Differential Analysis: The Key to Decision Making

LEARNING OBJECTIVES

After studying Chapter 12, you should be able to:

LO12-1 Identify relevant and irrelevant costs and benefits in a decision.

LO12-2 Prepare an analysis showing whether a product line or other business segment should be added or dropped.

LO12-3 Prepare a make or buy analysis.

LO12-4 Prepare an analysis showing whether a special order should be accepted.

LO12-5 Determine the most profitable use of a constrained resource.

LO12-6 Determine the value of obtaining more of the constrained resource.

LO12-7 Prepare an analysis showing whether joint products should be sold at the split-off point or processed further.

Moving Manufacturing Operations Overseas

BUSINESS FOCUS

A survey from **Ventoro Institute LLC** found that many companies expect to realize an 80% cost savings when moving manufacturing operations overseas. However, in this same survey, companies reported an average actual cost savings of less than 10%. Some of the problems encountered by these companies included miscommunications with offshore manufacturers, shipping delays, intellectual property infringement, and substandard product quality. William Botts, vice chairman of **Vegas Valley Angels** (an angel-investing group), suggests that companies with labor-intensive manufacturing processes are most likely to benefit from sending manufacturing operations overseas because the bulk of potential cost savings relate to labor costs. ■

Source: Small Talk, "Kelly Spors Answers Questions on Protecting Ideas, Cutting Off Junk Mail, and Overseas Manufacturing," The Wall Street Journal, *March 17, 2008, p. R2.*

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Managers must decide what products to sell, whether to make or buy component parts, what prices to charge, what channels of distribution to use, whether to accept special orders at special prices, and so forth. Making such decisions is often a difficult task that is complicated by numerous alternatives and massive amounts of data, only some of which may be relevant.

Every decision involves choosing from among at least two alternatives. In making a decision, the costs and benefits of one alternative must be compared to the costs and benefits of other alternatives. The key to making such comparisons is *differential analysis*—focusing on the costs and benefits that *differ* between the alternatives. A difference in cost between any two alternatives is known as a **differential cost**. A difference in revenue between any two alternatives is known as **differential revenue**. Differential costs and revenues are relevant to decision making, whereas costs and revenues that do not differ between alternatives are irrelevant to decision making. Because differential costs and differential revenues are the only inputs that are relevant to decision making, they are also often referred to as **relevant costs** and **relevant benefits**.

Distinguishing between relevant and irrelevant costs and benefits is critical for two reasons. First, irrelevant data can be ignored—saving decision makers tremendous amounts of time and effort. Second, bad decisions can easily result from erroneously including irrelevant costs and benefits when analyzing alternatives. To be successful in decision making, managers must be able to tell the difference between relevant and irrelevant data and must be able to correctly use the relevant data in analyzing alternatives. The purpose of this chapter is to develop these skills by illustrating their use in a wide range of decision-making situations. These decision-making skills are as important in your personal life as they are to managers. After completing your study of this chapter, you should be able to think more clearly about decisions in many facets of your life.

Cost Concepts for Decision Making

Identifying Relevant Costs and Benefits

LO12-1

Identify relevant and irrelevant costs and benefits in a decision.

Only those costs and benefits that differ in total between alternatives are relevant in a decision. If the total amount of a cost will be the same regardless of the alternative selected, then the decision has no effect on the cost, so the cost can be ignored. To elaborate on this point, we'd like to define the terms *avoidable cost, sunk cost,* and *opportunity cost,* and illustrate the concept of *future costs that do not differ between alternatives.*

Assume you are trying to decide whether to go to a movie or rent a DVD for the evening. The rent on your apartment is irrelevant. Whether you go to a movie or rent a DVD, the rent on your apartment will be exactly the same and is therefore irrelevant to the decision. On the other hand, the

cost of the movie ticket and the cost of renting the DVD would be relevant in the decision because they are *avoidable costs.*

An **avoidable cost** is a cost that can be eliminated by choosing one alternative over another. By choosing the alternative of going to the movie, the cost of renting the DVD can be avoided. By choosing the alternative of renting the DVD, the cost of the movie ticket can be avoided. Therefore, the cost of the movie ticket and the cost of renting the DVD are both avoidable costs. On the other hand, the rent on your apartment is not an avoidable cost of either alternative. You would continue to rent your apartment under either alternative. Avoidable costs are relevant costs. Unavoidable costs are irrelevant costs.

To refine the notion of relevant costs a little further, two broad categories of costs are never relevant in decisions—sunk costs and future costs that do not differ between the alternatives. As we learned in Chapter 2, a **sunk cost** is a cost that has already been incurred and cannot be avoided regardless of what a manager decides to do. For example, suppose a company purchased a five-year-old truck for $12,000. The amount paid for the truck is a sunk cost because it has already been incurred and the transaction cannot be undone. Even though it is perhaps counterintuitive, the amount the company paid for the

truck is irrelevant in making decisions such as whether to keep, sell, or replace the truck. Furthermore, any depreciation expense related to the truck is *irrelevant in making decisions.* This is true because depreciation is a noncash expense that simply spreads the cost of the truck over its useful life.[1] Sunk costs are always the same no matter what alternatives are being considered; therefore, they are irrelevant and should be ignored when making decisions.

Future costs that do not differ between alternatives should also be ignored. Continuing with the example discussed earlier, suppose you plan to order a pizza after you go to the movie theater or you rent a DVD. If you are going to buy the same pizza regardless of your choice of entertainment, the cost of the pizza is irrelevant to the choice of whether you go to the movie theater or rent a DVD. Notice, the cost of the pizza is not a sunk cost because it has not yet been incurred. Nonetheless, the cost of the pizza is irrelevant to the entertainment decision because it is a future cost that does not differ between the alternatives.

Opportunity costs also need to be considered when making decisions. An **opportunity cost** is the potential benefit that is given up when one alternative is selected over another. For example, if you were considering giving up a high-paying summer job to travel overseas, the forgone wages would be an opportunity cost of traveling abroad. Opportunity costs are not usually found in accounting records, but they are costs that must be explicitly considered in every decision a manager makes.

To summarize, only those costs and benefits that differ between alternatives are relevant in a decision. Differential costs are also referred to as relevant costs or avoidable costs. The key to successful decision making is to focus on relevant costs and benefits as well as opportunity costs while ignoring everything else—including sunk costs and future costs and benefits that do not differ between the alternatives.

IN BUSINESS

INDUSTRIAL MOTION HEADS EAST

Eric Kozlowski and Brian Pfeifer founded Industrial Motion Inc. in Rancho Santa Margarita, California; however, after 10 years in California, they decided to cut costs by relocating the company to Mooresville, North Carolina. In Mooresville, the company's 42 employees are paid salaries of $35,000–$45,000 instead of the $60,000 paid to employees in California; furthermore, worker's compensation insurance is one-tenth of the amount paid in California. Property taxes and the cost of real estate are 50% less in Mooresville compared to Rancho Santa Margarita. Even the company's security system in Mooresville costs only $25 per month instead of $280 per month in California.

Source: Simona Covel, "Moving Across the Country to Cut Costs," *The Wall Street Journal,* January 10, 2008, p. B4.

Different Costs for Different Purposes

We need to recognize a fundamental concept from the outset of our discussion—costs that are relevant in one decision situation are not necessarily relevant in another. This means that *managers need different costs for different purposes.* For one purpose, a particular group of costs may be relevant; for another purpose, an entirely different group of costs may be relevant. Thus, *each*

decision situation must be carefully analyzed to isolate the relevant costs. Otherwise, irrelevant data may cloud the situation and lead to a bad decision.

The concept of “different costs for different purposes” is basic to managerial accounting; we shall frequently see its application in the pages that follow.

An Example of Identifying Relevant Costs and Benefits

Cynthia is currently a student in an MBA program in Boston and would like to visit a friend in New York City over the weekend. She is trying to decide whether to drive or take the train. Because she is on a tight budget, she wants to carefully consider the costs of the two alternatives. If one alternative is far less expensive than the other, that may be decisive in her choice. By car, the distance between her apartment in Boston and her friend's apartment in New York City is 230 miles. Cynthia has compiled the following list of items to consider:

Automobile Costs

	Item	Annual Cost of Fixed Items	Cost per Mile (based on 10,000 miles per year)
(a)	Annual straight-line depreciation on car [($24,000 original cost − $10,000 estimated resale value in 5 years)/5 years]	$2,800	$0.280
(b)	Cost of gasoline ($3.30 per gallon ÷ 33 miles per gallon)		0.100
(c)	Annual cost of auto insurance and license	$1,380	0.138
(d)	Maintenance and repairs		0.065
(e)	Parking fees at school ($45 per month × 8 months)	$360	0.036
(f)	Total average cost per mile		$0.619

Additional Data

	Item	
(g)	Reduction in the resale value of car due solely to wear and tear	$0.026 per mile
(h)	Cost of round-trip train ticket from Boston to New York City	$104
(i)	Benefit of relaxing and being able to study during the train ride rather than having to drive	?
(j)	Cost of putting the dog in a kennel while gone	$40
(k)	Benefit of having a car available in New York City	?
(l)	Hassle of parking the car in New York City	?
(m)	Cost of parking the car in New York City	$25 per day

Which costs and benefits are relevant in this decision? Remember, only those costs and benefits that differ between alternatives are relevant. Everything else is irrelevant and can be ignored.

Start at the top of the list with item (a): the original cost of the car is a sunk cost. This cost has already been incurred and therefore can never differ between alternatives. Consequently, it is irrelevant and should be ignored. The same is true of the accounting depreciation of $2,800 per year, which simply spreads the sunk cost across five years.

Item (b), the cost of gasoline consumed by driving to New York City, is a relevant cost. If Cynthia takes the train, this cost would not be incurred. Hence, the cost differs between alternatives and is therefore relevant.

Item (c), the annual cost of auto insurance and license, is not relevant. Whether Cynthia takes the train or drives on this particular trip, her annual auto insurance premium and her auto license fee will remain the same.[2]

Item (d), the cost of maintenance and repairs, is relevant. While maintenance and repair costs have a large random component, over the long run they should be more or less proportional to the number of miles the car is driven. Thus, the average cost of $0.065 per mile is a reasonable estimate to use.

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Item (e), the monthly fee that Cynthia pays to park at her school during the academic year is not relevant. Regardless of which alternative she selects—driving or taking the train—she will still need to pay for parking at school.

Item (f) is the total average cost of $0.619 per mile. As discussed above, some elements of this total are relevant, but some are not relevant. Because it contains some irrelevant costs, it would be incorrect to estimate the cost of driving to New York City and back by simply multiplying the $0.619 by 460 miles (230 miles each way × 2). This erroneous approach would yield a cost of driving of $284.74. Unfortunately, such mistakes are often made in both personal life and in business. Because the total cost is stated on a per-mile basis, people are easily misled. Often people think that if the cost is stated as $0.619 per mile, the cost of driving 100 miles is $61.90. But it is not. Many of the costs included in the $0.619 cost per mile are sunk and/or fixed and will not increase if the car is driven another 100 miles. The $0.619 is an average cost, not an incremental cost. Beware of such unitized costs (i.e., costs stated in terms of a dollar amount per unit, per mile, per direct labor-hour, per machine-hour, and so on)—they are often misleading.

Item (g), the decline in the resale value of the car that occurs as a consequence of driving more miles, is relevant in the decision. Because she uses the car, its resale value declines, which is a real cost of using the car that should be taken into account. Cynthia estimated this cost by accessing the *Kelly Blue Book* website at **www.kbb.com**. The reduction in resale value of an asset through use or over time is often called *real* or *economic depreciation.* This is different from accounting depreciation, which attempts to match the sunk cost of an asset with the periods that benefit from that cost.

Item (h), the $104 cost of a round-trip ticket on the train, is relevant in this decision. If she drives, she would not have to buy the ticket.

Item (i) is relevant to the decision, even if it is difficult to put a dollar value on relaxing and being able to study while on the train. It is relevant because it is a benefit that is available under one alternative but not under the other.

Item (j), the cost of putting Cynthia's dog in the kennel while she is gone, is irrelevant in this decision. Whether she takes the train or drives to New York City, she will still need to put her dog in a kennel.

Like item (i), items (k) and (l) are relevant to the decision even if it is difficult to measure their dollar impacts.

Item (m), the cost of parking in New York City, is relevant to the decision.

Bringing together all of the relevant data, Cynthia would estimate the relevant costs of driving and taking the train as follows:

Relevant financial cost of driving to New York City:	
Gasoline (460 miles × $0.100 per mile)	$ 46.00
Maintenance and repairs (460 miles × $0.065 per mile)	29.90
Reduction in the resale value of car due solely to wear and tear (460 miles × $0.026 per mile)	11.96
Cost of parking the car in New York City (2 days × $25 per day)	50.00
Total	$137.86
Relevant financial cost of taking the train to New York City:	
Cost of round-trip train ticket from Boston to New York City	$104.00

What should Cynthia do? From a purely financial standpoint, it would be cheaper by $33.86 ($137.86 − $104.00) to take the train than to drive. Cynthia has to decide if the convenience of having a car in New York City outweighs the additional cost and the disadvantages of being unable to relax and study on the train and the hassle of finding parking in the city.

In this example, we focused on identifying the relevant costs and benefits—everything else was ignored. In the next example, we include all of the costs and benefits—relevant or not. Nonetheless, we'll still get the correct answer because the irrelevant costs and benefits will cancel out when we compare the alternatives.

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IN BUSINESS

UNDERSTANDING THE IMPORTANCE OF QUALITATIVE FACTORS

SAS is a privately held $2.26 billion company located on a 200-acre campus in Cary, North Carolina. The company has an on-site medical facility (including a lab for blood tests) that is staffed by doctors, nurse practitioners, physical therapists, and a nutritionist. The company also has an infant day care, a Montessori school, a hair salon, a dry cleaning shop, a fitness center, and jogging and biking trails on campus. Employees that use the day care pay $360 per month per child for the service and SAS covers the remaining $720 per month per child that it costs to retain 120 teachers and staffers.

Although it may be difficult to quantify the benefits of these investments, SAS firmly believes that retaining happy and healthy employees is instrumental to its success. Mary Simmons, a SAS software developer says, "At lunch I will go out and bike 20 miles. Then I'll get back and all of a sudden a thought comes to my brain, and I solve something I was struggling with."

Source: Christopher Tkaczyk, "Offer Affordable (Awesome) Day Care," *Fortune,* August 17, 2009, p. 26.

Reconciling the Total and Differential Approaches

Oak Harbor Woodworks is considering a new labor-saving machine that rents for $3,000 per year. The machine will be used on the company's butcher block production line. Data concerning the company's annual sales and costs of butcher blocks with and without the new machine are shown below:

	Current Situation	Situation with the New Machine
Units produced and sold	5,000	5,000
Selling price per unit	$40	$40
Direct materials cost per unit	$14	$14
Direct labor cost per unit	$8	$5
Variable overhead cost per unit	$2	$2
Fixed expenses, other	$62,000	$62,000
Fixed expenses, rental of new machine	—	$3,000

Given the data above, the net operating income for the product under the two alternatives can be computed as shown in Exhibit 12-1.

Note that the net operating income is $12,000 higher with the new machine, so that is the better alternative. Note also that the $12,000 advantage for the new machine can be obtained in two different ways. It is the difference between the $30,000 net operating income with the new machine and the $18,000 net operating income for the current situation. It is also the sum of the differential

costs and benefits as shown in the last column of Exhibit 12-1 ($15,000 + $(3,000) = $12,000). A positive number in the Differential Costs and Benefits column indicates that the difference between the alternatives favors the new machine; a negative number indicates that the difference favors the current situation. A zero in that column simply means that the total amount for the item is exactly the same for both alternatives. Thus, because the difference in the net operating incomes equals the sum of the differences for the individual items, any cost or benefit that is the same for both alternatives will have no impact on which alternative is preferred. This is the reason that costs and benefits that do not differ between alternatives are irrelevant and can be ignored. If we properly account for them, they will cancel out when we compare the alternatives.

EXHIBIT 12-1
Total and Differential Costs

	Current Situation	Situation with New Machine	Differential Costs and Benefits
Sales (5,000 units × $40 per unit)	$200,000	$200,000	$ 0
Variable expenses:			
Direct materials (5,000 units × $14 per unit)	70,000	70,000	0
Direct labor (5,000 units × $8 per unit; 5,000 units × $5 per unit)	40,000	25,000	15,000
Variable overhead (5,000 units × $2 per unit)	10,000	10,000	0
Total variable expenses	120,000	105,000	
Contribution margin	80,000	95,000	
Fixed expenses:			
Other	62,000	62,000	0
Rental of new machine	0	3,000	(3,000)
Total fixed expenses	62,000	65,000	
Net operating income	$ 18,000	$ 30,000	$12,000

We could have arrived at the same solution much more quickly by completely ignoring the irrelevant costs and benefits.

- The selling price per unit and the number of units sold do not differ between the alternatives. Therefore, the total sales revenues are exactly the same for the two alternatives as shown in Exhibit 12-1. Because the sales revenues are exactly the same, they have no effect on the difference in net operating income between the two alternatives. That is shown in the last column in Exhibit 12-1, which shows a $0 differential benefit.
- The direct materials cost per unit, the variable overhead cost per unit, and the number of units produced and sold do not differ between the alternatives. Consequently, the total direct materials cost and the total variable overhead cost are the same for the two alternatives and can be ignored.
- The "other" fixed expenses do not differ between the alternatives, so they can be ignored as well.

Indeed, the only costs that do differ between the alternatives are direct labor costs and the fixed rental cost of the new machine. Hence, the two alternatives can be compared based only on these relevant costs:

Net Advantage of Renting the New Machine	
Decrease in direct labor costs (5,000 units at a cost savings of $3 per unit)	$15,000
Increase in fixed expenses	(3,000)
Net annual cost savings from renting the new machine	$12,000

If we focus on just the relevant costs and benefits, we get exactly the same answer as when we listed all of the costs and benefits—including those that do not differ between the alternatives and, hence, are irrelevant. We get the same answer because the only costs

and benefits that matter in the final comparison of the net operating incomes are those that differ between the two alternatives and, hence, are not zero in the last column of Exhibit 12-1. Those two relevant costs are both included in the above analysis that quantifies the net advantage of renting the new machine.

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Why Isolate Relevant Costs?

In the preceding example, we used two different approaches to analyze the alternatives. First, we considered all costs, both those that were relevant and those that were not; and second, we considered only the relevant costs. We obtained the same answer under both approaches. It would be natural to ask, "Why bother to isolate relevant costs when total costs will do the job just as well?" Isolating relevant costs is desirable for at least two reasons.

First, only rarely will enough information be available to prepare a detailed income statement for both alternatives. Assume, for example, that you are called on to make a decision relating to a portion of a single business process in a multidepartmental, multi-product company. Under these circumstances, it would be virtually impossible to prepare an income statement of any type. You would have to rely on your ability to recognize which costs are relevant and which are not in order to assemble the data necessary to make a decision.

Second, mingling irrelevant costs with relevant costs may cause confusion and distract attention from the information that is really critical. Furthermore, the danger always exists that an irrelevant piece of data may be used improperly, resulting in an incorrect decision. The best approach is to ignore irrelevant data and base the decision entirely on relevant data.

Relevant cost analysis, combined with the contribution approach to the income statement, provides a powerful tool for making decisions. We will investigate various uses of this tool in the remaining sections of this chapter.

Adding and Dropping Product Lines and Other Segments

LO12-2

Prepare an analysis showing whether a product line or other business segment should be added or dropped.

Decisions relating to whether product lines or other segments of a company should be dropped and new ones added are among the most difficult that a manager has to make. In such decisions, many qualitative and quantitative factors must be considered. Ultimately, however, any final decision to drop a business segment or to add a new one hinges primarily on the impact the decision will have on net operating income. To assess this impact, costs must be carefully analyzed.

An Illustration of Cost Analysis

Exhibit 12-2 provides sales and cost information for the preceding month for the Discount Drug Company and its three major product lines—drugs, cosmetics, and housewares. A quick review of this exhibit suggests that dropping the housewares segment would increase the company's overall net operating income by $8,000. However, this would be a flawed conclusion because the data in Exhibit 12-2 do not distinguish between fixed expenses that can be avoided if a product line is dropped and common fixed expenses that cannot be avoided by dropping any particular product line.

In this scenario, the two alternatives under consideration are keeping the housewares product line and dropping the housewares product line. Therefore, only those costs that differ between these two alternatives (i.e., that can be avoided by dropping the housewares product line) are relevant. In deciding whether to drop housewares, it is crucial to identify which costs can be avoided, and hence are relevant to the decision, and which costs cannot be avoided, and hence are irrelevant. The decision should be analyzed as follows.

EXHIBIT 12-2
Discount Drug Company Product Lines

		Product Line		
	Total	Drugs	Cosmetics	House-wares
Sales	$250,000	$125,000	$75,000	$50,000
Variable expenses	105,000	50,000	25,000	30,000
Contribution margin	145,000	75,000	50,000	20,000
Fixed expenses:				
Salaries	50,000	29,500	12,500	8,000
Advertising	15,000	1,000	7,500	6,500
Utilities	2,000	500	500	1,000
Depreciation—fixtures	5,000	1,000	2,000	2,000
Rent	20,000	10,000	6,000	4,000
Insurance	3,000	2,000	500	500
General administrative	30,000	15,000	9,000	6,000
Total fixed expenses	125,000	59,000	38,000	28,000
Net operating income (loss)	$ 20,000	$ 16,000	$12,000	$ (8,000)

If the housewares line is dropped, then the company will lose $20,000 per month in contribution margin, but by dropping the line it may be possible to avoid some fixed costs such as salaries or advertising costs. If dropping the housewares line enables the company to avoid more in fixed costs than it loses in contribution margin, then its overall net operating income will improve by eliminating the product line. On the other hand, if the company is not able to avoid as much in fixed costs as it loses in contribution margin, then the housewares line should be kept. In short, the manager should ask, "What costs can I avoid if I drop this product line?"

As we have seen from our earlier discussion, not all costs are avoidable. For example, some of the costs associated with a product line may be sunk costs. Other costs may be allocated fixed costs that will not differ in total regardless of whether the product line is dropped or retained.

To show how to proceed in a product-line analysis, suppose that Discount Drug Company has analyzed the fixed costs being charged to the three product lines and determined the following:

1. The salaries expense represents salaries paid to employees working directly on the product. All of the employees working in housewares would be discharged if the product line is dropped.
2. The advertising expense represents advertisements that are specific to each product line and are avoidable if the line is dropped.
3. The utilities expense represents utilities costs for the entire company. The amount charged to each product line is an allocation based on space occupied and is not avoidable if the product line is dropped.

4. The depreciation expense represents depreciation on fixtures used to display the various product lines. Although the fixtures are nearly new, they are custom-built and will have no resale value if the housewares line is dropped.
5. The rent expense represents rent on the entire building housing the company; it is allocated to the product lines on the basis of sales dollars. The monthly rent of $20,000 is fixed under a long-term lease agreement.
6. The insurance expense is for insurance carried on inventories within each of the three product lines. If housewares is dropped, the related inventories will be liquidated and the insurance premiums will decrease proportionately.
7. The general administrative expense represents the costs of accounting, purchasing, and general management, which are allocated to the product lines on the basis of sales dollars. These costs will not change if the housewares line is dropped.

With this information, management can determine that $15,000 of the fixed expenses associated with the housewares product line are avoidable and $13,000 are not:

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Fixed Expenses	Total Cost Assigned to Housewares	Not Avoidable*	Avoidable
Salaries	$ 8,000		$ 8,000
Advertising	6,500		6,500
Utilities	1,000	$ 1,000	
Depreciation—fixtures	2,000	2,000	
Rent	4,000	4,000	
Insurance	500		500
General administrative	6,000	6,000	
Total	$28,000	$13,000	$15,000

*These fixed costs represent either sunk costs or future costs that will not change whether the housewares line is retained or discontinued.

As stated earlier, if the housewares product line were dropped, the company would lose the product's contribution margin of $20,000, but would save its associated avoidable fixed expenses. We now know that those avoidable fixed expenses total $15,000. Therefore, dropping the housewares product line would result in a $5,000 *reduction* in net operating income as shown below:

Contribution margin lost if the housewares line is discontinued (see Exhibit 12–2)	$(20,000)
Fixed expenses that can be avoided if the housewares line is discontinued (see above)	15,000
Decrease in overall company net operating income	$ (5,000)

In this case, the fixed costs that can be avoided by dropping the housewares product line ($15,000) are less than the contribution margin that will be lost ($20,000). Therefore, based on the data given, the housewares line should not be discontinued unless a more profitable use can be found for the floor and counter space that it is occupying.

A Comparative Format

This decision can also be approached by preparing comparative income statements showing the effects of either keeping or dropping the product line. Exhibit 12-3 contains such an analysis for the Discount Drug Company. As shown in the last column of the exhibit, if the housewares line is dropped, then overall company net operating income will decrease by $5,000 each period. This is the same answer, of course, as we obtained when we focused just on the lost contribution margin and avoidable fixed costs.

Beware of Allocated Fixed Costs

Go back to Exhibit 12-2. Does this exhibit suggest that the housewares product line should be kept—as we have just concluded? No, it does not. Exhibit 12-2 suggests that the housewares product line is losing money. Why keep a product line that is showing a loss? The explanation for this apparent inconsistency lies in part with the common fixed costs that are being allocated to the product lines. One of the great dangers in allocating common fixed costs is that such allocations can make a product line (or other business segment) look less profitable than it really is. In this instance, allocating the common fixed costs among all product lines makes the housewares product line appear to be unprofitable. However, as we have just shown, dropping the product line would result in a decrease in the company's overall net operating income. This point can be seen clearly if we redo Exhibit 12-2 by eliminating the allocation of the common fixed costs. Exhibit 12-4 uses the segmented approach from Chapter 6 to estimate the profitability of the product lines.

EXHIBIT 12-3
A Comparative Format for Product-Line Analysis

	Keep Housewares	Drop Housewares	Difference: Net Operating Income Increase (or Decrease)
Sales	$50,000	$ 0	$(50,000)
Variable expenses	30,000	0	30,000
Contribution margin	20,000	0	(20,000)
Fixed expenses:			
Salaries	8,000	0	8,000
Advertising	6,500	0	6,500
Utilities	1,000	1,000	0
Depreciation—fixtures	2,000	2,000	0
Rent	4,000	4,000	0
Insurance	500	0	500
General administrative	6,000	6,000	0
Total fixed expenses	28,000	13,000	15,000
Net operating loss	$ (8,000)	$(13,000)	$ (5,000)

Exhibit 12-4 gives us a much different perspective of the housewares line than does Exhibit 12-2. As shown in Exhibit 12-4, the housewares line is covering all of its own traceable fixed costs and generating a $3,000 segment margin toward covering the common fixed costs of the company. Unless another product line can be found that will generate a segment margin greater than $3,000, the company would be better off keeping the housewares line. By keeping the product line, the company's overall net operating income will be higher than if the product line were dropped.

Additionally, managers may choose to retain an unprofitable product line if the line helps sell other products, or if it serves as a "magnet" to attract customers. Bread, for example, may not be an especially profitable line in some food stores, but customers expect it to be available, and many of them would undoubtedly shift their buying elsewhere if a particular store decided to stop carrying it.

IN BUSINESS

POOR ECONOMY LEADS TO SEGMENT DISCONTINUATIONS

When the economy declines, many companies must decide whether to retain or discontinue struggling products and services. For example, Condé Nast Publications reacted to a steep drop in advertising revenues by cutting 180 jobs and discontinuing four magazines—*Gourmet, Modern Bride, Elegant Bride,* and *Cookie.* It also cut the budgets of its remaining magazines by 20–25%. Pioneer Corp.'s annual plasma television sales dropped from 460,000 units to 290,000 units. The company responded to its shrinking customer demand by cutting thousands of jobs and withdrawing from the plasma television business.

Sources: Russell Adams, “Ax Falls on Four Condé Nast Titles,” *The Wall Street Journal,* October 6, 2009, p. B1; and Daisuke Wakabayashi, “Pioneer Unplugs Its TV Business,” *The Wall Street Journal,* February 13, 2009, p. B1.

EXHIBIT 12-4
Discount Drug Company Product Lines—Recast in Contribution Format (from Exhibit 12-2)

		Product Line		
	Total	Drugs	Cosmetics	House-wares
Sales	$250,000	$125,000	$75,000	$50,000
Variable expenses	105,000	50,000	25,000	30,000
Contribution margin	145,000	75,000	50,000	20,000
Traceable fixed expenses:				
Salaries	50,000	29,500	12,500	8,000
Advertising	15,000	1,000	7,500	6,500
Depreciation—fixtures	5,000	1,000	2,000	2,000
Insurance	3,000	2,000	500	500
Total traceable fixed expenses	73,000	33,500	22,500	17,000
Product-line segment margin	72,000	$ 41,500	$27,500	$ 3,000*
Common fixed expenses:				
Utilities	2,000			
Rent	20,000			
General administrative	30,000			
Total common fixed expenses	52,000			
Net operating income	$ 20,000			

*If the housewares line is dropped, the company will lose the $3,000 segment margin generated by this product line. In addition, we have seen that the $2,000 depreciation on the fixtures is a sunk cost that cannot be avoided. The sum of these two figures ($3,000 + $2,000 = $5,000) would be the decrease in the company's overall profits if the housewares line were discontinued. Of course, the company may later choose to drop the product if circumstances change—such as a pending decision to replace the fixtures.

The Make or Buy Decision

LO12-3
Prepare a make or buy analysis.

Providing a product or service to a customer involves many steps. For example, consider all of the steps that are necessary to develop and sell a product such as tax preparation software in retail stores. First the software must be developed, which involves highly skilled software engineers and a great deal of project management effort. Then the product must be put into a form that can be delivered to customers. This involves burning the application onto a blank CD or DVD, applying a label, and

packaging the result in an attractive box. Then the product must be distributed to retail stores. Then the product must be sold. And finally, help lines and other forms of after-sale service may have to be provided. And we should not forget that the blank CD or DVD, the label, and the box must of course be made by someone before any of this can happen. All of these activities, from development, to production, to after-sales service are called a *value chain.*

Separate companies may carry out each of the activities in the value chain or a single company may carry out several. When a company is involved in more than one activity in the entire value chain, it is **vertically integrated**. Some companies control all of the activities in the value chain from producing basic raw materials right up to the final distribution of finished goods and provision of after-sales service. Other companies are content to integrate on a smaller scale by purchasing many of the parts and materials that go into their finished products. A decision to carry out one of the activities in the value chain internally, rather than to buy externally from a supplier, is called a **make or buy decision**. Quite often these decisions involve whether to buy a particular part or to make

it internally. Make or buy decisions also involve decisions concerning whether to outsource development tasks, after-sales service, or other activities.

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Strategic Aspects of the Make or Buy Decision

Vertical integration provides certain advantages. An integrated company is less dependent on its suppliers and may be able to ensure a smoother flow of parts and materials for production than a nonintegrated company. For example, a strike against a major parts supplier can interrupt the operations of a nonintegrated company for many months, whereas an integrated company that is producing its own parts would be able to continue operations. Also, some companies feel that they can control quality better by producing their own parts and materials, rather than by relying on the quality control standards of outside suppliers. In addition, an integrated company realizes profits from the parts and materials that it is "making" rather than "buying," as well as profits from its regular operations.

The advantages of vertical integration are counterbalanced by the advantages of using external suppliers. By pooling demand from a number of companies, a supplier may be able to enjoy economies of scale. These economies of scale can result in higher quality and lower costs than would be possible if the company were to attempt to make the parts or provide the service on its own. A company must be careful, however, to retain control over activities that are essential to maintaining its competitive position. For example, **Hewlett-Packard** controls the software for laser printers that it makes in cooperation with **Canon Inc.** of Japan. The present trend appears to be toward less vertical integration, with companies like **Oracle** and Hewlett-Packard concentrating on hardware and software design and relying on outside suppliers for almost everything else in the value chain.

An Example of Make or Buy

To provide an illustration of a make or buy decision, consider Mountain Goat Cycles. The company is now producing the heavy-duty gear shifters used in its most popular line of mountain bikes. The company's Accounting Department reports the following costs of producing 8,000 units of the shifter internally each year:

	Per Unit	8,000 Units
Direct materials	$ 6	$ 48,000
Direct labor	4	32,000
Variable overhead	1	8,000
Supervisor's salary	3	24,000
Depreciation of special equipment	2	16,000
Allocated general overhead	5	40,000
Total cost	$21	$168,000

An outside supplier has offered to sell 8,000 shifters a year to Mountain Goat Cycles for a price of only $19 each, or a total of $152,000 (= 8,000 shifters × $19 each). Should the company stop producing the shifters internally and buy them from the outside supplier? As always, the focus should be on the relevant costs—those that differ between the alternatives. And the costs that differ between

the alternatives consist of the costs that could be avoided by purchasing the shifters from the outside supplier. If the costs that can be avoided by purchasing the shifters from the outside supplier total less than $152,000, then the company should continue to manufacture its own shifters and reject the outside supplier's offer. On the other hand, if the costs that can be avoided by purchasing the shifters from the outside supplier total more than $152,000 the outside supplier's offer should be accepted.

IN BUSINESS

OUTSOURCING TASKS RATHER THAN JOBS

Pfizer saved 4,000 of its managers 66,500 hours of work by enabling them to outsource their tedious, time-consuming tasks to companies in India. With the click of a mouse the managers go to a website called PfizerWorks to prepare online work orders for services such as Powerpoint slide preparation, spreadsheet preparation, or basic market research. The requests are sent overseas and completed by a services-outsourcing firm. This outsourcing enables Pfizer's managers to spend their time on higher value work such as motivating teams, creating new products, and strategy formulation.

Source: Jena McGregor, "The Chore Goes Offshore," *BusinessWeek,* March 23 & 30, 2009, p. 50–51.

Note that depreciation of special equipment is listed as one of the costs of producing the shifters internally. Because the equipment has already been purchased, this depreciation is a sunk cost and is therefore irrelevant. If the equipment could be sold, its salvage value would be relevant. Or if the machine could be used to make other products, this could be relevant as well. However, we will assume that the equipment has no salvage value and that it has no other use except making the heavy-duty gear shifters.

Also note that the company is allocating a portion of its general overhead costs to the shifters. Any portion of this general overhead cost that would actually be eliminated if the gear shifters were purchased rather than made would be relevant in the analysis. However, it is likely that the general overhead costs allocated to the gear shifters are in fact common to all items produced in the factory and would continue unchanged even if the shifters were purchased from the outside. Such allocated common costs are not relevant costs (because they do not differ between the make or buy alternatives) and should be eliminated from the analysis along with the sunk costs.

The variable costs of producing the shifters can be avoided by buying the shifters from the outside supplier so they are relevant costs. We will assume in this case that the variable costs include direct materials, direct labor, and variable overhead. The supervisor's salary is also relevant if it could be avoided by buying the shifters. Exhibit 12-5 contains the relevant cost analysis of the make or buy decision assuming that the supervisor's salary can indeed be avoided.

Because the avoidable costs related to making the shifters is $40,000 less than the total amount that would be paid to buy them from the outside supplier, Mountain Goat Cycles should reject the

outside supplier's offer. However, the company may wish to consider one additional factor before coming to a final decision—the opportunity cost of the space now being used to produce the shifters.

EXHIBIT 12-5
Mountain Goat Cycles Make or Buy Analysis

	Total Relevant Costs—8,000 units	
	Make	Buy
Direct materials (8,000 units × $6 per unit)	$ 48,000	
Direct labor (8,000 units × $4 per unit)	32,000	
Variable overhead (8,000 units × $1 per unit)	8,000	
Supervisor's salary	24,000	
Depreciation of special equipment (not relevant)		
Allocated general overhead (not relevant)		
Outside purchase price		$152,000
Total cost	$112,000	$152,000
Difference in favor of continuing to make	$40,000	

Opportunity Cost

If the space now being used to produce the shifters *would otherwise be idle,* then Mountain Goat Cycles should continue to produce its own shifters and the supplier's offer should be rejected, as stated above. Idle space that has no alternative use has an opportunity cost of zero.

But what if the space now being used to produce shifters could be used for some other purpose? In that case, the space would have an opportunity cost equal to the segment margin that could be derived from the best alternative use of the space.

To illustrate, assume that the space now being used to produce shifters could be used to produce a new cross-country bike that would generate a segment margin of $60,000 per year. Under these conditions, Mountain Goat Cycles should accept the supplier's offer and use the available space to produce the new product line:

	Make	Buy
Total annual cost (see Exhibit 12–5)	$112,000	$152,000
Opportunity cost—segment margin forgone on a potential new product line	60,000	
Total cost	$172,000	$152,000
Difference in favor of purchasing from the outside supplier	$20,000	

Opportunity costs are not recorded in the organization's general ledger because they do not represent actual dollar outlays. Rather, they represent economic benefits that are *forgone* as a result of pursuing some course of action. The opportunity cost for Mountain Goat Cycles is sufficiently large in this case to change the decision.

IN BUSINESS

IS THERE SUCH A THING AS A $1 BUS TICKET?

When Megabus and Greyhound's Bolt Bus sell tickets for $1 it begs the question—how can that be profitable? The answer lies in understanding the concept of opportunity costs. The bus companies use computer algorithms to determine how many empty seats ordinarily exist on a given bus route. Since the incremental cost of allowing a customer to occupy a seat that would otherwise be empty is zero, the $1 price provides bus companies with additional contribution margin. Of course, only a few $1 tickets are available for each trip on a given bus route. Furthermore, these deeply discounted tickets must be purchased well in advance of the travel date. All other customers pay a higher fare that enables the bus company to earn a profit on its routes.

Source: Anne VanderMey, "What's Up With $1 Bus Tickets?" *Fortune,* November 7, 2011, p. 27.

Special Orders

LO12-4

Prepare an analysis showing whether a special order should be accepted.

Managers must often evaluate whether a *special order* should be accepted, and if the order is accepted, the price that should be charged. A **special order** is a one-time order that is not considered part of the company's normal ongoing business. To illustrate, Mountain Goat Cycles has just received a request from the Seattle Police Department to produce 100 specially modified mountain bikes at a price of $558 each. The bikes would

be used to patrol some of the more densely populated residential sections of the city. Mountain Goat Cycles can easily modify its City Cruiser model to fit the specifications of the Seattle Police. The normal selling price of the City Cruiser bike is $698, and its unit product cost is $564 as shown below:

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Direct materials	$372
Direct labor	90
Manufacturing overhead	102
Unit product cost	$564

The variable portion of the above manufacturing overhead is $12 per unit. The order would have no effect on the company's total fixed manufacturing overhead costs.

The modifications requested by the Seattle Police Department consist of welded brackets to hold radios, nightsticks, and other gear. These modifications would require $34 in incremental variable costs. In addition, the company would have to pay a graphics design studio $2,400 to design and cut stencils that would be used for spray painting the Seattle Police Department's logo and other identifying marks on the bikes.

This order should have no effect on the company's other sales. The production manager says that she can handle the special order without disrupting any of the company's regular scheduled production.

What effect would accepting this order have on the company's net operating income?

Only the incremental costs and benefits are relevant. Because the existing fixed manufacturing overhead costs would not be affected by the order, they are not relevant. The incremental net operating income can be computed as follows:

	Per Unit	Total 100 Bikes
Incremental revenue	$558	$55,800
Less incremental costs:		
Variable costs:		
Direct materials	372	37,200
Direct labor	90	9,000
Variable manufacturing overhead	12	1,200
Special modifications	34	3,400
Total variable cost	$508	50,800
Fixed cost:		
Purchase of stencils		2,400
Total incremental cost		53,200
Incremental net operating income		$ 2,600

Therefore, even though the $558 price on the special order is below the normal $564 unit product cost and the order would require additional costs, the order would increase net operating income. In general, a special order is profitable if the incremental revenue from the special order exceeds the

incremental costs of the order. However, it is important to make sure that there is indeed idle capacity and that the special order does not cut into normal unit sales or undercut prices on normal sales. For example, if the company was operating at capacity, opportunity costs would have to be taken into account, as well as the incremental costs that have already been detailed above.

Utilization of a Constrained Resource

What Is a Constraint?

A **constraint** is anything that prevents you from getting more of what you want. Every individual and every organization faces at least one constraint, so it is not difficult to find examples of constraints. You may not have enough time to study thoroughly for every subject *and* to go out with your friends on the weekend, so time is your constraint. **United Airlines** has only a limited number of loading gates available at its busy Chicago O'Hare hub, so its constraint is loading gates. **Vail Resorts** has only a limited amount of land to develop as homesites and commercial lots at its ski areas, so its constraint is land.

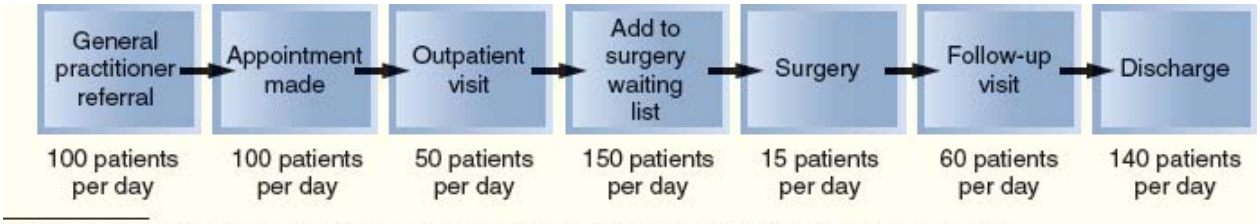
As an example, long waiting periods for surgery are a chronic problem in the **National Health Service (NHS)**, the government-funded provider of health care in the United Kingdom. The diagram in Exhibit 12-6 illustrates a simplified version of the steps followed by a surgery patient. The number of patients who can be processed through each step in a day is indicated in the exhibit. For example, appointments for outpatient visits can be made for as many as 100 referrals from general practitioners in a day.

The constraint, or **bottleneck**, in the system is determined by the step that limits total output because it has the smallest capacity—in this case surgery. The total number of patients processed through the entire system cannot exceed 15 per day—the maximum number of patients who can be treated in surgery. No matter how hard managers, doctors, and nurses try to improve the processing rate elsewhere in the system, they will never succeed in driving down wait lists until the capacity of surgery is increased. In fact, improvements elsewhere in the system—particularly before the constraint—are likely to result in even longer waiting times and more frustrated patients and health care providers. Thus, to be effective, improvement efforts must be focused on the constraint. A business process, such as the process for serving surgery patients, is like a chain. If you want to increase the strength of a chain, what is the most effective way to do this? Should you concentrate your efforts on strengthening the strongest link, all the links, or the weakest link? Clearly, focusing your effort on the weakest link will bring the biggest benefit.

The procedure to follow to strengthen the chain is clear. First, identify the weakest link, which is the constraint. In the case of the NHS, the constraint is surgery. Second, do not place a greater strain on the system than the weakest link can handle—if you do, the chain will break. In the case of the NHS, more referrals than surgery can accommodate lead to unacceptably long waiting lists. Third, concentrate improvement efforts on strengthening the weakest link. In the case of the NHS, this means finding ways to increase the number of surgeries that can be performed in a day. Fourth, if the improvement efforts are successful, eventually the weakest link will improve to the point where it is no longer the weakest link. At that point, the new weakest link (i.e., the new constraint) must be identified, and improvement efforts must be shifted over to that link. This simple sequential process provides a powerful strategy for optimizing business processes.

EXHIBIT 12-6

Processing Surgery Patients at an NHS Facility (simplified)*



*This diagram originally appeared in the February 1999 issue of the U.K. magazine *Health Management*.

Contribution Margin per Unit of the Constrained Resource

LO12-5

Determine the most profitable use of a constrained resource.

Managers routinely face the problem of deciding how constrained resources are going to be used. A department store, for example, has a limited amount of floor space and therefore cannot stock every product that may be available. A manufacturer has a limited number of machine-hours and a limited number of direct labor-hours at its disposal. Because the company cannot fully satisfy demand, managers must decide which products or services should be cut back. In other words, managers must decide which products or services make the best use of the constrained resource. Fixed costs are usually unaffected by such choices, so the course of action that will maximize the company's total contribution margin should ordinarily be selected.

If some products must be cut back because of a constraint, the key to maximizing the total contribution margin may seem obvious—favor the products with the highest unit contribution margins. Unfortunately, that is not quite correct. Rather, the correct solution is to favor the products that provide the highest *contribution margin per unit of the constrained resource.* To illustrate, in addition to its other products, Mountain Goat Cycles makes saddlebags for bicycles called *panniers.* These panniers come in two models—a touring model and a mountain model. Cost and revenue data for the two models of panniers follow:

	Mountain Pannier	Touring Pannier
Selling price per unit	$25	$30
Variable cost per unit	10	18
Contribution margin per unit	$15	$12
Contribution margin (CM) ratio	60%	40%

The mountain pannier appears to be much more profitable than the touring pannier. It has a $15 per unit contribution margin as compared to only $12 per unit for the touring model, and it has a 60% CM ratio as compared to only 40% for the touring model.

But now let us add one more piece of information—the plant that makes the panniers is operating at capacity. This does not mean that every machine and every person in the plant is working at the maximum possible rate. Because machines have different capacities, some machines will be operating at less than 100% of capacity. However, if the plant as a whole cannot produce any more units, some machine or process must be operating at capacity. The machine or process that is limiting overall output is called the bottleneck—it is the constraint.

At Mountain Goat Cycles, the bottleneck (i.e., constraint) is a stitching machine. The mountain pannier requires two minutes of stitching time per unit, and the touring pannier requires one minute of stitching time per unit. The stitching machine is available for 12,000 minutes per month, and the

company can sell up to 4,000 mountain panniers and 7,000 touring panniers per month. Producing up to this demand for both products would require 15,000 minutes, as shown below:

	Mountain Pannier	Touring Pannier	Total
Monthly demand (a)	4,000 units	7,000 units	
Stitching machine time required to produce one unit (b)	2 minutes	1 minute	
Total stitching time required (a) × (b)	8,000 minutes	7,000 minutes	15,000 minutes

Producing up to demand would require 15,000 minutes, but only 12,000 minutes are available. This simply confirms that the stitching machine is the bottleneck. By definition, because the stitching machine is a bottleneck, the stitching machine does not have enough capacity to satisfy the existing demand for mountain panniers and touring panniers Therefore, some orders for the products will have to be turned down. Naturally,

managers will want to know which product is less profitable. To answer this question, they should focus on the contribution margin per unit of the constrained resource. This figure is computed by dividing a product's contribution margin per unit by the amount of the constrained resource required to make a unit of that product. These calculations are carried out below for the mountain and touring panniers:

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	Mountain Pannier	Touring Pannier
Contribution margin per unit (a)	$15.00	$12.00
Stitching machine time required to produce one unit (b)	2 minutes	1 minute
Contribution margin per unit of the constrained resource, (a) ÷ (b)	$7.50 per minute	$12.00 per minute

It is now easy to decide which product is less profitable and should be deemphasized. Each minute on the stitching machine that is devoted to the touring pannier results in an increase of $12.00 in contribution margin and profits. The comparable figure for the mountain pannier is only $7.50 per minute. Therefore, the touring model should be emphasized. Even though the mountain model has the larger contribution margin per unit and the larger CM ratio, the touring model provides the larger contribution margin in relation to the constrained resource.

To verify that the touring model is indeed the more profitable product, suppose an hour of additional stitching time is available and that unfilled orders exist for both products. The additional hour on the stitching machine could be used to make either 30 mountain panniers (60 minutes ÷ 2 minutes per mountain pannier) or 60 touring panniers (60 minutes ÷ 1 minute per touring pannier), with the following profit implications:

	Mountain Pannier	Touring Pannier
Contribution margin per unit	$ 15	$ 12
Additional units that can be processed in one hour	× 30	× 60
Additional contribution margin	$450	$720

Because the additional contribution margin would be $720 for the touring panniers and only $450 for the mountain panniers, the touring panniers make the most profitable use of the company's constrained resource—the stitching machine.

The stitching machine is available for 12,000 minutes per month, and producing the touring panniers is the most profitable use of the stitching machine. Therefore, to maximize profits, the company should produce all of the touring panniers the market will demand (7,000 units) and use any remaining capacity to produce mountain panniers. The computations to determine how many mountain panniers can be produced are as follows:

Monthly demand for touring panniers (a)	7,000 units
Stitching machine time required to produce one touring pannier (b)	1 minute
Total stitching time required to produce touring panniers (a) × (b)	7,000 minutes
Remaining stitching time available (12,000 minutes − 7,000 minutes) (c)	5,000 minutes
Stitching machine time required to produce one mountain pannier (d)	2 minutes
Production of mountain panniers (c) ÷ (d)	2,500 units

Therefore, profit would be maximized by producing 7,000 touring panniers and then using the remaining capacity to produce 2,500 mountain panniers.

This example clearly shows that looking at each product's unit contribution margin alone is not enough; the contribution margin must be viewed in relation to the amount of the constrained resource each product requires.

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IN BUSINESS

BOEING IS CONSTRAINED BY A SUPPLIER

Boeing Co. had to delay delivery of its model 777 airplanes to Emirates airline because the German supplier Sell GmbH could not provide the equipment for cooking galleys to Boeing on time. The production bottleneck forced Emirates to repeatedly postpone its planned expansion into the U.S. west coast. It also forced Boeing to accept payment delays for airplanes that sell for more than $200 million apiece. In response, Sell GmbH hired 250 more employees and invested millions of euros in new machine tools and factory space to expand its production capacity.

Source: Daniel Michaels and J. Lynn Lunsford, "Lack of Seats, Galleys Stalls Boeing, Airbus," *The Wall Street Journal*, August 8, 2008, pp. B1 and B4.

Managing Constraints

LO12-6

Determine the value of obtaining more of the constrained resource.

Effectively managing an organization's constraints is a key to increased profits. As discussed above, when a constraint exists in the production process, managers can increase profits by producing the

products with the highest contribution margin per unit of the constrained resource. However, they can also increase profits by increasing the capacity of the bottleneck operation.

When a manager increases the capacity of the bottleneck, it is called **relaxing (or elevating) the constraint**. In the case of Mountain Goat Cycles, the company is currently working one eight-hour shift. To relax the constraint, the stitching machine operator could be asked to work overtime. No one else would have to work overtime. Because all of the other operations involved in producing panniers have excess capacity, up to a point, the additional panniers processed through the stitching machine during overtime could be finished during normal working hours in the other operations.

The benefits from relaxing the constraint are often enormous and can be easily quantified—the key is the contribution margin per unit of the constrained resource that we have already computed. This number, which was originally stated in terms of minutes in the Mountain Goat Cycles example, is restated below in terms of hours for easier interpretation:

	Mountain Pannier	Touring Pannier
Contribution margin per unit of the constrained resource (in minutes) . . .	$7.50 per minute	$12.00 per minute
	× 60 minutes per hour	× 60 minutes per hour
Contribution margin per unit of the constrained resource (in hours) . . .	= $450 per hour	= $720 per hour

So what is the value of relaxing the constraint—the time on the stitching machine? The manager should first ask, "What would I do with additional capacity at the bottleneck if it were available?" If the time were to be used to make additional mountain

panniers, it would be worth $450 per hour. If the time were to be used to make additional touring panniers, it would be worth $720 per hour. In this latter case, the company should be willing to pay an overtime *premium* to the stitching machine operator of up to $720 per hour! Suppose, for example, that the stitching machine operator is paid $20 per hour during normal working hours and time-and-a-half, or $30 per hour, for overtime. In this case, the premium for overtime is only $10 per hour, whereas in principle, the company should be willing to pay a premium of up to $720 per hour. The difference between what the company should be willing to pay as a premium, $720 per hour, and what it would actually have to pay, $10 per hour, is pure profit of $710 per hour.

To reinforce this concept, suppose that there are only unfilled orders for the mountain pannier. How much would it be worth to the company to run the stitching machine overtime in this situation? Because the additional capacity would be used to make the mountain pannier, the value of that additional capacity would drop to $7.50 per minute or $450 per hour. Nevertheless, the value of relaxing the constraint would still be quite high and the company should be willing to pay an overtime premium of up to $450 per hour.

These calculations indicate that managers should pay great attention to the bottleneck operation. If a bottleneck machine breaks down or is ineffectively utilized, the losses to the company can be quite large. In our example, for every minute the stitching machine is down due to breakdowns or setups, the company loses between $7.50 and $12.00.[3] The losses on an hourly basis are between $450 and $720! In contrast, there is no such loss of contribution margin if time is lost on a machine that is not a bottleneck—such machines have excess capacity anyway.

The implications are clear. Managers should focus much of their attention on managing the bottleneck. As we have discussed, managers should emphasize products that most profitably utilize the constrained resource. They should also make sure that products are processed smoothly through the bottleneck, with minimal lost time due to breakdowns and setups. And they should try to find ways to increase the capacity at the bottleneck.

The capacity of a bottleneck can be effectively increased in a number of ways, including:

- Working overtime on the bottleneck.
- Subcontracting some of the processing that would be done at the bottleneck.
- Investing in additional machines at the bottleneck.
- Shifting workers from processes that are not bottlenecks to the process that is the bottleneck.
- Focusing business process improvement efforts on the bottleneck.
- Reducing defective units. Each defective unit that is processed through the bottleneck and subsequently scrapped takes the place of a good unit that could have been sold.

The last three methods of increasing the capacity of the bottleneck are particularly attractive because they are essentially free and may even yield additional cost savings.

The Problem of Multiple Constraints

What does a company do if it has more than one potential constraint? For example, a company may have limited raw materials, limited direct labor-hours available, limited floor space, and limited advertising dollars to spend on product promotion. How would it determine the right combination of

products to produce? The proper combination or “mix” of products can be found by use of a quantitative method known as *linear programming,* which is covered in quantitative methods and operations management courses.

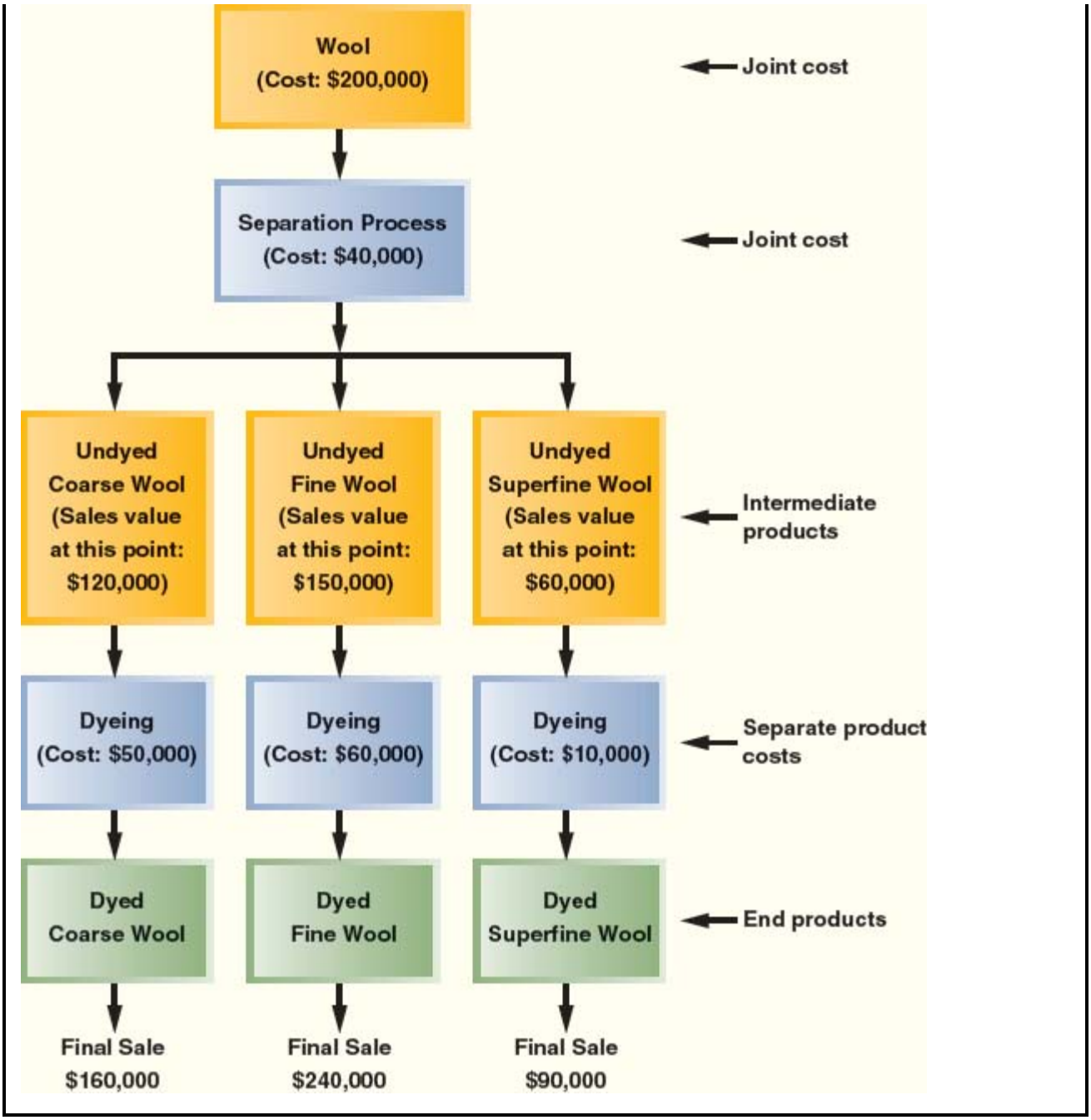
Joint Product Costs and the Contribution Approach

LO12-7

Prepare an analysis showing whether joint products should be sold at the split-off point or processed further.

In some industries, a number of end products are produced from a single raw material input. For example, in the petroleum refining industry a large number of products are extracted from crude oil, including gasoline, jet fuel, home heating oil, lubricants, asphalt, and various organic chemicals. Another example is provided by the Santa Maria Wool Cooperative of New Mexico. The company buys raw wool from local sheepherders, separates the wool into three grades—coarse, fine, and superfine—and then dyes the wool using traditional methods that rely on pigments from local materials. Exhibit 12-7 contains a diagram of the production process.

EXHIBIT 12-7
Santa Maria Wool Cooperative


Wool
(Cost: $200,000)
Joint cost
Separation Process
(Cost: $40,000)
Joint cost
Undyed
Coarse Wool
(Sales value
at this point:
$120,000)
Undyed
Fine Wool
(Sales value
at this point:
$150,000)
Undyed
Superfine Wool
(Sales value
at this point:
$60,000)
Intermediate
products
Dyeing
(Cost: $50,000)
Dyeing
(Cost: $60,000)
Dyeing
(Cost: $10,000)
Separate product
costs
Dyed
Coarse Wool
Dyed
Fine Wool
Dyed
Superfine Wool
End products
Final Sale
$160,000
Final Sale
$240,000
Final Sale
$90,000

At Santa Maria Wool Cooperative, coarse wool, fine wool, and superfine wool are produced from one input—raw wool. Two or more products that are produced from a common input are known as **joint products**. The **split-off point** is the point in the manufacturing process at which the joint products can be recognized as separate products. This does not occur at Santa Maria Wool Cooperative until the raw wool has gone through the separating process. The term **joint cost** is used to describe the costs incurred up to the split-off point. At Santa Maria Wool Cooperative, the joint costs are the $200,000 cost of the raw wool and the $40,000 cost of separating the wool. The undyed wool is called an *intermediate product* because it is not finished at this point. Nevertheless, a market does exist for undyed wool—although at a significantly lower price than finished, dyed wool.

The Pitfalls of Allocation

Joint costs are common costs that are incurred to simultaneously produce a variety of end products. These joint costs are often allocated among the different products at the split-off point. A typical approach is to allocate the joint costs according to the relative sales value of the end products.

Although allocation of joint product costs is needed for some purposes, such as balance sheet inventory valuation, allocations of this kind are extremely misleading for decision making. The In Business box "Getting It All Wrong" (see below) illustrates an incorrect decision that resulted from using such an allocated joint cost. You should stop now and read that box before proceeding further.

IN BUSINESS

GETTING IT ALL WRONG

A company located on the Gulf of Mexico produces soap products. Its six main soap product lines are produced from common inputs. Joint product costs up to the split-off point constitute the bulk of the production costs for all six product lines. These joint product costs are allocated to the six product lines on the basis of the relative sales value of each line at the split-off point.

A waste product results from the production of the six main product lines. The company loaded the waste onto barges and dumped it into the Gulf of Mexico because the waste was thought to have no commercial value. The dumping was stopped, however, when the company's research division discovered that with some further processing the waste could be sold as a fertilizer ingredient. The further processing costs $175,000 per year. The waste was then sold to fertilizer manufacturers for $300,000.

The accountants responsible for allocating manufacturing costs included the sales value of the waste product along with the sales value of the six main product lines in their allocation of the joint product costs at the split-off point. This allocation resulted in the waste product being allocated $150,000 in joint product cost. This $150,000 allocation, when added to the further processing costs of $175,000 for the waste, made it appear that the waste product was unprofitable—as shown in the table below. When presented with this analysis, the company's management decided that further processing of the waste should be stopped. The company went back to dumping the waste in the Gulf.

Sales value of the waste product after further processing	$300,000
Less costs assigned to the waste product	325,000
Net loss	$ (25,000)

Sell or Process Further Decisions

Joint costs are irrelevant in decisions regarding what to do with a product from the split-off point forward. Once the split-off point is reached, the joint costs have already been incurred and nothing can be done to avoid them. Furthermore, even if the product were disposed of in a landfill without any further processing, all of the joint costs must be incurred to obtain the other products that come out of the joint process. None of the joint costs are avoidable by disposing of any one of the products that emerge from the split-off point. Therefore, none of the joint costs are economically attributable to any one of the intermediate or end products. The joint costs are a common cost of all of the intermediate and end products and should not be allocated to them for purposes of making decisions about the individual products. In the case of the soap company in the accompanying In Business box "Getting It All Wrong," the $150,000 in allocated joint costs should not have influenced what was done with the waste product from the split-off point forward. Even ignoring the negative environmental impact of dumping the waste in the Gulf of Mexico, a correct analysis would have shown that the company was making money by further processing the waste into a fertilizer ingredient. The analysis should have been done as follows:

	Dump in Gulf	Process Further
Sales value of fertilizer ingredient	0	$300,000
Additional processing costs	0	175,000
Contribution margin	0	$125,000
Advantage of processing further	$125,000	

Decisions of this type are known as **sell or process further decisions**. It is profitable to continue processing a joint product after the split-off point *so long as the incremental revenue from such processing exceeds the incremental processing cost incurred after the split-off point.* Joint costs that have already been incurred up to the split-off point are always irrelevant in decisions concerning what to do from the split-off point forward.

To provide a detailed example of the sell or process further decision, return to the data for Santa Maria Wool Cooperative in Exhibit 12-7. We can answer several important questions using this data. First, is the company making money if it runs the entire process from beginning to end? Assuming there are no costs other than those displayed in Exhibit 12-7, the company is indeed making money as follows:

Analysis of the profitability of the overall operation:		
Combined final sales value		
($160,000 + $240,000 + $90,000)		$490,000
Less costs of producing the end products:		
Cost of wool	$200,000	
Cost of separating wool	40,000	
Combined costs of dyeing		
($50,000 + $60,000 + $10,000)	120,000	360,000
Profit		$130,000

Note that the joint costs of buying the wool and separating the wool *are* relevant when considering the profitability of the entire operation. This is because these joint costs *could* be avoided if the entire operation were shut down. However, these joint costs are *not* relevant when considering the profitability of any one product. As long as the process

is being run to make the other products, no additional joint costs are incurred to make the specific product in question.

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Even though the company is making money overall, it may be losing money on one or more of the products. If the company buys wool and runs the separation process, it will get all three intermediate products. Nothing can be done about that. However, each of these products can be sold *as is* without further processing. It may be that the company would be better off selling one or more of the products prior to dyeing to avoid the dyeing costs. The appropriate way to make this choice is to compare the incremental revenues to the incremental costs from further processing as follows:

Analysis of sell or process further:

	Coarse Wool	Fine Wool	Superfine Wool
Final sales value after further processing	$160,000	$240,000	$90,000
Less sales value at the split-off point	120,000	150,000	60,000
Incremental revenue from further processing	40,000	90,000	30,000
Less cost of further processing (dyeing)	50,000	60,000	10,000
Profit (loss) from further processing	$ (10,000)	$ 30,000	$20,000

As this analysis shows, the company would be better off selling the undyed coarse wool as is rather than processing it further. The other two products should be processed further and dyed before selling them.

Note that the joint costs of the wool ($200,000) and of the wool separation process ($40,000) play no role in the decision to sell or further process the intermediate products. These joint costs are relevant in a decision of whether to buy wool and to run the wool separation process, but they are not relevant in decisions about what to do with the intermediate products once they have been separated.

Activity-Based Costing and Relevant Costs

As discussed in an earlier chapter, activity-based costing can be used to help identify potentially relevant costs for decision-making purposes. Activity-based costing improves the traceability of costs by focusing on the activities caused by a product or other segment. However, managers should exercise caution against reading more into this "traceability" than really exists. People have a tendency to assume that if a cost is traceable to a segment, then the cost is automatically an avoidable cost. That is not true because the costs provided by a well-designed activity-based costing system are only *potentially* relevant. Before making a decision, managers must still decide which of the potentially relevant costs are actually avoidable. Only those costs that are avoidable are relevant and the others should be ignored.

To illustrate, refer again to the data relating to the housewares line in Exhibit 12-4. The $2,000 fixtures depreciation is a traceable cost of the housewares lines because it directly relates to activities in that department. We found, however, that the $2,000 is not avoidable if the housewares line is dropped. The key lesson here is that the method used to assign a cost to a product or other segment does not change the basic nature of the cost. A sunk cost such as depreciation of old equipment is still

a sunk cost regardless of whether it is traced directly to a particular segment on an activity basis, allocated to all segments on the basis of labor-hours, or treated in some other way in the costing process. Regardless of the method used to assign costs to products or other segments, the principles discussed in this chapter must be applied to determine the costs that are avoidable in each situation.

Summary

Everything in this chapter consists of applications of one simple but powerful idea—only those costs and benefits that differ between alternatives are relevant in a decision. All other costs and benefits are irrelevant and should be ignored. In particular, sunk costs are irrelevant as are future costs that do not differ between alternatives.

This simple idea was applied in a variety of situations including decisions that involve adding or dropping a product line, making or buying a component, accepting or rejecting a special order, using a constrained resource, and processing a joint product further. This list includes only a small sample of the possible applications of the relevant cost concept. Indeed, any decision involving costs hinges on the proper identification and analysis of the costs that are relevant. We will continue to focus on the concept of relevant costs in the following chapter where long-term investment decisions are considered.

Review Problem: Relevant Costs

Charter Sports Equipment manufactures round, rectangular, and octagonal trampolines. Sales and expense data for the past month follow:

		Trampoline		
	Total	Round	Rectangular	Octagonal
Sales	$1,000,000	$140,000	$500,000	$360,000
Variable expenses	410,000	60,000	200,000	150,000
Contribution margin	590,000	80,000	300,000	210,000
Fixed expenses:				
Advertising—traceable	216,000	41,000	110,000	65,000
Depreciation of special equipment	95,000	20,000	40,000	35,000
Line supervisors' salaries	19,000	6,000	7,000	6,000
General factory overhead*	200,000	28,000	100,000	72,000
Total fixed expenses	530,000	95,000	257,000	178,000
Net operating income (loss)	$ 60,000	$ (15,000)	$ 43,000	$ 32,000

*A common fixed cost that is allocated on the basis of sales dollars.

Management is concerned about the continued losses shown by the round trampolines and wants a recommendation as to whether or not the line should be discontinued. The special equipment used to produce the trampolines has no resale value. If the round trampoline model is dropped, the two line supervisors assigned to the model would be discharged.

Required:

1. Should production and sale of the round trampolines be discontinued? The company has no other use for the capacity now being used to produce the round trampolines. Show computations to support your answer.

2. Recast the above data in a format that would be more useful to management in assessing the profitability of the various product lines.

Solution to Review Problem

1. No, production and sale of the round trampolines should not be discontinued. Computations to support this answer follow:

Contribution margin lost if the round trampolines are discontinued . . .		$(80,000)
Less fixed expenses that can be avoided:		
Advertising—traceable	$41,000	
Line supervisors' salaries	6,000	47,000
Decrease in net operating income for the company as a whole		$(33,000)

The depreciation of the special equipment is a sunk cost, and therefore, it is not relevant to the decision. The general factory overhead is allocated and will presumably continue regardless of whether or not the round trampolines are discontinued; thus, it is not relevant.

2. If management wants a clearer picture of the profitability of the segments, the general factory overhead should not be allocated. It is a common cost and, therefore, should be deducted from the total product-line segment margin. A more useful income statement format would be as follows:

		Trampoline		
	Total	Round	Rectangular	Octagonal
Sales	$1,000,000	$140,000	$500,000	$360,000
Variable expenses	410,000	60,000	200,000	150,000
Contribution margin	590,000	80,000	300,000	210,000
Traceable fixed expenses:				
Advertising—traceable	216,000	41,000	110,000	65,000
Depreciation of special equipment	95,000	20,000	40,000	35,000
Line supervisors' salaries	19,000	6,000	7,000	6,000
Total traceable fixed expenses	330,000	67,000	157,000	106,000
Product-line segment margin	260,000	$ 13,000	$143,000	$104,000
Common fixed expenses	200,000			
Net operating income	$ 60,000			

Glossary

Avoidable cost A cost that can be eliminated by choosing one alternative over another in a decision. This term is synonymous with *differential cost* and *relevant cost.* (p. 532)

Bottleneck A machine or some other part of a process that limits the total output of the entire system. (p. 548)

Constraint A limitation under which a company must operate, such as limited available machine time or raw materials, that restricts the company's ability to satisfy demand. (p. 547)

Differential cost A difference in cost between any two alternatives. (p. 532)

Differential revenue A difference in revenue between any two alternatives. (p. 532)

Joint costs Costs that are incurred up to the split-off point in a process that produces joint products. (p. 553)

Joint products Two or more products that are produced from a common input. (p. 553)

Make or buy decision A decision concerning whether an item should be produced internally or purchased from an outside supplier. (p. 542)

Opportunity cost The potential benefit that is given up when one alternative is selected over another. (p. 533)

Relaxing (or elevating) the constraint An action that increases the amount of a constrained resource. Equivalently, an action that increases the capacity of the bottleneck. (p. 550)

Relevant benefit A benefit that differs between alternatives in a decision. *Differential revenue* is a *relevant benefit.* (p. 532)

Relevant cost A difference in cost between any two alternatives. Synonyms are *avoidable cost, differential cost,* and *incremental cost.* (p. 532)

Sell or process further decision A decision as to whether a joint product should be sold at the split-off point or sold after further processing. (p. 554)

Special order A one-time order that is not considered part of the company's normal ongoing business. (p. 545)

Split-off point That point in the manufacturing process where some or all of the joint products can be recognized as individual products. (p. 556)

Sunk cost Any cost that has already been incurred and that cannot be changed by any decision made now or in the future. (p. 532)

Vertical integration The involvement by a company in more than one of the activities in the entire value chain from development through production, distribution, sales, and after-sales service. (p. 542)

Questions

12-1 What is a *relevant cost?*

12-2 Define the following terms: *incremental cost, opportunity cost,* and *sunk cost.*

12-3 Are variable costs always relevant costs? Explain.

12-4 "Sunk costs are easy to spot—they're the fixed costs associated with a decision." Do you agree? Explain.

12-5 "Variable costs and differential costs mean the same thing." Do you agree? Explain.

12-6 "All future costs are relevant in decision making." Do you agree? Why?

12-7 Prentice Company is considering dropping one of its product lines. What costs of the product line would be relevant to this decision? What costs would be irrelevant?

12-8 "If a product is generating a loss, then it should be discontinued." Do you agree? Explain.

12-9 What is the danger in allocating common fixed costs among products or other segments of an organization?

12-10 How does opportunity cost enter into a make or buy decision?

12-11 Give at least four examples of possible constraints.

12-12 How will relating product contribution margins to the amount of the constrained resource they consume help a company maximize its profits?

12-13 Define the following terms: *joint products, joint costs,* and *split-off point.*

12-14 From a decision-making point of view, should joint costs be allocated among joint products?

12-15 What guideline should be used in determining whether a joint product should be sold at the split-off point or processed further?

12-16 Airlines sometimes offer reduced rates during certain times of the week to members of a businessperson's family if they accompany him or her on trips. How does the concept of relevant costs enter into the decision by the airline to offer reduced rates of this type?

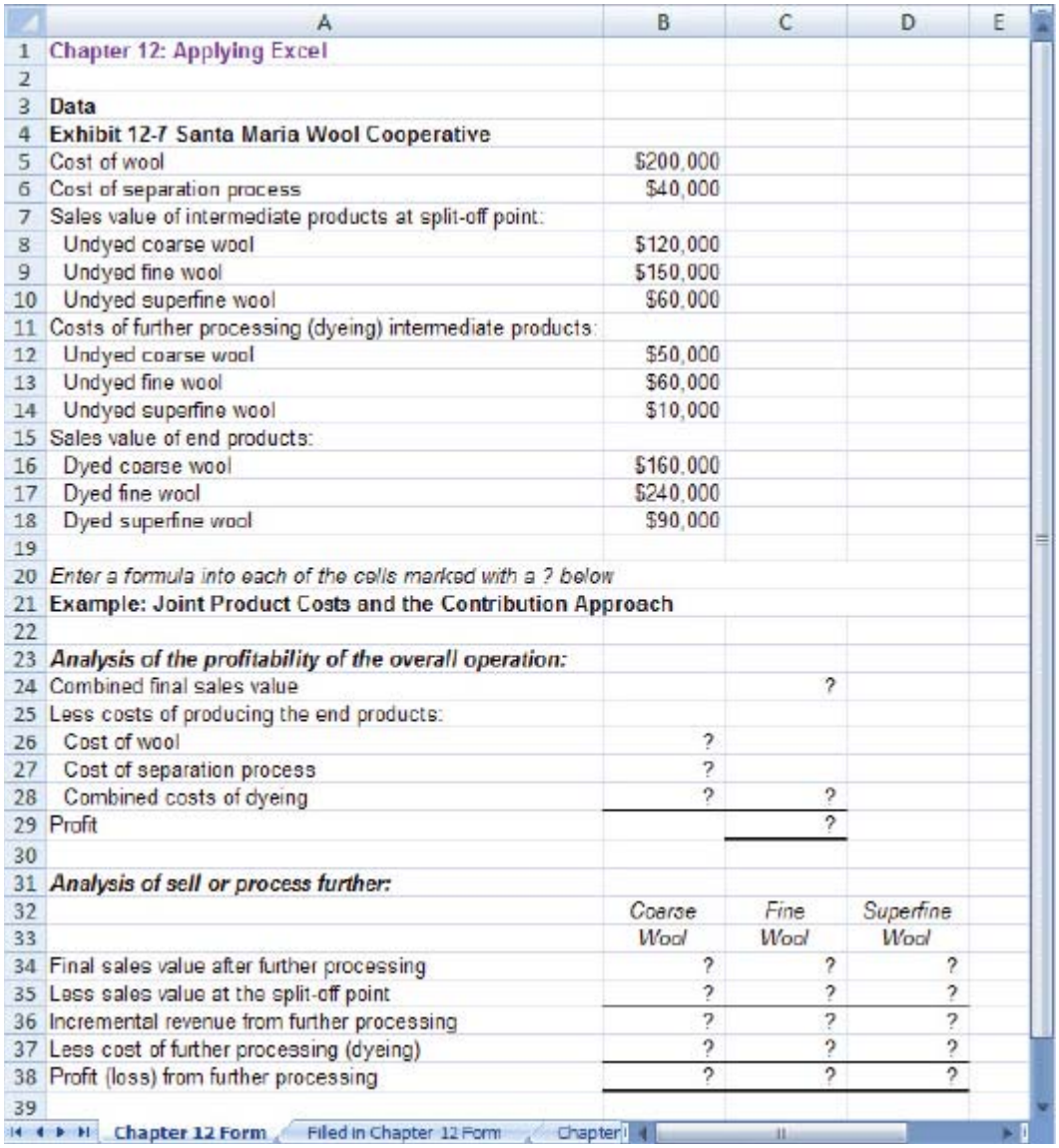
Multiple-choice questions are provided on the text website at **www.mhhe.com/garrison15e**.

Applying Excel

Available with McGraw-Hill's *Connect*® *Accounting.*

LO12-7

The Excel worksheet form that appears on the next page is to be used to recreate the example in the text on pages 552–555. Download the workbook containing this form from the Online Learning Center at **www.mhhe.com/garrison15e**. *On the website you will also receive instructions about how to use this worksheet form.*



	A	B	C	D	E
1	Chapter 12: Applying Excel				
2					
3	**Data**				
4	**Exhibit 12-7 Santa Maria Wool Cooperative**				
5	Cost of wool	$200,000			
6	Cost of separation process	$40,000			
7	Sales value of intermediate products at split-off point:				
8	Undyed coarse wool	$120,000			
9	Undyed fine wool	$150,000			
10	Undyed superfine wool	$60,000			
11	Costs of further processing (dyeing) intermediate products:				
12	Undyed coarse wool	$50,000			
13	Undyed fine wool	$60,000			
14	Undyed superfine wool	$10,000			
15	Sales value of end products:				
16	Dyed coarse wool	$160,000			
17	Dyed fine wool	$240,000			
18	Dyed superfine wool	$90,000			
19					
20	*Enter a formula into each of the cells marked with a ? below*				
21	**Example: Joint Product Costs and the Contribution Approach**				
22					
23	***Analysis of the profitability of the overall operation:***				
24	Combined final sales value		?		
25	Less costs of producing the end products:				
26	Cost of wool	?			
27	Cost of separation process	?			
28	Combined costs of dyeing	?	?		
29	Profit		?		
30					
31	***Analysis of sell or process further:***				
32		*Coarse*	*Fine*	*Superfine*	
33		*Wool*	*Wool*	*Wool*	
34	Final sales value after further processing	?	?	?	
35	Less sales value at the split-off point	?	?	?	
36	Incremental revenue from further processing	?	?	?	
37	Less cost of further processing (dyeing)	?	?	?	
38	Profit (loss) from further processing	?	?	?	
39					

Chapter 12 Form | Filed in Chapter 12 Form | Chapter

You should proceed to the requirements below only after completing your worksheet.

Required:

1. Check your worksheet by changing the cost of further processing undyed coarse wool in cell B12 to $30,000. The overall profit from processing all intermediate products into final products should now be $150,000 and the profit from further processing coarse wool should now be $10,000. If you do not get these answers, find the errors in your worksheet and correct them.

   How should operations change in response to this change in cost?

2.

In industries that process joint products, the costs of the raw materials inputs and the sales values of intermediate and final products are often volatile. Change the data area of your worksheet to match the following:

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Data Exhibit 12–7 Santa Maria Wool Cooperative	
Cost of wool	$290,000
Cost of separation process	$40,000
Sales value of intermediate products at split-off point:	
Undyed coarse wool	$100,000
Undyed fine wool	$110,000
Undyed superfine wool	$90,000
Costs of further processing (dyeing) intermediate products:	
Undyed coarse wool	$50,000
Undyed fine wool	$60,000
Undyed superfine wool	$10,000
Sales value of end products:	
Dyed coarse wool	$180,000
Dyed fine wool	$210,000
Dyed superfine wool	$90,000

a. What is the overall profit if all intermediate products are processed into final products?
b. What is the profit from further processing each of the intermediate products?
c. With these new costs and selling prices, what recommendations would you make concerning the company's operations? If your recommendation is followed, what should be the overall profit of the company?

The Foundational 15

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LO12-2, LO12-3, LO12-4, LO12-5, LO12-6

Cane Company manufactures two products called Alpha and Beta that sell for $120 and $80, respectively. Each product uses only one type of raw material that costs $6 per pound. The company has the capacity to annually produce 100,000 units of each product. Its unit costs for each product at this level of activity are given below:

	Alpha	Beta
Direct materials	$ 30	$12
Direct labor	20	15
Variable manufacturing overhead	7	5
Traceable fixed manufacturing overhead	16	18
Variable selling expenses	12	8
Common fixed expenses	15	10
Total cost per unit	$100	$68

The company considers its traceable fixed manufacturing overhead to be avoidable, whereas its common fixed expenses are deemed unavoidable and have been allocated to products based on sales dollars.

Required:
(Answer each question independently unless instructed otherwise.)

1. What is the total amount of traceable fixed manufacturing overhead for the Alpha product line and for the Beta product line?
2. What is the company's total amount of common fixed expenses?
3. Assume that Cane expects to produce and sell 80,000 Alphas during the current year. One of Cane's sales representatives has found a new customer that is willing to buy 10,000 additional Alphas for a price of $80 per unit. If Cane accepts the customer's offer, how much will its profits increase or decrease?

4. Assume that Cane expects to produce and sell 90,000 Betas during the current year. One of Cane's sales representatives has found a new customer that is willing to buy 5,000 additional Betas for a price of $39 per unit. If Cane accepts the customer's offer, how much will its profits increase or decrease?

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5. Assume that Cane expects to produce and sell 95,000 Alphas during the current year. One of Cane's sales representatives has found a new customer that is willing to buy 10,000 additional Alphas for a price of $80 per unit. If Cane accepts the customer's offer, it will decrease Alpha sales to regular customers by 5,000 units. Should Cane accept this special order?
6. Assume that Cane normally produces and sells 90,000 Betas per year. If Cane discontinues the Beta product line, how much will profits increase or decrease?
7. Assume that Cane normally produces and sells 40,000 Betas per year. If Cane discontinues the Beta product line, how much will profits increase or decrease?
8. Assume that Cane normally produces and sells 60,000 Betas and 80,000 Alphas per year. If Cane discontinues the Beta product line, its sales representatives could increase sales of Alpha by 15,000 units. If Cane discontinues the Beta product line, how much would profits increase or decrease?
9. Assume that Cane expects to produce and sell 80,000 Alphas during the current year. A supplier has offered to manufacture and deliver 80,000 Alphas to Cane for a price of $80 per unit. If Cane buys 80,000 units from the supplier instead of making those units, how much will profits increase or decrease?
10. Assume that Cane expects to produce and sell 50,000 Alphas during the current year. A supplier has offered to manufacture and deliver 50,000 Alphas to Cane for a price of $80 per unit. If Cane buys 50,000 units from the supplier instead of making those units, how much will profits increase or decrease?
11. How many pounds of raw material are needed to make one unit of Alpha and one unit of Beta?
12. What contribution margin per pound of raw material is earned by Alpha and Beta?
13. Assume that Cane's customers would buy a maximum of 80,000 units of Alpha and 60,000 units of Beta. Also assume that the company's raw material available for production is limited to 160,000 pounds. How many units of each product should Cane produce to maximize its profits?
14. If Cane follows your recommendation in requirement 13, what total contribution margin will it earn?
15. If Cane uses its 160,000 pounds of raw materials as you recommended in requirement 13, up to how much should it be willing to pay per pound for additional raw materials?

Exercises

All applicable exercises are available with McGraw-Hill's *Connect*® *Accounting.*

EXERCISE 12-1 Identifying Relevant Costs [LO12-1]

A number of costs are listed below that may be relevant in decisions faced by the management of Svahn, AB, a Swedish manufacturer of sailing yachts:

Item	Case 1 Relevant	Case 1 Not Relevant	Case 2 Relevant	Case 2 Not Relevant
a. Sales revenue				
b. Direct materials				
c. Direct labor				
d. Variable manufacturing overhead				
e. Depreciation—Model B100 machine				
f. Book value—Model B100 machine				
g. Disposal value—Model B100 machine				
h. Market value—Model B300 machine (cost)				
i. Fixed manufacturing overhead (general)				
j. Variable selling expense				
k. Fixed selling expense				
l. General administrative overhead				

Required:

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Copy the information above onto your answer sheet and place an X in the appropriate column to indicate whether each item is relevant or not relevant in the following situations. Requirement 1 relates to Case 1 above, and requirement 2 relates to Case 2.

1. The company chronically has no idle capacity and the old Model B100 machine is the company's constraint. Management is considering purchasing a Model B300 machine to use in addition to the company's present Model B100 machine. The old Model B100 machine will continue to be used to capacity as before, with the new Model B300 machine being used to expand production. This will increase the company's production and sales. The increase in volume will be large enough to require increases in fixed selling expenses and in general administrative overhead, but not in the fixed manufacturing overhead.
2. The old Model B100 machine is not the company's constraint, but management is considering replacing it with a new Model B300 machine because of the potential savings in direct materials with the new machine. The Model B100 machine would be sold. This change will have no effect on production or sales, other than some savings in direct materials costs due to less waste.

EXERCISE 12-2 Dropping or Retaining a Segment [LO12-2]

The Regal Cycle Company manufactures three types of bicycles—a dirt bike, a mountain bike, and a racing bike. Data on sales and expenses for the past quarter follow:

	Total	Dirt Bikes	Mountain Bikes	Racing Bikes
Sales	$300,000	$90,000	$150,000	$60,000
Variable manufacturing and selling expenses	120,000	27,000	60,000	33,000
Contribution margin	180,000	63,000	90,000	27,000
Fixed expenses:				
Advertising, traceable	30,000	10,000	14,000	6,000
Depreciation of special equipment	23,000	6,000	9,000	8,000
Salaries of product-line managers	35,000	12,000	13,000	10,000
Allocated common fixed expenses*	60,000	18,000	30,000	12,000
Total fixed expenses	148,000	46,000	66,000	36,000
Net operating income (loss)	$ 32,000	$17,000	$ 24,000	$ (9,000)

*Allocated on the basis of sales dollars.

Management is concerned about the continued losses shown by the racing bikes and wants a recommendation as to whether or not the line should be discontinued. The special equipment used to produce racing bikes has no resale value and does not wear out.

Required:

1. Should production and sale of the racing bikes be discontinued? Explain. Show computations to support your answer.
2. Recast the above data in a format that would be more usable to management in assessing the long-run profitability of the various product lines.

EXERCISE 12-3 Make or Buy a Component [LO12-3]

Troy Engines, Ltd., manufactures a variety of engines for use in heavy equipment. The company has always produced all of the necessary parts for its engines, including all of the carburetors. An outside supplier has offered to sell one type of carburetor to Troy Engines, Ltd., for a cost of $35 per unit. To evaluate this offer, Troy Engines, Ltd., has gathered the following information relating to its own cost of producing the carburetor internally:

	Per Unit	15,000 Units per Year
Direct materials	$14	$210,000
Direct labor	10	150,000
Variable manufacturing overhead	3	45,000
Fixed manufacturing overhead, traceable	6*	90,000
Fixed manufacturing overhead, allocated	9	135,000
Total cost	$42	$630,000

*One-third supervisory salaries; two-thirds depreciation of special equipment (no resale value).

Required:

1. Assuming that the company has no alternative use for the facilities that are now being used to produce the carburetors, should the outside supplier's offer be accepted? Show all computations.
2. Suppose that if the carburetors were purchased, Troy Engines, Ltd., could use the freed capacity to launch a new product. The segment margin of the new product would be $150,000 per year. Should Troy Engines, Ltd., accept the offer to buy the carburetors for $35 per unit? Show all computations.

EXERCISE 12-4 Evaluating a Special Order [LO12-4]

Imperial Jewelers is considering a special order for 20 handcrafted gold bracelets to be given as gifts to members of a wedding party. The normal selling price of a gold bracelet is $189.95 and its unit product cost is $149.00 as shown below:

Direct materials	$ 84.00
Direct labor	45.00
Manufacturing overhead	20.00
Unit product cost	$149.00

Most of the manufacturing overhead is fixed and unaffected by variations in how much jewelry is produced in any given period. However, $4.00 of the overhead is variable with respect to the number of bracelets produced. The customer who is interested in the special bracelet order would like special filigree applied to the bracelets. This filigree would require additional materials costing $2.00 per bracelet and would also require acquisition of a special tool costing $250 that would have no other use once the special order is completed. This order would have no effect on the company's regular sales and the order could be fulfilled using the company's existing capacity without affecting any other order.

Required:

What effect would accepting this order have on the company's net operating income if a special price of $169.95 per bracelet is offered for this order? Should the special order be accepted at this price?

EXERCISE 12-5 Utilizing a Constrained Resource [LO12-5]

Outdoor Luggage Inc. makes high-end hard-sided luggage for sports equipment. Data concerning three of the company's most popular models appear below.

	Ski Guard	Golf Guard	Fishing Guard
Selling price per unit	$200	$300	$255
Variable cost per unit	$60	$140	$55
Plastic injection molding machine processing time required to produce one unit	2 minutes	5 minutes	4 minutes
Pounds of plastic pellets per unit	7 pounds	4 pounds	8 pounds

Required:

1. The total time available on the plastic injection molding machine is the constraint in the production process. Which product would be the most profitable use of this constraint? Which product would be the least profitable use of this constraint?
2. A severe shortage of plastic pellets has required the company to cut back its production so much that the plastic injection molding machine is no longer the bottleneck. Instead, the constraint is the total available pounds of plastic pellets. Which product would be the most profitable use of this constraint? Which product would be the least profitable use of this constraint?
3. Which product has the largest unit contribution margin? Why wouldn't this product be the most profitable use of the constrained resource in either case?

EXERCISE 12-6 Managing a Constrained Resource [LO12-6]

Portsmouth Company makes fine colonial reproduction furniture. Upholstered furniture is one of its major product lines and the bottleneck on this production line is time in the upholstery shop. Upholstering is a craft that takes years of experience to master and the demand for upholstered furniture far exceeds the company's capacity in the upholstering shop. Information concerning three of the company's upholstered chairs appears below:

	Recliner	Sofa	Love Seat
Selling price per unit	$1,400	$1,800	$1,500
Variable cost per unit	$800	$1,200	$1,000
Upholstery shop time required to produce one unit	8 hours	10 hours	5 hours

Required:

1. More time could be made available in the upholstery shop by asking the employees who work in this shop to work overtime. Assuming that this extra time would be used to produce sofas, up to how much should the company be willing to pay per hour to keep the upholstery shop open after normal working hours?
2. A small nearby upholstering company has offered to upholster furniture for Portsmouth at a fixed charge of $45 per hour. The management of Portsmouth is confident that this upholstering company's work is high quality and their craftsmen should be able to work about as quickly as Portsmouth's own craftsmen on the simpler upholstering jobs such as the love seat. Should management accept this offer? Explain.

EXERCISE 12-7 Sell or Process Further [LO12-7]

Dorsey Company manufactures three products from a common input in a joint processing operation. Joint processing costs up to the split-off point total $350,000 per quarter. The company allocates these costs to the joint products on the basis of their relative sales value at the split-off point. Unit selling prices and total output at the split-off point are as follows:

Product	Selling Price	Quarterly Output
A	$16 per pound	15,000 pounds
B	$8 per pound	20,000 pounds
C	$25 per gallon	4,000 gallons

Each product can be processed further after the split-off point. Additional processing requires no special facilities. The additional processing costs (per quarter) and unit selling prices after further processing are given below:

Product	Additional Processing Costs	Selling Price
A	$63,000	$20 per pound
B	$80,000	$13 per pound
C	$36,000	$32 per gallon

Required:

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Which product or products should be sold at the split-off point and which product or products should be processed further? Show computations.

EXERCISE 12-8 Utilization of a Constrained Resource [LO12-5, LO12-6]

Barlow Company manufactures three products: A, B, and C. The selling price, variable costs, and contribution margin for one unit of each product follow:

	Product		
	A	B	C
Selling price	$180	$270	$240
Variable expenses:			
Direct materials	24	72	32
Other variable expenses	102	90	148
Total variable expenses	126	162	180
Contribution margin	$ 54	$108	$ 60
Contribution margin ratio	30%	40%	25%

The same raw material is used in all three products. Barlow Company has only 5,000 pounds of raw material on hand and will not be able to obtain any more of it for several weeks due to a strike in its supplier's plant. Management is trying to decide which product(s) to concentrate on next week in filling its backlog of orders. The material costs $8 per pound.

Required:

1. Compute the amount of contribution margin that will be obtained per pound of material used in each product.
2. Which orders would you recommend that the company work on next week—the orders for product A, product B, or product C? Show computations.
3. A foreign supplier could furnish Barlow with additional stocks of the raw material at a substantial premium over the usual price. If there is unfilled demand for all three products, what is the highest price that Barlow Company should be willing to pay for an additional pound of materials? Explain.

EXERCISE 12-9 Special Order [LO12-4]

Delta Company produces a single product. The cost of producing and selling a single unit of this product at the company's normal activity level of 60,000 units per year is:

Direct materials	$5.10
Direct labor	$3.80
Variable manufacturing overhead	$1.00
Fixed manufacturing overhead	$4.20
Variable selling and administrative expense	$1.50
Fixed selling and administrative expense	$2.40

The normal selling price is $21 per unit. The company's capacity is 75,000 units per year. An order has been received from a mail-order house for 15,000 units at a special price of $14.00 per unit. This order would not affect regular sales.

Required:

1. If the order is accepted, by how much will annual profits be increased or decreased? (The order will not change the company's total fixed costs.)
2. Assume the company has 1,000 units of this product left over from last year that are inferior to the current model. The units must be sold through regular channels at reduced prices. What unit cost is relevant for establishing a minimum selling price for these units? Explain.

EXERCISE 12-10 Make or Buy a Component [LO12-3]

For many years Futura Company has purchased the starters that it installs in its standard line of farm tractors. Due to a reduction in output, the company has idle capacity that could be used to

produce the starters. The chief engineer has recommended against this move, however, pointing out that the cost to produce the starters would be greater than the current $8.40 per unit purchase price:

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	Per Unit	Total
Direct materials	$3.10	
Direct labor	2.70	
Supervision	1.50	$60,000
Depreciation	1.00	$40,000
Variable manufacturing overhead	0.60	
Rent	0.30	$12,000
Total production cost	$9.20	

A supervisor would have to be hired to oversee production of the starters. However, the company has sufficient idle tools and machinery that no new equipment would have to be purchased. The rent charge above is based on space utilized in the plant. The total rent on the plant is $80,000 per period. Depreciation is due to obsolescence rather than wear and tear.

Required:
Prepare computations showing how much profits will increase or decrease as a result of making the starters.

EXERCISE 12-11 Make or Buy a Component [LO12-3]
Han Products manufactures 30,000 units of part S-6 each year for use on its production line. At this level of activity, the cost per unit for part S-6 is:

Direct materials	$ 3.60
Direct labor	10.00
Variable manufacturing overhead	2.40
Fixed manufacturing overhead	9.00
Total cost per part	$25.00

An outside supplier has offered to sell 30,000 units of part S-6 each year to Han Products for $21 per part. If Han Products accepts this offer, the facilities now being used to manufacture part S-6 could be rented to another company at an annual rental of $80,000. However, Han Products has determined that two-thirds of the fixed manufacturing overhead being applied to part S-6 would continue even if part S-6 were purchased from the outside supplier.

Required:
Prepare computations showing how much profits will increase or decrease if the outside supplier's offer is accepted.

EXERCISE 12-12 Utilization of a Constrained Resource [LO12-5]
Benoit Company produces three products, A, B, and C. Data concerning the three products follow (per unit):

	Product		
	A	B	C
Selling price	$80	$56	$70
Variable expenses:			
Direct materials	24	15	9
Other variable expenses	24	27	40
Total variable expenses	48	42	49
Contribution margin	$32	$14	$21
Contribution margin ratio	40%	25%	30%

Demand for the company's products is very strong, with far more orders each month than the company can produce with the available raw materials. The same material is used in each product. The material costs $3 per pound with a maximum of 5,000 pounds available each month.

Required:

Which orders would you advise the company to accept first, those for A, for B, or for C? Which orders second? Third?

EXERCISE 12-13 Sell or Process Further [LO12-7]

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Wexpro, Inc., produces several products from processing 1 ton of clypton, a rare mineral. Material and processing costs total $60,000 per ton, one-fourth of which is allocated to product X15. Seven thousand units of product X15 are produced from each ton of clypton. The units can either be sold at the split-off point for $9 each, or processed further at a total cost of $9,500 and then sold for $12 each.

Required:

Should product X15 be processed further or sold at the split-off point?

EXERCISE 12-14 Identification of Relevant Costs [LO12-1]

Kristen Lu purchased a used automobile for $8,000 at the beginning of last year and incurred the following operating costs:

Depreciation ($8,000 ÷ 5 years)	$1,600
Insurance	$1,200
Garage rent	$360
Automobile tax and license	$40
Variable operating cost	$0.14 per mile

The variable operating cost consists of gasoline, oil, tires, maintenance, and repairs. Kristen estimates that, at her current rate of usage, the car will have zero resale value in five years, so the annual straight-line depreciation is $1,600. The car is kept in a garage for a monthly fee.

Required:

1. Kristen drove the car 10,000 miles last year. Compute the average cost per mile of owning and operating the car.
2. Kristen is unsure about whether she should use her own car or rent a car to go on an extended cross-country trip for two weeks during spring break. What costs above are relevant in this decision? Explain.
3. Kristen is thinking about buying an expensive sports car to replace the car she bought last year. She would drive the same number of miles regardless of which car she owns and would rent the same parking space. The sports car's variable operating costs would be roughly the same as the variable operating costs of her old car. However, her insurance and automobile tax and license costs would go up. What costs are relevant in estimating the incremental cost of owning the more expensive car? Explain.

EXERCISE 12-15 Dropping or Retaining a Segment [LO12-2]

Thalassines Kataskeves, S.A., of Greece makes marine equipment. The company has been experiencing losses on its bilge pump product line for several years. The most recent quarterly contribution format income statement for the bilge pump product line follows:

Thalassines Kataskeves, S.A. Income Statement—Bilge Pump For the Quarter Ended March 31		
Sales		$850,000
Variable expenses:		
Variable manufacturing expenses	$330,000	
Sales commissions	42,000	
Shipping	18,000	
Total variable expenses		390,000
Contribution margin		460,000
Fixed expenses:		
Advertising	270,000	
Depreciation of equipment (no resale value)	80,000	
General factory overhead	105,000*	
Salary of product-line manager	32,000	
Insurance on inventories	8,000	
Purchasing department	45,000†	
Total fixed expenses		540,000
Net operating loss		$ (80,000)

*Common costs allocated on the basis of machine-hours.
†Common costs allocated on the basis of sales dollars.

Discontinuing the bilge pump product line would not affect sales of other product lines and would have no effect on the company's total general factory overhead or total Purchasing Department expenses.

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Required:

Would you recommend that the bilge pump product line be discontinued? Support your answer with appropriate computations.

EXERCISE 12-16 Identification of Relevant Costs [LO12-1]


Bill has just returned from a duck hunting trip. He has brought home eight ducks. Bill's friend, John, disapproves of duck hunting, and to discourage Bill from further hunting, John has presented him with the following cost estimate per duck:

Camper and equipment:	
Cost, $12,000; usable for eight seasons; 10 hunting trips per season	$150
Travel expense (pickup truck):	
100 miles at $0.31 per mile (gas, oil, and tires—$0.21 per mile; depreciation and insurance—$0.10 per mile)	31
Shotgun shells (two boxes)	20
Boat:	
Cost, $2,320, usable for eight seasons; 10 hunting trips per season	29
Hunting license:	
Cost, $30 for the season; 10 hunting trips per season	3
Money lost playing poker:	
Loss, $24 (Bill plays poker every weekend)	24
Bottle of whiskey:	
Cost, $15 (used to ward off the cold)	15
Total cost	$272
Cost per duck ($272 ÷ 8 ducks)	$ 34

Required:

1. Assuming that the duck hunting trip Bill has just completed is typical, what costs are relevant to a decision as to whether Bill should go duck hunting again this season?
2. Suppose that Bill gets lucky on his next hunting trip and shoots 10 ducks in the amount of time it took him to shoot 8 ducks on his last trip. How much would it have cost him to shoot the last two ducks? Explain.
3. Which costs are relevant in a decision of whether Bill should give up hunting? Explain.

EXERCISE 12-17 Dropping or Retaining a Segment [LO12-2]

Bed & Bath, a retailing company, has two departments, Hardware and Linens. The company's most recent monthly contribution format income statement follows:

		Department	
	Total	Hardware	Linens
Sales	$4,000,000	$3,000,000	$1,000,000
Variable expenses	1,300,000	900,000	400,000
Contribution margin	2,700,000	2,100,000	600,000
Fixed expenses	2,200,000	1,400,000	800,000
Net operating income (loss)	$ 500,000	$ 700,000	$ (200,000)

A study indicates that $340,000 of the fixed expenses being charged to Linens are sunk costs or allocated costs that will continue even if the Linens Department is dropped. In addition, the elimination of the Linens Department will result in a 10% decrease in the sales of the Hardware Department.

Required:

If the Linens Department is dropped, what will be the effect on the net operating income of the company as a whole?

Problems

All applicable problems are available with McGraw-Hill's *Connect*® *Accounting.*

PROBLEM 12-18 Relevant Cost Analysis in a Variety of Situations [LO12-2, LO12-3, LO12-4]

Andretti Company has a single product called a Dak. The company normally produces and sells 60,000 Daks each year at a selling price of $32 per unit. The company's unit costs at this level of activity are given below:

Direct materials	$10.00	
Direct labor	4.50	
Variable manufacturing overhead	2.30	
Fixed manufacturing overhead	5.00	($300,000 total)
Variable selling expenses	1.20	
Fixed selling expenses	3.50	($210,000 total)
Total cost per unit	$26.50	

A number of questions relating to the production and sale of Daks follow. Each question is independent.

Required:

1. Assume that Andretti Company has sufficient capacity to produce 90,000 Daks each year without any increase in fixed manufacturing overhead costs. The company could increase its sales by 25% above the present 60,000 units each year if it were willing to increase the fixed selling expenses by $80,000. Would the increased fixed selling expenses be justified?
2. Assume again that Andretti Company has sufficient capacity to produce 90,000 Daks each year. A customer in a foreign market wants to purchase 20,000 Daks. Import duties on the Daks would be $1.70 per unit, and costs for permits and licenses would be $9,000. The only selling costs that would be associated with the order would be $3.20 per unit shipping cost. Compute the per unit break-even price on this order.
3. The company has 1,000 Daks on hand that have some irregularities and are therefore considered to be “seconds.” Due to the irregularities, it will be impossible to sell these units at the normal price through regular distribution channels. What unit cost figure is relevant for setting a minimum selling price? Explain.
4. Due to a strike in its supplier's plant, Andretti Company is unable to purchase more material for the production of Daks. The strike is expected to last for two months. Andretti Company has enough material on hand to operate at 30% of normal levels for the two-month period. As an alternative, Andretti could close its plant down entirely for the two months. If the plant were closed, fixed manufacturing overhead costs would continue at 60% of their normal level during the two-month period and the fixed selling expenses would be reduced by 20%. What would be the impact on profits of closing the plant for the two-month period?

5. An outside manufacturer has offered to produce Daks and ship them directly to Andretti's customers. If Andretti Company accepts this offer, the facilities that it uses to produce Daks would be idle; however, fixed manufacturing overhead costs would be reduced by 75%. Because the outside manufacturer would pay for all shipping costs, the variable selling expenses would be only two-thirds of their present amount. Compute the unit cost that is relevant for comparison to the price quoted by the outside manufacturer.

PROBLEM 12-19 Dropping or Retaining a Segment [LO12-2]

Jackson County Senior Services is a nonprofit organization devoted to providing essential services to seniors who live in their own homes within the Jackson County area. Three services are

provided for seniors—home nursing, Meals On Wheels, and housekeeping. Data on revenue and expenses for the past year follow:

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	Total	Home Nursing	Meals On Wheels	House-keeping
Revenues	$900,000	$260,000	$400,000	$240,000
Variable expenses	490,000	120,000	210,000	160,000
Contribution margin	410,000	140,000	190,000	80,000
Fixed expenses:				
Depreciation	68,000	8,000	40,000	20,000
Liability insurance	42,000	20,000	7,000	15,000
Program administrators' salaries	115,000	40,000	38,000	37,000
General administrative overhead*	180,000	52,000	80,000	48,000
Total fixed expenses	405,000	120,000	165,000	120,000
Net operating income (loss)	$ 5,000	$ 20,000	$ 25,000	$ (40,000)

*Allocated on the basis of program revenues.

The head administrator of Jackson County Senior Services, Judith Miyama, is concerned about the organization's finances and considers the net operating income of $5,000 last year to be razor-thin. (Last year's results were very similar to the results for previous years and are representative of what would be expected in the future.) She feels that the organization should be building its financial reserves at a more rapid rate in order to prepare for the next inevitable recession. After seeing the above report, Ms. Miyama asked for more information about the financial advisability of perhaps discontinuing the housekeeping program.

The depreciation in housekeeping is for a small van that is used to carry the housekeepers and their equipment from job to job. If the program were discontinued, the van would be donated to a charitable organization. None of the general administrative overhead would be avoided if the housekeeping program were dropped, but the liability insurance and the salary of the program administrator would be avoided.

Required:

1. Should the Housekeeping program be discontinued? Explain. Show computations to support your answer.
2. Recast the above data in a format that would be more useful to management in assessing the long-run financial viability of the various services.

PROBLEM 12-20 Sell or Process Further [LO12-7]

(Prepared from a situation suggested by Professor John W. Hardy.) Lone Star Meat Packers is a major processor of beef and other meat products. The company has a large amount of T-bone steak on hand, and it is trying to decide whether to sell the T-bone steaks as they are initially cut or to process them further into filet mignon and the New York cut.

If the T-bone steaks are sold as initially cut, the company figures that a 1-pound T-bone steak would yield the following profit:

Selling price ($2.25 per pound)	$2.25
Less joint costs incurred up to the split-off point where T-bone steak can be identified as a separate product	1.80
Profit per pound	$0.45

As mentioned above, instead of being sold as initially cut, the T-bone steaks could be further processed into filet mignon and New York cut steaks. Cutting one side of a T-bone steak provides the filet mignon, and cutting the other side provides the New York cut. One 16-ounce T-bone steak cut in this way will yield one 6-ounce filet mignon and one 8-ounce New York cut; the remaining ounces are waste. The cost of processing the T-bone steaks into these cuts is $0.25 per

pound. The filet mignon can be sold for $4.00 per pound, and the New York cut can be sold for $2.80 per pound.

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Required:

1. Determine the profit per pound from processing the T-bone steaks into filet mignon and New York cut steaks.
2. Would you recommend that the T-bone steaks be sold as initially cut or processed further? Why?

PROBLEM 12-21 Dropping or Retaining a Flight [LO12-2]

Profits have been decreasing for several years at Pegasus Airlines. In an effort to improve the company's performance, consideration is being given to dropping several flights that appear to be unprofitable.

A typical income statement for one round-trip of one such flight (flight 482) is as follows:

Ticket revenue (175 seats × 40% occupancy × $200 ticket price)	$14,000	100.0%
Variable expenses ($15 per person)	1,050	7.5
Contribution margin	12,950	92.5%
Flight expenses:		
Salaries, flight crew	1,800	
Flight promotion	750	
Depreciation of aircraft	1,550	
Fuel for aircraft	5,800	
Liability insurance	4,200	
Salaries, flight assistants	1,500	
Baggage loading and flight preparation	1,700	
Overnight costs for flight crew and assistants at destination	300	
Total flight expenses	17,600	
Net operating loss	$ (4,650)	

The following additional information is available about flight 482:

a. Members of the flight crew are paid fixed annual salaries, whereas the flight assistants are paid based on the number of round trips they complete.
b. One-third of the liability insurance is a special charge assessed against flight 482 because in the opinion of the insurance company, the destination of the flight is in a “high-risk” area. The remaining two-thirds would be unaffected by a decision to drop flight 482.
c. The baggage loading and flight preparation expense is an allocation of ground crews' salaries and depreciation of ground equipment. Dropping flight 482 would have no effect on the company's total baggage loading and flight preparation expenses.
d. If flight 482 is dropped, Pegasus Airlines has no authorization at present to replace it with another flight.

e. Aircraft depreciation is due entirely to obsolescence. Depreciation due to wear and tear is negligible.
f. Dropping flight 482 would not allow Pegasus Airlines to reduce the number of aircraft in its fleet or the number of flight crew on its payroll.

Required:

1. Prepare an analysis showing what impact dropping flight 482 would have on the airline's profits.
2. The airline's scheduling officer has been criticized because only about 50% of the seats on Pegasus' flights are being filled compared to an industry average of 60%. The scheduling officer has explained that Pegasus' average seat occupancy could be improved considerably by eliminating about 10% of its flights, but that doing so would reduce profits. Explain how this could happen.

PROBLEM 12-22 Accept or Reject a Special Order [LO12-4]

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Polaski Company manufactures and sells a single product called a Ret. Operating at capacity, the company can produce and sell 30,000 Rets per year. Costs associated with this level of production and sales are given below:

	Unit	Total
Direct materials	$15	$ 450,000
Direct labor	8	240,000
Variable manufacturing overhead	3	90,000
Fixed manufacturing overhead	9	270,000
Variable selling expense	4	120,000
Fixed selling expense	6	180,000
Total cost	$45	$1,350,000

The Rets normally sell for $50 each. Fixed manufacturing overhead is constant at $270,000 per year within the range of 25,000 through 30,000 Rets per year.

Required:

1. Assume that due to a recession, Polaski Company expects to sell only 25,000 Rets through regular channels next year. A large retail chain has offered to purchase 5,000 Rets if Polaski is willing to accept a 16% discount off the regular price. There would be no sales commissions on this order; thus, variable selling expenses would be slashed by 75%. However, Polaski Company would have to purchase a special machine to engrave the retail chain's name on the 5,000 units. This machine would cost $10,000. Polaski Company has no assurance that the retail chain will purchase additional units in the future. Determine the impact on profits next year if this special order is accepted.
2. Refer to the original data. Assume again that Polaski Company expects to sell only 25,000 Rets through regular channels next year. The U.S. Army would like to make a one-time-only purchase of 5,000 Rets. The Army would pay a fixed fee of $1.80 per Ret, and it would reimburse Polaski Company for all costs of production (variable and fixed) associated with the units. Because the army would pick up the Rets with its own trucks, there would be no variable selling expenses associated with this order. If Polaski Company accepts the order, by how much will profits increase or decrease for the year?
3. Assume the same situation as that described in (2) above, except that the company expects to sell 30,000 Rets through regular channels next year. Thus, accepting the U.S. Army's order would require giving up regular sales of 5,000 Rets. If the Army's order is accepted, by how much will profits increase or decrease from what they would be if the 5,000 Rets were sold through regular channels?

PROBLEM 12-23 Make or Buy Decision [LO12-3]

Silven Industries, which manufactures and sells a highly successful line of summer lotions and insect repellents, has decided to diversify in order to stabilize sales throughout the year. A natural area for the company to consider is the production of winter lotions and creams to prevent dry and chapped skin.

After considerable research, a winter products line has been developed. However, Silven's president has decided to introduce only one of the new products for this coming winter. If the product is a success, further expansion in future years will be initiated.

The product selected (called Chap-Off) is a lip balm that will be sold in a lipstick-type tube. The product will be sold to wholesalers in boxes of 24 tubes for $8 per box. Because of excess capacity, no additional fixed manufacturing overhead costs will be incurred to produce the product. However, a $90,000 charge for fixed manufacturing overhead will be absorbed by the product under the company's absorption costing system.

Using the estimated sales and production of 100,000 boxes of Chap-Off, the Accounting Department has developed the following cost per box:

Direct material	$3.60
Direct labor	2.00
Manufacturing overhead	1.40
Total cost	$7.00

The costs above include costs for producing both the lip balm and the tube that contains it. As an alternative to making the tubes, Silven has approached a supplier to discuss the possibility of purchasing the tubes for Chap-Off. The purchase price of the empty tubes from the supplier would be $1.35 per box of 24 tubes. If Silven Industries accepts the purchase proposal, direct labor and variable manufacturing overhead costs per box of Chap-Off would be reduced by 10% and direct materials costs would be reduced by 25%.

Required:

1. Should Silven Industries make or buy the tubes? Show calculations to support your answer.
2. What would be the maximum purchase price acceptable to Silven Industries? Explain.
3. Instead of sales of 100,000 boxes, revised estimates show a sales volume of 120,000 boxes. At this new volume, additional equipment must be acquired to manufacture the tubes at an annual rental of $40,000. Assuming that the outside supplier will not accept an order for less than 120,000 boxes, should Silven Industries make or buy the tubes? Show computations to support your answer.
4. Refer to the data in (3) above. Assume that the outside supplier will accept an order of any size for the tubes at $1.35 per box. How, if at all, would this change your answer? Show computations.
5. What qualitative factors should Silven Industries consider in determining whether they should make or buy the tubes?

(CMA, adapted)

PROBLEM 12-24 Shutting Down or Continuing to Operate a Plant [LO12-2]

(Note: This type of decision is similar to keeping or dropping a product line.)
Birch Company normally produces and sells 30,000 units of RG-6 each month. RG-6 is a small electrical relay used as a component part in the automotive industry. The selling price is $22 per unit, variable costs are $14 per unit, fixed manufacturing overhead costs total $150,000 per month, and fixed selling costs total $30,000 per month.

Employment-contract strikes in the companies that purchase the bulk of the RG-6 units have caused Birch Company's sales to temporarily drop to only 8,000 units per month. Birch Company estimates that the strikes will last for two months, after which time sales of RG-6 should return to normal. Due to the current low level of sales, Birch Company is thinking about closing down its own plant during the strike, which would reduce its fixed manufacturing overhead costs by $45,000 per month and its fixed selling costs by 10%. Start-up costs at the end of the shutdown period would total $8,000. Because Birch Company uses Lean Production methods, no inventories are on hand.

Required:

1. Assuming that the strikes continue for two months, would you recommend that Birch Company close its own plant? Explain. Show computations.
2. At what level of sales (in units) for the two-month period should Birch Company be indifferent between closing the plant or keeping it open? Show computations. (Hint: This is a type of break-even analysis, except that the fixed cost portion of your break-even computation should include only those fixed costs that are relevant [i.e., avoidable] over the two-month period.)

PROBLEM 12-25 Utilization of a Constrained Resource [LO12-5, LO12-6]

The Walton Toy Company manufactures a line of dolls and a doll dress sewing kit. Demand for the dolls is increasing, and management requests assistance from you in determining an economical sales and production mix for the coming year. The company has provided the following data:

Product	Demand Next Year (units)	Selling Price per Unit	Direct Materials	Direct Labor
Debbie	50,000	$13.50	$4.30	$3.20
Trish	42,000	$5.50	$1.10	$2.00
Sarah	35,000	$21.00	$6.44	$5.60
Mike	40,000	$10.00	$2.00	$4.00
Sewing kit	325,000	$8.00	$3.20	$1.60

The following additional information is available:

a. The company's plant has a capacity of 130,000 direct labor-hours per year on a single-shift basis. The company's present employees and equipment can produce all five products.
b. The direct labor rate of $8 per hour is expected to remain unchanged during the coming year.

Fixed costs total $520,000 per year. Variable overhead costs are $2 per direct labor-hour.

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d. All of the company's nonmanufacturing costs are fixed.
e. The company's finished goods inventory is negligible and can be ignored.

Required:

1. Determine the contribution margin per direct labor-hour expended on each product.
2. Prepare a schedule showing the total direct labor-hours that will be required to produce the units estimated to be sold during the coming year.
3. Examine the data you have computed in (1) and (2) above. How would you allocate the 130,000 direct labor-hours of capacity to Walton Toy Company's various products?
4. What is the highest total contribution margin that the company can earn if it makes optimal use of its constrained resource?
5. What is the highest price, in terms of a rate per hour, that Walton Toy Company would be willing to pay for additional capacity (that is, for added direct labor time)?
6. Assume again that the company does not want to reduce sales of any product. Identify ways in which the company could obtain the additional output.

(CMA, adapted)

PROBLEM 12-26 Close or Retain a Store [LO12-2]

Superior Markets, Inc., operates three stores in a large metropolitan area. A segmented absorption costing income statement for the company for the last quarter is given below:

Superior Markets, Inc.
Income Statement
For the Quarter Ended September 30

	Total	North Store	South Store	East Store
Sales	$3,000,000	$720,000	$1,200,000	$1,080,000
Cost of goods sold	1,657,200	403,200	660,000	594,000
Gross margin	1,342,800	316,800	540,000	486,000
Selling and administrative expenses:				
Selling expenses	817,000	231,400	315,000	270,600
Administrative expenses	383,000	106,000	150,900	126,100
Total expenses	1,200,000	337,400	465,900	396,700
Net operating income (loss)	$ 142,800	$ (20,600)	$ 74,100	$ 89,300

The North Store has consistently shown losses over the past two years. For this reason, management is giving consideration to closing the store. The company has asked you to make a recommendation as to whether the store should be closed or kept open. The following additional information is available for your use:

a. The breakdown of the selling and administrative expenses is as follows:

	Total	North Store	South Store	East Store
Selling expenses:				
Sales salaries	$239,000	$ 70,000	$ 89,000	$ 80,000
Direct advertising	187,000	51,000	72,000	64,000
General advertising*	45,000	10,800	18,000	16,200
Store rent	300,000	85,000	120,000	95,000
Depreciation of store fixtures	16,000	4,600	6,000	5,400
Delivery salaries	21,000	7,000	7,000	7,000
Depreciation of delivery equipment	9,000	3,000	3,000	3,000
Total selling expenses	$817,000	$231,400	$315,000	$270,600

*Allocated on the basis of sales dollars.

	Total	North Store	South Store	East Store
Administrative expenses:				
Store management salaries	$ 70,000	$ 21,000	$ 30,000	$ 19,000
General office salaries*	50,000	12,000	20,000	18,000
Insurance on fixtures and inventory	25,000	7,500	9,000	8,500
Utilities	106,000	31,000	40,000	35,000
Employment taxes	57,000	16,500	21,900	18,600
General office—other*	75,000	18,000	30,000	27,000
Total administrative expenses	$383,000	$106,000	$150,900	$126,100

*Allocated on the basis of sales dollars.

b. The lease on the building housing the North Store can be broken with no penalty.
c. The fixtures being used in the North Store would be transferred to the other two stores if the North Store were closed.
d. The general manager of the North Store would be retained and transferred to another position in the company if the North Store were closed. She would be filling a position that would otherwise be filled by hiring a new employee at a salary of $11,000 per quarter. The general manager of the North Store would be retained at her normal salary of $12,000 per quarter. All other employees in the store would be discharged.
e. The company has one delivery crew that serves all three stores. One delivery person could be discharged if the North Store were closed. This person's salary is $4,000 per quarter. The delivery equipment would be distributed to the other stores. The equipment does not wear out through use, but does eventually become obsolete.
f. The company's employment taxes are 15% of salaries.
g. One-third of the insurance in the North Store is on the store's fixtures.
h. The "General office salaries" and "General office—other" relate to the overall management of Superior Markets, Inc. If the North Store were closed, one person in the general office could be discharged because of the decrease in overall workload. This person's compensation is $6,000 per quarter.

Required:

1. Prepare a schedule showing the change in revenues and expenses and the impact on the company's overall net operating income that would result if the North Store were closed.
2. Assuming that the store space can't be subleased, what recommendation would you make to the management of Superior Markets, Inc.?
3. Disregard requirement 2. Assume that if the North Store were closed, at least one-fourth of its sales would transfer to the East Store, due to strong customer loyalty to Superior Markets. The East Store has enough capacity to handle the increased sales. You may assume that the increased sales in the East Store would yield the same gross margin as a percentage of sales as present sales in that store. What effect would these factors have on your recommendation concerning the North Store? Show all computations to support your answer.

PROBLEM 12-27 Sell or Process Further [LO12-7]

Come-Clean Corporation produces a variety of cleaning compounds and solutions for both industrial and household use. While most of its products are processed independently, a few are related, such as the company's Grit 337 and its Sparkle silver polish.

Grit 337 is a coarse cleaning powder with many industrial uses. It costs $1.60 a pound to make, and it has a selling price of $2.00 a pound. A small portion of the annual production of Grit 337 is retained in the factory for further processing. It is combined with several other ingredients to form a paste that is marketed as Sparkle silver polish. The silver polish sells for $4.00 per jar.

This further processing requires one-fourth pound of Grit 337 per jar of silver polish. The additional direct costs involved in the processing of a jar of silver polish are:

Other ingredients	$0.65
Direct labor	1.48
Total direct cost	$2.13

Overhead costs associated with processing the silver polish are:

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Variable manufacturing overhead cost	25% of direct labor cost
Fixed manufacturing overhead cost (per month):	
Production supervisor	$3,000
Depreciation of mixing equipment	$1,400

The production supervisor has no duties other than to oversee production of the silver polish. The mixing equipment is special-purpose equipment acquired specifically to produce the silver polish. Its resale value is negligible and it does not wear out through use.

Direct labor is a variable cost at Come-Clean Corporation.

Advertising costs for the silver polish total $4,000 per month. Variable selling costs associated with the silver polish are 7.5% of sales.

Due to a recent decline in the demand for silver polish, the company is wondering whether its continued production is advisable. The sales manager feels that it would be more profitable to sell all of the Grit 337 as a cleaning powder.

Required:

1. What is the incremental contribution margin per jar from further processing of Grit 337 into silver polish?
2. What is the minimum number of jars of silver polish that must be sold each month to justify the continued processing of Grit 337 into silver polish? Explain. Show all computations.

(CMA, adapted)

PROBLEM 12-28 Make or Buy Analysis [LO12-3]

"In my opinion, we ought to stop making our own drums and accept that outside supplier's offer," said Wim Niewindt, managing director of Antilles Refining, N.V., of Aruba. "At a price of $18 per drum, we would be paying $5 less than it costs us to manufacture the drums in our own plant. Since we use 60,000 drums a year, that would be an annual cost savings of $300,000." Antilles Refining's current cost to manufacture one drum is given below (based on 60,000 drums per year):

Direct materials	$10.35
Direct labor	6.00
Variable overhead	1.50
Fixed overhead ($2.80 general company overhead, $1.60 depreciation and, $0.75 supervision)	5.15
Total cost per drum	$23.00

A decision about whether to make or buy the drums is especially important at this time because the equipment being used to make the drums is completely worn out and must be replaced. The choices facing the company are:

Alternative 1: Rent new equipment and continue to make the drums. The equipment would be rented for $135,000 per year.
Alternative 2: Purchase the drums from an outside supplier at $18 per drum.

The new equipment would be more efficient than the equipment that Antilles Refining has been using and, according to the manufacturer, would reduce direct labor and variable overhead costs by 30%. The old equipment has no resale value. Supervision cost ($45,000 per year) and direct materials cost per drum would not be affected by the new equipment. The new equipment's capacity would be 90,000 drums per year.

The company's total general company overhead would be unaffected by this decision.

Required:

1. To assist the managing director in making a decision, prepare an analysis showing the total cost and the cost per drum for each of the two alternatives given above. Assume that 60,000 drums are needed each year. Which course of action would you recommend to the managing director?
2. Would your recommendation in (1) above be the same if the company's needs were: (a) 75,000 drums per year or (b) 90,000 drums per year? Show computations to support your answer, with costs presented on both a total and a per unit basis.
3. What other factors would you recommend that the company consider before making a decision?

Cases

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CASE 12-29 Sell or Process Further Decision [LO12-7]

The Scottie Sweater Company produces sweaters under the "Scottie" label. The company buys raw wool and processes it into wool yarn from which the sweaters are woven. One spindle of wool yarn is required to produce one sweater. The costs and revenues associated with the sweaters are given below:

		Per Sweater
Selling price		$30.00
Cost to manufacture:		
Raw materials:		
Buttons, thread, lining	$ 2.00	
Wool yarn	16.00	
Total raw materials	18.00	
Direct labor	5.80	
Manufacturing overhead	8.70	32.50
Manufacturing profit (loss)		$ (2.50)

Originally, all of the wool yarn was used to produce sweaters, but in recent years a market has developed for the wool yarn itself. The yarn is purchased by other companies for use in production of wool blankets and other wool products. Since the development of the market for the wool yarn, a continuing dispute has existed in the Scottie Sweater Company as to whether the yarn should be sold simply as yarn or processed into sweaters. Current cost and revenue data on the yarn are given below:

		Per Spindle of Yarn
Selling price		$20.00
Cost to manufacture:		
Raw materials (raw wool)	$7.00	
Direct labor	3.60	
Manufacturing overhead	5.40	16.00
Manufacturing profit		$ 4.00

The market for sweaters is temporarily depressed, due to unusually warm weather in the western states where the sweaters are sold. This has made it necessary for the company to discount the selling price of the sweaters to $30 from the normal $40 price. Since the market for wool yarn has remained strong, the dispute has again surfaced over whether the yarn should be sold outright rather than processed into

sweaters. The sales manager thinks that the production of sweaters should be discontinued; she is upset about having to sell sweaters at a $2.50 loss when the yarn could be sold for a $4.00 profit. However, the production superintendent does not want to close down a large portion of the factory. He argues that the company is in the sweater business, not the yarn business, and that the company should focus on its core strength.

All of the manufacturing overhead costs are fixed and would not be affected even if sweaters were discontinued. Manufacturing overhead is assigned to products on the basis of 150% of direct labor cost. Materials and direct labor costs are variable.

Required:

1. Would you recommend that the wool yarn be sold outright or processed into sweaters? Support your answer with appropriate computations and explain your reasoning.
2. What is the lowest price that the company should accept for a sweater? Support your answer with appropriate computations and explain your reasoning.

CASE 12-30 Ethics and the Manager; Shut Down or Continue Operations [LO12-2]

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Haley Romeros had just been appointed vice president of the Rocky Mountain Region of the Bank Services Corporation (BSC). The company provides check processing services for small banks. The banks send checks presented for deposit or payment to BSC, which records the data on each check in a computerized database. BSC then sends the data electronically to the nearest Federal Reserve Bank check-clearing center where the appropriate transfers of funds are made between banks. The Rocky Mountain Region has three check processing centers, which are located in Billings, Montana; Great Falls, Montana; and Clayton, Idaho. Prior to her promotion to vice president, Ms. Romeros had been the manager of a check processing center in New Jersey.

Immediately after assuming her new position, Ms. Romeros requested a complete financial report for the just-ended fiscal year from the region's controller, John Littlebear. Ms. Romeros specified that the financial report should follow the standardized format required by corporate headquarters for all regional performance reports. That report follows:

Bank Services Corporation (BSC)
Rocky Mountain Region
Financial Performance

		Check Processing Centers		
	Total	Billings	Great Falls	Clayton
Sales	$50,000,000	$20,000,000	$18,000,000	$12,000,000
Operating expenses:				
Direct labor	32,000,000	12,500,000	11,000,000	8,500,000
Variable overhead	850,000	350,000	310,000	190,000
Equipment depreciation	3,900,000	1,300,000	1,400,000	1,200,000
Facility expense	2,800,000	900,000	800,000	1,100,000
Local administrative expense*	450,000	140,000	160,000	150,000
Regional administrative expense†	1,500,000	600,000	540,000	360,000
Corporate administrative expense‡	4,750,000	1,900,000	1,710,000	1,140,000
Total operating expense	46,250,000	17,690,000	15,920,000	12,640,000
Net operating income (loss)	$ 3,750,000	$ 2,310,000	$ 2,080,000	$ (640,000)

*Local administrative expenses are the administrative expenses incurred at the check processing centers.
†Regional administrative expenses are allocated to the check processing centers based on sales.
‡Corporate administrative expenses are charged to segments of the company such as the Rocky Mountain Region and the check processing centers at the rate of 9.5% of their sales.

Upon seeing this report, Ms. Romeros summoned John Littlebear for an explanation.

Romeros: What's the story on Clayton? It didn't have a loss the previous year did it?

Littlebear: No, the Clayton facility has had a nice profit every year since it was opened six years ago, but Clayton lost a big contract this year.

Romeros: Why?

Littlebear: One of our national competitors entered the local market and bid very aggressively on the contract. We couldn't afford to meet the bid. Clayton's costs—particularly their facility expenses—are just too high. When Clayton lost the contract, we had to lay off a lot of employees, but we could not reduce the fixed costs of the Clayton facility.

Romeros: Why is Clayton's facility expense so high? It's a smaller facility than either Billings or Great Falls and yet its facility expense is higher.

Littlebear: The problem is that we are able to rent suitable facilities very cheaply at Billings and Great Falls. No such facilities were available at Clayton; we had them built. Unfortunately, there were big cost overruns. The contractor we hired was inexperienced at this kind of work and in fact went bankrupt before the project was completed. After hiring another contractor to finish the work, we were way over budget. The large depreciation charges on the facility didn't matter at first because we didn't have much competition at the time and could charge premium prices.

Romeros: Well we can't do that anymore. The Clayton facility will obviously have to be shut down. Its business can be shifted to the other two check processing centers in the region.

Littlebear: I would advise against that. The $1,200,000 in depreciation at the Clayton facility is misleading. That facility should last indefinitely with proper maintenance. And it has no resale value; there is no other commercial activity around Clayton.

Romeros: What about the other costs at Clayton?

Littlebear: If we shifted Clayton's business over to the other two processing centers in the region, we wouldn't save anything on direct labor or variable overhead costs. We might save $90,000 or so in local administrative expense, but we would not save any regional administrative expense and corporate headquarters would still charge us 9.5% of our sales as corporate administrative expense.

In addition, we would have to rent more space in Billings and Great Falls in order to handle the work transferred from Clayton; that would probably cost us at least $600,000 a year. And don't forget that it will cost us something to move the equipment from Clayton to Billings and Great Falls. And the move will disrupt service to customers.

Romeros: I understand all of that, but a money-losing processing center on my performance report is completely unacceptable.

Littlebear: And if you shut down Clayton, you are going to throw some loyal employees out of work.

Romeros: That's unfortunate, but we have to face hard business realities.

Littlebear: And you would have to write off the investment in the facilities at Clayton.

Romeros: I can explain a write-off to corporate headquarters; hiring an inexperienced contractor to build the Clayton facility was my predecessor's mistake. But they'll have my head at headquarters if I show operating losses every year at one of my processing centers. Clayton has to go. At the next corporate board meeting, I am going to recommend that the Clayton facility be closed.

Required:

1. From the standpoint of the company as a whole, should the Clayton processing center be shut down and its work redistributed to other processing centers in the region? Explain.
2. Do you think Haley Romeros's decision to shut down the Clayton facility is ethical? Explain.
3. What influence should the depreciation on the facilities at Clayton have on prices charged by Clayton for its services?

CASE 12-31 Integrative Case: Relevant Costs; Pricing [LO12-1, LO12-4]

Wesco Incorporated's only product is a combination fertilizer/weedkiller called GrowNWeed. GrowNWeed is sold nationwide to retail nurseries and garden stores.

Zwinger Nursery plans to sell a similar fertilizer/weedkiller compound through its regional nursery chain under its own private label. Zwinger does not have manufacturing facilities of its own, so it has asked Wesco (and several other companies) to submit a bid for manufacturing and delivering a 20,000-pound order of the private brand compound to Zwinger. While the chemical composition of the Zwinger compound differs from that of GrowNWeed, the manufacturing processes are very similar.

The Zwinger compound would be produced in 1,000-pound lots. Each lot would require 25 direct labor-hours and the following chemicals:

Chemicals	Quantity in Pounds
AG-5	300
KL-2	200
CW-7	150
DF-6	175

The first three chemicals (AG-5, KL-2, and CW-7) are all used in the production of GrowNWeed. DF-6 was used in another compound that Wesco discontinued several months ago. The supply of DF-6 that Wesco had on hand when the other compound was discontinued was not discarded. Wesco could sell its supply of DF-6 at the prevailing market price less $0.10 per pound selling and handling expenses.

Wesco also has on hand a chemical called BH-3, which was manufactured for use in another product that is no longer produced. BH-3, which cannot be used in GrowNWeed, can be substituted for AG-5 on a one-for-one basis without affecting the quality of the Zwinger compound. The BH-3 in inventory has a salvage value of $600.

Inventory and cost data for the chemicals that can be used to produce the Zwinger compound are shown below:

Raw Material	Pounds in Inventory	Actual Price per Pound When Purchased	Current Market Price per Pound
AG-5	18,000	$1.15	$1.20
KL-2	6,000	$1.10	$1.05
CW-7	7,000	$1.35	$1.35
DF-6	3,000	$0.80	$0.70
BH-3	3,500	$0.90	(Salvage)

The current direct labor wage rate is $14 per hour. The predetermined overhead rate is based on direct labor-hours (DLH). The predetermined overhead rate for the current year, based on a two-shift capacity with no overtime, is as follows:

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Variable manufacturing overhead	$ 3.00 per DLH
Fixed manufacturing overhead	10.50 per DLH
Combined predetermined overhead rate	$13.50 per DLH

Wesco's production manager reports that the present equipment and facilities are adequate to manufacture the Zwinger compound. Therefore, the order would have no effect on total fixed manufacturing overhead costs. However, Wesco is within 400 hours of its two-shift capacity this month. Any additional hours beyond the 400 hours must be done in overtime. If need be, the Zwinger compound could be produced on regular time by shifting a portion of GrowNWeed production to overtime. Wesco's direct labor wage rate for overtime is $21 per hour. There is no allowance for any overtime premium in the predetermined overhead rate.

Required:

1. Wesco has decided to submit a bid for the 20,000 pound order of Zwinger's new compound. The order must be delivered by the end of the current month. Zwinger has indicated that this is a one-time order that will not be repeated. Calculate the lowest price that Wesco could bid for the order without reducing its net operating income.
2. Refer to the original data. Assume that Zwinger Nursery plans to place regular orders for 20,000-pound lots of the new compound. Wesco expects the demand for GrowNWeed to remain strong. Therefore, the recurring orders from Zwinger would put Wesco over its two-shift capacity. However, production could be scheduled so that 90% of each Zwinger order could be completed during regular hours. As another option, some GrowNWeed production could be shifted temporarily to overtime so that the Zwinger orders could be produced on regular time. Current market prices are the best available estimates of future market prices.

   Wesco's standard markup policy for new products is 40% of the full manufacturing cost, including fixed manufacturing overhead. Calculate the price that Wesco, Inc., would quote Zwinger Nursery for each 20,000 pound lot of the new compound, assuming that it is to be treated as a new product and this pricing policy is followed.

(CMA, adapted)

CASE 12-32 Make or Buy; Utilization of a Constrained Resource [LO12-1, LO12-3, LO12-5]

TufStuff, Inc., sells a wide range of drums, bins, boxes, and other containers that are used in the chemical industry. One of the company's products is a heavy-duty corrosion-resistant metal drum, called the WVD drum, used to store toxic wastes. Production is constrained by the capacity of an automated welding machine that is used to make precision welds. A total of 2,000 hours of welding time is available annually on the machine. Because each drum requires 0.4 hours of welding machine time, annual production is limited to 5,000 drums. At present, the welding machine is used exclusively to make the WVD drums. The accounting department has provided the following financial data concerning the WVD drums:

WVD Drums		
Selling price per drum		$149.00
Cost per drum:		
Direct materials	$52.10	
Direct labor ($18 per hour)	3.60	
Manufacturing overhead	4.50	
Selling and administrative expense	29.80	90.00
Margin per drum		$ 59.00

Management believes 6,000 WVD drums could be sold each year if the company had sufficient manufacturing capacity. As an alternative to adding another welding machine, management has considered buying additional drums from an outside supplier. Harcor Industries, Inc., a supplier of quality products, would be able to provide up to 4,000 WVD-type drums per year at a price of $138 per drum, which TufStuff would resell to its customers at its normal selling price after appropriate relabeling.

Megan Flores, TufStuff's production manager, has suggested that the company could make better use of the welding machine by manufacturing bike frames, which would require only 0.5 hours of welding machine time per frame and yet sell for far more than the drums. Megan believes that TufStuff could sell up to 1,600 bike frames per year to bike manufacturers at a price of $239 each. The accounting department has provided the following data concerning the proposed new product:

Bike Frames		
Selling price per frame		$239.00
Cost per frame:		
Direct materials	$99.40	
Direct labor ($18 per hour)	28.80	
Manufacturing overhead	36.00	
Selling and administrative expense	47.80	212.00
Margin per frame		$ 27.00

The bike frames could be produced with existing equipment and personnel. Manufacturing overhead is allocated to products on the basis of direct labor-hours. Most of the manufacturing overhead consists of fixed common costs such as rent on the factory building, but some of it is variable. The variable manufacturing overhead has been estimated at $1.35 per WVD drum and $1.90 per bike frame. The variable manufacturing overhead cost would not be incurred on drums acquired from the outside supplier.

Selling and administrative expenses are allocated to products on the basis of revenues. Almost all of the selling and administrative expenses are fixed common costs, but it has been estimated that variable selling and administrative expenses amount to $0.75 per WVD drum whether made or purchased and would be $1.30 per bike frame.

All of the company's employees—direct and indirect—are paid for full 40-hour workweeks and the company has a policy of laying off workers only in major recessions.

Required:

1. Would you be comfortable relying on the financial data provided by the accounting department for making decisions related to the WVD drums and bike frames? Why?
2. Compute the contribution margin per unit for:
   a. Purchased WVD drums.
   b. Manufactured WVD drums.
   c. Manufactured bike frames.
3. Determine the number of WVD drums (if any) that should be purchased and the number of WVD drums and/or bike frames (if any) that should be manufactured. What is the increase in net operating income that would result from this plan over current operations?

   As soon as your analysis was shown to the top management team at TufStuff, several managers got into an argument concerning how direct labor costs should be treated when making this decision. One manager argued that direct labor is always treated as a variable cost in textbooks and in practice and has always been considered a variable cost at TufStuff. After all, “direct” means you can directly trace the cost to products. “If direct labor is not a variable cost, what is?” Another manager argued just as strenuously that direct labor should be considered a fixed cost at TufStuff. No one had been laid off in over a decade, and for all practical purposes, everyone at the plant is on a monthly salary. Everyone classified as direct labor works a regular 40-hour workweek and overtime has not been necessary since the company adopted Lean Production techniques. Whether the welding machine is used to make drums or frames, the total payroll would be exactly the same. There is enough slack, in the form of idle time, to accommodate any increase in total direct labor time that the bike frames would require.
4. Redo requirements (2) and (3) making the opposite assumption about direct labor from the one you originally made. In other words, if you treated direct labor as a variable cost, redo the analysis

treating it as a fixed cost. If you treated direct labor as a fixed cost, redo the analysis treating it as a variable cost.

5. What do you think is the correct way to treat direct labor cost in this situation—as variable or as fixed? Explain.

CASE 12-33 Plant Closing Decision [LO12-1, LO12-2]

QualSupport Corporation manufactures seats for automobiles, vans, trucks, and various recreational vehicles. The company has a number of plants around the world, including the Denver Cover Plant, which makes seat covers.

Ted Vosilo is the plant manager of the Denver Cover Plant but also serves as the regional production manager for the company. His budget as the regional manager is charged to the Denver Cover Plant.

Vosilo has just heard that QualSupport has received a bid from an outside vendor to supply the equivalent of the entire annual output of the Denver Cover Plant for $35 million. Vosilo was astonished at the low outside bid because the budget for the Denver Cover Plant's operating costs

for the upcoming year was set at $52 million. If this bid is accepted, the Denver Cover Plant will be closed down.

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The budget for Denver Cover's operating costs for the coming year is presented below.

Denver Cover Plant
Annual Budget for Operating Costs

Materials		$14,000,000
Labor:		
Direct	$13,100,000	
Supervision	900,000	
Indirect plant	4,000,000	18,000,000
Overhead:		
Depreciation—equipment	3,200,000	
Depreciation—building	7,000,000	
Pension expense	5,000,000	
Plant manager and staff	800,000	
Corporate expenses*	4,000,000	20,000,000
Total budgeted costs		$52,000,000

*Fixed corporate expenses allocated to plants and other operating units based on total budgeted wage and salary costs.

Additional facts regarding the plant's operations are as follows:

a. Due to Denver Cover's commitment to use high-quality fabrics in all of its products, the Purchasing Department was instructed to place blanket purchase orders with major suppliers to ensure the receipt of sufficient materials for the coming year. If these orders are canceled as a consequence of the plant closing, termination charges would amount to 20% of the cost of direct materials.
b. Approximately 400 plant employees will lose their jobs if the plant is closed. This includes all of the direct laborers and supervisors as well as the plumbers, electricians, and other skilled workers classified as indirect plant workers. Some would be able to find new jobs while many others would have difficulty. All employees would have difficulty matching Denver Cover's base pay of $18.80 per hour, which is the highest in the area. A clause in Denver Cover's contract with the union may help some employees; the company must provide employment assistance to its former employees for 12 months after a plant closing. The estimated cost to administer this service would be $1.5 million for the year.
c. Some employees would probably choose early retirement because QualSupport has an excellent pension plan. In fact, $3 million of the annual pension expense would continue whether Denver Cover is open or not.
d. Vosilo and his staff would not be affected by the closing of Denver Cover. They would still be responsible for administering three other area plants.
e. If the Denver Cover Plant were closed, the company would realize about $3.2 million salvage value for the equipment and building. If the plant remains open, there are no plans to make any significant investments in new equipment or buildings. The old equipment is adequate and should last indefinitely.

Required:

1. Without regard to costs, identify the advantages to QualSupport Corporation of continuing to obtain covers from its own Denver Cover Plant.
2. QualSupport Corporation plans to prepare a financial analysis that will be used in deciding whether or not to close the Denver Cover Plant. Management has asked you to identify:
    a. The annual budgeted costs that are relevant to the decision regarding closing the plant (show the dollar amounts).
    b. The annual budgeted costs that are *not* relevant to the decision regarding closing the plant and explain why they are not relevant (again show the dollar amounts).
    c. Any nonrecurring costs that would arise due to the closing of the plant, and explain how they would affect the decision (again show any dollar amounts).
3. Looking at the data you have prepared in (2) above, should the plant be closed? Show computations and explain your answer.
4. Identify any revenues or costs not specifically mentioned in the problem that QualSupport should consider before making a decision.

(CMA, adapted)

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[1] See Appendix 13C for a discussion of how depreciation expense impacts decisions when tax implications are considered.

[2] If Cynthia has an accident while driving to New York City or back, this might affect her insurance premium when the policy is renewed. The increase in the insurance premium would be a relevant cost of this particular trip, but the normal amount of the insurance premium is not relevant in any case.

[3] Setups are required when production switches from one product to another. For example, consider a company that makes automobile side panels. The panels are painted before shipping them to an automobile manufacturer for final assembly. The customer might require 100 blue panels, 50 black panels, and 20 yellow panels. Each time the color is changed, the painting equipment must be purged of the old paint color, cleaned with solvents, and refilled with the new paint color. This takes time. In fact, some equipment may require such lengthy and frequent setups that it is unavailable for actual production more often than not.