

5

Activity-Based Costing and Management

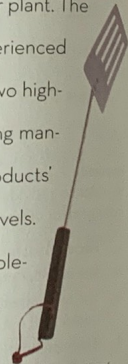
FOCUS COMPANY >>>



© Getty Images/Blend Images RF

THIS CHAPTER'S FOCUS COMPANY is the Patio Grill Company, which manufactures high-end gas barbeque grills in its Denver plant. The company has recently experienced intense competition in its two high-volume product lines, forcing management to drop these products' prices below their target levels. But then management implemented a new costing system, called activity-based costing, or ABC. ABC assigns product costs more accurately than traditional product-costing systems and, armed with the cost insights from the ABC system, management was able to change its pricing structure to compete more effectively in the gas-grill market.

Patio Grill
company



© Ingram Publishing/
SuperStock RF

<<< IN CONTRAST



In contrast to the manufacturing setting of the Patio Grill Company, we explore the use of activity-based costing by Immunity Medical Center in its Primary Care Unit. ABC is used in this health care services setting to assign treatment costs to categories of patient visits, such as routine, extended, and complex visits, as well as new and continuing patients. With a good understanding of how much it costs the Primary Care Unit to provide various types of patient care, the clinic's administration is in a much better position to make decisions about scheduling, services offered, and physician support.

© Sean Locke/Getty Images RF



After completing this chapter, you should be able to:

- 5-1** Compute product costs under a traditional, volume-based product-costing system.
- 5-2** Explain how an activity-based costing system operates, including the use of a two-stage procedure for cost assignment, the identification of activity cost pools, and the selection of cost drivers.
- 5-3** Explain the concept of cost levels, including unit-level, batch-level, product-sustaining-level, and facility-level costs.
- 5-4** Compute product costs under an activity-based costing system.
- 5-5** Explain why traditional, volume-based costing systems tend to distort product costs.
- 5-6** Explain three criteria for selecting cost drivers.
- 5-7** Discuss several key issues in activity-based costing, including data collection and storyboarding.
- 5-8** Explain the concepts of activity-based management and two-dimensional ABC.
- 5-9** Explain and execute a customer-profitability analysis.
- 5-10** Understand and discuss how activity-based costing is used in service-industry organizations.

Major manufacturers worldwide must be nimble to respond to dynamic forces such as the evolving global marketplace, the breakneck pace of technological innovation, and constant advances in operational and business platforms like cloud-based computing. New manufacturing companies have emerged in response to this disruption, companies like camera maker **GoPro** and consumer drone producer **DJI**. And some long-established manufacturers have emerged as world-class producers, while others have fallen by the wayside. World-class companies such as **Caterpillar**, **Coca-Cola**, **Johnson & Johnson**, and **Pfizer** are among the many manufacturers that have changed key business processes to compete effectively in this environment.

The service industry also is undergoing dramatic transformation. App-based platforms and the willingness of businesses to outsource many critical service functions have created many new companies, like **Uber** and **Airbnb**, and caused many service organizations to reinvent the way they do business. Among the many established service-industry firms that have adapted most successfully to the changing business environment are **American Express**, **Bank of America**, **UPS**, **Google**, and **Southwest Airlines**.

What is the role of managerial accounting in this rapidly changing environment? We will begin our exploration of this issue by considering recent events at **Patio Grill Company**.

Traditional, Volume-Based Product-Costing System

Patio Grill Company's Denver plant manufactures three product lines, all high-end gas barbecue grills. The plant's three gas grill lines are the **Patio Standard (STD)**, the **Deluxe (DEL)**, and the **Ultimate (ULT)**. Until recently, the Denver plant used a job-order product-costing system similar to the one described in Chapter 3: the cost of each product was the sum of its actual direct-material cost, actual direct-labor cost, and applied manufacturing overhead, which was applied using a predetermined overhead rate based on direct-labor hours. Exhibit 5-1 provides the basic data upon which the traditional costing system was based.

The Excel spreadsheet in Exhibit 5-2 shows the calculation of the product cost for each of three gas-grill lines (STD, DEL, and ULT). Overhead is applied to the products at the rate of \$24 per direct-labor hour. Notice that all of the Denver plant's budgeted manufacturing overhead costs are lumped together in a single cost pool. This total budgeted overhead amount (\$4,896,000) then is divided by the plant's total budgeted direct-labor hours (204,000 hours). The 204,000 direct labor hours is also equal to the plant's practical capacity for production, as expressed in terms of direct-labor hours.

Patio Grill Company's labor-hour-based product-costing system is typical of many manufacturing companies. Because labor hours are related closely to the volume of activity in the factory, these traditional product-costing systems often are said to be **volume-based (or throughput-based) costing systems**.

Learning Objective 5-1

Compute product costs under a traditional, volume-based product-costing system.

Patio Grill
company

Exhibit 5-1

Basic Production and Cost Data: **Patio Grill Company**

Patio Grill
company

	Patio Standard Grill STD	Deluxe Grill DEL	Ultimate Grill ULT
Planned annual production:			
Volume in units	10,000	8,000	2,000
Production runs	80 runs of 125 units each	80 runs of 100 units each	40 runs of 50 units each
Direct material	\$100	\$120	\$180
Direct labor	\$180 (9 hours	\$220 (11 hours	\$260 (13 hours
(not including setup time)	@ \$20 per hour)	@ \$20 per hour)	@ \$20 per hour)
Machine hours (MH)			
per product unit	10 MH	12 MH	17 MH
Total machine hours	100,000	96,000	34,000
consumed by product line	(10 MH × 10,000 units)	(12 MH × 8,000 units)	(17 MH × 2,000 units)

Patio Grill Company - Excel

	A	B	C	D	E	F	G
		STD		DEL		ULT	
1							
2							
3	Direct material	\$ 100.00		\$ 120.00		\$ 180.00	
4	Direct labor						
5	(not including set-up time)	180.00 (9 hr. @ \$20)		220.00 (11 hr. @ \$20)		260.00 (13 hr. @ \$20)	
6	Manufacturing overhead*	216.00 (9 hr. @ \$24)		264.00 (11 hr. @ \$24)		312.00 (13 hr. @ \$24)	
7	Total cost	\$ 496.00		\$ 604.00		\$ 752.00	
8							
9							
10	*Calculation of predetermined-overhead rate:						
11							
12	Budgeted manufacturing overhead	\$ 4,896,000					
13							
14	Direct labor, budgeted hours:						
15	STD: 10,000 units × 9 hours	90,000					
16	DEL: 8,000 units × 11 hours	88,000					
17	ULT: 2,000 units × 13 hours	26,000					
18	Total direct-labor hours	204,000					
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74							
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							
95							
96							
97							
98							
99							
100							

Exhibit 5-2

Product Costs from Traditional, Volume-Based Product-Costing System: **Patio Grill Company**

Patio Grill
company

Exhibit 5-3

Target and Actual Selling
Prices: Patio Grill CompanyPatio Grill
company

	Patio Standard Grill STD	Deluxe Grill DEL	Ultimate Grill ULT
Production cost under traditional, volume-based system (Exhibit 5-2)	\$496.00	\$604.00	\$752.00
Target selling price (cost $\times$ 120%)	595.20	724.80	902.40
Actual current selling price	585.00	705.00	940.00

Trouble in Denver

The profitability of Patio Grill Company's Denver operation has been faltering in recent years. The company's pricing policy has been to set a target price for each grill equal to 120 percent of the full product cost. Thus, the desired prices were determined as shown in Exhibit 5-3. Also shown are the actual prices that Patio Grill Company has been obtaining for its products. Due to price competition from other grill manufacturers, the company's Standard (STD) grills were selling at \$585, approximately \$10 below their target price of \$595.20. Moreover, Patio Grill Company's competition had forced management to reduce the price of the Deluxe grill (DEL) to \$705, almost \$20 below its target price of \$724.80. Even at this lower price, the sales team was having difficulty getting orders for its planned volume of Deluxe grill production.

Fortunately, the disappointing profitability of the Patio Standard and Deluxe model grills was partially offset by greater-than expected profits on the Ultimate (ULT) line of grills. Patio Grill Company's sales personnel had discovered that the company was swamped with orders when the Ultimate grill's target price of \$902.40 was charged. Consequently, in response to market demand management had raised the price on the Ultimate grills several times, and eventually the product was selling well for \$940. Even at this price, Patio Grill Company's customers did not seem to hesitate to place orders.

Moreover, the company's competitors did not mount a challenge in the market for the Ultimate line of grills. Patio's management was pleased to have a niche for the Ultimate grill market, which appeared to be a highly profitable, low-volume specialty product. Nevertheless, concern continued to mount in Denver about the difficulty in the Patio Standard and Deluxe grill markets. After all, these were the Denver plant's bread-and-butter products, with projected annual sales of 10,000 Patio Standard grills and 8,000 Deluxe grills.

Activity-Based Costing System

Learning Objective 5-2

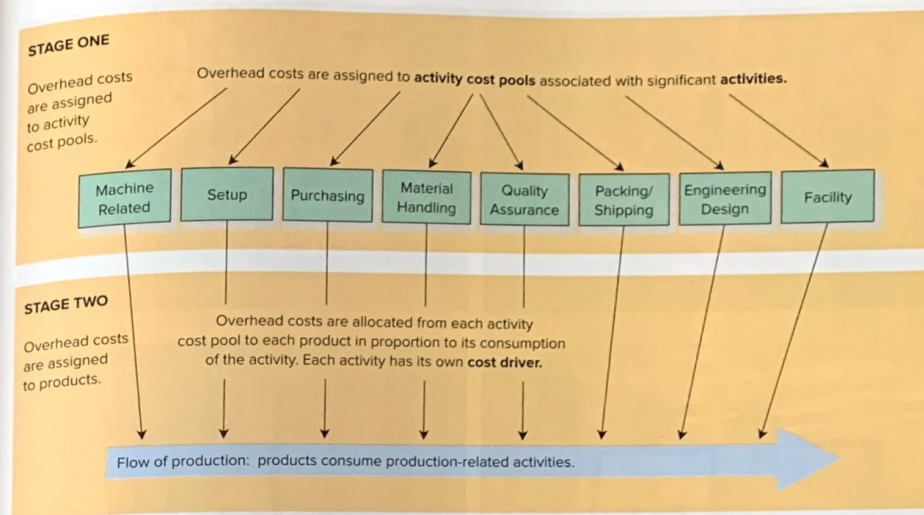
Explain how an activity-based costing system operates, including the use of a two-stage procedure for cost assignment, the identification of activity cost pools, and the selection of cost drivers.

Patio Grill Company's director of cost management, Hunter Burger, had been thinking for some time about a refinement in the Denver plant's product-costing system. He wondered if the traditional, volume-based system was providing management with accurate data about product costs. Burger had read about **activity-based costing (ABC) systems**, which follow a two-stage procedure to assign overhead costs to products. The first stage identifies significant activities in the production of the three products and assigns overhead costs to each activity in accordance with the cost of the organization's resources used by the activity. The overhead costs assigned to each activity comprise an **activity cost pool**.

After assigning overhead costs to activity cost pools in stage one, cost drivers appropriate for each cost pool are identified in stage two. Then the overhead costs are allocated from each activity cost pool to each product line in proportion to the amount of the cost driver consumed by the product line.

The two-stage cost-assignment process of activity-based costing is depicted in Exhibit 5-4.

Burger discussed activity-based costing with Esperanza Alvarez-Cook, the assistant director of cost management. Together they met with all of Patio Grill Company's department supervisors to discuss development of an ABC system. After initial discussion, an ABC proposal was made to the company's top management. Approval was obtained, and an

Exhibit 5-4
Activity-Based Costing
System

ABC project team was formed, which included Burger, Alvarez-Cook, and representatives of various functional departments. Through several months of painstaking data collection and analysis, the project team was able to gather the data necessary to implement an ABC system.

ABC Stage One

Patio Grill Company's ABC project team identified eight activity cost pools, which fall into four broad categories.

1. **Unit level.** This type of activity must be done for each unit of production. The machine-related activity cost pool represents a **unit-level activity** since every product unit requires machine time.
2. **Batch level.** These activities must be performed for each batch of products, rather than each unit. Patio Grill Company's **batch-level activities** include the setup, purchasing, material handling, quality assurance, and packing/shipping activity cost pools.
3. **Product-sustaining level.** This category includes activities that are needed to support an entire product line but are not performed every time a new unit or batch of products is produced. Patio Grill Company's project team identified engineering design costs as a **product-sustaining-level activity** cost pool.
4. **Facility (or general operations) level.** **Facility-level activities** are required in order for the entire production process to occur. Examples of such activity costs include plant management salaries, plant depreciation, property taxes, plant maintenance, and insurance.

This classification of activities into unit-level, batch-level, product-sustaining-level, and facility-level activities is called a **cost hierarchy**.

Patio Grill Company's eight activity cost pools are depicted in Exhibit 5-5. Notice that the total overhead cost for all eight activity cost pools, \$4,896,000, is shown at the top of the exhibit. This amount is the same as the total overhead cost shown in Exhibit 5-2, which shows the details of the product costs calculated under Patio Grill Company's traditional product-costing system.

Learning Objective 5-3

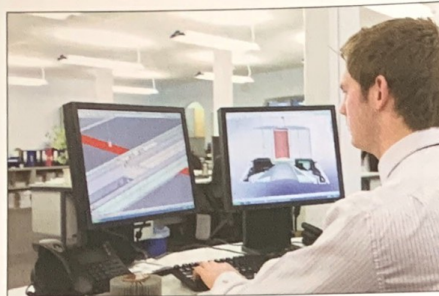
Explain the concept of cost levels, including unit-level, batch-level, product-sustaining-level, and facility-level costs.



© Culture Creative/Alamy RF



© Alistar Berg/Digital Vision/Getty Images RF



© Juice Images/Alamy RF



© Glow Images RF

The hierarchy of costs attempts to classify costs in a way that allows them to be applied to products or services more accurately. Here is an example from manufacturing. Upper left: When direct material is applied to products, the amount used is proportional to the number of units of product produced, so it is classified as a **unit-level activity**. Upper right: This forklift operator is engaged in material handling, which is usually a **batch-level activity** in an ABC system because multiple units of varying amounts can be handled in one move. Lower left: When used by manufacturing engineers in a company, the depreciation of a computer-aided-design (CAD) system would be related to the **product-sustaining-level activity** of product support. Lower right: Once the commitment has been made to have a manufacturing facility, its related costs (insurance, taxes, depreciation, etc.) are incurred regardless of what happens inside, so it is usually classified as a **facility-level activity**.

ABC Stage Two

Learning Objective 5-4

Compute product costs under an activity-based costing system.

In stage two of the activity-based costing project, Burger and Alvarez-Cook identified cost drivers for each activity cost pool. Then they used a three-step process to compute unit activity costs for each of Patio Grill Company's three product lines, and for each of the eight activity cost pools. In the following sections, we will discuss in detail how stage two of the ABC project was carried out for the various activity cost pools identified in stage one. Then we will complete the ABC project by developing new product costs for each of the company's gas-grill product lines.

Machine-Related Cost Pool Let's begin by focusing on only one of the eight activity cost pools. The machine-related cost pool, a unit-level activity, totals \$1,242,000 and includes the costs of machine maintenance, depreciation, computer support, lubrication, electricity, and calibration. Burger and Alvarez-Cook selected machine hours for the cost driver, since a product that uses more machine hours should bear a larger share of machine-related costs. Exhibit 5-6 shows how machinery costs are assigned to products in stage two of the ABC analysis. Notice that the exhibit includes just a portion of a larger spreadsheet that we will examine in due course. The spreadsheet rows shown in Exhibit 5-6 focus just on the machine-related activity cost pool. Most of the columns in

Exhibit 5-5
Stage One of Activity-Based Costing: Identification of Activity Cost Pools

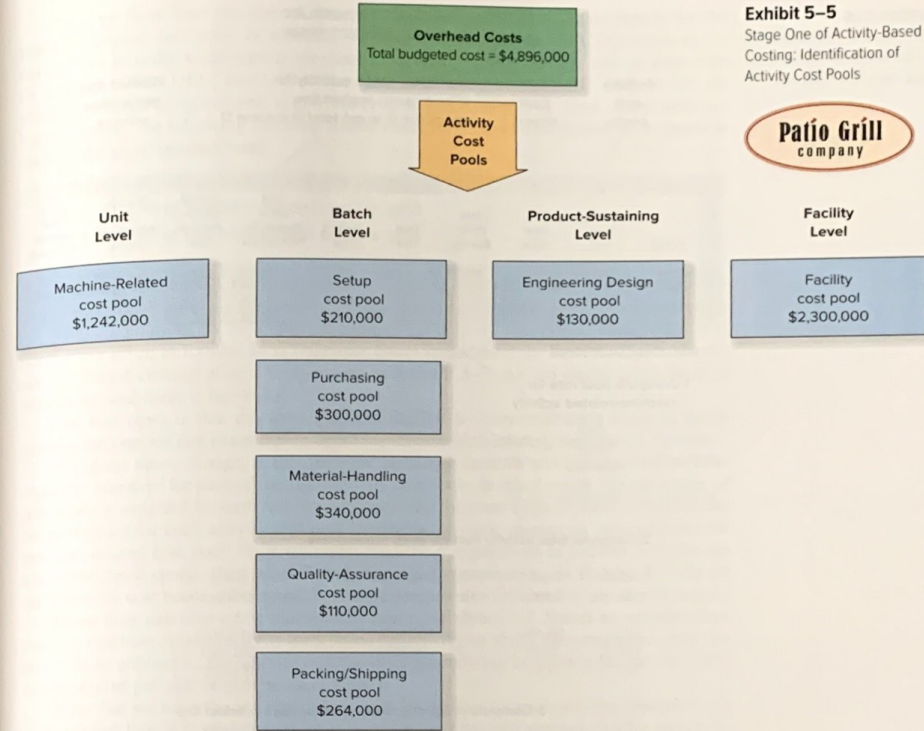


Exhibit 5-6 contains ABC data that were collected by the ABC project team. We will learn more later in this chapter about how that information is collected. For now, though, let's just take this ABC information as a given. As noted in Exhibit 5-6, the following columns contain data collected by the ABC project team.

Data Collected by ABC Project Team (Exhibit 5-6)

Column A	Activity: machine related
Column B	Activity cost pool: \$1,242,000 (from Exhibit 5-5)
Column C	Cost driver: machine hours
Column D	Cost driver quantity: 230,000 machine hours (total of machine hours for the three product lines in column G) ¹
Column E	Product lines: STD, DEL, ULT
Column F	Cost driver quantity for each product line (from Exhibit 5-1): STD: 100,000 machine hours DEL: 96,000 machine hours ULT: 34,000 machine hours
Column I	Product line production volume (from Exhibit 5-1): STD: 10,000 units DEL: 8,000 units ULT: 2,000 units

¹The 230,000 machine hours used to compute the pool rate for the machine-related cost pool is also equal to management's estimate of the company's practical capacity of production, as expressed in terms of machine hours.

Patio Grill Company - Excel									
=J6+J10+J14+J18+J22+J26+J30+J34									
	A	B	C	D	E	F	G	H	I
	Activity	Cost Pool	Cost Driver	Pool Rate	Product Line	Cost Driver Quantity for Product Line	Activity Cost for Product Line	Product Line Production Volume	Activity Cost per Unit of Product
1									
2									
3									
4									
5									
6	Machine	\$ 1,242,000	Machine	230,000	\$ 5.40	STD	100,000	\$ 540,000	10,000
7	Related		Hours			DEL	96,000	518,400	8,000
8						ULT	34,000	183,600	2,000
9						Total	230,000	\$ 1,242,000	
10	Setup	210,000	Production	200	1,050.00	STD	80	\$ 84,000	10,000
11			Runs			DEL	80	84,000	8,000
12						ULT	40	42,000	2,000
13						Total	200	\$ 210,000	
14	Purchasing	300,000	Purchase	600	500.00	STD	200	\$ 100,000	10,000
15			Orders			DEL	192	96,000	8,000
16						ULT	208	104,000	2,000
17						Total	600	\$ 300,000	
18	Material	340,000	Production	200	1,700.00	STD	80	\$ 136,000	10,000
19	Handling		Runs			DEL	80	136,000	8,000
20						ULT	40	68,000	2,000
21						Total	200	\$ 340,000	
22	Quality	110,000	Inspection	2,200	50.00	STD	800	\$ 40,000	10,000
23	Assurance		Hours			DEL	800	40,000	8,000
24						ULT	600	30,000	2,000
25						Total	2,200	\$ 110,000	
26	Packing/	264,000	Shipments	2,200	120.00	STD	1,000	\$ 120,000	10,000
27	Shipping					DEL	800	96,000	8,000
28						ULT	400	48,000	2,000
29						Total	2,200	\$ 264,000	
30	Engineering	130,000	Engineering	1,300	100.00	STD	500	\$ 50,000	10,000
31	Design		Hours			DEL	400	40,000	8,000
32						ULT	400	40,000	2,000
33						Total	1,300	\$ 130,000	
34	Facility	2,300,000	Machine	230,000	10.00	STD	100,000	\$ 1,000,000	10,000
35			Hours			DEL	96,000	960,000	8,000
36						ULT	34,000	340,000	2,000
37						Total	230,000	\$ 2,300,000	
38									
39	Grand Total	\$ 4,896,000				Grand Total	\$ 4,896,000	Total Overhead by Product	
40								STD	\$ 207.00
41								DEL	246.30
42								ULT	427.80

Exhibit 5-7

Activity-Based Costing Data and Calculations: Patio Grill Company

Patio Grill
company

grills at the old target price of \$724.80," said Burger to Alvarez-Cook, as they looked over the data. "Our competitors probably knew their deluxe grills cost around \$586 to produce, and they priced them accordingly." When he got to the ULT column in Exhibit 5-9, Burger was appalled. "We thought those ultimate grills were a winner," lamented Burger. "but we've been selling them at a price that is only 8 percent over what it costs us to make them!" (Burger had made this calculation: actual current selling price of \$940 ÷ ABC product cost of \$867.80.) "And worse yet," Burger continued, "we've been selling the ultimate grills for more than one-hundred dollars below the new target price of \$1,041.36." After looking over the data, Burger made a beeline for the president's office. "We've got to get this operation straightened out," he thought.

Burger also realized that the comparison of the two product-costing systems was even more striking when he focused on just the reported overhead costs. He commented

Patio Grill Company - Excel									
=SUM(D9:D16)									
	A	B	C	D	E	F	G	H	I
		STD	DEL	ULT					
1									
2									
3	Direct material	\$ 100.00	\$ 120.00	\$ 180.00					
4	Direct labor								
5	(not including set-up time)	180.00 (9 hr. @ \$20)	220.00 (11 hr. @ \$20)	260.00 (13 hr. @ \$20)					
6	Total direct costs per unit	\$ 280.00	\$ 340.00	\$ 440.00					
7									
8	Manufacturing overhead (based on ABC):*								
9	Machine-related	\$ 54.00	\$ 64.80	\$ 91.80					
10	Setup	8.40	10.50	21.00					
11	Purchasing	10.00	12.00	24.00					
12	Material handling	13.60	17.00	34.00					
13	Quality assurance	4.00	5.00	10.00					
14	Packing/shipping	12.00	12.00	24.00					
15	Engineering design	5.00	5.00	10.00					
16	Facility	100.00	120.00	170.00					
17	Total ABC overhead cost per unit	\$ 207.00	\$ 246.30	\$ 427.80					
18	Total product cost per unit	\$ 487.00	\$ 586.30	\$ 867.80					
19									
20	*ABC overhead costs from Exhibit 5-7								
21									

Exhibit 5-8

Product Costs from Activity-Based Costing System: Patio Grill Company

Patio Grill
company

to Alvarez-Cook, "The direct-material and direct-labor costs for each product line don't change under ABC. They're the same under both costing systems. Since these are direct costs, it's straightforward to trace these costs to each product with considerable accuracy. It's the overhead costs that cause the problem." To see what Burger was getting at, look again at Exhibit 5-9 and focus on the top two rows. The overhead cost of a STD grill dropped from the old reported cost of \$216 to \$207 under ABC. Similarly, the overhead cost of a DEL grill dropped from the old reported cost of \$264 to \$246.30 under ABC. Now look at the ULT column, though. Here the overhead cost rose from the old reported cost of \$312 to \$427.80 under ABC! This represents an increase of more than a third. (\$427.80 ÷ \$312.00 is a little over 137 percent, which yields an increase of over 37 percent.)

The Punch Line

What has happened at Patio Grill Company's Denver plant? The essence of the problem is that the traditional, volume-based costing system was overcosting the high-volume product lines (STD and DEL) and undercosting the complex, relatively low-volume product line (ULT). The high-volume products basically subsidized the low-volume line. The

Learning Objective 5-5

Explain why traditional, volume-based costing systems tend to distort product costs.

	STD	DEL	ULT
Reported unit overhead cost:			
Traditional volume-based costing system (Exhibit 5-2)	\$216.00	\$264.00	\$ 312.00
Activity-based costing system (Exhibit 5-8)	207.00	246.30	427.80
Reported unit product cost (direct material, direct labor, and overhead):			
Traditional volume-based costing system (Exhibit 5-2)	496.00	604.00	752.00
Activity-based costing system (Exhibit 5-8)	487.00	586.30	867.80
Sales price data:			
Original target price (120% of product cost based on traditional volume-based costing system (Exhibit 5-3))	595.20	724.80	902.40
New target price (120% of product cost based on activity-based costing system)	584.40	703.56	\$1,041.36
Actual current selling price (Exhibit 5-3)	585.00	705.00	940.00

Exhibit 5-9

Comparison of Product Costs and Target Prices from Alternative Product-Costing Systems: Patio Grill Company

Patio Grill
company

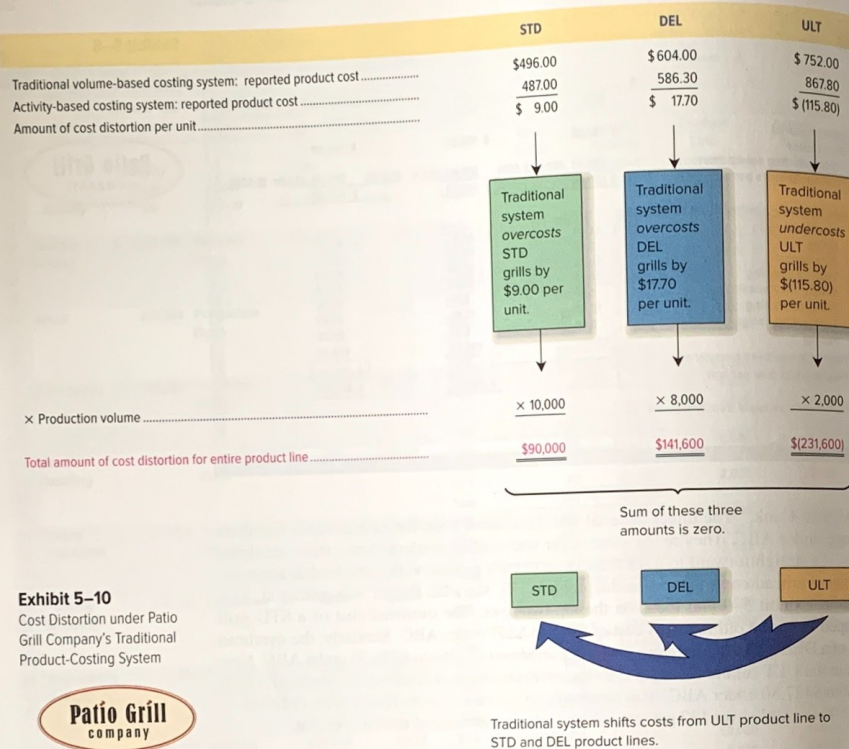


Exhibit 5-10

Cost Distortion under Patio Grill Company's Traditional Product-Costing System



activity-based costing system revealed this problem by more accurately assigning overhead costs to the three product lines.

Exhibit 5-10 summarizes the effects of the cost distortion under the traditional product-costing system. Patio Grill Company's traditional system *overcosted* each STD grill by \$9.00, for a total of \$90,000 for the STD product line on a volume of 10,000 units. Each DEL grill was *overcosted* by \$17.70, for a total of \$141,600 on a volume of 8,000 units for the DEL product line. These excess costs had to come from somewhere, and that place was the ULT product line. Each ULT grill was *undercosted* by \$115.80, for a total of \$231,600 for the ULT product line on a volume of 2,000 units. Notice that the *total* amount by which the STD and DEL grill lines were overcosted equals the *total* amount by which the ULT grill line was undercosted.

Why Traditional Volume-Based Systems Distort Product Costs

Why did Patio Grill Company's traditional product-costing system distort its product costs? The answer lies in the use of a single, volume-based cost driver. The company's old costing system assigned overhead to products on the basis of their relative usage of direct labor. Since the STD and DEL grill lines use substantially more direct labor than the ULT grill line, *in total*, the traditional system assigned them more overhead costs.

The problem with this result is that for every one of Patio Grill Company's overhead activities, the proportion of the activity actually consumed by the ULT grill line is far greater than its low volume would suggest. The ULT grill line has a budgeted production volume of just 2,000 units, which is only 10 percent of Patio Grill Company's total budgeted production volume of 20,000 units. (20,000 units = 10,000 STD units + 8,000 DEL units + 2,000 ULT units.) Now examine the ABC calculations in Exhibit 5-7. Focus on column G, which details the consumption of the cost driver by each product line for each activity cost pool. Notice that for every one of the overhead activities, the ULT grill line consumes much more than a 10 percent share of the activity, even though the ULT line represents only 10 percent of budgeted production volume. The relatively heavy consumption of overhead activities by the ULT product line is due to its greater complexity and small production runs. We must conclude, therefore, that direct labor is not a suitable cost driver for Patio Grill Company's overhead costs. Usage of direct labor does not drive most overhead costs in this company.

There are actually two factors working against Patio Grill Company's old product-costing system. First, many of the activities that result in the company's overhead costs are *not* unit-level activities. Second, the company manufactures a *diverse set of products*.

Non-Unit-Level Overhead Costs When Patio Grill Company's ABC project team designed the activity-based costing system, only the machine-related overhead cost pool was classified as a unit-level activity. All of the other activities were classified as batch-level, product-sustaining-level, or facility-level activities. This means that many of the company's overhead costs are not incurred every time a unit is produced. Instead, many of these overhead costs are related to starting new production batches, supporting an entire product line, or running the entire operation. Since direct labor is a unit-level cost driver, it fails to capture the forces that drive these other types of costs. In Patio Grill Company's new ABC system, cost drivers were chosen that were appropriate for each activity cost pool. For example, since setting up machinery for a new production run is a batch-level activity, the number of production runs is an appropriate batch-level cost driver.

Product Diversity Patio Grill Company manufactures three different products. Although all three are gas barbecue grills, the three grills are quite different. The STD and DEL grills are high-volume, relatively simple products. The ULT grills constitute a considerably more complex, and relatively low-volume, product line. As a result of this *product line diversity*, Patio Grill Company's three product lines consume overhead activities in different proportions. For example, compare the *consumption ratios* for the purchasing and material-handling activity cost pools shown below. The **consumption ratio** is the proportion of an activity consumed by a particular product.

Activity Cost Pool	Consumption Ratios*		
	STD	DEL	ULT
Purchasing activity (cost driver is purchase orders, or POs)	200 POs (33%)	192 POs (32%)	208 POs (35%)
Material-handling activity (cost driver is production runs)	80 runs (40%)	80 runs (40%)	40 runs (20%)

*The purchase order and production run data come from Exhibit 5-7.

These widely varying consumption ratios result from Patio Grill Company's product line diversity. A single cost driver will not capture the widely differing usage of these activities by the three products. The activity-based costing system uses two different cost drivers to assign these costs to the company's diverse products.

Management Accounting Practice

Rockwell International (now part of Meritor)

COST DISTORTION AT ROCKWELL INTERNATIONAL

When managers at **Rockwell International** noticed erratic sales in one of the company's lines of truck axles, they investigated. One of the company's best axle products was losing market share. A special cost study revealed that the firm's costing system, which applied costs to products in proportion to direct-labor costs, had resulted in major distortions. The reported product costs for high-volume axles were approximately 20 percent too high, and the low-volume axles were being undercosted by roughly 40 percent. The firm's practice of basing prices on reported product costs resulted in the overpricing of the high-volume axles. As a consequence, Rockwell's competitors entered the market for the high-volume axle business.²

Two Key Points To summarize, each of the following characteristics will undermine the ability of a volume-based product-costing system to assign overhead costs accurately.

- *A large proportion of non-unit-level activities.* A unit-level cost driver, such as direct labor, machine hours, or throughput, will not be able to assign the costs of non-unit-level activities accurately.
- *Product diversity.* When the consumption ratios differ widely between activities, no single cost driver will accurately assign the resulting overhead costs.

When either of these characteristics is present, a volume-based product-costing system is likely to distort product costs.

Activity-Based Costing: Some Key Issues

"Before the industry really became wide open in long distance competition [as the result of deregulation], you could get by with knowing less. You could get by with having price structures that were not based on the underlying activities and the costs associated with those activities, but were instead based on broad averages. It was okay. It worked. But it's not good enough anymore. We have to get more precise in our costs. We have to deliver the kinds of prices to our customers that they're willing to pay." (5a)

TELUS

Patio Grill Company's movement toward activity-based costing is typical of cost system enhancements made in many companies. Added domestic and foreign competition is forcing manufacturers to strive for a better understanding of their cost structures. Moreover, the cost structures of many manufacturers have changed significantly over the past decade. Years ago, a typical manufacturer produced a relatively small number of products that did not differ much in the amount and types of manufacturing support they required. Labor was the dominant element in such a firm's cost structure. Now, products are more numerous, tailored to more market segments, more complicated to produce, and vary more in their production requirements. Perhaps most important, labor has become a very small part of total production costs, less than five percent in many manufacturing companies. Just go to YouTube and look for one of the many manufacturing videos there: lots of machines and robots, not so many people.

All these factors mean manufacturers must take a close look at their traditional, volume-based costing systems and consider a move toward a more sophisticated approach to product costing. Among the many well-known manufacturers that have benefited from ABC are **Boise Cascade**, **Caterpillar**, **Coca-Cola**, **Chrysler**, **Hewlett-Packard**, **John Deere**, **Johnson & Johnson**, **Pennzoil**, and **Pfizer**, to name only a few.

The service sector also has undergone dynamic change in recent years. Increasing competition, outsourcing of key business processes, and the growth of the Internet have changed many service companies' business models. As their business environment changes, many service-industry firms have made use of activity-based costing. Service

²For up to date information about Meritor, see *The New York Times* (Business Day Section), March 1, 2013. The information about Meritor's Rockwell axles is from Ford S. Worthy, "Accounting Bores You? Wake Up," *Fortune* 116, no. 8, pp. 43–53. For another example of cost distortion, see S. L. Mintz, "Compaq's Secret Weapon," *CFO* 10, no. 10, pp. 93–97.

companies benefiting from ABC include **American Airlines**, **American Express**, **AT&T**, **Blue Cross/Blue Shield**, **DHL Express**, **FedEx**, **Genworth**, and **Toronto Dominion Bank**, among many others. Governmental units also have implemented activity-based costing. Among the governmental units that have benefited from ABC are such diverse organizations as the **British Navy**, the **California Department of Taxation**, the **City of Indianapolis**, and several agencies of the U.S. government, including the **Citizenship and Immigration Services**, the **Internal Revenue Service**, the **Veterans Affairs Department**, and the **U.S. Postal Service**.

An important factor in the move toward ABC systems is related to the information requirements of such systems. The data required for activity-based costing are more readily available than in the past. Increasing automation, coupled with sophisticated real-time information systems, provides the kind of data necessary to implement highly accurate product-costing systems. Some key issues related to activity-based costing systems are discussed in the following sections.

Cost Drivers

A **cost driver** is a characteristic of an event or activity that results in the incurrence of costs. In activity-based costing systems, an organization's most significant cost drivers are identified. Then a database is created, which shows how these cost drivers are distributed across products. Three factors are important in selecting appropriate cost drivers.

Learning Objective 5-6

Explain three criteria for selecting cost drivers.

"BIG DATA" AND ACTIVITY-BASED COSTING AT DHL EXPRESS

DHL Express, a division of the German logistics company **Deutsche Post AE**, provides international express mail services. DHL ships packages to 220 countries and territories throughout the world. Management at DHL found that it wasn't taking advantage of the masses of available data to gain insights about the company's operations and performance. Such masses of data, often called "big data," are challenging for companies like DHL to analyze, but they offer tantalizing opportunities for companies to outperform their competition - if they can work through the mass of data. (We discuss big data in greater depth in chapter 6.)

In order to access those insights, DHL "used data that already existed and then linked that to operational databases, billing systems to get revenue and customer information. We're in a very competitive industry. We have to distinguish ourselves from the competition, and one of the biggest advantages is data." But they found that some of the data that was needed wasn't collected, and the cost accounting system had distorted costs between the various types of express transport services the firm provided. "We couldn't produce a standard cost of shipment or pickup because we didn't have the data. We couldn't distinguish fixed and variable costs." For example, before implementation of a full activity-based costing system at DHL, express transport services provided to banks appeared to be unprofitable, whereas transport services provided to heavy manufacturers appeared to be highly profitable. "This was bad news because we [DHL] had a lot more banking customers than heavy manufacturing customers." After fully implementing ABC, however, management found that the previous costing system had used cost drivers that failed to account for costs and activities associated with package weights, thereby overcosting services to banks and undercosting those to heavy manufacturers. The ABC analysis revealed that express transport services to banks were actually quite profitable after all.³

Management Accounting Practice

DHL Express (now a division of Deutsche Post AE)

³See Joanne Chiu, "DHL to Expand Asia Operations," *The Wall Street Journal Asia Business*, June 21, 2012, p. 1; Taylor Provost, "How DHL's Big Data Boosts Performance," *CFO.com*, January 30, 2013; and S. Player and C. Cobble, *Cornerstones of Decision Making: Profiles of Enterprise ABM* (Greensboro, NC: Oakhill Press, 1999), pp. 131–44.

1. **Degree of correlation.** The central concept of an activity-based costing system is to assign the costs of each activity to product lines on the basis of how each product line consumes the cost driver identified for that activity. The idea is to *infer* how each product line consumes the activity by *observing* how each product line consumes the cost driver. Therefore, the accuracy of the resulting cost assignments depends on the *degree of correlation* between consumption of the activity and consumption of the cost driver.

Say that inspection cost is selected as an activity cost pool. The objective of the ABC system is to assign inspection costs to product lines on the basis of their consumption of the inspection activity. Two potential cost drivers come to mind: number of inspections and hours of inspection time. If every inspection requires the same amount of time for all products, then the number of inspections on a product line will be highly correlated with the consumption of inspection activity by that product line. On the other hand, if inspections vary significantly in the time required, then simply recording the number of inspections will not adequately portray the consumption of inspection activity. In this case, hours of inspection time would be more highly correlated with the actual consumption of the inspection activity.

2. **Cost of measurement.** Designing any information system entails cost-benefit trade-offs. The more activity cost pools there are in an activity-based costing system, the greater will be the accuracy of the cost assignments. However, more activity cost pools also entail more cost drivers, which results in greater costs of implementing and maintaining the system.

Similarly, the higher the correlation between a cost driver and the actual consumption of the associated activity, the greater the accuracy of the cost assignments. However, it also may be more costly to measure the more highly correlated cost driver. Returning to our example of the inspection activity, it may be that inspection hours make a more accurate cost driver than the number of inspections. It is likely, however, that inspection hours also will be more costly to measure and track over time.

3. **Behavioral effects.** Information systems have the potential not only to facilitate decisions but also to influence the behavior of decision makers. This can be good or bad, depending on the behavioral effects. In identifying cost drivers, an ABC analyst should consider the possible behavioral consequences. For example, in a just-in-time (JIT) production environment, a key goal is to reduce inventories and material-handling activities to the absolute minimum level possible. The number of material moves may be the most accurate measure of the consumption of the material-handling activity for cost assignment purposes. It also may have a desirable behavioral effect of inducing managers to reduce the number of times materials are moved, thereby reducing material-handling costs.

Dysfunctional behavioral effects are also possible. For example, the number of vendor contacts may be a cost driver for the purchasing activity of vendor selection. This could induce purchasing managers to contact fewer vendors, which could result in the failure to identify the lowest-cost or highest-quality vendor.

Collecting ABC Data

The output of an organization's various departments consists of the activities performed by personnel or machines in those departments. Activities usually result in paperwork or the generation of computer documents. For example, engineering departments typically deal with documents such as specification sheets and engineering change orders. Purchasing departments handle requisitions and orders, which may be either hard-copy or computer documents. In an ABC system, analysis of documents such as these can be

"ABC is not a magic bullet, but it is a tool to help you understand your business better." (5b)

Braas Company

"After the initial run-through, we completed a separate analysis detailing how many times a [cost] driver was used. We performed a sort of cost-benefit analysis. We gave each [cost] driver a grade, such as how easy would the driver be to collect." (5c)

John Deere Health Care, Inc.
(now part of
UnitedHealthcare)

Learning Objective 5-7

Discuss several key issues in activity-based costing including data collection and storyboarding.

used to assign the costs of activities to product lines on the basis of the amount of activity generated by each product.

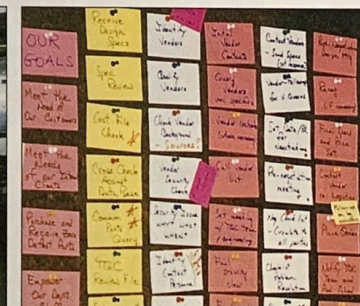
Interviews and Paper Trails The information used in Patio Grill Company's ABC system came initially from extensive interviews with key employees in each of the organization's support departments and a careful review of each department's records. In the engineering area, for example, ABC project team members interviewed each engineer to determine the breakdown of time spent on each of the three products. They also examined every engineering change order completed in the past two years. The team concluded that engineering costs were driven largely by engineering hours and that the breakdown was 500 hours for the STD grill line, 400 hours for the DEL grill line, and 400 hours for the ULT grill line.

Storyboarding As Patio Grill Company's project team delved further into the ABC analysis, they made considerable use of another technique for collecting activity data. **Storyboarding** is a procedure used to develop a detailed process flowchart, which visually represents activities and the relationships among the activities. A storyboarding session involves all or most of the employees who participate in the activities oriented toward achieving a specific objective. A facilitator helps the employees identify the key activities involved in their jobs. These activities are written on small cards and placed on a large board in the order they are accomplished. Relationships among the activities are shown by the order and proximity of the cards. Other information about the activities is recorded on the cards, such as the amount of time and other resources that are expended on each activity and the events that trigger the activity. After several storyboarding sessions, a completed storyboard emerges, recording key activity information vital to the ABC project. Historically, storyboards have been used by Walt Disney and other film producers in the development of plots for animated films. More recently, storyboarding has been used by advertising agencies in developing event sequences for TV commercials.

Storyboarding provides a powerful tool for collecting and organizing the data needed in an ABC project. Patio Grill Company's ABC project team used storyboarding very effectively to study each of the firm's activity cost pools. The team concluded that purchasing costs were driven by the number of purchase orders. Material-handling costs were driven by the number of production runs. Quality-assurance costs were driven by the number of inspection hours devoted to each product line. Packaging and shipping costs were driven by the number of shipments made.



© ColorBlind Images/Getty Images RF



© Ronald W. Hilton

Interviews with department personnel and storyboarding sessions are often used by activity-based costing project teams to accumulate the data needed for an ABC study. In the interview sessions, an ABC project team member asks departmental employees to detail their activities, as well as the time and other resources consumed by the activities. Storyboards, like the one depicted here, visually show the relationships between the activities performed in an organization.

"We were negotiating fees, and the customer was under the impression that they were paying more than they should. . . . To make this customer comfortable with the pricing, we needed a [more accurate] costing system." (5d)

Dana Commercial Credit
Corporation

In summary, the ABC project team conducted a painstaking and lengthy analysis involving many employee interviews, the examination of hundreds of documents, and storyboarding sessions. The final result was the data used in the ABC calculations depicted in Exhibits 5-7 and 5-8.

Multidisciplinary ABC Project Teams In order to gather information from all facets of an organization's operations, it is essential to involve personnel from a variety of functional areas. A typical ABC project team includes accounting and finance people as well as engineers, marketing personnel, production and operations managers, and so forth. A multidisciplinary project team not only designs a better ABC system but also helps in gaining credibility for the new system throughout the organization.

Activity Dictionary and Bill of Activities

Many organizations' ABC teams compile an **activity dictionary**, which is a complete listing of the activities identified and used in the ABC analysis. An activity dictionary helps in the implementation of activity-based costing across several divisions of an organization, because it provides for consistency in the ABC system terminology and the complexity of the ABC analyses in the various divisions.

A **bill of activities** is another commonly used element in an ABC analysis. A bill of activities for a product or service is a complete listing of the activities required for the product or service to be produced. As a familiar analogy, think about a recipe for chocolate chip cookies. The *bill of materials* for the cookies is the list of ingredients provided in the recipe. The *bill of activities* is the list of steps given in the recipe for making the cookies (e.g., combine ingredients in a bowl, stir in chocolate chips, place spoon-size globs of dough on greased cookie sheet, bake at 375° for 10 minutes or until done).

"Having a plant-level activity dictionary allows the plant to manage its activities locally and serves as a standard reference that employees can use to see which activities roll up into which processes." (5e)

Navistar International Corporation

Activity-Based Management

Learning Objective 5-8

Explain the concepts of activity-based management and two-dimensional ABC.

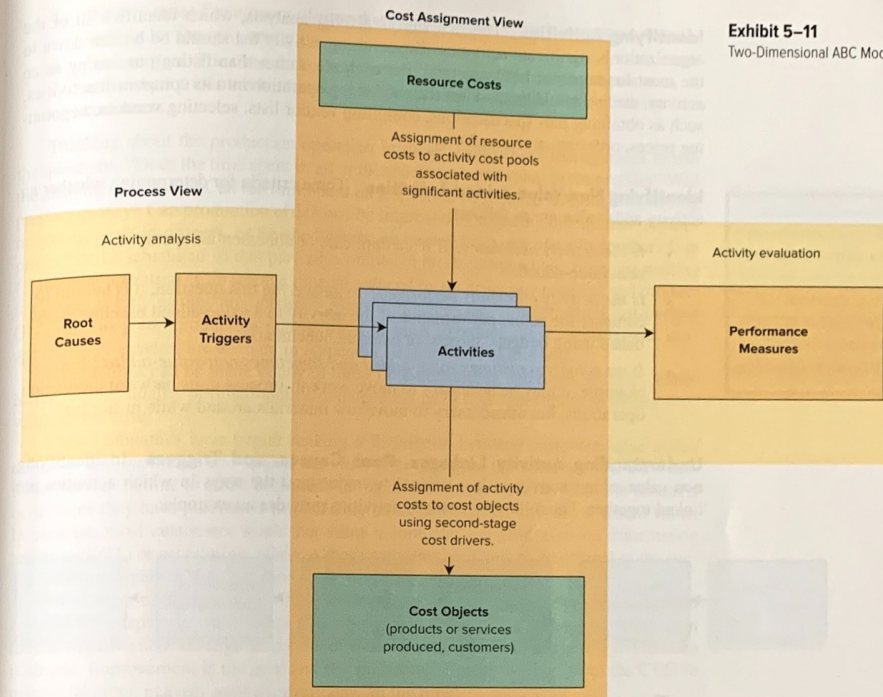
Using activity-based costing (ABC) information to support organizational strategy, improve operations, and manage costs is called **activity-based management** or **ABM**. We have already caught a glimpse of activity-based management earlier in this chapter, where the management of Patio Grill Company used ABC information to better understand its product-pricing decisions. The company's management discovered through the ABC analysis that some products were overcosted and some products were undercosted by their traditional product-costing system. This important insight presented management with the opportunity to revise its product pricing in order to reflect the more accurate product costs provided by the ABC analysis. When management followed up on this product-pricing opportunity, it was engaging in activity-based management. However, ABM is a much broader concept than this. Activity-based management involves any use of ABC information to support the organization's strategy, improve operations, or manage activities and their resulting costs.

Two-Dimensional ABC

One way of picturing the relationship between ABC and ABM is in terms of the **two-dimensional ABC model** depicted in Exhibit 5-11.⁴ The vertical dimension of the model depicts the cost assignment view of an ABC system. From the *cost assignment viewpoint*, the ABC system uses two-stage cost allocation to *assign* the costs of resources to the firm's cost objects. These cost objects could be products manufactured, services produced, or customers served.

⁴This section draws on Lewis J. Soloway, "Using Activity-Based Management in Aerospace and Defense Companies," *Journal of Cost Management* 6, no. 4 (Winter 1993), pp. 56-66; and Peter B. B. Turney, "What an Activity-Based Cost Model Looks Like," *Journal of Cost Management* 5, no. 4 (Winter 1992), pp. 54-60.

Exhibit 5-11
Two-Dimensional ABC Model



Now focus on the horizontal dimension of the model. Depicted here is the *process view* of an ABC system. The emphasis now is on the activities themselves, the various processes by which work is accomplished in the organization. The left-hand side of Exhibit 5-11 depicts **activity analysis**, which is the detailed identification and description of the activities conducted in the enterprise. Activity analysis entails identification not only of the activities but also of their *root causes*, the events that *trigger* activities, and the *linkages* among activities. The right-hand side of Exhibit 5-11 depicts the evaluation of activities through performance measures. It is these processes of *activity analysis* and *evaluation* that comprise activity-based management. Notice that the *activities*, which appear in the center of both dimensions in Exhibit 5-11, are the focal point of ABC and ABM.

Using ABM to Identify Non-Value-Added Activities and Costs

An important goal of activity-based management is to identify and eliminate non-value-added activities and costs. **Non-value-added activities** are operations that are either (1) unnecessary and dispensable or (2) necessary, but inefficient and improvable.⁵ **Non-value-added costs**, which result from such activities, are the costs of activities that can be eliminated without deterioration of product quality, performance, or perceived value. The following five steps provide a strategy for eliminating non-value-added costs in both manufacturing and service industry firms.

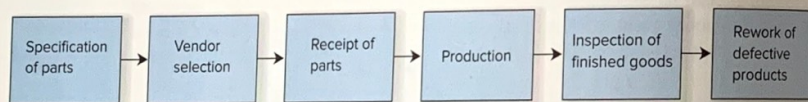
⁵This definition, as well as other material in this section, is drawn from James A. Brimson, "Improvement and Elimination of Non-Value-Added Costs," *Journal of Cost Management* 2, no. 2 (Summer 1988), pp. 62-65.

Identifying Activities The first step is activity analysis, which identifies all of the organization's significant activities. The resulting activity list should be broken down to the most fundamental level practical. For example, rather than listing purchasing as an activity, the list should break down the purchasing operation into its component activities, such as obtaining part specifications, compiling vendor lists, selecting vendors, negotiating prices, ordering, and expediting.

Identifying Non-Value-Added Activities Three criteria for determining whether an activity adds value are as follows:

- *Is the activity necessary?* If it's a duplicate or nonessential operation, it is non-value-added.
- *Is the activity efficiently performed?* In answering this question, it is helpful to compare the actual performance of the activity to a value-added baseline established using budgets, targets, or external benchmarks.
- *Is an activity sometimes value-added and sometimes non-value-added?* For example, it may be necessary to move work-in-process units between production operations, but unnecessary to move raw materials around while in storage.

Understanding Activity Linkages, Root Causes, and Triggers In identifying non-value-added activities, it is critical to understand the ways in which activities are linked together. The following chain of activities provides an example:



The rework of defective units is a non-value-added activity. The rework is triggered by the identification of defective products during inspection. The root cause of the rework, however, could lie in any one of a number of preceding activities. Perhaps the part specifications were in error. Possibly an unreliable vendor was selected. Maybe the wrong parts were received. Perhaps the production activity is to blame.

A set of linked activities (such as that depicted above) is called a **process**. Sometimes activity analysis is referred to as **process value analysis (PVA)**.

Reporting Non-Value-Added Costs Non-value-added costs should be highlighted in activity center cost reports. By identifying non-value-added activities, and reporting their costs, management can strive toward the ongoing goals of process improvement and elimination of non-value-added costs.

One approach that cost-management analysts find helpful in identifying non-value-added activities is to categorize the ways in which time is spent in a production process. Let's return to our illustration of Patio Grill Company's Denver plant, where gas barbecue grills are manufactured. How is time spent in the plant from the time raw material arrives until a finished gas grill is shipped to a customer? As in most manufacturing operations, time is spent in the following five ways.

1. **Process time.** The time during which a product is undergoing conversion activity.
2. **Inspection time.** The amount of time spent ensuring that the product is of high quality.
3. **Move time.** The time spent moving raw materials, work in process, or finished goods between operations.

4. **Waiting time.** The amount of time that raw materials or work in process spend waiting for the next operation.
5. **Storage time.** The time during which materials, partially completed products, or finished goods are held in stock before further processing or shipment to customers.

Thinking about the production operation in these terms allows management to ask the questions, "Does the time spent in all of these activities add value to the product? Will the customer pay for it? Can the time spent on inspection be reduced without diminishing product quality? Can production efficiency be improved by reducing the number of times materials, work-in-process, or finished goods are moved from one place to another? Can production be scheduled so that partially completed products spend less time just waiting for the next operation? Can storage time be reduced by ordering raw material and producing products only as they are needed?" Many companies have implemented just-in-time (JIT) inventory and production management systems to reduce move, waiting, and storage time. JIT systems are covered in Appendix III at the end of this text.

If reductions can be made in any of these time-consuming activities, without diminishing product quality or functionality, management has a real opportunity to reduce non-value-added costs.

Some companies have begun making a distinction between *customer-value-added activities* and *business-value-added activities*. For example, the addition of a 24/7 customer-service hotline to assist customers in maximizing their benefits from the products or services they have purchased would likely be an activity that customers would value. In contrast, most customers would not value a company's expenditures on information technology (IT) or accounting, whereas these activities are likely to be critical to the success of the company's business model.

One widely used approach to cost reduction during a production process is **kaizen costing**. This Japanese word refers to continual and gradual cost reduction, rather than radical improvement through major innovation or investments in technology. The idea is simple. Improvement is the goal and responsibility of every worker, from the CEO to manual laborers, in every activity, every day, all the time!

Customer-Profitability Analysis

It is quite possible for a company to have profitable products and, at the same time, incur customer-related costs that make certain customer relationships unprofitable. **Customer-profitability analysis** uses activity-based costing to determine the activities, costs, and profit associated with serving particular customers. Suppose, for example, that customer X frequently changes its orders after they are placed, but customer Y typically does not. Then the costs incurred in updating sales orders for changes should be recorded in a manner that reflects the fact that customer X is more responsible for those activities and costs than is customer Y. An effective cost management system should allow managers to derive such cost details.

Many factors can result in some customers being more profitable than others. Customers that order in small quantities, order frequently, often change their orders, require special packaging or handling, demand faster delivery, or need special parts or engineering design generally are less profitable than customers who demand less in terms of customized services. If managers have a good understanding of which customers are generating the greatest profit, they can make more-informed decisions about customer service. Moreover, this allows customers to be educated as to the costs they are causing when demanding special services. In many cases, customers' behavior can be changed in a way that reduces costs to the supplier. Then these cost savings can be shared by the supplier and the customer.

The task of assigning costs to customers is a challenge. A system must be in place that enables the company to identify which customers are using customer support services and how frequently they do so. How much time must the company spend on a customer to make

Learning Objective 5-9

Explain and execute a customer-profitability analysis.

"You would be surprised. You put a bunch of people in a room to describe how a process works, and they don't all agree with each other - and they all work on the same process." (5f)
Dr Pepper Snapple Group

the sale and to provide ongoing support services? These costs are in addition to the cost of manufacturing the product or initially providing a service for the customer.

Illustration of Customer-Profitability Analysis

To illustrate customer-profitability analysis, let's focus again on Patio Grill Company. Two more years have passed, and the company has successfully implemented its activity-based costing system in its Denver plant. At a recent strategy meeting with her senior management team, Patio Grill Company's president and CEO expressed interest in assessing the profitability of the entire company's various customer relationships. She found support for the idea from the director of cost management, who had been reading about customer-profitability analysis in some of his professional journals. The company's marketing manager also expressed interest in customer-profitability analysis, since he was concerned about the profitability of a couple of Patio Grill Company's customers in particular. "We have a few customers who seem to want the moon and the stars when it comes to customer service," he complained. "I know the customer is always right and all, but you really have to wonder if we're making any money from a couple of these customers, what with all the extra design and packaging they demand. And some of our other customers seem to require an awful lot of extra attention in sales calls, order processing, and billing. If we had a better idea of each customer's profitability, it would help our marketing and sales staffs to focus their efforts."

The controller soon had his cost management staff attacking the customer-profitability analysis that the president had requested. The first step required an activity-based costing analysis of certain *customer-related costs* that could seriously affect a customer's profitability. Recall that ABC analysis relies on a cost hierarchy with cost levels, such as unit-level, batch-level, product-line-level, customer-level, and facility- or general-operations-level costs. In this use of activity-based costing, the cost management team is focusing on the customer-related costs. After an extensive analysis and several interviews with personnel throughout Patio Grill Company, the cost management team came up with the ABC analysis in Exhibit 5-12.⁶

Based on the activity-based costing information, the cost management team assessed the profitability of each of Patio Grill Company's customer relationships. Detailed information from that analysis for five of these customers appears in the Excel spreadsheet in Exhibit 5-13. These five customers were singled out because three of them are key customers (i.e., customers 106, 112, and 113), and two of them (107 and 119) were suspected by the marketing manager to be at best marginally profitable. As it turned out, suspicions about customers 107 and 119 were well founded. Both customers were found to be unprofitable; in fact, customer 119 had caused a loss of almost \$120,000 during the year.

A complete customer-profitability analysis for all of Patio Grill Company's customers appears in the spreadsheet in Exhibit 5-14. This exhibit reveals several interesting aspects of the company's customer-profitability profile. Seventeen of 20 customers are profitable.

Exhibit 5-12

ABC Analysis for Customer-Related Costs: Patio Grill Company

Patio Grill
company

Customer-Related Activities	Cost Driver Base	Cost Driver Rate
Order processing.....	Purchase orders.....	\$ 150
Sales contacts (phone calls, faxes, etc.).....	Contacts.....	100
Sales visits.....	Visits.....	1,000
Shipment processing.....	Shipments.....	200
Billing and collection.....	Invoices.....	160
Design/engineering change orders.....	Engineering/design changes.....	4,000
Special packaging.....	Units packaged.....	40
Special handling.....	Units handled.....	60

⁶An important point that could be overlooked here is that activity-based costing analysis can be used in a very specific, targeted manner to address a particular management problem. In this case, the ABC focus is customer-profitability analysis. This is the essence of activity-based management, using the results of an ABC analysis to manage an enterprise more effectively.

Patio Grill Company - Excel					
Designated Customers (by 3-Digit Customer Code)					
	Customer 106	Customer 107	Customer 112	Customer 113	Customer 119
1 Sales revenue	\$ 4,320,000	\$ 3,480,000	\$ 6,500,000	\$ 4,490,000	\$ 1,960,000
2 Cost of goods sold	3,220,000	2,810,000	4,890,000	3,380,000	1,480,000
3 Gross margin	\$ 1,100,000	\$ 670,000	\$ 1,610,000	\$ 1,110,000	\$ 480,000
4 Selling and administrative costs:					
5 General selling costs	\$ 362,000	\$ 220,000	\$ 530,000	\$ 366,000	\$ 160,000
6 General administrative costs	181,000	110,000	265,000	183,000	80,000
7 Customer-related costs:					
8 Order processing	11,100	80,250	16,050	22,200	38,400
9 Sales contacts	22,000	13,400	32,000	24,100	28,800
10 Sales visits	44,000	20,000	47,000	38,000	32,000
11 Shipment processing	33,000	27,800	64,200	44,600	19,200
12 Billing and collection	33,600	14,000	80,480	22,400	9,600
13 Design/engineering changes	93,000	96,000	84,000	112,000	68,000
14 Special packaging	88,000	27,200	64,440	44,480	76,800
15 Special handling	33,000	80,400	48,300	33,300	86,400
16 Total customer-related costs	357,700	359,050	436,470	341,080	359,200
17 Total selling and administrative costs	\$ 900,700	\$ 689,050	\$ 1,231,470	\$ 890,080	\$ 599,200
18 Operating income	\$ 199,300	\$ (19,050)	\$ 378,530	\$ 219,920	\$ (119,200)

Exhibit 5-13
Customer-Profitability
Analysis for Five Designated
Customers: Patio Grill
Company

Patio Grill
company

CUSTOMER PROFITABILITY ANALYSIS AT BANK ONE CORP.

The *Wall Street Journal* described how **Bank One Corp.** (now part of **JPMorgan Chase**) has used customer-profitability analysis to guide decisions about customer service.

At Bank One Corp., at the time one of the largest banks, "the line in the sand between preferred and nonpreferred customers has become strikingly obvious." The bank redesigned its 218 branches in Louisiana so that its "Premier One" customers could be whisked away to a special teller window with no wait, or to the desk of an appropriate bank officer. "Customers qualify by keeping at least \$2,500 in a checking account or a total of \$25,000 in a combination of certain bank accounts," or by paying a \$17 monthly fee. "Management estimates that the extra attention will go only to the top 20 percent of its customers."⁷

Management
Accounting
Practice

Bank One Corp. (now
part of JPMorgan Chase)

The three unprofitable customers (107, 134, and 119) resulted in losses of over \$240,000 in operating income for Patio Grill Company in a single year! Notice that over 25 percent of the company's profit is generated by its top three customers. Almost half the company's profit comes from its top six customers, and fully three-quarters of its profit is generated by half its customers. This sort of customer-profitability profile is quite typical for manufacturers. The lion's share of most companies' profits comes from a handful of customers. Such an insight is important for management as it determines where to devote the company's resources in serving customers.⁸

A graphical portrayal of Patio Grill Company's complete customer-profitability analysis is given in Exhibit 5-15. This graph, formally called a **customer-profitability profile**, but more commonly referred to as a "whale chart" because of its characteristic shape, is a common and useful way of presenting the insights from customer-profitability analysis to management.

"Almost any person in any organization that implements ABM has some real surprises when they start seeing the data about customer profitability and product profitability." (Sh)

Shiloh Industries, Inc.

⁷"Alienating Customers Isn't Always a Bad Idea Many Firms Discover," *The Wall Street Journal*, January 7, 1999.

⁸In a conversation with a vice president from a large consumer-products manufacturer, the author was struck by the executive's statement that, "You can bet we pay a lot of attention to the needs and desires of the 'Mart Brothers,' K and Wal."

Exhibit 5-14

Customer-Profitability
Analysis with Customers
Ranked by Operating
Income: Patio Grill Company

Patio Grill
company

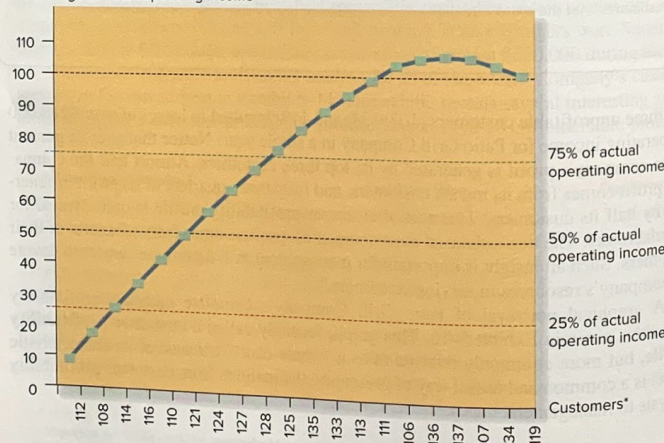
Patio Grill Company - Excel						
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW						
=SUM(D6:D25)						
	A	B	C	D	E	F
	3-Digit Customer Code	Customer Sales Revenue	Customer Gross Margin	Customer Operating Income	Cumulative Operating Income	Cumulative Operating Income as a % of Total Operating Income
1						
2	112	\$ 6,500,000	\$ 1,610,000	\$ 378,530	\$ 378,530	8.8%
3	108	6,964,000	1,570,000	370,000	748,530	17.3%
4	114	6,694,000	1,484,300	351,000	1,099,530	25.5%
5	116	5,846,000	1,461,600	340,000	1,439,530	33.4%
6	110	5,602,000	1,430,000	336,070	1,775,600	41.1%
7	121	5,400,000	1,413,000	331,000	2,106,600	48.8%
8	124	5,601,000	1,405,520	330,000	2,436,600	56.5%
9	127	5,090,000	1,280,020	300,000	2,736,600	63.4%
10	128	4,760,000	1,160,200	281,400	3,018,000	69.9%
11	125	5,000,200	1,181,000	276,000	3,294,000	76.3%
12	135	4,431,000	1,150,000	270,000	3,564,000	82.6%
13	133	4,008,000	1,059,800	251,400	3,815,400	88.4%
14	113	4,490,000	1,110,000	219,920	4,035,320	93.5%
15	111	4,200,000	875,220	205,000	4,240,320	98.2%
16	106	4,320,000	1,100,000	199,300	4,439,620	102.9%
17	136	1,920,000	351,200	82,000	4,521,620	104.8%
18	137	1,641,000	139,400	35,600	4,557,220	105.6%
19	107	3,480,000	670,000	(19,050)	4,538,170	105.1%
20	134	2,820,000	582,000	(102,600)	4,435,570	102.8%
21	119	1,960,000	480,000	(119,200)	4,316,370	100.0%
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

Exhibit 5-15

Customer-Profitability Profile in Terms of Cumulative Operating Income as a Percentage of Total Operating Income: Patio Grill Company

Patio Grill
company

Cumulative Operating Income as a Percentage of Total Operating Income



*Customers ranked by operating income.

Activity-Based Costing in the Service Industry

We conclude this chapter with the important point that activity-based costing has found widespread usage in the service industry as well as in manufacturing. There have been many ABC success stories in such diverse organizations as airlines, insurance companies, banks, hospitals, financial services firms, hotels, railroads, and government agencies. Among the service organizations that have used activity-based costing are *Air France*, *American Airlines*, *American Express*, *Bank of America*, *Cambridge Health Alliance*, *City of Indianapolis*, *FedEx*, *Owens & Minor*, *Telus*, *Union Pacific*, *U.S. Naval Supply Center*, and the *U.S. Postal Service*.

The overall objectives of ABC in service firms are no different than they are in manufacturing companies. Managers want more accurate information about the cost of producing the services they are selling. Moreover, they want to use this information to improve operations and to better meet the needs of their customers in a more cost-effective manner. The general approach of identifying activities, activity cost pools, and cost drivers is used in the service industry as well as in manufacturing. The classification of activities into unit-level, batch-level, product-sustaining-level, and facility-level activities also applies in service industry settings. For example, a *Blue Cross Blue Shield* health insurance program in Pennsylvania used these activity classifications in its ABC system.⁹ Examples from the Blue Cross Blue Shield system are as follows:

- **Unit level:** Entering initial claim data into the computer (for each claim received).
- **Batch level:** Moving a batch of claims from one processing step to the next.
- **Product-sustaining level:** Maintenance of the medical-services provider network (i.e., maintaining relationships with physicians and hospitals providing medical care to claimants).
- **Facility (general operations) level:** General administration of the claims business unit.

Time-Driven Activity-Based Costing

A version of ABC that has found wide acceptance in service-industry settings is called **time-driven activity-based costing (TDABC)**. In TDABC, costs are generally assumed to be driven by the time taken to perform various activities. As such, it is a simplified form of activity-based costing, and the time-driven element is well aligned with service industries where the resources deployed are often associated with labor and the amount of resources provided can be readily expressed in units of time. An overhead rate per time unit (typically cost per minute) can be calculated by dividing the cost of production overhead by the *practical capacity* of the company's resources expressed in time (minutes). The cost of an activity is simply the overhead cost per minute multiplied by the number of minutes the activity is expected to take.

The TDABC approach has two main advantages over conventional ABC:

- It is much easier to collect the time-based resource and activity data than it is to collect data on the variety of measures used in conventional ABC, many of which are not normally tracked by the company.
- Because the time-driven cost driver rate is calculated based on the practical capacity of the (often human) resources provided to perform the activities, the TDABC system will not assign costs to products or services for capacity that is (or should be) unused, instead leaving it unapplied as cost of excess capacity.

⁹Angela Norkiewicz, "Nine Steps to Implementing ABC," *Management Accounting* 75, no. 10 (April 1994), pp. 28-33.

Learning Objective 5-10

Understand and discuss how activity-based costing is used in service-industry organizations.

"If you know the true cost of providing care, you can ask yourself whether doing one thing is really more important than doing something else. Our mission statement is: the best medical result at the lowest necessary cost . . . But to do that, I've got to be able to measure and manage those costs." (5)

Intermountain Healthcare

The latter advantage has a dual benefit of assigning less cost to products or services, which makes the managers responsible for them happier, while also highlighting for management the cost associated with having capacity that is unused.¹⁰

Activity-Based Costing at Immunity Medical Center



To see how management can use activity-based costing in a service-industry setting, let's explore how TDABC is used at Immunity Medical Center's Primary Care Unit.¹¹ Immunity Medical Center serves patients in Raleigh, North Carolina, and several surrounding counties. The Primary Care Unit is the medical center's outpatient clinic and provides nearly 25,000 patient appointments in a typical year. The Primary Care Unit's administration implemented time-driven activity-based costing in order to determine how much it costs to serve patients in various categories. The most significant activities, representing almost 80 percent of spending, are time driven, although a few non-time cost drivers are included as well. Overall, it is reasonable to characterize this as a TDABC system. Notice that, consistent with TDABC, the Cost Driver Quantity for each cost driver associated with an activity cost pool is the practical capacity of that cost driver.

The Primary Care Unit classifies patient appointments as routine, extended, or complex, depending on the appointment length and complexity. In addition, each appointment is classified as either a new-patient appointment or a continuing-patient appointment. Thus, every patient appointment is one of the following six types.

	Routine	Extended	Complex
New patient	New patient; routine appointment	New patient; extended appointment	New patient; complex appointment
Continuing patient	Continuing patient; routine appointment	Continuing patient; extended appointment	Continuing patient; complex appointment

Every patient appointment involves a registered nurse (RN), who takes vital signs and prepares the patient for the primary health care professional. Then, every patient is seen by one primary health care professional, which can be a physician, a nurse practitioner, an intern, or a resident. No appointment involves more than one of these types of primary health care professionals.

The Primary Care Unit's TDABC project team designated the following activities and cost drivers.

Activity	Cost Driver
Physician time	Physician minutes with patient
Nurse practitioner time	Nurse practitioner minutes with patient
Intern or resident time	Intern or resident minutes with patient
Registered nurse time	Registered nurse minutes with patient
Clerical time: new patients	New patient visits
Clerical time: continuing patients	Continuing patient visits
Billing	Billing lines (i.e., number of line items on bill)
Facility	Patient visits (both new and continuing)

¹⁰TDABC is covered in greater detail in Cost Accounting texts. For a more detailed introduction to the technique, see Robert S. Kaplan and Steven R. Anderson, "Time-Driven Activity-Based Costing," *Harvard Business Review*, November 2004. For a discussion of the pros and cons of TDABC vs. conventional ABC, see Gary Cokins and Douglas Paul, "Time-Driven or Driver Rate-Based ABC: How Do You Choose?" *Strategic Finance*, February 2016.

¹¹For a thorough discussion of costing in a medical context, including the application of time-driven activity-based costing (TDABC) in that setting, see Robert S. Kaplan and Michael E. Porter, "The Big Idea: How to Solve the Cost Crisis in Health Care," *Harvard Business Review*, September 2011. For a more elaborate example of activity-based costing in a hospital's primary care unit, see V. G. Narayanan, R. Moore, and L. Brem, "Cambridge Hospital Community Health Care Network—The Primary Care Unit" (Boston: The President and Fellows of Harvard College, 2000). In this case, minutes of time with a health care professional is a key cost driver.

Activity	Activity Cost Pool	Cost Driver	Cost Driver Quantity (Practical Capacity)	Pool Rate	Patient Visit Type	Cost Driver Quantity for Patient Visit Type	Activity Cost for Patient Visit Type	Patient Visit Volume	Activity Cost per Patient Visit of Each Type
Physician	\$ 960,000	Physician	240,000	\$ 4.00	Routine	80,000	\$ 320,000	8,000	\$ 40.00
Time		Minutes			Extended	100,000	400,000	5,000	80.00
		With Patient			Complex	60,000	240,000	2,000	120.00
					Total	240,000	\$ 960,000		
Nurse Practitioner	90,000	NP	30,000	3.00	Routine	12,000	36,000	1,200	30.00
(NP) Time		Minutes			Extended	10,000	30,000	500	60.00
		With Patient			Complex	8,000	24,000	320	75.00
					Total	30,000	\$ 90,000		
Intern or Resident	412,500	I/R	125,000	3.30	Routine	40,000	\$ 132,000	4,000	33.00
(I/R) Time		Minutes			Extended	50,000	165,000	2,500	66.00
		With Patient			Complex	35,000	115,500	1,000	115.50
					Total	125,000	\$ 412,500		
Registered Nurse	281,980	RN	245,200	1.15	Routine	132,000	\$ 151,800	13,200	11.50
(RN) Time		Minutes			Extended	80,000	92,000	8,000	11.50
		With Patient			Complex	33,200	38,180	3,320	11.50
					Total	245,200	\$ 281,980		
Clerical Time: New Patients	135,300	New Patient	12,300	11.00	Routine	7,200	\$ 79,200	7,200	11.00
		Visits			Extended	3,000	33,000	3,000	11.00
					Complex	2,100	23,100	2,100	11.00
					Total	12,300	\$ 135,300		
Clerical Time: Continuing Patients	61,100	Continuing Patient	12,220	5.00	Routine	6,000	\$ 30,000	6,000	5.00
		Visits			Extended	5,000	25,000	5,000	5.00
					Complex	1,220	6,100	1,220	5.00
					Total	12,220	\$ 61,100		
Billing	38,480	Billing Lines	76,960	0.50	Routine	26,400	\$ 13,200	13,200	1.00
					Extended	24,000	12,000	8,000	1.50
					Complex	26,560	13,280	3,320	4.00
					Total	76,960	\$ 38,480		
Facility	245,200	Patient Visits	24,520	10.00	Routine	13,200	\$ 132,000	13,200	10.00
		(Both New & Continuing)			Extended	8,000	80,000	8,000	10.00
					Complex	3,320	33,200	3,320	10.00
					Total	24,520	\$ 245,200		
Grand Total	\$2,224,560				Grand Total		\$2,224,560		

Exhibit 5-16

Time-Driven Activity-Based Costing Analysis: Immunity Medical Center



The time-driven activity-based costing analysis is displayed in the Excel spreadsheet in Exhibit 5-16. Notice that this TDABC spreadsheet for Immunity Medical Center's Primary Care Unit has a format that is identical to the ABC spreadsheet prepared for Patio Grill Company (Exhibit 5-7). The column headings are different, because the Primary Care Unit provides medical services to patients, whereas Patio Grill Company manufactures barbecue grills. Conceptually and computationally, however, the two Excel spreadsheets are identical.

The information supplied by the Primary Care Unit's TDABC project team is located in the following columns.

Column A: Activity

Column B: Activity cost pool

Column C: Cost driver

Column D: Cost driver quantity (practical capacity)

Column F: Patient visit type (routine, extended, or complex)

Column G: Cost driver quantity for each type of patient visit

Column I: Patient volume for each type of visit

The TDABC computations are in columns E, H, and J and are shown in red.

Column E: Pool rate

$$\text{Pool rate (column E)} = \frac{\text{Activity cost pool (column B)}}{\text{Cost driver quantity (column D)}}$$

For example, the pool rate for physician time (cell E7) is calculated as follows:

$$\text{\$4.00 per physician minute} = \$960,000 \div 240,000 \text{ minutes of physician time}$$

Column H: Activity cost for patient type

$$\text{Activity cost for patient visit type (column H)} = \frac{\text{Pool rate (column E)}}{\text{visit type (column G)}} \times \text{Cost driver quantity for patient visit type (column G)}$$

For example, the physician activity cost for a routine visit (cell H7) is calculated as follows:

$$\text{\$320,000} = \$4.00 \text{ per physician minute} \times 80,000 \text{ physician minutes on routine visits}$$

Column J: Activity cost per patient visit of each type

$$\text{Activity cost per patient visit of each type (column J)} = \frac{\text{Activity cost for patient visit type (column H)}}{\text{Patient visit type volume (column I)}}$$

For example, the physician activity cost per routine patient visit (cell J7) is calculated as follows:

$$\text{\$40 per routine visit attended by a physician} = \$320,000 \div 8,000 \text{ routine visits attended by a physician}$$

Interpreting the Primary Care Unit's TDABC Information

The Immunity Medical Center Primary Care Unit's administration can use the TDABC information in Exhibit 5-16 to determine the cost of each of the six types of patient appointments discussed earlier. Notice, though, that there is an important conceptual difference in the interpretation of the Primary Care Unit's TDABC data in Exhibit 5-16 versus the interpretation of Patio Grill Company's ABC data in Exhibit 5-7.

In the Patio Grill Company manufacturing illustration, *all eight of the activities* identified in the ABC analysis were required by each line of barbecue grills manufactured. However, that is not true in the Primary Care Unit example. In this health care services setting, each patient sees *either* a physician, *or* a nurse practitioner, *or* an intern, *or* a resident—not all four. Moreover, each patient is *either* a new patient *or* a continuing patient—not both.

Therefore, to compute the cost of a particular type of appointment, we must select *only one of the primary health care professionals*, which are highlighted by the red bar on the right-hand side of Exhibit 5-16. Moreover, we select *just one of the two categories for clerical time*, new patient or continuing patient, which are highlighted by the green bar on the right-hand side of Exhibit 5-16. Finally, since every patient appointment involves a registered nurse, *and* billing, *and* use of the primary care unit facility, *all* of these activities must be included in the cost calculation. (These activities are highlighted by the yellow bars on the right-hand side of Exhibit 5-16.)

Let's compute the cost of an extended appointment in which a new patient sees a nurse practitioner.

Activity	Cost (spreadsheet cell)
Nurse practitioner time	\\$60.00 (cell J12 in Exhibit 5-16)
Registered nurse time	11.50 (cell J20)
Clerical time: new patients	11.00 (cell J24)
Billing	1.50 (cell J32)
Facility	10.00 (cell J36)
Total	<u>\\$94.00</u>

Now let's compute the cost of a routine appointment in which a continuing patient sees a physician.

Activity	Cost (spreadsheet cell)
Physician time	\\$40.00 (cell J7 in Exhibit 5-16)
Registered nurse time	11.50 (cell J19)
Clerical time: continuing patients	5.00 (cell J27)
Billing	1.00 (cell J31)
Facility	10.00 (cell J35)
Total	<u>\\$67.50</u>

With a good understanding of how much it costs the Primary Care Unit to provide various types of patient appointments, the clinic's administration is in a much better position to make decisions. Determining appropriate charges for appointments, justifying third-party reimbursements from insurance companies and government agencies, and adding or discontinuing services are among the types of decisions that will be enhanced by the ABC information.

Focus on Ethics

ETHICAL ISSUES SURROUNDING ACTIVITY-BASED COSTING

Xavier Auto Parts, Inc. manufactures a wide range of auto parts, which it sells to auto manufacturers, primarily in the United States and Canada. The company's Engine Parts Division operated three plants in South Carolina and specialized in engine parts. The division's Charlotte plant manufactured some 6,500 different parts.

Trouble Brewing

Both the Engine Parts Division, as well as the Charlotte plant in particular, had shown satisfactory profitability for the past 20 years. In 2013, however, the Charlotte plant's profitability took a sharp downward turn, in spite of rising sales. The trend continued through the next several years. Management at both the division and plant levels took note of the plant's declining profits and held several strategy meetings as a result.

Division Strategy

The Engine Parts Division had always positioned itself as the industry's full-line producer. If a customer wanted a product, the division would make it. Although occasionally very-low-volume products were discontinued due to lack of consistent orders, the division's product line remained a full line of engine parts. As part of its strategy review, division management did two things. First, an activity-based costing study was initiated in the Charlotte plant in order to give management a better picture of each product line's profitability. Second, a high-level review was undertaken to determine whether the full-line-producer strategy continued to make sense.

Activity-based Costing

An ABC project team was formed, and a successful pilot study was conducted on two of the Charlotte plant's product lines. Then the ABC project was extended to the entire Charlotte operation. Management was astonished to find that fully a quarter of the plant's products were selling at a loss. Moreover, the ABC project highlighted the extent of the product-line proliferation at the Charlotte plant. It turned out that in many instances, unprofitable products had been dropped only to creep back into the product line-up after a customer requested it and a salesperson acquiesced. It became a joke around the plant that the only way to be sure a dropped product was really gone was to burn the engineering drawings and destroy the special tools required to make it.

ABC Team Recommendations

The ABC project team made sweeping recommendations to division management, which suggested that the Charlotte plant's product lines be pruned and that roughly 20 percent of its products be dropped. New emphasis would then be devoted to increasing the profitability of the remaining 80 percent of the Charlotte plant's products. Attention would be given to identifying inefficient processes, and process improvements would be evaluated.

Top Management Response

Top management balked at the recommendations of the ABC project team. Some top managers did not believe the ABC results. It just seemed impossible to them that so many of the Charlotte plant's products were losers. Other members of the management team largely accepted the validity

of the ABC study, but they, too, hesitated to drop so many products. To do so would most likely have meant massive layoffs and even the possibility of closing the Charlotte plant altogether, while shifting its remaining production to the division's other two plants. Some members of the ABC project team quietly speculated that some of the division's managers were more concerned about their own pay and perks than they were about the well-being of the division. In the final analysis, only a handful of products were dropped, and then only if they were suspected to be unprofitable before the ABC study was undertaken.

Aftermath

The Charlotte plant's profits continued to deteriorate, as did the Engine Parts Division's profitability. Eventually, Xavier's corporate management cut its losses by selling off the

Engine Parts Division to a competitor at bargain-basement prices. The division's new owners closed the Charlotte plant and changed the division's focus to be a boutique producer of high-quality engine parts, which was more in line with its own corporate strategy.

Ethical Issues

What ethical issues do you see in this scenario? How would you resolve them?

*The scenario described here, while fictitious, is based on several real-world events described in the ABC literature. Anecdotes in various ABC cases and other sources, as well as the author's research, form the basis for the events described. A key source is the well-known "Schrader-Bellows" case, by R. Cooper (Boston: President and Fellows of Harvard College), which remains a classic case describing issues surrounding activity-based costing.

Chapter Summary

LO5-1 Compute product costs under a traditional, volume-based product-costing system. Traditional product-costing systems are structured on single, volume-based cost drivers, such as direct labor or machine hours. Overhead is applied to production jobs using a predetermined overhead rate, which is based on estimates of manufacturing overhead (in the numerator) and the level of some cost driver (in the denominator).

LO5-2 Explain how an activity-based costing system operates, including the use of a two-stage procedure for cost assignment, the identification of activity cost pools, and the selection of cost drivers. In the first stage of ABC, resource costs are identified and divided into activity cost pools. In the second stage, a cost driver is selected for each activity cost pool, and the costs in each pool are assigned to cost objects, such as products, services, product lines, customers, and so forth.

LO5-3 Explain the concept of cost levels, including unit-level, batch-level, product-sustaining-level, and facility-level costs. Unit-level costs are incurred for each unit produced. Batch-level costs are incurred once for each batch of products (i.e., one production run). Product-sustaining-level costs are incurred once for each product line. Facility-level costs are incurred to keep the overall facility in operation.

LO5-4 Compute product costs under an activity-based costing system. A product's cost is the sum of its direct-material cost, its direct-labor cost, and its overhead cost, which is the accumulation of all the resource costs driven to the product by the various cost drivers selected for the ABC system.

LO5-5 Explain why traditional, volume-based costing systems tend to distort product costs. Traditional, volume-based costing systems tend to distort product costs because of two factors: (1) product-line diversity and (2) non-unit-level overhead costs. No single cost driver can capture the complex relationships between products and the myriad activities necessary to produce and sell them.

LO5-6 Explain three criteria for selecting cost drivers. Three criteria for selecting cost drivers are: (1) the degree of correlation between the cost driver and the incurrence of costs in the activity cost pool associated with the cost driver; (2) the cost of measurement of the cost driver; and (3) the behavioral effects that might result from the selection of a cost driver.

LO5-7 Discuss several key issues in activity-based costing, including data collection and storyboarding. Collecting ABC data is difficult and costly. Techniques for data collection include interviews, examination of work product and other documentation, and sometimes storyboarding, which is a detailed map of the processes used in the organization.

LO5-8 Explain the concepts of activity-based management and two-dimensional ABC. Activity-based management (ABM) is the use of activity-based costing information to improve operations and eliminate non-value-added costs. One way of depicting ABM is the two-dimensional ABC model. This model combines the cost assignment role of ABC with the process and activity evaluation view of an ABC system.

LO5-9 Explain and execute a customer-profitability analysis. Customer profitability analysis is an application of ABM in which management determines the cost drivers for customer-related costs. The resulting ABC information is then used to assess the profitability of key customer relationships.

LO5-10 Understand and discuss how activity-based costing is used in service-industry organizations. Activity-based costing has found widespread successful implementation in the service industry. While structurally similar to ABC in manufacturing, employing the same two-stage costing model, ABC in the service industry often takes the form of time-driven activity-based costing (TDABC). In TDABC, the practical capacity of activities and the quantity of the cost driver are both measured in units of time.

Review Problem on Cost Drivers and Product-Cost Distortion

Edgeworth Box Corporation manufactures a variety of special packaging boxes used in the pharmaceutical industry. The company's Dallas plant is semiautomated, but the special nature of the boxes requires some manual labor. The controller has chosen the following activity cost pools, cost drivers, and pool rates for the Dallas plant's product-costing system.

Activity Cost Pool	Overhead Cost	Cost Driver	Budgeted Level for Cost Driver	Pool Rate
Purchasing, storage, and material handling	\$ 200,000	Raw-material costs	\$ 1,000,000	20% of material cost
Engineering and product design	100,000	Hours in design department	5,000 hrs.	\$20 per hour
Machine setup costs	70,000	Production runs	1,000 runs	\$70 per run
Machine depreciation and maintenance	300,000	Machine hours	100,000 hrs.	\$3 per hour
Factory depreciation, taxes, insurance, and utilities	200,000	Machine hours	100,000 hrs.	\$2 per hour
Other manufacturing-overhead costs	150,000	Machine hours	100,000 hrs.	\$1.50 per hour
Total	<u>\$1,020,000</u>			

Two recent production orders had the following requirements.

	20,000 Units of Box C52	10,000 Units of Box W29
Direct-labor hours	42 hr.	21 hr.
Raw-material cost	\$40,000	\$35,000
Hours in design department	10	25
Production runs	2	4
Machine hours	24	20

Required:

1. Compute the total overhead that should be assigned to each of the two production orders, C52 and W29.
2. Compute the overhead cost per box in each order.
3. Suppose the Dallas plant were to use a single predetermined overhead rate based on direct-labor hours. The direct-labor budget calls for 4,000 hours.
 - a. Compute the predetermined overhead rate per direct-labor hour.
 - b. Compute the total overhead cost that would be assigned to the order for box C52 and the order for box W29.
 - c. Compute the overhead cost per box in each order.
4. Why do the two product-costing systems yield such widely differing overhead costs per box?

Solution to Review Problem

- 1.
- | | Box C52 | Box W29 |
|---|--------------------------|--------------------------|
| Purchasing, storage, and material handling | \$8,000 (20% × \$40,000) | \$7,000 (20% × \$35,000) |
| Engineering and product design | 200 (10 × \$20/hr.) | 500 (25 × \$20/hr.) |
| Machine setup costs | 140 (2 × \$70/run) | 280 (4 × \$70/run) |
| Machine depreciation and maintenance | 72 (24 × \$3/hr.) | 60 (20 × \$3/hr.) |
| Factory depreciation, taxes, insurance, and utilities | 48 (24 × \$2/hr.) | 40 (20 × \$2/hr.) |
| Other manufacturing overhead costs | 36 (24 × \$1.50/hr.) | 30 (20 × \$1.50/hr.) |
| Total overhead assigned to production order | \$8,496 | \$7,910 |
2. Overhead cost: Box C52 = \$0.4248 per box ($\frac{\$8,496}{20,000}$); Box W29 = \$0.79 per box ($\frac{\$7,910}{10,000}$)
3. Computations based on a single predetermined overhead rate based on direct-labor hours:
- a. $\frac{\text{Total budgeted overhead}}{\text{Total budgeted direct-labor hours}} = \frac{\$1,020,000}{4,000} = \$255/\text{hr.}$
- b. Total overhead assigned to each order:
- Box C52 order: 42 direct-labor hours × \$255/hr. = \$10,710
- Box W29 order: 21 direct-labor hours × \$255/hr. = \$5,355
- c. Overhead cost per box:
- Box C52: $\$10,710 \div 20,000 = \0.5355 per box
- Box W29: $\$5,355 \div 10,000 = \0.5355 per box
4. The widely differing overhead costs are assigned as a result of the inherent inaccuracy of the single, volume-based overhead rate. The relative usage of direct labor by the two production orders does not reflect their relative usage of other manufacturing support services.

Key Terms

For each term's definition refer to the indicated page, or turn to the glossary at the end of the text.

activity analysis, 187	consumption ratio, 181
activity-based costing (ABC) system, 172	cost driver, 183
activity-based management (ABM), 186	cost hierarchy, 173
activity cost pool, 172	customer-profitability analysis, 189
activity dictionary, 186	customer profitability profile, 191
batch-level activity, 173	facility-(or general-operations) level activity, 173
bill of activities, 186	

kaizen costing, 189	product-sustaining-level activity, 173
non-value-added activities, 187	storyboarding, 185
non-value-added costs, 187	two-dimensional ABC model, 186
pool rate, 175	unit-level activity, 173
process, 188	volume-based (or throughput-based) costing system, 171
process value analysis (PVA), 188	

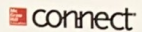
Review Questions

- 5-1. Briefly explain how a traditional, volume-based product-costing system operates.
- 5-2. Why was Patio Grill Company's management being misled by the traditional product-costing system? What mistakes were being made?
- 5-3. Explain how an activity-based costing system operates.
- 5-4. What are cost drivers? What is their role in an activity-based costing system?
- 5-5. List and briefly describe the four broad categories of activities identified in stage one of an activity-based costing system.
- 5-6. How can an activity-based costing system alleviate the problems Patio Grill Company's management was having under its traditional, volume-based product-costing system?
- 5-7. Why do product-costing systems based on a single, volume-based cost driver tend to overcost high-volume products? What undesirable strategic effects can such distortion of product costs have?
- 5-8. How is the distinction between direct and indirect costs handled differently under volume-based versus activity-based costing systems?
- 5-9. Explain the concept of a *pool rate* in activity-based costing. (Refer to Exhibit 5-6.)
- 5-10. Briefly explain two factors that tend to result in product cost distortion under traditional, volume-based product-costing systems.

- 5-11. List three factors that are important in selecting cost drivers for an ABC system.
- 5-12. What is the role of *activity dictionary* in an ABC project?
- 5-13. Explain why a new product-costing system may be needed when line managers suggest that an apparently profitable product be dropped.
- 5-14. Explain why a manufacturer with diverse product lines may benefit from an ABC system.
- 5-15. Are activity-based costing systems appropriate for the service industry? Explain.
- 5-16. Explain why maintaining their medical-services provider network is treated as a product-sustaining-level activity by Blue Cross Blue Shield.
- 5-17. How could the administration at Immunity Medical Center's Primary Care Unit use the information developed by the TDABC project team?
- 5-18. Explain a key difference in the interpretation of the ABC data in Exhibit 5-7 (Patio Grill Company) and the TDABC data in Exhibit 5-16 (Immunity Medical Center).
- 5-19. Explain the concept of *two-dimensional ABC*. Support your explanation with a diagram.
- 5-20. What is meant by the term *activity analysis*? Give three criteria for determining whether an activity adds value.
- 5-21. Distinguish between an activity's trigger and its root cause. Give an example of each.
- 5-22. What is meant by customer-profitability analysis? Give an example of an activity that might be performed more commonly for one customer than for another.
- 5-23. Explain the relationship between customer profitability analysis and activity-based costing.
- 5-24. What is a customer profitability profile?
- 5-25. Describe the use of practical capacity in a TDABC system.

Exercises

All applicable Exercises are available in Connect.



Tioga Company manufactures sophisticated lenses and mirrors used in large optical telescopes. The company is now preparing its annual profit plan. As part of its analysis of the profitability of individual products, the controller estimates the amount of overhead that should be allocated to the individual product lines from the following information.

	Lenses	Mirrors
Units produced	25	25
Material moves per product line	5	15
Direct-labor hours per unit	200	200

The total budgeted material-handling cost is \$50,000.

Required:

1. Under a costing system that allocates overhead on the basis of direct-labor hours, the material-handling costs allocated to one lens would be what amount?
2. Answer the same question as in requirement (1), but for mirrors.
3. Under activity-based costing (ABC), the material-handling costs allocated to one lens would be what amount? The cost driver for the material-handling activity is the number of material moves.
4. Answer the same question as in requirement (3), but for mirrors.

(CMA, adapted)

Urban Elite Cosmetics has used a traditional cost accounting system to apply quality-control costs uniformly to all products at a rate of 14.5 percent of direct-labor cost. Monthly direct-labor cost for Satin Sheen makeup is \$27,500. In an attempt to more equitably distribute quality-control costs, management is considering activity-based costing. The monthly data shown in the following chart have been gathered for Satin Sheen makeup.

Activity Cost Pool	Cost Driver	Pool Rates	Quantity of Driver for Satin Sheen
Incoming material inspection	Type of material	\$11.50 per type	12 types
In-process inspection	Number of units	.14 per unit	17,500 units
Product certification	Per order	77.00 per order	25 orders

Exercise 5-26

Volume-Based Cost Driver versus ABC
(LO 5-1, 5-2, 5-4)

Exercise 5-27

Activity-Based Costing; Quality Control Costs
(LO 5-1, 5-2, 5-4)

The company president recently asked the controller, "Why can't we compete with these other companies? They're selling motors just like our standard model for 106 dollars. That's only a buck more than our production cost. Are we really that inefficient? What gives?"

The controller responded by saying, "I think this is due to an outmoded product-costing system. As you may remember, I raised a red flag about our system when I came on board last year. But the decision was to keep our current system in place. In my judgment, our product-costing system is distorting our product costs. Let me run a few numbers to demonstrate what I mean."

Getting the president's go-ahead, the controller compiled the basic data needed to implement an activity-based costing system. These data are displayed in the following table. The percentages are the proportion of each cost driver consumed by each product line.

Activity Cost Pool	Cost Driver	Product Lines		
		Standard Model	Deluxe Model	Heavy-Duty Model
I. Depreciation, machinery				
Maintenance, machinery	Machine time	40%	13%	47%
II. Engineering				
Inspection and repair of defects	Engineering hours	47%	6%	47%
III. Purchasing, receiving, and shipping				
Material handling	Number of material orders	47%	8%	45%
IV. Depreciation, taxes, and insurance for factory				
Miscellaneous manufacturing overhead	Factory space usage	42%	15%	43%

Required:

1. Compute the target prices for the three models, based on the traditional, volume-based product-costing system.
2. Compute new product costs for the three products, based on the new data collected by the controller. Round to the nearest cent.
3. Calculate a new target price for the three products, based on the activity-based costing system. Compare the new target price with the current actual selling price for the standard-model electric motor.
4. Write a memo to the company president explaining what has been happening as a result of the firm's traditional, volume-based product-costing system.
5. What strategic options does Morelli Electric Motor Corporation have? What do you recommend, and why?

Case 5-69

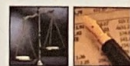
Cost Distortion; Continuation of Preceding Case
(LO 5-2, 5-5)

Traditional system undercosts Deluxe Model by \$222.75 per unit



Case 5-70

Ethical Issues Related to Product-Cost Distortion; Activity-Based Costing; Continuation of Case 5-69
(LO 5-2, 5-5, 5-7)



Refer to the product costs developed in requirement (2) of the preceding case. Prepare a table showing how Morelli Electric Motor Corporation's traditional, volume-based product-costing system distorts the product costs of the standard, deluxe, and heavy-duty models. (You may wish to refer to Exhibit 5-10 for guidance. Because of rounding in the calculation of the product costs, there will be a small rounding error in this cost distortion analysis as well.)

Morelli Electric Motor Corporation's controller, Erin Jackson, developed new product costs for the standard, deluxe, and heavy-duty models using activity-based costing. It was apparent that the firm's traditional product-costing system had been undercosting the deluxe-model electric motor by a significant amount. This was due largely to the low volume of the deluxe-model motor. Before she could report back to the president, Jackson received a phone call from her friend, Alan Tyler. He was the production manager for the deluxe-model electric motor. Tyler was upset, and he let Jackson know it. "Erin, I've gotten wind of your new product-cost analysis. There's no way the deluxe model costs anywhere near what your numbers say. For years and years, this line has been highly profitable, and its reported product cost was low. Now you're telling us it costs more than twice what we thought. I just don't buy it."

Jackson briefly explained to her friend about the principles of activity-based costing and why it resulted in more accurate product costs. "Alan, the deluxe model is really losing money. It simply has too low a volume to be manufactured efficiently."

Tyler was even more upset now. "Erin, if you report these new product costs to the president, he's going to discontinue the deluxe model. My job's on the line, Erin! How about massaging those numbers a little bit. Who's going to know?"

"I'll know, Alan. And you'll know," responded Jackson. "Look, I'll go over my analysis again, just to make sure I haven't made an error."

Required:

Discuss the ethical issues involved in this scenario.

1. Is the controller, Erin Jackson, acting ethically?
2. Is the production manager, Alan Tyler, acting ethically?
3. What are Jackson's ethical obligations? To the president? To her friend?