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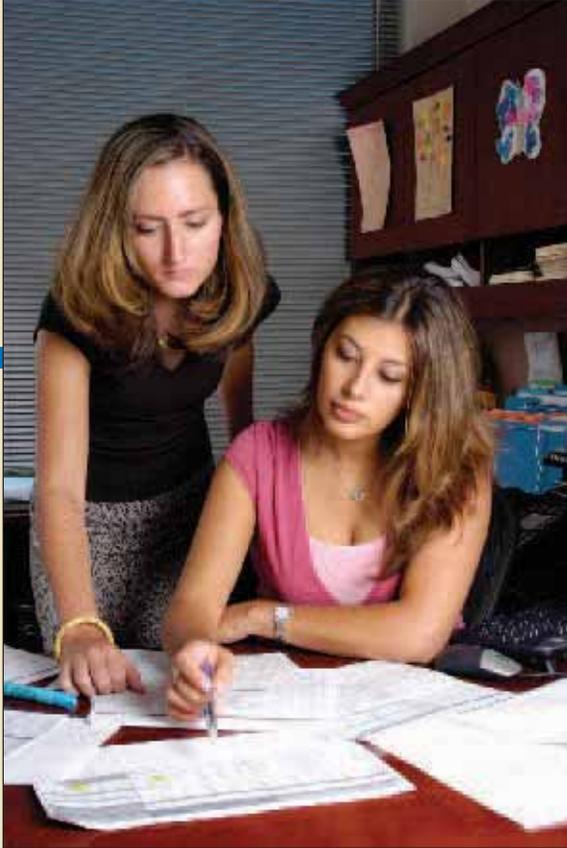
Using Discounted Cash-Flow Analysis to Make Investment Decisions

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The screenshot shows the Charter One website's 'Working Capital Needs' calculator. It features a navigation bar with links for Home, Personal Finance, Small Business, Commercial, and Customer Service. Below the navigation bar, there are three dropdown menus for 'Order Billing', 'Open an Account', and 'Apply for a Loan'. The main content area is titled 'Working Capital Needs' and includes a text box explaining the calculator's purpose: 'How much working capital do I need? Your working capital is the need to pay short-term obligations such as your accounts payable and inventory. If your working capital is too low, you risk running out of cash, even when profitable business can run and hinder in they use the ability to meet their short-term obligations. The calculator assists you in determining working capital needs for the next year.' At the bottom, a prominent message states: 'You may need to increase your working capital \$4,000.' Below this message is a slider control for 'Annual growth' ranging from 0% to 100%.

www.toolkit.cch.com/text/P07_2960.asp Additional depreciation tables and tax rules for various investment classes.

www.charteronebank.com/calculators/capital.asp A calculator relating growth rates to the need for working capital.



Calculating NPV can be hard work. But you've got to sweat the details and learn to do it right.

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Think of the problems that GM's managers face when considering whether to introduce a new model. How much will we need to invest in new plant and equipment? What will it cost to market and promote the new car? How soon can we get the car into production? What is the projected production cost? What do we need in the way of inventories of raw materials and finished cars? How many cars can we expect to sell each year and at what price? What credit arrangements will we need to give our dealers? How long will the model stay in production? What happens at the end of that time? Can we use the plant and equipment elsewhere in the company? All of these issues affect the level and timing of project cash flows. In this chapter we continue our analysis of the capital budgeting decision by turning our focus to how the financial manager should prepare cash-flow estimates for use in net present value analysis.

In Chapter 7 you used the net present value rule to make a simple capital budgeting decision. You tackled the problem in four steps:

- Step 1.** Forecast the project cash flows.
- Step 2.** Estimate the opportunity cost of capital—that is, the rate of return that your shareholders could expect to earn if they invested their money in the capital market.
- Step 3.** Use the opportunity cost of capital to discount the future cash flows. The project's present value (PV) is equal to the sum of the discounted future cash flows.
- Step 4.** Net present value (NPV) measures whether the project is worth more than it costs. To calculate NPV, you need to subtract the required investment from the present value of the future payoffs:

$$\text{NPV} = \text{PV} - \text{required investment}$$

You should go ahead with the project if it has a positive NPV.

We now need to consider how to apply the net present value rule to practical investment problems. The first step is to decide what to discount. We know the answer in principle: discount cash flows. This is why capital budgeting is often referred to as *discounted cash-flow*, or *DCF*, analysis. But useful forecasts of cash flows do not arrive on a silver platter. Often the financial manager has to make do with raw data supplied by specialists in product design, production, marketing, and so on, and must check and combine this information. In addition, most financial forecasts are prepared in accordance with accounting principles that do not necessarily recognize cash flows when they occur. These forecasts must also be adjusted.

We look first at what cash flows should be discounted. We then present an example designed to show how standard accounting information can be used to compute cash flows and why

cash flows and accounting income usually differ. The example will lead us to various further points, including the links between depreciation and taxes and the importance of tracking investments in working capital.

After studying this chapter you should be able to:

- Identify the cash flows properly attributable to a proposed new project.

- Calculate the cash flows of a project from standard financial statements.
- Understand how the company's tax bill is affected by depreciation and how this affects project value.
- Understand how changes in working capital affect project cash flows.

8.1 Identifying Cash Flows

Discount Cash Flows, Not Profits

Up to this point we have been concerned mainly with the mechanics of discounting and with the various methods of project appraisal. We have had almost nothing to say about the problem of *what* you should discount. The first and most important point is this: To calculate net present value, you need to discount cash flows, *not* accounting profits.

We stressed the difference between cash flows and profits in Chapter 3. Here we stress it again. Income statements are intended to show how well the firm has performed. They do not track cash flows.

If the firm lays out a large amount of money on a big capital project, you do not conclude that the firm performed poorly that year, even though a lot of cash is going out the door. Therefore, the accountant does not deduct capital expenditure when calculating the year's income but, instead, depreciates it over several years.

That is fine for computing year-by-year profits, but it could get you into trouble when working out net present value. For example, suppose that you are analyzing an investment proposal. It costs \$2,000 and is expected to bring in a cash flow of \$1,500 in the first year and \$500 in the second. You think that the opportunity cost of capital is 10 percent and so calculate the present value of the cash flows as follows:

$$PV = \frac{\$1,500}{1.10} + \frac{\$500}{(1.10)^2} = \$1,776.86$$

The project is worth less than it costs; it has a negative NPV:

$$NPV = \$1,776.86 - \$2,000 = -\$223.14$$

The project costs \$2,000 today, but accountants would not treat that outlay as an immediate expense. They would depreciate that \$2,000 over 2 years and deduct the depreciation from the cash flow to obtain accounting income:

	Year 1	Year 2
Cash inflow	+\$1,500	+\$ 500
Less depreciation	- 1,000	- 1,000
Accounting income	+ 500	- 500

Thus an accountant would forecast income of \$500 in year 1 and an accounting loss of \$500 in year 2.

Suppose you were given this forecast income and loss and naively discounted them. Now NPV *looks* positive:

$$\text{Apparent NPV} = \frac{\$500}{1.10} + \frac{-\$500}{(1.10)^2} = \$41.32$$

Of course we know that this is nonsense. The project is obviously a loser; we are spending money today (\$2,000 cash outflow), and we are simply getting our money back (\$1,500 in year 1 and \$500 in year 2). We are earning a zero return when we could get a 10 percent return by investing our money in the capital market.

The message of the example is this: **When calculating NPV, recognize investment expenditures when they occur, not later when they show up as depreciation. Projects are financially attractive because of the cash they generate, either for distribution to shareholders or for reinvestment in the firm. Therefore, the focus of capital budgeting must be on cash flow, not profits.**

We saw another example of the distinction between cash flow and accounting profits in Chapter 3. Accountants try to show profit as it is earned, rather than when the company and the customer get around to paying their bills. For example, an income statement will recognize revenue when the sale is made, even if the bill is not paid for months. This practice also results in a difference between accounting profits and cash flow. The sale generates immediate profits, but the cash flow comes later.

EXAMPLE 8.1**Sales before Cash**

Your firm's ace computer salesman closed a \$500,000 sale on December 15, just in time to count it toward his annual bonus. How did he do it? Well, for one thing he gave the customer 180 days to pay. The income statement will recognize the sale in December, even though cash will not arrive until June. But a financial analyst tracking cash flows would concentrate on the latter event.

The accountant takes care of the timing difference by adding \$500,000 to accounts receivable in December and then reducing accounts receivable when the money arrives in June. (The total of accounts receivable is just the sum of all cash due from customers.)

You can think of the increase in accounts receivable as an investment—it's effectively a 180-day loan to the customer—and therefore a cash outflow. That investment is recovered when the customer pays. Thus financial analysts often find it convenient to calculate cash flow as follows:

December		June	
Sales	\$500,000	Sales	0
Less investment in accounts receivable	<u>-500,000</u>	Plus recovery of accounts receivable	<u>+\$500,000</u>
Cash flow	0	Cash flow	\$500,000

Note that this procedure gives the correct cash flow of \$500,000 in June. ◀

It is not always easy to translate accounting data back into actual dollars. If you are in doubt about what is a cash flow, simply count the dollars coming in and take away the dollars going out.

Self-Test 8.1

A regional supermarket chain is deciding whether to install a tewgit machine in each of its stores. Each machine costs \$250,000. Projected income per machine is as follows:

Year:	1	2	3	4	5
Sales	\$250,000	\$300,000	\$300,000	\$250,000	\$250,000
Operating expenses	200,000	200,000	200,000	200,000	200,000
Depreciation	50,000	50,000	50,000	50,000	50,000
Accounting income	0	50,000	50,000	0	0

Why would a store continue to operate a machine in years 4 and 5 if it produces no profits? What are the cash flows from investing in a machine? Assume each tewigit machine is completely depreciated and has no salvage value at the end of its 5-year life.

Discount Incremental Cash Flows

A project's present value depends on the *extra* cash flows that it produces. Forecast first the firm's cash flows if you go ahead with the project. Then forecast the cash flows if you *don't* accept the project. Take the difference and you have the extra (or *incremental*) cash flows produced by the project:

$$\text{Incremental cash flow} = \text{cash flow with project} - \text{cash flow without project}$$

EXAMPLE 8.2

▶ Launching a New Product

Consider the decision by Microsoft to develop a new operating system, today code-named Vista. A successful launch could lead to several billion dollars in profits.

But are these profits all incremental cash flows? Certainly not. Our with-versus-without principle reminds us that we need also to think about what the cash flows would be *without* the new system. If Microsoft goes ahead with Vista, demand for Windows XP will be reduced. The incremental cash flows therefore are

$$\begin{array}{r} \text{Cash flow with Vista} \\ \text{(including lower cash flow} \\ \text{from Windows XP)} \end{array} - \begin{array}{r} \text{cash flow without Vista} \\ \text{(with higher cash flow} \\ \text{from Windows XP)} \end{array}$$

The trick in capital budgeting is to trace all the incremental flows from a proposed project. Here are some things to look out for.

Include All Indirect Effects Microsoft's new operating system illustrates a common indirect effect. New products often damage sales of an existing product. Of course, companies frequently introduce new products anyway, usually because they believe that their existing product line is under threat from competition. Even if you don't go ahead with a new product, there is no guarantee that sales of the existing product line will continue at their present level. Sooner or later they will decline.

Sometimes a new project will *help* the firm's existing business. Suppose that you are the financial manager of an airline that is considering opening a new short-haul route from Peoria, Illinois, to Chicago's O'Hare Airport. When considered in isolation, the new route may have a negative NPV. But once you allow for the additional business that the new route brings to your other traffic out of O'Hare, it may be a very worthwhile investment. **To forecast incremental cash flow, you must trace out all indirect effects of accepting the project.**

Some capital investments have very long lives once all indirect effects are recognized. Consider the introduction of a new jet engine. Engine manufacturers often offer attractive pricing to achieve early sales, because once an engine is installed, 15

years’ sales of replacement parts are almost ensured. Also, since airlines prefer to reduce the number of different engines in their fleet, selling jet engines today improves sales tomorrow as well. Later sales will generate further demands for replacement parts. Thus the string of incremental effects from the first sales of a new model engine can run for 20 years or more.

Forget Sunk Costs Sunk costs are like spilled milk: They are past and irreversible outflows. **Sunk costs remain the same whether or not you accept the project. Therefore, they do not affect project NPV.**

Unfortunately, managers often are influenced by sunk costs. A classic case occurred in 1971, when Lockheed sought a federal guarantee for a bank loan to continue development of the Tristar airplane. Lockheed and its supporters argued that it would be foolish to abandon a project on which nearly \$1 billion had already been spent. This was a poor argument, however, because the \$1 billion was sunk. The relevant questions were how much more needed to be invested and whether the finished product warranted the *incremental* investment.

Lockheed’s supporters were not the only ones to appeal to sunk costs. Some of its critics claimed that it would be foolish to continue with a project that offered no prospect of a satisfactory return on that \$1 billion. This argument too was faulty. The \$1 billion was gone, and the decision to continue with the project should have depended only on the return on the incremental investment.

Include Opportunity Costs Resources are almost never free, even when no cash changes hands. For example, suppose a new manufacturing operation uses land that could otherwise be sold for \$100,000. This resource is costly; by using the land, you pass up the opportunity to sell it. There is no out-of-pocket cost, but there is an **opportunity cost**, that is, the value of the forgone alternative use of the land.

opportunity cost
Benefit or cash flow forgone as a result of an action.

This example prompts us to warn you against judging projects “before versus after” rather than “with versus without.” A manager comparing before versus after might not assign any value to the land because the firm owns it both before and after:

Before	Take Project	After	Cash Flow, Before versus After
Firm owns land	—————▶	Firm still owns land	0

The proper comparison, with versus without, is as follows:

Before	Take Project	After	Cash Flow, with Project
Firm owns land	—————▶	Firm still owns land	0

Before	Do Not Take Project	After	Cash Flow, without Project
Firm owns land	—————▶	Firm sells land for \$100,000	\$100,000

Comparing the cash flows with and without the project, we see that \$100,000 is given up by undertaking the project. The original cost of purchasing the land is irrelevant—that cost is sunk. **The opportunity cost equals the cash that could be realized from selling the land now and therefore is a relevant cash flow for project evaluation.**

When the resource can be freely traded, its opportunity cost is simply the market price.¹ However, sometimes opportunity costs are difficult to estimate. Suppose that

¹ If the value of the land to the firm were less than the market price, the firm would sell it. On the other hand, the opportunity cost of using land in a particular project cannot exceed the cost of buying an equivalent parcel to replace it.

you go ahead with a project to develop Computer Nouveau, pulling your software team off their work on a new operating system that some existing customers are not-so-patiently awaiting. The exact cost of infuriating those customers may be impossible to calculate, but you'll think twice about the opportunity cost of moving the software team to Computer Nouveau.

net working capital

Current assets minus
current liabilities.

Recognize the Investment in Working Capital **Net working capital** (often referred to simply as *working capital*) is the difference between a company's short-term assets and its liabilities. The principal short-term assets are cash, accounts receivable (customers' unpaid bills), and inventories of raw materials and finished goods, and the principal short-term liabilities are accounts payable (bills that *you* have not paid), notes payable, and accruals (liabilities for items such as wages or taxes that have recently been incurred but have not yet been paid).

Most projects entail an additional investment in working capital. For example, before you can start production, you need to invest in inventories of raw materials. Then, when you deliver the finished product, customers may be slow to pay and accounts receivable will increase. (Remember the computer sale described in Example 8.1. It required a \$500,000, 6-month investment in accounts receivable.) Next year, as business builds up, you may need a larger stock of raw materials and you may have even more unpaid bills. **Investments in working capital, just like investments in plant and equipment, result in cash outflows.**

We find that working capital is one of the most common sources of confusion in forecasting project cash flows.² Here are the most common mistakes:

1. *Forgetting about working capital entirely.* We hope that you never fall into that trap.
2. *Forgetting that working capital may change during the life of the project.* Imagine that you sell \$100,000 of goods per year and customers pay on average 6 months late. You will therefore have \$50,000 of unpaid bills. Now you increase prices by 10 percent, so revenues increase to \$110,000. If customers continue to pay 6 months late, unpaid bills increase to \$55,000, and therefore you need to make an *additional* investment in working capital of \$5,000.
3. *Forgetting that working capital is recovered at the end of the project.* When the project comes to an end, inventories are run down, any unpaid bills are (you hope) paid off, and you can recover your investment in working capital. This generates a *cash inflow*.

Beware of Allocated Overhead Costs We have already mentioned that the accountant's objective in gathering data is not always the same as the project analyst's. A case in point is the allocation of overhead costs such as rent, heat, or electricity. These overhead costs may not be related to a particular project, but they must be paid for nevertheless. Therefore, when the accountant assigns costs to the firm's projects, a charge for overhead is usually made. But our principle of incremental cash flows says that in investment appraisal we should include only the *extra* expenses that would result from the project.

A project may generate extra overhead costs, but then again it may not. We should be cautious about assuming that the accountant's allocation of overhead costs represents the incremental cash flow that would be incurred by accepting the project.

Self-Test 8.2

A firm is considering an investment in a new manufacturing plant. The site already is owned by the company, but existing buildings would need to be demolished. Which of the following should be treated as incremental cash flows?

² If you are not clear *why* working capital affects cash flow, look back to Chapter 3, where we gave a primer on working capital and a couple of simple examples.

- a. The market value of the site.
- b. The market value of the existing buildings.
- c. Demolition costs and site clearance.
- d. The cost of a new access road put in last year.
- e. Lost cash flows on other projects due to executive time spent on the new facility.
- f. Future depreciation of the new plant.

Discount Nominal Cash Flows by the Nominal Cost of Capital

The distinction between nominal and real cash flows and interest rates is crucial in capital budgeting. Interest rates are usually quoted in *nominal* terms. If you invest \$100 in a bank deposit offering 6 percent interest, then the bank promises to pay you \$106 at the end of the year. It makes no promises about what that \$106 will buy. The real rate of interest on the bank deposit depends on inflation. If inflation is 2 percent, that \$106 will buy you only 4 percent more goods at the end of the year than your \$100 could buy today. The *real* rate of interest is therefore about 4 percent.³

If the discount rate is nominal, consistency requires that cash flows be estimated in nominal terms as well, taking account of trends in selling price, labor and materials costs, and so on. This calls for more than simply applying a single assumed inflation rate to all components of cash flow. Some costs or prices increase faster than inflation, some slower. For example, perhaps you have entered into a 5-year fixed-price contract with a supplier. No matter what happens to inflation over this period, this part of your costs is fixed in nominal terms.

Of course, there is nothing wrong with discounting real cash flows at the real interest rate, although this is not commonly done. We saw in Chapter 4 that real cash flows discounted at the real discount rate give exactly the same present values as nominal cash flows discounted at the nominal rate.

It should go without saying that you cannot mix and match real and nominal quantities. Real cash flows must be discounted at a real discount rate, nominal cash flows at a nominal rate. Discounting real cash flows at a nominal rate is a big mistake.

While the need to maintain consistency may seem like an obvious point, analysts sometimes forget to account for the effects of inflation when forecasting future cash flows. As a result, they end up discounting real cash flows at a nominal discount rate. This can grossly understate project values.

EXAMPLE 8.3

Cash Flows and Inflation

City Consulting Services is considering moving into a new office building. The cost of a 1-year lease is \$8,000, paid immediately. This cost will increase in future years at the annual inflation rate of 3 percent. The firm believes that it will remain in the building for 4 years. What is the present value of its rental costs if the discount rate is 10 percent?

The present value can be obtained by discounting the nominal cash flows at the 10 percent discount rate as follows:

³ Remember from Chapter 4,

$$\text{Real rate of interest} \approx \text{nominal rate of interest} - \text{inflation rate}$$

The exact formula is

$$1 + \text{real rate of interest} = \frac{1 + \text{nominal rate of interest}}{1 + \text{inflation rate}} = \frac{1.06}{1.02} = 1.0392$$

Therefore, the real interest rate is .0392, or 3.92 percent.

Year	Cash Flow	Present Value at 10% Discount Rate
0	8,000	8,000
1	$8,000 \times 1.03 = 8,240$	$8,240/1.10 = 7,490.91$
2	$8,000 \times 1.03^2 = 8,487.20$	$8,487.20/(1.10)^2 = 7,014.22$
3	$8,000 \times 1.03^3 = 8,741.82$	$8,741.82/(1.10)^3 = 6,567.86$
		<u>\$29,072.98</u>

Alternatively, the real discount rate can be calculated as $1.10/1.03 - 1 = .067961 = 6.7961$ percent.⁴ The present value of the cash flows can also be computed by discounting the real cash flows at the real discount rate as follows:

Year	Real Cash Flow	Present Value at 6.7961% Discount Rate
0	8,000	8,000
1	8,000	$8,000/1.067961 = 7,490.91$
2	8,000	$8,000/(1.067961)^2 = 7,014.22$
3	8,000	$8,000/(1.067961)^3 = 6,567.86$
		<u>\$29,072.98</u>

Notice the real cash flow is a constant, since the lease payment increases at the rate of inflation. The present value of *each* cash flow is the same regardless of the method used to discount it. The sum of the present values is, of course, also identical. ◀

Self-Test 8.3

Nasty Industries is closing down an outmoded factory and throwing all of its workers out on the street. Nasty's CEO is enraged to learn that the firm must continue to pay for workers' health insurance for 4 years. The cost per worker next year will be \$2,400 per year, but the inflation rate is 4 percent, and health costs have been increasing at 3 percentage points faster than inflation. What is the present value of this obligation? The (nominal) discount rate is 10 percent.

Separate Investment and Financing Decisions

Suppose you finance a project partly with debt. How should you treat the proceeds from the debt issue and the interest and principal payments on the debt? You would *neither* subtract the debt proceeds from the required investment *nor* recognize the interest and principal payments on the debt as cash outflows. Regardless of the actual financing, we should view the project as if it were all equity-financed, treating all cash outflows required for the project as coming from stockholders and all cash inflows as going to them.

This procedure allows us to focus exclusively on the *project* cash flows, not the cash flows associated with alternative financing schemes. By proceeding in this manner, we separate the analysis of the investment decision from that of the financing decision. First, we determine whether the project has a positive net present value, assuming all-equity financing. Then, if the project is viable, we can undertake a separate analysis of the best financing strategy. Financing decisions are considered later in the text.

8.2 Calculating Cash Flow

It is often helpful to think of a project as progressing through three distinct stages. Initially, there is the start-up stage, which typically requires considerable investments in

⁴ We calculate the real discount rate to four decimal places to avoid confusion from rounding. Such precision is rarely necessary in practice.

plant and equipment. The start-up stage also entails investments in working capital, as the firm builds up inventories of materials and product. In the middle period, projects throw off cash flows from operations as the product is sold for more than its cost of production. There are investments in working capital in this period as well. For example, as we've seen, increasing sales usually entail additions to accounts receivable until the cash is collected. Finally, when the project is liquidated in the terminal or wind-down period, plant and equipment can be sold or moved to other applications. This *disinvestment* in fixed assets results in a positive cash flow. As the project comes to its end, there is a similar disinvestment in working capital, which also generates a positive cash flow as inventories are sold off and accounts receivable are collected.

This suggests that cash flow is the sum of three components: investment (or disinvestment) in fixed assets such as plant and equipment, net investment in working capital, and cash flow from operations:

$$\begin{aligned} \text{Total cash flow} &= \text{cash flow from investment in fixed assets} \\ &+ \text{cash flow from investments in working capital} \\ &+ \text{cash flow from operations} \end{aligned}$$

Remember that investments in either fixed assets or working capital result in negative cash flows: The firm uses cash to acquire those assets. Conversely, when the firm disinvests, or sells off these assets, it realizes positive cash flows. Let's now examine each component of cash flow in turn.

Capital Investment

To get a project off the ground, a company will typically need to make considerable up-front investments in plant, equipment, research, marketing, and so on. For example, Gillette spent about \$750 million to develop and build the production line for its Mach3 razor cartridge and an additional \$300 million in its initial marketing campaign, largely before a single razor was sold. These expenditures are negative cash flows—negative because they represent a cash outflow from the firm.

Conversely, if a piece of machinery can be sold when the project winds down, the sales price (net of any taxes on the sale) represents a positive cash flow to the firm.

EXAMPLE 8.4



Cash Flow from Investments

Gillette's competitor, Slick, invests \$800 million to develop the Mock4 razor blade. The specialized blade factory will run for 7 years, until it is replaced by a more advanced technology. At that point, the machinery will be sold for scrap metal, for a price of \$50 million. Taxes of \$10 million will be assessed on the sale.

The initial cash flow from investment is $-\$800$ million, and the after-tax cash flow in 7 years from the disinvestment in (equivalently, the sale of) the production line will be $\$50 \text{ million} - \$10 \text{ million} = \$40 \text{ million}$. ◀

Investment in Working Capital

We pointed out earlier in the chapter that when a company builds up inventories of raw materials or finished product, the company's cash is reduced; the reduction in cash reflects the firm's investment in inventories. Similarly, cash is reduced when customers are slow to pay their bills—in this case, the firm makes an investment in accounts receivable. Investment in working capital, just like investment in plant and equipment, represents a negative cash flow. On the other hand, later in the life of a project, when inventories are sold off and accounts receivable are collected, the firm's investment in working capital is reduced as it converts these assets into cash.

EXAMPLE 8.5



Cash Flow from Investments in Working Capital

Slick makes an initial (year 0) investment of \$10 million in inventories of plastic and steel for its blade plant. Then in year 1 it accumulates an additional \$20 million of raw

materials. The total level of inventories is now \$10 million + \$20 million = \$30 million, but the cash expenditure in year 1 is simply the \$20 million addition to inventory. The \$20 million investment in additional inventory results in a cash flow of –\$20 million. Notice that the increase in working capital is an *investment* in the project. Like other investments, a buildup of working capital requires cash. Increases in the *level* of working capital therefore show up as *negative* cash flows.

Later on, say, in year 5, the company begins planning for the next-generation blade. At this point, it decides to reduce its inventory of raw material from \$20 million to \$15 million. This reduction in inventory investment frees up \$5 million of cash, which is a positive cash flow. Therefore, the cash flows from inventory investment are –\$10 million in year 0, –\$20 million in year 1, and +\$5 million in year 5.

These calculations can be summarized in a simple table, as follows:

	Year:	0	1	2	3	4	5
1. Total working capital, year-end (\$ million)		10	30	30	30	30	25
2. Investment in working capital (\$ million)		10	20	0	0	0	–5
3. Cash flow from investments in working capital		–10	–20	0	0	0	+5

In years 0 and 1, there is a net investment in working capital (line 2), corresponding to a negative cash flow (line 3), and an increase in the *level* of total working capital (line 1). In years 2 to 4, there is no investment in working capital, so its level remains unchanged at \$30 million. But in year 5, as the firm begins to disinvest in working capital, the total declines, which provides a positive cash flow. ◀

In general: **An increase in working capital is an investment and therefore implies a negative cash flow; a decrease in working capital implies a positive cash flow. The cash flow is measured by the change in working capital, not the level of working capital.**

Cash Flow from Operations

The third component of project cash flow is cash flow from operations. There are several ways to work out this component.

Method 1: Dollars In Minus Dollars Out Take only the items from the income statement that represent actual cash flows. We start with cash revenues and subtract cash expenses and taxes paid. We do not, however, subtract a charge for depreciation because depreciation is just an accounting entry, not a cash expense. Thus,

$$\text{Cash flow from operations} = \text{revenues} - \text{cash expenses} - \text{taxes}$$

Method 2: Adjusted Accounting Profits Alternatively, you can start with after-tax accounting profits and add back any deductions that were made for noncash expenses such as depreciation. While these noncash expenses reduce accounting profits in the current period, they do not affect cash flows. (Remember from our earlier discussion that you want to discount cash flows, not profits.) By this reasoning,

$$\text{Cash flow from operations} = \text{after-tax profit} + \text{depreciation}$$

Method 3: Tax Shields Although the depreciation deduction is *not* a cash expense, it does affect net profits and therefore taxes paid, which *is* a cash item. For example, if the firm’s tax bracket is 35 percent, each additional dollar of depreciation reduces taxable income by \$1. Tax payments therefore fall by \$.35, and cash flow increases by the same amount. The total **depreciation tax shield** equals the product of depreciation and the tax rate:

depreciation tax shield

Reduction in taxes attributable to depreciation.

Depreciation tax shield = depreciation × tax rate

This suggests a third way to calculate cash flow from operations. First, calculate net profit *assuming* zero depreciation. This item would be $(\text{revenues} - \text{cash expenses}) \times (1 - \text{tax rate})$. Now add back the tax shield created by depreciation. We then calculate operating cash flow as follows:

$$\text{Cash flow from operations} = (\text{revenues} - \text{cash expenses}) \times (1 - \text{tax rate}) + (\text{depreciation} \times \text{tax rate})$$

The following example confirms that the three methods for estimating cash flow from operations all give the same answer.

EXAMPLE 8.6 ▶ Cash Flow from Operations

A project generates revenues of \$1,000, cash expenses of \$600, and depreciation charges of \$200 in a particular year. The firm's tax bracket is 35 percent. Net income is calculated as follows:

Revenues	1,000
– Cash expenses	600
– Depreciation expense	<u>200</u>
= Profit before tax	200
– Tax at 35%	<u>70</u>
= Net profit	130

Methods 1, 2, and 3 all show that cash flow from operations is \$330:

$$\text{Method 1: Cash flow from operations} = \text{revenues} - \text{cash expenses} - \text{taxes} \\ = 1,000 - 600 - 70 = 330$$

$$\text{Method 2: Cash flow from operations} = \text{net profit} + \text{depreciation} \\ = 130 + 200 = 330$$

$$\text{Method 3: Cash flow from operations} = (\text{revenues} - \text{cash expenses}) \\ \times (1 - \text{tax rate}) + (\text{depreciation} \times \text{tax rate}) \\ = (1,000 - 600) \times (1 - .35) + (200 \times .35) = 330 \blacktriangleleft$$

Self-Test 8.4

A project generates revenues of \$600, expenses of \$300, and depreciation charges of \$200 in a particular year. The firm's tax bracket is 35 percent. Find the operating cash flow of the project by using all three approaches.

In many cases, a project will seek to improve efficiency or cut costs. A new computer system may provide labor savings. A new heating system may be more energy-efficient than the one it replaces. These projects also contribute to the operating cash flow of the firm—not by increasing revenue but by reducing costs. As the next example illustrates, we calculate the addition to operating cash flow on cost-cutting projects just as we would for projects that increase revenues.

EXAMPLE 8.7 ▶ Operating Cash Flow of Cost-Cutting Projects

Suppose the new heating system costs \$100,000 but reduces heating costs by \$30,000 a year. The system will be depreciated straight-line over a 5-year period, so the annual depreciation charge will be \$20,000. The firm's tax rate is 35 percent. We calculate the *incremental* effects on revenues, expenses, and depreciation charges as follows. Notice that the reduction in expenses increases revenues minus cash expenses.

Increase in (revenues minus expenses)	30,000
– Additional depreciation expense	– 20,000
= Incremental profit before tax	= 10,000
– Incremental tax at 35%	– 3,500
= Change in net profit	= 6,500

Therefore, the increment to operating cash flow can be calculated by *method 1* as

$$\begin{aligned} & \text{Increase in (revenues – cash expenses) – additional taxes} \\ & = \$30,000 – \$3,500 = \$26,500 \end{aligned}$$

or by *method 2*:

$$\text{Increase in net profit + additional depreciation} = \$6,500 + \$20,000 = \$26,500$$

or by *method 3*:

$$\begin{aligned} & \text{Increase in (revenues – cash expenses)} \times (1 - \text{tax rate}) \\ & + (\text{additional depreciation} \times \text{tax rate}) = \$30,000 \times (1 - .35) + (\$20,000 \times .35) \\ & = \$26,500 \end{aligned}$$

8.3 An Example: Blooper Industries

Now that we have examined many of the pieces of a cash-flow analysis, let's try to put them together into a coherent whole. As the newly appointed financial manager of Blooper Industries, you are about to analyze a proposal for mining and selling a small deposit of high-grade magnoosium ore.⁵ You are given the forecasts shown in the spreadsheet in Table 8–1. We will walk through the lines in the table.

Cash-Flow Analysis

Investment in Fixed Assets Panel A of the spreadsheet details investments and disinvestments in fixed assets. The project requires an investment of \$10 million, as shown in cell B3. After 5 years, the ore deposit is exhausted, so the mining equipment may be sold for \$2 million, a forecast that already reflects the likely impact of inflation.

When you sell the equipment, the IRS will check to see whether any taxes are due on the sale. Any difference between the sale price (\$2 million) and the book value of the equipment will be treated as a taxable gain.

We assume that Blooper depreciates the equipment to a final value of zero. Therefore, the book value of the equipment when it is sold in year 6 will be zero, and you will be subject to taxes on the full \$2 million proceeds. Your sale of the equipment will land you with an additional tax bill in year 6 of $.35 \times \$2 \text{ million} = \$.70 \text{ million}$. The net cash flow from the sale in year 6 is therefore

$$\text{Salvage value – tax on gain} = \$2 \text{ million} – \$.70 \text{ million} = \$1.30 \text{ million}$$

This amount is recorded in cell H4.

Row 5 summarizes the cash flows from investments in and sales of fixed assets. The entry in each cell equals the after-tax proceeds from asset sales (row 4) minus the investments in fixed assets (row 3).

⁵ Readers have inquired whether magnoosium is a real substance. Here, now, are the facts: Magnoosium was created in the early days of television, when a splendid-sounding announcer closed a variety show by saying, “This program has been brought to you by Blooper Industries, proud producer of aleemium, magnoosium, and stool.” We forget the company, but the blooper really happened.

TABLE 8-1 Financial projections for Blooper's magnoosium mine (figures in thousands of dollars)

	A	B	C	D	E	F	G	H
1	Year:	0	1	2	3	4	5	6
2	A. Fixed assets							
3	Investment in fixed assets	10,000						
4	Sales of fixed assets							1,300
5	CF, invest. in fixed assets	-10,000	0	0	0	0	0	1,300
6								
7	B. Working capital							
8	Working capital	1,500	4,075	4,279	4,493	4,717	3,039	0
9	Change in working capital	1,500	2,575	204	214	225	-1,679	-3,039
10	CF, invest. in wk capital	-1,500	-2,575	-204	-214	-225	1,679	3,039
11								
12	C. Operations							
13	Revenues		15,000	15,750	16,538	17,364	18,233	
14	Expenses		10,000	10,500	11,025	11,576	12,155	
15	Depreciation		2,000	2,000	2,000	2,000	2,000	
16	Pretax profit		3,000	3,250	3,513	3,788	4,078	
17	Tax		1,050	1,138	1,229	1,326	1,427	
18	Profit after tax		1,950	2,113	2,283	2,462	2,650	
19	Cash flow from operations		3,950	4,113	4,283	4,462	4,650	
20								
21	D. Project valuation							
22	Total project cash flow	-11,500	1,375	3,909	4,069	4,238	6,329	4,339
23	Discount factor	1.0	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066
24	PV of cash flow	-11,500	1,228	3,116	2,896	2,693	3,591	2,198
25	Net present value	4,223						
26								
27	E. Other inputs							
28	Inflation rate	0.05						
29	Discount rate	0.12						
30	Acct receiv. as % of sales	1/6						
31	Inven. as % of expenses	0.15						
32	Tax rate	0.35						



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Investments in Working Capital Row 8 shows the *level* of working capital. As the project gears up in the early years, working capital increases, but later in the project's life, the investment in working capital is recovered and the level declines.

Row 9 shows the *change* in working capital from year to year. Notice that in years 1 to 4 the change is positive; in these years the project requires a continuing investment in working capital. Starting in year 5 the change is negative; there is a disinvestment as working capital is recovered. Cash flow associated with investments in working capital (row 10) is the negative of the change in working capital. Just like investment in plant and equipment, investment in working capital produces a negative cash flow, and disinvestment produces a positive cash flow.

Operating Cash Flow The company expects to be able to sell 750,000 pounds of magnoosium a year at a price of \$20 a pound in year 1. That points to initial revenues of $750,000 \times \$20 = \$15,000,000$. But be careful; inflation is running at about 5 percent a year. If magnoosium prices keep pace with inflation, you should increase your forecast of the second-year revenues by 5 percent. Third-year revenues should increase by a further 5 percent, and so on. Row 13 in Table 8-1 shows revenues rising in line with inflation.

The sales forecasts in Table 8-1 are cut off after 5 years. That makes sense if the ore deposit will run out at that time. But if Blooper could make sales for year 6, you should include them in your forecasts. We have sometimes encountered financial

straight-line depreciation

Constant depreciation for each year of the asset's accounting life.

managers who assume a project life of (say) 5 years, even when they confidently expect revenues for 10 years or more. When asked the reason, they explain that forecasting beyond 5 years is too hazardous. We sympathize, but you just have to do your best. Do not arbitrarily truncate a project's life.

Expenses in year 1 are \$10,000 (cell C14). We assume that the expenses of mining and refining (row 14) also increase in line with inflation at 5 percent a year.

We also assume for now that the company applies **straight-line depreciation** to the mining equipment over 5 years. This means that it deducts one-fifth of the initial \$10 million investment from profits. Thus row 15 shows that the annual depreciation deduction is \$2 million.

Pretax profit, shown in row 16, equals (revenues – expenses – depreciation). Taxes (row 17) are 35 percent of pretax profit. For example, in year 1,

$$\text{Tax} = .35 \times 3,000 = 1,050, \text{ or } \$1,050,000$$

Profit after tax (row 18) equals pretax profit less taxes.

The last row of panel C presents cash flows from operations. We use the adjusted accounting profit approach, calculating cash flow as the sum of after-tax profits plus depreciation. Therefore, row 19 is the sum of rows 18 and 15.

Total Project Cash Flow Total cash flow is the sum of cash flows from each of the three sources: net investments in fixed assets and working capital, and cash flow from operations. Therefore, total cash flow in row 22 is just the sum of rows 5, 10, and 19.

Calculating the NPV of Blooper's Project

You have now derived (in row 22) the forecast cash flows from Blooper's magnoosium mine. Suppose that investors expect a return of 12 percent from investments in the capital market with the same risk as the magnoosium project. This is the opportunity cost of the shareholders' money that Blooper is proposing to invest in the project. Therefore, to calculate NPV, you need to discount the cash flows at 12 percent.

Rows 23 and 24 set out the calculations. Remember that to calculate the present value of a cash flow in year t you can divide the cash flow by $(1 + r)^t$ or you can multiply by a discount factor that is equal to $1/(1 + r)^t$. Row 23 presents the discount factors for each year, and row 24 is the present value of each cash flow, equal to the cash flow in row 22 times the discount factor. When all cash flows are discounted and added up, the magnoosium project is seen to offer a positive net present value of \$4,223 thousand (cell B25), or about \$4.2 million.

Now here is a small point that often causes confusion: To calculate the present value of the first year's cash flow, we divide by $(1 + r) = 1.12$. Strictly speaking, this makes sense only if all the sales and all the costs occur exactly 365 days, zero hours, and zero minutes from now. Of course the year's sales don't all take place on the stroke of midnight on December 31. However, when making capital budgeting decisions, companies are usually happy to pretend that all cash flows occur at 1-year intervals. They pretend this for one reason only—simplicity. When sales forecasts are sometimes little more than intelligent guesses, it may be pointless to inquire how the sales are likely to be spread out during the year.⁶

Further Notes and Wrinkles Arising from Blooper's Project

Before we leave Blooper and its magnoosium project, we should cover a few extra wrinkles.

⁶ Financial managers sometimes assume cash flows arrive in the middle of the calendar year, that is, at the end of June. This midyear convention is roughly equivalent to assuming cash flows are distributed evenly throughout the year. This is a bad assumption for some industries. In retailing, for example, most of the cash flow comes late in the year, as the holiday season approaches.

Forecasting Working Capital Table 8–1 shows that Blooper expects its magnoosium mine to produce revenues of \$15,000 in year 1 and \$15,750 in year 2. But Blooper will not actually receive these amounts in years 1 and 2, because some of its customers will not pay up immediately. We have assumed that, on average, customers pay with a 2-month lag, so that $2/12$ of each year's sales are not paid for until the following year. These unpaid bills show up as accounts receivable. For example, in year 1 Blooper will have accounts receivable of $(2/12) \times 15,000 = \$2,500$.⁷

Consider now the mine's expenses. These are forecast at \$10,000 in year 1 and \$10,500 in year 2. But not all of this cash will go out of the door in these 2 years, for Blooper must produce the magnoosium before selling it. Each year, Blooper mines magnoosium ore, but some of this ore is not sold until the following year. The ore is put into inventory, and the accountant does not deduct the cost of its production until it is taken out of inventory and sold. We assume that 15 percent of each year's expenses correspond to an investment in inventory that took place in the previous year. Thus the investment in inventory is forecast at $.15 \times 10,000 = \$1,500$ in year 0 and at $.15 \times 10,500 = \$1,575$ in year 1.

We can now see how Blooper arrives at its forecast of working capital:

	0	1	2	3	4	5	6
1. Receivables ($2/12 \times$ revenues)	\$ 0	\$2,500	\$2,625	\$2,756	\$2,894	\$3,039	0
2. Inventories ($.15 \times$ following year's expenses)	1,500	1,575	1,654	1,736	1,823	0	0
3. Working capital (1 + 2)	1,500	4,075	4,279	4,493	4,717	3,039	0

Note: Columns may not sum due to rounding.

Notice that working capital builds up in years 1 to 4, as sales of magnoosium increase, and then fall. Year 5 is the last year of sales, so Blooper can reduce its inventories to zero in that year. In year 6 the company expects to collect any unpaid bills from year 5 and so in that year receivables also fall to zero. This decline in working capital increases cash flow. For example, in year 6 cash flow is increased as the \$3,039 of outstanding bills are paid.

The construction of the Blooper spreadsheet is discussed further in the nearby box. Once the spreadsheet is set up, it is easy to try out different assumptions for working capital. For example, you can adjust the level of receivables and inventories by changing the values in cells B30 and B31.

A Further Note on Depreciation We warned you earlier not to assume that all cash flows are likely to increase with inflation. The depreciation tax shield is a case in point, because the Internal Revenue Service lets companies depreciate only the amount of the original investment. For example, if you go back to the IRS to explain that inflation mushroomed since you made the investment and you should be allowed to depreciate more, the IRS won't listen. The *nominal* amount of depreciation is fixed, and therefore the higher the rate of inflation, the lower the *real* value of the depreciation that you can claim.

We assumed in our calculations that Blooper could depreciate its investment in mining equipment by \$2 million a year. That produced an annual tax shield of \$2 million $\times .35 =$ \$.70 million per year for 5 years. These tax shields increase cash flows from operations and therefore increase present value. So if Blooper could get those tax shields sooner, they would be worth more, right? Fortunately for corporations, tax law allows them to do just that. It allows *accelerated depreciation*.

⁷ For convenience, we assume that, although Blooper's customers pay with a lag, Blooper pays all its bills on the nail. If it didn't, these unpaid bills would be recorded as accounts payable. Working capital would be reduced by the amount of the accounts payable.

TABLE 8-2 Tax depreciation allowed under the modified accelerated cost recovery system (figures in percent of depreciable investment)

Year(s)	Recovery Period Class					
	3 Year	5 Year	7 Year	10 Year	15 Year	20 Year
1	33.33	20.00	14.29	10.00	5.00	3.75
2	44.45	32.00	24.49	18.00	9.50	7.22
3	14.81	19.20	17.49	14.40	8.55	6.68
4	7.41	11.52	12.49	11.52	7.70	6.18
5		11.52	8.93	9.22	6.93	5.71
6		5.76	8.92	7.37	6.23	5.28
7			8.93	6.55	5.90	4.89
8			4.45	6.55	5.90	4.52
9				6.56	5.90	4.46
10				6.55	5.90	4.46
11				3.29	5.90	4.46
12					5.90	4.46
13					5.91	4.46
14					5.90	4.46
15					5.91	4.46
16					2.99	4.46
17-20						4.46
21						2.23

Notes:

1. Tax depreciation is lower in the first year because assets are assumed to be in service for 6 months.
2. Real property is depreciated straight-line over 27.5 years for residential property and 39 years for nonresidential property.

modified accelerated cost recovery system (MACRS)
Depreciation method that allows higher tax deductions in early years and lower deductions later.

The rate at which firms are permitted to depreciate equipment is known as the **modified accelerated cost recovery system**, or **MACRS**. MACRS places assets into one of six classes, each of which has an assumed life. Table 8-2 shows the rate of depreciation that the company can use for each of these classes. Most industrial equipment falls into the 5- and 7-year classes. To keep life simple, we will assume that all of Bloopers' mining equipment goes into 5-year assets. Thus Bloopers can depreciate 20 percent of its \$10 million investment in year 1. In the second year it can deduct depreciation of $.32 \times 10 = \$3.2$ million, and so on.⁸

How does MACRS depreciation affect the value of the depreciation tax shield for the magnoosium project? Table 8-3 gives the answer. Notice that MACRS does not affect the total amount of depreciation that is claimed. This remains at \$10 million just as before. But MACRS allows companies to get the depreciation deduction earlier, which increases the present value of the depreciation tax shield from \$2,523,000 to \$2,583,000, an increase of \$60,000. Before we recognized MACRS depreciation, we calculated project NPV as \$4,223,000. When we recognize MACRS, we should increase that figure by \$60,000.

All large corporations in the United States keep two sets of books, one for stockholders and one for the Internal Revenue Service. It is common to use straight-line depreciation on the stockholder books and MACRS depreciation on the tax books. Only the tax books are relevant in capital budgeting.

⁸ You might wonder why the 5-year asset class provides a depreciation deduction in years 1 through 6. This is because the tax authorities assume that the assets are in service for only 6 months of the first year and 6 months of the last year. The total project life is 5 years, but that 5-year life spans parts of 6 calendar years. This assumption also explains why the depreciation is lower in the first year than it is in the second.

FINANCE IN PRACTICE



MidAmerican's Wind Power Project

In 2005, MidAmerican Energy will bring into operation in Iowa one of the largest wind farms in the world. The wind farm will cost \$386 million, contain 257 wind turbines, and have a capacity of 360.5 megawatts (mW). Wind speeds fluctuate, and most wind farms are expected to operate at an average of only 35 percent of their rated capacity. In this case, at an electricity price of \$55 per megawatt-hour (mWh), the project will produce revenues in its first year of \$60.8 million (i.e., $.35 \times 8,760 \text{ hours} \times 360.5 \text{ mW} \times \55 per mWh). A reasonable estimate of maintenance and other costs is about \$18.9 million in the first year of operation. Thereafter, revenues and costs should increase with inflation by around 3 percent a year. Conventional power stations can be depreciated using 20-year MACRS, and their profits are taxed at 35 percent. A project such as this one might last 25 years and entail a cost of capital of 12 percent.

Wind power is more costly than conventional fossil-fueled power, but to encourage the development of renewable energy sources, the government provides several tax breaks to companies constructing wind farms. How large do

these tax breaks need to be to make the wind farm viable for MidAmerican? We estimate that in the absence of any tax breaks the project would have a net present value of $-\$68$ million. So any tax subsidy must have a value of at least \$68 million to entice a private firm such as MidAmerican to undertake the project.

You can find our calculations at the Online Learning Center at www.mhhe.com/bmm5e. Once you're there, you might consider the following questions. Suppose the government believes that the national security and environmental benefits of being able to generate clean energy domestically is worth 25 percent of the value of the electricity produced. Does the subsidy make economic sense for the government? Some wind farm operators assume a capacity factor of 30 percent rather than 35 percent. If MidAmerican's plant achieves only this level of operation, how much larger would the tax subsidy need to be? If no tax breaks were available for wind farms, how high would electricity prices need to be before this plant would be viable (i.e., have a positive NPV)?

Self-Test 8.5

Suppose that Blooper's mining equipment could be put in the 3-year recovery period class. What is the present value of the depreciation tax shield? Confirm that the change in the value of the depreciation tax shield equals the increase in project NPV from question 1 of the Spreadsheet Solutions box.

More on Salvage Value When you sell equipment, you must pay taxes on the difference between the sales price and the book value of the asset. The book value in turn equals the initial cost minus cumulative charges for depreciation. It is common when figuring tax depreciation to assume a salvage value of zero at the end of the asset's depreciable life.

For reports to shareholders, however, positive expected salvage values are often recognized. For example, Blooper's financial statements might assume that its \$10 million investment in mining equipment would be worth \$2 million in year 6. In this case, the depreciation reported to shareholders would be based on the difference between the investment and the salvage value, that is, \$8 million. Straight-line depreciation then would be \$1.6 million annually.

TABLE 8-3 The switch from straight-line to 5-year MACRS depreciation increases the value of Blooper's depreciation tax shield from \$2,523,000 to \$2,583,000 (figures in thousands of dollars)

Year	Straight-Line Depreciation			MACRS Depreciation		
	Depreciation	Tax Shield	PV Tax Shield at 12%	Depreciation	Tax Shield	PV Tax Shield at 12%
1	2,000	700	625	2,000	700	625
2	2,000	700	558	3,200	1,120	893
3	2,000	700	498	1,920	672	478
4	2,000	700	445	1,152	403	256
5	2,000	700	397	1,152	403	229
6	0	0	0	576	202	102
Totals	10,000	3,500	2,523	10,000	3,500	2,583

Note: Column sums subject to rounding error.



SPREADSHEET SOLUTIONS

The Blooper Spreadsheet Model

Discounted cash-flow analysis of proposed capital investments is clearly tailor-made for spreadsheet analysis. The formula view of the Excel spreadsheet used in the Blooper example appears below.

Notice that most of the entries in the spreadsheet are formulas rather than specific numbers. Once the relatively few input values are entered, the spreadsheet does most of the work by calculating the formulas. We enter only the initial investment (cell B3), the after-tax salvage value (cell H4), the initial levels of revenues and expenses (cells C13 and C14), and the parameters in panel E (cells B28 to B31).

Revenues and expenses in each year equal the value in the previous year times $(1 + \text{inflation rate})$, which is given in cell B28 as .05. For example, cell D13 equals $C13 \times 1.05$. To make the spreadsheet easier to read, we have defined names for a few cells, such as B28 (named *Inflation*) and B29 (named *Disc_rate*). These names can be assigned using the Insert command in Excel and thereafter can be used to refer to specific cells.

Row 8 sets out the level of working capital, which is the sum of accounts receivable and inventories. To capture the fact that inventories tend to rise with production, we set inventories equal to .15 times expenses recognized in the following year when the product is sold. Similarly, accounts receivable rise with sales, so we assume that they will be 2/12 times the current year's revenues (in other words, that Blooper's customers pay, on average, 2 months after purchasing the product). Each entry in row 8 is the sum of these two quantities.

We calculate the discount factor in row 23 using the discount rate of 12 percent, compute present values of each cash flow in row 24, and add the present value of each cash flow to find project NPV in cell B25.

Once the spreadsheet is up and running, it is easy to do "what if" analyses. Here are a few questions to try your hand.



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Formula view

	A	B	C	D	E	F	G	H
1	Year:	0	1	2	3	4	5	6
2	A. Fixed assets							
3	Investment in fixed assets	10000						
4	Sales of fixed assets							=2000*(1-Tax_rate)
5	CF, invest. in fixed assets	=-B3+B4	=-C3+C4	=-D3+D4	=-E3+E4	=-F3+F4	=-G3+G4	=-H3+H4
6								
7	B. Working capital							
8	Working capital	=B\$31*C14+B\$30*B13	=B\$31*D14+B\$30*C13	=B\$31*E14+B\$30*D13	=B\$31*F14+B\$30*E13	=B\$31*G14+B\$30*F13	=B\$31*H14+B\$30*G13	=B\$31*I14+B\$30*H13
9	Change in working capital	=B8	=C8-B8	=D8-C8	=E8-D8	=F8-E8	=G8-F8	=H8-G8
10	CF, invest. in wk capital	=-B9	=-C9	=-D9	=-E9	=-F9	=-G9	=-H9
11								
12	C. Operations							
13	Revenues		15000	=C13*(1+Inflation)	=D13*(1+Inflation)	=E13*(1+Inflation)	=F13*(1+Inflation)	
14	Expenses		10000	=C14*(1+Inflation)	=D14*(1+Inflation)	=E14*(1+Inflation)	=F14*(1+Inflation)	
15	Depreciation		=10000/5	=10000/5	=10000/5	=10000/5	=10000/5	
16	Pretax profit		=C13-C14-C15	=D13-D14-D15	=E13-E14-E15	=F13-F14-F15	=G13-G14-G15	
17	Tax		=C16*Tax_rate	=D16*Tax_rate	=E16*Tax_rate	=F16*Tax_rate	=G16*Tax_rate	
18	Profit after tax		=C16-C17	=D16-D17	=E16-E17	=F16-F17	=G16-G17	
19	Cash flow from operations		=C15+C18	=D15+D18	=E15+E18	=F15+F18	=G15+G18	
20								
21	D. Project valuation							
22	Total project cash flow	=B5+B10+B19	=C5+C10+C19	=D5+D10+D19	=E5+E10+E19	=F5+F10+F19	=G5+G10+G19	=H5+H10+H19
23	Discount factor	=1/(1+Disc_rate)^B1	=1/(1+Disc_rate)^C1	=1/(1+Disc_rate)^D1	=1/(1+Disc_rate)^E1	=1/(1+Disc_rate)^F1	=1/(1+Disc_rate)^G1	=1/(1+Disc_rate)^H1
24	PV of cash flow	=B22*B23	=C22*C23	=D22*D23	=E22*E23	=F22*F23	=G22*G23	=H22*H23
25	Net present value	=SUM(B24:H24)						
26								
27	E. Other inputs							
28	Inflation rate	0.05						
29	Discount rate	0.12						
30	Acct receiv. as % of sales	=2/12						
31	Inven. as % of expenses	0.15						
32								

Questions

1. What happens to cash flow in each year and the NPV of the project if the firm uses MACRS depreciation assuming a 3-year recovery period? Assume that year 1 is the first year that depreciation is taken.
2. Suppose the firm can economize on working capital by managing inventories more efficiently. If the firm can reduce inventories from 15 to 10 percent of next year's cost of goods sold, what will be the effect on project NPV?
3. What happens to NPV if the inflation rate falls from 5 percent to zero and the discount rate falls from 12 to 7 per-

cent? Given that the real discount rate is almost unchanged, why does project NPV increase? [To be consistent, you should assume that nominal salvage value will be lower in a zero-inflation environment. If you set (before-tax) salvage value to \$1.492 million, you will maintain its real value unchanged.]

Solutions (as well as the full spreadsheet) are available at the Online Learning Center for the text: www.mhhe.com/bmm5e.

SUMMARY

How should the cash flows of a proposed new project be calculated?

Here is a checklist to bear in mind when forecasting a project's cash flows:

- Discount cash flows, not profits.
- Estimate the project's *incremental* cash flows—that is, the difference between the cash flows with the project and those without the project.
- Include all indirect effects of the project, such as its impact on the sales of the firm's other products.
- Forget sunk costs.
- Include **opportunity costs**, such as the value of land that you could otherwise sell.
- Beware of allocated overhead charges for heat, light, and so on. These may not reflect the incremental effects of the project on these costs.
- Remember the investment in working capital. As sales increase, the firm may need to make additional investments in working capital, and as the project finally comes to an end, it will recover these investments.
- Treat inflation consistently. If cash flows are forecast in nominal terms (including the effects of future inflation), use a nominal discount rate. Discount real cash flows at a real rate.
- Do not include debt interest or the cost of repaying a loan. When calculating NPV, assume that the project is financed entirely by the shareholders and that they receive all the cash flows. This separates the investment decision from the financing decision.

How can the cash flows of a project be computed from standard financial statements?

Project cash flow does not equal profit. You must allow for changes in working capital as well as noncash expenses such as depreciation. Also, if you use a nominal cost of capital, consistency requires that you forecast *nominal* cash flows—that is, cash flows that recognize the effect of inflation.

How is the company's tax bill affected by depreciation, and how does this affect project value?

Depreciation is not a cash flow. However, because depreciation reduces taxable income, it reduces taxes. This tax reduction is called the **depreciation tax shield**. **Modified accelerated cost recovery system (MACRS)** depreciation schedules allow more of the depreciation allowance to be taken in early years than is possible under **straight-line depreciation**. This increases the present value of the tax shield.

How do changes in working capital affect project cash flows?

Increases in **net working capital** such as accounts receivable or inventory are investments and therefore use cash—that is, they reduce the net cash flow provided by the project in that period. When working capital is run down, cash is freed up, so cash flow increases.

QUIZ

1. **Cash Flows.** A new project will generate sales of \$74 million, costs of \$42 million, and depreciation expense of \$10 million in the coming year. The firm's tax rate is 35 percent. Calculate cash flow for the year by using all three methods discussed in the chapter, and confirm that they are equal.

2. **Cash Flows.** Canyon Tours showed the following components of working capital last year:

	Beginning	End of Year
Accounts receivable	\$24,000	\$23,000
Inventory	12,000	12,500
Accounts payable	14,500	16,500

- a. What was the change in net working capital during the year?
b. If sales were \$36,000 and costs were \$24,000, what was cash flow for the year? Ignore taxes.
3. **Cash Flows.** Tubby Toys estimates that its new line of rubber ducks will generate sales of \$7 million, operating costs of \$4 million, and a depreciation expense of \$1 million. If the tax rate is 35 percent, what is the firm's operating cash flow? Show that you get the same answer using all three methods to calculate operating cash flow.
4. **Cash Flows.** We've emphasized that the firm should pay attention only to cash flows when assessing the net present value of proposed projects. Depreciation is a noncash expense. Why then does it matter whether we assume straight-line or MACRS depreciation when we assess project NPV?
5. **Proper Cash Flows.** Quick Computing currently sells 10 million computer chips each year at a price of \$20 per chip. It is about to introduce a new chip, and it forecasts annual sales of 12 million of these improved chips at a price of \$25 each. However, demand for the old chip will decrease, and sales of the old chip are expected to fall to 3 million per year. The old chip costs \$6 each to manufacture, and the new ones will cost \$8 each. What is the proper cash flow to use to evaluate the present value of the introduction of the new chip?
6. **Calculating Net Income.** The owner of a bicycle repair shop forecasts revenues of \$160,000 a year. Variable costs will be \$50,000, and rental costs for the shop are \$30,000 a year. Depreciation on the repair tools will be \$10,000. Prepare an income statement for the shop based on these estimates. The tax rate is 35 percent.
7. **Cash Flows.** Calculate the operating cash flow for the repair shop in the previous problem using all three methods suggested in the chapter: (a) net income plus depreciation; (b) cash inflow/cash outflow analysis; and (c) the depreciation tax shield approach. Confirm that all three approaches result in the same value for cash flow.
8. **Cash Flows and Working Capital.** A house painting business had revenues of \$16,000 and expenses of \$9,000. There were no depreciation expenses. However, the business reported the following changes in working capital:

	Beginning	End
Accounts receivable	\$1,200	\$4,500
Accounts payable	700	300

Calculate net cash flow for the business for this period.

9. **Incremental Cash Flows.** A corporation donates a valuable painting from its private collection to an art museum. Which of the following are incremental cash flows associated with the donation?
- a. The price the firm paid for the painting.
b. The current market value of the painting.
c. The deduction from income that it declares for its charitable gift.
d. The reduction in taxes due to its declared tax deduction.
10. **Operating Cash Flows.** Laurel's Lawn Care, Ltd., has a new mower line that can generate revenues of \$120,000 per year. Direct production costs are \$40,000, and the fixed costs of maintaining the lawn mower factory are \$15,000 a year. The factory originally cost \$1 million and is being depreciated for tax purposes over 25 years using straight-line depreciation. Calculate the operating cash flows of the project if the firm's tax bracket is 35 percent.



PRACTICE PROBLEMS 

11. **Operating Cash Flows.** Talia's Tutus bought a new sewing machine for \$40,000 that will be depreciated using the MACRS depreciation schedule for a 5-year recovery period.
 - a. Find the depreciation charge each year.
 - b. If the sewing machine is sold after 3 years for \$22,000, what will be the after-tax proceeds on the sale if the firm's tax bracket is 35 percent?
12. **Proper Cash Flows.** Conference Services Inc. has leased a large office building for \$4 million per year. The building is larger than the company needs; two of the building's eight stories are almost empty. A manager wants to expand one of her projects, but this will require using one of the empty floors. In calculating the net present value of the proposed expansion, senior management allocates one-eighth of \$4 million of building rental costs (i.e., \$.5 million) to the project expansion, reasoning that the project will use one-eighth of the building's capacity.
 - a. Is this a reasonable procedure for purposes of calculating NPV?
 - b. Can you suggest a better way to assess a cost of the office space used by the project?
13. **Cash Flows and Working Capital.** A firm had after-tax income last year of \$1.2 million. Its depreciation expenses were \$.4 million, and its total cash flow was \$1.2 million. What happened to net working capital during the year?
14. **Cash Flows and Working Capital.** The only capital investment required for a small project is investment in inventory. Profits this year were \$10,000, and inventory increased from \$4,000 to \$5,000. What was the cash flow from the project?
15. **Cash Flows and Working Capital.** A firm's balance sheets for year-end 2006 and 2007 contain the following data. What happened to investment in net working capital during 2007? All items are in millions of dollars.

	Dec. 31, 2006	Dec. 31, 2007
Accounts receivable	32	36
Inventories	25	30
Accounts payable	12	26

16. **Salvage Value.** Quick Computing (from problem 5) installed its previous generation of computer chip manufacturing equipment 3 years ago. Some of that older equipment will become unnecessary when the company goes into production of its new product. The obsolete equipment, which originally cost \$40 million, has been depreciated straight-line over an assumed tax life of 5 years, but it can be sold now for \$18 million. The firm's tax rate is 35 percent. What is the after-tax cash flow from the sale of the equipment?
17. **Salvage Value.** Your firm purchased machinery with a 7-year MACRS life for \$10 million. The project, however, will end after 5 years. If the equipment can be sold for \$4.5 million at the completion of the project, and your firm's tax rate is 35 percent, what is the after-tax cash flow from the sale of the machinery?
18. **Depreciation and Project Value.** Bottoms Up Diaper Service is considering the purchase of a new industrial washer. It can purchase the washer for \$6,000 and sell its old washer for \$2,000. The new washer will last for 6 years and save \$1,500 a year in expenses. The opportunity cost of capital is 16 percent, and the firm's tax rate is 40 percent.
 - a. If the firm uses straight-line depreciation to an assumed salvage value of zero over a 6-year life, what are the cash flows of the project in years 0 to 6? The new washer will in fact have zero salvage value after 6 years, and the old washer is fully depreciated.
 - b. What is project NPV?
 - c. What is NPV if the firm uses MACRS depreciation with a 5-year tax life?
19. **Equivalent Annual Cost.** What is the equivalent annual cost of the washer in the previous problem if the firm uses straight-line depreciation?
20. **Cash Flows and NPV.** Johnny's Lunches is considering purchasing a new, energy-efficient grill. The grill will cost \$40,000 and will be depreciated according to the 3-year MACRS

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schedule. It will be sold for scrap metal after 3 years for \$10,000. The grill will have no effect on revenues but will save Johnny's \$20,000 in energy expenses. The tax rate is 35 percent.

- What are the operating cash flows in years 1 to 3?
- What are total cash flows in years 1 to 3?
- If the discount rate is 12 percent, should the grill be purchased?

21. **Project Evaluation.** Revenues generated by a new fad product are forecast as follows:

Year	Revenues
1	\$40,000
2	30,000
3	20,000
4	10,000
Thereafter	0

Expenses are expected to be 40 percent of revenues, and working capital required in each year is expected to be 20 percent of revenues in the following year. The product requires an immediate investment of \$45,000 in plant and equipment.

- What is the initial investment in the product? Remember working capital.
 - If the plant and equipment are depreciated over 4 years to a salvage value of zero using straight-line depreciation, and the firm's tax rate is 40 percent, what are the project cash flows in each year?
 - If the opportunity cost of capital is 12 percent, what is project NPV?
 - What is project IRR?
22. **Buy versus Lease.** You can buy a car for \$25,000 and sell it in 5 years for \$5,000. Or you can lease the car for 5 years for \$5,000 a year. The discount rate is 12 percent per year.
- Which option do you prefer?
 - What is the maximum amount you should be willing to pay to lease rather than buy the car?
23. **Project Evaluation.** Kinky Copies may buy a high-volume copier. The machine costs \$100,000 and will be depreciated straight-line over 5 years to a salvage value of \$20,000. Kinky anticipates that the machine actually can be sold in 5 years for \$30,000. The machine will save \$20,000 a year in labor costs but will require an increase in working capital, mainly paper supplies, of \$10,000. The firm's marginal tax rate is 35 percent, and the discount rate is 8 percent. Should Kinky buy the machine?
24. **Project Evaluation.** Blooper Industries must replace its magnoosium purification system. Quick & Dirty Systems sells a relatively cheap purification system for \$10 million. The system will last 5 years. Do-It-Right sells a sturdier but more expensive system for \$12 million; it will last for 8 years. Both systems entail \$1 million in operating costs; both will be depreciated straight-line to a final value of zero over their useful lives; neither will have any salvage value at the end of its life. The firm's tax rate is 35 percent, and the discount rate is 12 percent. Which system should Blooper install? *Hint:* Check the discussion of equivalent annual annuities in the previous chapter.
25. **Project Evaluation.** The following table presents sales forecasts for Golden Gelt Giftware. The unit price is \$40. The unit cost of the giftware is \$25.

Year	Unit Sales
1	22,000
2	30,000
3	14,000
4	5,000
Thereafter	0

It is expected that net working capital will amount to 20 percent of sales in the following year. For example, the store will need an initial (year-0) investment in working capital of $.20 \times 22,000 \times \$40 = \$176,000$. Plant and equipment necessary to establish the Giftware business will re-



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quire an additional investment of \$200,000. This investment will be depreciated using MACRS and a 3-year life. After 4 years, the equipment will have an economic and book value of zero. The firm's tax rate is 35 percent. What is the net present value of the project? The discount rate is 20 percent.

26. **Project Evaluation.** Ilana Industries, Inc., needs a new lathe. It can buy a new high-speed lathe for \$1 million. The lathe will cost \$35,000 to run, will save the firm \$125,000 in labor costs, and will be useful for 10 years. Suppose that for tax purposes, the lathe will be depreciated on a straight-line basis over its 10-year life to a salvage value of \$100,000. The actual market value of the lathe at that time also will be \$100,000. The discount rate is 8 percent, and the corporate tax rate is 35 percent. What is the NPV of buying the new lathe?

CHALLENGE PROBLEMS

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27. **Project Evaluation.** The efficiency gains resulting from a just-in-time inventory management system will allow a firm to reduce its level of inventories permanently by \$250,000. What is the most the firm should be willing to pay for installing the system?
28. **Project Evaluation.** Better Mousetraps has developed a new trap. It can go into production for an initial investment in equipment of \$6 million. The equipment will be depreciated straight-line over 5 years to a value of zero, but in fact it can be sold after 5 years for \$500,000. The firm believes that working capital at each date must be maintained at a level of 10 percent of next year's forecast sales. The firm estimates production costs equal to \$1.50 per trap and believes that the traps can be sold for \$4 each. Sales forecasts are given in the following table. The project will come to an end in 5 years, when the trap becomes technologically obsolete. The firm's tax bracket is 35 percent, and the required rate of return on the project is 12 percent. What is project NPV?

Year:	0	1	2	3	4	5	Thereafter
Sales (millions of traps)	0	.5	.6	1.0	1.0	.6	0

29. **Working Capital Management.** Return to the previous problem. Suppose the firm can cut its requirements for working capital in half by using better inventory control systems. By how much will this increase project NPV?
30. **Project Evaluation.** PC Shopping Network may upgrade its modem pool. It last upgraded 2 years ago, when it spent \$115 million on equipment with an assumed life of 5 years and an assumed salvage value of \$15 million for tax purposes. The firm uses straight-line depreciation. The old equipment can be sold today for \$80 million. A new modem pool can be installed today for \$150 million. This will have a 3-year life and will be depreciated to zero using straight-line depreciation. The new equipment will enable the firm to increase sales by \$25 million per year and decrease operating costs by \$10 million per year. At the end of 3 years, the new equipment will be worthless. Assume the firm's tax rate is 35 percent and the discount rate for projects of this sort is 10 percent.
- What is the net cash flow at time 0 if the old equipment is replaced?
 - What are the incremental cash flows in years 1, 2, and 3?
 - What are the NPV and IRR of the replacement project?

**STANDARD
& POOR'S**

- Go to Market Insight (www.mhhe.com/edumarketinsight). Find the net capital expenditures, capital expenditures less sales of plant and equipment, and total sales for General Motors (GM) and Microsoft (MSFT). What were the ratios of net capital expenditure to sales for the last 3 years for both companies? What were the sales and net capital expenditures relative to total

assets? What might explain the variation in these ratios for these two large corporations? Did the company make an investment or disinvestment in working capital in each of the 3 years?

SOLUTIONS TO SELF-TEST QUESTIONS

- 8.1 Remember, discount cash flows, not profits. Each tewgit machine costs \$250,000 right away. Recognize that outlay, but forget accounting depreciation. Cash flows per machine are:

Year:	0	1	2	3	4	5
Investment (outflow)	-250,000					
Sales		250,000	300,000	300,000	250,000	250,000
Operating expenses		<u>-200,000</u>	<u>-200,000</u>	<u>-200,000</u>	<u>-200,000</u>	<u>-200,000</u>
Cash flow	-250,000	+ 50,000	+100,000	+100,000	+ 50,000	+ 50,000

Each machine is forecast to generate \$50,000 of cash flow in years 4 and 5. Thus it makes sense to keep operating for 5 years.

- 8.2 a,b. The site and buildings could have been sold or put to another use. Their values are opportunity costs, which should be treated as incremental cash outflows.
 c. Demolition costs are incremental cash outflows.
 d. The cost of the access road is sunk and not incremental.
 e. Lost cash flows from other projects are incremental cash outflows.
 f. Depreciation is not a cash expense and should not be included, except as it affects taxes. (Taxes are discussed later in this chapter.)
- 8.3 Actual health costs will be increasing at about 7 percent a year.

Year:	1	2	3	4
Cost per worker	\$2,400	\$2,568	\$2,748	\$2,940

The present value at 10 percent is \$9,214 if the first payment is made immediately. If it is delayed a year, present value falls to \$8,377.

- 8.4 The tax rate is $T = 35$ percent. Taxes paid will be

$$T \times (\text{revenue} - \text{expenses} - \text{depreciation}) = .35 \times (600 - 300 - 200) = \$35$$

Operating cash flow can be calculated as follows.

- a. Revenue - expenses - taxes = $600 - 300 - 35 = \$265$
 b. Net profit + depreciation = $(600 - 300 - 200 - 35) + 200 = 65 + 200 = 265$
 c. $(\text{Revenues} - \text{cash expenses}) \times (1 - \text{tax rate}) + (\text{depreciation} \times \text{tax rate})$
 $= (600 - 300) \times (1 - .35) + (200 \times .35) = 265$

- 8.5

Year	MACRS 3-Year Depreciation	Tax Shield	PV Tax Shield at 12%
1	3,333	1,167	1,042
2	4,445	1,556	1,240
3	1,481	518	369
4	<u>741</u>	<u>259</u>	<u>165</u>
Totals	10,000	3,500	2,816

The present value increases to 2,816, or \$2,816,000.

MINICASE

Jack Tar, CFO of Sheetbend & Halyard, Inc., opened the company confidential envelope. It contained a draft of a competitive bid for a contract to supply duffel canvas to the U.S. Navy. The cover memo from Sheetbend's CEO asked Mr. Tar to review the bid before it was submitted.

The bid and its supporting documents had been prepared by Sheetbend's sales staff. It called for Sheetbend to supply 100,000 yards of duffel canvas per year for 5 years. The proposed selling price was fixed at \$30 per yard.

Mr. Tar was not usually involved in sales, but this bid was unusual in at least two respects. First, if accepted by the navy, it would commit Sheetbend to a fixed-price, long-term contract. Second, producing the duffel canvas would require an investment of \$1.5 million to purchase machinery and to refurbish Sheetbend's plant in Pleasantboro, Maine.

Mr. Tar set to work and by the end of the week had collected the following facts and assumptions:

- The plant in Pleasantboro had been built in the early 1900s and is now idle. The plant was fully depreciated on Sheetbend's books, except for the purchase cost of the land (in 1947) of \$10,000.
- Now that the land was valuable shorefront property, Mr. Tar thought the land and the idle plant could be sold, immediately or in the near future, for \$600,000.
- Refurbishing the plant would cost \$500,000. This investment would be depreciated for tax purposes on the 10-year MACRS schedule.

- The new machinery would cost \$1 million. This investment could be depreciated on the 5-year MACRS schedule.
- The refurbished plant and new machinery would last for many years. However, the remaining market for duffel canvas was small, and it was not clear that additional orders could be obtained once the navy contract was finished. The machinery was custom-built and could be used only for duffel canvas. Its second-hand value at the end of 5 years was probably zero.
- Table 8-4 shows the sales staff's forecasts of income from the navy contract. Mr. Tar reviewed this forecast and decided that its assumptions were reasonable, except that the forecast used book, not tax, depreciation.
- But the forecast income statement contained no mention of working capital. Mr. Tar thought that working capital would average about 10 percent of sales.

Armed with this information, Mr. Tar constructed a spreadsheet to calculate the NPV of the duffel canvas project, assuming that Sheetbend's bid would be accepted by the navy.

He had just finished debugging the spreadsheet when another confidential envelope arrived from Sheetbend's CEO. It contained a firm offer from a Maine real estate developer to purchase Sheetbend's Pleasantboro land and plant for \$1.5 million in cash.

Should Mr. Tar recommend submitting the bid to the navy at the proposed price of \$30 per yard? The discount rate for this project is 12 percent.

TABLE 8-4 Forecast income statement for the U. S. Navy duffel canvas project (dollar figures in thousands, except price per yard)

Year:	1	2	3	4	5
1. Yards sold	100.00	100.00	100.00	100.00	100.00
2. Price per yard	30.00	30.00	30.00	30.00	30.00
3. Revenue (1 × 2)	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
4. Cost of goods sold	2,100.00	2,184.00	2,271.36	2,362.21	2,456.70
5. Operating cash flow (3 - 4)	900.00	816.00	728.64	637.79	543.30
6. Depreciation	250.00	250.00	250.00	250.00	250.00
7. Income (5 - 6)	650.00	566.00	478.64	387.79	293.30
8. Tax at 35%	227.50	198.10	167.52	135.72	102.65
9. Net income (7 - 8)	\$422.50	\$367.90	\$311.12	\$252.07	\$190.65

Notes:

1. Yards sold and price per yard would be fixed by contract.
2. Cost of goods includes fixed cost of \$300,000 per year plus variable costs of \$18 per yard. Costs are expected to increase at the inflation rate of 4 percent per year.
3. Depreciation: A \$1 million investment in machinery is depreciated straight-line over 5 years (\$200,000 per year). The \$500,000 cost of refurbishing the Pleasantboro plant is depreciated straight-line over 10 years (\$50,000 per year).