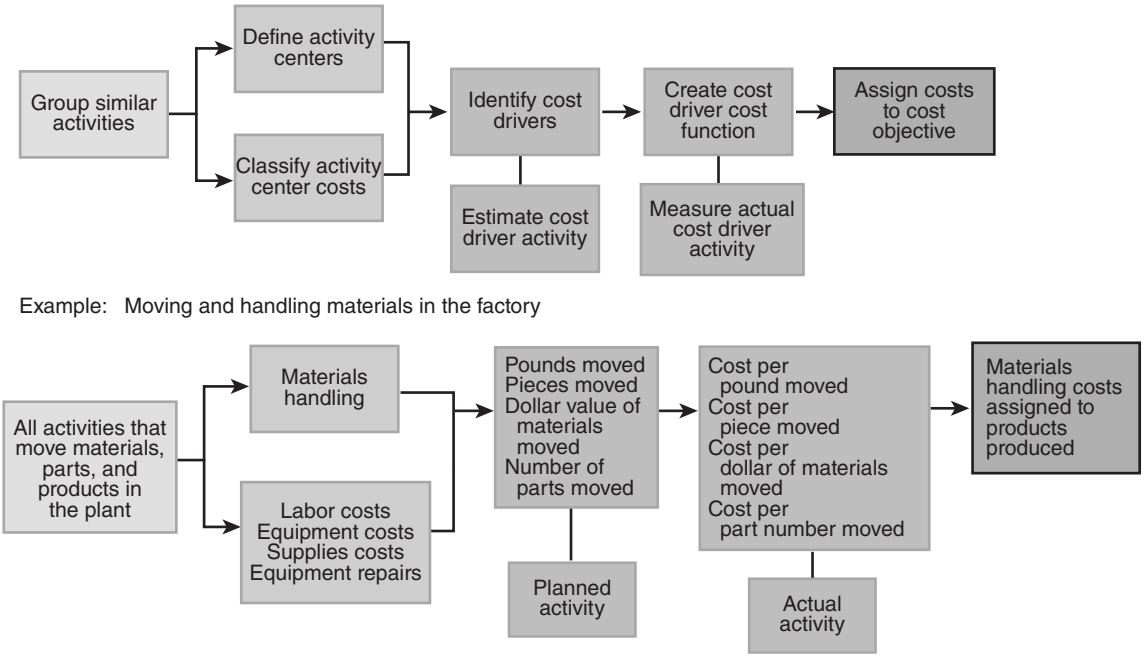
Figure 5.1: An overall view of ABC cost linkgage



Under activity-based costing, an effort is made to identify and account for as many costs as possible as direct costs of production. Any cost that can reasonably be traced to a particular product or service is treated as a direct cost. For example, under the traditional cost system, the cost of setup time (the factory downtime incurred in converting from producing one product to another) is included in manufacturing overhead and applied to products on the basis of direct labor hours. Under ABC, setup time might be measured for each product line, and setup costs would be directly assigned to each part or product manufactured.

An ABC system identifies the major activities in a production process, aggregates those activities into activity centers, accumulates costs in activity centers, selects cost drivers that link activities to products, and assigns the costs of activities to products. We show this process in Figure 5.2. An **activity center** is a segment of the organization for which management wants the costs of a set of activities to be reported separately. A mechanism called a cost driver is used for linking a given activity's pool of costs. A cost driver is an event, action, or activity that results in cost incurrence. It is any factor that causes costs to change. The basic concept is that cost drivers, such as number of purchase orders issued, measure the amount of resources a specific product uses. A cost function is created from the activity's planned costs and cost driver activity level.

Figure 5.2: An overall view of the ABC process



Although not always obvious, several different cost drivers could link an activity's costs and the cost objective. In the materials handling case in Figure 5.2, four possible cost drivers are listed. Assume that *pounds of materials moved* is considered to be the most appropriate cost driver. We therefore divide the planned materials handling costs by the planned pounds to be moved. Cost per pound moved is the cost function. Then, the actual pounds handled in the production of a product times the cost per pound moved is the amount of materials handling costs assigned to that product. Again, the overall process is to identify the best cost driver that links costs and activities and then to use that cost driver to link activities with products (or other cost objectives).

Flow of Costs Under Activity-Based Costing

In applying ABC to a specific organization, we follow five basic steps:

1. Assemble similar actions into activity centers.
2. Classify costs by activity center and by type of expense.
3. Select cost drivers.
4. Calculate a cost function to link costs and cost drivers with resource use.
5. Assign costs to the cost objective—often the product cost.

These steps are consistent with Figure 5.2.

Step 1: Assemble Similar Actions into Activity Centers. The number of actions performed in any organization can be quite numerous. Although the ideal is to relate the cost of every action to a cost driver and then to the product, the costs of doing this can far exceed

the benefits. Therefore, we combine actions into activity centers. Treating collections of actions as activity centers eliminates the need to measure and track the performance of numerous individual actions and costs.

One meaningful way of grouping actions is to classify them with different levels of activities. A common outline is unit-level activities, batch-level activities, product-level activities, and facility-level activities. Figure 5.3 illustrates the four types. **Unit-level activities** are performed each time a unit is produced or handled. These are repetitive activities. Direct labor or machining activities are examples. Costs of these activities vary with the number of units produced. **Batch-level activities** are performed each time a batch of goods is produced or handled. Machine setups, order processing, and materials handling are related to batches rather than individual units. The costs of these activities vary according to the number of batches but are common or fixed for all units in the batch. **Product-level activities** are those performed as needed to support the production of each different type of product or service. Maintaining bills of materials and routing information, processing engineering changes, and performing testing routines are examples of activities in this category. **Facility-level activities** are those which simply sustain a facility's general production process. Examples would include plant supervision and building occupancy. These costs are common to a variety of products and are the most difficult to link to product-specific activities. For this reason, many people question whether facility-level costs should be linked to products.

Figure 5.3: Levels of ABC activity groups

Unit-Level Activities
Activites:
- Assembly
- Stamping
- Machining

Resources used:
- Direct labor
- Direct materials
- Supplies
- Electricity

Cost drivers:
- Direct labor hours
- Machine hours
- Number of units produced

Batch-Level Activities
Activites:
- Batch changovers (setups)
- Materials handling
- Order processing
- Inspections

Resources used:
- Labor costs of setups
- Labor costs of materials handling
- Labor costs to process orders
- Labor costs to inspect

Cost drivers:
- Number of batches
- Number of setups
- Number of orders processed

Product-Level Activities
Activites:
- Production scheduling
- Product designing
- Parts and product testing
- Special handling and storing

Resources used:
- Specialized equipment
- Labor costs of design
- Testing facility costs

Cost drivers:
- Number of products
- Number of parts

Facility-Level Activities
Activites:
- Plant supervision
- Building occupancy
- Personnel administration

Resources used:
- Plant depreciation
- Insurance and property taxes
- Salaries of plant management

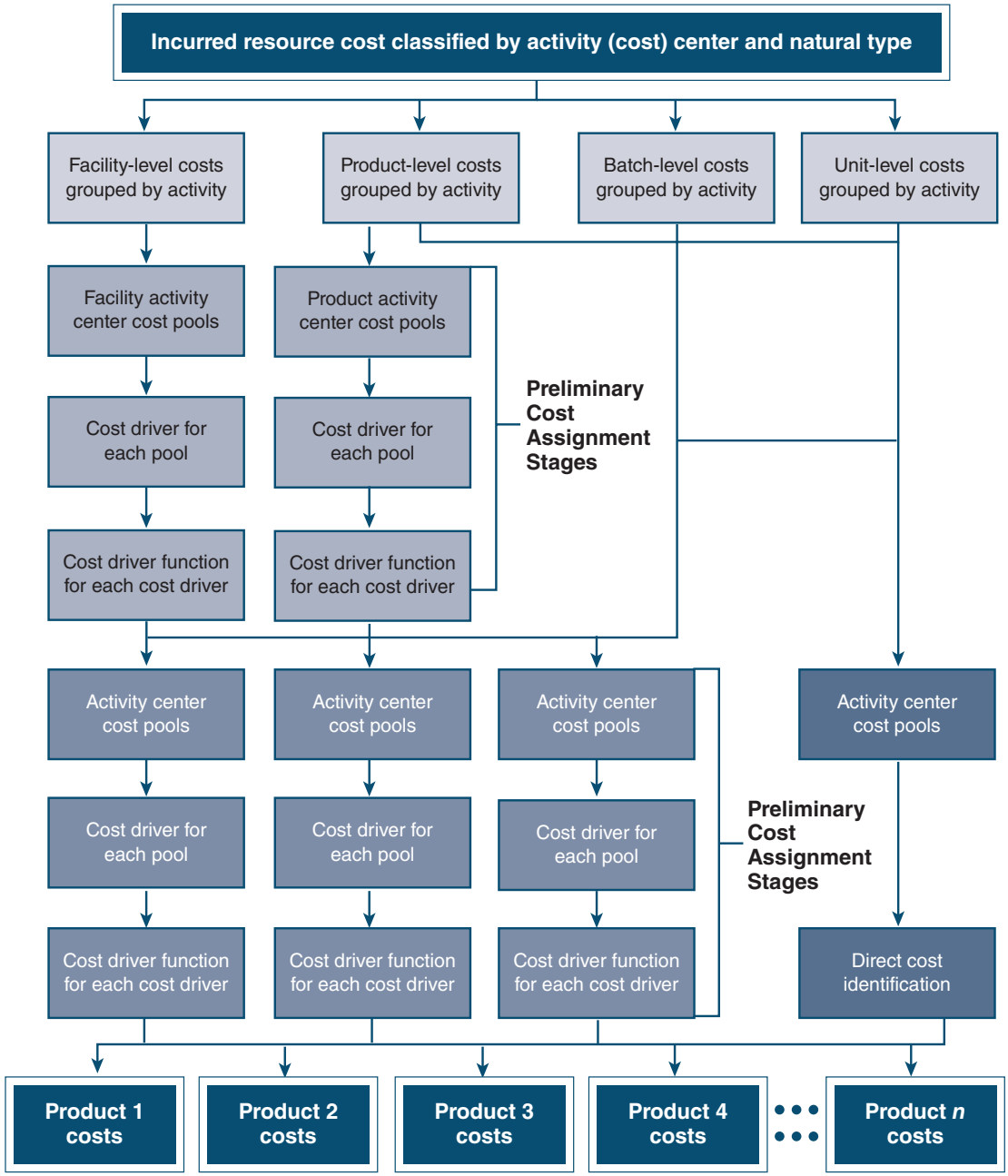
Cost drivers:
- Number of employees
- Number of units produced
- Labor hours

Traditionally, we classify overhead costs as variable or fixed. Relative to volume of outputs, costs of unit-level activities are predominately variable while costs of the other three levels are predominately fixed. However, identifying batch-, product-, and facility-level activity centers helps in selecting cost drivers. Often, the cost perspective changes; many costs that are fixed relative to units of output are now variable relative to the cost driver. This is particularly true for batch- and product-level activities. Costs of facility-level activities remain primarily in the fixed category and are often apportioned or allocated to products in some arbitrary manner.

Step 2: Classify Costs by Activity Center and by Type of Expense. Once the actions are grouped into activities, the next step is identifying the costs with the activities. The classifying of cost data at this early point determine the level of detail and the breakdowns of cost data available to management for all cost analysis purposes later. A chart of accounts or a data base classification scheme will identify the type of cost by natural classification: salary, postage, telephone, repair, supplies, etc. A second classification will identify the activity center. Often, this is called a **cost center**. An activity center and a cost center are both commonly defined as the smallest part of an organization for which costs are accumulated. In fact, in most carefully defined cost systems, the terms activity center and cost center can be used interchangeably.

Step 3: Select Cost Drivers. Direct costs can be traced immediately to a product without the need for a cost driver. All other costs need links between cost, activity, and product. Cost drivers are the links. A cost driver can link a pool of costs in an activity center to the product. Or a cost driver can link costs in one activity center to activities in another activity center. Multiple layers of activities can exist. One activity relates to another activity, which may relate to still another activity before relationships to products are identified. Figure 5.4 gives an example of the variety of these relationships. The first box at the top is the total costs of manufacturing during a production period. The costs are classified by activity center and by natural expense type. A manager is responsible for each activity center and the costs incurred in that center.

Figure 5.4: Relationships of activity (cost) centers, cost drivers, cost functions, and product costs



A **preliminary stage cost driver** links costs of resources consumed (inputs) in one activity center to other activity centers. A **primary stage cost driver** links costs in an activity center directly with products. Some costs, such as batch-level activity center costs in Figure 5.4, are initially assigned to a primary stage activity center and only need a single

stage assignment process. These primary stage centers may collect reassigned costs from numerous preliminary stage activity centers—based on cost drivers that reflect activities and resources used.

The activity centers are typically one of four types, as described above. Direct costs of unit-level activity centers are assumed in Figure 5.4 to be always traceable to specific products. Batch-level activity center costs should also be traceable to specific products but often use a cost driver. Product-level activity center costs may be related to a specific product or may be grouped by activities before being assigned to products at the primary stage. Facility-level activity center costs may go through multiple preliminary stages before being assigned to products.

ABC systems differ from traditional volume-based cost accounting systems in the number and variety of cost drivers used to trace costs. Traditional cost accounting systems use very few drivers—often only direct labor hours or dollars, which are related to volume of production. ABC systems, on the other hand, may use a multitude of cost drivers (for many different costs) that relate costs more closely to resources consumed and the activities occurring. In this way, ABC systems reflect the complexity of production and not just volume. Although not comprehensive, Figure 5.5 gives examples of cost drivers that might be found in an ABC system.

Figure 5.5: Common cost drivers used in actual ABC systems

Number of products or units.	Number of machine hours used.
Number of labor minutes per piece.	Number of vendors.
Amount of labor cost incurred.	Number of purchasing and ordering hours.
Value of materials in a product.	Number of customer options per product.
Number of materials moves.	Number of accessories.
Number of materials handling hours.	Number of times ordered.
Number of times handled.	Number of units scrapped.
Number of parts received per month.	Number of engineering change orders.
Number of part numbers maintained.	Number of die impressions.
Number of part numbers in a product.	Number of units reworked.
Amount of hazardous materials.	Volume of scrap—by weight or units.
Number of new parts introduced.	Number of customer orders processed.
Number of setup hours.	Square feet used by an activity.
Number of setups.	Number of employees.

Accountants must work with management to discover and identify activities and cost drivers. This is done through interviewing, process observation, simulation, diagramming, and analysis of current information systems.

Step 4: Calculate a Cost Function. Managers choose a driver for each of the cost pools to determine a rate per cost driver unit, a percentage of other cost amounts, or an allocation percentage. This cost function could be based on either planned or actual costs and activity levels. In Chapter 3, we discussed the creation of predetermined overhead rates using

planned costs and activity levels. Using planned activity levels and costs for an example, if costs of the setup activity center cost pool totaled $25,000, if setup hours were the cost driver, and if 500 hours were expected, the cost function would be $50 per setup hour. Costs are then distributed to products as setup hours are incurred. This approach is the same as that discussed in Chapter 3, except for the use of a different type of cost driver.

Step 5: Assign Costs to the Cost Objective. The final step is distributing costs to the users of the resources. The cost pool, the cost driver, and the cost function now combine to determine how much cost is charged to each resource user. If this is at a preliminary stage, the users are predominately other activity centers. Thus, a group of costs are now reassigned to other cost pools based on use. If the activity center is at the primary stage, the users are the products themselves. In the setup example, if 60 hours of setup time were used for Product A's production, $3,000 would be charged to Product A. All costs entering the manufacturing process during a given time period are eventually assigned to products.

Influence of Production Complexity

The primary goal of ABC for product costing is to generate accurate product costs. In general, this means the cost accounting system must handle the complexity of production while minimizing possible distortions caused by cost assignment processes. Production complexity plays a significant role in determining whether the costs of two or more activities can be combined and traced to a product by means of a single cost driver and still be assigned accurately. If a company wants more accurate product costs, it must increase the number of activity centers, cost pools, and cost drivers. Since the introduction of a new cost driver in the system has a cost/benefit value, most companies face a trade-off between more cost drivers, greater detail, and more expensive data processing versus more data aggregation and less expensive data processing. Two important issues that affect cost driver selection are product diversity and batch-size diversity.

Product diversity refers to the degree to which each product differs in the number of activities (that is, resources or inputs) required. The greater the difference in how two products use resources or inputs, the greater the distortion a single cost driver will make in tracing costs to these products. For example, producing an ornate bathroom faucet fixture may consume labor-intensive production resources, while producing a kitchen sink faucet may consume machine-intensive resources. Some products are simply larger than other products. A console model versus a portable model is one example. The size of the product influences how the product is produced and which resources are required.

The complexity of a product is determined by the differences in how a product is manufactured and by the number of options a manufacturer has for its products. Deluxe models and products with many customer options, for example, increase the manufacturing difficulty. Each option adds an extension to the production process. However, supervision and other departmental costs are not necessarily influenced by these options. Materials inputs may differ by product. Some materials may require more handling from the receiving dock through the storeroom to the production floor. In other cases, certain materials may require longer machining time or more time in trimming processes. Some products may have a high degree of vertical integration, from raw materials to finished products. Others are merely assembled from purchased parts.

Batch-size diversity occurs when products are manufactured in different-size batches. Batches refer not only to production orders but also to order quantities of raw materials and to shipping quantities of finished goods. In an automotive stamping plant, a weekly run of hood stampings for a popular model may be 3,000 units, while a very similar, but higher priced model hood, may have a biweekly run of 500.

Although we normally think of differing batch sizes when we produce different products, batch-size diversity can also occur with the same product over time. For instance, this week the production order consists of 500 units. Due to an increase in demand, the production schedule for next week calls for 800 units. Just-in-time production encourages producing only what is needed immediately—often smaller batches and more frequently. Frequent batch runs may also require that more attention be given to minimizing setup time and cost. In traditional cost systems, setup costs are added to other overhead costs, losing the separate identity and cost detail of setup activities. In ABC systems, a separate cost pool for setup costs would typically be formed and would be assigned to products using cost drivers such as setup hours or number of setups. Both of these cost drivers reflect batch-size diversity, with the former measure being more detailed and, thus, often more appropriate.

If computer resources were free and if managers had unlimited amounts of analysis time, more and more detail could be captured and evaluated. Since this is not the case, very practical decisions must be made. In large ABC applications, the number of cost drivers (both preliminary and primary) used across an entire facility may be as low as 20 or as high as several hundred. Often, a high percentage of costs are assigned using a small number of drivers. The cost system's design should allow judgments to be made about the number of cost pools and cost drivers and should allow for cost pools and cost drivers to be changed easily when the need arises.

5.2 A Comprehensive Activity-Based Costing Example

Guttman Cafeterias has just completed the installation of an activity-based cost system. The firm operates cafeterias within office buildings, factories, hospitals, and other institutions. These cafeterias produce and serve three standard meals: breakfast, lunch, and dinner. Activity centers consist of four support centers and two operating centers. The volume for October is as follows:

	Breakfast	Lunch	Dinner
# of Meals	22,000	15,000	12,000

The activity centers' traceable costs for October and cost drivers are as follows:

		Activity center information			
Code	**Activity center**	**Materials**	**Labor**	**Other costs**	**Cost driver**
	Support Centers:				
120	Occupancy			$60,000	Square feet used
130	Data Processing			30,000	Transactions processed
140	Personnel Benefits			9,000	Payroll cost
220	Materials Handling			16,000	Materials cost
	Operating Centers:				
410	Cooking	$18,000	$10,000	20,000	Cooking hours
420	Serving	14,000	20,000	15,000	Serving hours
	Total	$32,000	$30,000	$150.000	

Activities are grouped and activity centers are determined as a result of special studies. Each activity center has one cost driver. For example, the cost driver selected for Occupancy is square feet of space used by each activity.

The materials and labor costs are directly traceable to the three meals as follows:

	Materials	**Labor**
Breakfast:		
Cooking	$ 1,000	$ 2,000
Serving	4,000	2,000
Lunch:		
Cooking	6,000	2,000
Serving	2,000	8,000
Dinner:		
Cooking	11,000	6,000
Serving	8,000	10,000
Total	$32,000	$30,000

As for the other costs, cost drivers are selected after analysis of past cost behavior and activity levels within each activity center (i.e., relationship with resource usage). First, the other costs of the support centers are assigned to the operating centers. This is the preliminary stage allocation.

Preliminary Stage Allocation

The cost driver data for the preliminary stage cost assignments are as follows:

Cost driver data—preliminary stage allocation

			Activity centers using resources:	
Code	**Activity center**	**Cost driver**	**410**	**420**
120	Occupancy	Square feet used	80,000	40,000
130	Data Processing	Transactions processed	120,000	180,000
140	Personnel Benefits	Payroll cost	$10,000	$20,000
220	Materials Handling	Materials cost	$18,000	$14,000

Cost functions for each of the support centers are developed as follows:

Activity center	Calculation	Cost function
Occupancy	$60,000/(80,000+40,000)	$0.50 per square foot
Data Processing	$30,000/(120,000+180,000)	$0.10 per transaction
Personnel Benefits	$9,000/($10,000+$20,000)	30% of payroll cost
Materials Handling	$16,000/(18,000+$14,000)	50% of materials cost

Using these cost functions, the following costs are assigned to the two operating centers:

Cooking:

$$\$0.50(80,000) + \$0.10(120,000) + .30(\$10,000) + .50(\$18,000) = \$64,000$$

Serving:

$$\$0.50(40,000) + \$0.10(180,000) + .30(\$20,000) + .50(\$14,000) = \$51,000$$

Having made these preliminary cost assignments, the operating centers contain both direct costs and costs that have been assigned to them from the support centers. Both of these costs will be then assigned to meals using primary cost drivers.

Primary Stage Allocation

In the primary stage, costs are assigned from the Cooking and Serving centers to the three meals. The activities and cost drivers are as follows for each meal:

Cost driver data—primary stage allocation

			Cost driver activity linked to each meal		
Code	**Activity center**	**Cost driver**	**Breakfast**	**Lunch**	**Dinner**
410	Cooking	Cooking hours	2,000	3,000	5,000
420	Serving	Serving hours	2,500	1,500	1,000

As can be seen, different meals use different amounts of the resources in each activity center. Overhead cost functions for each of the operating centers are developed as follows:

Activity center	Calculation	Overhead cost function
Cooking	($20,000+$64,000)/(2,000+3,000+5,000)	$8.40 per cooking hour
Serving	($15,000+$51,000)/(2,500+1,500+1,000)	$13.20 per serving hour

Using these cost functions, the following overhead costs are assigned to the three products:

$$\text{Breakfast: } \$8.40(2{,}000) + \$13.20(2{,}500) = \$49{,}800$$

$$\text{Lunch: } \$8.40(3{,}000) + \$13.20(1{,}500) = \$45{,}000$$

$$\text{Dinner: } \$8.40(5{,}000) + \$13.20(1{,}000) = \$55{,}200$$

Materials and labor costs which are directly traceable are added to determine the total meal costs:

Cost item	Breakfast	Lunch	Dinner
Materials	$ 5,000	$ 8,000	$19,000
Labor	4,000	10,000	16,000
Overhead	49,800	45,000	55,200
Total cost	$58,800	$63,000	$90,200

Note that the total cost assigned to these meals equals the sum of the costs reported by the five activity centers (i.e., $58,800 + $63,000 + $90,200 = $32,000 + $30,000 + $150,000, or $212,000). Per unit costs for each meal are:

$$\text{Breakfast: } \$58{,}800/22{,}000 = \$2.67$$

$$\text{Lunch: } \$63{,}000/15{,}000 = \$4.20$$

$$\text{Dinner: } \$90{,}200/12{,}000 = \$7.52$$

Comparing ABC to Traditional Volume-Based Costing

As discussed, traditional volume-based cost systems unfortunately have paid less attention to the cause-and-effect relationships between resources used and production activities. Assume that the prior cost system in use by Guttman Cafeterias assigned overhead costs to meals using labor dollars. This is a common approach to assigning overhead. Let us also assume that the preliminary cost assignment steps are the same under either approach. Since $150,000 of total overhead cost is incurred and total labor cost is $30,000, an overhead rate of $5 for each $1 of labor is added to each product. The product costs would be as follows:

	Total	Breakfast	Lunch	Dinner
Direct materials	$32,000	$5,000	$8,000	$19,000
Direct labor	30,000	4,000	10,000	16,000
Overhead costs (500% of labor)	150,000	20,000	50,000	80,000
Total meal costs	$212,000	$29,000	$68,000	$115,000
Number of meals		22,000	15,000	12,000
Traditional cost per unit		$1.32	$4.53	$9.58
ABC cost per unit		$2.67	$4.20	$7.52
Difference				
Traditional minus ABC cost		$(1.35)	$0.33	$2.06
Percentage of ABC cost		(50.6%)	7.9%	27.4%

A dramatic picture appears. Using a cost system very common in many companies today, two of the three products have large cost differences: Breakfast and Dinner. Guttman had over-costed Dinners by 27.4 percent. This is a far more profitable meal than Guttman's management had thought. Guttman may be losing Dinner business because of its higher than necessary price. Conversely, Breakfast is less profitable than previously thought. With traditional costing, Breakfast received a disproportionately low amount of overhead allocation because its labor cost of $4,000 was much lower than those of Lunch and Dinner ($10,000 and $16,000, respectively). However, Breakfast consumed overhead resources, namely serving hours per unit, comparable to the other two meals. Breakfast prices might need to be raised to cover its actual use of resources.

ABC is also considered superior to volume-based costing when a company's sales mix includes the following two types of products or services:

- high volume, low complexity
- low volume, high complexity

To illustrate, suppose Reznick Food Corporation produces 50,000 boxes of "Bland," a breakfast cereal where each piece has the same shape, color, and flavor (high volume, low complexity). The company also produces 10,000 boxes of "Wow!," a cereal having a variety of shapes, colors, and flavors (low volume, high complexity). Setup costs of $2,000

and materials handling costs of $9,000 are to be assigned to the two cereals. The following activity information is obtained:

	"Bland"	"Wow!"
Direct labor hours	25,000	2,500
Production runs	10	20
Materials moves	50	40

Volume-based costing, using direct labor hours, would assign the costs as follows:

$$\text{"Bland"}: (\$2{,}000 + \$9{,}000) \times (25{,}000 \,/\, 27{,}500) = \$10{,}000$$

$$\text{"Wow!"}: (\$2{,}000 + \$9{,}000) \times (2{,}500 \,/\, 27{,}500) = \$1{,}000$$

An ABC system would use the number of production runs to assign setup costs and the number of materials moves to assign materials handling costs, as follows:

$$\text{"Bland"}: [\$2{,}000 \times (10 \,/\, 30)] + [\$9{,}000 \times (50 \,/\, 90)] = \$5{,}667$$

$$\text{"Wow!"}: [\$2{,}000 \times (20 \,/\, 30)] + [\$9{,}000 \times (40 \,/\, 90)] = \$5{,}333$$

After dividing these assigned costs by 50,000 boxes for "Bland" and 10,000 boxes for "Wow!," we obtain the following costs per box:

	"Bland"	"Wow!"
Volume-based costing	$0.20	$0.10
Activity-based costing	$0.11	$0.53

Compared to ABC, volume-based costing has over-costed the high volume, low complexity product ("Bland"), while under-costing the low volume, high complexity product ("Wow!"). This distortion is known as **product cross-subsidization** and has caused companies that use volume-based costing to set high prices for high volume, low complexity products and low prices for low volume, high complexity products. These prices can result in losing customers to competitors for the high volume, low complexity products and losing money on the low volume, high complexity products. Signals that companies may be experiencing product cross-subsidization include the inability to break into new markets or to maintain current market share as a result of competitors' seeming ability to price below cost.

Whether ABC costs are "correct" or not, they would appear to be more accurate than the traditional costs. ABC makes a greater effort to match resource use, costs, activities, and products.

5.3 ABC and Nonmanufacturing Activities

Historically, manufacturing-related costs comprised the bulk of a manufacturing organization's total costs. Only manufacturing-related costs are considered product costs for external reporting purposes. In recent times, emphasis on accounting for nonmanufacturing costs such as selling, distribution, general administration, and research and development has grown. One reason is that nonmanufacturing costs are a growing portion of companies' total costs. Another reason is that, due to computerization, it has become less costly to develop alternate accounting systems within a company. Therefore, in addition to the cost system needed for external reporting, companies now find it worthwhile to maintain alternate systems more useful for internal purposes such as pricing, control, decision making, and performance evaluation. With the growing emphasis on accounting for nonmanufacturing costs, manufacturing firms who have adopted ABC for manufacturing-related activities are increasingly expanding their implementation of ABC to include nonmanufacturing activities.

Contemporary Practice 5.1

ABC Applications in the U.K.

U.K. companies who adopted ABC reported the following purposes to which ABC systems were being put to use in 1999 (Innes, Mitchell, & Sinclair, 2000):

Application	Percent
Cost reduction	90
Pricing	81
Performance measurement	74
Cost modeling	65
Budgeting	55
Customer profitability analysis	52
Output decisions	52
New product/service design	42
Inventory valuation	16
Other	16

In addition to manufacturing firms, the usage of ABC is growing in the service sector. Competitive pressures in industries such as health care, financial services, telecommunications, and transportation have led to increased cost consciousness on the part of managers. Not only is ABC being used to assess costs associated with various services, but, increasingly, it is also being used to determine costs associated with particular customers. Customer profitability analysis is becoming an increasingly important issue with management.

5.4 Activity-Based Management

Aside from product costing purposes, ABC systems are also used to improve the operations of an organization. This extension of ABC is often referred to as **activity-based management (ABM)**. The ABM philosophy is that the activities identified for ABC can also be used for cost management and performance evaluation purposes.

One aspect of ABM which evolves from activity analysis is the identification and elimination of **nonvalue-added costs**. Activities and their costs that are eliminated without deterioration of product quality and value can reduce total production time and increase profitability. For instance, many companies have adopted just-in-time production systems in an effort to eliminate activities related to storing and handling inventories.

Another aspect of ABM is the determination of efficiency and effectiveness measures for all cost generating activities. Traditionally, accountants have been concerned only with financial performance measures. With ABM, performance evaluation of activities has been expanded to include many nonfinancial measures. Measures dealing with quality and productivity have become particularly prominent. Indeed, the phenomenon of total quality management is considered part of ABM. Examples of nonfinancial quality measures include product defect rates, number of customer complaints, number of engineering change orders, and amount of rework. Examples of nonfinancial productivity measures include the ratio of value-added time to total production time, amount of production per day per employee, and square footage required per day per unit of output.

ABM also encompasses innovations such as target costing, continuous improvement, employee empowerment, and benchmarking. These cost management and performance evaluation issues are discussed in detail in Chapter 12. The remainder of this chapter covers an ABM topic which deals with product costing: JIT costing.

5.5 JIT Costing

To reduce nonvalue-added costs, many companies in recent years have adopted **just-in-time (JIT) systems**. These systems generally have the following characteristics:

1. Raw materials, work in process, and finished goods inventories are reduced as much as possible, if not eliminated. Costs associated with inventories, such as storage and moving, are considered to add no value to the product. As such, the production system operates on a **demand-pull** basis. Raw materials are purchased only as demanded by production needs; production is scheduled only as demanded by sales orders.

2. Since little or no inventory buffers exist at various work stations, problems such as defective materials or machine breakdowns not only stop work at that station but also cause shutdowns at subsequent stations. Thus, total quality programs are emphasized in JIT environments.
3. Long-term agreements are negotiated with a small number of suppliers. The criteria for selecting suppliers focus on dependable delivery and quality.
4. Layouts of production facilities are structured in the form of **focused factories**, i.e., "factories within a factory." To simplify activities, especially materials handling, machines are grouped in arrangements that allow a worker or a team of workers to perform a variety of sequential operations. These arrangements are often referred to as **manufacturing cells**.
5. JIT is facilitated by automation in various forms—flexible manufacturing systems, automated materials handling systems, numerically-controlled machines, computer integrated manufacturing systems, etc. Thus, in JIT environments, direct labor cost is usually not significant and sometimes even nonexistent.

Due to these characteristics, firms with JIT systems sometimes record costs differently from how it is discussed in Chapter 3. **Just-in-time (JIT) costing** differs from traditional costing with regard to the accounts used and the timing of cost recording. Specifically, three major differences exist. First, instead of using separate accounts for Raw Materials and Work in Process, JIT costing combines these into a Raw and In-Process Inventory (RIP) account. The rationale is that the amount of work in process at any particular time will be low.

A second difference is that since direct labor is usually a minor cost item in a JIT setting, no separate account for direct labor in JIT costing is created. Rather, direct labor is combined with overhead into a Conversion Cost account. In some companies, direct labor is actually included in the Overhead account.

The third difference relates to the application of overhead. In traditional environments, overhead is applied to products as they are being produced. As such, overhead is applied to and recorded into the Work in Process account. In JIT costing, overhead is not applied to products until they are completed. No Work in Process account exists to accumulate conversion costs. When products are completed under JIT costing, conversion cost is applied to the Finished Goods account. In more "pure" JIT systems, the conversion cost is applied or added to Cost of Goods Sold, since the goods are sold soon after production is completed. JIT costing is sometimes termed **backflush costing** because the product costs are "flushed" out of the accounting system and are attached to the products only *after* they are completed. This is the reverse of the traditional approach which attaches costs to products, via the Work in Process account, as products are being produced.

Just as the Overhead account is closed out in the traditional cost system, the Conversion Cost account in the JIT system is closed out at the end of the period. In Chapter 3 we stated that Overhead should be closed out to Cost of Goods Sold or prorated among Cost of Goods Sold, Work in Process, and Finished Goods. With JIT costing, Conversion Cost would typically be closed out just to Cost of Goods Sold.

To illustrate JIT costing, suppose that Tex Rubin Tire Center sells, installs, and repairs auto and truck tires. Recently, the company has begun to consider implementing a JIT inventory system. The following transactions occurred during January:

(a) Tex Rubin purchased $17, 000 of materials.
(b) All materials purchased were requisitioned for use.
(c) Tex Rubin incurred direct labor costs of $8,000.
(d) Actual overhead costs amounted to $125,000.
(e) Tex Rubin applied conversion costs totaling $130,000. This includes $8,000 of direct labor.
(f) All jobs were completed. No jobs were in process on January 1.

These transactions would be recorded in a traditional costing system as follows:

Materials	
(a) 17,000	(b) 17,000

Accounts payable	
	(a) 17,000
	(d) 125,000

Work in process	
(b) 17,000	(f) 147,000
(c) 8,000	
(e) 122,000	

Wages payable	
	(c) 8,000

Overhead	
(d) 125,000	(e) 122,000

Finished jobs on hand	
(f) 147,000	

Under JIT costing, no entries are made for transactions (b), (c), and (e). Entry (b) is not necessary because the placement of materials into use is implied in transaction (a) when the materials are first received. No separate entry for (c) is made because direct labor is combined with overhead and recorded as a debit to Conversion Cost as part of entry (d). Finally, entry (e) is omitted because conversion cost is not applied until the jobs are completed. The entry for conversion cost application, therefore, becomes part of entry (f).

The JIT costing system would record the January transactions in the following manner:

Raw and in-process inventory	
(a) 17,000	(b) 17,000

Accounts payable	
	(a) 17,000
	(d) 125,000

Conversion cost	
(d) 133,000	(f) 130,000

Wages payable	
	(c) 8,000

Finished jobs on hand	
(f) 147,000	

Note that the JIT costing system is much simpler and less expensive than the traditional system because fewer entries are needed.

Chapter Summary

Activity-based costing is a system of accounting that focuses on activities performed to produce items or services. The activities are the primary building blocks in cost accumulation. Cost drivers are used to identify costs with activities and to identify activities with products. Preliminary stage cost drivers assign support activity costs to other activity centers. Primary stage cost drivers relate costs of activities to products or services.

In designing an activity-based cost system, five basic steps are followed. First, assemble similar actions into activity groups. This process involves categorizing activities as unit level, batch level, product level, and facility level. Second, classify costs by activity group and by expense. Third, select the appropriate preliminary stage and primary stage cost drivers. This process eliminates distortions in cost allocations to products that result from production complexity. Fourth, calculate a cost function to link costs and the cost driver activity. Finally, fifth, assign costs to the cost objective (often the product cost).

ABC can also be applied to nonmanufacturing activities and to service organizations. Activity-based management involves the analysis of activities for cost management and performance evaluation issues.

JIT costing differs from traditional cost systems in three respects. First, JIT costing does not use a Work in Process account. Second, JIT costing combines direct labor and overhead into one account. Third, in JIT costing, overhead is not applied to products until the products are completed.

Problem for Review

Lowy Manufacturing Company makes a variety of backpacks. The activity centers and budgeted information for the year are:

Activity center	Overhead costs	Cost driver	Activity center rate
Materials handling	$ 300,000	Weight of materials	$ 0.30 per pound
Cutting	1,800,000	Number of shapes	$3.00 per shape
Assembly	4,600,000	Direct labor hours	$12.00 per labor hour
Sewing	1,200,000	Machine hours	$8.00 per machine hour

Two styles of backpacks were produced in December: the EasyRider and the Overnighter. The quantities and other operating data for the month are:

	EasyRider	Overnighter
Direct materials weight in pounds	50,000	15,000
Assembly direct labor hours	7,500	1,200
Sewing machine hours	12,500	1,800
Units produced	5,000	1,000
Number of shapes	35,000	15,000

Questions:

1. Using the activity center rates, find the total overhead costs charged to each product during the month.
2. Calculate a per unit cost for each backpack.
3. With the information given, compute the budgeted level for each cost driver upon which the activity center rates were based.

Solution:

1.

Total overhead costs traced to products:	EasyRider	Overnighter
Materials handling:		
50,000 × $0.30	$ 15,000	
15,000 × $0.30		$ 4,500
Cutting:		
35,000 × $3	105,000	
15,000 × $3		45,000
Assembly:		
7,500 × $12	90,000	
1,200 × $12		14,400
Sewing:		
12,500 × $8	100,000	
1,800 × $8		14,400
Total costs	$310,000	$78,300

2.

Unit costs:	EasyRider	Overnighter
Total costs	$310,000	$78,300
Units	5,000	1,000
Unit costs	$ 62.00	$ 78.30

3.

Budgeted levels for cost drivers:

Materials handling	$300,000 / $0.30	=	1,000,000 pounds
Cutting	$1,800,000 / $3	=	600,000 shapes
Assembly	$4,600,000 / $12	=	383,333 labor hours
Sewing	$1,200,000 / $8	=	150,000 machine hours

Key Terms

activity-based costing (ABC) A system of accounting that focuses on activities performed to produce products or services.

activity-based management (ABM) A management approach that focuses on activities with the objective of improving operations.

activity center A segment of the organization for which management wants the costs of a set of activities to be reported separately.

backflush costing The costing approach used in JIT systems, in which product costs are "flushed" out of the accounting system and are attached to the products only after they are completed.

batch-level activities Activities that are performed each time a batch of goods is produced or handled.

batch-size diversity The manufacturing of products in different size batches.

cost center A responsibility center where control exists over the incurrence of cost.

demand-pull A production system in which raw materials are purchased only as demanded by production needs, and production is scheduled only as demanded by sales orders.

facility-level activities Activities that sustain a facility's general production process.

focused factory A factory layout that permits the production of a single product or family of products.

just-in-time (JIT) systems Systems whose objective is to eliminate waste by producing a product only when it is needed and only in the quantities demanded by customers.

just-in-time (JIT) costing A method of product costing used for JIT systems.

manufacturing cells Machines that are grouped in arrangements that allow a worker or team of workers to perform a variety of sequential operations.

nonvalue-added costs Costs that can be eliminated without deterioration of product quality and value.

preliminary stage cost driver A cost driver in an ABC system that assigns costs from activities to other activities.

primary stage cost driver A cost driver in an ABC system that assigns costs from activities to the cost objectives.

product cross-subsidization Cost distortion resulting from over-costing one product and under-costing another one.

product diversity The degree to which each product differs in the number of activities required.

product-level activities Activities that are performed as needed to support the production of each different type of product or service.

unit-level activities Activities that are performed each time a unit is produced or handled.

Questions for Review And Discussion

1. Describe the relationships among resources, activities, and products.
2. Identify the five basic steps in applying activity-based costing to a costing problem.
3. Define an activity center. How many activity centers can exist in one production department? Explain.
4. Describe the differences among unit-level activities, batch-level activities, and product-level activities.
5. Explain the difference between a preliminary stage cost driver and a primary stage cost driver.
6. What is meant by product diversity? Why is it important in product costing?
7. What factors have led to an increased emphasis on accounting for nonmanufacturing costs, such as selling, distribution, general administration, and research and development?
8. Identify the key characteristics associated with JIT systems (other than cost recording issues).
9. Why is JIT costing sometimes referred to as backflush costing?

Exercises

5-1. Classification of Activities. Lubin Electronics, Inc. makes avionics equipment for private aircraft manufacturers. The production process takes place in three departments. The following costs were budgeted for February:

Computer programming—production	$ 27,000
Custodial wages—plant	4,500
Depreciation—machinery	95,000
Depreciation—plant	60,000
Electricity—machinery	11,600
Electricity—plant	7,400
Engineering design	36,000
Equipment maintenance—wages	14,100
Equipment maintenance—parts and supplies	2,900
Heating—plant	3,200
Inspection—production	3,800
Insurance—plant	10,000
Property taxes	9,300
Raw materials, components, subassemblies	280,000
Setup wages	19,000

Questions:

1. Identify each of the costs as one of the following:
   (a) A unit-level activity.
   (b) A batch-level activity.
   (c) A product-level activity.
   (d) A facility-level activity.

2. Specify an appropriate cost driver for tracing to the products the costs that are associated with the various activity levels previously identified.

5-2. Appropriateness of ABC. Zalik Industries has identified the following activity centers and cost drivers:

Activity center	Cost driver
Purchasing	Number of purchase orders
Materials handling	Number of parts
Setups	Number of setups
Cutting	Number of parts
Assembly	Direct labor hours
Painting	Number of units painted

Two customer orders were received for the month. The cost drivers appearing on each order are as follows:

Cost drivers	Order 1	Order 2
Number of purchase orders	3	6
Number of parts	8	4
Number of setups	6	2
Direct labor hours	35	15
Number of units painted	11	33

Question:

1. Assuming the company traditionally allocated these costs using direct labor hours, how would activity-based costing, with the indicated cost drivers, improve the allocation of costs to products on the two customer orders?

5-3. Choosing an Activity Base. Costs and activity levels over the past three months are as follows for Mindi Stuart Enterprises, which operates a national chain of car washes:

	December	January	February
Activity center total costs	$ 20,000	$ 30,000	$ 40,000
Labor hours	1,000	1,000	1,000
Machine hours	3,000	4,500	6,000
Pounds of materials used	10,000	12,000	14,000
Number of cars washed	120,000	130,000	140,000

Question:

1. Which activity measure would appear to be the best cost driver for this cost center? Comment.

5-4. Overhead Cost Assignment. Litzman Enterprises manufactures two types of hats: Black and White. The overhead activities, costs, and related data are as follows:

	Black	White	Activity center costs
Receiving orders	120	180	$ 9,000
Machine hours	3,000	2,000	$90,000
Setups	50	25	$12,000
Shipping orders	250	150	$22,000

Question:

1. Using activity based costing, determine the overhead costs assigned to each of the two hats.

5-5. Cost Control with ABC. The Flying Llama Travel Agency of Lima, Peru, budgets its agents' expenses based on the following activities, cost drivers, and cost functions:

Activities	Cost drivers	Cost functions
Operations	Kilometers traveled	0.60 New Sol per kilometer
Entertainment	Admission expenses	15.00 New Sol per passenger
Trips	Trip agent costs	300.00 New Sol per trip

Juanita Garcia spent 8,200 New Sol in September. She ran 10 trips, had 20 persons per trip, and traveled a total of 4,000 kilometers. Other agents' spending averaged 8,600 New Sol.

Question:

1. Using activity-based costing, comment on Garcia's spending for September. Also, comment on the spending of the other agents.

5-6. Job Costing with Volume-Based Costing and with ABC. Bergen Corporation has four categories of overhead, with expected costs for next year as follows.

Maintenance	$820,000
Materials Handling	180,000
Inspection	390,000
Setups	315,000

Job #58 is scheduled for next year and has the following estimates:

Direct materials	$82,000
Direct labor (2,000 hours)	$97,000
Number of inspections	95
Number of setups	88
Number of machine hours	4,500
Number of materials moves	185

Sixty thousand direct labor hours are budgeted for next year. Expected activity for the activity-based cost drivers that could be used are:

Machine hours	34,000
Material moves	18,000
Setups	31,000
Quality inspections	37,000

Questions:

1. Determine the total cost of Job #58 if direct labor hours are used as the cost driver for overhead.
2. Determine the total cost of Job #58 if activity-based costing is used.

5-7. Activity Center Rates. The following budgeted activity data and costs are from Chernin Laundromats:

Activity centers	Direct costs	Support costs	Percentage of space used	Number of employees
Preliminary centers:				
Administration		$64,000	20%	
Maintenance		75,000		
Primary centers:				
Washing	$123,000	45,000	60%	30
Drying	69,000	88,000	20%	20

Administration uses number of employees as its cost driver. Maintenance uses percentage of space used as its cost driver. Washing uses machine hours as its cost driver and has budgeted 42,300 hours this month. Drying also uses machine hours as its cost driver and has budgeted 40,100 hours this month.

Question:

1. Find the cost rates that will be used this month in each primary center.

5-8. Product Costing with ABC. Linda Irvin, the controller of Sonya Electronics, wishes to use activity-based costing for a new circuit board produced for personal computers. Irvin has identified the following activities associated with circuit board production and the related conversion costs forecast for the period:

Activity	Conversion cost
Purchasing of parts	$ 72,000
Starting the product	90,000
Inserting the components	150,000
Soldering the boards	180,000
Testing the quality	140,000

The cost drivers which Irvin intends to use, as well as the amounts of activity forecast for the period, are:

Activity	Cost driver	Cost driver amounts
Purchasing of parts	Number of parts purchased	12 per board
Starting the product	Number of boards started	60,000
Inserting the components	Number of insertions	10 per board
Soldering the boards	Number of boards soldered	60,000
Testing the quality	Number of testing hours	2,000

Each circuit board has anticipated direct materials costs of $36. In addition, each circuit board takes, on average, 15 minutes to test.

Question:

1. Determine the cost of a circuit board produced by Sonya Electronics.

5-9. Finding Missing Costs. Susan Robinson, the operations manager for Flink Towing Service, is unable to locate the 2014 budget. You have managed to recover the following information for her:

Activity center	Budgeted overhead cost	Cost driver	Budgeted cost driver level
Dispatching	$14,000	Number of calls	350 calls
Towing	42,000	Towing hours	600 hours
Billing & Collection	15,000	Pages of forms processed	5,000 pages
Miscellaneous Overhead	?	Labor hours	10,000 hours

You have also obtained the following information pertaining to the Southern Region, which you learned was assigned an overhead cost of $9,500:

Labor hours	2,000
Number of calls	50
Towing hours	55
Pages of forms processed	430

Question:

1. Determine the amount of Miscellaneous Overhead that was budgeted for 2014.

5-10. Overhead Cost Assignment. Helene's Tennis Experts is a company that specializes in installing and resurfacing tennis courts. Using ABC, the company has assigned all overhead costs into five cost pools. The budgeted amounts for these cost pools and their associated cost drivers are:

Overhead cost pool	Budgeted costs	Cost driver	Budgeted level for cost driver
Purchasing & materials-related	$230,000	Materials costs	$1,450,000
Engineering	97,000	Engineering hours	5,300 hours
Office & storage rental	125,000	Square feet of jobs	478,500 sq. ft.
Equipment depreciation	150,000	Direct labor cost	$998,000
General administration	280,000	Direct labor hours	88,000 hours

The company has just completed resurfacing Thompson Park Tennis Courts, which had the following cost driver data:

Materials cost	$39,000
Direct labor cost	$15,200
Engineering hours	62
Square feet	4,100
Direct labor hours	75

Question:

1. Determine the total overhead cost that would be assigned to Thompson Park Tennis Courts.

5-11. Preliminary and Primary Stage Allocations. Maryland Forklift Manufacturing produced 100 electric forklifts and 150 propane forklifts during the year. Andy Weber, the controller, reported the following traceable costs, other than direct materials and direct labor, for its activity centers:

Activity center	Costs
Plant Administration	$ 66,000
Setup Operations	24,000
Materials Handling	47,000
Machining	180,000
Assembly	150,000

Data for the preliminary stage cost assignment are as follows:

	Activity centers using resources and receiving costs		
Activity center	Setup Operations	Machining	Assembly
Plant Administration	5%	40%	55%
Materials Handling		65%	35%

Data for the primary stage cost assignment are as follows:

		Cost driver activity linked to each product		
Activity center		Cost driver	Electric	Propane
Setup Operations		Number of setups	30 setups	20 setups
Machining	Machine hours	250 hours	150 hours	
Assembly	Labor hours	6,000 hours	9,000 hours	

Question:

Determine the overhead cost per unit assigned to each type of forklift.

5-12. **Recording Transactions Under JIT Costing.** Hyeun-Suk Rhee, owner of Taegu Supply Company in South Korea, which manufactures chopsticks for restaurants, has recently decided to implement a JIT cost system. Transactions (in South Korean won) for August are as follows:

(a) Raw materials were purchased at the cost of W950, 000.
(b) All materials purchased were requisitioned for production.
(c) Direct labor costs of W2,500,000 were incurred.
(d) Actual factory overhead costs amounted to W6,000,000.
(e) Applied conversion costs totaled W8,100,000. This included W2,500,000 of direct labor.
(f) All units were completed.

Question:

1. Enter the August transactions into T-accounts. Label these entries by the identifying letters.

Problems

5-13. Activities and Cost Drivers for an Employment Agency. Kelsey Relocation Services is an employment agency working specifically with mid-level executives looking for new career opportunities or seeking employment after a layoff. The company views its product as placements. These are identified in four categories: employer-paid fee, applicant-paid fee, out-placement contract, and executive-search contract.

The agency incurs a number of costs in performing its services. Those costs are classified as operating expenses as follows:

Acct #	Account title
402	Salaries and Wages
403	Payroll Taxes
404	Employee Benefits
408	Office Supplies (postage, stationery, etc.)
409	Dues and Publications
410	Utilities
412	Rent
413	Repairs and Maintenance (contracted from outside)
420	Business Promotion
421	Auto Expenses
422	Travel Expenses
430	Professional Fees
432	Collection Expenses
435	License
441	Property Taxes
444	Insurance Costs
445	State Franchise Tax
447	Bad Debt Expense
448	Depreciation and Amortization
449	Miscellaneous

Questions:

1. Classify each cost as related to unit-level, batch-level, product-level, or facility-level activities. Indicate an appropriate cost driver for each cost.
2. With the information from Part (1), group costs into logical activity groups and specify a cost driver for each activity group.
3. Explain what differences exist between applying activity-based costing to a manufacturing firm and to an employment agency.

5-14. Cost Estimation with Volume-Based Costing and ABC. Neil's Customized Gift Service (NCGS) contracts with corporate clients to print their logos and emblems on small giftware items such as pens, cups, calculators, coasters, etc. Cal Nitz, the controller of NCGS, has provided the following information on overhead cost estimates for 2014:

Activity	Estimated cost	Cost driver
Supervision	$855,000	Direct labor hours
Power	450,000	Kilowatt hours
Maintenance	720,000	Machine hours
Setups	225,000	Setup hours

The following are estimated 2014 and planned January activity levels of the cost drivers:

Cost driver	Estimated activity for 2014	Planned level in Jan. 2014
Direct labor hours	300,000	35,000
Kilowatt hours	150,000	12,000
Machine hours	120,000	10,000
Setup hours	100,000	8,000

Questions:

1. Estimate overhead costs for January 2014 using direct labor hours as the allocation base.
2. Estimate overhead costs for January 2014 using activity-based costing.

5-15. Overhead Cost Assignment – ABC and Overall Rates. Kallus Airlines uses activity-based costing for its ground handling department. The department has assigned all overhead costs into seven activity cost pools. The budgeted amounts and the associated cost drivers for these cost pools are as follows:

Activity cost pool	Budgeted costs	Cost driver	Budgeted level for cost driver
Loading and unloading cargo	$ 250,000	Pounds of cargo	2,000,000 lbs.
Directing planes to and from gates	110,000	Directing distance	5,500 miles
Loading and unloading baggage	300,000	Bags loaded & unloaded	100,000 bags
Communicating with pilots	80,000	Communication time	2,000 hours
Fueling planes	450,000	Fueling time	10,000 hours
Deicing planes	75,000	Deicing time	1,000 hours
Locating mishandled bags	200,000	Number of inquiries	5,000 inquiries
Total	$1,465,000		

A flight has just been completed with the following cost driver information available:

Pounds of cargo	40,000
Directing distance (miles)	1.5
Bags loaded & unloaded	200
Communication hours	0.9
Fueling hours	2.2
Deicing hours	0
Number of inquiries	3

Questions:

1. Determine the total overhead cost that would be assigned to the flight.
2. Compare the total overhead cost computed in Part (1) with one obtained by using an overall overhead rate based on number of bags loaded and unloaded.

5-16. ABC and Volume-Based Costing for Marketing Studies. Janet Emerson & Associates, a marketing research firm, uses ABC and has budgeted the following overhead costs and cost drivers (10,000 direct labor hours were budgeted):

Activities	Cost driver	Budgeted cost	Budgeted activity level
Phoning	Number of calls	$25,000	80,000
Mailing	Number of mailings	15,000	40,000
Personal visits	Miles driven	10,000	50,000

The following data were collected on three market research studies completed:

	Study #15	Study #19	Study #23
Direct materials cost	$ 6,020	$ 5,425	$ 4,885
Direct labor cost	$15,660	$12,235	$19,650
Direct labor hours	140	110	175
Number of calls	500	300	700
Number of mailings	7,000	6,000	2,000
Miles driven	900	1,300	1,600

Questions:

1. Using volume-based costing with direct labor hours as the cost driver, calculate the total cost of each of the three studies.
2. Using ABC, calculate the total cost of each of the three studies.

5-17. Two-stage Allocation and Overhead Rates. Koonin Corp. has provided the following information about overhead costs traceable to its activity centers:

Activity center	Overhead cost	Cost driver
Maintenance	$90,000	Maintenance hours
Receiving	40,000	Receiving orders
Fabrication	150,000	Labor hours
Assembly	280,000	Machine hours

The following activities were reported:

Activity center	Maintenance hours	Receiving orders	Labor hours	Machine hours
Fabrication	200	30	1700	450
Assembly	800	120	1300	550

Overhead allocations involving Maintenance and Receiving are performed in the preliminary stage; overhead costs for Fabrication and Assembly are assigned to products in the primary stage.

Question:

1. Compute the overhead rates for product costing in Fabrication and Assembly.

5-18. Distortion of Product Profitability. The Chromosome Manufacturing Company produces two products, X and Y. The company president, Gene Mutation, is concerned about the fierce competition in the market for product X. He notes that competitors are selling X for a price well below Chromosome's price of $12.70. At the same time, he notes that competitors are pricing product Y almost twice as high as Chromosome's price of $12.50.

Mr. Mutation has obtained the following data for a recent time period:

	Product X	Product Y
Number of units	11,000	3,000
Direct materials cost per unit	$3.23	$3.09
Direct labor cost per unit	$2.22	$2.10
Direct labor hours	10,000	2,500
Machine hours	2,100	2,800
Inspection hours	80	100
Purchase orders	10	30

Mr. Mutation has learned that overhead costs are assigned to products on the basis of direct labor hours. The overhead costs for this time period consisted of the following items:

Overhead cost item	Amount
Inspection costs	$16,200
Purchasing costs	8,000
Machine costs	49,000
Total	$73,200

Questions:

1. Using direct labor hours to allocate overhead costs, determine the gross margin per unit for each product.
2. Using activity-based costing, determine the gross margin per unit for each product.
3. How do your answers to Parts (1) and (2) help explain the observations made by Gene Mutation about competitors?

5-19. Overhead Rates and Cost Comparisons. Joe Asher's Machine Shop makes replacement parts for automotive transmissions. It produces three basic products: gears, shafts, and casings. The company is budgeting activity for 2014. The activity centers, costs, and cost drivers are as follows:

Activity center	Budgeted cost	Cost driver
Materials handling	$ 312,400	Direct materials cost
Production scheduling	116,000	Number of production orders
Setups	144,600	Number of setups
Manual machinery	986,000	Direct labor hours
Automated machinery	3,212,000	Machine hours
Finishing	1,798,000	Direct labor hours
Packaging and shipping	234,000	Number of orders shipped

The following data are predicted for 2014:

	Gears	Shafts	Casings
Units produced	10,000	2,000	700
Direct materials cost per unit	$ 60	$ 80	$ 100
Number of production orders	40	20	10
Number of setups	20	10	14
Direct labor hours	20,000	10,000	8,400
Machine hours	30,000	15,000	2,800
Number of orders shipped	1,000	1,500	70

Questions:

1. Compute an overhead rate for each activity center. Round calculations to four decimal places.
2. Compute an overall rate for the combined activities based on direct labor hours. Round calculations to four decimal places.
3. Show how much overhead is budgeted for gears, shafts, and casings using the activity center rates and the overall rate.
4. Calculate an overall rate for the combined activities based on the total number of units.

5. Show how much overhead is budgeted for gears, shafts, and casings using the rate in Part (4).
6. Explain why the overhead costs differ in Parts (3) and (5).

5-20. Activity-Based Costing for a Tour Company. Ozzie Tour Company provides tours in Australia and uses an activity-based cost system. The basic 10-day package covers the east coast, including Sydney, Melbourne, Canberra, Brisbane, and the Great Barrier Reef. The deluxe 21-day package adds the outback, west coast, and other areas, including Darwin, Tasmania, Adelaide, Perth, and Alice Springs. Direct labor (drivers, tour guides) and materials costs (e.g., fuel, brochures, various drinks and refreshments) for 2014 were (in Australian dollars):

	10-day package	21-day package
Direct labor	A$670,000	A$1,770,000
Materials	A$10,800	A$22,400

The following additional information for 2014 was provided by the owner, David Rogut:

			Activity (cost driver) level	
Activity	Overhead cost	Cost driver	10-day package	21-day package
Advertising	A$56,700	No. of ads	150	175
Organizing itinerary	A$89,300	No. of tours	55	72
Touring	A$380,500	No. of tourists	2,725	3,130

Question:

Compute the total cost per tour for each of the two tour packages.

5-21. Analysis of Accounts With JIT Costing. L.D. Ferreira, general manager of a highly automated coffee production plant in Sao Paulo, Brazil, has provided the following information for transactions that occurred during October. All amounts are in Brazilian real. The production plant uses a JIT cost system.

(a) Raw materials costing R$300, 000 were purchased.
(b) All materials purchased were requisitioned for production.
(c) Direct labor costs of R$200,000 were incurred.
(d) Actual factory overhead costs amounted to R$995,000.
(e) Applied conversion costs totaled R$1,300,000. This includes the direct labor cost.
(f) All units were completed and immediately sold.

Questions:

1. Determine the October 31 balance in the Cost of Goods Sold account. No adjustment has been made for overapplied or underapplied conversion cost.
2. What was the amount of overapplied or underapplied conversion cost for the month?

5-22. JIT and Conventional Costing. DeKalb Industrial Products manufactures automated materials-handling systems. The company currently uses a conventional job cost system. During November, the company plans to purchase $96,000 of raw materials. Of this amount, 75 percent will be used for current production, while the remainder will serve as a buffer in inventory. Direct labor cost is expected to be $18,000 during November, and the actual factory overhead is anticipated to total $85,000. The applied factory overhead is expected to be $90,000. By the end of the month, two materials-handling systems should be completed; no systems were in process at the beginning of the month or at the end of the month.

Robert Cohen, the owner, has been considering the use of a JIT inventory system. If implemented at the beginning of November, only the materials needed for current production would be purchased.

Questions:

1. Using T-accounts, enter the November transactions for the purchase and usage of materials under:
   (a) Conventional costing.
   (b) JIT costing.

2. Using T-accounts, enter the November transactions for the labor and actual overhead costs under:
   (a) Conventional costing.
   (b) JIT costing.

3. Using T-accounts, enter the November transactions for the application of overhead costs and the completion of the materials-handling systems under:
   (a) Conventional costing.
   (b) JIT costing.

Case: Druid Valley Apartments

Druid Valley Apartments (DVA) has 18 apartment buildings with a total of 600 units—420 two-bedroom units and 180 one-bedroom units. Also, the complex contains a sports area which has a basketball court, exercise room, tennis court, and two activity rooms. The sports area was used by 475 residents this past year. DVA currently has 1,580 tenants—280 in one-bedroom units and 1,300 in two-bedroom units. The one-bedroom apartments occupy 90,000 square feet, while the two-bedroom apartments occupy 275,000 square feet. The sports area occupies 35,000 square feet.

Jerry Siegel, DVA's Chief Operations Officer, oversees the day-to-day operations of the apartment complex. Doug Ross supervises the sports area. He organizes programs, classes, and other activities. The facilities are managed by Bruce Gaynes, who oversees the staff for building maintenance and grounds. Sylvia Miller does the bookkeeping and Colleen Weston is the secretary/receptionist.

The following expense report for the past year was given to Jerry Siegel:

Expense items	Amounts
Administrative salaries	$ 227,000
Custodial costs	177,000
Maintenance costs	90,000
Instructor/trainer costs	60,000
Grounds costs	55,000
Heat and electricity	42,000
Water	98,000
Office supplies	13,000
Building depreciation	795,000
Equipment depreciation	130,000
Liability and property insurance	720,000
Advertising	51,000
Telephone	17,000
Newsletter	10,000
Interest	20,000
Postage	11,000
Miscellaneous	27,000
Total Expenses	$2,543,000

Siegel wondered what it cost to operate the apartment units and the sports area. He contacted his CPA, Jay Starkman, who convinced him to install an activity-based costing (ABC) system. Siegel engaged Starkman to do this.

(continued)

Case: Druid Valley Apartments *(continued)*

After discussions with DVA staff, Starkman developed a list of eight activities that seemed to capture the operations at DVA:

No.	Activity
1	Attracting new residents
2	Servicing current residents
3	Maintaining the buildings
4	Maintaining the grounds
5	Cleaning the apartments/sports area
6	Providing recreational programs
7	Collecting rent and fees
8	Sustaining the business

Activity 6, "providing recreational programs," included classes, personal training, resident meetings, and any other events that took place in the sports area. Activity 8, "sustaining the business," is a catchall that includes tasks such as accounting, purchasing, general office management, and human resource management.

Starkman's next task was to assign costs to the eight activities. He asked all DVA administrative personnel to fill out estimates of how they spent their time, on average, during the past year. These estimates were as follows:

	J. Siegel	D. Ross	B. Gaynes	S. Miller	C. Weston
Salary:	$67,000	$48,000	$44,000	$35,000	$33,000
Activity:					
Attracting new residents	10%	5%			
Servicing current residents	20%	20%		15%	10%
Maintaining the buildings	5%		30%		
Maintaining the grounds	5%		25%		
Cleaning the apts./sports area	5%		30%		
Providing rec. programs		65%			
Collecting rent and fees	10%			60%	
Sustaining the business	45%	10%	15%	25%	90%
Total	100%	100%	100%	100%	100%

Some costs were assigned entirely to one activity. These included interest expense, instructor/trainer costs, custodial costs, maintenance costs, and grounds costs. The latter three costs consist of wages to workers as well as various supplies. Office supplies, equipment depreciation, telephone, postage, and miscellaneous expenses were distributed evenly to all eight activities. The remaining costs were assigned as follows: ***(continued)***

Case: Druid Valley Apartments *(continued)*

Cost	Assignment
Heat and electricity	10% to activity 1; 20% to activity 2; 40% to activity 6; 10% to activity 7; 20% to activity 8
Water	70% to activity 2; 15% to activity 4; 15% to activity 6
Building depreciation	95% to activity 2; 5% to activity 6
Liability and property insurance	60% to activity 2; 10% to activity 6; the remainder evenly
Advertising	90% to activity 1; 10% to activity 6
Newsletter	75% to activity 2; 25% to activity 6

After this cost assignment, Starkman decided to allocate evenly the costs that had been assigned to activity 8 to the other seven activities. Having done this, he then assigned the costs of these seven activities to the one-bedroom units, two-bedroom units, and sports area using the following cost drivers:

Activities	Cost driver	Cost objects
Attracting new residents	Number of units	1-bedroom units, 2-bedroom units
Servicing current residents	Number of residents	1-br. units, 2-br. units, sports area
Maintaining the buildings	square footage	1-br. units, 2-br. units, sports area
Maintaining the grounds	square footage	1-br. units, 2-br. units, sports area
Cleaning the apts./sports area	Number of residents	1-br. units, 2-br. units, sports area
Providing recreational programs		sports area
Collecting rent and fees	Number of residents	1-br. units, 2-br. units, sports area

Questions:

1. Determine the total costs assigned to the one-bedroom units, two-bedroom units, and the sports area. For the apartment units, also compute the costs per unit. Comment on these costs.