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20. Using accounting for quality and cost management

Learning objectives

After studying this chapter, you should be able to:

- Describe why managers need good accounting information to be competitive in the new production environment.
- Identify ways to improve quality.
- Develop measures of performance that help achieve high quality.
- Understand how the balanced scorecard helps organizations recognize and deal with opposing responsibilities.
- Explain how just-in-time purchasing and production can reduce costs and improve quality.
- Compare and contrast accounting in just-in-time settings with accounting in traditional settings.
- Define activity-based costing and explain its benefit to companies.
- List the four steps in activity-based costing.
- Compare product costs using activity-based costing with product costs using traditional costing methods.
- Describe the strategic and behavioral advantages of activity-based management.

Importance of good accounting information

Have you ever purchased a product and found it to be defective? If so, you may have sworn to yourself that you would never buy one of those again. By doing so, you have demonstrated why high-quality products are essential for business success. Successful companies remain in business by seeking continual improvement in the quality of their products. For example, Territory Ahead, a merchandising company tells its customers to please hassle them if not completely satisfied. Nordstrom's department stores, Southwest Airlines Company, and Apple . are companies that have built reputations based on the notion of hassle us if you are not completely satisfied.

In its plant near Nashville, Tennessee, USA, Nissan Motor Corporation places some of the previous day's production of cars and trucks in the lobby with charts showing the number of production defects for that day. Displaying products and reporting on performance gives workers a sense of pride in their work and an incentive to reduce defects.

Quality and the new production environment

Attention to quality is an important feature of the new production environment. The phrase, new production environment, refers to an environment in which company managers are concerned with (1) improving customer service and product quality and (2) reducing costs. Both actions are necessary to stay competitive.

In the new production environment, new technology is helping managers improve quality and reduce costs. Computer-assisted manufacturing enables managers to reduce inventories, yet respond quickly to customers' needs. For example, robots perform certain repetitive functions more reliably than humans. Computerized airline reservations systems also provide better customer service at a lower cost to airlines.

The new production environment is rooted in the new management philosophies that we discuss in this chapter. For example, managers now use nonfinancial as well as financial measures of quality performance. Many companies have adopted a just-in-time philosophy for managing purchasing and production. Managerial accountants are restructuring costing systems to provide activity-based costs resulting in better managerial decision making. Many observers believe that United States industry has fallen behind foreign competitors because managers and accountants have not worked together to produce the information management needs to make good decisions.

Improving quality

To make decisions about the costs and benefits of quality, we need to know what those costs and benefits of quality are. Managers at Texas Instruments have placed the costs of quality in these four categories:[2]

- Prevention costs. Prevention costs cover the cost of preventing poor-quality products from being produced. Prevention costs include training employees to do quality work.
- Appraisal costs. Appraisal costs are the costs of detecting poor-quality products. Appraisal costs include the costs of inspecting materials when purchased and product testing during production.
- Internal failure costs. Internal failure costs are the costs of producing poor-quality products detected before products are shipped to customers. Internal failure costs include the costs of reworking poor-quality products to bring their quality up to specifications.
- External failure costs. External failure costs are the costs incurred because customers purchased poor-quality products. External failure costs include the costs of dealing with returned products and future lost profits because customers are dissatisfied.

The manager's task is to minimize the sum of these costs. By incurring substantial costs of prevention, for example, a company might reduce costs of appraisal, internal failure, and external failure costs. This idea is a modern adaptation of the old saying, "An ounce of prevention is worth a pound of cure". Small prevention costs may even result in large cost savings in the other three categories.

Assume Diana's Secret is a company that sells clothing through catalogs. A marketing manager concerned about customer satisfaction noticed a substantial amount of returned merchandise. Upon investigating, the manager discovered that most returns were due to an incorrect color or size; most of these errors could be traced to mistakes made by order takers who had not been adequately trained.

2 "Texas Instruments: Cost of Quality (A)" (Boston: Harvard Business School, Case 9-189-029).

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The company decided to invest USD 5,000 per month in a training program for order takers. After the training program started, the amount of returned merchandise dropped dramatically. Working with people in the marketing department, accountants estimated the company saved USD 4,000 per month by having less returned merchandise and fewer refilled orders. In addition, marketing managers believed Diana's Secret's profits increased by USD 2,000 to USD 10,000 per month because of increased customer satisfaction. Management considered the USD 5,000 cost of prevention to be justified by the benefits of reduced returned merchandise and increased customer satisfaction.

As you already may have figured out, measuring the cost of quality has a major disadvantage. It is difficult to measure increased customer satisfaction (reflected in sales) resulting from additional spending on prevention costs (or any of the four categories), and it is difficult to measure decreased customer satisfaction resulting from a reduction in prevention costs. For example, if prevention costs are reduced, how do we measure lost sales as a result of this reduction? Conversely, how do we measure the increase in sales directly associated with an increase in prevention costs? It is difficult to accurately measure the change in sales specifically resulting from either scenario.

A current theme in business today is that "quality is free". The belief is that if quality is built into the product, the resulting benefits in customer satisfaction, reduced rework and warranty costs, and other important factors far outweigh the costs of improving quality. Cost-benefit analyses are no longer the primary focus in improving quality. Instead, the emphasis is on improving quality with the understanding that quality is free in the long run.

Those who subscribe to the quality is free concept believe that zero defects is the only acceptable goal. The production process should be continuously improved. The result? Quality will improve, customers will be increasingly satisfied, and the cost of improving quality will pay for itself through increased sales and lower costs (providing for increased profit margins).

Although both cost of quality and quality is free concepts strive for improved quality, the cost of quality approach assumes a cost-benefit trade-off when spending money on quality improvement. The quality is free approach assumes that the long-run benefits will always outweigh the costs of improving quality. One thing is for certain: quality is important to the success of any company!

The key quality concept in the new production environment is total quality management. **Total quality management (TQM)** is defined as managing the entire organization so it excels in its goods and services that are important to the customer. The key ideas are that the organization strives for excellence and that quality is ultimately defined by the customer.

Customer-driven quality standards Total quality management means that your goods and services are not excellent until the customer says they are excellent. It is not enough for production managers or engineers to say an automobile is well-designed and produced; customers must say they like it—a lot. TQM means translating customer needs and wants into specifications for product design. Southwest Airlines learned that customers want flights to leave and arrive on time. No amount of free food and beverages served to placate customers made up for late arrivals, missed connections, missed meetings, and missed birthday parties. So Southwest Airlines went to work to improve those things its customers wanted most; namely, on-time departures and arrivals. (Actually, the customers wanted on-time arrivals more than on-time departures, but on-time departures help you on-time arrivals.)

20. Using accounting for quality and cost management

How do companies identify quality problems? Three methods managers use to identify quality problems are the following:

- Control charts.
- Pareto diagrams.
- Cause and effect analyses.

Control charts Control charts help managers distinguish between random or routine variations in quality and variations that should be investigated. For example, the managers of CD, Inc., expect some returned merchandise and do not panic because a customer returns merchandise. They use a control chart to plot data that shows trends or unusually high rates of returned merchandise.

Look at Exhibit 15, a control chart for product defects in producing compact disc players at CD, Inc. Every compact disc player is tested to ensure it works. Those products failing the test are reworked or scrapped, an example of internal failure cost. Management expects an average failure rate of 2 per cent of the daily production. Management has set an upper limit for failure at 4 per cent of daily production. If the failure rate exceeds 4 per cent, management investigates to find out what is causing such a high rate.

Quality testers continuously record failure rates at CD, Inc. Managers can call up the results on their computers at any time. Note in Exhibit 15 that Wednesday's results exceeded the 4 per cent limit. Management investigated the problem Wednesday afternoon and found a machine improperly installing a switch. The machine was fixed Wednesday night and production returned to normal on Thursday.

Illustration 20.1 Control Chart for Defective Products

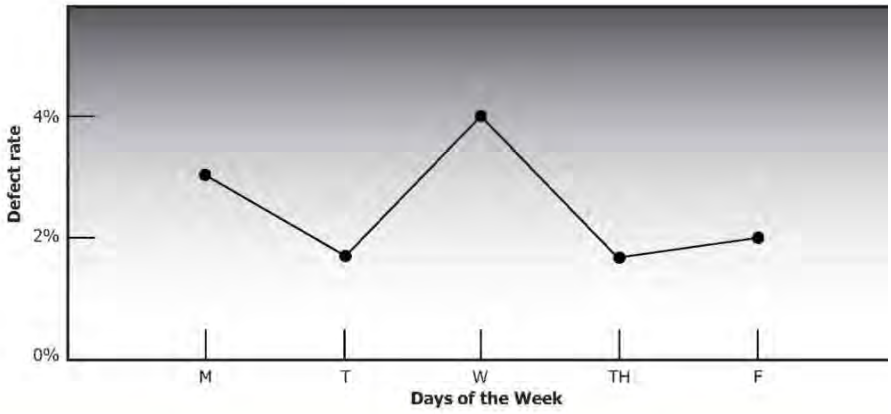

Exhibit 8: Control chart for defective products

Pareto diagrams Pareto diagrams indicate how frequently each type of failure occurs. Note the Pareto diagram for compact disc player production at CD, Inc., in Exhibit 9. Pareto diagrams have more information than simple control charts, but they require quality testers to classify and report defects. Managers learn more about the causes of problems from Pareto diagrams than they do from control charts.

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Illustration 20.2 Pareto Diagram for Production at CD, Inc.

Exhibit 9: Pareto diagram for production at CD, Inc.

Cause-and-effect analysis Cause-and-effect analysis identifies potential causes of defects. Consider the problem of cracked compact disc player cases, for example. Cracked cases could be due to breakage during production, faulty materials, or other handling problems. Managers must know the cause of problems to solve them. It makes no sense to focus on product handling, for example, if the problem is purchasing poor-quality materials.

Quality and customer satisfaction measures

Quality-oriented organizations continually monitor the quality of their products and solicit feedback from customers to assess their satisfaction with goods and services. For instance, in Exhibit 16 the second nonfinancial measure deals with delivery performance. Delivery performance is critical to success for companies such as FedEx, UPS, the US Postal Service, and other delivery services.

Performance measure	**Objective**
1. Quality control	
Number of customer complaints	Create customer satisfaction
Number of defects	Make a high-quality product
2. Delivery performance	
Percentage of on-time deliveries	Increase on-time deliveries
3. Materials waste	
Scrap and waste as a percentage of total materials used	Decrease scrap and waste; improve the quality of products
4. Machine downtime	
Percentage of time machines are not working	Decrease machine downtime; increase on-time delivery to customers

Exhibit 10: Nonfinancial performance measures

The success of Lands' End, L. L. Bean, The Territory Ahead, and other companies that sell through catalogs depends on quick delivery of their merchandise. Bottlers of soft drinks such as PepsiCola and canneries like Campbell Soup require precisely timed deliveries of cans and bottles. Ideally, the truck or railroad car unloads containers right onto the production line.

Nonfinancial performance measures are particularly important to motivate people to provide high-quality products and excellent customer service. For example, Exhibit 16 presents four nonfinancial performance measures used by managers to evaluate performance in providing quality products and service at a reasonable cost.

Quality control The first set of measures in Exhibit 16 reflect quality control. Firms measure their product quality by the number and type of customer complaints or by the number of product defects. By reducing the number of product defects, companies reduce the number of customer complaints. The objective is to increase customer satisfaction with the product, reduce the costs of dealing with customer complaints, and reduce the costs of repairing products or providing a new service.

Delivery performance The second type of nonfinancial measure in Exhibit 16 deals with delivery performance. As we noted earlier, delivery performance is critical for many companies. Domino's Pizza bases its success on delivery service. The objective is to deliver goods and services when promised. To achieve this objective, companies keep track of the percentage of total deliveries that are on time.

Materials waste Companies can take several steps to reduce materials waste, the third type of nonfinancial measure. They can purchase a higher quality of raw materials so there is less waste from defective materials, increase employee training so workers make fewer mistakes, and improve the production process. Reducing waste can improve quality. The causes of waste are often the causes of poor quality. For example, waste may reflect poor training of employees. Improving training could improve the quality of their work on all products, not just those that result in waste. Generally, workers are motivated to find ways to reduce waste when companies keep track of the quantity of materials wasted every day. Companies sometimes provide immediate feedback to workers the next day, often in the form of large charts showing the previous day's waste.

Machine downtime The fourth type of nonfinancial measure, machine downtime, is very important in all companies. At some automobile assembly plants, workers have the authority to stop the assembly line when they see something wrong. It should come as no surprise that such an action brings a lot of attention to the problem from many people in the plant. Stopping production causes a loss of output while people wait for the machinery to start up again. Machine downtime also can cause customer dissatisfaction and loss of sales. You may have experienced this dissatisfaction at a bank when you could not be served because the computer was down, or when your airline flight was canceled because of an airplane's maintenance problems.

People like to take pride in their work. Surveys indicate that workers prefer to do high-quality work rather than low-quality work. Companies generally find that workers respond favorably to performance measures and incentives measuring and rewarding high-quality work.

Many companies use high quality as their strategic advantage. For example, FedEx entered the air courier business with a promise that it would guarantee delivery the next day by mid-morning. By continually delivering on this promise, the company built up trust in its customers. Canon and Honda are other well-known companies that have used product quality to compete effectively.

Benchmarking is the continuous process of measuring how well one is doing against performance levels either inside or outside of the organization. For instance, students often benchmark by comparing their performance against the professor's standards or other students' performance. Students often are interested in how well

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graduates of their school compare to graduates of other schools on CPA exams, bar exams, or other standardized exams.

Companies are benchmarking in a similar way. American Airlines looks at its own on-time arrival performance by computing the percentage of its flights that land within 15 minutes of their scheduled arrival time. The company compares the results with its own past experience and with its competitors' performance. American Airlines also compares its own per cent of lost luggage to its own past experience and the performance of major competitors such as United Airlines and Delta Air Lines.

Benchmarking transforms the theory of quality products or service into practice. Benchmarking focuses attention on the objective. When American Airlines benchmarks on-time arrivals, it focuses the attention of its pilots, ground crews, mechanics, and everyone else on ways to improve on-time arrival performance.

An accounting perspective:

Managers executed for poor quality

Business insight

Eighteen managers were executed for poor product quality in a refrigerator plant on the outskirts of Beijing, China. The managers—12 men and 6 women-were taken to a rice paddy outside of the factory and shot while plant workers watched.

A government official stated the action was required for committing unpardonable sins against the people of China. Apparently, workers complained the managers were forcing the production of poor quality products. When workers complained that components did not meet specifications and the refrigerators did not function as required, the managers told them to ship the products. Customers also had complained. This factory had a reputation for turning out poor quality products.

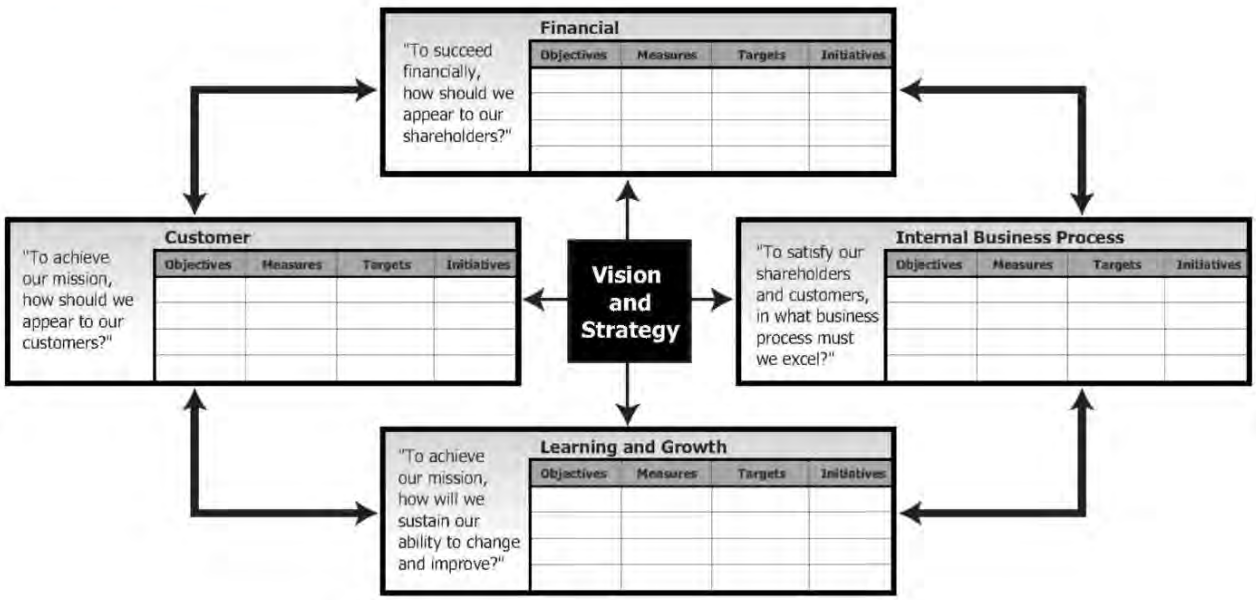
Source: Authors' research.

The **balanced scorecard** is a set of performance targets and results that show an organization's performance in meeting its objectives to its stakeholders. It is a management tool that recognizes organizational responsibility to different stakeholder groups, such as employees, suppliers, customers, business partners, the community, and shareholders. Often different stakeholders have different needs or desires that the managers of the organization must balance. The concept of a balanced scorecard is to measure how well the organization is doing in view of those competing stakeholder concerns.

An example of a balanced scorecard is shown in Exhibit 11. As you can see, the focus is to balance the efforts of the organization between the financial, customer, process, and innovative responsibilities. Traditionally, business organizations have focused on financial results, which mainly have reflected the shareholders' interests. In recent years, organizations have shifted attention to customer issues, such as quality and service, to employees, and to the community. For example, Ben & Jerry's Ice Cream measures its social performance along with financial

performance and presents a social audit in its annual report next to its financial audit. Johnson & Johnson's code of conduct makes it clear that the company has a responsibility to several competing stakeholders.

Illustration 20.4 Balanced Scorecard



Source: R. S. Kaplan and D. P. Norton, "Using the Balanced Scorecard as a Strategic Management System," *Harvard Business Review*, January–February 1996.

Exhibit 11: Balanced scorecard

The balanced scorecard has been developed and used in many companies. It primarily has been used at the top management level to support the organization's development of strategies. For example, Kaplan and Norton describe the development of the balanced scorecard at an insurance company as follows:[3]

Step 1: Ten of the company's top executives formed a team to clarify the company's strategy and objectives to meet responsibilities.

Step 2: The top three layers of the company's management (100 people) were brought together to discuss the new strategy and to develop performance measures for each part of the company. These performance measures became the scorecards for each part of the business and reflected the company's desired balance in satisfying different stakeholders.

Step 3: Managers began eliminating programs that were not contributing to the company's objectives.

Step 4: Top management reviewed the scorecards for each part of the organization.

Step 5: Based on its reviews in step 4, top management went back to step 1 to refine and further clarify the company's strategy and objectives.

3 Based on R. S. Kaplan and D. P. Norton, "Using the Balanced Scorecard as a Strategic Management System," *Harvard Business Review*, January-February 1996.

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Organizations using the balanced scorecard generally have found it to be helpful for top and middle management to shape and clarify organization goals and strategy in the face of competing stakeholder wants.

Just-in-time method

Innovations in purchasing, production, and inventory management have the potential to revolutionize companies. One of these innovations is the **just-in-time (JIT) method**. Companies that use just-in-time methods purchase materials just in time for production, produce parts just when needed in the production process, and complete finished goods just in time for sale.

The principal feature of the just-in-time system is that production does not begin on an item until an order is received. When a company receives an order it buys the raw materials, and the production cycle begins. As soon as the order is filled, production ends. Consequently, just-in-time requires immediate correction of processes or people making defective products because there is no inventory where defective products can await reworking or scrapping.

In theory, a JIT system eliminates the need for inventories because no production takes place until the company knows its products will be sold. As a practical matter, companies using this system normally have a backlog of orders so they can keep their production operations going. The benefits of the JIT system would be lost if a company had to shut down its operations for lengthy periods while waiting for new orders.

Just-in-time helps assure quality. If a unit is defective, employees cannot simply put it aside in inventory. Production workers and machines must do it right the first time.

To achieve just-in-time production, many companies install a system of flexible manufacturing. A flexible manufacturing system is computer-based; it enables companies to make a variety of products with a minimum of setup time. The system does what its name implies: it enables companies to be flexible in making products just-in-time to fill customers' orders.

For example, consider a company that makes after-market running boards for trucks. Customers install these running boards on trucks after they purchase them. By using flexible manufacturing, the company that makes these running boards produces one set of running boards for a particular model of Dodge then one set for a particular GMC model, and so forth to fill customer orders. A traditional production system, by contrast, would produce numerous sets of running boards for the Dodge which would remain in inventory until needed to fill customer orders. The traditional company would then produce numerous sets of running boards for the GMC and place them in inventory until needed to fill customer orders.

Just-in-time is part of a lean production philosophy that has helped many companies successfully reduce costs and increase quality. One feature of lean production is the absence of shelves, floor space, and other places used to store partially finished products. For an example of lean production, imagine you are building a house and you have just enough materials arriving just when you need them. You do not have extra lumber lying about in case you make a mistake cutting the boards the first time. If your supplier of plumbing products does not deliver in time for your needs, you have to shut down production until the plumbing products arrive. As you can see, lean production requires high levels of efficiency and quality.

Accounting perspective:

Business insight

A labor strike at General Motors' Dayton, Ohio, USA, plant, which produces brake parts, demonstrated the far-reaching effects of just-in-time when companies face plant shutdowns. When the United Auto Workers (UAW) struck the Dayton plant, they forced 30,000 non-UAW workers off their jobs. As General Motors has moved toward just-in-time production methods, its inventories of brakes and other parts have decreased. Because of the strike at the Dayton plant, US and Canadian plants using the brakes shut down quickly. Mexican plants were slower to shut down because inventory in transit kept the Mexican plants going for about a week longer than their US and Canadian counterparts.

Source: Authors' research.

Accountants using traditional costing methods assign costs to products as they go through the production steps. Assigning costs to products is time-consuming and expensive, not only for accountants, but also for workers and managers. One of the reasons for assigning costs as products proceed through production steps is to know the value of work-in-process inventory at the end of an accounting period. Suppose a product has completed the first three steps in a six-step production process at the end of the month. By assigning costs at each step along the way, accountants know the cost of the product at the end of the third step.

Accountants in JIT production facilities do not have to compute the cost of work-in-process inventories. There are no such inventories. Instead, accountants assign costs directly to the Cost of Goods Sold account. Companies have been known to save the time of two or three full-time accountants by assigning costs directly to Cost of Goods Sold. Since JIT production responds to the receipt of an order for goods, a JIT accounting system normally debits all costs directly to cost of goods sold and bypasses the usual inventory accounts. When it is necessary to report inventory amounts in the financial statements, accountants back the inventory amounts out of the Cost of Goods Sold account using a method called backflush costing. **Backflush costing** is a method of assigning costs to inventories backwards from Cost of Goods Sold to Finished Goods Inventory and/or Work in Process Inventory accounts.

For example, say Arizona Sunscreen Company uses the JIT method. Direct materials costs are USD 3.00 per bottle and other manufacturing costs are USD 1.50 per bottle. The company received an order for 10,000 bottles of sunscreen. Materials costs were USD 30,000 and other manufacturing costs were USD 15,000. Assume that USD 6,000 of these other costs are wages and the remaining USD 9,000 were applied to production from overhead. Assume also the company had an inventory of USD 4,500 left in work in process as of the date financial statements were prepared.

Traditional methods Using traditional methods of recording costs, the costs would flow through the inventory accounts to Cost of Goods Sold as shown by the following journal entries:

(1) Materials inventory (+A) 30,000

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	Accounts payable (+L)		30,000
	To record the purchase of materials.		
(2)	Work in process inventory (+A)	45,000	
	Materials inventory (-A)		30,000
	Payroll summary (+L)		6,000
	Overhead (applied) (+SE)		9,000
	To record production costs in the work in process account.		
(3)	Finished goods inventory (+A)	40,500	
	Work in process inventory (-A)		40,500
	To transfer product from work in process to finished goods.		
(4)	Cost of goods sold (-SE)	40,500	
	Finished goods inventory (-A)		40,500
	To record the cost of the goods sold.		

Just-in-time and backflush costing Using a just-in-time accounting system, the accountants would initially assume the company has no inventories. Therefore, they would debit all costs directly to Cost of Goods Sold, as follows:

(1)	Cost of goods sold (-SE)	30,000	
	Accounts payable (+L)		30,000
	To record the use of materials.		
(2)	Cost of goods sold (-SE)	15,000	
	Payroll summary (+L)		6,000
	Overhead (applied) (+SE)		9,000
	To record other manufacturing costs.		

Upon learning the company has USD 4,500 of inventory in work in process, the accountants would back out USD 4,500 from Cost of Goods Sold, as follows:

(3)	Work in process inventory (+A)	4,500	
	Cost of goods sold (+SE)		4,500
	To record inventory.		

This last entry is the backflush costing step. These entries appear in T-accounts in Exhibit 12.

Just-in-time production simplifies accounting procedures. If the costs of these sunscreen bottles were charged into production using traditional costing methods, it would be necessary to debit the materials costs to a Materials Inventory account. As the materials were used, their costs would be transferred to Work in Process Inventory and other manufacturing costs would be charged to Work in Process Inventory. As goods were completed, costs would be transferred out of Work in Process Inventory, into Finished Goods Inventory, and finally, into Cost of Goods Sold. Exhibit 12 contrasts traditional versus just-in-time cost flows.

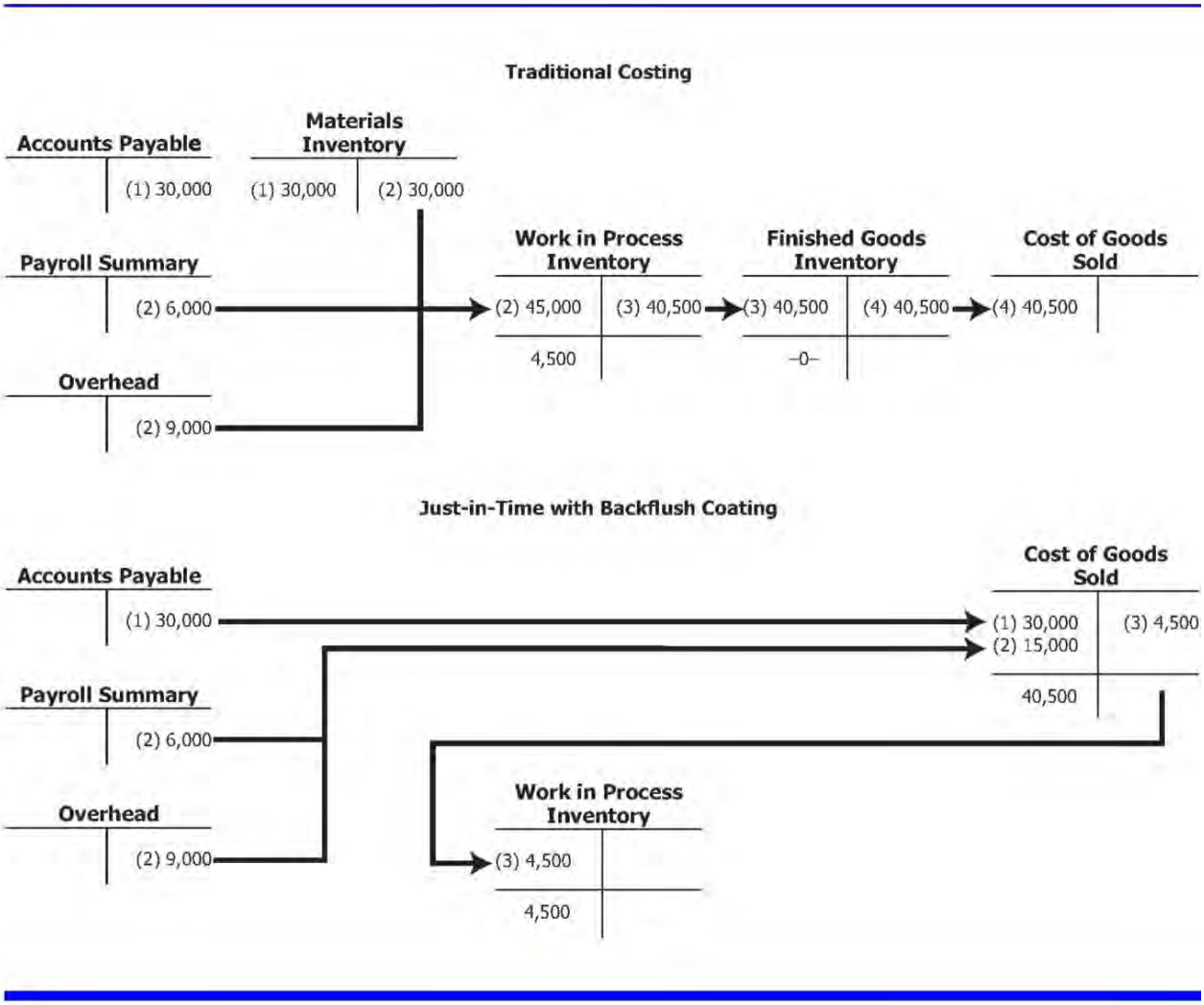

Exhibit 12: Traditional versus just-in-time cost flows

By reducing inventories, a just-in-time system offers potentially great cost savings. As noted earlier, it simplifies the accounting system. By reducing inventories, it releases investment dollars for use elsewhere and frees space that the inventory previously occupied. Companies also have found that reducing inventories where defective products could be hidden helps management detect production problems more quickly. By tying JIT to quality improvement programs, companies move toward zero defect production.

Activity-based costing and management

Suppose you go to a movie theater that has five screens showing five different movies. Jerome Justin works for the movie theater selling tickets for all five movies. Suppose management wants to know the cost of selling tickets per movie and asks you to assign Justin's wages to each of the five movies. How would you assign his wages?

You could simply divide Justin's wages by the number of movies and allocate 20 per cent of his salary to each movie. Or you could figure out how many tickets he sold to each movie, and allocate his wages on the basis of ticket sales. For example, if 50 per cent of the ticket sales were for *Avatar*, you might allocate 50 per cent of Justin's

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wages to *Avatar*. You probably also could think of additional ways to allocate Justin's wages. No matter how we allocate Justin's wages, his wages would not be directly traceable to one of the movies if he sold tickets for all five movies. In short, the allocation of Justin's wages to a particular movie is at least somewhat arbitrary because alternative methods could allocate different amounts of Justin's wages to each movie. Justin's wages would be indirect costs to the different movies because his wages could not be directly assigned to any one of the movies.

By definition, the allocation of indirect costs is at least somewhat arbitrary. Nevertheless, accountants have discovered that they can improve the ways costs are assigned, such as to movies in this case, by using activity-based costing.

Activity-based costing is a costing method that assigns indirect costs to activities and to the products based on each product's use of activities. Activity-based costing is based on the premise: Products consume activities; activities consume resources.

Numerous companies, such as HP, Caterpillar, and IBM, have implemented activity-based costing. Activity-based costing (ABC) has revealed startling information in these companies. For example, after installing new costing methods, one well-known company found that one of its products, a printed circuit board, was generating negative margins of 46 per cent.

Activity-based costing identifies the activities generating costs and assigns costs to those activities. Take the earlier Justin example. By focusing on Justin's activities, management could learn what caused costs and find ways to improve Justin's efficiency. Suppose that by studying Justin's activities, management learns he spends 40 per cent of his time answering questions about movies, 40 per cent of his time selling tickets, and 20 per cent doing nothing. Based on this information, management could think about better ways to use Justin's time. By improving their signs and posting information about the movies, management could reassign Justin to other tasks.

Closely related to activity-based costing is the notion of activity-based management (ABM). Using activity-based management, managers identify which activities consume resources. The focus is then to effectively manage costly activities with the goal of reducing costs and improving quality. Consider Justin and the movie theater again. Using activity-based management, managers would identify what Justin did with his time and perhaps find ways to help him become more efficient.

The following discussion at a textile company that makes jeans demonstrates important issues about the difficulty with traditional cost allocation methods and the advantages of activity-based costing. The participants are concerned about their company's ability to compete with foreign manufacturers that have lower labor costs. Many people in the company believe the company's managerial accounting system provides inadequate information. In this discussion, George, a managerial accountant, reports on his recent study of activity-based costing.

A broader perspective: HP

When a division of Hewlett-Packard Company introduced the just-in-time production method, the accountants found their traditional methods of cost accounting were no longer applicable. Reducing

the work in process and finished goods inventories meant the accountants no longer needed to keep detailed records for inventory valuation.

Lowering inventories to immaterial levels for financial reporting purposes reduces the amount of accounting time required to make journal entries to transfer costs between inventory accounts. This Hewlett-Packard plant saved an estimated 100,000 journal entries per month by simplifying the accounting for work in process inventories.

JIT did not eliminate the need for product costing. Managers needed to know how much products cost so they could make decisions, plan, and evaluate performance. After simplifying inventory accounting at the Hewlett-Packard plant, the accountants turned their attention to providing better information in a form managers could understand and use. The accountants found their new role in helping managers plan and control production exciting and challenging.

Source: Authors' research.

George (managerial accountant): I have been reading a lot of articles about companies like Ford and HP that have discovered major problems with their cost systems. Their symptoms are similar to ours. Namely, they cannot lower prices to be competitive on high-volume products, and their profits are shrinking.

Pam (company president): That sounds like us! What are they doing about it?

George: Well, they are putting in a new type of cost system called activity-based costing, or ABC for short. This system gives more detailed and better estimates of product costs, which helps their friends in marketing set prices. Applying this to ourselves, we may find, for example, that activity-based costing could reveal that the cost of skirts is lower than we thought, meaning we could lower our prices.

Lynn (vice president of marketing): That would be good news, but I thought costs were pretty cut-and-dried. How can a product cost less under one cost system than under another?

George: Actually, Lynn, the product does not cost less under one system or another. Our problem is that no cost system measures costs perfectly. We are able to trace some costs directly to the product. For example, we are pretty accurate in measuring the cost of denim, which is a direct material, in each of our shirts, pants, jackets, and so forth.

Overhead costs are another matter. Overhead includes costs like electricity to run machines and salaries of product designers and inspectors. All these costs are allocated to products. We know quality control inspectors cost money, but we do not know how much of that cost is caused by a particular jacket or pair of pants. So we make some assumptions about the relation between products and overhead costs. For example, we typically allocate overhead based on machine-hours required to stitch and fasten snaps. While that is probably a reasonable way to allocate the costs of electricity to run machines, its not a desirable way to allocate the cost of quality control inspectors.

Pam: As I understand it, overhead allocation is somewhat arbitrary. How will activity-based costing help?

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George: Activity-based costing provides more accurate information because we can identify which activities cause costs, and we can determine the cost of the activity. Activity-based costing identifies and measures the costs of performing the activities that go into a product much better than traditional cost methods. For example, if a particular jacket requires 10 inspections for a production run of 1,000 jackets, we figure out the cost of those inspections and assign that cost to the production run for this particular jacket.

Martha (vice president of production): That makes sense to me. But exactly how would activity-based costing help us cut production costs?

George: Once we identify activities that cause costs, we can eliminate or modify costly activities. For example, if we find that a jacket requires too many costly inspections, we could redesign the jacket to reduce the need for inspections. Our current cost system allocates all overhead costs, including inspection costs, to products based on machine-hours. We really do not know how much it costs to make an inspection and how much inspection cost is required by each product.

Pam: George, why have you not used activity-based costing before?

George (feeling somewhat defensive): Because activity-based costing provides more information, it takes more time than traditional cost systems. New accounting methods sound great in theory, but there must be enough benefit from improved management decisions to justify the additional work required to provide numbers. Until now, I did not think activity-based costing would pass a cost-benefit test.

Pam: I see many benefits in better pricing, reducing the costs of high-cost activities, and possibly dropping some products if we learn that their costs are too high. Our long-term strategy calls for new product lines in new markets where we are low-cost, low-price producers. We need the best cost information we can get to succeed in those markets. George, what do you need to get started developing an activity-based costing system for us?

George: I need a lot of support. Installing a new cost system requires teamwork between management, accounting, marketing, engineering, production, purchasing, and everybody else. This is not something to be done in an ivory tower.

Remember these important points about activity-based costing:

- The allocation of indirect costs is at least somewhat arbitrary, even using sophisticated accounting methods.
- Activity-based costing provides more detailed measures of costs than traditional allocation methods.
- Activity-based costing can help marketing people by providing more accurate product cost numbers for decisions about pricing and which unprofitable products the company should eliminate.
- Production also benefits because activity-based costing provides better information about the cost of each activity. In practice, ABC helps managers identify cost-causing activities. To manage costs, production managers learn to manage the activities that cause costs.
- Activity-based costing provides more information about product costs than traditional methods but requires more record-keeping. Managers must decide whether the benefits or improved decisions justify the additional record-keeping cost.

- Installing activity-based costing requires teamwork among accountants, production managers, marketing managers, and other nonaccounting people.

Next, we discuss the methods used for activity-based costing and illustrate them with an example.

Methods used for activity-based costing

Activity-based costing requires accountants to use the following four steps:

- Identify the activities that consume resources and assign costs to those activities. Purchasing materials would be an activity, for example.
- Identify the cost drivers associated with each activity. A **cost driver** is an activity or transaction that causes costs to be incurred. For the purchasing materials activity, the cost drivers could be the number of orders placed or the number of items ordered. Each activity could have multiple cost drivers.
- Compute a cost rate per cost driver unit. The cost driver rate could be the cost per purchase order, for example.
- Assign costs to products by multiplying the cost driver rate times the volume of cost driver units consumed by the product. For example, the cost per purchase order times the number of orders required for Product A for the month of December would measure the cost of the purchasing activity for Product A for December.

The next section describes these four steps.

Step one is often the most interesting and challenging part of the exercise. This step requires people to understand all of the activities required to make the product. Imagine the activities involved in making a simple product like a pizza—ordering, receiving and inspecting materials, making the dough, putting on the ingredients, baking, and so forth. Or imagine the activities involved in making a complex product such as an automobile or computer.

Complexity as an activity that consumes resources One of the lessons of activity-based costing has been that the more complex the business, the higher the indirect costs. Imagine that each month you produce 100,000 gallons of vanilla ice cream and your friend produces 100,000 gallons of 39 different flavors of ice cream. Further, assume your ice cream is sold only in one liter containers, while your friend sells ice cream in various containers. Your friend has more complicated ordering, storage, product testing (one of the more desirable jobs, nevertheless), and packing in containers. Your friend has more machine setups, too. Presumably, you can set the machinery to one setting to obtain the desired product quality and taste. Your friend has to set the machines each time a new flavor is produced. Although both of you produce the same total volume of ice cream, it is not hard to imagine that your friend's overhead costs would be considerably higher.

In Exhibit 13, we present several examples of the cost drivers companies use. Most cost drivers are related to either the volume of production or to the complexity of the production or marketing process. In deciding which cost drivers to use, managers consider these three factors:

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Cost driver	Cost of assigned cost driver
Miles driven	Automobile costs
Machine-hours	Electricity to run machines
Customers served	Overhead in a bank
Flight hours	Airplane maintenance costs
Number of customers	Selling costs

Exhibit 13: Cost drivers

• Causal relation. Choosing a cost driver that causes the cost is ideal. For example, suppose students in biology classes are messier than students in history classes. As a result, the university does more maintenance per square foot in biology classrooms and labs than in history classrooms. Further, it is possible to keep track of the time maintenance people spend cleaning classrooms and labs. The university could assign maintenance costs based on the time spent in history classrooms and in biology classrooms and labs, respectively, to the history and biology departments.

• Benefits received. Choose a cost driver so costs are assigned in proportion to benefits received. For example, if the physics department in a university benefits more from the university's supercomputer than the German department does, the university should select a cost driver that recognizes such differences in benefits. The cost driver could be the number of faculty and/or students in each department who use the computer.

• Reasonableness. Some costs that cannot be linked to products based on causality or benefits received are assigned on the basis of reasonableness.

In general, predetermined rates for allocating indirect costs to products are computed as follows:

$$\text{Predetermined indirect cost rate} = \frac{\text{Estimated indirect cost}}{\text{Estimated volume of the allocation base}}$$

This formula applies to all indirect costs, whether manufacturing overhead, administrative costs, distribution costs, selling costs, or any other indirect cost.

Using activity-based costing, we first define the notion of an activity center. An **activity center** is a unit of the organization that performs some activity. For example, the costs of setting up machines would be assigned to the activity center that sets up machines. This means that each activity has associated costs. When the cost driver is the number of inspections, for example, the company must keep track of the cost of inspections.

Workers and machines perform activities on each product as it is produced. Accountants allocate costs to products by multiplying each activity's indirect cost rate by the volume of activity used in making the product.

The following example illustrates how unit costs are computed when companies use activity-based costing. We contrast the results using activity-based costing to those using a departmental rate.

Assume High Challenge Company makes two products, touring bicycles and mountain bicycles. The touring bicycles product line is a high-volume line, while the mountain bicycle is a low-volume, specialized product.

Traditional costing method Using a traditional costing method, assume that High Challenge Company followed this procedure to allocate manufacturing overhead costs to the two products for the month of January 2011.

20. Using accounting for quality and cost management

• Managers and accountants developed an overhead rate based on the following data for 2011:

Overhead for department A for 2011	$2,000,000
Machine-hours worked during 2011 in department A	20,000 hours
Department A overhead rate ($2,000,000/20,000 hours)	$100 per machine-hour

• To compare activity-based costing with the company's traditional method, the accountants selected the month of January to study. At the end of January 2011 the following information was available for the month:

Actual machine-hours used in January 2011:	
Touring bicycle products	1,500
Mountain bicycle products	500
Total	2,000

• Using a traditional costing method, accountants then allocated overhead to the products worked on in January using the overhead rate of USD 100 per machine-hour times the machine-hours worked on each product in Department A during January:

Overhead allocated to products worked on in January:	
Touring bicycles ($100 x 1,500 hours)	$150,000
Mountain bicycles ($100 x 500 hours)	50,000
Total overhead	$200,000

In using activity-based costing, the company identified four activities that were important cost drivers and a cost driver used to allocate overhead. These activities were (1) purchasing materials, (2) setting up machines when a new product was started, (3) inspecting products, and (4) operating machines.

Accountants estimated the overhead and the volume of events for each activity. For example, management estimated the company would purchase 100,000 pieces of materials that would require overhead costs of USD 200,000 for the year. These overhead costs included salaries of people to purchase, inspect, and store materials. Consequently, each piece of material used to make a product would be assigned an overhead cost of USD 2.00 (USD 200,000/100,000 pieces).

These estimates made in 2010 were used during all of 2011. In practice, companies most frequently set rates for the entire year, although some set rates for shorter periods, such as a quarter. Look at the overhead rates computed for the four activities in Exhibit 14. Note that the total overhead for 2011 is USD 2,000,000 using activity-based costing, just as it was using a traditional costing method. The total amount of overhead should be the same whether using activity-based costing or traditional methods of cost allocation to products. The primary difference between activity-based costing and the traditional allocation methods is the amount of detail; particularly, the number of activities used to assign overhead costs to products. Traditional allocation uses just one activity, such as machine-hours. Activity-based costing used four activities in this case. In practice, companies using activity-based costing generally use more than four activities because more than four activities are important. We used four to keep the illustration as simple as possible. (Many companies that use traditional allocation methods use just one activity, as we have in this example.)

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(1) **Activity**	**(2) Cost driver used to allocate overhead cost driver**	**(3) Overhead cost for the activity**	**(4) Cost driver units for 2011**	**(5) Rate: column (3)/column (4)**
1. Purchasing materials	Pieces of materials in each unit	$ 200,000	100,000 pieces	$2/piece
2. Machine setups	Machine setups	800,000	400 setups	$2,000/setup
3. Inspections	Inspection hours	400,000	4,000 hours	$100/hour
4. Running machines	Machine-hours	600,000	20,000	$30/hour
Total overhead		$ 2,000,000		

Exhibit 14: Overhead rates for activity-based costing

For January 2011, the High Challenge Company has the following information about the actual number of cost driver units for each of the two products:

	Touring bicycles	**Mountain bicycles**
1. Purchasing materials	6,000 pieces	4,000 pieces
2. Machine setups	10 setups	30 setups
3. Inspections	200 hours	200 hours
4. Running machines	1,500 hours	500 hours

Multiplying the actual activity events for each product times the predetermined rates computed earlier resulted in the overhead allocated to the two products shown in Exhibit 8.

Activity	**Rate**	**Touring Actual cost driver units**	**Bicycles Cost allocated to Product**	**Mountain Actual cost driver units**	**Bicycles Cost allocated to product**
1. Purchasing materials	$2/piece	6,000 pieces	$12,000	4,000 pieces	$ 8,000
2. Machine setups	$2,000/setup	10 setups	20,000	30 setups	60,000
3. Inspections	$100/hour	200 hours	20,000	200 hours	20,000
4. Running machines	$30/hour	1,500 hours	45,000	500 hours	15,000
Total cost allocated to each product			$97,000		$ 103,000

Exhibit 15: Overhead costs assigned to products using activity-based costing

Now we can compare the overhead allocated to the two product lines using the traditional method and activity-based costing, as follows:

	Touring bicycles	**Mountain bicycles**
Traditional method	$150,000	$50,000
Activity-based costing	97,000	103,000

Unit costs Assume High Challenge Company produced 1,000 units of touring bicycles and 200 units of mountain bicycles in January. The direct materials cost is USD 100 per unit for touring bicycles and USD 200 per unit for mountain bicycles. Direct labor cost is USD 20 per unit for touring bicycles and USD 30 per unit for mountain bicycles. Comparing the overhead allocations using the department allocation and the activity-based costing allocation reveals the differences in unit costs, as we show in Exhibit 10.

	Traditional Costing		Activity-based Costing	
	Touring bicycles	Mountain bicycles	Touring bicycles	Mountain bicycles
Direct materials	$ 100	$200	$100	$200
Direct labor	20	30	20	30
Overhead	150[a]	250[b]	97	515[d]
Total	$270	$480	$217	$745

[A] $150 = overhead cost allocation to products using departmental rate divided by number of units produced = $150,000/1,000 units.
[B] $250 = overhead cost allocation to products using departmental rate divided by number of units produced = $50,000/200 units.
[C] $97 = overhead cost allocation to products using activity-based costing divided by number of units produced = $97,000/1,000 units.
[D] $515 = overhead cost allocation to products using activity-based costing divided by number of units produced = $103,000/200 units.

Exhibit 16: Comparison of product costs using traditional costing and activity-based costing

Analysis More overhead is allocated to the lower volume mountain bicycles using activity-based costing. The mountain bicycles are allocated more overhead per unit primarily because activity-based costing recognizes the need for more setups for mountain bicycles and for as many inspection hours for the more specialized mountain bicycles as for the higher volume touring bicycles. By failing to assign costs to all of the activities, touring bicycles were subsidizing mountain bicycles. Many companies have found themselves in similar situations. Activity-based costing has revealed that low-volume, specialized products have been the cause of greater costs than managers had realized.

Impact of new production environment on cost drivers

When cost systems were first developed in industry, companies were far more labor intensive than they are today. The majority of the overhead cost was related to the support of labor, so it made sense to allocate overhead to products based on the amount of labor in the products. Labor is still a major product cost in many companies, especially service organizations such as public accounting firms. Often they allocate overhead to products (which are called jobs) on the basis of the amount of labor in the product.

As manufacturers and service companies have become more automated, direct labor has become less appropriate as a basis for allocating overhead. Direct labor has shrunk to less than 5 per cent of product costs in many companies and overhead has increased. Thus, companies that continue to allocate overhead to products based on direct labor are seeing rates increase as high as 500 per cent or more. (Some overhead rates are more than 1,000 per cent of direct labor costs.)

When labor is such a small part of product costs, there is little—if any—relationship between labor and overhead. Further, small errors in assigning labor to products are magnified many times when overhead rates are several hundred per cent of labor costs, or more.

Finally, allocating overhead on the basis of direct labor sends signals that direct labor is more expensive than it really is. This also creates tremendous incentives to reduce the labor content of products. While this may be desirable in particular circumstances, such decisions should be based on accurate cost numbers, not numbers heavily biased because of an arbitrary cost allocation method.

Activity-based costing in marketing

Activity-based costing is not limited to the cost of producing goods and services; companies also apply it to marketing or administrative activities. The principles and methods are the same as discussed earlier: (1) identify activities or cost drivers, (2) compute an indirect cost rate for each activity, and (3) allocate indirect costs by multiplying the indirect cost rate for each activity by the volume of activities.

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Instead of computing a cost of production, however, accountants compute a cost of performing an administrative or marketing service. Tissue products, for example, can be sold to grocery stores, convenience stores, the industrial market, and other channels of distribution. Each channel has different activities:

- Convenience stores would require many shipments in small orders and considerable marketing support.
- Grocery stores would require relatively large shipments, a variety of products, and considerable marketing support.
- Industrial users would involve brokers, minimum marketing support, and large orders.

Information on the cost of alternative channels of distribution is useful to marketing managers who make decisions about which channel to use. In this case, obvious cost drivers would include the number of shipments per period, size of shipment, number of products in a shipment, and measures of merchandising support.

Strategic use of activity-based management

Many believe activity-based costing offers strategic opportunities for companies. One of the key ways companies develop a competitive advantage is by becoming low-cost producers or sellers. Companies such as Wal-Mart Stores in retailing, UPS in delivery services, and Southwest Airlines in the airline industry have created competitive advantages by reducing costs. Professor Michael Porter of the Harvard Business School, among others, has pointed out that certain companies have learned to use the information they have gained from their cost systems to make substantial price cuts to increase market share.

Activity-based costing plays an important role in companies' strategies and long-range plans to develop a competitive cost advantage. Activity-based costing focuses attention on activities. Cost reduction generally requires a change in activities. Although top management can send notices asking company employees to reduce costs, the implementation requires a change in activities. If you have been in school during a period when education costs were cut, you know that achieving the cut required a change in activities such as canceled classes, larger class sizes, and reduced services. It is impossible to know the effect of a change in activities on costs without the cost information provided by activity-based costing.

Behavioral and implementation issues

Accountants cannot implement activity-based costing without becoming familiar with the operations of the company. In identifying activities, accountants team up with management and people from production, engineering, marketing, and other departments in identifying the activities that drive the company's costs. This often creates discomfort at first as accountants are forced to deal with unfamiliar areas; in the long run their familiarity with the company's operating activities can improve their contribution to the company. Nonaccounting personnel also feel a greater sense of ownership of the numbers reported by the accounting system so accounting improves its credibility among nonaccountants.

One of the problems encountered when implementing activity-based costing is the failure to get influential people in the organization to buy into the process. Accounting methods in companies are like rules in sports; people become accustomed to playing by the rules and oppose changing to something unknown.

For example, two analysts at one company spent several months of their time and hundreds of hours of computer time to develop an activity-based costing system. Their analysis revealed several hundred products that

were clearly unprofitable and should be eliminated. However, the key managers who made product elimination decisions agreed to drop only about 20 products. Why? The analysts had failed to talk to these key managers early in the process. When presented with the final results, these managers raised numerous objections that the analysts had not anticipated. Moral: If you are involved in trying to make a change, get all of the people who are important to that change to buy into the process early.

Opportunities to improve activity-based costing in practice

The use of activity-based costing in industry is relatively new. Companies are continually encountering limitations and finding ways to improve activity-based costing. A philosopher once said that our knowledge is like a circle; the more we know, the larger the circle. But the larger the circle, the greater its boundary and the more we realize the limits of our knowledge. Activity-based costing has shown managers they have much to learn about the cost of the activities required to make their products.

Understanding the learning objectives

- The new production environment refers to an environment in which company managers are concerned with (1) improving quality and (2) reducing costs. Accounting information can help managers assess the costs of quality and reduce the costs of making products.
- Three methods managers use to identify quality problems are control charts, Pareto diagrams, and cause and effect analyses.
- Knowing the four costs of quality—prevention, appraisal, internal failure, and external failure—can help managers minimize the cost of quality while providing high-quality products to customers.
- Four such measures are quality control, delivery performance, materials waste, and machine downtime.
- Managers can use benchmarking to focus attention on measuring how well one is doing against levels of performance either inside or outside of the organization.
- The balanced scorecard is a set of performance targets and results that show an organization's performance in meeting its stakeholder objectives.
- JIT substantially reduces or eliminates the need for inventories and improves quality by eliminating the flexibility provided by inventories. Products must be produced properly the first time.
- Just-in-time accounting procedures normally debit all costs directly to cost of goods sold and bypass the usual inventory accounts. When it is necessary to report inventories in financial statements, the inventory amounts are backed out of the Cost of Goods Sold account.
- Activity-based costing is a costing method that assigns costs to activities and then to the products based on each product's use of activities. Activity-based costing is based on the premise that products consume activities; activities consume resources.
- Companies benefit from activity-based costing because managers have more detailed information about the cost of activities and better product cost information.

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• First, identify the activities that consume resources and assign costs to those activities. Second, identify the cost drivers associated with each activity. Third, compute a cost rate per cost driver unit. Fourth, assign costs to products by multiplying the cost driver rate times the volume of cost driver units consumed by the product.

• In many companies, activity-based costing has revealed that low-volume, specialized products have been more costly than managers had realized.

• By focusing attention on activities that cause costs, activity-based management helps managers eliminate activities that consume resources, thereby becoming more efficient and competitive.

Demonstration problem

To continue the text example, consider December 2011 for High Challenge Company. Recall that the departmental overhead rate for 2011 was USD 100 per machine-hour. The following information for December is available:

	Touring bicycles	**Mountain bicycles**
Machine-hours	2,000	1,000
Units	1,300	400
Activities		
1. Purchasing materials	10,000 pieces	10,000 pieces
2. Machine setups	15 setups	40 setups
3. Inspections	200 hours	400 hours
4. Running machines	2,000 hours	1,000 hours

Compute the costs in total and per unit for touring bicycle and mountain bicycle products using both the traditional method based on machine-hours to allocate overhead and the activity-based costing rates. The actual activity levels for December are given in this problem; however, you should use the rates presented earlier in the text. Do not assume that the total overhead assigned to products for December using activity-based costing necessarily equals the total overhead allocated using the departmental allocation rate. Assume the direct materials costs are USD 100 and USD 200 per unit for touring bicycles and mountain bicycles, respectively; and direct labor costs are USD 20 and USD 30 per unit, respectively. Production was 1,300 touring bicycles and 400 mountain bicycles. Round unit costs to the nearest dollar.

Solution to demonstration problem

Overhead costs allocated to products using the traditional method:

Touring bicycles ($100 x 2,000 machine-hours)	$200,000
Mountain bicycles ($100 x 1,000 machine-hours)	100,000
Total	$300,000

Overhead costs assigned to products using activity-based costing:

		Touring Bicycles		**Mountain Bicycles**	
Activity	**Rate**	**Actual cost driver units**	**Cost allocated to product**	**Actual cost driver units**	**Cost allocated to product**
1. Purchasing materials	$2/piece	10,000 pieces	$ 20,000	10,000 pieces	$ 20,000
2. Machine setups	$2,000/setup	15 setups	30,000	40 setups	80,000
3. Inspections	$100/hour	200 hours	20,000	400 hours	40,000
4. Running machines	$30/hour	2,000 hours	60,000	1,000	30,000
Total cost allocated to each product			$ 130,000		$ 170,000

Comparison of product costs using traditional costing and activity-based costing:

Traditional Costing	**Activity-based Costing**

20. Using accounting for quality and cost management

	Touring bicycles	Mountain bicycles	Touring bicycles	Mountain bicycles
Direct materials	$100	$200	$100	$200
Direct labor	20	30	20	30
Overhead	154[a]	250[b]	100[c]	425[d]
Total	$274	$480	$220	$655

[A] $154 = overhead cost allocation to products using departmental rate divided by number of units produced = $200,000/1,300 units.
[B] $250 = overhead cost allocation to products using departmental rate divided by number of units produced = $100,000/400 units.
[C] $100 = overhead cost allocation to products using activity-based costing divided by number of units produced = $130,000/1,300 units.
[D] $425 overhead cost allocation to products using activity-based costing divided by number of units produced = $170,000/400 units.

Key terms

Activity-based costing A costing method that first assigns costs to activities, then assigns costs to products based on their consumption of activities.

Activity center An activity center is a unit of the organization that performs some activity.

Backflush costing Backflush costing is a method of assigning costs to inventories backwards from Cost of Goods Sold to Work in Process or Finished Goods Inventory accounts.

Balanced scorecard A set of performance targets and results that show an organization's performance in meeting its responsibilities to various stakeholders.

Benchmarking Benchmarking is the continuous process of measuring how well one is doing against performance levels either inside or outside of the organization.

Cause-and-effect analysis Cause-and-effect analysis identifies potential causes of defects.

Control charts Control charts help managers distinguish between random or routine variations in quality and variations that they should investigate.

Cost driver A cost driver is an activity or transaction that causes costs to be incurred.

Just-in-time (JIT) method The just-in-time method manages purchasing and production so that materials are purchased just in time for production, parts are produced just when needed for the next step in the production process, and finished goods are completed just in time for sale.

Pareto diagrams Pareto diagrams indicate how frequently each type of failure occurs.

Total quality management (TQM) Defined as managing the entire organization so it excels in its goods and services that are important to the customer.

Self-test

True-false

Indicate whether each of the following statements is true or false.

In Texas Instruments' cost of quality program, the managers' task was to maximize the sum of prevention, appraisal, internal failure, and external failure costs.

Control charts are a means of distinguishing between random or routine variation in product quality and variations that managers should investigate.

The allocation of indirect costs is never arbitrary.

A cost driver is an activity or transaction that causes costs to be incurred.

The formula for computing an indirect cost rate has the cost in the numerator and the volume of the cost driver or allocation base in the denominator.

Multiple-choice

Select the best answer for each of the following questions.

The new production environment refers to an environment in which company managers are concerned with:

a. Improving customer service and product quality.

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b. Reducing costs.

c. Increasing government regulation.

d. a and b above.

e. All of the above.

Just-in-time production and purchasing methods:

a. Must be used in conjunction with activity- based costing.

b. Require government regulation.

c. Eliminate the need for inventories in theory because production does not take place until it is known the item will be sold.

d. Require the use of Pareto charts.

e. All of the above.

UR Company has two products, U and R. Overhead costs are presently allocated to the two products based on the labor-hours used to produce each product. It takes one labor-hour to make one unit of each product. The chief financial officer has suggested converting to activity-based costing. She collected the data shown below for three cost drivers and activities to be used under activity-based costing:

			Cost driver	**Volume**
Activity	**Cost driver**	**Amount**	**U**	**R**
Production	Number of setups	$82,000	8	12
Quality control	Number of inspections	48,000	56	24
Packaging costs	Number of units produced	130,000	80,000	50,000
Total overhead		$260,000		

What is the total overhead allocated to Product U using the current method of allocating overhead based on labor-hours (80,000 labor-hours for U and 50,000 labor-hours for R)?

a. USD 113,600.

b. USD 130,000.

c. USD 146,400.

d. USD 160,000.

e. None of the above.

Refer to the facts for in the above question. What is the overhead per unit assigned to Product R using activity-based costing? (Round to the nearest cent.)

a. USD 2.60.

b. USD 2.27.

c. USD 2.00.

d. USD 1.83.

e. None of the above.

Now turn to “Answers to self-test” at the end of the chapter to check your answers.

Questions

- To what does the phrase new production environment refer?
- Explain the purpose of using control charts, Pareto diagrams, and cause and effect analyses. You may find it useful to use examples.
- Audio Company makes compact disc players. After producing a compact disc player, the company tests it, then scraps it because it does not work. Is this an example of an internal failure cost, an appraisal cost, or a prevention cost?
- A company's performance measure is the number of customer complaints. Why would the company measure the number of customer complaints?
- A company's performance measure is the percentage of time that machines are not working. Why would the company measure the percentage of time that the machines are not working?
- How could reducing materials waste during production improve the quality of products?
- What is benchmarking? Give an example of benchmarking that you might use.
- What is the benefit to American Airlines of benchmarking on-time airplane arrivals?
- How does just-in-time help assure quality of production?
- Elimination of inventories through a just-in-time (JIT) method is believed to result in different types of cost savings. Give an example of a type of savings from JIT.
- What is the difference between accounting for costs using a JIT method and using traditional cost flows through inventory accounts?
- What operating conditions are necessary for a company to make use of a JIT method?
- What is the difference between activity-based costing and activity-based management?
- Activity-based costing methods use four steps in computing a product's cost. What are these steps?
- "Activity-based costing is great for manufacturing plants, but does not really address the needs of the service sector." Do you agree with this statement? Explain.
- What is a cost driver? Give three examples.
- The vice president of marketing wonders how products can cost less under one cost system than under another. How would you respond to her question "Are not costs cut-and-dried?"
- A drawback to activity-based costing is that it requires more record-keeping and extensive teamwork between all departments. What are the potential benefits of a more detailed product cost system?
- Give three criteria for choosing cost drivers for allocating costs to products.

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- "Activity-based costing is for accountants and production managers. I plan to be a marketing specialist so ABC will not help me." Do you agree with this statement? Explain.
- Observe the workings of a food service or coffee house. What activities are being performed? Give examples of some cost drivers that cause the cost of those activities. (For example, cooking food is an activity; the number of meals could be a cost driver for the cooking activity.)
- Observe the workings of a bank, credit union, or savings and loan institution. What activities are being performed? Give examples of some cost drivers that cause the cost of those activities. (For example, opening checking accounts is an activity; the number of accounts opened could be a cost driver for the opening accounts activity.)
- Activity-based costing assigns costs to activities that consume resources and to the products based on each product's use of activities. What is a benefit of this approach compared to a traditional approach that allocates costs to products based on the machine-hours used to produce the product?
- What is a balanced scorecard?
- **Real world question** Refer to the discussion "A broader perspective: HP" of the impact of just-in-time on accounting methods at HP. What effect did the implementation have on the HP plant's accounting methods?
- **Real world question** Why might Domino's Pizza make such a big deal out of delivering pizzas within 30 minutes?

Exercises

Exercise A Classify Curly Company's costs for a typical month into prevention costs, appraisal costs, internal failure costs, and external failure costs:

Inspection at the end of the production process	$10,000
Scrap	9,000
Design work to improve the way products are made	12,000
Cost of customer complaints	20,000
Employee training	6,000
Incoming materials inspection	5,000

Suppose Curly Company could increase employee training by USD 7,500 per month, and thereby reduce internal failure and external failure costs by 20 per cent each per month. (Appraisal costs would not be affected.) Would this be a wise thing for Curly Company to do?

Exercise B You have been hired by a food service organization on campus to help assess the quality of food services in the student union building. The following food service information is for the month of February:

Customer complaints	60
Waste as a percentage of total food prepared	10%
Cases of food poisoning	2

What additional information would you like to have to assess the quality of the food service organization's performance?

Exercise C Network, Inc., manufactures networking devices for personal computer systems, using just-in-time methods. After receiving an order for 300 devices, the company bought materials (for cash) costing USD 14,000 to fill this order. It incurred labor and overhead costs of USD 48,000, of which USD 10,000 was for wages and the rest overhead.

After the production was finished, but before all goods were sold, the company needed to compute an inventory cost for financial statement purposes. The cost of finished goods inventory was USD 2,480.

a. Use T-accounts to show the flow of costs under a traditional costing system.

b. Prepare journal entries for these transactions using backflush costing.

c. Use T-accounts to show the flow of costs using a JIT system with backflush costing.

Exercise D Quality Sound Corporation produces two types of compact discs (CDs), one is to install on touring bicycles and the other is a high-grade product for home and car use. The touring bicycles' CDs are designed for durability rather than accurate sound reproduction. The company only recently began producing the high-grade disc. Management believes the accounting system may not be accurately allocating costs to products.

Management asked you to investigate the cost allocation problem. You found that manufacturing overhead is currently assigned based on the direct labor costs in the products. For your investigation, you are using data from last year. Last year's manufacturing overhead was USD 440,000 based on production of 320,000 touring bicycle CDs and 100,000 high-grade CDs. Direct labor and direct materials costs were as follows:

	Touring bicycle	**High grade**	**Total**
Direct labor	$180,000	$60,000	$240,000
Materials	120,000	112,000	232,000

Management believes three activities cause overhead costs. The cost drivers and related costs for your analysis are as follows:

		Activity Level		
Cost drivers	**Cost assigned**	**Touring bicycle**	**High grade**	**Total**
Number of production runs	$200,000	40	10	50
Quality tests performed	180,000	12	18	30
Shipping orders processed	60,000	100	50	150
Total overhead	$440,000			

a. How much of the overhead would be assigned to each product if the three cost drivers are used to allocate overhead? What would be the cost per unit (including materials, labor, and overhead) for each product if overhead is assigned to products using the three cost drivers?

b. How much of the overhead would be assigned to each product if direct labor costs had been used as the basis for allocating overhead to each product? What would be the cost per unit (including materials, labor, and overhead) for each product if overhead is allocated to products using direct labor cost as the allocation base?

Exercise E Landscape, Inc., is a lawn and garden service. The company originally specialized in serving small residential clients; recently it has started contracting for work on larger office building grounds.

Employees worked a total of 10,000 hours last year, 6,500 on residential jobs and 3,500 on commercial jobs. Wages amounted to USD 10 per hour for all work done. Materials used are included in overhead and called supplies. All overhead is allocated on the basis of labor-hours worked, which is also the basis for customer charges.

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Landscape, Inc., can charge USD 30 per hour for residential work but, because of greater competition for commercial accounts, only USD 20 per hour for commercial work.

a. Using labor-hours as the basis for allocating overhead, what was the gross margin (revenues minus labor and overhead expense) for (1) commercial and (2) residential service? Assume overhead was USD 50,000.

b. Overhead consists of transportation, lawn mowing and landscaping equipment costs, depreciation on equipment, supplies, fuels, and maintenance. These costs can be traced to the following activities:

			Activity Level	
Activity	**Cost driver**	**Cost**	**Commercial**	**Residential**
Transportation	Clients served	$10,000	15	45
Equipment costs:				
Fuel, maintenance, depreciation	Equipment hours	25,000	3,000	2,000
Supplies	Square yards serviced per year	15,000	100,000	50,000
Total overhead		$50,000		

Recalculate gross margin for commercial and residential services based on these cost driver bases.

c. Would you advise Landscape, Inc., to drop either the residential or commercial service based on your analysis? Explain.

Problems

Problem A Here are cost items from Huskie Company's accounts for a typical month:

Inspection at the end of the production process	$80,000
Cost of returned goods	36,000
Design work to improve the way products are made	48,000
Repairs to satisfy customer complaints	20,000
Employee training	24,000
Incoming materials inspection	20,000
Scrap	36,000

a. Classify these items into prevention costs, appraisal costs, internal failure costs, and external failure costs.

b. Suppose Huskie Company could spend an additional USD 40,000 per month on design work to improve the way products are made, and thereby reduce internal failure and external failure costs by 30 per cent each per month. (Appraisal costs would not be affected.) Would this be a wise thing for Huskie Company to do?

c. Give two examples of additional nonfinancial quality measures that Huskie Company could use to help improve quality. (Hint: See Exhibit 16.)

Problem B You have been hired by Bucks 'R' Us Bank to help assess the quality of their services. This information is for the month of March:

Customer complaints	60
Average customer waiting time	22 minutes
Number of lost files	2
Lawsuits filed against the bank	1

What additional information would you like to have to assess the quality of the bank's performance?

Problem C Heatseek Precision Instruments produces sensitive heat measurement meters. The company has a large backlog of orders and no beginning inventories because all units in production last year were sold by the end of the year. At the start of this year, an order was received for 2,000 meters.

The company purchased and used USD 105,000 of materials in production for this order. Direct labor costs of USD 320,000 were incurred, and overhead costs of USD 520,000 were applied. Goods representing 10 per cent of these costs were still in finished goods inventory at the end of the period.

a. Use T-accounts to show the flow of costs under a traditional costing system.

b. Prepare journal entries for these transactions using backflush costing.

c. Use T-accounts to show the flow of costs using a JIT system with backflush costing.

Problem D C & W Corporation manufactures travel clocks and watches. Overhead costs are currently allocated using direct labor-hours, but the controller has recommended using an activity-based costing system based on the following data:

Activity	Cost driver	Cost	Activity Level	
			Travel clocks	Watches
Production setup	Setups	$100,000	20	30
Material handling and requisition	Parts	30,000	24	36
Packaging and shipping	Units shipped	60,000	80,000	120,000
Total overhead		$190,000		

a. Compute the amount of total overhead allocated to each of the products under activity-based costing.

b. Compute the amount of total overhead allocated to each product using labor-hours as the allocation base. Assume labor-hours required to assemble each unit are .5 per travel clock and 1.0 per watch, and that 80,000 travel clocks and 120,000 watches were produced.

c. Should the company follow the controller's recommendations?

Problem E Sunshield Company makes three types of sunglasses: Nerds, Stars, and Fashions. Sunshield presently allocates overhead to products using a rate based on direct labor-hours. A consultant recommended that Sunshield switch to activity-based costing. Management decided to give ABC a try and identified the following activities, cost drivers, and costs for a typical year for each activity center. Use this information to compute the overhead rates for each cost driver.

Activity	Recommended cost driver	Costs	Cost driver units
Production setup	Production runs	$ 30,000	100
Order processing	Orders	50,000	200
Materials handling	Pounds of materials used	20,000	8,000
Equipment depreciation and maintenance	Machine-hours	60,000	10,000
Quality management	Inspections	50,000	40
Packing and shipping	Units shipped	40,000	20,000
Total overhead		$250,000	

In addition, there are 2,500 direct labor-hours in a typical year.

Assume the following activities occurred in February of 2011:

	Nerds	Stars	Fashions
Units produced	1,000	500	400
Direct materials costs	$4,000	$2,500	$2,000
Direct labor-hours	100	100	89
Orders	8	8	4
Production runs	2	4	8
Pounds of material	400	200	200
Machine-hours	500	300	300

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Inspections	2	2	2
Units shipped	1,000	500	300

Direct labor costs are USD 15 per hour.

a. Compute an overhead allocation rate (1) for each of the cost drivers recommended by the consultant and (2) for direct labor.

b. Management wants to compare the product costs using ABC and the traditional method for the month of February. Compute the production costs for each product for February using direct labor-hours as the allocation base. (Note: Production costs are direct materials, direct labor, and overhead.)

c. To derive product costs under ABC, compute the production costs for each product for February using the cost drivers recommended by the consultant.

d. Management has seen your numbers and wants to know how you account for the discrepancy between the product costs using direct labor-hours as the allocation base and using activity-based costing. Write a brief response to management.

Problem F Filmworks Photography offers two types of services, student portraits and family portraits. Last year, Filmworks had the following costs and revenues:

Filmworks Photography Income statement			
	Deluxe	**Family**	**Total**
Revenue	$180,000	$200,000	$380,000
Direct materials	25,000	25,000	50,000
Direct labor	90,000	60,000	150,000
Indirect costs:			
Administration	-------	----------	25,000
Production setup	-------	----------	50,000
Quality control	-------	----------	25,000
Marketing	-------	----------	20,000
Operating profit			$60,000

Filmworks Photography currently uses labor costs to allocate all overhead, but management is considering implementing an activity-based costing system. After interviewing the sales and production staff, management decides to allocate administrative costs on the basis of direct labor costs and to use the following bases to allocate the remaining overhead:

		Cost driver	**Units**
Activity	**Cost driver**	**Student**	**Family**
Production setup	Photo sessions	150	250
Quality control	Customer inspections	300	200
Marketing	Advertisements	60	40

a. Complete the income statement using these activity bases.

b. Write a report describing how management might use activity-based costing to reduce costs.

c. Restate the income statement for Filmworks Photography using direct labor costs as the only overhead allocation base.

d. Write a report to management stating why product line profits differ using activity-based costing compared to the traditional approach. Indicate whether the activity-based costing method provides more accurate information

and why (if you believe it does provide more accurate information). Indicate in your report how the use of labor-based overhead allocation could result in Filmworks Photography management making suboptimal decisions.

Alternate problems

Alternate problem A These cost items are from Rocket Company's accounts for a typical month:

Design work to improve the way products are made	$48,000
Warranty work to satisfy customer complaints	24,000
Employee training	36,000
Incoming materials inspection	40,000
Scrap	36,000
Cost of returned goods	48,000
Inspection at the end of the production process	60,000

a. Classify these items into prevention costs, appraisal costs, internal failure costs, and external failure costs.

b. Suppose Rocket Company could spend an additional USD 40,000 per month on incoming materials inspection, and thereby reduce internal failure and external failure costs by 20 per cent each per month. Would this be a wise thing for Rocket Company to do?

c. Give two examples of additional nonfinancial quality measures that Rocket Company could use to help improve quality. (Hint: See Exhibit 16.)

Alternate problem B You have been hired by Student Health Services to help assess the quality of their services. You have been looking over the following information for the month of May:

Number of patient complaints	120
Minutes the average patient waits	3.8
Cases of missed diagnosis	4

What additional information would you like to have to assess the quality of the organization's performance?

Alternate problem C Precision Instruments produces high-tech devices. The company has a large backlog of orders and had no beginning inventories because all units in production last year were sold by the end of the year. At the start of this year, the firm received an order for 6,000 items.

The company purchased and used USD 200,000 of materials in production for this order. Direct labor costs of USD 150,000 and overhead costs of USD 400,000 were incurred. Goods representing 10 per cent of these costs were still in finished goods inventory at the end of the period.

a. Use T-accounts to show the flow of costs under a traditional costing system.

b. Prepare journal entries for these transactions using backflush costing.

c. Use T-accounts to show the flow of costs using a JIT system with backflush costing.

Alternate problem D The manager of Rafting Excursions uses activity-based costing to compute the costs of her raft trips. Each raft holds six paying customers and a guide. She offers two types of raft trips, a three-day float trip for beginners, and a three-day white-water trip for seasoned rafters. The breakdown of costs is as follows:

Activities (with cost drivers)	**Costs per float trip**	**Costs per white-water trip**
Advertising (trips)	$430	$430
Permit to use the river (trips)	60	100
Equipment use (trips, people)	40 + 10 per person	80 + $16 per person
Insurance (trips)	150	300
Paying guide (trips, guides)	600 per guide	800 per guide
Food (people)	120 per person	120 per person

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a. Compute the cost of a 28-person (including guides) float trip with four rafts and four guides.

b. Compute the cost of a 28-person (including guides) white-water trip with four rafts and four guides.

c. How much should the manager charge each customer if she wants to cover her costs?

Alternate problem E Shoe Express, Inc., manufactures two types of shoes, B-Ball and Marathon. The B-Ball shoe has a complex design that uses gel-filled compartments to provide support. The Marathon shoe is simpler to manufacture and uses conventional foam padding. Last year, Shoe Express had the following revenues and costs:

	Shoe Express, Inc. Income Statement		
	B-Ball	**Marathon**	**Total**
Revenue	$390,000	$368,000	$758,000
Direct materials	110,000	100,000	210,000
Direct labor	80,000	40,000	120,000
Indirect costs:			
Administration	--------	---------	40,000
Production setup	---------	---------	90,000
	---------	---------	
Quality control	---------	---------	60,000
Advertising	----------	---------	120,000
Net income before taxes			$118,000

Shoe Express currently uses labor costs to allocate all overhead, but management is considering implementing an activity-based costing system. After interviewing the sales and production staff, management decides to allocate administrative costs on the basis of direct labor costs, but to use the following bases to allocate the remaining overhead:

		Activity Level	
Activity	**Cost drivers**	**B-ball**	**Marathon**
Production setup	Production runs	20	20
Quality control	Inspections	40	20
Advertising	Advertisements	12	48

a. Complete the income statement using these activity bases.

b. Write a brief report indicating how management could use activity-based costing to reduce costs.

c. Restate the income statement for Shoe Express, Inc., using direct labor costs as the only overhead allocation base.

d. Write a report to management stating why product line profits differ using activity-based costing compared to the traditional approach. Indicate whether the activity-based costing method provides more accurate information and why (if you believe it does provide more accurate information). Indicate in your report how the use of labor-based overhead allocation could result in Shoe Express management making suboptimal decisions.

Beyond the numbers—Critical thinking

Business decision case A Many companies recognize that their cost systems are inadequate for today's global market. Managers in companies selling multiple products are making important product decisions based on distorted cost information.

Write a short paper describing the benefits management should expect from implementing activity-based costing.

Business decision case B A company that makes Halloween costumes is considering using just-in-time purchasing and production methods. Write a short paper describing the problems this company might face in using just-in-time.

Business decision case C Managers at Texas Instruments developed these four cost-of-quality categories: prevention costs, appraisal costs, internal failure costs, and external failure costs. Give an example of a cost for each of these four categories. Would minimizing the sum of these four costs assure high-quality products? Why or why not? Write a short paper summarizing your analysis.

Group project D The chapter listed the following six important points to remember about activity-based costing. Following each point are the comments of a cynic in italics. After forming six groups, discuss one of these points in each group. How would you respond to the cynic's comments? (It is okay to agree; even cynics have good points to make.) Choose one group member to report your group's response to the class.

- The allocation of indirect costs is at least somewhat arbitrary, even using sophisticated accounting methods. ("*This means no method gives you a true cost; all are arbitrary. So why go to the trouble of implementing ABC*?")

- Activity-based costing provides more detailed measures of costs than traditional allocation methods. ("*Who needs more detail? Life is already too complicated*".)

- Activity-based costing can help marketing people by providing more accurate product cost numbers for decisions about pricing and which unprofitable products the company should eliminate. ("*Why should accountants want to help marketing people*?")

- Production also benefits because activity-based costing provides better information about the cost of each activity. In practice, ABC helps managers identify cost causing activities. To manage costs, production managers learn to manage the activities that cause costs. ("*If production people know their jobs, they do not need help from accountants*".)

- Activity-based costing provides more information about product costs than traditional methods but requires more record-keeping. Managers must decide whether the benefits of improved decisions justify the additional record-keeping cost. ("*ABC sounds like a lot of work. Why bother?*")

- Installing activity-based costing requires teamwork among accountants, production managers, marketing managers, and other nonaccounting people. ("*You will never get these people to work together. Accountants and marketing people? You have got to be kidding*!")

Group project E Form a group of three or four students and assume you are hired as business consultants for each of the cases below. Respond to each of the comments made in case 1 and case 2. Your response should assume you are talking directly to the CEO. State whether you agree or disagree with the statement and justify your response. (Hint: Consider the potential costs and benefits associated with each case.)

Case 1 Your group is meeting with the CEO of a relatively small company that produces one model of bicycles. After lengthy discussion regarding the company's costing system, the CEO makes the following statement: "From

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what I have seen at other companies lately, activity-based costing is the wave of the future. Everyone, including us, should drop existing cost systems and adopt ABC!"

Case 2 Your group is meeting with the CEO of a relatively large company that produces hundreds of expensive custom computers. After lengthy discussion regarding the company's costing system, the CEO makes the following statement: "From what I have seen at other companies lately, activity-based costing is the wave of the future. Everyone, including us, should drop existing cost systems and adopt ABC!"

Group project F In teams of two or three, interview the manager of a retail (or wholesale) store such as a music store, an automobile parts store, or the parts department of an appliance dealership. Ask the manager how items are ordered to replace those sold. For example, does he or she order based on observing inventory levels or place an order each time a customer buys an item? Does he or she appear to use just-in-time inventory? Write a memorandum to the instructor summarizing the results of the interview. Information contained in the memo should include:

Date:

To:

From:

Subject:

Content of the memo must include the name and title of the person interviewed, name of the company, date of the interview, and the results of the interview.

Group project G In teams of two or three, observe an organization of your choice—wholesale, retail, or service. Give examples of warning and diagnostic signals the organization uses. How could it use control charts, Pareto charts, and cause-and-effect analysis?

Using the Internet—A view of the real world

The Malcolm Baldrige National Quality Award is awarded to companies meeting certain quality standards and criteria. This award is issued annually by the National Institute of Standards and Technology (NIST). Visit the following website:

http://www.baldrige.nist.gov

Click on "Criteria and their Impact". What criteria are used as a basis for making awards to applicants? Click on "Winners Showcase". Who were the most recent winners of the Baldrige Award? What products or services do these companies provide?

Based on the results of the previous Internet project, perform an Internet search to find at least one recent Baldrige Award winning company. Does the company provide information on the Internet about being the recipient of the award? If so, write a report summarizing this information. If not, search for a recent award winner that does provide this information, and write a report summarizing the information provided.

Answers to self-test

True-false

20. Using accounting for quality and cost management

False. The managers' task is to minimize these costs, not maximize them.

True. Control charts are a means of distinguishing between random or routine variations in product quality and variations that managers should investigate.

False. To the contrary, the allocation of indirect costs is, by definition, at least somewhat arbitrary.

True. A cost driver is an activity or transaction that causes costs to be incurred.

True. The formula for computing an indirect cost rate has the cost in the numerator and the volume of the cost driver or allocation base in the denominator.

Multiple-choice

d. The new production environment refers to an environment in which company managers are concerned with improving customer service and product quality, and reducing costs.

c. Production does not begin on an item until an order is received.

d. USD 160,000

USD 260,000/(80,000 hours + 50,000 hours) = USD 2. USD 2 X 80,000 hours = USD 160,000.

b. USD 2.27

First find the rates:

$$\frac{\text{USD}\,82{,}000}{(8+12)} = \text{USD}\,4{,}100. \qquad \frac{\text{USD}\,48{,}000}{(56+24)} = \text{USD}\,600.$$

$$\frac{\text{USD}\,130{,}000}{(80{,}000+50{,}000)} = \text{USD}\,1.$$

Next assign overhead to Product R:

(USD 4,100 X 12) + (USD 600 X 24) + (USD 1 X 50,000) = USD 49,200 + USD 14,400 + USD 50,000 = USD 113,600.

Now find the unit cost:

$$\frac{\text{USD}\,113{,}600}{50{,}000\,\text{units}} = \text{USD}\,2.27.$$