Appendix E

Capital Budgeting Decisions

LEARNING OBJECTIVES

After completing this module, you should be able to:

LO1 Explain the role of capital budgeting in long-range planning.

LO2 Apply capital budgeting models, such as net present value and internal rate of return, that consider the time value of money.

LO3 Apply capital budgeting models, such as payback period and accounting rate of return, that do not consider the time value of money.

LO4 Evaluate the strengths and weaknesses of alternative capital budgeting models.

LO5 Discuss the importance of judgment, attitudes toward risk, and relevant cash flow information for capital budgeting decisions.

LO6 Determine the net present value of investment proposals with consideration of taxes.

DOES SIZE AND SPEED MATTER?

Estimates are key to managers' decisions on capital expenditures. In both the airline and aircraft manufacturing markets, estimates are that air travel will grow by 5 percent per year over the next decade or two. By 2025, airline fleets are expected to exceed 35,000 airliners, or more than double the current number. In this growth environment for commercial aviation, the two world leaders in the production of large airliners—Airbus and Boeing—have different expectations about the next generation of jumbo jet aircraft.

Airbus estimates the worldwide market for jumbo passenger jets at about 1,500 planes and has launched a new model to meet this demand. The double-deck A380 will carry 555 passengers for about 9,000 miles at 565 miles per hour. Airbus has orders for this $230-million plus plane from **Air France, Singapore Airlines, Quantas,** and **FedEx.** Engineers estimate that the A380 is 20 percent cheaper to fly than a Boeing 747-400—the only current plane in this size class.

The A380's performance relies on breakthroughs in design, technology, and manufacturing methods. Airbus managers plan to cover the estimated $12 billion in development costs in several ways including a risk-sharing plan that relies on funding from vendors and partners.

Boeing Company has different expectations. It estimates that the airliner market in the next two or three decades will require only about 500

Digital Vision/Getty Images

jumbo jets. Boeing will launch the Sonic Cruiser—a plane that carries about 250 passengers but would travel about 9,000 miles at nearly 750 miles per hour. With a development cost of about $10 billion, the Sonic Cruiser would save about one hour of flight time for every 3,000 miles flown when compared with most current aircraft as well as the A380.

The Sonic Cruiser addresses what Boeing managers expect is a growing fragmentation trend in transcontinental air travel. Rather than flying only from New York to London, many air travelers want the convenience of connections between more cities on each continent. This requires smaller, faster planes. Although the Sonic Cruiser has higher estimated operating costs, airlines might charge higher fares on flights that cover the distance in fewer hours. When asked about the differences between the Airbus and Boeing approaches, a Boeing executive commented that the two firms have different views of the world.

As these decisions of Airbus and Boeing illustrate, managers face high stakes in capital expenditure decisions. Expectations and plans often depend solely on marketing research information and unproved technology. No analytical tools eliminate the inherent uncertainty of such decisions. Still, executives can use management accounting methods to organize information about a particular decision to better evaluate the alternatives.

Source: *The Wall Street Journal, Fortune, Business Week, 10-K Reports.*[1]

Capital expenditures are investments of financial resources in projects to develop or introduce new products or services, to expand current production or service capacity, or to change current production or service facilities. Capital expenditures are made with the expectation that the new product, process, or service will generate future financial inflows that exceed the initial costs. Capital expenditure decisions affect structural cost drivers. They are made infrequently but once made are difficult to change. They commit the organization to the use of certain facilities and activities to satisfy customer needs. In making large capital expenditure decisions, management is risking the future existence of the company.

Although capital expenditure decisions are fraught with risk, management accounting provides the concepts and tools needed to organize information and evaluate the alternatives. This systematic organization and analysis is the essence of capital budgeting. This module introduces important capital budgeting concepts and models, and it explains the proper use of accounting data in these models.

Capital budgeting is a process that involves identifying potentially desirable projects for capital expenditures, evaluating capital expenditure proposals, and selecting proposals that meet minimum criteria. A number of quantitative models are available to assist managers in evaluating capital expenditure proposals.

The best capital budgeting models are conceptually similar to the short-range planning models used in Modules 3 and 4. They all emphasize cash flows and focus on future costs (and revenues) that differ among decision alternatives. The major difference is that capital budgeting models involve cash flows over several years, whereas short-range planning models involve cash flows for a year or less. When the cash flows associated with a proposed activity extend over several years, an adjustment is necessary to make the cash flows comparable when they are expected to occur at different points in time.

The *time value of money concept* explains why monies received or paid at different points in time must be adjusted to comparable values. The time value of money is introduced in Appendix E-A to this module.

LONG-RANGE PLANNING AND CAPITAL BUDGETING

LO1 Explain the role of capital budgeting in long-range planning.

Most organizations plan not only for operations in the current period but also for the longer term, perhaps 5, 10, or even 20 years in the future. Most planning beyond the next budget year is called *long-range planning*.

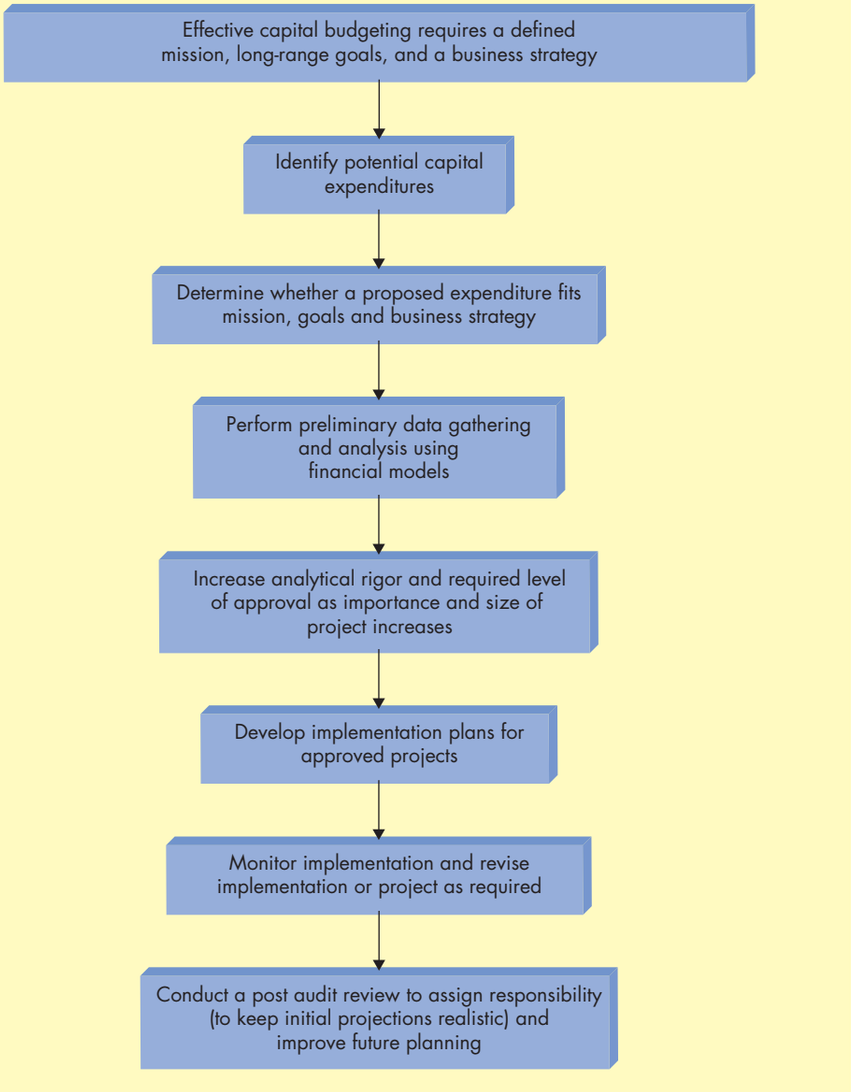
Increased uncertainty and business alternatives add to the difficulty of planning as the horizon lengthens. Even though long-range planning is difficult and involves uncertainties, management must make long-range planning and capital expenditure decisions. Capital expenditure decisions will be made. The question is: How will they be made? Will they be made on the basis of the best information available? Will care be taken to ensure that capital expenditure decisions are in line with the organization's long-range goals? Will the potential consequences, both positive and negative, of capital expenditures be considered? Will important alternative uses of the organization's limited financial resources be considered in a systematic manner? Will managers be held accountable for the capital expenditure programs they initiate? The alternative to a systematic approach to capital budgeting is the haphazard expenditure of resources on the basis of a hunch, immediate need, or persuasion—without accountability by the person(s) making the capital expenditure decisions.

The steps of an effective capital budgeting process are outlined in Exhibit E-1. A basic requirement for a systematic approach to capital budgeting is a defined mission, a set of long-range goals, and a business strategy. These elements provide boundaries that reduce the types of capital expenditure decisions management considers. If, for example, **KFC's** goal is to become the largest fast-food restaurant chain in North America, its management should not consider a proposal to purchase and operate a bus line.

A well-defined business strategy will likewise guide capital expenditure decisions. If **Cisco Systems** is following a strategy to obtain technological leadership, it might seriously consider a proposal to meet customer needs by investing in innovative production facilities but would not consider a proposal to purchase and refurbish used (but seemingly cost-efficient) equipment.

Management should also developed procedures for the review, evaluation, approval, and post-audit of capital expenditure proposals. In a large organization, a capital budgeting committee that provides guidance to managers in the formulation of capital expenditure proposals is key to these procedures. This committee also reviews, analyzes, and approves or rejects major capital expenditure proposals.

EXHIBIT E-1 Capital Budgeting Procedures



Major projects often require the approval of top management and even the board of directors. The capital budgeting committee should include persons knowledgeable in capital budgeting models; financing alternatives and costs; operating procedures; cost estimation and prediction methods; research and development efforts; the organization's goals and basic strategy; and the expectations of the organization's stockholders or owners. A management accountant who is generally expert in data collection, retrieval, and analysis is normally part of the capital budgeting committee.

Not all capital expenditure proposals require committee approval or are subject to formal evaluation. With the approval of top management, the committee might provide guidelines indicating the type and dollar amount of capital expenditures that line managers at each level of the organization can make without formal evaluation or committee approval, or both. The guidelines might state that expenditures of less than $5,000 do not require committee approval and that only expenditures of more than $10,000 must be evaluated using capital budgeting models.

Typically, managers at higher levels have greater discretion in making capital expenditures. In a college or university, a department chairperson could have authority to purchase office and instructional equipment with a maximum limit of $3,000 per year. A dean may have authority to renovate offices or classrooms with a maximum limit of $20,000 per year, but the conversion of the power plant from one fuel

E-1 BUSINESS INSIGHT Capital Budgeting gone Awry

Economic growth and winter storms led to frequent delays at **Denver's Stapleton International Airport**. This led city officials to commit to build a new airport (DEN). At an initial projected cost of $1.2 billion, the new facility was to be one of the world's largest and most technologically advanced all-weather airports. Plans called for an automated baggage system that would move each bag on an underground rail track. Soon, the projected cost of the new airport had increased to $3.1 billion, and the opening of the airport was delayed due to problems with the automated baggage and other systems. Then, Denver's mayor announced that the baggage handling system "does not work" and that $50 million was needed to install a manual system. By this time, the projected cost of the airport was $4 billion, and delays in opening were costing the city $2 million a day. The airport did finally open with costs exceeding $5 billion.

United Airlines, with a major hub at Denver, expressed concerns about the increase in landing fees and turnaround time at the new airport. The low-tech baggage handling system required so much time to move baggage between airplanes that United had to extend passenger layovers and keep aircraft on the ground longer, thereby increasing operating costs and reducing service. Many attribute the airport's problems to the egos of designers and politicians who refused to believe that they had not considered every contingency. One example is the airport's automated trains, which were the only way to move people between terminals. When asked what would happen if they broke down, designers stated, "They won't." Alas, they did, and the result was chaos. Further, its high airport fees limit the growth of air traffic, and passengers who frequently fly through Denver are sticking to carry-on baggage. DEN does have the fewest weather delays among the 20 busiest U.S. airports, but passenger traffic lags behind projections, and airlines complain about paying for empty space.[2]

source to another at a cost of $225,000 could require the formal review of a capital budgeting committee and final approval of the board of trustees.

The post-audit of approved capital expenditure proposals is an important part of a well-formulated approach to capital budgeting. A *post-audit* involves the development of project performance reports comparing planned and actual results. Project performance reports should be provided to the manager who initiated the capital expenditure proposal, the manager assigned responsibility for the project (if a different person), the project manager's supervisor, and the capital budgeting committee. These reports help keep the project on target (especially during the initial investment phase), identify the need to re-evaluate the project if the initial analysis was in error or significant environmental changes occur, and improve the quality of investment proposals. When managers know they will be held accountable for the results of projects they initiate, they are likely to put more care into the development of capital expenditure proposals and take a greater interest in approved projects. Problems can occur when decision makers are rewarded for undertaking major projects but are not held responsible for the consequences that occur several years later. This problem is particularly acute in government organizations, such as with the city of Denver's construction of a new airport, discussed in Business Insight E-1.

A post-audit review of approved projects also helps the capital budgeting committee do a better job in evaluating new proposals. The committee might learn how to adjust proposals for the biases of individual managers; learn of new factors that should be considered in evaluating proposals, and avoid the routine approval of projects that appear desirable by themselves but are related to larger projects that are not meeting management's expectations.

LO2 Apply capital budgeting models, such as net present value and internal rate of return, that consider the time value of money.

CAPITAL BUDGETING MODELS THAT CONSIDER TIME VALUE OF MONEY

The capital budgeting models in this module have gained wide acceptance by for-profit and not-for-profit organizations. Our primary focus is on the *net present value* and the *internal rate of return models*, which are superior because they consider the time value of money. Later discussions will consider more traditional capital budgeting models, such as the payback period and the accounting rate of return that, while useful under certain circumstances, do not consider the time value of money. Although we briefly

consider the cost of financing capital expenditures, we leave a detailed treatment of this topic, as well as a detailed examination of the sources of funds for financing investments, to books on financial management.

Expected Cash Flows

The focus of capital budgeting models that consider the time value of money is on future cash receipts and future cash disbursements that differ under decision alternatives. It is often convenient to distinguish between the following three phases of a project's cash flows:

- Initial investment
- Operation
- Disinvestment

All cash expenditures necessary to begin operations are classified as part of the project's *initial investment phase*. Expenditures to acquire property, plant, and equipment are part of the initial investment. Less obvious, but equally important, are expenditures to acquire working capital to purchase inventories and recruit and train employees. Although the initial investment phase often extends over many years, in our examples, we assume that the initial investment takes place at a single point in time.

Cash receipts from sales of goods or services, as well as normal cash expenditures for materials, labor, and other operating expenses, occur during the operation phase. The *operation phase* is typically broken down into one-year periods; for each period, operating cash expenditures are subtracted from operating cash receipts to determine the net operating cash inflow or outflow for the period.

The *disinvestment phase* occurs at the end of the project's life when assets are disposed of for their salvage value and any initial investment of working capital is recovered. Although this phase might also extend over many years, in our examples, we frequently assume disinvestment takes place at a single point in time.

To illustrate the analysis of a project's cash flows, assume the management of Mobile Yogurt Shoppe is considering a capital expenditure proposal to operate a new shop in a resort community in the Ozark Mountains. Each Mobile Yogurt Shoppe is located in a specially constructed motor vehicle that moves on a regular schedule throughout the community it serves. The predicted cash flows associated with the project, which has an expected life of five years, are presented in Exhibit E-2.

EXHIBIT E-2 Analysis of a Project's Predicted Cash Flows

Initial investment (at time 0)		
Vehicle and equipment		$ 90,554
Inventories and other working capital		4,000
Total		$ 94,554
Operation (per year for 5 years)		
Sales		$175,000
Cash expenditures		
Food	$47,000	
Labor	65,000	
Supplies	9,000	
Fuel and utilities	8,000	
Advertising	4,000	
Miscellaneous	12,000	(145,000)
Net annual cash inflow		$ 30,000
Disinvestment (at the end of 5 years)		
Sale of vehicle and equipment		$ 8,000
Recovery of investment in inventories and other working capital		4,000
Total		$ 12,000

Manager Behavior and Expected Cash Flows

Accurately predicting the cash flows associated with a capital expenditure proposal is critical to properly evaluating the proposal. Managers might be overly optimistic with their predictions, and they are sometimes tempted to modify predictions to justify capital expenditures. Perhaps they are interested in personal rewards. They might also want to avoid a loss of prestige or employment for themselves or to keep a local facility operating for the benefit of current employees and the local economy. Unfortunately, if a major expenditure does not work out, not only the local plant but also the entire company could be forced out of business. For example, under pressure to increase current sales, automobile leasing companies could be tempted to overstate cash receipts during the disinvestment phase of a lease. Business Insight E-2 considers the financial consequences of overstating residual values for automobile leases.

E-2 BUSINESS INSIGHT **Manager Behavior and Expected Vehicle Value**

To increase demand for their products, managers of automobile leasing companies have incentives to lower monthly lease rates. Important factors in setting vehicles' lease rates include vehicle cost, interest rate, lease period, and the residual value of the vehicle at lease-end. The most difficult item to predict is residual value. That value, the future selling price of the vehicle, is a function of its condition, economic climate, actions of competitors, and its popularity when the lease expires. If residual values are predicted to be high, the monthly lease can be set low enough to attract customers and still earn a profit. Favorable lease terms help bring down monthly payments of popular Ford Explorers and Jeep Grand Cherokees. With the profitability of leases substantially determined by residual values, a small decrease in market prices of used vehicles can yield a substantial loss.[3]

Net Present Value

A project's **net present value,** usually computed as of the time of the initial investment, is the present value of the project's net cash inflows from operations and disinvestment less the amount of the initial investment. In computing a project's net present value, the cash flows occurring at different points in time are adjusted for the time value of money using a **discount rate** that is the minimum rate of return required for the project to be acceptable. Projects with positive net present values (or values at least equal to zero) are acceptable, and projects with negative net present values are unacceptable. Two methods to compute net present value follow.

Table Approach

Assuming that management uses a 12 percent discount rate, the net present value of the proposed investment in a Mobile Yogurt Shoppe is shown in Exhibit E-3 (a) to be $20,400. Since the net present value is more than zero, the investment in the Mobile Yogurt Shoppe is expected to be profitable, even when adjusted for the time value of money.

We can verify the amounts and computations in Exhibit E-3. Start by tracing the cash flows back to Exhibit E-2. Next, verify the 12 percent present value factors in Tables E-A-1 and E-A-2 in Appendix E-A of this module. The initial investment is assumed to occur at a single point in time (identified as time 0), the start of the project. In net present value computations, all cash flows are restated in terms of their value at time 0. Hence, time 0 cash flows have a present value factor of 1. To simplify computations, all other cash flows are assumed to occur at the end of years 1 through 5, even if they occurred during the year. Although further refinements could be made to adjust for cash flows occuring throughout each year, such adjustments are seldom necessary. Observe that net operating cash inflows are treated as an *annuity*, whereas cash flows for the initial investment and disinvestment are treated as *lump-sum amounts*. If net operating cash flows varied from year to year, we would treat each year's cash flow as a separate amount.

Spreadsheet Approach

Spreadsheet software contains functions that compute the present value of a series of cash flows. With this software, simply enter a column or row containing the net cash flows for each period and the

appropriate formula. The discount rate of 0.12 is entered as part of the formula. Sample spreadsheet input to determine the net present value of the proposed investment in a Mobile Yogurt Shoppe is shown on the left in Exhibit E-3 (b). The spreadsheet output is shown on the right, in Exhibit E-3 (b).

EXHIBIT E-3 Net Present Value of a Project's Predicted Cash Flows

(a) Table approach:

	Predicted Cash Inflows (outflows) (A)	Year(s) of Cash Flows (B)	12% Present Value Factor (C)	Present Value of Cash Flows (A) × (C)
Initial investment	$(94,554)	0	1.000	$ (94,554)
Operation	30,000	1–5	3.605	108,150
Disinvestment	12,000	5	0.567	6,804
Net present value of all cash flows				$ 20,400

(b) Spreadsheet approach:

Input:

	A	B
1	Year of cash flow	Cash flow
2	1	$30,000
3	2	30,000
4	3	30,000
5	4	30,000
6	5	42,000
7	Present value	=NPV(0.12,B2:B6)
8	Initial investment at time 0	(94,554)
9	Net present value	=B7+B8

Output:

	A	B
1	Year of cash flow	Cash flow
2	1	$ 30,000
3	2	30,000
4	3	30,000
5	4	30,000
6	5	42,000
7	Present value	$114,952.41
8	Initial investment at time 0	(94,554.00)
9	Net present value	$ 20,398.41

Two cautionary notes follow:

1. The spreadsheet formula for the net present value assumes that the first cash flow occurs at time "1," rather than at time "0." Hence, we cannot include the initial investment in the data set analyzed by the spreadsheet formula when computing the net present value. Instead, the initial investment is subtracted from the present value of future cash flows.
2. Arrange the cash flows subsequent to the initial investment from *top* to bottom in a column, or *left* to right in a row.

Internal Rate of Return

The **internal rate of return (IRR)**, often called the **time-adjusted rate of return**, is the discount rate that equates the present value of a project's cash inflows with the present value of the project's cash outflows. Other ways to describe IRR include: (1) The minimum rate that could be paid for the money invested in a project without losing money, and (2) The discount rate that results in a project's net present value equaling zero.

All practical applications of the IRR model use a calculator or spreadsheet. Thus, we illustrate determining an IRR with a spreadsheet. A table approach to determining a project's internal rate of return is illustrated in Appendix E-B of this module.

With spreadsheet software, simply enter a column or row containing the net cash flows for each period and the appropriate formula. Spreadsheet input for Mobile Yogurt Shoppe's investment proposal is shown in Exhibit E-4. The spreadsheet formula for the IRR assumes that the first cash flow occurs at time "0."

The spreadsheet approach requires an initial prediction or guess of the project's internal rate of return. Although the closeness of the prediction to the final solution affects computational speed, for textbook examples almost any number can be used. We use an initial estimate of 0.08 in all illustrations. Because the IRR formula assumes that the first cash flow occurs at time 0, the initial investment is included in the data analyzed by the IRR formula. Again, we must order the cash flows from top to bottom in a column or left to right in a row. As shown on the right column in Exhibit E-4, the spreadsheet software computes the IRR as 20 percent.

EXHIBIT E-4 Spreadsheet Approach to Determining Internal Rate of Return

Input:

	A	B
1	Year of cash flow	Cash flow
2	0	$(94,554)
3	1	30,000
4	2	30,000
5	3	30,000
6	4	30,000
7	5	42,000
8	IRR	=IRR(B2:B7,0.08)*

Output:

	A	B
1	Year of cash flow	Cash flow
2	0	$(94,554)
3	1	30,000
4	2	30,000
5	3	30,000
6	4	30,000
7	5	42,000
8	IRR	0.20

**The formula is "=IRR(Input data range, guess)." The guess, which is any likely rate of return, is used as an initial starting point in determining the solution. We use 0.08 in all illustrations.*

Although a project's IRR should be compared to the discount rate established by management, such a discount rate is often unknown. In these situations, computing the IRR still provides insights into a project's profitability. Research Insight E-1 illustrates the use of the IRR model to examine the time-adjusted profitability of Social Security contributions.

The calculated internal rate of return is compared to the discount rate established by management to evaluate investment proposals. If the proposal's IRR is greater than or equal to the discount rate, the project is acceptable; if it is less than the discount rate, the project is unacceptable. Because Mobile Yogurt Shoppes has a 12 percent discount rate, the project is acceptable using the IRR model.

Although a computer and appropriate software quickly and accurately perform tedious computations, computational ease increases the opportunity for inappropriate use. The ability to plug numbers into a computer or calculator and obtain an output labeled NPV or IRR could mislead the unwary into believing that capital budgeting models are easy to use. This is not true. Training and professional judgment are required to identify relevant costs, to implement procedures to obtain relevant cost information, and to make a good decision once results are available. Capital budgeting models are merely decision aids. Managers, not models, make the decisions. To better illustrate underlying concepts, all subsequent textbook illustrations use a table approach.

Cost of Capital

When discounting models are used to evaluate capital expenditure proposals, management must determine the discount rate (1) used to compute a proposal's net present value or (2) used as the standard for evaluating a proposal's IRR. An organization's cost of capital is often used as this discount rate.

The **cost of capital** is the average cost an organization pays to obtain the resources necessary to make investments. This average rate considers items such as the:

E-1 RESEARCH INSIGHT **Social Security IRR varies with Income and Age**

Under the current Social Security law, more than 12 percent of nearly every U.S. employee's gross annual wage (up to a set maximum) is contributed to the Old Age and Survivor's Insurance (OASI) program. An important purpose of the program is to provide financial support to employees after retirement. Researchers determined the internal rate of return (IRR) for several categories of Social Security participants. The expected IRR for the lowest paid workers is between 4 and 5 percent, for middle income workers is between 1 and 2 percent, for the highest paid workers is below 1 percent, and for members of this final group born after 1975, could be negative. These results stem from the design of the Social Security program that provides low-paid workers a higher percentage of their preretirement income. Additional factors include increases in the maximum annual wage subject to Social Security contributions and to increases in the age required to receive full Social Security benefits.[4]

- Effective interest rate on debt (notes or bonds).
- Effective dividend rate on preferred stock.
- Discount rate that equates the present value of all dividends expected on common stock over the life of the organization to the current market value of the organization's common stock.

The cost of capital for a company that has no debt or preferred stock equals the cost of equity capital, computed as follows:

$$\text{Cost of equity capital} = \frac{\text{Current annual dividend per common share}}{\text{Current market price per common share}} + \text{Expected dividend growth rate}$$

Procedures for determining the cost of capital for more complex capital structures are covered in finance books. Investing in a project that has an internal rate of return equal to the cost of capital should not affect the market value of the firm's securities. Investing in a project that has a return higher than the cost of capital should increase the market value of a firm's securities. If, however, a firm invests in a project that has a return less than the cost of capital, the market value of the firm's securities should fall.

The cost of capital is the minimum return that is acceptable for investment purposes. Any investment proposal not expected to yield this minimum rate should normally be rejected. Because of difficulties encountered in determining the cost of capital, many organizations adopt a discount rate or a target rate of return without complicated mathematical analysis.

CAPITAL BUDGETING MODELS THAT DO NOT CONSIDER TIME VALUE OF MONEY

LO3 Apply capital budgeting models, such as payback period and accounting rate of return, that do not consider the time value of money.

Years ago, capital budgeting models that do not consider the time value of money were more widely used than were discounting models. Although most large organizations use net present value or internal rate of return as their primary evaluation tool, they often use nondiscounting models as an initial screening device. Further, as discussed in Research Insight E-2, nondiscounting models remain entrenched in small businesses. We consider two nondiscounting models, the *payback period* and the *accounting rate of return*.

Payback Period

The **payback period** is the time required to recover the initial investment in a project from operations. The payback decision rule states that acceptable projects must have less than some maximum payback period designated by management. Payback emphasizes management's concern with liquidity and the need to minimize risk through a rapid recovery of the initial investment. It is frequently used for small expenditures having such obvious benefits that the use of more sophisticated capital budgeting models is not required or justified.

E-2 RESEARCH Nondiscounting Models Used in Small Businesses

Small businesses employ almost two-thirds of the U.S. workforce. A study examined small businesses with less than $5 million sales and fewer than 1,000 employees. It found that most small businesses used the payback period as their primary method of investment analysis. Furthermore, most small businesses required a payback period of less than three years; see below:

Primary Method of Investment Analysis		Minimum Acceptable Payback Period	
Payback period	42.7%	1 year	9.5%
Accounting rate of return	22.4	2 years	43.2
Internal rate of return	16.4	3 years	31.1
Net present value	7.3	4 years or more	16.2

The study suggests that the predominance of the payback method is attributed to its simplicity, emphasis on liquidity, and response to external financial pressures. It observed, "Bankers are primarily interested in the firm's ability to meet short-term obligations associated with a loan, rather than maximizing the wealth of the owners of the firm. When the small business owner approaches a banker for a loan to finance a capital investment, he better be prepared to demonstrate his capacity to repay the loan within a set period of time."[5]

When a project is expected to have equal annual operating cash inflows, its payback period is computed as follows:

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Annual operating cash inflows}}$$

For Mobile Yogurt Shoppe's investment proposal, outlined in Exhibit E-2, the payback period is 3.15 years:

$$\text{Payback period} = \frac{\$94{,}554}{\$30{,}000} = 3.15$$

Determining the payback period for a project having unequal cash flows is slightly more complicated. Assume that Alderman Company is evaluating a capital expenditure proposal that requires an initial investment of $50,000 and has the following expected net cash inflows:

Year	Net Cash Inflow
1	$15,000
2	25,000
3	40,000
4	20,000
5	10,000

To compute the payback period, we must determine the net unrecovered amount at the end of each year. In the year of full recovery, the net cash inflows are assumed to occur evenly and are prorated based on the unrecovered investment at the start of the year. Full recovery of Alderman Company's investment proposal is expected to occur in Year 3:

Year	Net Cash Inflow	Unrecovered Investment
0	$ - 0	$50,000
1	15,000	35,000
2	25,000	10,000
3	40,000	0

Therefore, $10,000 of $40,000 is needed in Year 3 to complete the recovery of the initial investment. This provides a proportion of 0.25 ($10,000 ÷ $40,000) and a payback period of 2.25 years (2 years plus 0.25 of Year 3). This project is acceptable if management specified a maximum payback period of three years. Because they occur after the payback period, the net cash inflows of Years 4 and 5 are ignored.

Accounting Rate of Return

The **accounting rate of return** is the average annual increase in net income that results from the acceptance of a capital expenditure proposal divided by either the initial investment or the average investment in the project. This method differs from other capital budgeting models in that it focuses on accounting income rather than on cash flow. In most capital budgeting applications, accounting net income is approximated as net cash inflow from operations minus expenses not requiring the use of cash, such as depreciation.

Consider Mobile Yogurt Shoppe's capital expenditure proposal whose cash flows were outlined in Exhibit E-2. The vehicle and equipment cost $90,554 and have a disposal value of $8,000 at the end of five years, resulting in an average annual increase in net income of $13,489:

Annual net cash inflow from operations	$30,000
Less average annual depreciation ([$90,554 − $8,000] ÷ 5)	(16,511)
Average annual increase in net income	$13,489

Considering the investment in inventories and other working capital, the initial investment is $94,554 ($90,554 + $4,000), and the *accounting rate of return on initial investment* is 14.27 percent:

$$\text{Accounting rate of return on initial investment} = \frac{\text{Average annual increase in net income}}{\text{Initial investment}} = \frac{\$13,489}{\$94,554} = 0.1427$$

The average investment, computed as the initial investment plus the expected value of any disinvestment, all divided by 2, is $53,277 [($94,554 + $12,000) ÷ 2]. The *accounting rate of return on average investment* is 25.32 percent:

$$\text{Accounting rate of return on average investment} = \frac{\text{Average annual increase in net income}}{\text{Average investment}} = \frac{\$13,489}{\$53,277} = 0.2532$$

When using the accounting rate of return, management specifies either the initial investment or average investment plus some minimum acceptable rate. Management rejects capital expenditure proposals with a lower accounting rate of return but accepts proposals with an accounting rate of return higher than or equal to the minimum.

EVALUATION OF CAPITAL BUDGETING MODELS

LO4 Evaluate the strengths and weaknesses of alternative capital budgeting models.

As a single criterion for evaluating capital expenditure proposals, capital budgeting models that consider the time value of money are superior to models that do not consider it. The payback model concerns merely how long it takes to recover the initial investment from a project, yet investments are not made with the objective of merely getting the money back. Indeed, not investing has a payback period of 0. Investments are made to earn a profit. Hence, what happens after the payback period is more important than is the payback period itself. The payback period model, when used as the sole investment criterion, has a fatal flaw in that it fails to consider cash flows after the payback period. Despite this flaw, payback is a rough-and-ready approach to getting a handle on investment proposals. Sometimes a project is so attractive using payback that, when its life is considered, no further analysis is necessary.

For total life evaluations, the accounting rate of return is superior to the payback period because it does consider a capital expenditure proposal's profitability. Using the accounting rate of return, a project that merely returns the initial investment will have an average annual increase in net income of 0 and an accounting rate of return of 0. The problem with the accounting rate of return is that it fails to

consider the timing of cash flows. It treats all cash flows within the life of an investment proposal equally despite the fact that cash flows occurring early in a project's life are more valuable than cash flows occurring late in a project's life. Early period cash flows can earn additional profits by being invested elsewhere. Consider the two investment proposals summarized in Exhibit E-5. Both have an accounting rate of return of 5 percent, but Proposal A is superior to Proposal B because most of its cash flows occur in the first two years. Because of the timing of the cash flows when discounted at an annual rate of 10 percent, Proposal A has a net present value of $1,140 while Proposal B has a negative net present value of $(10,940).

EXHIBIT E-5 Evaluating Capital Budgeting Models with Differences in Cash Flow Timing

Accounting rate of return analysis of Projects A and B

	Project A	Project B
Predicted net cash inflow from operations		
Year 1	$ 50,000	$ 10,000
Year 2	50,000	10,000
Year 3	10,000	50,000
Year 4	10,000	50,000
Total	120,000	120,000
Total depreciation	(100,000)	(100,000)
Total net income	$ 20,000	$ 20,000
Project life	÷ 4 years	÷ 4 years
Average annual increase in net income	$ 5,000	$ 5,000
Initial investment	÷ 100,000	÷ 100,000
Accounting rate of return on initial investment	0.05	0.05

Net present value analysis of Project A

	Predicted Cash Inflows (outflows)	Year(s) of Cash Flows	10% Present Value Factor	Present Value of Cash Flows
Initial investment	$(100,000)	0	1.000	$(100,000)
Operation	50,000	1–2	1.736	86,800
Operation	10,000	3–4	3.170−1.736	14,340
Net present value of all cash flows				$ 1,140

Net present value analysis of Project B

	Predicted Cash Inflows (outflows)	Year(s) of Cash Flows	10% Present Value Factor	Present Value of Cash Flows
Initial investment	$(100,000)	0	1.000	$(100,000)
Operation	10,000	1–2	1.736	17,360
Operation	50,000	3–4	3.170−1.736	71,700
Net present value of all cash flows				$ (10,940)

The net present value and the internal rate of return models both consider the time value of money and project profitability. They almost always provide the same evaluation of individual projects whose acceptance or rejection will not affect other projects. (An exception can occur when periods of net cash outflows are mixed with periods of net cash inflows. Under these circumstances, an investment proposal could have multiple internal rates of return.) The net present value and the internal rate of return

models, however, have two basic differences that often lead to differences in the evaluation of competing investment proposals:

1. The net present value model gives explicit consideration to investment size. The internal rate of return model does not.
2. The net present value model assumes that all net cash inflows are reinvested at the discount rate; the internal rate of return model assumes that all net cash inflows are reinvested at the project's internal rate of return.

These differences are considered later when we discuss mutually exclusive investments.

ADDITIONAL ASPECTS OF CAPITAL BUDGETING

LO5 Discuss the importance of judgment, attitudes toward risk, and relevant cash flow information for capital budgeting decisions.

The capital budgeting models discussed do not make investment decisions. Rather, they help managers separate capital expenditure proposals that meet certain criteria from those that do not. Managers then focus on those proposals that pass the initial screening.

Using Multiple Investment Criteria

In performing this initial screening, management can use a single capital budgeting model or multiple models, including some we have not discussed. Management might specify that proposals must be in line with the organization's long-range goals and business strategy, have a maximum payback period of three years, have a positive net present value when discounted at 14 percent, and have an initial investment of less than $500,000. The maximum payback period might be intended to reduce risk, the present value criterion might be to ensure an adequate return to investors, and the maximum investment size might reflect the resources available for investment. The research team of Arya, Fellingham, and Glover believe the use of multiple criteria is a useful way of evaluating projects from different perspectives. "If many of the criteria suggest the project should be taken, the chance is greater that the project is desirable."[6]

Nonquantitative factors such as market position, operational performance improvement, and strategy implementation often play a decisive role in management's final decision to accept or reject a capital expenditure proposal that has passed the initial screening. Also important at this point are top management's attitudes toward risk and financing alternatives, their confidence in the professional judgment of other managers making investment proposals, their beliefs about the future direction of the economy, and their evaluation of alternative investments. In the following sections, we will focus on evaluating risk, differential analysis of project cash flows, predicting differential costs and revenues for high-tech investments, and evaluating mutually exclusive investments.

Evaluating Risk

All capital expenditure proposals involve risk, including risk related to

- Cost of the initial investment.
- Time required to complete the initial investment and begin operations.
- Whether the new facilities will operate as planned.
- Life of the facilities.
- Customers' demand for the product or service.
- Final selling price.
- Operating costs.
- Disposal values.

Projected cash flows (such as those summarized for the Mobile Yogurt Shoppe proposal in Exhibit E-2) are based on management's best predictions. Although these predictions are likely to reflect the professional judgment of economists, marketing personnel, engineers, and accountants, they are far from certain.

Many techniques have been developed to assist in the analysis of the risks inherent in capital budgeting. Suggested approaches include the following:

- *To adjust the discount rate for individual projects based on management's perception of the risks associated with a project*. A project perceived as being almost risk free might be evaluated using a discount rate of 12 percent; a project perceived as having moderate risk may be evaluated using a discount rate of 16 percent; and a project perceived as having high risk might be evaluated using a discount rate of 20 percent.
- *To compute several internal rates of return and/or net present values for a project*. For example, a project's net present value might be computed three times: first assuming the most optimistic projections of cash flows; second assuming the most likely projections of cash flows; and third assuming the most pessimistic projections of cash flows. The final decision is then based on management's attitudes toward risk. A project whose most likely outcome is highly profitable would probably be rejected if its pessimistic outcome might lead to bankruptcy.
- *To subject a capital expenditure proposal to sensitivity analysis*, which was defined in Module 3 as a study of the responsiveness of a model's dependent variable(s) to changes in one or more of its independent variables. Management might want to know, for example, the minimum annual net cash inflows that will provide an internal rate of return of 12 percent with other cost and revenue projections being as expected.

Consider the situation presented in Exhibit E-2 and analyzed using the net present value and the internal rate of return models in Exhibits E-3 and E-4. This proposal has a positive net present value when its cash flows are discounted at 12 percent and an expected IRR of 20 percent. Assuming that Mobile Yogurt Shoppes has a 12 percent discount rate, management might wish to know the minimum annual net cash inflow that will meet this criterion.

In Exhibit E-3, disinvestment cash inflows have a net present value of $6,804. When this amount is subtracted from the initial investment, $87,750 ($94,554 − $6,804) of the initial investment must be recovered from operations. If this amount is to be recovered over a five-year period with equal annual net cash inflows and a 12 percent discount rate, the factor 3.605 (see Exhibit E-2) must equate the annual net cash inflows with the portion of the initial investment to be recovered from operations. Hence, the minimum annual net cash inflows must be $24,341:

$$\text{Minimum annual net cash inflow} = \frac{\$87{,}750}{3.605} = \$24{,}341$$

If management could then predict the probability of annual net cash inflows being more than or equal to $24,341, this would be the likelihood of the project meeting or exceeding a 12 percent discount rate. Again, the ultimate decision to accept or reject the proposal rests with management and their attitudes toward risk.

Notice the similarity of determining the minimum annual net cash inflows and that of determining the break-even point in Module 3. In effect, $24,341 in annual net cash inflows is a time-adjusted break-even point.

Differential Analysis of Project Cash Flows

All previous examples assume that capital expenditure proposals produce additional net cash inflows, but this is not always the case. Units of government and not-for-profit organizations might provide services that do not produce any cash inflows. For-profit organizations might be required to make capital expenditures to maintain product quality or to bring facilities up to environmental or safety standards. In these situations, it is impossible to compute a project's payback period, accounting rate of return, or internal rate of return. It is possible, however, to compute the present value of all life cycle costs associated with alternative ways of providing the service or meeting the environmental or safety standard. Here, the alternative with the smallest negative net present value is preferred.

Capital expenditure proposals to reduce operating costs by upgrading facilities might not provide any incremental cash inflows. Again, we can use a total cost approach and calculate the present value of the

costs associated with each alternative, with the low-cost alternative being preferred. Alternatively, we can perform a differential analysis of cash flows and, treating any reduced operating costs as if they were cash inflows, compute the net present value or the internal rate of return of the cost reduction proposal. Recall from Module 3 that a differential cost analysis focuses on the costs that differ under alternative actions. Once the differential amounts have been determined, they can be adjusted for the time value of money. To illustrate the differential approach, we consider an example introduced in Module 4.

Ace Welding Company uses a Model I welding machine to produce 10,000 Mountain bicycle frames per year. The Model I welding machine is two years old and has a remaining useful life of four years. It cost $90,000 and has an estimated salvage value of zero dollars at the end of its useful life. Its current book value (original cost less accumulated depreciation) is $60,000, but its current disposal value is only $35,000.

Management is evaluating the desirability of replacing the Model I welding machine with a new Model II welding machine. The new machine costs $80,000, has a useful life of four years, and a predicted salvage value of zero dollars at the end of its useful life. Although the new machine has the same productive capacity as the old machine, its predicted operating costs are lower because it requires less electricity. Furthermore, because of a computer control system, the Model II machine will require less frequent and less expensive inspections and adjustments. Finally, the Model II machine requires less maintenance.

A differential analysis of the cash flows associated with this cost reduction proposal, separated into the three phases of the project's life, are presented in Exhibit E-6. Because the proposal does not have a disposal value, this portion of the analysis could have been omitted. (A detailed explanation of the relevant costs included in this analysis is in Exhibit 4-1 and the accompanying Module 4 discussion of relevant costs.) Assuming that Ace Welding has a discount rate of 12 percent, the proposal's net present value (computed in Exhibit E-7) is $2,681, and the proposal is acceptable.

EXHIBIT E-6 Differential Analysis of Predicted Cash Flows

	Differential Analysis of-Predicted-Cash Flows		
	Keep Old Model I Machine (A)	Replace with New Model II Machine (B)	Difference (income effect of replacement) (A) − (B)
Initial investment			
Cost of new machine		$80,000	$80,000
Disposal value of old machine		(35,000)	(35,000)
Net initial investment			$45,000
Annual operating cash savings			
Conversion			
Mountain frames, Model I (10,000 units × $5)	$50,000		
Mountain frames, Model II (10,000 units × $4)		$40,000	$10,000
Inspection and adjustment			
Mountain frames, Model I (10 × $500)	5,000		
Mountain frames, Model II (5 × $300)		1,500	3,500
Machine maintenance			
Mountain frames, Model I ($200 × 12 months)	2,400		
Mountain frames, Model II ($200 per year)		200	2,200
Net annual cost savings			$15,700
Disinvestment at end of life			
Old machine	$ 0		
New machine		$ 0	

EXHIBIT E-7 Differential Analysis of Predicted Cash Flows

	Predicted Cash Inflows (outflows) (A)	Year(s) of Cash Flows (B)	12% Present Value Factor (C)	Present Value of Cash Flows (A) × (C)
Initial investment	$(45,000)	0	1.000	$(45,000)
Operation	15,700	1–4	3.037	47,681
Disinvestment	0	4	0.636	0
Net present value of all cash flows				$ 2,681

Predicting Differential Costs and Revenues for High-Tech Investments

Care must be taken when evaluating proposals for investments in the most current technological innovations such as flexible manufacturing systems and computer integrated manufacturing. The three types of errors to consider are: (1) investing in unnecessary or overly complex equipment, (2) overestimating cost saving, and (3) underestimating incremental sales.

Investing in Unnecessary or Overly Complex Equipment

A common error is to simply compare the cost associated with the current inefficient way of doing things with the predicted cost of performing the identical operations with more modern equipment. Although capital budgeting models might suggest that such investments are justifiable, the result could be the costly and rapid completion of non-value-added activities. Consider the following examples.

- A company invests in an automated system to speed the movement of work in process between workstations on the shop floor without first evaluating the plant layout. The firm is still unable to compete with other companies having better organized plants that allow lower cycle times, lower work-in-process inventories, and lower manufacturing costs. Management should have evaluated the plant layout before investing in new equipment. They may have found that rearranging the factory floor would have reduced materials movement and eliminated the need for the investment.
- A company invests in a large automated warehouse to permit the rapid storage and retrieval of goods while competitors work to eliminate excess inventory. The firm is left with large inventories and a large investment in the automated warehouse while competitors, not having to earn a return on similar investments, are able to charge lower prices. Management should have evaluated the need for current inventory levels and perhaps shifted to a just-in-time approach to inventory management before considering the investment in an automated warehouse.
- A company invests in equipment to perform quality inspections while competitors implement total quality management and seek to eliminate the need for quality inspections. While defective products are now detected before shipment to customers, they are still being produced. Furthermore, the company has a higher capital investment than competitors have. The result is, again, a less competitive cost structure. The inspection equipment might not have been needed if management had shifted from inspecting all finished goods for conformance to an emphasis on "doing it right the first time."
- A company invests in automated welding equipment to more efficiently produce printer casings while competitors simplify the product design and shift from welded to molded plastic casings. Although the cost of producing the welded casings might be lower, the company's cost structure is still not competitive.

All of these examples illustrate the limitations of capital budgeting models and the need for good judgment. *In the final analysis, managers, not models, make decisions*. Management must carefully evaluate the situations and determine whether they have considered the proper alternatives and all important cash flows.

Overestimating Cost Savings

When a number of activities drive manufacturing overhead costs, estimates of overhead cost savings based on a single activity cost driver can significantly overestimate cost savings. Assume, for example, that a company containing both machine-intensive and labor-intensive operations develops a cost-estimating equation for manufacturing overhead with direct labor as the only independent variable. Because of this, all overhead costs are associated with direct labor. The predicted cost savings can be computed as the sum of predicted reductions in direct labor plus predicted reductions in overhead; the predicted reductions in overhead are computed as the overhead per direct labor dollar or labor hour multiplied by the predicted reduction in direct labor dollars or labor hours. Because a major portion of the manufacturing overhead is driven by factors other than direct labor, reducing direct labor will not provide the predicted savings. Capital budgeting models might suggest that the investment is acceptable, but the models are based on inaccurate cost data.

Management should beware of overly simplistic computations of cost savings. This is an area in which management needs the assistance of well-trained management accountants and engineers.

Underestimating Incremental Sales or Cost Savings

In evaluating proposals for investments in new equipment, management often assumes that the baseline for comparison is the current sales level, but this might not be the case. If competitors are investing in equipment to better meet customer needs and to reduce costs, a failure to make similar investments might result in uncompetitive prices and declining, rather than steady, sales. Hence, the baseline for sales without the investment is overstated, and the incremental sales of the investment is understated. Not considering the likely decline in sales understates the incremental sales associated with the investment and biases the results against the proposed investment.

Investments in the most advanced manufacturing technologies, such as flexible manufacturing systems (FMS) and computer integrated manufacturing (CIM), do more than simply allow the efficient production of current products. Such investments also make possible the rapid, low-cost switching to new products. The result is expanded sales opportunities.

Such investments might also produce cost savings further down the value chain, either within or outside the company. Ace Welding Company's decision to acquire a new Model II welding machine might have the unanticipated consequence of reducing customer warranty claims or increasing sales because customers are attracted to a higher-quality product. Business Inight E-3 discusses how taking a value chain perspective might affect capital budgeting and other strategic decisions.

E-3 BUSINESS INSIGHT **Value Chain and Capital Budgeting**

Yakima-Olympia (Y-O) is a vertically integrated forest product company whose activities range from developing and planting improved seedlings to the retail distribution of wood products. Like most forest product firms, Y-O hires private logging contractors to cut trees (primarily for cost reasons such as nonunion wages). These contractors follow traditional procedures to fell all trees in an area, remove branches with chain saws, and drag trees to loading areas. Y-O wanted its logging contractors in the Tidewater region of Virginia to switch to harvesting machines that could selectively cut and trim mature trees to meet current production specifications. To do this, a logging contractor would have to make a capital investment of approximately $600,000 in new equipment. Over the harvesting machine's five-year life, it would have annual cash operating costs of approximately $250,000. Following standard rates, the contractor would receive annual revenues of approximately $400,000 from Y-O. With a 12 percent time value of money, the proposed investment's net present value is minus $60,000. Consequently, Y-O met with little success in convincing contractors to switch to harvesting machines.

A later study concluded that Y-O's proposal was rejected because of its failure to analyze costs through the entire value chain. The study reports that use of harvesting machines would produce significant savings in land management, sorting, reduced waste, and reduced processing costs. Although the investment would produce major financial benefits, the stage in the value chain at which the investment must be made, under traditional pricing policies, would receive none of the benefits. The study observed that Y-O should consider a gain-sharing mechanism to convince logging contractors to make the necessary investment. If this is not feasible, Y-O might decide that the economic gains from the investment are large enough to stop outside contracting and internalize logging operations.[7]

Unfortunately, because such opportunities are difficult to quantify, they are often ignored in the evaluation of capital expenditure proposals. The result is a bias against investments in FMS and CIM. The solution to this dilemma involves the application of management's professional judgment, a willingness to take risks based on this professional judgment, and recognition that certain investments transcend capital budgeting models in that they involve strategic as well as long-range planning. At this level of planning, qualitative decisions concerning the nature of the organization are at least as important as quantified factors. Business Insight E-4 examines the difficulty **Aetna Life and Casualty Company** encountered in evaluating strategic investments in information technology.

E-4 BUSINESS INSIGHT **Investment Returns Are Not Always Quantifiable**

After spending a year trying to determine how to measure the return from investments in information technology, the senior vice president of information and technology at **Aetna Life & Casualty Company** gave up, calling it "an exercise in futility." He observed that while there appears to be a correlation between investments in information technology and reductions in cost, it is difficult to say that one caused the other. Aetna has a complex computer system that links a collection of central databases with computer networks around the country. The system provides up-to-date information so that agents can immediately respond to customer questions. The complexity of the system makes it difficult to evaluate proposals for additional investments in the system. The vice president's frustration came from the fact that "once a business unit implemented a new technology solution, the [business and technology] became so integrated that you couldn't tell them apart." Aetna managers now make the case for additional investments in technology on the basis of business objectives such as customer satisfaction and product improvements.[8]

Evaluating Mutually Exclusive Investments

Two or more capital expenditure proposals are **mutually exclusive investments** if the acceptance of one automatically causes the rejection of the other(s). Perhaps a builder with a tract of land on the outskirts of Paris is trying to determine the most profitable use of the land. Because of the size of the tract and zoning requirements, the land can be used for only one of three purposes: a shopping center, a housing development, or an office park.

When faced with mutually exclusive investments, management must determine which one to accept. The decision is relatively easy if only one of the proposals meets the organization's investment criteria. If, however, two or more proposals pass the initial screening performed by the investment criteria, management faces the task of selecting the best of the acceptable proposals. To help in this determination, management could request that the proposals be ranked on the basis of some criterion such as net present value or internal rate of return. Unfortunately, while these models almost always lead to identical decisions when used to evaluate individual investment proposals, they frequently produce different rankings of acceptable proposals. Assume that management can select only one of three mutually exclusive investment proposals. Relevant information is summarized in Exhibit E-8.

Assuming that the organization has a 12 percent cost of capital, all projects have a positive net present value and an internal rate of return in excess of 12 percent. Therefore, all are acceptable. The problem is to determine which of these acceptable proposals is most desirable. Ranking the proposals by their net present value indicates that Proposal B is best, while ranking by IRR indicates that Proposal C is best.

A frequent criticism of net present value to rank investment proposals is that it fails to adjust for the size of the proposed investment. To overcome this difficulty, managers can rank projects on the basis of each project's **present value index**, which is computed as the present value of the project's subsequent cash flows divided by the initial investment:

$$\text{Present value index} = \frac{\text{Present value of subsequent cash flows}}{\text{Initial investment}}$$

For Proposal A, the present value of the subsequent cash flows, discounted at 12 percent, is $30,370,000 ($10,000,000 × 3.037), and the present value index is 1.129:

EXHIBIT E-8 Ranking Capital Budgeting Proposals

($ thousands)	Proposal A	Proposal B	Proposal C
Predicted cash flows			
Initial investment	$(26,900)	$(55,960)	$(30,560)
Operation			
Year 1	10,000	20,000	20,000
Year 2	10,000	20,000	20,000
Year 3	10,000	20,000	0
Year 4	10,000	20,000	0
Disinvestment	0	0	0
Investment criterion			
Net present value at 12%	$ 3,470	$ 4,780	$ 3,240
Internal rate of return	18%	16%	20%
Present value index	1.129	1.085	1.106
Ranking by investment criterion			
Net present value	2	1	3
Internal rate of return	2	3	1
Present value index	1	3	2

$$\text{Present value index} = \frac{\$30{,}370{,}000}{\$26{,}900{,}000} = 1.129$$

Using this criterion, projects that have a present value index of 1.0 or higher are acceptable, and the project with the highest present value index is preferred. Ranking the proposals in Exhibit E-8 on the basis of their present value index results in Proposal A being ranked number 1.

We now have three acceptable proposals, three criteria, three different rankings, and the task of selecting only one of the three proposals. Many managers would select Proposal C because it has the highest IRR or Proposal A because it has the highest present value index. Either selection provides a satisfactory, but not an optimal, solution to the dilemma. If the true cost of capital is 12 percent and other investment opportunities return only 12 percent, the net present value criterion provides the proper choice. This is illustrated in Exhibit E-9 by evaluating the additional return earned on the differences between Proposals B and A and on the differences between Proposals B and C.

The difference in the net present value and internal rate of return rankings results from differences in their reinvestment assumptions. The net present value model assumes that all net cash inflows from a project are reinvested at the discount rate; the internal rate of return model assumes that all net cash inflows from a project are reinvested at the project's internal rate of return. If unlimited funds are available at the discount rate, marginal investments are made at this rate, and the assumption underlying the net present value model is the correct one. Returning to Exhibit E-9, if all funds not invested in the chosen project and all funds recovered from the chosen project can earn only the discount rate, the firm is $1,540,000 better off by selecting Proposal B rather than Proposal C.

The present value index eliminates the impact of size from net present value computations. However, size is an important consideration in evaluating investment proposals, especially if funds not invested in a project can earn only the discount rate. In Exhibit E-9, we see that if funds not invested in the chosen project can be invested only at the discount rate, the firm is $1,310,000 better off by selecting Proposal B rather than Proposal A.

TAXES IN CAPITAL BUDGETING DECISIONS

LO6 Determine the net present value of investment proposals with consideration of taxes.

To focus on capital budgeting concepts, we deferred consideration of the impact of taxes. Because income taxes affect cash flows and income, their consideration is important in evaluating any business decision.

EXHIBIT E-9 Analysis of Incremental Investments

($ thousands)	Proposal B	Proposal A	Difference B − A
Predicted cash flows			
Initial investment	$(55,960)	$(26,900)	$(29,060)
Operation			
Year 1	20,000	10,000	10,000
Year 2	20,000	10,000	10,000
Year 3	20,000	10,000	10,000
Year 4	20,000	10,000	10,000
Disinvestment	0	0	0

Net present value of difference (B − A)

	Cash Inflows (outflows)	Year(s) of Cash Flows	12% Present Value Factor	Present Value of Cash Flows
Initial investment	$(29,060)	0	1.000	$(29,060)
Operation	10,000	1–4	3.037	30,370
Disinvestment	0	4	0.636	0
Net present value				$ 1,310

	Proposal B	Proposal C	Difference B − C
Predicted cash flows			
Initial investment	$(55,960)	$(30,560)	$(25,400)
Operation			
Year 1	20,000	20,000	0
Year 2	20,000	20,000	0
Year 3	20,000	0	20,000
Year 4	20,000	0	20,000
Disinvestment	0	0	0

Net present value of difference (B − C)

	Cash Inflows (outflows)	Year(s) of Cash Flows	12% Present Value Factor	Present Value of Cash Flows
Initial investment	$(25,400)	0	1.000	$(25,400)
Operation	20,000	2–4	3.037 − 1.690	26,940
Disinvestment	0	4	0.636	0
Net present value				$ 1,540

The cost of investments in plant and equipment is not deducted from taxable revenues in determining taxable income and income taxes at the time of the initial investment. Instead, the amount of the initial investment is deducted as depreciation over the operating life of an asset. To illustrate the impact of taxes on operating cash flows, assume these facts:

- Revenues and operating cash receipts are the same each year.
- Depreciation is the only noncash expense of an organization.

Depreciation Tax Shield

Depreciation does not require the use of cash (the funds were spent at the initial investment), but depreciation is said to provide a "tax shield" because it reduces cash payments for income taxes. The **depreciation tax shield** (the reduction in taxes due to the deductibility of depreciation from taxable revenues) is computed as follows:

Depreciation tax shield = Depreciation × Tax rate

The value of the depreciation tax shield is illustrated using Mobile Yogurt Shoppe's capital expenditure proposal summarized in Exhibit E-2. Assuming a tax rate of 34 percent, the annual net income and after-tax cash flows for this investment without depreciation and with straight-line depreciation are shown in Exhibit E-10. Examine this exhibit, paying particular attention to the lines for depreciation, income taxes, and net annual cash flow.

EXHIBIT E-10 Effect of Depreciation on Taxes, Income, and Cash Flow

Annual Taxes and Income without Depreciation		Annual Taxes and Income with Depreciation	
Sales	$175,000	Sales	$175,000
Operating expenses (except depreciation)	(145,000)	Operating expenses (except depreciation)	(145,000)
Depreciation	0	Depreciation ($90,554 ÷ 5 years)	(18,111)
Income before taxes without depreciation	30,000	Income before taxes with depreciation	11,889
Income taxes (34%)	(10,200)	Income taxes (34%)	(4,042)
Net income	$ 19,800	Net income	$ 7,847

Depreciation reduces income taxes by the amount of depreciation times the tax rate. The difference in taxes, $6,158 ($10,200 − $4,042), is equal to the difference in depreciation multiplied by the tax rate, $6,158 ($18,111 × 0.34).

Annual Taxes and Cash Flow without Depreciation		Annual Taxes and Cash Flow with Depreciation	
Sales	$175,000	Sales	$175,000
Operating expenses (except depreciation)	(145,000)	Operating expenses (except depreciation)	(145,000)
Income taxes	(10,200)	Income taxes	(4,042)
Net annual cash inflow	$ 19,800	Net annual cash inflow	$ 25,958

The deductibility of depreciation for tax purposes reduces cash payments for taxes, thus increasing the net cash flow by the depreciation tax shield. The difference in cash flow, $6,158 ($25,958 − $19,800), is explained by the depreciation multiplied by the tax rate, $6,158 ($18,111 × 0.34). This is the *depreciation tax shield.*

Mobile Yogurt Shoppe's annual depreciation tax shield, using straight-line depreciation, is $6,158, computed as annual depreciation of $18,111 ($90,554 investment in depreciable assets ÷ 5-year life) multiplied by an assumed tax rate of 34 percent. Without the depreciation tax shield, annual cash payments for income taxes would be $6,158 more, and after-tax cash flows would be $6,158 less.

The U.S. Tax Code contains guidelines concerning the depreciation of various types of assets. (Analysis of these guidelines is beyond the scope of this text.) Tax guidelines allow organizations a choice in tax depreciation procedures between straight-line depreciation and an accelerated depreciation method detailed in the Tax Code. Because of the time value of money, profitable businesses should usually select the tax depreciation procedure that provides the earliest depreciation. To illustrate the effect of accelerated depreciation on taxes and capital budgeting, we use double-declining balance depreciation rather than the accelerated method detailed in the Code. When making capital expenditure decisions, managers should, of course, refer to the most current version of the Tax Code to determine the specific depreciation guidelines in effect at that time.

Exhibits E-11 and E-12 illustrate the effect of two alternative depreciation procedures, straight-line and double-declining balance, on the net present value of Mobile Yogurt Shoppe's proposed investment.

EXHIBIT E-11 Analysis of Capital Expenditures Including Tax Effects: Straight-Line Depreciation

	Predicted Cash Inflows (outflows) (A)	Year(s) of Cash Flows (B)	12% Present Value Factor (C)	Present Value of Cash Flows (A) × (C)
Initial investment				
Vehicle and equipment	$(90,554)	0	1.000	$ (90,554)
Inventory and other working capital	(4,000)	0	1.000	(4,000)
Operations				
Annual taxable income without depreciation	30,000	1–5	3.605	108,150
Taxes on income ($30,000 × 0.34)	(10,200)	1–5	3.605	(36,771)
Depreciation tax shield*	6,158	1–5	3.605	22,200
Disinvestment				
Sale of vehicle and equipment	8,000	5	0.567	4,536
Taxes on gain on sale ($8,000 × 0.34)	(2,720)	5	0.567	(1,542)
Inventory and other working capital	4,000	5	0.567	2,268
Net present value of all cash flows				$ 4,287

*Computation of depreciation tax shield:

Annual straight-line depreciation ($90,554 ÷ 5)	$18,111
Tax rate	× 0.34
Depreciation tax shield	$ 6,158

We assume that the asset is fully depreciated for tax purposes during its five-year life and is sold for a taxable gain equal to its predicted salvage value. The cash flows for this investment were presented in Exhibit E-2, and the effect of taxes on the investment's annual cash flows were examined in Exhibit E-10. Ignoring taxes, the investment was shown (in Exhibit E-3) to have a positive net present value of $20,400 at a discount rate of 12 percent. With taxes, the investment has a positive net present value of $4,287 using straight-line depreciation and $6,084 using double-declining balance depreciation. Although taxes over the entire life of the project are identical, the use of double-declining balance depreciation for taxes results in a higher net present value because it results in lower cash expenditures for taxes in the earlier years of an asset's life.

Investment Tax Credit

From time-to-time, for the purpose of stimulating investment and economic growth, the U.S. federal government has implemented an investment tax credit. An **investment tax credit** reduces taxes in the year a new asset is placed in service by some stated percentage of the cost of the asset. Typically, this is done without reducing the depreciation base of the asset for tax purposes. An investment tax credit reduces cash

EXHIBIT E-12 Analysis of Incremental Investments

Predicted	Cash Inflows (outflows) (A)	12% Year(s) of Cash Flows (B)	Present Present Value Factor (C)	Value of Cash Flows (A) × (C)
Initial investment				
Vehicle and equipment	$(90,554)	0	1.000	$ (90,554)
Inventory and other working capital	4,000	0	1.000	(4,000)
Operations				
Annual taxable income without depreciation	30,000	1–5	3.605	108,150
Taxes on income ($30,000 × 0.34)	(10,200)	1–5	3.605	(36,771)
Depreciation tax shield*				
Year 1	12,315	1	0.893	10,997
Year 2	7,389	2	0.797	5,889
Year 3	4,434	3	0.712	3,157
Year 4	2,660	4	0.636	1,692
Year 5	3,990	5	0.567	2,262
Disinvestment				
Sale of vehicle and equipment	8,000	5	0.567	4,536
Taxes on gain on sale ($8,000 × 0.34)	(2,720)	5	0.567	(1,542)
Inventory and other working capital	4,000	5	0.567	2,268
Net present value of all cash flows				$ 6,084

*Computation of depreciation tax shield:

Year	Depreciation Base† (A)	Annual Rate (B)	Annual Depreciation (C) = (A) × (B)	Tax Rate (D)	Tax Shield (E) = (C) × (D)
1	$90,554	2/5	$36,222	0.34	$12,315
2	54,332	2/5	21,733	0.34	7,389
3	32,599	2/5	13,040	0.34	4,434
4	19,559	2/5	7,824	0.34	2,660
5	11,735	balance	11,735	0.34	3,990

†The depreciation base is reduced by the amount of all previous depreciation. The annual rate is twice the straight-line rate. For simplicity, we depreciated the remaining balance in the fifth year and did not switch to straight-line depreciation when the straight-line amount exceeds the double-declining balance amount. This-would happen in the fourth year, when $19,559 ÷ 2 = $9,780.

payments for taxes and, hence, is treated as a cash inflow for capital budgeting purposes. This additional cash inflow increases the probability that a new asset will meet a taxpayer's capital expenditure criteria.

SUMMARY

Capital budgeting is the identification of potentially desirable projects for capital expenditures, the subsequent evaluation of capital expenditure proposals, and the selection of proposals that meet certain criteria. This module presented a number of *capital budgeting models* used to assist managers in evaluating capital expenditure proposals. We saw that capital budgeting models that consider the *time value of money*, such

as *net present value* and *internal rate of return*, are superior to capital budgeting models that do not consider the time value of money, such as the *payback period* and the *accounting rate of return*.

It is important to remember that capital budgeting models do not make investment decisions. Rather, they help managers separate capital expenditure proposals that meet certain criteria from those that do not. In making the final decision to accept or reject a capital expenditure proposal that has passed the initial screening, nonquantitative factors, such as management's attitude toward risk, are apt to play a decisive role.

In the latter portion of this module, we outlined some suggested approaches to analyzing risk, illustrated how differential analysis can aid in evaluating capital expenditure proposals that do not produce additional cash inflows, and discussed the problems involved in selecting from among *mutually exclusive investments*. We concluded by considering the impact of *taxes* and the *depreciation tax shield* on capital expenditure proposals.

MODULE-END REVIEW

Consider the following investment proposal:

Initial investment	
Depreciable assets	$27,740
Working capital	3,000
Operations (per year for 4 years)	
Cash receipts	25,000
Cash expenditures	15,000
Disinvestment	
Salvage value of plant and equipment	2,000
Recovery of working capital	3,000

Required

Determine each of the following:

a. Net present value at a 10 percent discount rate.
b. Internal rate of return. (Refer to Appendix E-B if using the table approach.)
c. Payback period.
d. Accounting rate of return on initial investment and on average investment.

Solution

Basic computations:

Initial investment	
Depreciable assets	$27,740
Working capital	3,000
Total	$30,740
Operation	
Cash receipts	$25,000
Cash expenditures (15,000)	
Net cash inflow	$10,000
Disinvestment	
Sale of depreciable assets	$ 2,000
Recovery of working capital	3,000
Total	$ 5,000

a. Net present value at a 10 percent discount rate:

	Predicted Cash Inflows (outflows) (A)	Year(s) of Cash Flows (B)	10% Present Value Factor (C)	Present Value of Cash Flows (A) × (C)
Initial investment	$(30,740)	0	1.000	$(30,740)
Operation	10,000	1–4	3.170	31,700
Disinvestment	5,000	4	0.683	3,415
Net present value of all cash flows				$ 4,375

b. Internal rate of return:
Using a spreadsheet, the proposal's internal rate of return is readily determined to be 16 percent:

	A	B
1	Year of cash flow	Cash flow
2	0	$(30,740)
3	1	10,000
4	2	10,000
5	3	10,000
6	4	15,000
7	IRR	0.16

The table approach requires additional analysis. Because the proposal has a positive net present value when discounted at 10 percent, its internal rate of return must be higher than 10 percent. Through a trial-and-error approach, the internal rate of return is determined to be 16 percent.

	Predicted Cash Inflows (outflows) (A)	Year(s) of Cash Flows (B)	16% Present Value Factor (C)	Present Value of Cash Flows (A) × (C)
Initial investment	$(30,740)	0	1.000	$(30,740)
Operation	10,000	1–4	2.798	27,980
Disinvestment	5,000	4	0.552	2,760
Net present value of all cash flows				$ 0

c. Payback period = $30,740 ÷ $10,000
= 3.074 years

d. Accounting rate of return on initial and average investments:

Annual net cash inflow from operations	$10,000
Less average annual depreciation ([$27,740 − $2,000] ÷ 4)	(6,435)
Average annual increase in net income	$ 3,565

$$\text{Average investment} = (\$30{,}740 + \$5{,}000) \div 2$$
$$= \$17{,}870$$
$$\text{Accounting rate of return on initial investment} = \frac{\$3{,}565}{\$30{,}740}$$
$$= 0.1160, \text{ or } 11.6\%$$
$$\text{Accounting rate of return on average investment} = \frac{\$3{,}565}{\$17{,}870}$$
$$= 0.1995, \text{ or } 19.95\%$$

APPENDIX E-A: Time Value of Money

When asked to choose between $500 today or an IOU for $500 to be paid one year later, rational decision makers choose the $500 today. Two reasons for this involve the time *value of money* and the *risk*. A dollar today is worth more than a dollar tomorrow or at some future time. Having a dollar provides flexibility. It can be spent, buried, or invested in a number of projects. If invested in a savings account, it will amount to more than one dollar at some future time because of the effect of interest. The interest paid by a bank (or borrower) for the use of money is analogous to the rent paid for the use of land, buildings, or equipment. Furthermore, we live in an uncertain world, and, for a variety of reasons, the possibility exists that an IOU might not be paid.

Future Value

Future value is the amount that a current sum of money earning a stated rate of interest will accumulate to at the end of a future period. Suppose we deposit $500 in a savings account at a financial institution that pays interest at the rate of 10 percent per year. At the end of the first year, the original deposit of $500 will total $550 ($500 × 1.10). If we leave the $550 for another year, the amount will increase to $605 ($550 × 1.10). It can be stated that $500 today has a future value in one year of $550, or conversely, that $550 one year from today has a present value of $500. Interest of $55 ($605 − $550) was earned in the second year, whereas interest of only $50 was earned in the first year. This happened because interest during the second year was earned on the principal plus interest from the first year ($550). When periodic interest is computed on principal plus prior periods' accumulated interest, the interest is said to be *compounded*. Compound interest is used throughout this text.

To determine future values at the end of one period (usually a year), multiply the beginning amount (present value) by 1 plus the interest rate. When multiple periods are involved, the future value is determined by repeatedly multiplying the beginning amount by 1 plus the interest rate for each period. When $500 is invested for two years at an interest rate of 10 percent per year, its future value is computed as $500 × 1.10 × 1.10. The following equation is used to figure future value:

$$\mathbf{fv = pv(1 + i)^n}$$

where:

fv = future value amount
pv = present value amount
i = interest rate per period
n = number of periods

For our $500 deposit, the equation becomes:

$$\begin{aligned}\textbf{fv of \$500} &= \textbf{pv}(1 + \textbf{i})^{\textbf{n}} \\ &= \textbf{\$500}(1 + \textbf{0.10})^{\textbf{2}} \\ &= \textbf{\$605}\end{aligned}$$

In a similar manner, once the interest rate and number of periods are known, the future value amount of any present value amount is easily determined.

Present Value

Present value is the current worth of a specified amount of money to be received at some future date at some interest rate. Solving for pv in the future value equation, the new present value equation is determined as follows:

$$\mathbf{pv} = \frac{\mathbf{fv}}{(\mathbf{1 + i})^{\mathbf{n}}}$$

Using this equation, the present value of $8,800 to be received in one year, discounted at 10 percent, is computed as follows:

$$\begin{aligned}\textbf{pv of \$8,800} &= \frac{\textbf{\$8,800}}{(\textbf{1 + 0.10})^{\textbf{1}}} \\ &= \frac{\textbf{\$8,800}}{(\textbf{1.10})} \\ &= \textbf{\$8,000}\end{aligned}$$

Thus, when the discount rate is 10 percent, the present value of $8,800 to be received in one year is $8,000.

The present value equation is often expressed as the future value amount times the present value of $1:

$$pv = fv \times \frac{\$1}{(1 + i)^n}$$

Using the equation for the present value of $1, the present value of $8,800 to be received in one year, discounted at 10 percent, is computed as follows:

$$\begin{aligned} \text{pv of \$8,800} &= \$8{,}800 \times \frac{\$1}{(1 + 0.10)^1} \\ &= \$8{,}800 \times 0.909 \\ &= \$8{,}000 \end{aligned}$$

The present value of $8,800 two periods from now is $7,273, computed as [$8,800 ÷ $(1.10)^2$] or [$8,800 × $1 ÷ $(1.10)^2$].

If a calculator is not available, present value computations can be done by hand. Tables, such as Table 10-1 for the present value of $1 at various interest rates and time periods, can be used to simplify hand computations. Using the factors in Table 10-1, the present values of any future amount can be determined. For example, with an interest rate of 10 percent, the present value of the following future amounts to be received in one period are as follows:

Future Value Amount		Present Value Factor of $1		Present Value
$ 100	×	0.909	=	$ 90.90
628	×	0.909	=	570.85
4,285	×	0.909	=	3,895.07
9,900	×	0.909	=	8,999.10

To further illustrate the use of Table 10-1, consider the following application. Alert Company wants to invest its surplus cash at 12 percent to have $10,000 to pay off a long-term note due at the end of five years. Table 10-1 shows that the present value factor of $1, discounted at 12 percent per year for five years, is 0.567. Multiplying $10,000 by 0.567, the present value is determined to be $5,670:

$$\begin{aligned} \text{pv of \$10,000} &= \$10{,}000 \times \text{Present value factor for \$1} \\ &= \$10{,}000 \times 0.567 \\ &= \$5{,}670 \end{aligned}$$

Therefore, if Alert invests $5,670 today, it will have $10,000 available to pay off its note in five years.

Managers also use present value tables to make investment decisions. Assume that Monroe Company can make an investment that will provide a cash flow of $12,000 at the end of eight years. If the company demands a rate of return of 14 percent per year, what is the most it will be willing to pay for this investment? From Table EA.1, we find that the present value factor for $1, discounted at 14 percent per year for eight years, is 0.351:

$$\begin{aligned} \text{pv of \$12,000} &= \$12{,}000 \times \text{Present value factor for \$1} \\ &= \$12{,}000 \times 0.351 \\ &= \$4{,}212 \end{aligned}$$

If the company demands an annual return of 14 percent, the most it would be willing to invest today is $4,212.

Annuities

Not all investments provide a single sum of money. Many investments provide periodic cash flows called *annuities*. An **annuity** is a series of equal cash flows received or paid over equal intervals of time. Suppose that $100 will be received at the end of each of the next three years. If the discount rate is 10 percent, the present value of this annuity can be determined by summing the present value of each receipt:

Year 1 $100 × $1 ÷ (1 + 0.10)1 =	$ 90.90
Year 2 $100 × $1 ÷ (1 + 0.10)2 =	82.65
Year 3 $100 × $1 ÷ (1 + 0.10)3 =	75.13
Total	$248.68

Alternatively, the following equation can be used to compute the present value of an annuity with cash flows at the end of each period:

TABLE E-A-1 Present Value of $1

$$\text{Present value of \$1} = \frac{1}{(1 + r)^n}$$

Periods (n)	Discount rate (r)												
	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%	26%	28%	30%
1	0.943	0.926	0.909	0.893	0.877	0.862	0.847	0.833	0.820	0.806	0.794	0.781	0.769
2	0.890	0.857	0.826	0.797	0.769	0.743	0.718	0.694	0.672	0.650	0.630	0.610	0.592
3	0.840	0.794	0.751	0.712	0.675	0.641	0.609	0.579	0.551	0.524	0.500	0.477	0.455
4	0.792	0.735	0.683	0.636	0.592	0.552	0.516	0.482	0.451	0.423	0.397	0.373	0.350
5	0.747	0.681	0.621	0.567	0.519	0.476	0.437	0.402	0.370	0.341	0.315	0.291	0.269
6	0.705	0.630	0.564	0.507	0.456	0.410	0.370	0.335	0.303	0.275	0.250	0.227	0.207
7	0.665	0.583	0.513	0.452	0.400	0.354	0.314	0.279	0.249	0.222	0.198	0.178	0.159
8	0.627	0.540	0.467	0.404	0.351	0.305	0.266	0.233	0.204	0.179	0.157	0.139	0.123
9	0.592	0.500	0.424	0.361	0.308	0.263	0.225	0.194	0.167	0.144	0.125	0.108	0.094
10	0.558	0.463	0.386	0.322	0.270	0.227	0.191	0.162	0.137	0.116	0.099	0.085	0.073
11	0.527	0.429	0.350	0.287	0.237	0.195	0.162	0.135	0.112	0.094	0.079	0.066	0.056
12	0.497	0.397	0.319	0.257	0.208	0.168	0.137	0.112	0.092	0.076	0.062	0.052	0.043
13	0.469	0.368	0.290	0.229	0.182	0.145	0.116	0.093	0.075	0.061	0.050	0.040	0.033
14	0.442	0.340	0.263	0.205	0.160	0.125	0.099	0.078	0.062	0.049	0.039	0.032	0.025
15	0.417	0.315	0.239	0.183	0.140	0.108	0.084	0.065	0.051	0.040	0.031	0.025	0.020
16	0.394	0.292	0.218	0.163	0.123	0.093	0.071	0.054	0.042	0.032	0.025	0.019	0.015
17	0.371	0.270	0.198	0.146	0.108	0.080	0.060	0.045	0.034	0.026	0.020	0.015	0.012
18	0.350	0.250	0.180	0.130	0.095	0.069	0.051	0.038	0.028	0.021	0.016	0.012	0.009
19	0.331	0.232	0.164	0.116	0.083	0.060	0.043	0.031	0.023	0.017	0.012	0.009	0.007
20	0.312	0.215	0.149	0.104	0.073	0.051	0.037	0.026	0.019	0.014	0.010	0.007	0.005

$$\text{pva} = \frac{\text{a}}{\text{i}} \times \left[1 - \frac{1}{(1 + 0.10)^{\text{n}}}\right]$$

where:

pva = present value of an annuity (also called the annuity factor)
i = prevailing rate per period
n = number of periods
a = annuity amount

This equation was used to compute the factors presented in Table EA.2 for an annuity amount of $1. The present value of an annuity of $1 per period for three periods discounted at 10 percent per period is as follows:

$$\begin{aligned}\text{pva of \$1} &= \frac{1}{0.10} \times \left[1 - \frac{1}{(1 + 0.10)^3}\right] \\ &= 2.4868\end{aligned}$$

Using this factor, the present value of a $100 annuity can be computed as $100 × 2.4868, which yields $248.68. To determine the present value of an annuity of any amount, the annuity factor for $1 can be multiplied by the annuity amount.

To further illustrate the use of Table EA.2, assume that Red Kite Company is considering an investment in a piece of equipment that will produce net cash inflows of $2,000 at the end of each year for five years. If the company's desired rate of return is 12 percent, an investment of $7,210 will provide such a return:

$$\begin{aligned}\text{pva of \$2,000} &= \$2{,}000 \times \begin{array}{l}\text{Present value factor for an annuity of} \\ \text{\$1 for five periods discounted at 12\%}\end{array} \\ &= \$2{,}000 \times 3.605 \\ &= \$7{,}210\end{aligned}$$

Here, the $2,000 annuity is multiplied by 3.605, the factor for an annuity of $1 for five periods found in Table EA.2, discounted at 12 percent per period.

Another use of Table EA.2 is to determine the amount that must be received annually to provide a desired rate of return on an investment. Assume that Burnsville Company invests $33,550 and desires a return of the investment plus interest of 8 percent in equal year-end payments for ten years. The minimum amount that must be received each year is determined by solving the equation for the present value of an annuity:

$$\text{pva} = \text{a} \times (\text{pva of \$1})$$

$$\text{a} = \frac{\text{pva}}{\text{pva of \$1}}$$

From Table EA.2, we see that the 8 percent factor for ten periods is 6.710. Dividing the $33,550 investment by 6.710, the required annuity is computed to be $5,000:

$$\begin{aligned}\text{a} &= \frac{\$33{,}550}{6.710} \\ &= \$5{,}000\end{aligned}$$

Unequal Cash Flows

Many investment situations do not produce equal periodic cash flows. When this occurs, the present value for each cash flow must be determined independently because the annuity table can be used only for equal periodic cash flows. Table EA.1 is used to determine the present value of each future amount separately. To illustrate, assume that the **Atlanta Braves** wish to acquire the contract of a popular baseball player who is known to attract large crowds. Management believes this player will return incremental cash flows to the team at the end of each of the next three years in the amounts of $2,500,000, $4,000,000, and $1,500,000. After three years, the player anticipates retiring. If the team's owners require a minimum return of 14 percent on their investment, how much would they be willing to pay for the player's contract?

To solve this problem, it is necessary to determine the present value of the expected future cash flows. Here we use Table EA.1 to find the $1 present value factors at 14 percent for Periods 1, 2, and 3. The cash flows are then multiplied by these factors:

TABLE E-A-2 Present Value of an Annuity of $1

$$\text{Present value of an annuity of \$1} = \frac{1}{r}\left[1 - \frac{1}{(1+r)^n}\right]$$

Discount rate (r)

Periods (n)	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%	25%	26%	28%	30%
1	0.943	0.926	0.909	0.893	0.877	0.862	0.847	0.833	0.820	0.806	0.800	0.794	0.781	0.769
2	1.833	1.783	1.736	1.690	1.647	1.605	1.566	1.528	1.492	1.457	1.440	1.424	1.392	1.361
3	2.673	2.577	2.487	2.402	2.322	2.246	2.174	2.106	2.042	1.981	1.952	1.923	1.868	1.816
4	3.465	3.312	3.170	3.037	2.914	2.798	2.690	2.589	2.494	2.404	2.362	2.320	2.241	2.166
5	4.212	3.993	3.791	3.605	3.433	3.274	3.127	2.991	2.864	2.745	2.689	2.635	2.532	2.436
6	4.917	4.623	4.355	4.111	3.889	3.685	3.498	3.326	3.167	3.020	2.951	2.885	2.759	2.643
7	5.582	5.206	4.868	4.564	4.288	4.039	3.812	3.605	3.416	3.242	3.161	3.083	2.937	2.802
8	6.210	5.747	5.335	4.968	4.639	4.344	4.078	3.837	3.619	3.421	3.329	3.241	3.076	2.925
9	6.802	6.247	5.759	5.328	4.946	4.607	4.303	4.031	3.786	3.566	3.463	3.366	3.184	3.019
10	7.360	6.710	6.145	5.650	5.216	4.833	4.494	4.192	3.923	3.682	3.571	3.465	3.269	3.092
11	7.887	7.139	6.495	5.938	5.453	5.029	4.656	4.327	4.035	3.776	3.656	3.544	3.335	3.147
12	8.384	7.536	6.814	6.194	5.660	5.197	4.793	4.439	4.127	3.851	3.725	3.606	3.387	3.190
13	8.853	7.904	7.103	6.424	5.842	5.342	4.910	4.533	4.203	3.912	3.780	3.656	3.427	3.223
14	9.295	8.244	7.367	6.628	6.002	5.468	5.008	4.611	4.265	3.962	3.824	3.695	3.459	3.249
15	9.712	8.559	7.606	6.811	6.142	5.575	5.092	4.675	4.315	4.001	3.859	3.726	3.483	3.268
16	10.106	8.851	7.824	6.974	6.265	5.669	5.162	4.730	4.357	4.033	3.887	3.751	3.503	3.283
17	10.477	9.122	8.022	7.120	6.373	5.749	5.222	4.775	4.391	4.059	3.910	3.771	3.518	3.295
18	10.828	9.372	8.201	7.250	6.467	5.818	5.273	4.812	4.419	4.080	3.928	3.786	3.529	3.304
19	11.158	9.604	8.365	7.366	6.550	5.877	5.361	4.844	4.442	4.097	3.942	3.799	3.539	3.311
20	11.470	9.818	8.514	7.469	6.623	5.929	5.353	4.870	4.460	4.110	3.954	3.808	3.546	3.316

Year	Annual Cash Flow		Present Value of $1 at 14 Percent		Present Value Amount
1	$2,500,000	×	0.877	=	$2,192,500
2	4,000,000	×	0.769	=	3,076,000
3	1,500,000	×	0.675	=	1,012,500
Total					$6,281,000

The total present value of the cash flows for the three years, $6,281,000, represents the maximum amount the team would be willing to pay for the player's contract.

Deferred Returns

Many times, organizations make investments for which they receive no cash until several periods have passed. The present value of an investment discounted at 12 percent per year, which has a $2,000 return only at the end of Years 4, 5, and 6, can be determined as follows:

Year	Amount		Present Value of $1 at 12 Percent		Present Value Amount
1	$ 0	×	0.893	=	$ 0
2	0	×	0.797	=	0
3	0	×	0.712	=	0
4	2,000	×	0.636	=	1,272
5	2,000	×	0.567	=	1,134
6	2,000	×	0.507	=	1,014
Total					$3,420

Computation of the present value of the deferred annuity can also be performed using the annuity tables if the cash flow amounts are equal for each period. The present value of an annuity for six years minus the present value of an annuity for three years yields the present value of an annuity for Years 4 through 6.

Present value of an annuity for 6 years at 12 percent: $2,000 × 4.111 =	$8,222
Present value of an annuity for 3 years at 12 percent: 2,000 × 2.402 =	(4,804)
Present value of the deferred annuity	$3,418*

*The difference between the $3,420 above and the $3,418 here is due to rounding.

APPENDIX E-B: Table Approach to Determining Internal Rate of Return

We consider the use of present value tables to determine the internal rate of return of a series of cash flows with (1) equal net cash flows after the initial investment and (2) unequal net cash flows after the initial investment.

Equal Cash Inflows

An investment proposal's internal rate of return is easily determined when a single investment is followed by a series of equal annual net cash flows. The general relationship between the initial investment and the equal annual cash inflows is expressed as follows:

$$\text{Initial investment} = \text{Present value factor for an annuity of \$1} \times \text{Annual net cash inflow}$$

Solve for the appropriate present value factor as follows:

$$\text{Present value factor for an annuity of \$1} = \frac{\text{Initial investment}}{\text{Annual net cash inflows}}$$

Once the present value factor is calculated, use Table EA.2 and go across the row corresponding to the expected life of the project until a table factor equal to or closest to the project's computed present value factor is found. The corresponding percentage for the present value factor is the proposal's internal rate of return. If a table factor does not exactly equal the proposal's present value factor, a more accurate answer can be obtained by interpolation (which is not discussed in this text).

To illustrate, assume that Mobile Yogurt Shoppe's proposed investment has a zero disinvestment value. Using all information in Exhibit E-2 (except that for disinvestment), the proposal's present value factor is 3.152:

$$\text{Present value factor for an annuity of \$1} = \frac{\text{Initial investment}}{\text{Annual net cash inflows}}$$
$$= \frac{\$94{,}554}{\$30{,}000}$$
$$= 3.152$$

Using Table EA.2, go across the row for five periods; the closest table factor is 3.127, which corresponds to an internal rate of return of 18 percent.

Unequal Cash Inflows

If periodic cash flows subsequent to the initial investment are unequal, the simple procedure of determining a present value factor and looking up the closest corresponding factor in Table EA.2 cannot be used. Instead, a trial-and-error approach must be used to determine the internal rate of return.

The first step is to select a discount rate estimated to be close to the proposal's IRR and to compute the proposal's net present value. If the resulting net present value is zero, the selected discount rate is the actual rate of return. However, it is unlikely that the first rate selected will be the proposal's IRR. If the computation results in a positive net present value, the actual IRR is higher than the initially selected rate. In this case, the next step is to compute the proposal's net present value using a higher rate. If the second computation produces a negative net present value, the actual IRR is less than the selected rate. Therefore, the actual IRR is between the first and the second rates. This trial-and-error approach continues until a discount rate is found that equates the proposal's cash inflows and outflows. For Mobile Yogurt Shoppe's investment proposal outlined in Exhibit E-2, the details of the trial-and-error approach are presented in Exhibit E-B-1.

In Exhibit E-B-1 the first rate produced a negative net present value, indicating that the proposal's IRR is less than 24 percent. To produce a positive net present value, a smaller rate was selected for the second trial. Since the second rate produced a positive net present value, the proposal's true IRR must be between 16 and 24 percent. The 20 percent rate selected for the third trial produced a net present value of zero, indicating that this is the proposal's IRR.

Superscript [A] denotes assignments based on Appendix E-A.

QUESTIONS

QE-1 What is the relationship between long-range planning and capital budgeting?

QE-2 What tasks are often assigned to the capital budgeting committee?

QE-3 What purposes are served by a post-audit of approved capital expenditure proposals?

QE-4 Into what three phases are a project's cash flows organized?

QE-5 State three alternative definitions or descriptions of the internal rate of return.

QE-6 Why is the cost of capital an important concept when discounting models are used for capital budgeting?

QE-7 What weakness is inherent in the payback period when it is used as the sole investment criterion?

QE-8 What weakness is inherent in the accounting rate of return when it is used as an investment criterion?

QE-9 Why are the net present value and the internal rate of return models superior to the payback period and the accounting rate of return models?

QE-10 State two basic differences between the net present value and the internal rate of return models that often lead to differences in the evaluation of competing investment proposals.

QE-11 Identify several nonquantitative factors that are apt to play a decisive role in the final selection of projects for capital expenditures.

QE-12 In what way does depreciation affect the analysis of cash flows for a proposed capital expenditure?

EXHIBIT E-B-1 Internal Rate of Return with Unequal Cash Flows

First trial with a 24 percent discount rate

Predicted	Cash Inflows (outflows) (A)	24% Year(s) of Cash Flows (B)	Present Present Value Factor (C)	Value of Cash Flows (A) × (C)
Initial investment	$(94,554)	0	1.000	$(94,554)
Operation	30,000	1–5	2.745	82,350
Disinvestment	12,000	5	0.341	4,092
Net present value of all cash flows				$ (8,112)

Second trial with a 16 percent discount rate

Predicted	Cash Inflows (outflows) (A)	16% Year(s) of Cash Flows (B)	Present Present Value Factor (C)	Value of Cash Flows (A) × (C)
Initial investment	$(94,554)	0	1.000	$(94,554)
Operation	30,000	1–5	3.274	98,220
Disinvestment	12,000	5	0.476	5,712
Net present value of all cash flows				$ 9,378

Third trial with a 20 percent discount rate

Predicted	Cash Inflows (outflows) (A)	20% Year(s) of Cash Flows (B)	Present Present Value Factor (C)	Value of Cash Flows (A) × (C)
Initial investment	$(94,554)	0	1.000	$(94,554)
Operation	30,000	1–5	2.991	89,730
Disinvestment	12,000	5	0.402	4,824
Net present value of all cash flows				$ 0

EXERCISES

E E-13[A] Time Value of Money: Basics (LO2)

Using the equations and tables in Appendix E-A of this module, determine the answers to each of the following independent situations:

a. The future value in two years of $1,000 deposited today in a savings account with interest compounded annually at 6 percent.

b. The present value of $9,000 to be received in four years, discounted at 12 percent.

c. The present value of an annuity of $2,000 per year for five years discounted at 14 percent.

d. An initial investment of $32,010 is to be returned in eight equal annual payments. Determine the amount of each payment if the interest rate is 10 percent.

e. A proposed investment will provide cash flows of $20,000, $8,000, and $6,000 at the end of Years 1, 2, and 3, respectively. Using a discount rate of 20 percent, determine the present value of these cash flows.

f. Find the present value of an investment that will pay $4,000 at the end of Years 10, 11, and 12. Use a discount rate of 14 percent.

E E-14[A] Time Value of Money: Basics (LO2)

Using the equations and tables in Appendix E-A of this module, determine the answers to each of the following independent situations:

a. The future value in two years of $4,000 invested today in a certificate of deposit with interest compounded annually at 10 percent.
b. The present value of $6,000 to be received in five years, discounted at 8 percent.
c. The present value of an annuity of $20,000 per year for four years discounted at 12 percent.
d. An initial investment of $29,480 is to be returned in six equal annual payments. Determine the amount of each payment if the interest rate is 16 percent.
e. A proposed investment will provide cash flows of $6,000, $8,000, and $20,000 at the end of Years 1, 2, and 3, respectively. Using a discount rate of 18 percent, determine the present value of these cash flows.
f. Find the present value of an investment that will pay $6,000 at the end of Years 8, 9, and 10. Use a discount rate of 12 percent.

E E-15 NPV and IRR: Equal Annual Net Cash Inflows (LO2)

Apache Junction Company is evaluating a capital expenditure proposal that requires an initial investment of $9,350, has predicted cash inflows of $2,000 per year for 15 years, and has no salvage value.

Required

a. Using a discount rate of 16 percent, determine the net present value of the investment proposal.
b. Determine the proposal's internal rate of return. (Refer to Appendix E-B if you use the table approach.)
c. What discount rate would produce a net present value of zero?

E E-16 NPV and IRR: Equal Annual Net Cash Inflows (LO2)

Sun Devil Company is evaluating a capital expenditure proposal that requires an initial investment of $32,160, has predicted cash inflows of $7,500 per year for seven years, and has no salvage value.

Required

a. Using a discount rate of 18 percent, determine the net present value of the investment proposal.
b. Determine the proposal's internal rate of return. (Refer to Appendix E-B if you use the table approach.)
c. What discount rate would produce a net present value of zero?

E E-17 NPV and IRR: Unequal Annual Net Cash Inflows (LO2)

Assume that **Goodrich Corporation** is evaluating a capital expenditure proposal that has the following predicted cash flows:

Initial investment	$(85,160)
Operation	
Year 1	36,000
Year 2	50,000
Year 3	40,000
Salvage	0

Required

a. Using a discount rate of 12 percent, determine the net present value of the investment proposal.
b. Determine the proposal's internal rate of return. (Refer to Appendix E-B if you use the table approach.)

E E-18 NPV and IRR: Unequal Annual Net Cash Inflows (LO2)

Salt River Company is evaluating a capital expenditure proposal that has the following predicted cash flows:

Initial investment	$(43,270)
Operation	
Year 1	20,000
Year 2	30,000
Year 3	10,000
Salvage	0

Required

a. Using a discount rate of 14 percent, determine the net present value of the investment proposal.
b. Determine the proposal's internal rate of return. (Refer to Appendix E-B if you use the table approach.)

E E-19 Payback Period and the Accounting Rate of Return (LO3)

Following is information pertaining to three capital expenditure proposals:

	Proposal X	Proposal Y	Proposal Z
Initial investment			
Depreciable assets	$70,000	$120,000	$90,000
Working capital	0	0	10,000
Net cash inflow from operations (per year for 4 years)	20,000	40,000	25,000
Disinvestment			
Depreciable assets	0	20,000	10,000
Working capital	0	0	10,000

Required

a. Determine each proposal's payback period.

b. Determine each proposal's accounting rate of return on:
1. Initial investment.
2. Average investment.

c. Why is the accounting rate of return higher on an average investment than on an initial investment?

E E-20 Payback Period, IRR, and Minimum Cash Flows (LO2, 3)

The management of Mesquite Limited is currently evaluating the following investment proposal:

	Time 0	Year 1	Year 2	Year 3	Year 4
Initial investment	$240,000	—	—	—	—
Net operating cash inflows	—	$100,000	$100,000	$100,000	$100,000

Required

a. Determine the proposal's payback period.

b. Determine the proposal's internal rate of return. (Refer to Appendix E-B if you use the table approach.)

c. Given the amount of the initial investment, determine the minimum annual net cash inflows required to obtain an internal rate of return of 14 percent. Round the answer to the nearest dollar.

E E-21 Time-Adjusted Cost-Volume-Profit Analysis (LO2, 3)

Mill Avenue Treat Shop is considering the desirability of producing a new chocolate candy called Pleasure Bombs, Before purchasing the new equipment required to manufacture Pleasure Bombs, Zita Peña, the shop's proprietor performed the following analysis:

Unit selling price	$1.45
Variable manufacturing and selling costs	(1.15)
Unit contribution margin	$0.30
Annual fixed costs	
Depreciation (straight line for 3 years)	$ 20,000
Other (all cash)	25,000
Total	$45,000
Annual break-even sales volume = $45,000 ÷ $0.30 = 150,000 units	

Because the expected annual sales volume is 150,000 units, Zita decided to undertake the production of Pleasure Bombs. This required an immediate investment of $60,000 in equipment that has a life of three years and no salvage value. After three years, the production of Pleasure Bombs will be discontinued.

Required

a. Evaluate the analysis performed by Zita Peña

b. If Mill Avenue Treat Shop has a time value of money of 14 percent, should it make the investment with projected annual sales of 160,000 units?

c. Considering the time value of money, what annual unit sales volume is required to break even?

E E-22 Time-Adjusted Cost-Volume-Profit Analysis with Income Taxes (LO6)

Assume the same facts as given in Exercise E-21.

Required

With a 40 percent tax rate and a 14 percent time value of money, determine the annual unit sales required to break even on a time-adjusted basis.

PROBLEMS

P E-23 Ranking Investment Proposals: Payback Period, Accounting Rate of Return, and Net Present Value (LO2, 3, 4)

Presented is information pertaining to the cash flows of three mutually exclusive investment proposals:

	Proposal X	Proposal Y	Proposal Z
Initial investment	$45,000	$45,000	$45,000
Cash flow from operations			
Year 1	40,000	22,500	45,000
Year 2	5,000	22,500	
Year 3	22,500	22,500	
Disinvestment	0	0	0
Life (years)	3 years	3 years	1 year

Required

a. Rank these investment proposals using the payback period, the accounting rate of return on initial investment, and the net present value criteria. Assume that the organization's cost of capital is 14 percent. Round calculations to four decimal places.

b. Explain the difference in rankings. Which investment would you recommend?

P E-24 Ranking Investment Proposals: Net Present Value and Present Value Index (LO2, 4)

Assume that Nestlé Purina is considering the replacement of its traditional canned dog food with dog food packaged in either resealable plastic containers or in disposable foil-lined pouches. Although either alternative will produce significant cost savings and marketing benefits, limitations on available shelf space in stores require management to select only one alternative. Cash flow information on each alternative follows.

	Plastic Containers	Lined Pouches
Initial investment in necessary equipment	$50,000	$150,000
Increase in annual net cash flows	$20,000	$56,000
Life of equipment (years)	5 years	5 years
Salvage value of equipment	$10,000	$12,000

Nestlé Purina has a 12 percent cost of capital.

Required

a. Evaluate the investment alternatives using the net present value and the present value index criteria.

b. Explain the difference in rankings. Which investment would you recommend?

P E-25 Ranking Investment Proposals: Net Present Value and Present Value Index (LO2, 4)

Ocean Breeze Cat Sand Company is considering the replacement of its traditional bag packaging of cat sand with either reusable plastic or aluminum pails. Customers would make a refundable deposit on the container each time they purchased cat sand. Because the pails would be reusable, the net cost of cat sand to customers who returned the pail for a refund would be lower than the cost of cat sand sold in bags. Ocean Breeze has a 16 percent cost of capital. Cash flow information on each alternative follows.

	Plastic	Aluminum
Initial investment	$120,000	$68,000
Increase in annual net cash flows	$ 52,500	$30,000
Life of equipment (years)	4 years	4 years
Disposal value of equipment	$ 12,000	$9,000

Required

a. Evaluate the investment alternatives using the net present value and the present value index criteria.
b. Explain the difference in rankings. Which investment would you recommend if unlimited funds were available at Ocean Breeze's cost of capital?

P E-26 Cost Reduction Proposal: IRR, NPV, and Payback Period (LO2, 3)

JB Chemical currently discharges liquid waste into Calgary's municipal sewer system. However, the Calgary municipal government has informed JB that a surcharge of $4 per thousand cubic liters will soon be imposed for the discharge of this waste. This has prompted management to evaluate the desirability of treating its own liquid waste.

A proposed system consists of three elements. The first is a retention basin, which would permit unusual discharges to be held and treated before entering the downstream system. The second is a continuous self-cleaning rotary filter required where solids are removed. The third is an automated neutralization process required where materials are added to control the alkalinity-acidity range.

The system is designed to process 500,000 liters a day. However, management anticipates that only about 200,000 liters of liquid waste would be processed in a normal workday. The company operates 300 days per year. The initial investment in the system would be $450,000, and annual operating costs are predicted to be $150,000. The system has a predicted useful life of ten years and a salvage value of $50,000.

Required

a. Determine the project's net present value at a discount rate of 14 percent.
b. Determine the project's approximate internal rate of return. (Refer to Appendix E-B if you use the table approach.)
c. Determine the project's payback period.

P E-27 NPV with Income Taxes: Straight-Line versus Accelerated Depreciation (LO2, 6)

John Paul Jones Inc. is a conservatively managed boat company whose motto is, "The old ways are the good ways." Management has always used straight-line depreciation for tax and external reporting purposes. Although they are reluctant to change, they are aware of the impact of taxes on a project's profitability.

Required

For a typical $100,000 investment in equipment with a five-year life and no salvage value, determine the present value of the advantage resulting from the use of double-declining balance depreciation as opposed to straight-line depreciation. Assume an income tax rate of 40 percent and a discount rate of 16 percent. Also assume that there will be a switch from double-declining balance to straight-line depreciation in the fourth year.

P E-28 Payback Period, NPV, and PVI: Taxes and Straight-Line Depreciation (LO2, 3, 6)

Assume that **United Technologies** is evaluating a proposal to change the company's manual design system to a computer-aided design (CAD) system. The proposed system is expected to save 10,000 design hours per year; an operating cost savings of $40 per hour. The annual cash expenditures of operating the CAD system are estimated to be $200,000. The CAD system requires an initial investment of $500,000. The estimated life of this system is five years with no salvage value. The tax rate is 40 percent, and United Technologies uses straight-line depreciation for tax purposes. United Technologies has a cost of capital of 16 percent.

Required

a. Compute the annual after-tax cash flows related to the CAD project.
b. Compute each of the following for the project:
1. Payback period.
2. Net present value.
3. Present value index.

P E-29 NPV: Taxes and Accelerated Depreciation (LO6)

Assume the same facts as given in Exercise E-28, except that Sonoran intends to use double-declining balance depreciation with a switch to straight-line depreciation (applied to any undepreciated balance) starting in Year 4.

Required

Determine the project's net present value.

P E-30 NPV Total and Differential Analysis of Replacement Decision (LO2)

Gusher Petro is evaluating a proposal to purchase a new processor that would cost $120,000 and have a salvage value of $12,000 in five years. Gusher's cost of capital is 16 percent. It would provide annual operating cash savings of $15,000, as follows:

	Old Processor	New Processor
Salaries	$34,000	$44,000
Supplies	6,000	5,000
Utilities	13,000	6,000
Cleaning and maintenance	22,000	5,000
Total cash expenditures	$75,000	$60,000

If the new processor is purchased, Gusher will sell the old processor for its current salvage value of $30,000. If the new processor is not purchased, the old processor will be disposed of in five years at a predicted scrap value of $2,000. The old processor's present book value is $50,000. If kept, the old processor will require repairs predicted to cost $40,000 in one year.

Required

a. Use the total cost approach to evaluate the alternatives of keeping the old processor and purchasing the new processor. Indicate which alternative is preferred.

b. Use the differential cost approach to evaluate the desirability of purchasing the new processor.

P E-31 NPV Total and Differential Analysis of Replacement Decision (LO2)

White Snow Automatic Laundry must either have a complete overhaul of its current dry-cleaning system or purchase a new one. Its cost of capital is 20 percent. White Snow's accountant has developed the following cost projections:

	Present System	New System
Purchase cost (new)	$40,000	$50,000
Remaining book value	15,000	
Overhaul needed	20,000	
Annual cash operating costs	35,000	20,000
Current salvage value	10,000	
Salvage value in 5 years	2,500	10,000

If White Snow keeps the old system, it will have to be overhauled immediately. With the overhaul, the old system will have a useful life of five more years.

Required

a. Use the total cost approach to evaluate the alternatives of keeping the old system and purchasing the new system. Indicate which alternative is preferred.

b. Use the differential cost approach to evaluate the desirability of purchasing the new system.

P E-32 NPV Differential Analysis of Replacement Decision (LO2, 5)

The management of Essen Manufacturing Company is currently evaluating a proposal to purchase a new, innovative drill press as a replacement for a less efficient piece of similar equipment, which would then be sold. The cost of the equipment, including delivery and installation, is $175,000. If the equipment is purchased, Essen will incur a $5,000 cost in removing the present equipment and revamping service facilities. The present equipment has a book value of $100,000 and a remaining useful life of ten years. Because of new technical improvements that have made the present equipment obsolete, it now has a disposal value of only $40,000. Management has provided the following comparison of manufacturing costs:

	Present Equipment	New Equipment
Annual production (units)	400,000	400,000
Annual costs		
Direct labor (per unit)	$0.075	$0.05
Overhead		
Depreciation (10% of asset's book value)	$10,000	$17,500
Other	$48,000	$20,000

Additional information follows:

- Management believes that if the current equipment is not replaced now, it will have to wait ten years before replacement is justifiable.
- Both pieces of equipment are expected to have a negligible salvage value at the end of ten years.

- Management expects to sell the entire annual production of 400,000 units.
- Essen's cost of capital is 14 percent.

Required

Evaluate the desirability of purchasing the new equipment

CASES

C E-33 Post-Audit Review of Capital Expenditures (LO1, 5)

Business Insight E-1, Capital Budgeting gone Awry, examines a capital budgeting decision to construct and operate a major international airport.

Required

a. Identify the errors made in developing the capital expenditure proposal for the airport.
b. What factors are preventing the airport from achieving the planned passenger volume?

C E-34 Payback Period (LO3, 5)

In response to a significant increase in energy costs, **American Energy Systems** of Hutchinson, Minnesota, introduced a stove that uses dry-shelled field corn as fuel. Depending on the size of the house and weather conditions, tests indicated that heating an average house requires 15 to 30 bushels of corn per month. The stove recently sold for $2,170 and, with corn at a historical low cost of $2 a bushel, heating with corn was ten times cheaper than gas or heating oil and seven times cheaper than electricity.9

Required

a. Determine the range of possible payback periods in months.
b. What other factors should be considered before purchasing a stove that uses corn?
c. Assuming the corn stove has a life of ten years, do you feel comfortable making this decision using only the payback capital budgeting model? Why or why not?

C E-35 Determining Terms of Automobile Leases (Requires Spreadsheet) (LO2, 5)

Avant-Garde Motor Company has asked you to develop lease terms for the firm's popular Avant-Garde Challenger, which has an average selling price (new) of $25,000. You know that leasing is attractive because it assists consumers in obtaining new vehicles with a small down payment and "reasonable" monthly payments. Market analysts have told you that to attract the widest number of young professionals, the Challenger must have an initial down payment of no more than $1,000, monthly payments of no more than $450, and lease terms of no more than three years. When the lease expires, Avant-Garde will sell the used Challengers at the automobile's resale market price at that time. It is difficult to predict the future price of the increasingly popular Challenger, but you have obtained the following information on the average resale prices of used Challengers:

Age	Resale Price
1 year	$20,000
2 years	18,500
3 years	16,000
4 years	13,500
5 years	12,500

Avant-Garde's cost of capital is 18 percent per year, or 1.5 percent per month.

Required

a. With the aid of spreadsheet software, develop a competitive and profitable lease payment program. Assume the down payment and the first lease payment are made immediately and that all subsequent lease payments are made at the start of the month. [Hint: Most software packages include a function such as the following: PMT (rate,nper,pv,fv,type), where rate = the time value of money; nper = the number of periods; pv = the present value; fv = the future value; and type = 0 (when the payment is at the end of the period) or 1 (when the payment is at the beginning of the period). For monthly payments, rate should be set at the annual rate divided by 12, and npr should be set at the number of months in the lease. Here, fv is the residual value. Consider the residual value as a future value and enter it as a negative number, indicating the lessor has not paid the full cost of the car.]
b. Reevaluate the lease program assuming a down payment of $2,000.
c. Reevaluate the lease program assuming a down payment of $1,000 and a $2,000 increase in residual values.
d. Reevaluate the lease program assuming a down payment of $2,000 and a $2,000 increase in residual values.
e. What is your final recommendation? What risks are associated with your recommendation? Are there any other actions to consider?

C E-36 Evaluating Data and Using Payback Period for an Investment Proposal (LO3, 5)

To determine the desirability of investing in a 17-inch monitor (as opposed to the typical 14-inch monitor that comes with a new personal computer), the editors of PC Computing developed an experiment testing the time required to perform a set of tasks. The tasks included the following:

- Setting up a meeting using electronic mail.
- Reviewing meeting requests.
- Checking an on-line schedule.
- Embedding a video file into a document.
- Searching a customer database to find a specific set of contracts.
- Copying a database into a spreadsheet.
- Modifying a slide presentation.

The editors assumed this was a typical set of tasks performed by a manager. They determined that there was a 9 percent productivity gain using the 17-inch monitor. One test manager commented that the largest productivity gain came from being able to have multiple applications open at the same time and from being able to view several slides at once.

Required

- Accepting the 9 percent productivity gain as accurate, what additional information is needed to determine the payback period of an investment in one 17-inch monitor that is to be used by a manager?
- Make any necessary assumptions and obtain whatever data you can (perhaps from computer component advertisements) to determine the payback period for the proposed investment.

C E-37 IRR and NPV with Performance Evaluation Conflict (LO2, 4, 5)

Pepperoni Pizza Company owns and operates fast-service pizza parlors throughout North America. The firm operates on a regional basis and provides almost complete autonomy to the manager of each region. Regional managers are responsible for long-range planning, capital expenditures, personnel policies, pricing, and so forth. Each year the performance of regional managers is evaluated by determining the accounting return on fixed assets in their regions; a return of 14 percent is expected. To determine this return, regional net income is divided by the book value of fixed assets at the start of the year. Managers of regions earning a return of more than 16 percent are identified for possible promotion, and managers of regions with a return of less than 12 percent are subject to replacement.

Mr. Light, with a degree in hotel and restaurant management, is the manager of the Northeast region. He is regarded as a "rising star" and will be considered for promotion during the next two years. Light has been with Pepperoni for a total of three years. During that period, the return on fixed assets in his region (the oldest in the firm) has increased dramatically. He is currently considering a proposal to open five new parlors in the Boston area. The total project involves an investment of $640,000 and will double the number of Pepperoni pizzas sold in the Northeast region to a total of 600,000 per year. At an average price of $6 each, total sales revenue will be $3,600,000.

The expenses of operating each of the new parlors include variable costs of $4 per pizza and fixed costs (excluding depreciation) of $80,904 per year. Because each of the new parlors has only a five-year life and no salvage value, yearly straight-line depreciation will be $25,600 [($640,000 ÷ 5 parlors) ÷ 5 years].

Required

a. Evaluate the desirability of the $640,000 investment in new pizza parlors by computing the internal rate of return and the net present value. Assume a time value of money of 14 percent. (Refer to Appendix E-B if you use the table approach.)

b. If Light is shrewd, will he approve the expansion? Why or why not? (Additional computations are suggested.)

C E-38 NPV and Project Reevaluation with Taxes, Straight-Line Depreciation (LO2, 5, 6)

In 2007, the Bayside Chemical Company prepared the following analysis of an investment proposal for a new manufacturing facility:

Because the proposal had a positive net present value when discounted at Bayside's cost of capital of 12 percent, the project was approved; all investments were made at the end of 2007. Shortly after production began in January 2008, a government agency notified Bayside of required additional expenditures totaling $200,000 to bring the plant into compliance with new federal emission regulations. Bayside has the option either to comply with the regulations by December 31, 2008, or to sell the entire operation (fixed assets and working capital) for $250,000 on December 31, 2008. The improvements will be depreciated over the remaining four-year life of the plant using straight-line depreciation. The cost of site restoration will not be affected by the improvements. If Bayside elects to sell the plant, any book loss can be treated as an offset against taxable income on other operations. This tax reduction is an additional cash benefit of selling.

	Predicted Cash Inflows (outflows) (A)	Year(s) of Cash Flows (B)	12% Present Value Factor (C)	Present Value of Cash Flows (A) × (C)
Initial investment				
Fixed assets	$(800,000)	0	1.000	$ (800,000)
Working capital	(100,000)	0	1.000	(100,000)
Operations				
Annual taxable income without depreciation	300,000	1–5	3.605	1,081,500
Taxes on income ($300,000 × 0.34)	(102,000)	1–5	3.605	(367,710)
Depreciation tax shield	54,400*	1–5	3.605	196,112
Disinvestment				
Site restoration	80,000	5	0.567	(45,360)
Tax shield of restoration ($80,000 × 0.34)	27,200	5	0.567	15,422
Working capital	100,000	5	0.567	56,700
Net present value of all cash flows				$ 36,664

*Computation of depreciation tax shield:

Annual straight-line depreciation ($800,000 ÷ 5)	*$160,000*
Tax rate	*× 0.34*
Depreciation tax shield	*$ 54,400*

Required

a. Should Bayside sell the plant or comply with the new federal regulations? To simplify calculations, assume that any additional improvements are paid for on December 31, 2008.

b. Would Bayside have accepted the proposal in 2007 if it were aware of the forthcoming federal regulations?

c. Do you have any suggestions that might increase the project's net present value? (No calculations are required.)

C E-39 NPV Analysis of Labor Saving Investment: Cross-Subsidization (LO2, 5)

Heavy Loading Company's plant has three production departments. Presented are the actual cost functions for each department (DLH = direct labor hour; MH = machine hour):

D1—Total annual overhead = $150,000 + $5DLH + $12MH
D2—Total annual overhead = $185,000 + $2DLH + $10MH
D3—Total annual overhead = $50,000 + $10DLH

The direct labor rate is $12 per hour in all departments. Departments 1 and 2 are machine intensive; Department 3 is labor intensive. The fixed overhead in Departments 1 and 2 is related to building occupancy, machine depreciation, and machine maintenance. The fixed overhead in Department 3 is related to building occupancy.

Required

(The requirements are interrelated and concern a decision to introduce labor-saving equipment into Department 3.)

a. Management is not aware of the actual overhead cost functions. A plantwide overhead rate (based on the historic relationship between the plant's total annual overhead and total direct labor hours) is used to assign overhead to departments and products. Presented are the actual number of direct labor hours and machine hours for a typical year:

	Department 1	Department 2	Department 3
Direct labor hours	2,000	5,000	10,000
Machine hours	5,000	20,000	0

Determine the plantwide overhead rate per direct labor hour and the annual overhead assigned to Department 3.

b. Management is concerned about the high cost of products subject to Department 3 manufacturing operations. It is evaluating a proposal to invest in a machine that would substantially reduce the labor content of Department 3 operations. The machine would require an initial investment of $500,000. In addition to fixed maintenance costs of $35,000 per year, the machine would have operating costs of $15 per machine hour. It is predicted to operate 4,000 hours during a typical year. Direct labor savings would amount to 7,000 hours per year. The machine is estimated to have a life of five years with no salvage value. Heavy Loading's cost of capital is 16 percent. In evaluating the investment proposal, management included overhead cost savings at the plantwide rate per direct labor hour as determined in requirement (a). Following management's procedures, determine the investment proposal's net present value. Based on this analysis, indicate whether management should accept the proposal.

c. Assuming no change in costs (except in Department 3), determine the plantwide overhead rate per direct labor hour if the proposal is accepted. Why does the rate change from that computed in requirement (a)? Also determine the annual overhead now assigned to Department 3.

d. Evaluate the decision to invest in the new machine. Was this the correct decision? Why or why not? (Provide additional analysis as appropriate.)

e. Assume that Heavy Loading did invest in the machine. Because the machine is a special purpose one, it does not have any resale value, and its scrap value is exactly equal to removal costs. Based on your analysis in requirement (d), what should management do now?

C E-40 NPV Analysis of Replacement and Expansion: Relevant Costs (LO2)

Illinois Products Company manufactures several different products. One of its principal products sells for $20 per unit. The sales manager of Illinois Products has stated repeatedly that he could sell more units of this product if they were available. In an attempt to substantiate his claim, the sales manager conducted a market research study last year at a cost of $44,000 to determine potential demand for this product. The study indicated that Illinois Products could sell 18,000 units of this product annually for the next five years. The equipment currently in use has the capacity to produce 11,000 units annually. The variable production costs are $9 per unit. The equipment has a book value of $60,000 and a remaining useful life of five years. The salvage value is negligible now and will be zero in five years.

A maximum of 20,000 units could be produced annually on a new machine, which could be purchased for $300,000. The new machine has an estimated life of five years and no salvage value. Illinois Products' production manager has estimated that the new equipment would enhance production efficiency, thereby reducing the variable production costs to $7 per unit. The sales manager believed so strongly that additional capacity was needed that he attempted to prepare an economic justification for the equipment even though this was not part of his responsibilities. His analysis (as follows) disappointed him because it did not justify acquiring the equipment.

Required investment	
Purchase price of new equipment	$300,000
Loss on disposal of old equipment	60,000
Cost of market research study	44,000
Total investment	$404,000
Annual returns	
Contribution from product	
Using new equipment (20,000 × [$20 − $7])	$260,000
Using existing equipment (11,000 × [$20 − $9])	(121,000)
Increase in contribution	139,000
Less depreciation ($300,000 ÷ 5 years)	(60,000)
Increase in income	79,000
Less cost of capital on additional required investment (0.20 × $404,000)	(80,800)
Net annual return of proposed investment in new equipment	$ (1,800)

Illinois Products Company has a 20 percent cost of capital.

Required

a. The controller of Illinois Products Company plans to prepare a discounted cash flow analysis of this investment proposal and has asked you to prepare correct calculations of

1. The required investment in the new equipment.
2. The recurring annual cash flows.

Explain the treatment of each item you consider differently from the original analysis prepared by the sales manager.

b. Calculate the net present value of the proposed investment in the new equipment and indicate whether the investment proposal is acceptable.

(CMA Adapted)

C E-41 Project Screening and Evaluation with Risk: Multiple Criteria (LO1, 2, 3, 4, 5)

Transhemisphere uses a capital budgeting committee to evaluate and approve capital expenditure proposals. Because the committee is composed of busy executives, a staff has been assigned to assist the committee in the mechanical aspects of proposal evaluation. As a member of this staff, you have been requested to evaluate five mutually exclusive capital expenditure proposals.

Transhemisphere uses multiple criteria in evaluating capital expenditure proposals. The criteria are designed to consider the time period for which monies invested in a project are unavailable for other purposes, the maximum possible time-adjusted loss on a project, and the time-adjusted relative profitability of a project. To assist in monitoring accepted proposals, the committee also requests information regarding the minimum annual cash flows required for a time-adjusted break-even point. The criteria are applied on a sequential basis, with only proposals that meet the earlier criteria receiving further evaluation. The following specific procedures are to be followed in the evaluation:

1. Only proposals having an expected bailout and/or payback period of three years or less are subject to further evaluation. The bailout period is the time it takes to recover the investment in a project from any source, including disposal.
2. Evaluate the net present value of the pessimistic cash flows associated with each project using Transhemisphere's cost of capital of 16 percent. Projects whose pessimistic cash flows have a negative net present value of $50,000 or more are eliminated from further consideration.
3. Rank the remaining projects on the basis of the internal rate of return of their expected cash flows. (Refer to Appendix E-B if you use the table approach.)
4. For the highest ranked project, determine the minimum annual net cash inflows needed to provide an internal rate of return equal to the company's cost of capital.

Information pertaining to the five capital expenditure proposals you have been asked to evaluate follows in thousands of dollars (000):

		Disposal Value at End of Year			Pessimistic		Expected	
Proposal	Initial Investment	1	2	3	Annual Net Cash Inflow	Life	Annual Net Cash Inflow	Life
A	$196	$150	$100	$ 0	$ 40	7 years	$ 50	10 years
B	500	400	350	0	75	10 years	110	12 years
C	400	300	100	0	40	8 years	50	10 years
D	420	250	200	150	100	7 years	100	10 years
E	250	150	75	0	15	9 years	75	12 years

The nature of the investments is such that none of them has a disposal value after the end of its third year.

Required

a. Following Transhemisphere's capital budgeting procedures, evaluate the five proposals. (Round calculations to the nearest dollar; do not interpolate.)

b. Regardless of Transhemisphere's procedures, which proposal do you recommend and why?

C E-42 Post-Audit and Reevaluation of Investment Proposal: NPV (LO1, 2, 5)

Anthony Company's capital budgeting committee is evaluating a capital expenditure proposal for the production of a high definition receiver to be sold as an add-on feature for television sets. The proposal calls for an independent contractor to construct the necessary facilities by December 31, 2008, at a total cost of $250,000. Payment for all construction costs will be made on that date. An additional $50,000 in cash will also be made available on December 31, 2008, for working capital to support sales and production activities.

Management anticipates that the receiver has a limited market life; there is a high probability that by 2015 all quality television sets will have built-in high definition receivers. Accordingly, the proposal specifies that production will cease on December 31, 2014. The investment in working capital will be recovered on that date, and the production facilities will be sold for $30,000. Predicted net cash inflows from operations for 2009 through 2014 are as follows:

2009	$100,000
2010	100,000
2011	100,000
2012	40,000
2013	40,000
2014	40,000

Anthony Company has a time value of money of 16 percent. For capital budgeting purposes, all cash flows are assumed to occur at the end of each year.

Required

a. Evaluate the capital expenditure proposal using the net present value method. Should Anthony accept the proposal?

b. Assume that the capital expenditure proposal is accepted, but construction delays caused by labor problems and difficulties in obtaining the necessary construction permits delay the completion of the project. Payments totaling $200,000 were made to the construction company on December 31, 2008, for that year's construction. However, completion is now scheduled for December 31, 2009, and an additional $100,000 will be required to complete construction. If the project is continued, the additional $100,000 will be paid at the end of 2009, and the plant will begin operations on January 1, 2010.

Because of the cost overruns, the capital budgeting committee requests a reevaluation of the project in early 2009, before agreeing to any additional expenditures. After much effort, the following revised predictions of net operating cash inflows are developed:

2010	$120,000
2011	100,000
2012	40,000
2013	40,000
2014	40,000

The working capital investment and disinvestment and the plant salvage values have not changed, except that the cash for working capital would now be made available on December 31, 2009. Use the net present value method to reevaluate the initial decision to accept the proposal. Given the information currently available about the project, should it have been accepted in 2008? (Hint: Determine the net present value as of December 31, 2008, assuming management has not committed Anthony to the proposal.)

c. Given the situation that exists in early 2009, should management continue or cancel the project? Assume that the facilities have a current salvage value of $50,000. (Hint: Assume that the decision is being made on January 1, 2009.)

C E-43 Post-Audit and Reevaluation of Investment Proposal: IRR (LO1, 2, 5)

Throughout his four years in college, Ronald King worked at the local Beef Burger Restaurant in College City. Although the working conditions were good and the pay was not bad, Ron believed he could do a much better job of managing the restaurant than the current owner-manager. In particular, Ron believed that the proper use of marketing campaigns and sales incentives, such as selling a second burger for a 25 percent discount, could increase annual sales by 50 percent.

Just before graduation in 2009, Ron inherited $500,000 from his great uncle. He seriously considered buying the restaurant. It seemed like a good idea because he liked the town and its college atmosphere, knew the business, and always wanted to work for himself. He also knew that the current owner wanted to sell the restaurant and retire to Florida. As part of a small business management course, Ron developed the following income statement for the restaurant's 2008 operations:

Beef Burger Restaurant: College City
Income Statement
For Year Ended December 31, 2008

Sales		$450,000
Expenses		
Cost of food	$150,000	
Supplies	20,000	
Employee expenses	140,000	
Utilities	28,000	
Property taxes	20,000	
Insurance	10,000	
Advertising	8,000	
Depreciation	60,000	436,000
Net income		$ 14,000

Ron believed that the cost of food and supplies were all variable, the employee expenses and utilities were one-half variable and one-half fixed in 2008, and all other expenses were fixed. If Ron purchased the restaurant and followed through on his plans, he believed there would be a 50 percent increase in unit sales volume and all variable costs. Of the fixed costs, only advertising would increase by $12,000. The use of discounts and special promotions would, however, limit the increase in sales revenue to only 40 percent even though sales volume increased 50 percent.

Required

a. Determine
   1. The current annual net cash inflow.
   2. The predicted annual net cash inflow if Ron executes his plans and his assumptions are correct.

b. Ron believes his plan would produce equal net cash inflows during each of the next 15 years, the period remaining on a long-term lease for the land on which the restaurant is built. At the end of that time, the restaurant would have to be demolished at a predicted net cost of $80,000. Assuming Ron would otherwise invest the money in stock expected to yield 12 percent, determine the maximum amount he should pay for the restaurant.

c. Assume that Ron accepts an offer from the current owner to buy the restaurant for $400,000. Unfortunately, although the expected increase in sales volume does occur, customers make much more extensive use of the promotions than Ron had anticipated. As a result, total sales revenues are 8 percent below projections. Furthermore, to improve employee attitudes, Ron gave a 10 percent raise immediately after purchasing the restaurant. Reevaluate the initial decision using the actual sales revenue and the increase in labor costs, assuming conditions will remain unchanged over the remaining life of the project. Was the investment decision a wise one? (Round calculations to the nearest dollar.)

d. Ron can sell the restaurant to a large franchise operator for $300,000. Alternatively, he believes that additional annual marketing expenditures and changes in promotions costing $20,000 per year could bring the sales revenues up to their original projections, with no other changes in costs. Should Ron sell the restaurant or keep it and make the additional expenditures? (Round calculations to the nearest dollar.) (Hint: Ron has just bought the restaurant.)