CHAPTER

2

Relevant Costing

LEARNING OBJECTIVES

After completing this chapter, you should be able to answer the following questions:

1. What factors are relevant in making decisions and why?
2. How do opportunity costs affect decision making?
3. What are sunk costs and why are they not relevant in making decisions?
4. What are the relevant financial considerations in outsourcing?
5. How can management make the best use of a scarce resource?
6. How does sales mix pertain to relevant costing problems?
7. How are special prices set and when are they used?
8. How is segment margin used to determine whether a product line should be retained or eliminated?
9. (Appendix) How is a linear programming problem formulated?

INTRODUCING

Price-waterhouse-Coopers

http://www.pwcglobal.com

During the last decade, increasing competition has forced many companies to refocus their resources and to defend their core businesses against aggressors. In developing strategies to fight this war, managers have generally reached a consensus on two strategic criteria. First, to win a battle, the focus of organizations must be on delivering products and services in the manner most consistent with the desires of customers. Second, no company can do all things well.

The strategies managers devise in this intensive struggle evolve from internal evaluations in which the managers identify the functions they must do well to survive. These functions are regarded as core competencies and maintaining leadership in these areas is regarded as vital. All other functions, although important to the organization, are regarded as noncore functions.

By intensely focusing on core functions, managers try to maintain a competitive advantage. However, an undesirable consequence of focusing on only the core competencies is that the quality and capabilities of the noncore functions can deteriorate. This deterioration, in turn, can reduce a firm's ability to attract customers to its products and services.

Outsourcing the noncore functions to firms that have core competencies in those functions frequently solves the dilemma of maintaining a focus on core competencies while also maintaining excellence in noncore functions. A key player in outsourcing financial services is PricewaterhouseCoopers.

PricewaterhouseCoopers, PwC, serves its outsourcing clients by providing high-quality services including payroll, internal audit, tax compliance, accounts receivable collection and many other services. Clients hire PwC to provide financial services at a cost and quality level that cannot be achieved internally by the client. Outsourcing services has become a major revenue generator for PwC and other financial services firms.

In responding to the demand from its clients, PwC has created many innovative services. Today, PwC even provides some strategic services to its clients such as financial management, human resource management, supply chain management, and customer management processes.

SOURCE: PricewaterhouseCoopers Web site, http://www.pwcglobal.com (November 15, 1999).

Managers are charged with the responsibility of managing organizational resources effectively and efficiently relative to the organization's goals and objectives. Making decisions about the use of organizational resources is a key process in which managers fulfill this responsibility. Accounting and finance professionals contribute to the decision-making process by providing expertise and information.

Accounting information can improve, but not perfect, management's understanding of the consequences of decision alternatives. To the extent that accounting information can reduce management's uncertainty about economic facts, outcomes, and relationships involved in various courses of action, such information is valuable for decision-making purposes.

relevant costing

As discussed in Chapter 11, many decisions can be made using incremental analysis. This chapter continues that discussion by introducing the topic of **relevant costing,** which focuses managerial attention on a decision's relevant (or pertinent) facts. Relevant costing techniques are applied in virtually all business decisions in both short-term and long-term contexts. This chapter examines their application to several common types of business decisions: replacing an asset, outsourcing a product or part, allocating scarce resources, determining the appropriate sales/production mix, and accepting specially priced orders. The discussion of decision tools applied to some longer term decisions is deferred to Chapter 14. In general these decisions require a consideration of costs and benefits that are mismatched in time; that is, the cost is incurred currently but the benefit is derived in future periods.

In making a choice among the alternatives available, managers must consider all relevant costs and revenues associated with each alternative. One of the most

important concepts discussed in this chapter is the relationship between time and relevance. As the decision time horizon becomes shorter, fewer costs and revenues are relevant because only a limited set of them are subject to change by short-term management actions. Over the long term, virtually all costs can be influenced by management actions. Regardless of whether the decision is short or long term, all decision making requires

> *relevant information at the point of decision; the knowledge of how to analyze that information at the point of decision; and enough time to do the analysis.*
>
> *In today's corporations, oceans of data drown most decision makers. Eliminating irrelevant information requires the knowledge of what is relevant, the knowledge of how to access and select appropriate data, and the knowledge of how best to prepare the data by sorting and summarizing it to facilitate analysis. This is the raw material of decision making.*[1]

THE CONCEPT OF RELEVANCE

1

What factors are relevant in making decisions and why?

For information to be relevant, it must possess three characteristics. It must (1) be associated with the decision under consideration, (2) be important to the decision maker, and (3) have a connection to or bearing on some future endeavor.

Association with Decision

incremental revenue
incremental cost
differential cost

Costs or revenues are relevant when they are logically related to a decision and vary from one decision alternative to another. Cost accountants can assist managers in determining which costs and revenues are relevant to decisions at hand. To be relevant, a cost or revenue item must be differential or incremental. An **incremental revenue** is the amount of revenue that differs across decision choices and **incremental cost** (**differential cost**) is the amount of cost that varies across the decision choices.

To the extent possible and practical, relevant costing compares the incremental revenues and incremental costs of alternative choices. Although incremental costs can be variable or fixed, a general guideline is that most variable costs are relevant and most fixed costs are not. The logic of this guideline is that as sales or production volume changes, within the relevant range, variable costs change, but fixed costs do not change. As with most generalizations, some exceptions can occur in the decision-making process.

The difference between the incremental revenue and the incremental cost of a particular alternative is the positive or negative incremental benefit (incremental profit) of that course of action. Management can compare the incremental benefits of alternatives to decide on the most profitable (or least costly) alternative or set of alternatives. Such a comparison may sound simple; it often is not. The concept of relevance is an inherently individual determination and the quantity of information available to make decisions is increasing. The challenge is to get information that identifies relevant costs and benefits:

> *If executives once imagined they could gather enough information to read the business environment like an open book, they have had to dim their hopes. The flow of information has swollen to such a flood that managers are in danger of drowning; extracting relevant data from the torrent is increasingly a daunting task.*[2]

Some relevant factors, such as sales commissions or prime costs of production, are easily identified and quantified because they are integral parts of the accounting system. Other factors may be relevant and quantifiable, but are not part of the

[1] Edward G. Mahler, "Perform as Smart as You Are," *Financial Executive* (July–August 1991), p. 18.
[2] Amitai Etzioni, "Humble Decision Making," *Harvard Business Review* (July–August 1989), p. 122.

College students have decided that the benefits of attending classes outweigh those of working full-time for four years. The opportunity costs to these students are the foregone wages and experience from jobs.

accounting system. Such factors cannot be overlooked simply because they may be more difficult to obtain or may require the use of estimates. For instance, **opportunity costs** represent the benefits foregone because one course of action is chosen over another. These costs are extremely important in decision making, but are not included in the accounting records.

opportunity cost

To illustrate the concept of an opportunity cost, assume that on August 1, Jane purchases a ticket for $50 to attend a play to be presented in November. In October, Jane is presented with an opportunity to sell her ticket to a friend who is very eager to attend the play. The friend has offered $100 for the ticket. The $100 price offered by Jane's friend is an opportunity cost—it is a benefit that Jane will sacrifice if she chooses to attend the play rather than sell the ticket.

Importance to Decision Maker

2

How do opportunity costs affect decision making?

The need for specific information depends on how important that information is relative to the objectives that a manager wants to achieve. Moreover, if all other factors are equal, more precise information is given greater weight in the decision-making process. However, if the information is extremely important, but less precise, the manager must weigh importance against precision. The News Note on the following page illustrates that in one of the most crucial industries, health care, accurate financial data are virtually nonexistent.

http://www.arthurandersen.com
http://www.idgresearch.com

Bearing on the Future

Information can be *based* on past or present data, but is relevant only if it pertains to a future decision choice. All managerial decisions are made to affect future events, so the information on which decisions are based should reflect future conditions. The future may be the short run (two hours from now or next month) or the long run (three years from now).

Future costs are the only costs that can be avoided, and a longer time horizon equates to more costs that are controllable, avoidable, and relevant. *Only information that has a bearing on future events is relevant in decision making.* But people too often forget this adage and try to make decisions using inapplicable data. One common error is trying to use a previously purchased asset's acquisition cost or book value in current decision making. This error reflects the misconception that sunk costs are relevant costs.

NEWS NOTE  GENERAL BUSINESS

Health Care Accounting Systems Are Seriously Sick

Managed care and an increased emphasis on cost management have created an urgent need among healthcare providers for relevant cost information, but organizations lack the necessary tools to gather the information. That was one of the key findings in a recent survey conducted by IDG Research. The respondents were 200 senior finance, operations, and information services executives from hospitals, integrated delivery networks, and clinics.

"The healthcare market has shifted from a revenue focus to a cost focus, but organizations haven't yet acquired the tools needed for success in this new environment," Doug Williams, a partner with Arthur Andersen's healthcare business consulting practice, explained. Here are other key findings:

Cost management is the dominant force in today's healthcare environment. It was cited by 95 percent of the respondents and ran far ahead of revenue generation, resource availability, and integration of multiple facilities.

There is a lack of actionable information for decision making. Eighty percent of the respondents want to measure costs over the entire episode of care, but only 33 percent are confident about the quality of their cost data, and only 26 percent said their data are timely for decision making. Fewer than a third thought they even had data they could use for decision making.

There is a dramatic lack of tools for bidding, administering, and evaluating managed care contracts. When respondents were asked about their ability to project revenue, costs, volume/utilization, and profit projections when bidding managed care contracts, 84 percent called the information necessary and valuable, yet only 48 percent were confident about their revenue projection abilities, 31 percent about costs, 26 percent about volume/utilization, and 20 percent about profit projection abilities.

SOURCE: Kathy Williams, "Cost Management Is Biggest Healthcare Issue," *Management Accounting* (May 1997), pp. 16–18. Copyright Institute of Management Accountants, Montvale, N.J.

SUNK COSTS

3

What are sunk costs and why are they not relevant in making decisions?

Costs incurred in the past for the acquisition of an asset or a resource are called sunk costs. They cannot be changed, no matter what future course of action is taken because past expenditures are not recoverable, regardless of current circumstances.

After an asset or resource is acquired, managers may find that it is no longer adequate for the intended purposes, does not perform to expectations, is technologically out of date, or is no longer marketable. A decision, typically involving two alternatives, must then be made: keep or dispose of the old asset. In making this decision, a current or future selling price may be obtained for the old asset, but such a price is the result of current or future conditions and does not "recoup" a historical cost. The historical cost is not relevant to the decision.

While asset-acquisition decisions are covered in depth in Chapter 14, these decisions provide an excellent introduction to the concept of relevant information. The following illustration makes some simplistic assumptions regarding asset acquisitions, but is used to demonstrate why sunk costs are not relevant costs.

Assume that Eastside Technologies purchases a statistical process control system for $2,000,000 on January 6, 2001. This system (the "original" system) is expected to have a useful life of five years and no salvage value. Five days later, on January 11, Trisha Black, vice president of production, notices an advertisement for a similar system for $1,800,000. This "new" system also has an estimated life of five years and no salvage value; its features will allow it to perform as well as the original system, and in addition, it has analysis tools that will save $50,000 per year in operating costs over the original system. On investigation, Ms. Black discovers that the original system can be sold for only $1,300,000. The data on the original and new statistical process control systems are shown in Exhibit 12–1.

Eastside Technologies has two options: (1) use the original system or (2) sell the original system and buy the new system. Exhibit 12–2 presents the costs Ms. Black should consider in making her asset replacement decision—that is, the *relevant*

EXHIBIT 12–1

Eastside Technologies: Statistical Process Control System Decision

	Original System (Purchased Jan. 6)	New System (Available Jan. 11)
Cost	$2,000,000	$1,800,000
Life in years	5	5
Salvage value	$0	$0
Current resale value	$1,300,000	Not applicable
Annual operating cost	$105,000	$55,000

costs. As shown in the computations in Exhibit 12–2, the $2,000,000 purchase price of the original system does not affect the decision process. This amount was "gone forever" when the company bought the system. However, if the company sells the original system, it will effectively reduce the net cash outlay for the new system to $500,000 because it will generate $1,300,000 from selling the old system. Using either system, Eastside Technologies will incur operating costs over the next five years, but it will spend $250,000 less using the new system ($50,000 savings per year × 5 years).

The common tendency is to include the $2,000,000 cost of the old system in the analysis. However, this cost is not differential between the decision alternatives. If Eastside Technologies keeps the original system, that $2,000,000 will be deducted as depreciation expense over the system's life. Alternatively, if the system is sold, the $2,000,000 will be charged against the revenue realized from the sale of the system. Thus, the $2,000,000 loss, or its equivalent in depreciation charges, is the same in magnitude whether the company retains the original or disposes of it and buys the new one. Since the amount is the same under both alternatives, it is not relevant to the decision process.

Ms. Black must condition herself to make decisions given her set of *future* alternatives. The relevant factors in deciding whether to purchase the new system are

1. cost of the new system ($1,800,000),
2. current resale value of the original system ($1,300,000), and
3. annual savings of the new system ($50,000) and the number of years (5) such savings would be enjoyed.[3]

EXHIBIT 12–2

Relevant Costs Related to Eastside Technologies' Alternatives

Alternative (1): Use original system		
Operating cost over life of original system ($105,000 × 5 years)		$ 525,000
Alternative (2): Sell original system and buy new		
Cost of new system	$1,800,000	
Resale value of original system	(1,300,000)	
Effective net outlay for new system	$ 500,000	
Operating cost over life of new system ($55,000 × 5 years)	275,000	
Total cost of new system		(775,000)
Benefit of keeping the old system		$(250,000)
The alternative, incremental calculation follows:		
Savings from operating the new system for 5 years		$ 250,000
Less: Effective incremental outlay for new system		(500,000)
Incremental advantage of keeping the old system		$(250,000)

[3] In addition, two other factors that were not discussed are also important: the potential tax effects of the transactions and the time value of money. The authors have chosen to defer consideration of these items to Chapter 14, which covers capital budgeting. Because of the time value of money, both systems were assumed to have zero salvage values at the end of their lives—a fairly unrealistic assumption.

This example demonstrates the difference between relevant and irrelevant costs, including sunk costs. The next section shows how the concepts of relevant costing, incremental revenues, and incremental costs are applied in making some common managerial decisions.

RELEVANT COSTS FOR SPECIFIC DECISIONS

Managers routinely choose a course of action from alternatives that have been identified as feasible solutions to problems. In so doing, managers weigh the costs and benefits of these alternatives and determine which course of action is best. Incremental revenues, costs, and benefits of all courses of action are measured against a baseline alternative. In making decisions, managers must provide for the inclusion of any inherently nonquantifiable considerations. Inclusion can be made by attempting to quantify those items or by simply making instinctive value judgments about nonmonetary benefits and costs.

In evaluating courses of action, managers should select the alternative that provides the highest incremental benefit to the company. One course of action that is often used as the baseline case is the "change nothing" option.

While other alternatives have certain incremental revenues and incremental costs associated with them, the "change nothing" alternative has a zero incremental benefit because it represents the current conditions. Some situations occur that involve specific government regulations or mandates in which a "change nothing" alternative does not exist. For example, if a company were polluting river water and a duly licensed governmental regulatory agency issued an injunction against it, the company (assuming it wishes to continue in business) would be forced to correct the pollution problem. The company could delay the installation of pollution control devices at the risk of fines or closure. Such fines would be incremental costs that would need to be considered; closure would create an opportunity cost amounting to the income that would have been generated had sales continued.

Rational decision-making behavior includes a comprehensive evaluation of the monetary effects of all alternative courses of action. The chosen course should be one that will make the business better off. Decision choices can be evaluated using relevant costing techniques.

OUTSOURCING DECISIONS

4

What are the relevant financial considerations in outsourcing?

A daily question faced by managers is whether the right components and services will be available at the right time to ensure that production can occur. Additionally, the inputs must be of the appropriate quality and obtainable at a reasonable price. Traditionally, companies ensured themselves of service and part availability and quality by controlling all functions internally. However, as discussed in the opening vignette, there is a growing trend toward "outsourcing" (buying) a greater percentage of required materials, components, and services.

outsourcing decision
make-or-buy decision

This **outsourcing decision** (**make-or-buy decision**) is made only after an analysis that compares internal production and opportunity costs with purchase cost and assesses the best uses of available facilities. Consideration of an insource (make) option implies that the company has available capacity for that purpose or has considered the cost of obtaining the necessary capacity. Relevant information for this type of decision includes both quantitative and qualitative factors. Exhibit 12–3 lists the top motivations for companies to pursue outsourcing.

Exhibit 12–4 presents factors that should be considered in the outsourcing decision. Several of the quantitative factors, such as incremental direct material and direct labor costs per unit, are known with a high degree of certainty. Other factors, such as the variable overhead per unit and the opportunity cost associated

EXHIBIT 12–3

Top Ten Reasons to Outsource

1. Reduce and control operating costs.
2. Improve company focus.
3. Gain access to world-class capabilities.
4. Free internal resources for other purposes.
5. Obtain resources not available internally.
6. Accelerate reengineering benefits.
7. Eliminate a function difficult to manage/out of control.
8. Make capital funds available.
9. Share risks.
10. Obtain cash infusion.

SOURCE: The Outsourcing Institute, *Survey of Current and Potential Outsourcing End-Users 1998,* http://www.outsourcing.com/howandwhy/research/surveyresults/main.htm (August 14, 1999).

EXHIBIT 12–4

Outsource Decision Considerations

Relevant Quantitative Factors:
Incremental production costs for each unit
Unit cost of purchasing from outside supplier (price less any discounts available plus shipping, etc.)
Number of available suppliers
Production capacity available to manufacture components
Opportunity costs of using facilities for production rather than for other purposes
  Amount of space available for storage
  Costs associated with carrying inventory
  Increase in throughput generated by buying components

Relevant Qualitative Factors:
Reliability of supply sources
Ability to control quality of inputs purchased from outside
Nature of the work to be subcontracted (such as the importance of the part to the whole)
Impact on customers and markets
Future bargaining position with supplier(s)
Perceptions regarding possible future price changes
Perceptions about current product prices (are the prices appropriate or, in some cases with international suppliers, is product dumping involved?)

with production facilities, must be estimated. The qualitative factors should be evaluated by more than one individual so personal biases do not cloud valid business judgment.

Although companies may gain the best knowledge, experience, and methodology available in a process through outsourcing, they also lose some degree of control. Thus, company management should carefully evaluate the activities to be outsourced. The pyramid shown in Exhibit 12–5 is one model for assessing outsourcing risk. Factors to consider include whether (1) a function is considered critical to the organization's long-term viability (such as product research and development); (2) the organization is pursuing a core competency relative to this function; or (3) issues such as product/service quality, time of delivery, flexibility of use, or reliability of supply cannot be resolved to the company's satisfaction.

Exhibit 12–6 provides information about cases for inkjet printers produced by Online Computers. The total cost to manufacture one case is $5.50. The company can purchase the case from a chemical products company for $4.30 per unit. Online Computers' cost accountant is preparing an analysis to determine if the company should continue making the cases or buy them from the outside supplier.

Production of each case requires a cost outlay of $4.10 per unit for materials, labor, and variable overhead. In addition, $0.50 of the fixed overhead is considered direct product cost because it specifically relates to the manufacture of cases.

EXHIBIT 12–5

Outsourcing Risk Pyramid

SOURCE: The Yankee Group, "Innovators in Outsourcing," *Forbes* (October 23, 1995), p. 266.

This $0.50 is an incremental cost since it could be avoided if cases were not produced. The remaining fixed overhead ($0.90) is not relevant to the outsourcing decision. This amount is a common cost incurred because of general production activity, unassociated with the cost object (cases). Therefore, because this portion of the fixed cost would continue under either alternative, it is not relevant.

The relevant cost for the insource alternative is $4.60—the cost that would be avoided if the product were not made. This amount should be compared to the $4.30 cost quoted by the supplier under the outsource alternative. Each amount is the incremental cost of making and buying, respectively. All else being equal, management should choose to purchase the cases rather than make them, because $0.30 will be saved on each case that is purchased rather than made. Relevant costs are those costs that are avoidable by choosing one decision alternative over another, regardless of whether they are variable or fixed. In an outsourcing decision, variable production costs are relevant. Fixed production costs are relevant if they can be avoided when production is discontinued.

EXHIBIT 12–6

Online Computers—Outsource Decision Cost Information

	Present Manufacturing Cost per Case	Relevant Cost of Manufacturing per Case
Direct material	$1.70	$1.70
Direct labor	2.00	2.00
Variable factory overhead	0.40	0.40
Fixed factory overhead*	1.40	0.50
Total unit cost	$5.50	$4.60
Quoted price from supplier	$4.30	

*Of the $1.40 fixed factory overhead, only $0.50 is actually caused by case production and could be avoided if the firm chooses not to produce cases. The remaining $0.90 of fixed factory overhead is allocated indirect (common) costs that would continue even if case production ceases.

The opportunity cost of the facilities being used by production is also relevant in this decision. If a company chooses to outsource a product component rather than to make it, an alternative purpose may exist for the facilities now being used for manufacturing. If a more profitable alternative is available, management should consider diverting the capacity to this use.

Assume that Online Computers has an opportunity to rent the physical space now used to produce printer cases for $90,000 per year. If the company produces 600,000 cases annually, there is an opportunity cost of $0.15 per unit ($90,000 ÷ 600,000 cases) from using, rather than renting, the production space. The existence of this cost makes the outsource alternative even more attractive.

The opportunity cost is added to the production cost since the company is foregoing this amount by choosing to make the cases. Sacrificing potential revenue is as much a relevant cost as is the incurrence of expenses. Exhibit 12–7 shows calculations relating to this decision on both a per-unit and a total cost basis. Under either format, the comparison indicates that there is a $0.45 per-unit advantage to outsourcing over insourcing.

Another opportunity cost associated with insourcing is the increased plant throughput that is sacrificed to make a component. Assume that case production uses a resource that has been determined to be a bottleneck in the manufacturing plant. Management calculates that plant throughput can be increased by 1 percent per year on all products if the cases are bought rather than made. Assume this increase in throughput would provide an estimated additional annual contribution margin (with no incremental fixed costs) of $210,000. Dividing this amount by the 600,000 cases currently being produced results in a $0.35 per-unit opportunity cost related to manufacturing. When added to the production costs of $4.60, the relevant cost of manufacturing cases becomes $4.95.

Based on the information in Exhibit 12–7 (even without the inclusion of the throughput opportunity cost), Online Computers' cost accountant should inform company management that it is more economical to outsource cases for $4.30 than to manufacture them. This analysis is the typical starting point of the decision process—determining which alternative is preferred based on the *quantitative* considerations. Managers then use judgment to assess the decision's qualitative aspects.

Assume that Online Computers' purchasing agent read in the newspaper that the supplier being considered was in poor financial condition and there was a high probability of a bankruptcy filing. In this case, management would likely decide to insource rather than outsource the cases from this supplier. In this instance,

EXHIBIT 12–7

Online Computers' Opportunity Costs and Outsource Decision

	Insource	Outsource
Per unit:		
Direct production costs	$4.60	
Opportunity cost (revenue)	0.15	
Purchase cost		$4.30
Cost per case	$4.75	$4.30

	Insource	Outsource	Difference in Favor of Outsourcing
In total:			
Revenue from renting capacity	$ 0	$ 90,000	$ 90,000
Cost for 600,000 cases	(2,760,000)	(2,580,000)	180,000
Net cost	$(2,760,000)	$(2,490,000)	$270,000*

*The $270,000 represents the net purchase benefit of $0.45 per unit multiplied by the 600,000 units to be purchased during the year.

quantitative analysis supports the purchase of the units, but qualitative considerations suggest this would not be a wise course of action because the stability of the supplying source is questionable.

This additional consideration also indicates that there are many potential long-run effects of a theoretically short-run decision. If Online Computers had stopped case production and rented its production facilities to another firm, and the supplier had then gone bankrupt, the company could be faced with high start-up costs to revitalize its case production process. This was essentially the situation faced by Stonyfield Farm, a New Hampshire-based yogurt company. Stonyfield Farm subcontracted its yogurt production, and one day found its supplier bankrupt—creating an inability to fill customer orders. It took Stonyfield two years to acquire the necessary production capacity and regain market strength.

http://www.stonyfield.com

This long-run view is also expressed in Chapter 3 where it is suggested that the term *fixed cost* is really a misnomer. These costs should be referred to as long-run variable costs because, while they do not vary with volume in the short run, they *do* vary in the long run. As such, they are relevant for long-run decision making.

For example, assume a part or product is manufactured (rather than outsourced) and the company expects demand for that item to increase in the next few years. At a future time, the company may be faced with a need to expand capacity and incur additional "fixed" capacity costs. These long-run costs would, in turn, theoretically cause product costs to increase because of the need to allocate the new overhead to production. To suggest that products made before capacity is added would cost less than those made afterward is a short-run view. The long-run viewpoint would consider both the current and "long-run" variable costs over the product life cycle. However, many firms expect prices charged by their suppliers to change over time and actively engage in cooperative efforts with their suppliers to control costs and reduce prices.

Outsourcing decisions are not confined to manufacturing entities. Many service organizations must also make these decisions. For example, accounting and law firms must decide whether to prepare and present in-house continuing education programs or to outsource such programs to external organizations or consultants. Private schools must determine whether to have their own buses or use independent contractors. Doctors investigate the differences in cost, quality of results, and convenience to patients between having blood samples drawn and tested in the office or in an independent lab facility. Outsourcing can include product and process design activities, accounting and legal services, utilities, engineering services, and employee health services.

Outsourcing decisions consider the opportunity costs of facilities. If capacity is occupied in one way, it cannot be used at the same time for another purpose. Limited capacity is only one type of scarce resource that managers need to consider when making decisions.

Scarce Resources Decisions

5

How can management make the best use of a scarce resource?

scarce resource

Managers are frequently confronted with the short-run problem of making the best use of scarce resources that are essential to production activity, but are available only in limited quantity. **Scarce resources** create constraints on producing goods or providing services and can include machine hours, skilled labor hours, raw materials, and production capacity and other inputs. Management may, in the long run, obtain a greater quantity of a scarce resource. For instance, additional machines could be purchased to increase availability of machine hours. However, in the short run, management must make the most efficient use of the scarce resources it has currently.

Determining the best use of a scarce resource requires managerial recognition of company objectives. If the objective is to maximize company profits, a scarce resource is best used to produce and sell the product having the highest contri-

bution margin *per unit of the scarce resource.* This strategy assumes that the company is faced with only one scarce resource.

Exhibit 12–8 presents information on two products being manufactured by Online Computers. The company's scarce resource is a data chip that it purchases from a supplier. Each desktop computer requires one chip and each notebook computer requires three chips. Currently, the firm has access to only 5,100 chips per month to make either desktop or notebook computers or some combination of both. Demand is above 5,100 units per month for both products and there are no variable selling or administrative costs related to either product.

The desktop's $650 selling price less its $545 variable cost provides a contribution margin of $105 per unit. The notebook's contribution margin per unit is $180 ($900 selling price minus $720 variable cost). Fixed annual overhead related to these two product lines totals $6,570,000 and is allocated to products for purposes of inventory valuation. Fixed overhead, however, does not change with production levels within the relevant range and, accordingly, is not relevant in a short-run scarce resource decision.

Because fixed overhead per unit is not relevant in the short run, unit contribution margin rather than unit gross margin is the appropriate measure of profitability of the two products.[4] Unit contribution margin is divided by the input quantity of the scarce resource (in this case, data chips) to obtain the contribution margin per unit of scarce resource. The last line in Exhibit 12–8 shows the $105 contribution margin per chip for the desktop compared to $60 for the notebook. Thus, it is more profitable for Online Computers to produce desktop computers than notebooks.

At first glance, it would appear that the notebook would be, by a substantial margin, the more profitable of the two products because its contribution margin per unit ($180) is significantly higher than that of the desktop ($105). However, because the notebook requires three times as many chips as the desktop, a greater amount of contribution margin per chip is generated by the production of the desktops. If these were the only two products made by Online Computers and the company wanted to achieve the highest possible profit, it would dedicate all available data chips to the production of desktops. Such a strategy would provide a total contribution margin of $535,500 per month (5,100 × $105), if all units produced were sold.

When one limiting factor is involved, the outcome of a scarce resource decision will indicate that a single type of product should be manufactured and sold. Most situations, however, involve several limiting factors that compete with one another in the process of striving to attain business objectives. One method used to solve problems that have several limiting factors is linear programming, which is discussed in the Appendix to this chapter.

EXHIBIT 12–8

Online Computers—Desktop and Notebook Computer Information

	Desktop	Notebook
Selling price per unit (a)	$650	$900
Variable production cost per unit:		
Direct material	$345	$480
Direct labor	115	125
Variable overhead	85	115
Total variable cost (b)	$545	$720
Unit contribution margin [(c) = (a) − (b)]	$105	$180
Divided by chips required per unit (d)	1	3
Contribution margin per chip [(c) ÷ (d)]	$105	$ 60

[4] Gross margin (or gross profit) is unit selling price minus total production cost per unit. Total production cost includes allocated fixed overhead.

In addition to considering the monetary effects related to scarce resource decisions, managers must remember that all factors cannot be readily quantified and the qualitative aspects of the situation must be evaluated in addition to the quantitative ones. For example, before choosing to produce only desktops, Online Computers' managers would need to assess the potential damage to the firm's reputation and markets if the company limited its product line to a single item. Such a choice severely restricts its customer base and is especially important if the currently manufactured products are competitively related. For example, if Hewlett-Packard began making only ink jet printers, many printer buyers would not find that product appropriate for their needs. These buyers would purchase their printers from another company.

http://www.hp.com

Concentrating on a single product can also create market saturation or company stagnation. Some products, such as refrigerators and Rolex watches, are purchased by customers infrequently or in single units. Making such a product limits the company's opportunity for repeat business. And, if the company concentrates on the *wrong* single product (such as buggywhips or pet rocks), that exclusionary choice can be the beginning of the end for the company.

http://www.rolex.com

In some cases, the revenues and expenses of a group of products must be considered as a set of decisions in allocating scarce resources. It is possible that multiple products may be complementary or that one product is sold as part of a package with other products, cannot be used effectively without another product, or will be the key to revenue generation in future periods. To illustrate these possibilities, consider the following products: Cross's well-known ballpoint pen and mechanical pencil sets; dining room tables and dining room chairs produced by Drexel Heritage Furniture; and the Barbie "family" of products made by Mattel, Inc. Would it be reasonable for Cross to make only pens, Drexel Heritage to make only tables, or Mattel to make only Barbie dolls? In the case of Mattel, company management would probably choose to manufacture Barbie dolls even if they produced zero contribution so that profits could be earned on Barbie accessories.

http://www.cross.com
http://www.drexelheritage.com
http://www.mattel.com

Thus, company management may decide that production and sale of some number of less profitable products is necessary to maintain either customer satisfaction or sales of other products. Production mix translates on the revenue side into sales mix, which is addressed in the next section.

Sales Mix Decisions

6

How does sales mix pertain to relevant costing problems?

Managers continuously strive to achieve a variety of company objectives such as profit maximization, improvement of the company's relative market share, and generation of customer goodwill and loyalty. Selling products or performing services accomplishes these objectives. Regardless of whether the company is a retailer, manufacturer, or service organization, **sales mix** refers to "the relative quantities of the products that make up the total sales of a company."[5] Some important factors affecting the sales mix of a company are product selling prices, sales force compensation, and advertising expenditures. A change in one or all of these factors may cause a company's sales mix to shift. As indicated in the accompanying News Note, the management of sales mix requires a basic understanding of marketing.

sales mix

Information on Online Computers' ink jet printer line is presented in Exhibit 12–9 and is used to illustrate the effects of the three factors mentioned earlier on sales mix. The product line includes student, commercial, and professional printers, each having different features and being targeted at a different market segment.

[5] Institute of Management Accountants (formerly National Association of Accountants), *Statements of Management Accounting Number 2: Management Accounting Terminology* (Montvale, N.J.: NAA, June 1, 1983), p. 94.

GENERAL BUSINESS  NEWS NOTE

The A B Ps of Marketing

To understand clients and develop products and services, planners should consider the four P's of marketing: product, price, promotion, and position. Marketing is creating an environment conducive to sales. Unfortunately, with all that's going on in our business today, most of us don't spend any time reviewing our marketing mix. Taking the time to see how your marketing plan aligns with these classic Marketing 101 cornerstones will help you and your clients reach your goals.

In planning your four-P's strategy, it's a good idea to write a marketing plan that begins with the objectives you want to achieve in each area. One of the ways of defining objectives is to think of them as the intended results. Once you have identified your intended results, you can develop strategies for achieving those results.

Next determine your tactics, the specific actions you are going to use to achieve the intended results. Use the objective, strategy and tactic planning to map out each of the four P's. Make sure to assign responsibilities for each of the areas to either yourself or to key employees.

SOURCE: John J. Bowen, Jr., "Four P's of Marketing: Product, Price, Promotion and Position Are All Essential for Creating an Environment Conducive to Sales," *Financial Planning* (October 1, 1998), pp. 139–140.

EXHIBIT 12–9

Online Computers—Printer Product Information

	Student	Commercial	Professional
Unit selling price	$100	$250	$450
Unit costs:			
Variable costs:			
Direct material	$ 33	$ 95	$205
Direct labor	12	35	45
Variable factory overhead	15	25	30
Total variable production cost	$ 60	$155	$280
Product contribution margin	$ 40	$ 95	$170
Less variable selling expense*	(10)	(25)	(45)
Contribution margin per unit	$ 30	$ 70	$125

Total fixed costs:	
Production	$2,700,000
Selling & administrative	1,300,000
Total	$4,000,000

*The only variable selling expense is for sales commissions, which are always set at 10% of the selling price per unit.

SALES PRICE CHANGES AND RELATIVE PROFITABILITY OF PRODUCTS

Managers must continuously monitor the relative selling prices of company products, both with respect to each other as well as to competitors' prices. This process may provide information that causes management to change one or more selling prices. Factors that might influence price changes include fluctuations in demand or production/distribution cost, economic conditions, and competition. Any shift in the selling price of one product in a multiproduct firm will normally cause a change in sales mix of that firm because of the economic law of demand elasticity with respect to price.[6]

[6] The law of demand elasticity indicates how closely price and demand are related. Product demand is highly elastic if a small price reduction generates a large demand increase. If demand is less elastic, large price reductions are needed to bring about moderate sales volume increases. In contrast, if demand is highly elastic, a small price increase results in a large drop in demand.

Online Computers' management has set profit maximization as the primary corporate objective. Such a strategy does not necessarily translate to maximizing unit sales of the product with the highest selling prices and minimizing unit sales of the product with the lowest selling price. The product with the highest selling price per unit does not necessarily yield the highest contribution margin per unit or per dollar of sales. In Online Computers' case, the printer with the highest selling price (the professional model) yields the highest unit contribution margin of the three products but the lowest contribution margin as a percent of sales. It is more profit-beneficial to sell a dollar's worth of the student printer than a dollar's worth of either the commercial or professional models. A dollar of sales of the student printer yields $0.30 of contribution margin; this compares to $0.28 for the commercial printer and $0.278 for the professional printer.

If profit maximization is a company's goal, management should consider the sales volume and unit contribution margin of each product. Total company contribution margin is the sum of the contribution margins provided by all of the products' sales. Exhibit 12–10 provides information on sales volumes and indicates the respective total contribution margins of the three types of printers. To maximize profits from this product line, company management must maximize total contribution margin rather than per-unit contribution margin.

A product's sales volume is almost always intricately related to its selling price. Generally, when the selling price of a product or service is increased and demand is elastic with respect to price, demand for that product decreases.[7] Thus, if Online Computers' management, in an attempt to increase profits, raises the price of the student printer to $120, there should be some decline in demand. Assume that consultation with the marketing research personnel indicates that such a price increase would cause demand for that product to drop from 42,000 to 31,000 printers per period. Exhibit 12–11 shows the effect of this pricing decision on the printer product line income of Online Computers.

EXHIBIT 12–10

Online Computers—Relationship Between Contribution Margin and Sales Volume

	Unit Contribution Margin (from Exhibit 12–9)	Current Sales Volume in Units	Income Statement Information
Student printers	$ 30	42,000	$ 1,260,000
Commercial printers	70	29,000	2,030,000
Professional printers	125	11,000	1,375,000
Total contribution margin of product sales mix			$ 4,665,000
Fixed expenses (from Exhibit 12–9)			(4,000,000)
Product line income at present volume and sales mix			$ 665,000

EXHIBIT 12–11

Online Computers—Relationship Between Selling Price and Demand

	Unit Contribution Margin	New Sales Volume in Units	Income Statement Information
Student printers	$ 48*	31,000	$ 1,488,000
Commercial printers	70	29,000	2,030,000
Professional printers	125	11,000	1,375,000
Total contribution margin of product sales mix			$ 4,893,000
Fixed expenses			(4,000,000)
Product line income at new volume of sales			$ 893,000

*New selling price of $120 minus [total variable production costs of $60 plus variable selling expense of $12 (10% of new selling price)].

[7] Such a decline in demand would generally not occur when the product in question has no close substitutes or is not a major expenditure in consumers' budgets.

Because the contribution margin per unit of the student printer increased, the total dollar contribution margin generated by sales of that product increased despite the decrease in sales volume. This example assumed that customers did not switch their purchases from student printers to other Online Computers products when the price of the student printer was raised. When prices of some products in a product line remain fixed while others are changed, customers will substitute the purchase of one product for another. Switching within the company was ignored in this instance and it should be recognized that some customers would likely purchase one of the more expensive printers after the price of the student printer is increased. For example, customers might believe that the difference in functionality between the student and commercial printer models is worth the price difference and make such a purchasing switch.

In making decisions to raise or lower prices, the relevant quantitative factors include (1) new contribution margin per unit of product; (2) both short-term and long-term changes in product demand and production volume because of the price change; and (3) best use of the company's scarce resources. Some relevant qualitative factors involved in pricing decisions are (1) impact of changes on customer goodwill toward the company; (2) customer loyalty toward company products; and (3) competitors' responses to the firm's new pricing structure.[8] Also, changes in the competitive environment create opportunities to produce new products. Exploiting such opportunities leads to changes in the sales mix.

When pricing proposed new products, a long-run view of the product's life cycle should be taken. This view would include assumptions about consumer behavior, competitor behavior, pace of technology changes, government posture, environmental concerns, size of the potential market, and demographic changes. These considerations would affect product price estimates at the various stages in the product's life cycle. Then, as discussed in Chapter 4, these estimates would be averaged to obtain the starting point in the process of target costing. Also, as discussed in the News Note on page 514, in pricing a service, prices should reflect consumer value, and should help signal the quality of the service provided.

COMPENSATION CHANGES

Many companies compensate their salespeople by paying a fixed rate of commission on gross sales dollars. This approach motivates salespeople to sell the highest priced product rather than the product providing the highest contribution margin to the company. If the company has a profit-maximization objective, a commission policy of a percentage of sales will not be effective in achieving that objective.

Assume Online Computers has a price structure for its printers as indicated in Exhibit 12–11: student, $120; commercial, $250; and professional, $450. The company has a current policy of paying sales commissions equal to 10 percent of selling price. This commission structure encourages sales of the professional printers, rather than the commercial or student printers. The company is considering a new compensation structure for its sales force. The new structure would provide for a base salary to all salespeople, which would total $875,000 per period.[9] In addition, the salespeople would be paid a 15 percent commission on product contribution margin (selling price minus total variable *production* costs). The per-unit product contribution margins of the printers are $60, $95, and $170, respectively, for student, commercial, and professional printers. The new compensation policy should motivate sales personnel to sell more of the products that produce the highest commission, which would correspondingly be the company's most profitable products.[10]

[8] With regard to actions of competitors, consider what occurs when one airline raises or lowers its fares between cities. It typically does not take very long for all the other airlines flying that route to adjust their fares accordingly. Thus, any competitive advantage is only for a short time span.

[9] The revised compensation structure should allow the sales personnel to achieve the same or higher income as before the change given a similar level of effort.

[10] This statement relies on the assumption that the salespersons' efforts are more highly correlated with unit sales than dollar sales. If the salespersons' efforts are more highly correlated with dollar sales, the commission structure should encourage sales of products with higher contribution margin ratios.

NEWS NOTE  QUALITY

Dental Practices Satisfy Patients or Get Flossed

There is a new game in the dental profession with new rules of competition. The new game has to do with creating patient value. With this game, good no longer is good enough.

Historically, a practice could be in one of three positions in the dental community. In the top 10 percent, you found the very successful practices, those with excellent profitability and the resources to stay on top. In the second position was the business-as-usual practice. Most diligent, hard-working practices filled this position in the competitive dental-practice environment. In the bottom 5–10 percent were the practices that were constantly struggling to make ends meet or were outright failing.

Today, there are only two positions in the competitive environment—a practice is either winning or losing. Indeed, good no longer is good enough. The business-as-usual group is quietly, but very rapidly, polarizing to the winner or loser ends of the spectrum. Here are the new rules of the game:

Rule 1 Cost and quality are enemies versus efficiency and excellence go hand in hand. The old rule was that to increase the quality in a practice you had to raise your cost. Although in some cases this can be true, in many instances this does not hold. The bottom line is dollars spent on increasing quality should raise the value to the patient and reduce the cost.

Rule 2 Suppliers must be price conscious versus value sensitive. The day when a practice thinks it should be out there alone fighting the battles is over. A practice's strategic alliances are critical.

Rule 3 Patients buy on price versus patients buy on value. How is it that Starbucks is able to charge more for a cup of coffee than the little coffee shop on the corner? It has to do with the value proposition offered. Do not market your practice as the best in town and then price it low. You sent a message and are wasting your marketing dollars.

Rule 4 Training is expensive versus training is a must. Training your team is one of the best investments practices you can adopt. You must keep your team members stimulated and at the top of their game.

SOURCE: Robert H. Maccario, "Patient Values: A New Game with New Rules," *Dental Economics* (August 1999), pp. 73–74.

Exhibit 12–12 compares Online Computers' total contribution margin using the original sales mix and commission with total contribution margin provided under a newly assumed sales mix and the new salesperson compensation structure. The new structure increases profits because sales are shifted from the lower contribution margin ratio printers toward the higher contribution margin ratio printers. The sales personnel also benefit from the new compensation structure because their combined incomes are significantly higher than under the original structure. Reflected in the sales mix change is the fact that student model printers can be sold with substantially less salesperson effort per unit than that required for the other models.

Fixed expenses would not be considered in setting compensation structures unless those expenses were incremental relative to the new policy or to changes in sales volumes. The new base salaries were an incremental cost of Online Computers' proposed compensation plan.

ADVERTISING BUDGET CHANGES

Either adjusting the advertising budgets respective to each company product or increasing the company's total advertising budget may also lead to shifts in the sales mix. This section continues using the data for Online Computers from Exhibit 12–11 and examines a proposed increase in the company's total advertising budget.

Online Computers' advertising manager, Harry Sells, has proposed increasing the advertising budget from $300,000 to $740,000 per year. Mr. Sells believes the

Old Policy—Commissions equal to 10% of selling price.

	Product Contribution Margin	–	Commission	=	Contribution Margin after Commission	×	Old Volume	=	Total Contribution Margin
Student	$ 60		(0.1 × $120), or $12		$ 48		31,000		$1,488,000
Commercial	95		(0.1 × $250), or $25		70		29,000		2,030,000
Professional	170		(0.1 × $450), or $45		125		11,000		1,375,000
Total contribution margin for product sales							71,000		$4,893,000

New Policy—Commissions equal to 15% of product contribution margin per unit and incremental base salaries of $875,000.

	Product Contribution Margin	–	Commission	=	Contribution Margin after Commission	×	Assumed New Volume	=	Total Contribution Margin
Student	$ 60		(0.15 × $60), or $9.00		$ 51.00		60,000		$3,060,000
Commercial	95		(0.15 × $95), or $14.25		80.75		25,000		2,018,750
Professional	170		(0.15 × $125), or $18.75		151.25		10,000		1,512,500
Total contribution margin for product sales							95,000		$6,591,250
Less sales force base salaries									(875,000)
Contribution margin adjusted for sales force base salaries									$5,716,250

EXHIBIT 12–12

Online Computers—Impact of Change in Commission Structure

increased advertising will result in the following additional unit sales during the coming year: student, 4,000; commercial, 1,500; and professional, 500.

The question to be answered is this: If the company spends the additional $440,000 for advertising, will the additional 6,000 units of sales produce larger profits than Online Computers is currently experiencing on this product line? The original fixed costs, as well as the contribution margin generated by the old sales level, are irrelevant to the decision. The relevant items are the increased sales revenue, increased variable costs, and increased fixed cost—the incremental effects of the advertising change. The difference between incremental revenues and incremental variable costs is the incremental contribution margin from which the incremental fixed cost is subtracted to provide the incremental benefit (or loss) of the decision.[11]

Exhibit 12–13 shows calculations of the expected increase in contribution margin if the increased advertising expenditure is made. The $359,500 of additional contribution margin is less than the $440,000 incremental cost for advertising, indicating company management should not increase its advertising by $440,000.

Increased advertising may cause changes in the sales mix or in the number of units sold. By targeting advertising efforts at specific products, either of these changes can be effected. Sales can also be influenced by opportunities that allow companies to obtain business at a sales price that differs from the normal price.

	Student	Commercial	Professional	Total
Increase in volume	4,000	1,500	500	6,000
Contribution margin per unit	× $48	× $70	× $125	
Incremental contribution margin	$192,000	$105,000	$62,500	$359,500
Incremental fixed cost of advertising				(440,000)
Incremental loss of increased advertising expenditure				$ (80,500)

EXHIBIT 12–13

Online Computers—Analysis of Increased Advertising Cost

[11] This same type of incremental analysis is shown in Chapter 11 in relation to CVP computations.

7

How are special prices set and when are they used?

special order decision

Special Order Decisions

A **special order decision** requires that management compute a reasonable sales price for production or service jobs outside the company's normal realm of operations. Special order situations include jobs that require a bid, are taken during slack periods, or are made to a particular buyer's specifications. Typically, the sales price quoted on a special order job should be high enough to cover the job's variable and incremental fixed costs and to generate a profit. Moreover, as discussed in Chapter 4, overhead costs tend to rise with increases in product variety and product complexity. The increases are typically experienced in receiving, inspection, order processing, and inventory carrying costs. Activity-based costing techniques allow managers to more accurately determine these incremental costs and, thereby, properly include them in analyzing special orders.

Sometimes companies will depart from their price-setting routine and "low-ball" bid jobs. A low-ball bid may cover only costs and produce no profit or may even be below cost. The rationale of low-ball bids is to obtain the job and have the opportunity to introduce company products or services to a particular market segment. Special pricing of this nature may provide work for a period of time, but it cannot be continued over the long run. To remain in business, a company must set selling prices to cover total costs and provide a reasonable profit margin.[12]

Another type of special pricing job is that of private-label orders in which the buyer's name (rather than the seller's) is attached to the product. Companies may accept these jobs during slack periods to more effectively use available capacity. Fixed costs are typically not allocated to special order, private-label products. Some variable costs (such as sales commissions) can be reduced or eliminated by the very nature of the private-label process. The prices on these special orders are typically set high enough to cover the actual variable costs and thereby contribute to overall profits.

Special prices may also be justified when orders are of an unusual nature (because of the quantity, method of delivery, or packaging) or because the products are being tailor-made to customer instructions. Last, special pricing may be used when goods are produced for a one-time job, such as an overseas order that will not affect domestic sales.

Assume that Online Computers has been given the opportunity to bid on a special order for 50,000 private-label printers for a major electronics retailer. Company management wants to obtain the order as long as the additional business will provide a satisfactory contribution to profit. Online Computers has available production capacity that is not currently being used and necessary components and raw material can be obtained from suppliers. Also, the company has no immediate opportunity to apply its currently unused capacity in another way, so there is no opportunity cost.

Exhibit 12–14 presents information that management has gathered to determine a price to bid on the printers. Direct material and components, direct labor, and *variable* factory overhead costs are relevant to setting the bid price because these costs will be incurred for each printer produced. Although all variable costs are normally relevant to a special pricing decision, the variable selling expense is irrelevant in this instance because no sales commission will be paid on this sale. Fixed manufacturing overhead and fixed selling and administrative expenses are not expected to increase because of this sale, so these expenses are not included in the pricing decision.

Using the available cost information, the relevant cost for determining the bid price for each printer is $120 (direct material and components, direct labor, and

[12] An exception to this general rule may occur when a company produces related or complementary products. For instance, an electronics company may sell a video game at or below cost and allow the ancillary software program sales to be the primary source of profit.

EXHIBIT 12–14

Online Computers—Printer Product Information

	Normal Costs	Relevant Costs
Per unit cost for 1 printer:		
Direct material and components	$ 87	$ 87
Direct labor	15	15
Variable overhead	18	18
Variable selling expense (commission)	6	0
Total variable cost	$126	$120
Fixed factory overhead (allocated)	30	
Fixed selling & administrative expense	9	
Total cost per printer	$165	

variable overhead). This cost is the *minimum* price at which the company should sell one printer. Any price higher than $120 will provide the company some profit on the sale.

Assume that Online Computers' printer line is currently experiencing a $2,420,000 net loss and that company managers want to set a bid price that would cover the net loss and create $400,000 of before-tax profit. In this case, Online Computers would spread the total $2,820,000 desired contribution margin over the 50,000 unit special order at $56.40 per printer. This decision would give a bid price of $176.40 per printer ($120 variable cost + $56.40). However, *any* price above the $120 variable cost will contribute toward reducing the $2,420,000 product line loss.

In setting the bid price, management must decide how much profit it would consider reasonable on the special order. Assume that Online Computers' usual selling price for this printer model is $190 and each sale provides a normal profit margin of $25 per printer or 15 percent (rounded) of the $165 total cost. Setting the bid price for the special order at $138 would cover the variable production costs of $120 and provide a normal 15 percent profit margin ($18) on the incremental unit cost. This computation illustrates a simplistic cost-plus approach to pricing, but ignores both product demand and market competition. Online Computers' bid price should also reflect these considerations. In addition, company management should consider the effect that the additional job will have on the activities engaged in by the company and whether these activities will create additional, unforeseen costs.

When setting a special order price, management must consider the qualitative issues as well as the quantitative ones. For instance, will setting a low bid price cause this customer (or others) to believe that a precedent has been established for future prices? Will the contribution margin on a bid, set low enough to acquire the job, earn a sufficient amount to justify the additional burdens placed on management and employees by this activity? Will the additional production activity require the use of bottleneck resources and reduce company throughput? How, if at all, will special order sales affect the company's normal sales? If the job is scheduled during a period of low business activity (off-season or recession), is management willing to take the business at a lower contribution or profit margin simply to keep a trained workforce employed?

Robinson-Patman Act

A final management consideration in special pricing decisions is the **Robinson-Patman Act**, which prohibits companies from pricing the same product at different levels when those amounts do not reflect related cost differences. Cost differences must result from actual variations in the cost to manufacture, sell, or distribute a product because of differing methods of production or quantities sold.

ad hoc discount

Companies may, however, give **ad hoc discounts**, which are price concessions that relate to real (or imagined) competitive pressures rather than to location of the merchandising chain or volume purchased. Such discounts are not usually subject to detailed justification, because they are based on a competitive market

environment. While ad hoc discounts do not require intensive justification under the law, other types of discounts do because they may reflect some type of price discrimination. Prudent managers must understand the legalities of special pricing and the factors that allow for its implementation. For merchandise that is normally stocked, the only support for pricing differences is a difference in distribution costs.

In making pricing decisions, managers typically first analyze the market environment, including the degree of industry competition and competitor's prices. Then, managers normally consider full production cost in setting normal sales prices. Full production cost includes an allocated portion of fixed costs of the production process, which in a multiproduct environment could include common costs of production relating to more than one type of product. Allocations of common costs can distort the results of operations shown for individual products.

Product Line Decisions

8

How is segment margin used to determine whether a product line should be retained or eliminated?

Operating results of multiproduct environments are often presented in a disaggregated format that shows results for separate product lines within the organization or division. In reviewing these disaggregated statements, managers must distinguish relevant from irrelevant information regarding individual product lines. If all costs (variable *and* fixed) are allocated to product lines, a product line or segment may be perceived to be operating at a loss when actually it is not. The commingling of relevant and irrelevant information on the statements may cause such perceptions.

Exhibit 12–15 presents basic earnings information for the Printer Division of Online Computers, which manufactures three product lines: laser, ink jet, and dot matrix printers.

The format of the information given in the exhibit makes it appear that the dot matrix line is operating at a net loss of $165,000. Managers reviewing such results might reason that the firm would be $165,000 more profitable if dot matrix printers were eliminated. Such a conclusion may be premature because of the mixture of relevant and irrelevant information in the income statement presentation.

All fixed expenses have been allocated to the individual product lines in Exhibit 12–15. Such allocations are traditionally based on one or more measures of "presumed" equity, such as square footage of the manufacturing plant occupied by each product line, number of machine hours incurred for production of each product line, or number of employees directly associated with each product line. In all cases, however, allocations may force fixed expenses into specific product line operating results even though some of those expenses may not have actually been incurred for the benefit of the specific product line.

EXHIBIT 12–15

Printer Division of Online Computers Product Line Income Statements

	(In $000)			
	Laser	Ink Jet	Dot Matrix	Total
Sales	$8,000	$9,800	$3,000	$20,800
Total direct variable expenses	(5,400)	(5,700)	(2,200)	(13,300)
Total contribution margin	$2,600	$4,100	$ 800	$ 7,500
Total fixed expenses	(2,100)	(3,700)	(965)	(6,765)
Net income (loss)	$ 500	$ 400	$ (165)	$ 735
Fixed expenses are detailed below:				
(1) Avoidable fixed expenses	$1,200	$3,000	$ 450	$ 4,650
(2) Unavoidable fixed expenses	600	420	300	1,320
(3) Allocated common expenses	300	280	215	795
Total	$2,100	$3,700	$ 965	$ 6,765

In Exhibit 12–16, the fixed expenses of the Printer Division are segregated into three subcategories: (1) those that are avoidable if the particular product line is eliminated (these expenses can also be referred to as attributable expenses); (2) those that are directly associated with a particular product line but are unavoidable; and (3) those that are incurred for the benefit of the company as a whole (common expenses) and that are allocated to the individual product lines. The latter two subcategories are irrelevant to the question of whether to eliminate a product line. An unavoidable expense will merely be shifted to another product line if the product line with which it is associated is eliminated. Common expenses will be incurred regardless of which product lines are eliminated. An example of a common cost is the insurance premium on a manufacturing facility that houses all product lines.

If the dot matrix line is eliminated, total divisional profit will decline by $350,000. This amount represents the lost segment margin of the dot matrix product line. **Segment margin** represents the excess of revenues over direct variable expenses and avoidable fixed expenses. It is the amount remaining to cover unavoidable direct fixed expenses and common expenses, and to provide profits.[13] The segment margin figure is the appropriate one on which to base the continuation or elimination decision since it measures the segment's contribution to the coverage of indirect and unavoidable expenses. The decrease in total income that would result with only one product line can be shown in the following alternative computations. With only two product lines, laser and ink jet, the Printer Division would generate a total net income of only $385,000, computed as follows:

segment margin

	(In $000)
Current net income	$ 735
Decrease in income due to elimination of dot matrix (segment margin)	(350)
New net income	$ 385

This new net income can be proven by the following computation:

Total contribution margin of laser and ink jet lines	$6,700
Less avoidable fixed expenses of the laser and ink jet lines	(4,200)
Segment margin of laser and ink jet lines	$2,500
Less *all* remaining unavoidable and allocated expenses shown on Exhibit 12–16 ($1,320 + $795)	(2,115)
Remaining income with two product lines	$ 385

EXHIBIT 12–16

Printer Division of Online Computers Segment Margin Income Statements

	(In $000)			
	Laser	Ink Jet	Dot Matrix	Total
Sales	$8,000	$9,800	$3,000	$20,800
Total direct variable expenses	(5,400)	(5,700)	(2,200)	(13,300)
Total contribution margin	$2,600	$4,100	$ 800	$ 7,500
(1) Avoidable fixed expenses	(1,200)	(3,000)	(450)	(4,650)
Segment Margin	$1,400	$1,100	$ 350	$ 2,850
(2) Unavoidable fixed expenses	(600)	(420)	(300)	(1,320)
Product Line Result	$ 800	$ 680	$ 50	$ 1,530
(3) Allocated common expenses	(300)	(280)	(215)	(795)
Net income (loss)	$ 500	$ 400	$ (165)	$ 735

[13] All common expenses are assumed to be fixed; this is not always the case. Some common costs could be variable, such as expenses of processing purchase orders or computer time-sharing expenses for payroll or other corporate functions.

Based on the information shown in Exhibit 12–16, the Printer Division should not eliminate the dot matrix product line because it is generating a positive segment margin and, therefore, is generating enough revenue to cover its relevant expenses. If this product line were eliminated, total divisional profit would decrease by $350,000, the amount of the product line's segment margin.

In classifying product line costs, managers should be aware that some costs may appear to be avoidable but are actually not. For example, the salary of a supervisor working directly with a product line appears to be an avoidable fixed cost if the product line is eliminated. However, if this individual has significant experience, the supervisor is often retained and transferred to other areas of the company even if product lines are cut. Determinations such as these need to be made before costs can be appropriately classified in product line elimination decisions.

Depreciation on factory equipment used to manufacture a specific product is an irrelevant cost in product line decisions. But, if the equipment can be sold, the selling price is relevant to the decision because it would increase the marginal benefit of the decision to discontinue the product line. Even if the equipment will be kept in service and be used to produce other products, the depreciation expense is unavoidable and irrelevant to the decision.

Before making spontaneous decisions to discontinue a product line, management should carefully consider what it would take to "turn the product line around" and the long-term ramifications of the elimination decision. For example, elimination of a product line shrinks market assortment, which may cause some customers to seek other suppliers that maintain a broader market assortment. And, as in other relevant costing situations, a decision to eliminate a product line has qualitative as well as quantitative factors that must be analyzed. Also, as discussed in the accompanying News Note, in the same manner that product lines are scrutinized, unprofitable customers should also be identified and studied for ways to improve profitability.

Management's task is to effectively and efficiently allocate its finite stock of resources to accomplish its chosen set of objectives. A cost accountant needs to learn what uses will be made of the information requested by managers to make certain that the relevant information is provided in the appropriate form. Managers

NEWS NOTE  GENERAL BUSINESS

Firing Customers to Increase Profits

Managers across most industries are increasingly realizing the need for customer profitability information to run their businesses. The customer profitability information is required to focus expensive marketing, customer acquisition and customer retention programs on profitable customers. Constantly increasing competition means companies can no longer afford to subsidize non-profitable customers. Information is required to identify non-profitable customers and design actions to move them into profitability.

Good accounting and management practice dictates that only relevant costs should be considered in management decision making. That is, only costs that are incremental to the decision at hand are appropriate. Sunk costs and other costs that do not change based on the decision to be made are not relevant to the decision. This is often forgotten in the implementation of activity-based costing, often causing executives to throw away the hard work of the finance team by not using the information produced, or worse still, to make decisions which have a negative effect on the company.

A customer profitability analysis must provide flexible data which enables the relevant costs for specific decisions to be identified. Whether costs are predominantly fixed or variable is key to this type of analysis. While some managers like to see all of a company's costs allocated to products, it is vital that nonincremental costs are excluded from decision analysis.

SOURCE: Mark Pickering, "Customer Profitability: The Approach Counts," *Charter* (July 1998), pp. 32–35.

must have a reliable quantitative basis on which to analyze problems, compare viable solutions, and choose the best course of action. Because management is a social rather than a natural science, there are no fundamental "truths" and few problems are susceptible to black-or-white solutions. Relevant costing is a process of making human approximations of the costs of alternative decision results.

REVISITING

Price-waterhouse-Coopers

http://www.pwcglobal.com

Most organizations are now realizing that, to succeed, they must focus on a few core competencies, things they uniquely do very well. Most organizations have utilized outsourcing in the past, but the scope of outsourced activities is increasing in most firms.

PricewaterhouseCoopers, PwC, commissioned a study of outsourcing trends among 300 of the largest global companies, including 26 Canadian organizations. The research, conducted by an independent market research organization, highlighted some interesting issues and trends. Among the key findings were

1. Outsourcing is increasing in importance.
2. In general, the experience with outsourcing has been positive.
3. Outsourcing to date has been predominantly of lower risk, narrower activities. The outsourcing of broader, more important processes is increasing but is still in its early stages.
4. Organizations are starting to view outsourcing as a broad management strategy rather than just a cost reduction tool.

PwC sees the outsourcing market changing quite dramatically over the next few years towards a new relationship characterized by the following factors:

- ✓ a broadening of the scope of outsourcing relationships;
- ✓ a significant investment by the service provider, particularly in information technology and infrastructure to support service delivery; and
- ✓ sharing of risks and rewards associated with the outsourcing.

PwC has invested heavily in preparing for an increased role in the outsourcing market. As outsourcing activities increasingly encompass intangible inputs, i.e., knowledge, PwC's outsourcing services will be in greater demand. To meet this demand, the firm established its BPO (Business Process Outsourcing) group in 1996. The group is organized on a global basis, and operates as one cohesive network of professionals with centralized management, proprietary methodologies, and leading-edge technologies. These services provided by the BPO group center around the firm's core competencies which are ever-expanding.

Today, worldwide, PwC has more than 10,000 professionals dedicated to providing BPO services to more than 500 multinational and other large organizations.

SOURCE: PricewaterhouseCoopers Web site, http://www.pwcglobal.com (November 15, 1999).

CHAPTER SUMMARY

Relevant information is logically related and pertinent to a given decision. Relevant information may be both quantitative and qualitative. Variable costs are generally relevant to a decision; they are irrelevant only when they cannot be avoided under any possible alternative or when they do not differ across alternatives. Direct avoidable fixed costs are also relevant to decision making. Sometimes costs give the illusion of being relevant when they actually are not. Examples of such irrelevant costs include sunk costs, arbitrarily allocated common costs, and nonincremental fixed and variable costs.

Relevant costing compares the incremental revenues and/or costs associated with alternative decisions. Managers use relevant costing to determine the incremental benefits of decision alternatives. One decision is established as a base line against which the alternatives are compared. In many decisions the alternative of "change nothing" is the obvious base line case.

Common situations in which relevant costing techniques are applied include asset replacements, outsourcing decisions, scarce resource allocations, special price determinations, sales mix distributions, and retention or elimination of product lines. The following points are important to remember:

1. In an asset replacement decision, costs paid in the past are not relevant to decisions being made currently; these are sunk costs and should be ignored.
2. In an outsourcing decision, include the opportunity costs associated with the outsource alternative; nonproduction potentially allows management an opportunity to make plant assets and personnel available for other purposes.
3. In a decision involving a single scarce resource, if the objective is to maximize company contribution margin and profits, then production and sales should be focused toward the product with the highest contribution margin per unit of the scarce resource.
4. In a special order decision, the minimum selling price that a company should charge is the sum of all the incremental costs of production and sales on the order.
5. In a sales mix decision, changes in selling prices and advertising will normally affect sales volume and change the company's contribution margin ratio. Tying sales commissions to contribution margin will motivate salespeople to sell products that will most benefit the company's profits.
6. In a product line decision, product lines should be evaluated based on their segment margins rather than on net income. Segment margin captures the change in corporate net income that would occur if the segment were discontinued.

Quantitative analysis is generally short range in perspective. After analyzing the quantifiable factors associated with each alternative, a manager must assess the merits and potential risks of the qualitative factors involved to select the best possible course of action. Some of these qualitative factors (such as the community economic impact of closing a plant) may present long-range planning and policy implications. Other qualitative factors may be short range in nature, such as competitor reactions. Managers must decide the relevance of individual factors based on experience, judgment, knowledge of theory, and use of logic.

APPENDIX

9

How is a linear programming problem formulated?

Linear Programming

Factors exist that restrict the immediate attainment of almost any objective. For example, assume that the objective of the board of directors at Washington Hospital is to aid more sick people during the coming year. Factors restricting the attainment of that objective include number of beds in the hospital, size of the hospital staff, hours per week the staff is allowed to work, and number of charity patients the hospital can accept. Each factor reflects a limited or scarce resource and Washington Hospital must find a means of achieving its objective by efficiently and effectively allocating its limited resources.

Managers are always concerned with allocating scarce resources among competing uses. If a company has only one scarce resource, managers will schedule production or other measures of activity in a way that maximizes the use of the

scarce resource. Most situations, however, involve several limiting factors that compete with one another during the process of striving to attain business objectives. Solving problems having several limiting factors requires the use of **mathematical programming**, which refers to a variety of techniques used to allocate limited resources among activities to achieve a specific goal or purpose. This appendix provides an introduction to linear programming, which is one form of mathematical programming.[14]

mathematical programming

Basics of Linear Programming

Linear programming (LP) is a method used to find the optimal allocation of scarce resources in a situation involving one objective and multiple limiting factors.[15] The objective and restrictions on achieving that objective must be expressible as linear equations.[16] The equation that specifies the objective is called the **objective function**; typically, the objective is to maximize or to minimize some measure of performance. For example, a company's objective could be to maximize contribution margin or to minimize product cost.

linear programming

objective function

A **constraint** is any type of restriction that hampers management's pursuit of the objective. Resource constraints involve limited availability of labor time, machine time, raw material, space, or production capacity. Demand or marketing constraints restrict the quantity of product that can be sold during a time period. Constraints can also be in the form of technical product requirements. For example, management may be constrained in the production requirements for frozen meals by caloric or vitamin content.

constraint

A final constraint in all LP problems is a **nonnegativity constraint**. This constraint specifies that negative values for physical quantities are not allowed. Constraints, like the objective function, are specified in mathematical equations and represent the limits imposed on optimizing the objective function.

nonnegativity constraint

Almost every allocation problem has multiple **feasible solutions** that do not violate any of the problem constraints. Different solutions generally give different values for the objective function, although in some cases, a problem may have several solutions that provide the same value for the objective function. Solutions can be generated that contain fractional values. If solutions for variables must be restricted to whole numbers, **integer programming** techniques must be used to add additional constraints to the problem. The **optimal solution** to a maximization or minimization goal is the one that provides the best answer to the allocation problem. Some LP problems may have more than one optimal solution.

feasible solution

integer programming

optimal solution

Formulating a LP Problem

Two common situations for applying linear programming techniques are scheduling production and combining ingredients. Management's goal in determining production mix in a multiproduct environment is to find the mix of products that, when sold, will maximize the company's contribution margin (the goal). The goal in determining the mix of ingredients for a specific product is to find that mix providing the specified level of quality at the minimum variable cost.

Each LP problem contains a dependent variable, two or more independent (or decision) variables, and one or more constraints. A **decision variable** is an unknown item for which the problem is being solved. The first and most important step in solving linear programming problems is setting up the information in mathematical equation form. The objective function and each of the constraints must be identified. The objective function is frequently stated such that the solution will

decision variable

[14] This chapter discusses basic linear programming concepts; it is not an all-inclusive presentation. Any standard management science text should be consulted for an in-depth presentation of the subject.

[15] Finding the best allocation of resources when multiple goals exist is called *goal programming*. This topic is not addressed in this text.

[16] If the objective and/or restrictions cannot be expressed in linear equations, the technique of nonlinear programming must be used. No general method has been developed that can solve all types of nonlinear programming problems.

either maximize contribution margin or minimize variable costs. Basic objective function formats for maximization and minimization problems are shown below:

Maximization problem

Objective function: MAX $CM = CM_1X_1 + CM_2X_2$

Minimization problem

Objective function: MIN $VC = VC_1X_1 + VC_2X_2$

where CM = contribution margin

CM_1 = contribution margin per unit of the first product

CM_2 = contribution margin per unit of the second product

X_1 = number of units of the first product

X_2 = number of units of the second product

VC = variable cost

VC_1 = variable cost per unit of the first product

VC_2 = variable cost per unit of the second product

Resource constraints are usually expressed as inequalities.[17] The following is the general formula for a less-than-or-equal-to resource constraint:

Resource constraint(1): $A_1X_1 + A_2X_2 \leq$ Resource 1

where X_1 = number of units of the first product

X_2 = number of units of the second product

input–output coefficients

The coefficients (A_1 and A_2) are **input–output coefficients** that indicate the rate at which each decision variable uses up or depletes the scarce resource.

Machine time is an example of a resource constraint. Assume that Online Computers has only 10,000 machine hours available to produce disk drives and external modems. One-half machine hour is required to produce a disk drive unit and 0.25 hour is needed for one modem. The resource constraint is shown as:

$$0.5X_1 + 0.25X_2 \leq 10{,}000$$

where X_1 = number of disk drive units

X_2 = number of modem units

If Online Computers manufactured only one of the two types of products, it could produce 20,000 (10,000 ÷ 0.5) disk drives or 40,000 modems. In manufacturing both products, the company must recognize that producing one disk drive precludes manufacturing two modems. The mix of units to be produced will be determined by the contribution margin of each product and the other constraints under which the company operates.

All of the general concepts of formatting a linear programming problem are shown in the following maximization problem using data for the Office Storage Company. Office Storage sells two office storage products: file cabinets and storage shelves. Information on these products and the constraints that must be considered are provided in Exhibit 12–17. Office Storage managers want to know the mix

[17] It is also possible to have strict equality constraints. For example, in producing a ten-pound bag of dog food, ingredients could be combined in a variety of ways, but total weight is required to be ten pounds.

EXHIBIT 12–17

Office Storage Company Product Information and Constraints

FILE CABINET	
Contribution margin per unit	$25
Labor hours to manufacture one unit	3
Machine hours to assemble one unit	2
Cubic feet of warehouse space per unit	8
STORAGE SHELVES	
Contribution margin per unit	$9
Labor hours to manufacture one unit	2
Machine hours to assemble one unit	1
Cubic feet of warehouse space per unit	3
CONSTRAINTS	
Total labor time available each month	2,100 hours
Total machine time available each month	850 hours
Warehouse cubic feet available	4,000

of products to produce and sell that will generate the maximum contribution margin. The company is producing the items for future sale and must store them for the near term in its warehouse. For Office Storage Company, the problem is composed of the following factors: (1) the objective is to maximize contribution margin (CM); (2) the decision variables are the file cabinet (X_1) and storage shelves (X_2); and (3) the constraints are labor time, machine time, and warehouse storage space.

Equations used to express objective functions should indicate the purpose of the problem and how that purpose is to be realized. Office Storage Company's purpose (objective) is to maximize its contribution margin by producing and selling the combination of file cabinets and storage shelves that provide contribution margins of $25 and $9, respectively. The objective function is stated as

$$\text{MAX CM} = 25X_1 + 9X_2$$

The constraint inequalities indicate the demands made by each decision variable on scarce resource availability. Total labor time for producing the two products must be less than or equal to 2,100 hours per month. It is possible that all labor time will not be used each month. Each file cabinet and storage shelf produced takes 3 and 2 labor hours, respectively. The labor constraint is expressed as

$$3X_1 + 2X_2 \leq 2{,}100$$

Expressing the machine time constraint equation is similar to that of the labor time constraint. Each file cabinet requires 2 hours of machine time and each storage shelf requires 1 hour. Total machine time available per month is 850 hours. This resource constraint is

$$2X_1 + 1X_2 \leq 850$$

The file cabinets and storage shelves produced cannot exceed available warehouse storage space. Each file cabinet consumes substantially more space than each storage shelf. The production constraint is expressed as

$$8X_1 + 3X_2 \leq 4{,}000$$

Although not shown in Exhibit 12–17, nonnegativity constraints exist for this problem. The nonnegativity constraints simply state that production of either product cannot be less than zero units. Nonnegativity constraints are shown as

$$X_1 \geq 0$$
$$X_2 \geq 0$$

The mathematical formulas needed to solve the Office Storage Company LP production problem are shown in Exhibit 12–18. Next, a method for solving the problem must be chosen.

Solving a LP Problem

Linear programming problems can be solved by a graphical approach or by the simplex method. Graphs are simple to use and provide a visual representation of the problem. The computer-adaptable simplex method is a more efficient means to handle complex linear programming problems. Graphical methods of solving linear programming problems are useful only when there are two decision variables and few constraints or two constraints and few decision variables. Graphs also illustrate the process of solving a LP problem. Such illustrations are helpful in visualizing how the simplex method works.

The graphical method of solving a linear programming problem consists of five steps:

1. State the problem in terms of a linear objective function and linear constraints.
2. Graph the constraints and determine the feasible region. The **feasible region** is the graphical space contained within and on all of the constraint lines.
3. Determine the coordinates of each corner (**vertex**) of the feasible region.
4. Calculate the value of the objective function at each vertex.
5. Select the optimal solution. The optimal solution for a maximization problem is the one with the highest objective function value. The optimal solution in a minimization problem has the lowest objective function value.

feasible region

vertex

Exhibit 12–19 shows the labeled constraint lines and the corner values.

The feasible region is shaded and one can see that its corners are A–B–C. Only the machine hours constraint is binding; the other two constraints are redundant. The total contribution margin at each corner is calculated as follows:

	VALUES		
Corner	X_1	X_2	
A	0	0	CM = \$25(0) + \$9(0) = \$0
B	425	0	CM = \$25(425) + \$9(0) = \$10,625
C	0	850	CM = \$25(0) + \$9(850) = \$7,650

EXHIBIT 12–18

Office Storage Company LP Problem Statement

Objective Function: MAX CM = $25X_1 + 9X_2$

Constraints (Subject to):

$3X_1 + 2X_2 \leq 2{,}100$	(labor time in hours)
$2X_1 + 1X_2 \leq 850$	(machine time in hours)
$8X_1 + 3X_2 \leq 4{,}000$	(warehouse storage space)
$X_1 \geq 0$	(nonnegativity of file cabinets)
$X_2 \geq 0$	(nonnegativity of storage shelves)

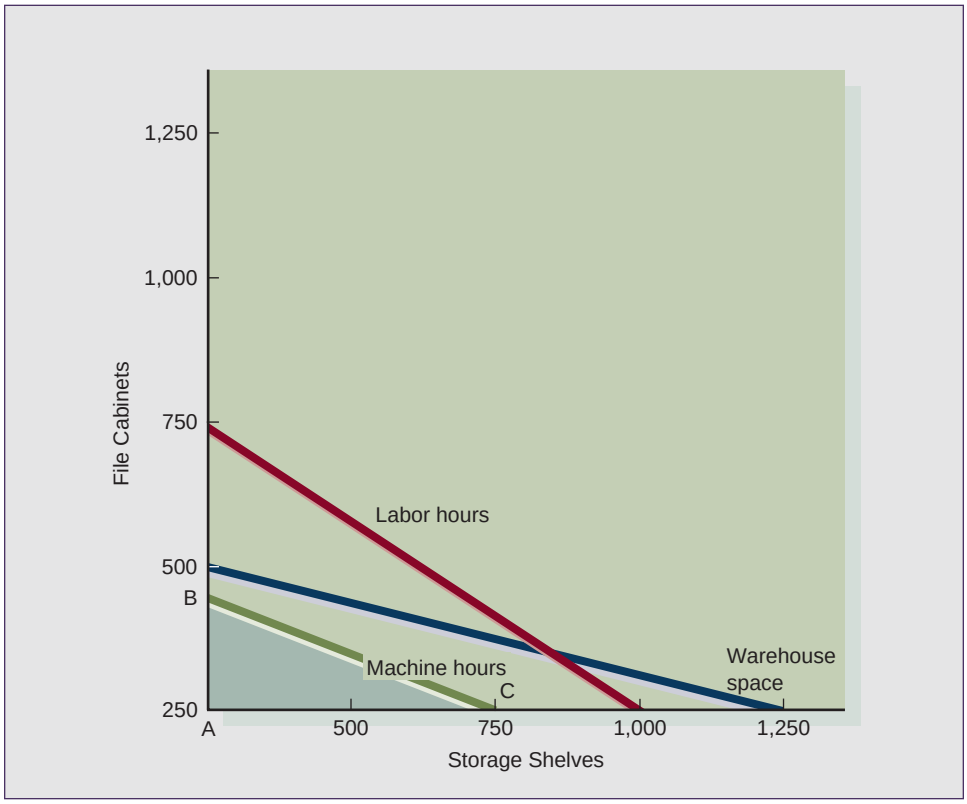

EXHIBIT 12–19

Office Storage Company Production Constraints

Inspection reveals that the contribution margin is at its highest ($10,625) at point B. The corners that are not part of the feasible region are not evaluated because they do not satisfy all of the constraints of the problem.

simplex method
algorithm

The **simplex method** is an iterative (sequential) algorithm that solves multivariable, multiconstraint linear programming problems. An **algorithm** is a logical step-by-step problem-solving technique (generally utilizing a computer) that continuously searches for an improved solution from the one previously computed. The simplex method does not check every feasible solution. It checks only those occurring at the corners of the feasible region. Because corners always represent the extremities of the feasible region, a corner is where the maximum or minimum value of the objective function is always located.

The simplex method begins with a mathematical statement of the objective function and constraints. The inequalities in the constraints must be expressed as equalities to solve the problems algebraically. Expressing inequalities as equalities is accomplished by introducing slack or surplus variables (S) into constraint equations. A **slack variable** represents the unused amount of a resource at any level of operation. The amount of the slack variable can range from zero to the total amount of the constrained resource. Slack variables are associated with "less than or equal to" ($\leq$) constraints and are added to the left side of the constraint equation. A **surplus variable** represents overachievement of a minimum requirement and is associated with "greater than or equal to" ($\geq$) constraints. Surplus variables are subtracted from the left side of a constraint equation. The formulas for Office Storage Company shown in Exhibit 12–18 are repeated below with the inclusion of slack variables (S_1, S_2, and S_3) for each constrained resource. There are no surplus variables for Office Storage Company because all constraints were "less than or equal to" constraints.

slack variable

surplus variable

$$\text{Objective Function: MAX CM} = 25X_1 + 9X_2$$

Constraints (Subject to):

$$3X_1 + 2X_2 + S_1 = 2{,}100 \text{ (labor time in hours)}$$
$$2X_1 + 1X_2 + S_2 = 850 \text{ (machine time in hours)}$$
$$8X_1 + 3X_2 + S_3 = 4{,}000 \text{ (warehouse storage in cubic feet)}$$

Solving a linear programming problem using the simplex method requires either the use of matrix algebra or a computer.

KEY TERMS

ad hoc discount (p. 517)
algorithm (p. 527)
constraint (p. 523)
decision variable (p. 523)
differential cost (p. 500)
feasible region (p. 526)
feasible solution (p. 523)
incremental cost (p. 500)
incremental revenue (p. 500)
input–output coefficients (p. 524)
integer programming (p. 523)
linear programming (p. 523)
make-or-buy decision (p. 504)
mathematical programming (p. 523)
nonnegativity constraint (p. 523)
objective function (p. 523)
opportunity cost (p. 501)
optimal solution (p. 523)
outsourcing decision (p. 504)
relevant costing (p. 499)
Robinson-Patman Act (p. 517)
sales mix (p. 510)
scarce resource (p. 508)
segment margin (p. 519)
simplex method (p. 527)
slack variable (p. 527)
special order decision (p. 516)
surplus variable (p. 527)
vertex (p. 526)

SOLUTION STRATEGIES

General rule of decision making: Choose the alternative that yields the greatest incremental benefit.

Incremental (additional) revenues
– Incremental (additional) costs
Incremental benefit (positive or negative)

Relevant Costs

- Direct material
- Direct labor
- Variable production overhead
- Variable selling expenses related to *each* alternative (may be greater or less than under the "change nothing" alternative)
- Avoidable fixed production overhead
- Avoidable fixed selling/administrative costs (if any)
- Opportunity cost of choosing some other alternative (will either increase the cost of one alternative or reduce the cost of another alternative)

Relevant Cost Analysis in Specific Decisions

Single Scarce Resource

1. Determine the scarce resource.
2. Determine the production per unit of the scarce resource.
3. Determine the contribution margin per unit of the scarce resource.
4. Multiply production (step 2) times contribution margin (step 3) to obtain total contribution margin provided by the product per unit of the scarce resource. Production and sale of the product with the highest contribution margin per unit of scarce resource will maximize profits.

Product Lines Analysis

Sales
− Direct variable expenses
= Product line contribution margin
− Avoidable fixed expenses
= Segment (product line) margin*
− Unavoidable fixed expenses
= Product line operating results

*Make decision to retain or eliminate based on this line item.

DEMONSTRATION PROBLEM

Green Thumb Industries produces a variety of equipment used by professional gardeners. The key machine in the company's product lineup is a riding lawnmower. Each lawnmower produced requires two hydraulic cylinders that allow the mower bed to be raised and lowered by the operator with the simple movement of a lever. The firm currently manufactures the cylinders and the costs incurred to make each cylinder unit are as follows:

Direct material	$24
Direct labor	16
Variable overhead	10
Fixed overhead	10

Of the per-unit fixed overhead, $4 could be avoided if the firm did not make the cylinders. Another company has offered to sell to Green Thumb an equivalent cylinder for $56. Green Thumb produces 20,000 cylinders annually.

Required: (Consider each requirement to be independent of the other requirements.)

a. Should Green Thumb outsource the component? Show calculations.

b. Green Thumb's vice president, Joe Weber, estimates that the company can rent out the facilities used to make the cylinders for $60,000 annually. What should the company do? Show calculations.

c. What are some of the qualitative factors that should be considered if Green Thumb is contemplating outsourcing the cylinder component?

Solution to Demonstration Problem

a. Relevant cost of making:

Direct material	$24
Direct labor	16
Variable overhead	10
Avoidable fixed overhead	4
Total	$54
Cost to outsource	$56

Therefore, Green Thumb should continue to make the cylinder.

b. $60,000 rental income ÷ 20,000 components = $3 opportunity cost per unit

Relevant cost to insource [part (a)]	$54
Opportunity cost	3
Total	$57

The cost to insource now exceeds the cost to outsource. Therefore, Green Thumb should purchase the item.

c. Some qualitative factors include the following:

- Future control by Green Thumb of quality, supply, cost, and price of the cylinder
- Supplier's long-run chances of being in business
- Existence and number of other suppliers
- Impact on customers and markets

QUESTIONS

1. Define a relevant cost. For a hospital considering the purchase of a new X-ray machine, what are examples of the relevant costs of the purchase decision? What would be one of the alternatives to purchasing the X-ray machine?
2. What are the characteristics of a relevant cost? Why are future costs not always relevant? Are all relevant costs found in accounting records? Explain.
3. What is an opportunity cost? In an outsourcing decision, what opportunity cost might be associated with the production facilities?
4. Which are more important in decision making: quantitative or qualitative factors? Why? How can qualitative factors be explicitly considered in making a decision?
5. Can a particular cost be relevant for one purpose, but not for other purposes? Give three examples in which this would be the case.
6. Are sunk costs ever relevant in decision making? If so, give one or more examples.
7. You are considering the sale of your old stereo system. According to your records, you paid $500 for the stereo system. The current market value of the stereo is $150. A new stereo of the same make and model could be purchased today for $375. Which of these figures is relevant to your decision to sell or keep the stereo system? If any figures are not relevant, explain why.
8. Kelly O'Riley, owner of Juanita's Mexican Cafe, is trying to decide whether to make tortillas or buy them from a supplier, Ricardo's Super Mercado. Kelly has come to you for advice. What factors would you tell her to consider in making her choice?
9. What is a scarce resource? Why will the resource that is most scarce in an organization be likely to change from time to time?
10. Suggest possible alternatives to basing sales commissions on the sales revenue generated by each salesperson. What would be the benefits and drawbacks of your methods to the salesperson and to the company?
11. Why is the effect of a sales price change on volume partly determined by the elasticity of demand for the product?
12. What is the special order decision? What typical circumstances lead to the need to make this type of decision?
13. What are the differences among avoidable fixed costs, unavoidable direct fixed costs, and common fixed costs? Which are relevant and which are irrelevant in the decision to keep or eliminate a particular product line?

14. Lazlow Optical Mfg. produces a line of single-reflex cameras. Corporate records reveal that one of the midpriced cameras is producing a negative segment margin. Before discontinuing production of the camera, what factors should Lazlow's managers consider?
15. Are segment margin or product line operating results more important in product line decisions? Why?
16. (Appendix) Why is linear programming used in business organizations?
17. (Appendix) What are two typical objective function expressions that are stated in terms of accounting information?
18. (Appendix) What are nonnegativity constraints in the linear programming model? Why is it not necessary that they be specified for every linear programming problem?
19. (Appendix) What is the difference between a feasible solution and an optimal solution?
20. (Appendix) "Resource constraints are always inequalities." Is this statement true or false? Why?
21. (Appendix) What is the difference between a slack variable and a surplus variable? Can each exist in the same linear programming problem? If so, discuss how; if not, discuss why.

EXERCISES

22. *(Relevant costs)*

Businesses in Chattanooga, Tenn., will be asked to give up a bit of their independence to cut costs and help clean up the environment.

The Chattanooga Institute, a nonprofit advocate of environmentally friendly development, announced the next phase in the creation of a $70 million "eco-industrial park": a six-month feasibility study that would lay out the blueprint for a community in which businesses swap one another's waste and other by-products, from hot water to used paper. First envisioned in meetings two years ago with President Clinton's Council on Sustainable Development, planners said the park will be fully operational as early as 2001.

http://www.csc2.org/index.htm

If successful, the city's blighted Southside community could become a magnet for companies willing to use one another's waste products as both raw materials and sources of energy.

"Everything [would be] reused or recycled to create something that is needed by someone else," says Woodley Murphy, Chattanooga Institute executive director.

SOURCE: Adapted from Motoko Rich, "Urban Plan Taps Waste as a Resource," *The Wall Street Journal* (November 19, 1997) p. S1.

The preceding article discusses a way in which a company can take a more expansive view of its operations to define relevant costs. Discuss why firms of the future will increasingly find it necessary to look across the supply chain, rather than just internally, to identify relevant costs.

23. *(Time and relevant costs)* The following are costs associated with a product line of Johnson Safety Systems. The costs reflect capacity-level production of 45,000 units per year.

Variable production costs	$45
Fixed production costs	27
Variable selling costs	12
Fixed selling and administrative costs	16

Prepare a written presentation showing how time affects relevant costs for a product line. Determine which costs would be relevant at each of the following points in time:

a. The point in time at which the product and production facilities are in the planning stage.
b. The point in time just after acquisition of the production facilities but before actual production commences.
c. The point in time after production of products is complete but before the units are sold.

24. *(Relevant costs)* Assume that you are about to graduate from your university. You are trying to decide whether to apply for graduate school or enter the job market. To help make the decision you have gathered the following data:

Costs incurred for the bachelor's degree	$83,000
Out-of-pocket costs for the master's degree	$51,000
Estimated starting salary with B.A.	$38,300
Estimated starting salary with M.A.	$44,400
Estimated time to complete master's degree	2 years
Estimated time from the present to retirement	40 years

a. Which of these factors are relevant to your decision?
b. What is the opportunity cost associated with earning the master's degree? What is the out-of-pocket cost to obtain the master's degree?
c. What other factors should you consider before making a decision?

25. *(Relevant costs)* Because of a monumental error committed by its purchasing department, John's Super Grocery received 50,000 heads of lettuce rather than the 500 that were actually ordered. The company paid $0.50 per head for the lettuce. Although the management is confident that 1,000 units can be sold through its regular sales, the market is not large enough to absorb the other 49,000 heads. Management has identified two ways to dispose of the excess heads. First, a wholesaler has offered to purchase them for $0.25 each. Second, a restaurant chain has offered to purchase the heads if John's will agree to convert the heads into packaged lettuce salads. This option would require John's to incur additional costs of $11,000 for conversion and the heads could then be sold for $0.48 each.

a. Which costs are sunk in this decision?
b. There are actually three alternatives John's can consider. Describe the alternative that is not mentioned in the story.
c. What are the relevant costs of each decision alternative and what should the company do?

26. *(Relevant vs. sunk costs)* Your friend, Bill Hawkins, purchased a new, combination phone and answering machine just prior to the start of this school term. He paid $95 for the equipment. Shortly after the start of the semester, during a party at his apartment, Bill's answering machine was crushed by an errant "flying plant." Returning the equipment to his retailer, Bill was informed that the estimated cost of repairs was $45.

Bill, pondering the figures, was ready to conclude that repairs should be made; after all, he had recently paid $95 for the equipment. However, before making a decision, Bill decided to ask for your advice, knowing that you were enrolled in a cost accounting course this term.

a. Using concepts learned from this chapter, prepare a brief presentation which outlines factors Bill should consider in making his decision.
b. Continue the presentation in part (a) by discussing the options Bill should consider in making his decision. Start by defining a base case against which alternatives may be compared.

27. *(Relevant costs)*

An analysis of GM's labor costs at its parts plant in Dayton, Ohio, provided evidence of one source of the firm's competitive problems. Its UAW employees are provided fringe benefits that cost, on average, about $16 per labor hour. Fringe benefits provided include full health-care coverage (no deductibles or co-payments), vision care, dental care, full pension after 30 years, life insurance, disability benefits, legal services, and supplemental unemployment benefits. Add to the $16 cost per hour of fringe benefits about $18 per hour in base pay, plus an additional increment for profit sharing, and the total cost of the average laborer was about $43 an hour.

http://www.gm.com

SOURCE: Adapted from Nichole M. Christian, "Rich Benefits Plan Gives GM Competitors Cost Edge," *The Wall Street Journal* (March 21, 1996), pp. B1, B4.

Assume you have been hired as a cost analyst by GM management. Write a report offering specific suggestions as to actions GM could take to control its parts and components costs.

28. *(Asset replacement)* Certain production equipment used in Flatburg's Canadian plant has become obsolete relative to current technology. The company is considering whether it should keep its existing equipment or purchase new equipment. To aid in this decision, the company's controller gathered the following data:

	Old Equipment	New Equipment
Original cost	$72,000	$99,000
Remaining life	5 years	5 years
Accumulated depreciation	$39,500	$0
Annual cash operating costs	$17,000	$4,000
Current salvage value	$22,000	NA
Salvage value in 5 years	$0	$0

a. Identify any sunk costs listed in the data.
b. Identify any irrelevant (nondifferential) future costs.
c. Identify all relevant costs to the equipment replacement decision.
d. What are the opportunity costs associated with the alternative of keeping the old equipment?
e. What is the incremental cost to purchase the new equipment?
f. What qualitative considerations should be taken into account before making any decision?

29. *(Asset replacement)* Modern Products Co. purchased new computer scheduling software on April 1, 2001, for $120,000 to manage its production. On May 15, 2001, a representative of a computerized manufacturing technology company demonstrated new software that was clearly superior to that purchased by the firm earlier in the year. The price of this software is $210,000. Corporate managers estimate that the new software would save the company $18,000 annually in schedule-related costs compared to the recently installed software. Both software systems should last 10 years (the expected life of the computer hardware) and have no salvage value at that time. The company can sell its existing software for $60,000 if it chooses to purchase the new system. Should the company keep and use the software purchased earlier in the year or buy the new software?

30. *(Outsourcing)* Mountain Technologies manufactures fiberglass housings for portable generators. One of the parts required to manufacture a housing is a metal latch. Currently the company produces all of the metal latches that it requires (120,000 units annually). The company's management is considering

purchasing the part from an external vendor, Austin Mechanical. The following data are available for making the decision:

COST PER UNIT TO MANUFACTURE

Direct material	$0.40
Direct labor	0.34
Variable overhead	0.18
Fixed overhead—applied	0.28
Total cost	$1.20

COST PER UNIT TO BUY

Purchase price	$0.98
Freight charges	0.02
Total cost	$1.00

a. Assuming all of Mountain Technologies' internal production costs are avoidable if it purchases rather than makes the latch, what would be the net annual cost advantage to Mountain Technologies of purchasing?

b. Assume that some of Mountain Technologies' fixed overhead costs could not be avoided if it purchases rather than makes the latches. How much of the fixed overhead must be avoidable for the company to be indifferent between making and buying the component?

31. *(Outsourcing)* Greenburg Automotive produces pickup truck bumpers that are sold on a wholesale basis to new car retailers. The average sales price of a bumper is $150. Normal annual sales volume is 100,000 units, which is maximum production capacity. At this capacity, the company's costs per unit are as follows:

Direct material	$ 56	(including mounting hardware @ $12 per unit)
Direct labor	16	
Overhead (2/3 is fixed)	36	
Total	$108	

A key component in the production of bumpers is the mounting hardware that is used to attach the bumpers to the vehicles. Pittsburgh Metal Stamping has offered to sell Greenburg as many mounting units as the company needs for its bumper production. The offering price is $16 per unit. If Greenburg accepts the offer, the released facilities (that are currently used to produce mounting hardware) could be used to produce an additional 4,800 bumpers. What alternative is more desirable and by what amount? (Assume the company is currently operating at its capacity of 100,000 units.)

32. *(Outsourcing)* The Air Ride Shoe Company manufactures various types of shoes for sports and recreational use. Several types of shoes require a built-in air pump. Presently, the company makes all of the air pumps it requires for production. However, management is presently evaluating an offer from Aire Supply Co. to provide air pumps at a cost of $3 each. Air Ride management has estimated that the variable production costs of the air pump are $2.50 per unit. The firm also estimates that it could avoid $20,000 per year in fixed costs if it purchased rather than produced the air pumps.

a. If Air Ride requires 20,000 pumps per year, should it make them or buy them from Aire Supply Co.?

b. If Air Ride requires 60,000 pumps per year, should it make them or buy them?

c. Assuming all other factors are equal, at what level of production would the company be indifferent between making and buying the pumps?

33. *(Allocation of scarce resources)* Because the employees of one of its plants are out on strike, Allentown Electronics has found itself operating at peak capacity. The firm makes two electronic products, beepers and cell phones. Presently, the company can sell as many of each product as it can make, but it takes twice as long in production labor time to make a cell phone as it does to make a beeper. The firm's production capacity is only 120,000 labor hours per month. Data on each product follow:

	Beepers	Cell Phones
Sales	$30	$56
Variable costs	(24)	(46)
Contribution margin	$ 6	$10
Labor hours required	2	4

Fixed costs are $140,000 per month.

a. How many of each product should the company make? Explain your answer.

b. What qualitative factors would you consider in making this product mix decision?

34. *(Allocation of scarce resources)* Jill Rose received her accounting degree in 1972. Since receiving her degree, Ms. Rose has obtained significant experience in a variety of job settings. Her skills include auditing, income and estate taxation, and business consulting. Ms. Rose currently has her own practice and her skills are in such demand that she limits her practice to taxation issues. Most of her engagements are one of three types: individual income taxation, estate taxation, or corporate taxation. Following are data pertaining to the revenues and costs of each tax area (per tax return):

	Individual	Estate	Corporate
Revenue	$350	$1,200	$750
Variable costs	$50	$200	$150
Hours per return required of Ms. Rose	2	8	5

Fixed costs of operating Ms. Rose's office are $40,000 per year. Ms. Rose has such significant demand for her work that she must ration her time. She desires to work no more than 2,500 hours in the coming year. She can allocate her time such that she works only on one type of tax return or on any combination of the three types.

a. How should Ms. Rose allocate her time in the coming year to maximize her income?

b. Based on the optimal allocation, what is Ms. Rose's projected pretax income for the coming year?

c. What other factors should Ms. Rose consider in allocating her time?

35. *(Special order)* Quality Fencing produces 18-gauge barbed wire that is retailed through farm supply companies. Presently, the company has the capacity to produce 42,000 tons of wire per year. The firm is operating at 85 percent of annual capacity, and at this level of operations the cost per ton of wire is as follows:

Direct material	$320
Direct labor	80
Variable overhead	50
Fixed overhead	160
Total	$610

The average sales price for the output produced by the firm is $800 per ton. The firm has been approached by an Australian company about supplying 400 tons

of wire for a new game preserve. The company has offered Quality Fencing $480 per ton for the order (FOB Quality Fencing's plant). No production modifications would be necessary to fulfill the order from the Australian company.

a. What costs are relevant to the decision to accept this special order?

b. What would be the dollar effect on pretax income if this order were accepted?

36. *(Special order)* Touch-O-Class produces high-quality wooden commemorative plaques. Each plaque is hand-made and hand-finished using the finest materials available. The firm has been operating at capacity for the past three years (1,000 plaques per year). Based on the capacity level operations, the firm's costs per plaque are as follows:

Material	$125
Direct labor	135
Variable overhead	35
Fixed overhead	60
Total cost	$355

All selling and administrative expenses incurred by the firm are fixed. The firm has generated an average selling price of $550 for its plaques.

Recently, a large corporation approached Connie Kwiken, the president of Touch-O-Class, about supplying the corporation with three special plaques commemorating the retirement of three high-level executives. These plaques would be approximately two times as large as the typical plaque the company now makes. Ms. Kwiken has estimated that the following per-unit costs would be incurred to make the three plaques:

Material	$425
Direct labor	465
Variable overhead	80
Total direct costs	$970

To accept the special order, the firm would have to sacrifice production of 25 regular units.

a. Identify all of the relevant costs that Ms. Kwiken should consider in deciding whether she will accept the special order.

b. Assume the large corporation offers a total of $3,400 for the three plaques. How would Touch-O-Class' pretax income be affected by the acceptance of this offer?

37. *(Sales mix)*

India's domestic airlines have battled antiquated airports, high fuel prices and government rules that force them to fly unprofitable routes.

In 1999, they were wounding one another with a price war.

Hints of the looming dogfight emerged even before the start of India's traditionally slack June-to-September travel season. Sahara Airlines, the smallest of three major domestic carriers, slashed rupee fares between 10% and 20% on some major routes in March.

At first, larger competitors Jet Airways and Indian Airlines were unruffled. But they followed suit in June, cutting fares and unveiling incentives to attract travelers, including hotel discounts and the chance to win trips abroad. Air India, the state-owned international carrier, joined the fray, with bargain fares on some domestic routes that made flying cheaper than taking the train.

http://www.saharaairline.com
http://www.indian-airlines.nic.in
http://www.airindia.com/
http://www.jetairways.com/homeie.htm

SOURCE: Adapted from Rasul Bailay, "Air-Fare War in India Lowers Sky-High Prices—Nation's Domestic Carriers Fight to Lure Travelers Away From Busy Trains," *The Wall Street Journal* (August 3, 1999), p. B11D.

a. Change in pricing is only one tool companies may wield to change the volume of their sales. Discuss why airlines tend to use this tool more so than other tools.

b. Why, in the airline industry as well as other industries, is it necessary to carefully consider the response of competitors before using price changes to stimulate demand for services?
c. How is the circumstance with the Indian air carriers similar to a special pricing decision?

38. *(Sales mix)* Wild Hound provides two types of services to dog owners: grooming and training. All company personnel can perform either service equally well. To expand sales and market share, the Wild Hound's manager, Jim Dachshund, relies heavily on radio and billboard advertising. For 2001, advertising funding is expected to be very limited. Information on projected operations for 2001 follows:

	Grooming	Training
Revenue per billable hour	$30	$50
Variable cost of labor	$10	$20
Material costs per billable hour	$2	$4
Allocated fixed costs per year	$200,000	$180,000
Projected billable hours for 2001	20,000	16,000

a. What is Wild Hound's projected pretax profit or (loss) for 2001?
b. If $1 spent on advertising could increase either grooming revenue by $20 or training revenue by $20, on which service should the advertising dollar be spent?
c. If $1 spent on advertising could increase grooming billable time by one hour or training billable time by one hour, on which service should the advertising dollar be spent?

39. *(Sales mix)* One of the products produced and sold by Industrial Supply Co. is a 90-quart cold drink cooler. The company's projections for this product for 2002 follow:

Sales price per unit	$36
Variable production costs	$21
Variable selling costs	$4
Fixed production costs	$225,000
Fixed selling & administration costs	$75,000
Projected volume	90,000 units

a. Compute the projected pretax profit to be earned on the cooler during 2002.
b. Corporate management estimates that unit volume could be increased by 20 percent if the sales price were decreased by 10 percent. How would such a change affect the profit level projected in part (a)?
c. Rather than cutting the sales price, management is considering holding the sales price at the projected level and increasing advertising by $200,000. Such a change would increase volume by 25 percent. How would the level of profit under this alternative compare to the profit projected in part (a)?

40. *(Product line)* Online Toy Co.'s operations are separated into two geographical divisions: United States and Mexico. The operating results of each division for 2001 are shown below:

	United States	Mexico	Total
Sales	$ 7,200,000	$ 3,600,000	$10,800,000
Variable costs	(4,740,000)	(2,088,000)	(6,828,000)
Contribution margin	$ 2,460,000	$ 1,512,000	$ 3,972,000
Fixed costs:			
Direct	(900,000)	(480,000)	(1,380,000)
Segment margin	$ 1,560,000	$ 1,032,000	$ 2,592,000
Fixed costs:			
Corporate	(1,800,000)	(900,000)	(2,700,000)
Operating income (loss)	$ (240,000)	$ 132,000	$ (108,000)

Corporate fixed costs are allocated to the divisions based on relative sales. Assume that all direct fixed costs of a division could be avoided if the division were eliminated. Because the U.S. Division is operating at a loss, the president is considering eliminating it.

a. If the U.S. Division had been eliminated at the beginning of the year, what would pretax income have been for Online Toy Co.?

b. Recast the income statements into a more meaningful format than the one given. Why would total corporate operating results go from a $108,000 loss to the results determined in part (a)?

41. *(Product line)* Johnson Metal Products produces three products: wire, tubing, and sheet metal. The company is currently contemplating the elimination of the tubing product line because it is showing a pretax loss. An annual income statement follows:

JOHNSON METAL PRODUCTS
Income Statement by Product Line
For the Year Ended July 31, 2001
(in thousands)

	Wire	Tubing	Sheet Metal	Total
Sales	$ 2,200	$ 1,600	$ 1,800	$ 5,600
Cost of sales	(1,400)	(1,000)	(1,080)	(3,480)
Gross margin	$ 800	$ 600	$ 720	$ 2,120
Avoidable fixed and variable costs	$ 630	$ 725	$ 520	$ 1,875
Allocated fixed costs	90	80	105	275
Total fixed costs	$ 720	$ 805	$ 625	$ 2,150
Operating profit	$ 80	$ (205)	$ 95	$ (30)

a. Should corporate management drop the tubing product line? Support your answer with appropriate schedules.

b. How would the pretax profit of the company be affected by the decision?

42. *(Appendix)* The contribution margins for three different products are $9.50, $5.00, and $1.50. State the objective function in equation form to maximize the contribution margin.

43. *(Appendix)* The variable costs for four different products are $0.65, $0.93, $1.39, and $0.72. State the objective function in equation form to minimize the variable costs.

44. *(Appendix)* Carolina Textiles makes three items: pants, shorts and shirts. The contribution margins are $3.25, $2.05, and $2.60 per unit, respectively. The manager must decide what mix of clothes to make. He has 800 labor hours and 4,000 yards of material available. Additional information for labor and material requirements is given here:

	Sewing Time	Fabric Needed
Pants	2.0 hours	3.0 yards
Shorts	1.5 hours	1.0 yards
Shirts	2.5 hours	1.5 yards

Write the objective function and constraints for the clothes manufacturer.

45. *(Appendix)* Janet Terwilliger is a college student and has set a budget of $120 per month for food. She wants to get a certain level of nutritional benefits from the food she has selected to buy. The following table lists the types of food she may buy, along with the nutritional information per serving of that food.

	Carbohydrates	Protein	Potassium	Calories	Cost
Pizza	38 g.	10 g.	-0-	500	$3.99
Tuna	1 g.	13 g.	-0-	60	1.29
Cereal	35 g.	7 g.	120 mg.	190	0.93
Macaroni & cheese	23 g.	3 g.	110 mg.	110	2.12
Spaghetti	42 g.	8 g.	100 mg.	210	3.42
Recommended daily allowance	50 g.	10 g.	100 mg.	2,000	

Write the objective function and constraints to minimize the cost and yet meet the recommended daily nutritional allowances.

PROBLEMS

46. *(Asset replacement)* The manager of the Plastics Fabrication Division of Gulf Chemical Corp., Kathy Johnson, has heard about a new extruding machine that could replace one of her existing machines. The manufacturer has suggested to Ms. Johnson that the new machine would save $90,000 per year in the costs of operations. Ms. Johnson's controller compiled additional information as follows:

OLD MACHINE

Original cost	$375,000
Present book value	$250,000
Annual cash operating costs	$250,000
Market value now	$50,000
Market value in 5 years	$0
Remaining useful life	5 years

NEW MACHINE

Cost	$450,000
Annual cash operating costs	$150,000
Market value in 5 years	$0
Useful life	5 years

a. Based on financial considerations alone, should Ms. Johnson purchase the new machine? Show computations to support your answer.

b. What qualitative factors should Ms. Johnson consider before making a decision about purchasing the new machine?

47. *(Asset replacement)* Sandhills Energy Company provides electrical services to several rural Nebraska counties. The company's efficiency has been greatly affected by changes in technology. Most recently, the company is considering replacement of its main steam turbine. The existing turbine was put in place in the 1970s but has become obsolete. While the system's operation is very reliable, it is much less efficient than newer turbines that are computer controlled. The company has gathered financial information pertaining to the new and old technologies. The following information was presented by the controller to corporate management:

	Old Turbine	New Turbine
Original cost	$3,000,000	$2,000,000
Market value now	$400,000	$2,000,000
Remaining life	8 years	8 years
Quarterly operating costs	$120,000	$45,000
Salvage value in 8 years	$0	$0
Accumulated depreciation	$1,000,000	—

a. Identify the costs that are relevant to the company's equipment replacement decision.
b. Determine which alternative is better from a financial perspective. Provide your own computations based on relevant costs only.
c. For this part only, assume that the cost of the new technology is unknown. What is the maximum amount that Sandhills could pay for the new technology and be no worse off financially?

48. *(Outsourcing)* Clothes Solutions Inc. manufactures vinyl-clad wire storage systems. Each system requires two to six standard fasteners to attach it to structural members of closets. Historically, the company has produced the fasteners. The costs to produce a fastener (based on capacity operation of 4,000,000 units per year) are:

Direct material	$0.06
Direct labor	0.03
Variable factory overhead	0.03
Fixed factory overhead	0.06
Total	$0.18

The fixed factory overhead includes $160,000 of depreciation on equipment for which there is no alternative use and no market value. The balance of the fixed factory overhead pertains to the salary of the production supervisor. While the supervisor of fastener production has a lifetime employment contract, she has skills that could be used to displace another manager (the supervisor of floor maintenance) who draws a salary of $30,000 per year but is due to retire from the company.

Modern Fastener Systems has recently approached Clothes Solutions Inc. with an offer to supply all required fasteners at a price of $0.13 per unit. Anticipated sales demand for the coming year will require 4,000,000 fasteners.

a. Identify the costs that are relevant in this outsourcing decision.
b. What is the total annual advantage or disadvantage (in dollars) of outsourcing the fasteners rather than making them?
c. What qualitative factors should be taken into account in this decision?

49. *(Outsourcing)* Omaha Building Systems manufactures steel buildings for agricultural and commercial applications. Currently, the company is trying to decide between two alternatives regarding a major overhead door assembly for the company's buildings. The alternatives are as follows:

#1: Purchase new equipment at a cost of $5,000,000. The equipment would have a five-year life and no salvage value. Omaha Building Systems uses straight-line depreciation and allocates that amount on a per unit of production basis.

#2: Purchase the door assemblies from an outside vendor who will sell them for $240 each under a five-year contract. Following is Omaha's present cost of producing the door assemblies. The costs are based on current and normal activity of 50,000 units per year.

Direct material	$139
Direct labor	66
Variable overhead	43
Fixed overhead*	36
Total	$284

*The fixed overhead includes $7 supervision cost, $9 depreciation, and $20 general company overhead.

The new equipment would be more efficient than the old and would reduce direct labor costs and variable overhead costs by 25 percent. Supervisory

costs of $350,000 would be unaffected. The new equipment would have a capacity of 75,000 units per year. Omaha could lease the space occupied by subassembly production to another firm for $114,000 per year if the company decides to buy from the outside vendor.

a. Show an analysis, including relevant unit and total costs, for each alternative. Assume 50,000 subassemblies are needed each year.
b. How would your answer differ if 60,000 subassemblies were needed?
c. How would your answer differ if 75,000 subassemblies were needed?
d. In addition to quantitative factors, what qualitative factors should be considered?

50. *(Sales mix with scarce resources)* Hartford Furniture makes three unique wood products: desks, chairs, and footstools. These products are made wholly by hand; no electric or hydraulic machinery is used in production. All products are made by skilled craftspeople who have been trained to make all three products. Because it takes about a year to train each craftsperson, labor is a fixed production constraint over the short term. For 2002, the company expects to have available 34,000 labor hours. The average hourly labor rate is $25. Data regarding the current product line follow:

	Desks	Chairs	Footstools
Selling price	$900	$680	$240
Variable costs:			
Direct material	$220	$160	$ 60
Direct labor	300	275	75
Variable factory overhead	180	120	41
Variable selling	20	15	10
Fixed costs:			
Factory	$150,000		
Selling & administrative	75,000		

The company is in the 50 percent tax bracket.

a. If the company can sell an unlimited amount of any of the products, how many of each product should it make? What pretax income will the company earn given your answer?
b. How many of each product must the company make if it has a policy of devoting no more than 50 percent of its available skilled labor capacity to any one product and at least 20 percent to every product? What pretax income will the company earn given your answer?
c. Given the nature of the three products, is it reasonable to believe that there are market constraints on the mix of products that can be sold? Explain.
d. How does the company's tax rate enter into the calculation of the optimal labor allocation.

51. *(Sales mix)* Phoenix Fashions produces silk scarves and handkerchiefs, which sell for $40 and $10, respectively. The company currently sells 100,000 units of each type with the following operating results:

SCARVES

Sales (100,000 × $40)		$ 4,000,000
Variable costs:		
Production (100,000 × $22)	$2,200,000	
Selling (100,000 × $6)	600,000	(2,800,000)
Contribution margin		$ 1,200,000
Fixed costs:		
Production	$ 400,000	
Selling & administrative	180,000	(580,000)
Income from Scarves		$ 620,000

HANDKERCHIEFS

Sales (100,000 × $10)		$1,000,000
Variable costs:		
Production (100,000 × $5)	$ 500,000	
Selling (100,000 × $1)	100,000	(600,000)
Contribution margin		$ 400,000
Fixed costs:		
Production	$ 100,000	
Selling & administrative	80,000	(180,000)
Income from Handkerchiefs		$ 220,000

Corporate management has expressed its disappointment with the income being generated from the sales of these two products. Managers have asked for your help to analyze alternative plans that have been formulated to improve operating results.

1. Change the sales commission to 11 percent of sales price less variable production costs for each product rather than the current 5 percent of selling price. The marketing manager believes that the sales of the scarves will decline by 5,000 units, but the sales of handkerchiefs will increase by 15,000 units.

2. Increase the advertising budget for scarves by $25,000. The marketing manager believes this will increase the sales of the scarves by 19,000 units but will decrease the sales of the handkerchiefs by 9,000 units.

3. Raise the price of the handkerchiefs by $3 per unit and the scarves by $5 per unit. The marketing manager believes this will cause a decrease in the sales of the scarves by 6,000 units and a decrease in the handkerchiefs by 10,000 units.

a. Determine the effects on income of each product line and the company in total if each of the alternative plans given is put into effect.

b. What is your recommendation to the management of Phoenix Fashions?

52. *(Product line)* Festival Packing Company sells two major lines of products, fish and chicken, to grocery chains and food wholesalers. Income statements showing revenues and costs of fiscal year 2000 for each product line follow:

	Fish	Chicken
Sales	$ 4,000,000	$ 1,800,000
Less: Cost of merchandise sold	(2,400,000)	(1,300,000)
Less: Commissions to salespeople	(400,000)	(150,000)
Less: Delivery costs	(600,000)	(120,000)
Less: Depreciation on equipment	(200,000)	(100,000)
Less: Salaries of division managers	(80,000)	(75,000)
Less: Allocated corporate costs	(100,000)	(100,000)
Net income (loss)	$ 220,000	$ (45,000)

Management is concerned about profitability of chicken sales and is considering the possibility of dropping the line. Management estimates that the equipment currently used to process chickens could be rented to a competitor for $85,000 annually. If the chicken product line is dropped, allocated corporate costs will decrease from a total of $200,000 to $185,000; and all employees, including the manager of the product line, would be dismissed. The depreciation would be unaffected by the decision, but $105,000 of the delivery costs charged to the chicken line could be eliminated if the chicken product line is dropped.

a. Recast the above income statements in a format that provides more information in making this decision regarding the chicken product line.

b. What is the net advantage or disadvantage (change in total company pretax profits) of continuing sales of chicken?

c. Should the company be concerned about losing sales of fish products if it drops the chicken line? Explain.
d. How would layoffs that would occur as a consequence of dropping the chicken line potentially adversely affect the whole company?

53. *(Product line)* You have been engaged to assist the management of Quality Chair Company in resolving certain decisions. Quality has its home office in Tennessee and leases facilities in Tennessee, Georgia, and Florida, which produce a high-quality bean bag chair designed for residential use. The management of Quality has provided you with a projection of operations for fiscal 2001, the forthcoming year, as follows:

	Total	Tennessee	Georgia	Florida
Sales	$ 8,800,000	$ 4,400,000	$ 2,800,000	$ 1,600,000
Fixed costs:				
Factory	$ 2,200,000	$ 1,120,000	$ 560,000	$ 520,000
Administration	700,000	420,000	220,000	60,000
Variable costs	2,900,000	1,330,000	850,000	720,000
Allocated home office costs	1,000,000	450,000	350,000	200,000
Total	$(6,800,000)	$(3,320,000)	$(1,980,000)	$(1,500,000)
Pretax profit from operations	$ 2,000,000	$ 1,080,000	$ 820,000	$ 100,000

The sales price per unit is $50.

Due to the marginal results of operations in Florida, Quality has decided to cease operations and sell that factory's machinery and equipment by the end of 2001. Managers expect proceeds from the sale of these assets will exceed the assets' book values by enough to cover termination costs.

However, Quality would like to continue serving its customers in that area if it is economically feasible and is considering one of the following three alternatives:

1. Expand the operations of the Georgia factory by using space that is currently idle. This move would result in the following changes in that factory's operations:

	Increase over Factory's Current Operations
Sales	50%
Fixed costs:	
Factory	20%
Administration	10%

Under this proposal, variable costs would be $16 per unit sold.

2. Enter into a long-term contract with a competitor who will serve that area's customers. This competitor would pay Quality a royalty of $8 per unit based on an estimate of 30,000 units being sold.
3. Close the Florida factory and not expand the operations of the Georgia factory.

To assist the management of Quality Chair Company in determining which alternative is more economically feasible, prepare a schedule computing Quality's estimated pretax profit from total operations that would result from each of the following methods:

a. Expansion of the Georgia factory.
b. Negotiation of a long-term contract on a royalty basis.
c. Shutdown the Florida operations with no expansion at other locations.

Note: Total home office costs of $500,000 will remain the same under each situation. *(AICPA adapted)*

54. *(Comprehensive)* Eastern Glass Products has processing plants in Ohio and New Jersey. Both plants use recycled glass to produce jars that are used in food canning by a variety of food processors. The jars sell for $10 per hundred units. Budgeted revenues and costs for the year ending December 31, 2001, are:

	(In $000)		
	Ohio	New Jersey	Total
Sales	$1,100	$2,000	$3,100
Variable production costs:			
Direct material	$ 275	$ 500	$ 775
Direct labor	330	500	830
Factory overhead	220	350	570
Fixed factory overhead	350	450	800
Fixed regional promotion costs	50	50	100
Allocated home office costs	55	100	155
Total costs	$1,280	$1,950	$3,230
Operating income (loss)	$ (180)	$ 50	$ (130)

Home office costs are fixed, and are allocated to manufacturing plants on the basis of relative sales levels. Fixed regional promotional costs are discretionary advertising costs needed to obtain budgeted sales levels.

Because of the budgeted operating loss, Eastern Glass is considering the possibility of ceasing operations at its Ohio plant. If Eastern Glass ceases operations at its Ohio plant, proceeds from the sale of plant assets will exceed asset book values and exactly cover all termination costs; fixed factory overhead costs of $25,000 would not be eliminated. Eastern Glass is considering the following three alternative plans:

PLAN A: Expand Ohio's operations from its budgeted 11,000,000 units to a budgeted 17,000,000 units. It is believed that this can be accomplished by increasing Ohio's fixed regional promotional expenditures by $120,000.

PLAN B: Close the Ohio plant and expand New Jersey's operations from the current budgeted 20,000,000 units to 31,000,000 units in order to fill Ohio's budgeted production of 11,000,000 units. The Ohio region would continue to incur promotional costs in order to sell the 11,000,000 units. All sales and costs would be budgeted through the New Jersey plant.

PLAN C: Close the Ohio plant and enter into a long-term contract with a competitor to serve the Ohio region's customers. This competitor would pay Eastern Glass a royalty of $1.25 per 100 units sold. Eastern Glass would continue to incur fixed regional promotional costs to maintain sales of 11,000,000 units in the Ohio region.

a. Without considering the effects of implementing Plans A, B, and C, compute the number of units that must be produced and sold by the Ohio plant to cover its fixed factory overhead costs and fixed regional promotional costs.

b. Prepare a schedule by plant, and in total, computing Eastern Glass's budgeted contribution margin and operating income resulting from the implementation of each of the following plans:
   1. Plan A.
   2. Plan B.
   3. Plan C. *(AICPA adapted)*

CASES

55. *(Sales and profit improvement)* Sixteen Candles is a retail organization that sells upscale clothing to girls and young women in the Northeast. Each year, store managers, in consultation with their supervisors, establish financial goals and then actual performance is captured by a monthly reporting system.

One sales district of the firm, District A, contains three stores. This district has historically been a very poor performer. Consequently, its supervisor has been searching for ways to improve the performance of her three stores. For the month of May, the district supervisor has set performance goals with the managers of Stores 1 and 2. The managers will receive bonuses if certain performance measures are exceeded. The manager of Store 3 decided not to participate in the bonus scheme. Since the district supervisor is unsure what type of bonus will encourage better performance, the manager of Store 1 will receive a bonus based on sales in excess of budgeted sales of $570,000, while the manager of Store 2 will receive a bonus based on net income in excess of budgeted net income. The company's net income goal for each store is 12 percent of sales. The budgeted sales for Store 2 are $530,000.

Other pertinent data for May follow:

- At Store 1, sales were 40 percent of total District A sales while sales at Store 2 were 35 percent of total District A sales. The cost of goods sold at both stores was 42 percent of sales.
- Variable selling expenses (sales commissions) were 6 percent of sales for all stores and districts.
- Variable administrative expenses were 2.5 percent of sales for all stores and districts.
- Maintenance cost includes janitorial and repair services and is a direct cost for each store. The store manager has complete control over this outlay; however, this cost should not be below 1 percent of sales.
- Advertising is considered a direct cost for each store and is completely under the control of the store manager. Store 1 spent two-thirds of District A's total outlay for advertising, which was ten times more than Store 2 spent on advertising.
- The rental expenses at Store 1 are 40 percent of District A's total, while Store 2 incurs 30 percent of District A's total.
- District A expenses are allocated to the stores based on sales.

a. Which store, Store 1 or Store 2, would appear to be generating the most profit under the new bonus scheme?
b. Which store, Store 1 or Store 2, would appear to be generating the most revenue under the new bonus scheme?
c. Why would Store 1 have an incentive to spend so much more on advertising than Store 2?
d. Which store manager has the most incentive to spend money on regular maintenance? Explain.
e. Which bonus scheme appears to offer the most incentive to improve the profit performance of the district in the short term? Long term?

(CMA adapted)

56. *(Special order)* Hastings Group is a multiproduct company with several manufacturing plants. The Cincinnati Plant manufactures and distributes two household cleaning and polishing compounds, regular and heavy-duty, under the HouseSafe label. The forecasted operating results for the first six months of 2001, when 100,000 cases of each compound are expected to be manufactured and sold, are presented in the following statement:

HOUSESAFE COMPOUNDS—CINCINNATI PLANT
Forecasted Results of Operations
For the Six-Month Period Ending June 30, 2001

	(In $000)		
	Regular	Heavy-Duty	Total
Sales	$ 2,000	$ 3,000	$ 5,000
Cost of sales	(1,600)	(1,900)	(3,500)
Gross profit	$ 400	$ 1,100	$ 1,500
Selling and administrative expenses			
Variable	$ 400	$ 700	$ 1,100
Fixed*	240	360	600
Total selling and administrative expenses	$ (640)	$(1,060)	$(1,700)
Income (loss) before taxes	$ (240)	$ 40	$ (200)

*The fixed selling and administrative expenses are allocated between the two products on the basis of dollar sales volume on the internal reports.

The regular compound sold for $20 a case and the heavy-duty sold for $30 a case during the first six months of 2001. The manufacturing costs by case of product are presented in the following schedule.

	COST PER CASE	
	Regular	Heavy-Duty
Raw material	$ 7.00	$ 8.00
Direct labor	4.00	4.00
Variable manufacturing overhead	1.00	2.00
Fixed manufacturing overhead*	4.00	5.00
Total manufacturing cost	$16.00	$19.00
Variable selling and administrative costs	$ 4.00	$ 7.00

*Depreciation charges are 50 percent of the fixed manufacturing overhead of each line.

Each product is manufactured on a separate production line. Annual normal manufacturing capacity is 200,000 cases of each product. However, the plant is capable of producing 250,000 cases of regular compound and 350,000 cases of heavy-duty compound annually.

The schedule below reflects the consensus of top management regarding the price/volume alternatives for the HouseSafe products for the last six months of 2001. These are essentially the same alternatives management had during the first six months of 2001.

REGULAR COMPOUND		HEAVY-DUTY COMPOUND	
Alternative Prices (per case)	Sales Volume (in cases)	Alternative Prices (per case)	Sales Volume (in cases)
$18	120,000	$25	175,000
20	100,000	27	140,000
21	90,000	30	100,000
22	80,000	32	55,000
23	50,000	35	35,000

Top management believes the loss for the first six months reflects a tight profit margin caused by intense competition. Management also believes that many companies will be forced out of this market by next year and profits should improve.

a. What unit selling price should Hastings Group select for each of the HouseSafe compounds for the remaining six months of 2001? Support your answer with appropriate calculations.

b. Without prejudice to your answer for requirement (a), assume the optimum price/volume alternatives for the last six months were a selling price of $23

and volume level of 50,000 cases for the regular compound and a selling price of $35 and volume of 35,000 cases for the heavy-duty compound.

1. Should Hastings Group consider closing down its operations until 2002 in order to minimize its losses? Support your answer with appropriate calculations.
2. Identify and discuss the qualitative factors that should be considered in deciding whether the Cincinnati plant should be closed down during the last six months of 2001. *(CMA adapted)*

57. *(Special order)* Hydraulic Engineering, located in Toronto, manufactures a variety of industrial valves and pipe fittings that are sold to customers in the United States. Currently, the company is operating at 70 percent of capacity and is earning a satisfactory return on investment.

Prince Industries Ltd. of Scotland has approached management with an offer to buy 120,000 units of a pressure valve. Prince Industries manufactures a valve that is almost identical to Hydraulic Engineering's pressure valve; however, a fire in Prince Industries' valve plant has shut down its manufacturing operations. Prince needs the 120,000 valves over the next four months to meet commitments to its regular customers; the company is prepared to pay $19 each for the valves, FOB shipping point.

Hydraulic Engineering's product cost, based on current attainable standards, for the pressure valve is

Direct material	$ 5
Direct labor	6
Manufacturing overhead	9
Total cost	$20

Manufacturing overhead is applied to production at the rate of $18 per standard direct labor hour. This overhead rate is made up of the following components:

Variable factory overhead	$ 6
Fixed factory overhead—direct	8
Fixed factory overhead—allocated	4
Applied manufacturing overhead rate	$18

Additional costs incurred in connection with sales of the pressure valve include sales commissions of 5 percent and freight expense of $1 per unit. However, the company does not pay sales commissions on special orders that come directly to management.

In determining selling prices, Hydraulic Engineering adds a 40 percent markup to product cost. This provides a $28 suggested selling price for the pressure valve. The marketing department, however, has set the current selling price at $27 to maintain market share.

Production management believes that it can handle the Prince Industries order without disrupting its scheduled production. The order would, however, require additional fixed factory overhead of $12,000 per month in the form of supervision and clerical costs.

If management accepts the order, 30,000 pressure valves will be manufactured and shipped to Prince Industries each month for the next four months. Shipments will be made in weekly consignments, FOB shipping point.

a. Determine how many additional direct labor hours would be required each month to fill the Prince Industries order.

b. Prepare an incremental analysis showing the impact of accepting the Prince Industries order.

c. Calculate the minimum unit price that Hydraulic Engineering's management could accept for the Prince Industries order without reducing net income.

d. Identify the factors, other than price, that Hydraulic Engineering should consider before accepting the Prince Industries order. *(CMA adapted)*

REALITY CHECK

58. *Some evidence suggests consumers are less than thrilled with what they are purchasing. American consumers are notoriously finicky, and pleasing them has always been difficult. But the latest results of the American Customer Satisfaction Index (ACSI) show consumers barely give companies a passing grade when it comes to satisfying their expectations of quality and service.*

The ACSI is based on a quarterly survey conducted by the National Quality Research Center at the University of Michigan Business School in partnership with Arthur Andersen consultants and the American Society for Quality. The overall index declined slightly in the second quarter (1999) to 72, out of a possible score of 100, from 72.1 in the first quarter. Since 1994, when the index made its debut, it has fallen 3.4%.

This is the downside of corporate America's cost cutting drive, says Claes Fornell, director of the research center and keeper of the index. Cost cutting has boosted earnings for many companies, but may hurt profits in the long term by undermining customer relationships. "If you cut too much on the cost side," says Mr. Fornell, "customer satisfaction goes down." And that, he contends could signal problems for the economy as a whole in years to come.

http://www.bus.umich.edu/research/nqrc/index.html
http://www.arthurandersen.com/
http://www.asq.org

SOURCE: Adapted from Darren McDermott, "Customer Satisfaction: Quality, Service Barely Pass Muster with Consumer —Satisfaction Index Fell Slightly During the Second Quarter: Cost Cutting Gets Blame," *The Wall Street Journal* (August 16, 1999), p. A2.

a. Does cost cutting automatically result in quality reductions? Defend your answer.
b. How can managers be confident that they are not harming long-term survival of their organizations as they strive to manage "relevant" costs?

59. In Japan, the decision to stop production of a product or to close down a plant has different cost consequences than in the United States. One principal difference is that Japanese managers are much less likely to fire workers who are displaced by an event such as a plant closing. Japanese managers would simply try to move the displaced workers to active plants. However, this concept of permanent or lifetime employment can be awkward to manage when economic times become difficult and prudent financial management suggests that activities, including employment, be scaled back to cut costs. One Japanese company found an interesting solution:

Nissan Motor Co., in a sign that its severe slump may be worsening, took the unusual step of loaning some of its idle factory workers to a rival automaker.

Nissan assigned 250 of its production employees to work for six months at factories run by Isuzu Motors Ltd., a 37% owned affiliate of General Motors Corp.

Nissan's spokesman, Koji Okuda, called the move an attempt to deal with the company's sharp drop in auto output in Japan. Nissan's Japanese auto production had fallen 26% from a year earlier. "Demand is low," Mr. Okuda said. "We have to adjust our operations."

http://www.nissan-usa.com
http://www.isuzu.com

SOURCE: Michael Williams, "Nissan Will Loan Workers to Rival Amid Low Demand," *The Wall Street Journal* (June 24, 1994), p. A4. Permission conveyed through the Copyright Clearance Center.

a. What specific types of costs might Nissan have considered relevant in its decision to loan employees to Isuzu?
b. Why would Isuzu be interested in hiring, on a temporary basis, workers of Nissan?
c. What are the likely impacts of this arrangement on quality of the output at Isuzu? The quality of output at Nissan?

60. Carter's Computers manufactures computers and all components. The purchasing agent informed the company owner, Abraham Carter, that another company has offered to supply keyboards for Carter's computers at prices below the variable costs at which Carter can make them. Incredulous, Mr. Carter hired an industrial consultant to explain how the supplier could offer the keyboards at less than Carter's variable costs. It seems that the competitor supplier is suspected by the consultant of using many illegal aliens to work in that plant. These people are poverty stricken and will take such work at substandard wages. The purchasing agent and the plant manager feel that Carter should buy the keyboards from the competitor supplier as "no one can blame us for his hiring practices and will not even be able to show that we knew of those practices."

a. What are the ethical issues involved in this case?

b. What are the advantages and disadvantages of buying from this competitor supplier?

c. What do you think Mr. Carter should do and why?

61. *In 1987 EEOC's [Equal Opportunity Employment Commission] local field office wrote me a letter saying they had reason to believe I didn't have enough women "food servers" and "busers." No woman had complained against me. So the EEOC advertised in the local paper to tell women whose job applications we had rejected—or even women who had just thought of applying—that they could be entitled to damages. Twenty-seven women became plaintiffs in a lawsuit against me. The EEOC interviewed me for hours to find out what kind of person I was. I told them in Sicily where I came from I learned to respect women. I supplied them with hundreds of pounds of paper. I had to hire someone full time for a year just to respond to EEOC demands. I finally settled. I agreed to pay $150,000 damages and as jobs open up, to hire the women on the EEOC's list. Even if they don't know what spaghetti looks like! I have to advertise twice a year even if I have no openings, just to add possible female employees to my files. I also had to hire an EEOC-approved person to teach my staff how not to discriminate. I employ 12 food servers in these two restaurants. Gross sales, around $2 million. How much did it all cost me? Cash outlay, about $400,000.*

What the government's done to me—devastating. I wouldn't wish it on my worst enemy.

Thomas Maggiore
Phoenix, Arizona

SOURCE: Brimelow, Peter and Leslie Spencer, "When Quotas Replace Merit, Everybody Suffers," *Fortune* (February 15, 1993), pp. 80–82, ff. © 1993 Time Inc. Reprinted by permission.

a. Do you think Mr. Maggiore's cash outlay of $400,000 includes all of the costs he incurred because of the EEOC regulation? Try breaking down the various costs that he may have incurred into three categories: direct costs, indirect costs, and opportunity costs.

b. Are hiring policies based on quotas ethical? How do quota systems affect the economic viability of American firms?

c. If EEOC regulations are intended to right past wrongs, should EEOC guidelines apply differently to immigrant Americans than to second-, third-, and fourth-generation Americans. (Consider, for example, that any immigrant that falls into a protected class qualifies for all U.S. quota programs just like an American whose great-great-great-grandfather was a slave.)

d. How can quota systems have an effect on the quality of American products?