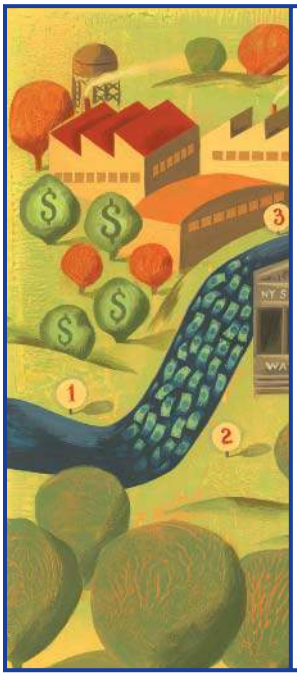
Cash Flow Estimation

CHAPTER 11

CHAPTER OUTLINE



Early in the last chapter we said that any project to be analyzed by capital budgeting techniques must be represented as a series of estimated cash flows. We portrayed the flows for a typical project as C_0, C_1, . . . , C_n, and assumed that they were readily available. In this chapter we'll consider exactly how such cash flow estimates are developed. In the next chapter we'll look into some modern developments in capital budgeting that deal with incorporating risk into the analysis.

CASH FLOW ESTIMATION

We'll begin by placing cash flow estimation within the overall capital budgeting process and making some important observations about people's perceptions.

CAPITAL BUDGETING PROCESSES

Capital budgeting consists of two distinct processes. The first is estimation of the cash flows associated with projects. The second is evaluation of the estimates using techniques like NPV and IRR. There is a tendency to take the forecast cash flows for granted and to overlook the difficulties involved in their estimation. Further, once a set of projections is made, people tend to treat it as a concrete fact not subject to error.

The same tendency leads to associating the capital budgeting concept solely with the evaluation techniques, especially NPV and IRR, and becoming caught up in an incorrect perception of the accuracy and precision of the whole process. Indeed, the techniques we studied in the last chapter seem like

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Estimating project **cash flows** is the **most difficult** and error-prone part of capital budgeting.

"financial engineering" in their direct and unambiguous approach to the task of choosing among projects. Problem solutions come out to what seems like hair-splitting accuracy, and it's easy to get a feeling of comfort and security in the correctness of the method.

However, this secure feeling of great accuracy is misplaced. The results of an NPV or IRR analysis are only as accurate as the cash flow estimates used as inputs. And those estimates are forecasts of the *future*, which are always difficult to make and subject to considerable error.

In practice, forecasting accurate project cash flows is the more difficult and arbitrary of the two capital budgeting processes. In a sense it's the more important, because it's where error and bias can creep into the analysis. Applying NPV and/or IRR is a straightforward task that isn't likely to result in error or misinterpretation. The calculation may be complicated, but it's easy in the sense that we don't have to make any judgments about what we're doing. Making cash flow estimates, on the other hand, requires the exercise of a good deal of judgment about what to include, what to leave out, and how heavily to weight things in relation to one another. As a result, a particular set of estimated flows may be very good or very bad depending on the nature of the project and who's doing the estimating.

This is an important point that's often overlooked. Anyone can make the right capital budgeting decisions with NPV and IRR *given* a set of cash flows. It's developing the right set of cash flows that's tough.

In this chapter we'll take a close look at what goes into estimating cash flows. We'll be especially concerned with the practical matter of ambiguities and uncertainties in the process.

PROJECT CASH FLOWS—AN OVERVIEW AND SOME SPECIFICS

First we'll sketch a broad approach to the estimating process, then we'll consider a few issues that require special treatment, and finally we'll look into some detailed examples.

THE GENERAL APPROACH TO CASH FLOW ESTIMATION

Cash flow estimation can be a messy calculation, but it's conceptually quite simple. We just think through all the events a project is expected to bring about, and write down the financial implications of each event in the future time period in which we expect it to occur. Then we add up everything in each time period.

Cash estimates are done on **spreadsheets** by enumerating the issues that impact cash and forecasting each over time.

We generally use a spreadsheet format for our estimations. The sheet's columns are time periods starting with the present and extending into the future over the project's life. The rows are financial items that will either generate or require cash.

For example, a sales forecast leads to an estimate of cash inflows from customers, while an expense projection leads to a pattern of outflows to employees and vendors. When everything is enumerated, we add up each column to arrive at a forecast of each future period.

It will help your perspective if you look ahead at Table 11.1 on page 464 to get an idea of what the finished product looks like.

Forecasts for new ventures tend to be the most complex, so we'll consider them before talking briefly about expansion and replacement projects. For those projects we generally just leave out some of the issues considered for new ventures. It helps to organize our thinking if we consider things in several separate categories. A general outline for estimating new venture cash flows follows.

Pre–Start-Up, the Initial Outlay

Enumerate everything that has to be spent before the project is truly started. Include expenses and assets that have to be purchased. Also include the tax impact of expense items. The sum of these things is C_0, the *initial outlay*.

The Sales Forecast, Units and Revenues

The incremental business expected from the project is laid out in spreadsheet form (on paper or in a computer) over future time periods. It's best to forecast in terms of units and then multiply by projected prices to arrive at sales dollars.

Cost of Sales and Expenses

Plan for costs directly related to the new sales forecast as well as expenses necessary for indirect support of the increased activity level. To do that, assume relationships between sales and cost and between sales and expense based on the nature of the business being analyzed.

Assets

New assets to be acquired with cash are planned over the project's life whenever they're expected to be acquired. Most are needed during the initial, pre–start-up period. It's important not to neglect working capital, which requires cash like any other asset.

Depreciation

When planning for physical assets, it's important to forecast depreciation even though it's a noncash expense because it affects taxes.

Taxes and Earnings

Summarizing the taxable and tax deductible items in each period lets us calculate the project's impact on earnings and taxes. Calculate incremental taxes and treat them like any other cash flow item.

Summarize and Combine

Adjust earnings for depreciation and combine it with the balance sheet items to arrive at a cash flow estimate in each forecast period.

Expansion projects tend to require the same elements as new ventures, but generally require less new equipment and facilities.

Replacement projects are generally expected to save costs without generating new revenue, so the estimating process tends to be somewhat less elaborate. The expected dollar savings are planned over future periods along with the assets required to realize those savings. Depreciation and tax calculations are necessary in most cases.

We'll look at some examples after the next section.

A FEW SPECIFIC ISSUES

It helps to keep a few specific items in mind when making cash flow estimates. We'll consider several before moving on to examples.

The Typical Pattern

Nearly all projects require an *initial outlay* of funds before getting started. Subsequently, flows tend to be positive (inflows) with some notable exceptions. The typical pattern is characterized by early outflows followed by later inflows.

A replacement project is generally fairly simple in this respect. The initial outlay is the cost of the new equipment less any salvage value available for the old. Future cash flows are the savings or benefits of using the new, more efficient machinery. They start immediately and are generally relatively stable.

Most cash **outflows** occur **early**; inflows happen **later**.

Other kinds of projects can have several negative cash flow periods. New ventures, for example, typically lose money for the first few years after an initial outlay, so there are several negative periods at the outset. More complex projects can require infusions of cash at different times, so it's possible to have negative flows at any time. For example, a cleanup requirement at the end can make the last flow of a project negative.

Project Cash Flows Are Incremental

Only **incremental** cash flows count.

The most fundamental concept about project cash flows is that they are *incremental* to the company's normal business. "Incremental" means *in addition to*, and at least conceptually *separate from*. In other words, we must answer the following question: What cash flows will occur if we undertake this project that wouldn't occur if we left it undone and continued business as before?

Sunk Costs

Sunk costs have already been spent and are ignored.

Some expenditures associated with a project should not be included in capital budgeting cash flows. **Sunk costs** are monies that have already been spent at the time of the analysis. The fact that sunk money is gone cannot be changed by decisions about the project.

For example, suppose a company spends money to study a new area of business and later conducts an analysis to decide whether to enter the field. The cost of the study should *not* be included in the project's cash flow stream for capital budgeting analysis, because at the time of the analysis the money has already been spent.

The analysis of a decision must include only *future* costs that are dependent on the decision. The study money is gone and won't be recovered whether the new field is entered or not, so it's irrelevant to the decision.

Opportunity Cost

Resources aren't free even though they sometimes seem to be. Suppose a firm has an idle production facility and is evaluating a project that requires a similar resource. The idle factory will be used if the project is undertaken, and won't require a cash outlay. Does that mean the facility is a zero cost item in the project's capital budgeting analysis?

The **opportunity cost** of a resource is its value in its best alternative use and is included in capital budgeting analyses.

It's tempting to say yes, especially if there are no other plans for the building. However, that's not the right way to look at the problem. The appropriate cost of any resource is whatever has to be *given up* to use it, in other words, its value in the next best use.

In this example, suppose the firm has no other production use for the idle factory, but can sell it for $1 million (the next most lucrative use). In such a case we'd say $1 million is the *opportunity cost* of the factory and use that amount as a cash outflow in the analysis. In effect, the company is forgoing a $1 million cash inflow by using the facility in the project. The factory would be free only if it had no market value and no other use by the company.

Impacts on Other Parts of the Company

Projects sometimes have impacts on other parts of the company that have to be considered. Suppose a company sells a family model product and is considering introducing a luxury model. Some customers who buy the family model will probably switch to

the luxury line. The result will be a loss of income in the family line that should be reflected as a negative cash flow in the analysis of the new proposal.

Overhead Levels

Basic overheads are usually considered fixed and left out of project analysis. There are times, however, when overhead changes have to be considered.

For example, suppose a company has a central personnel department that is considered overhead by operating departments. Most capital budgeting projects involve the addition of only a few new people in operating departments, so the workload of the personnel department isn't increased significantly by the larger staff. But suppose a particular project calls for so many new employees that an additional personnel administrator is required for their support. In such a case, the increased cost *in the personnel department* must be reflected as a cost of the project. In other words, the project has an *incremental overhead effect* that should be reflected in its projected cash flows.

Taxes

All capital budgeting cash flows are stated **after tax**.

Capital projects are generally expected to improve profitability, but more profit usually means more taxes. It's important to calculate incremental cash flows net of any additional taxes caused by the project.

To do that we have to calculate the incremental impact of the project on earnings before tax, and then calculate the extra tax and include it as a cash outflow. In other words, we deal with *after-tax cash flows* in capital budgeting.

Cash versus Accounting Results

It's important to keep the distinction between earnings and cash flows in mind when doing project projections. Capital budgeting deals only with cash flows, so in theory we hardly need mention accounting net income at all. However, business managers invariably want to know the *net income impact* of projects as well as the results of the capital budgeting analysis. It's therefore important to keep both available although separate.

Working Capital

Projects generally require new **working capital**, which requires cash.

Projects that involve increased sales normally also require increases in receivables and inventories (partially offset by payables). In other words, higher revenue demands more working capital, which builds up during the project's early years along with revenue. It's important to recognize that increases in working capital have to be funded with cash outflows just like the acquisition of any other asset, and that these flows have to be included in the project's forecast.

Ignore Financing Costs

Ignore interest **expense** when estimating incremental cash flows.

When project cash flows are projected, we do *not* include the interest expense of carrying a cumulative outflow over time. This is the most significant difference between cash flow estimation and the financial forecasting associated with business planning (Chapter 4). Cash flow estimation is concerned with the value of projects irrespective of how they're financed, so we look only at operating cash flows.

This is not to say that the capital budgeting concept ignores interest expenses or the time value of money. The time cost of money is explicitly accounted for in the evaluation process when the NPV and/or IRR techniques are applied. Because it's taken into account there, we don't need to consider it when estimating cash flows.

Old Equipment

Some projects, especially replacements, involve getting rid of old capital equipment. Such material generally can be sold on a secondhand market, providing a cash inflow that to some extent offsets the expense of the new equipment.

It's important to consider this source of funds in cash flow estimation. It's also important to recognize that the income from the sale of old equipment may be reduced by taxes on the accounting profit recognized with the sale.

ESTIMATING NEW VENTURE CASH FLOWS

New venture projects tend to be larger and more elaborate than expansions or replacements. However, incremental cash flows can be easier to isolate with new ventures, because the whole project is easily seen as distinct and separate from the rest of the company.

Example 11.1

The Wilmont Bicycle Company manufactures a line of traditional multispeed road bicycles. Management is considering a new business proposal to produce a line of off-road mountain bikes. The proposal has been studied carefully and the following information is forecast.

Cost of new production equipment and machinery including freight and setup		$200,000
Expense of hiring and training new employees		125,000
Pre–start-up advertising and other miscellaneous expenses		20,000
Additional selling and administrative expense per year after start-up		120,000
Unit sales forecast		
Year 1	200	
Year 2	600	
Year 3	1,200	
Year 4 and beyond	1,500	
Unit price		600
Unit cost to manufacture (60% of revenue)		360

Last year, anticipating an interest in off-road bicycles, the company bought the rights to a new gearshift design for $50,000.

Wilmont's production facilities are currently being utilized to capacity, so a new shop has to be acquired for incremental production. The company owns a lot near the present facility on which a new building can be constructed for $60,000. The land was purchased 10 years ago for $30,700, and now has an estimated market value of $150,000.

If Wilmont produces off-road bicycles, it expects to lose some of its current sales to the new product. Three percent of the new unit forecast is expected to come out of sales that would have been made in the old line. Prices and direct costs are about the same in the old line as in the new.

Wilmont's general overhead includes personnel, finance, and executive functions, and runs about 5% of revenue. Small one-time increments in business don't affect overhead spending, but a major continuing increase in volume would require additional support. Management estimates that additional spending in overhead areas will amount to about 2% of the new project's revenues.

New revenues are expected to be collected in 30 days. Incremental inventories are estimated at $12,000 at start-up and for the first year. After that an inventory turnover of 12 times based on cost of sales is expected. Incremental payables are estimated to be 25% of inventories.

Wilmont's current business is profitable, so losses in the new line will result in tax credits. The company's marginal tax rate is 34%.

SOLUTION: The Initial Outlay. First we'll consider cash flows required before start-up, which comprise the initial outlay, C_0. We'll work in thousands of dollars and carry one decimal place. That amounts to forecasting to the nearest $100, which provides more than enough detail for estimating purposes.

Expenses of an operating nature can be expected to be tax deductible against other income in the period before start-up. These include the cost of hiring, training, advertising, and other miscellaneous items.

Hiring and training	$125.0
Advertising and miscellaneous	20.0
Deductible expense	$145.0
Tax credit @ 34%	49.3
Net after tax expenses	$ 95.7

Next add the cash needed for physical assets necessary to get started.

Equipment	$200.0
New construction	60.0
Initial inventory	12.0
Assets subtotal	$272.0

Add the operating items and the physical assets to get the total, actual pre–start-up outlay.

Net after-tax expenses	$ 95.7
Assets subtotal	272.0
Actual pre–start-up outlay	$367.7

Next we have to recognize the opportunity cost of the land. The property has a market value of $150,000, but if it's sold for that amount, a capital gains tax will be due on the increase in value over its original cost. Corporations don't get favorable capital gains rates, so the tax rate will be 34%.

Sales price	$150.0
Cost	30.7
Capital gain	$119.3
Tax @ 34%	40.6
Cash forgone (price − tax)	$109.4

Summarizing, we obtain a figure for C_0.

Actual pre–start-up cash outlay	$367.7
Opportunity cost of land	109.4
C_0 (initial outlay for analysis)	$477.1

Cash Flows after Start-Up. Incremental sales forecasts often begin small, grow for a few years, and then level off. Other forecast elements commonly do the same thing, change for a few years and then remain constant. When that happens, we have to forecast out in time only until the numbers stop changing from year to year. Subsequent years are then repetitive.

In this case, sales are forecast to grow for four years before leveling off. However, a change in depreciation after the fifth year affects taxes. Hence, the annual cash flow estimate changes each year until the sixth year and then remains constant. We'll therefore estimate only the first

six years, understanding that for a longer forecast we just need to repeat the last year as many times as we like. The calculations are laid out in Table 11.1 and discussed in the following paragraphs. **Follow Table 11.1 as you continue to read this example.**

It's generally best to forecast revenue with **unit and price** detail.

The revenue forecast at the top of the table is developed by laying out the unit sales projection and multiplying by the projected price of $600. It's important to forecast both physical units and future prices rather than just total revenue. Maintaining unit-price detail makes it easier to alter the forecast to reflect different assumptions as well as check the reasonability of the entire estimate.

Production cost can be built up from components or forecast as a percentage of revenue consistent with previous experience in the same or similar businesses. In this case, Wilmont is experienced in making bicycles, and feels that a *cost ratio* of 60% will be appropriate for the new line. Applying this ratio to the revenue figures yields the projected cost line. Gross margin follows by subtracting cost from revenue.

Table 11.1

Cash Flow Estimation

Wilmont Bicycle Company
Estimated Cash Flows
Mountain Bike Project ($ooos)

	Year					
	1	*2*	*3*	*4*	*5*	*6+*
Revenue and Gross Margin						
Units	200	600	1,200	1,500	1,500	1,500
Revenue	$120.0	$360.0	$720.0	$ 900.0	$900.0	$900.0
Cost	72.0	216.0	432.0	540.0	540.0	540.0
Gross margin	$ 48.0	$144.0	$288.0	$ 360.0	$360.0	$360.0
Tax Deductible Expenses						
SG&A expense	$120.0	$120.0	$120.0	$ 120.0	$120.0	$120.0
Depreciation	41.5	41.5	41.5	41.5	41.5	1.5
General overhead	2.4	7.2	14.4	18.0	18.0	18.0
Loss old line	1.4	4.3	8.6	10.8	10.8	10.8
Total	$165.3	$173.0	$184.5	$ 190.3	$190.3	$150.3
Profit Impact and Tax						
EBT impact	$(117.3)	$ (29.0)	$103.5	$ 169.7	$169.7	$209.7
Tax	(39.9)	(9.9)	35.2	57.7	57.7	71.3
EAT impact	$ (77.4)	$ (19.1)	$ 68.3	$ 112.0	$112.0	$138.4
Add depreciation	41.5	41.5	41.5	41.5	41.5	1.5
Subtotal	$ (35.9)	$ 22.4	$109.8	$ 153.5	$153.5	$139.9
Working Capital						
Accounts receivable	$ 20.0	$ 45.0	$ 67.5	$ 75.5	$ 75.5	$ 75.5
Inventory	12.0	18.0	36.0	45.0	45.0	45.0
Payables	(3.0)	(4.5)	(9.0)	(11.3)	(11.3)	(11.3)
Working capital	$ 29.0	$ 58.5	$ 94.5	$ 109.2	$109.2	$109.2
Change in working capital	$ (17.0)	$ (29.5)	$ (36.0)	$ (14.7)	—	—
Net Cash Flow						
Net cash flow	$ (52.9)	$ (7.1)	$ 73.8	$ 138.8	$153.5	$139.9

Next we calculate items that affect pretax income, beginning with selling, general and administrative (SG&A) expense estimated at $120,000 per year.

Deductible depreciation is in two separate pieces because equipment and buildings are depreciated over different lives. Equipment can be written off over 5 years for tax purposes, while the building has to be amortized over 39 years. We'll assume straight line depreciation for both and ignore partial-year conventions for convenience. Then the annual depreciation is as follows.

Equipment ($200,000/5)	$40,000
Building ($60,000/39)	1,538
Depreciation, first five years	$41,538
Thereafter	1,538

The next line represents the expected increase in general overhead calculated at 2% of incremental revenues. Following that is an allowance for the lost business expected in the old product line. It was estimated that 3% of the unit forecast would come from the old line. Assuming the cost and price relationships are about the same in the old line as in the new, we can estimate the profit impact of this loss as 3% of the new gross margin forecast.

Add these items and subtract from gross margin for the impact on earnings before tax (EBT). The tax calculation is just 34% of EBT, which leads to the impact of the project on earnings after tax (EAT). *Although this figure isn't relevant for capital budgeting purposes, it's invariably important to operating managers and should therefore be calculated and displayed as part of the analysis*. The cash impact of these operating items is calculated by adding back depreciation, the only noncash charge in this example.

from the **CFO**

Finally, we calculate the cash required to build up the working capital necessary to support the project. This means estimating the year-end balances for accounts receivable, inventories, and accounts payable.

We're assuming that receivables are collected in 30 days, meaning there's one month of uncollected revenue in accounts receivable (A/R) all the time. The average level during each year is therefore one-twelfth of that year's revenue. Having the average figure in two successive years, we can average them to get the year-end figure for the first of the years. The calculations for the first two years are shown here. Year 1's average monthly revenue is $10,000; in year 2 that figure builds to $30,000. On the way between the two levels, assuming the growth is smooth, it passes through $20,000 at year end.

Year	Revenue	Average A/R	Year-End A/R
1	$120,000	$10,000	$20,000
2	360,000	30,000	45,000
3	720,000	60,000	

Inventory is estimated as one month's cost of goods sold, so take the annual cost figure divided by 12 except in the first year where a $12,000 level has been assumed. Finally, payables are 25% of inventory.

Summarize these items and calculate the year-to-year *change* in working capital, which reflects the cash required to fund it over the project's life. In the first year the change in working capital is $17,000 rather than $29,000, because an initial inventory of $12,000 is assumed to have been acquired before start-up.

The after-tax cash flow estimates for years 1 through 6 are calculated by adding the working capital requirements to the subtotal just above the working capital section. These figures along with the initial outlay calculated earlier represent the cash flows for the off-road bike project.

C_0	C_1	C_2	C_3	C_4	C_5	C_6
$(477.1)	$(52.9)	$(7.1)	$73.8	$139.3	$153.5	$139.9

Notice that the cash forecasts for subsequent years will be repetitions of the sixth year if sales remain at a steady 1,500 units. Therefore, in this case, we can extend the forecast by just adding more inflows of $139,900.

It's important to notice two things that are not in the calculations above. First, there is no provision for the $50,000 already spent for the new gearshift design. That money is gone whether the mountain bike project is accepted or not and is therefore irrelevant. Only *future* flows that depend on the decision to go ahead should be considered in the project's analysis. Past or *sunk* costs that can't be changed or recovered aren't considered even though they're related to the project.

Second, there's no allowance for interest on accumulated cash flows as a cost or income of the project. The cost of funds is explicitly included in capital budgeting when the NPV and IRR techniques are applied. Therefore, it doesn't need to be considered in the estimation of project cash flows.

TERMINAL VALUES

Cash flows forecast to continue forever are compressed into finite **terminal values** using perpetuity formulas.

It's possible to assume the incremental cash flows associated with a project go on forever. The assumption is especially common with respect to new ventures that are expected to continue as businesses indefinitely. For example, in the Wilmont Bicycle Company problem we've just completed, it's not unreasonable to assume that the year 6 cash flow of approximately $140,000 continues into the indefinite future.

There's a convenient way to reflect this assumption in the cash flow stream that Wilmont will use in capital budgeting. The repetitive cash flow starting in period 7 is a perpetuity whose "present" value at the beginning of period 7 (end of period 6) is C_7/k, where k is the cost of capital (see perpetuities on pages 253–254). This amount, known as the project's *terminal value*, is added to the *period* 6 cash flow to reflect the continuation of the project. If Wilmont's cost of capital is 10%, the project's terminal value would be

$$\frac{\$140{,}000}{.10} = \$1{,}400{,}000$$

It's also possible to assume a perpetual cash flow that grows at some rate, g. In that case, the terminal value is calculated by dividing the first ongoing cash flow by $k - g$ instead of k. Suppose Wilmont forecasts a 3% growth in the mountain bike project's cash flows starting with $140,000 in period 7. The project's terminal value would then be

$$\frac{\$140{,}000}{.10 - .03} = \$2{,}000{,}000$$

Notice how large the terminal value cash flow is relative to the project's earlier flows. Indeed the terminal value assumption overwhelms everything else in the projection. Also notice that the magnitude of the terminal value is very sensitive to the growth rate assumed.

from the CFO

This is a big problem with respect to the accuracy of capital budgeting analyses. An optimistic long-run forecast can make a project look good on an NPV or IRR basis even if the short-run projections are poor. Since the terminal period doesn't start for some time, it's hard to disprove the assumptions behind it. Hence, people who propose projects tend to portray them as growing rapidly into the indefinite future. It's generally up to the finance department to keep such projections reasonable and conservative.

There's a strong argument that infinite projections shouldn't be used at all because of the uncertainty of the distant future. This position maintains that if a project can't be justified in a reasonably long time—say, 10 years—it shouldn't be undertaken.

ACCURACY AND ESTIMATES

VIDEO >>

Now that we've had a look at the estimating process, we need to revisit the important point about precision that we discussed briefly at the beginning of the chapter.

The NPV and IRR techniques give the impression of great accuracy, since NPVs and IRRs are easily calculated to several decimal places. Such precision isn't real, however. Although IRR and NPV calculations are very exact, they're based on the cash flows input to the capital budgeting model. Those flows are *estimates* of the future and, like all estimates, are subject to error and bias.

Capital budgeting results are **no more accurate** than the **projections of the future** used as inputs.

In Example 11.1, Wilmont's cash flow estimates were built on the unit sales forecast. But for a new product, that forecast could easily be off by 20%. Such variability implies that it usually doesn't pay to expend a great deal of effort to make other elements of the estimate precise. For example, an estimator might spend a lot of time determining whether the appropriate cost ratio for the mountain bike project is 60 or 61%. That would be a waste of time given the inaccuracy of the underlying sales forecast. Notice that we worked in tenths of thousands of dollars in Table 11.1, and could easily have rounded to thousands without loss of substance.

from the CFO

Estimating inaccuracies come from any number of sources, but unintentional biases are probably the biggest problem in capital budgeting. Projects are usually proposed by people who have an interest in their approval, and it's generally those same individuals who provide the technical input for the estimated cash flows used in capital budgeting. This creates an inherent conflict of interest.

For example, suppose a company's manufacturing department has proposed buying a new, state-of-the-art production machine to replace an old machine that's beginning to wear out. If the new machine is purchased, product quality will be consistently higher, and there will be fewer equipment breakdowns that cause production stoppages. Such problems create the most stress in manufacturing managers' lives and significantly affect their performance ratings. Therefore, manufacturing managers are likely to perceive the new machine as a way to make their lives easier and better.

It is true that the manufacturing department will be charged with the cost of the new machine, but if that cost is included in the department's budget, it won't create an overrun that requires explaining. All things considered, manufacturing executives are likely to perceive the machine in an entirely positive light.

Projects are generally proposed by people who want to **see them approved** leading to **favorable biases.**

Representing the new machine as a series of cash flows requires putting a dollar value on the improved quality of output and on the machine's higher reliability. The implication is that the increased quality will result in higher customer satisfaction and fewer complaints. The better reliability will presumably result in less lost time on the production floor.

Making financial estimates of effects like these is a very subjective affair. We can generally say that the new machine will have a positive effect, but exactly how large

it will be is hard to pin down. The results are difficult to identify even after the project is implemented. The effects of happier customers and fewer breakdowns rarely show up clearly on a financial statement. If they happen at all, they're just rolled into the normal financial results of operations.

As a result of all this, estimating the financial impact of such a project often turns out to be little more than educated guesswork that can never be proven right or wrong. But the people making the guesses are probably going to be members of the manufacturing team who proposed the project in the first place and feel that it's a terrific idea. Therefore, their tendency will be to overestimate the benefits and underestimate the costs. We'll consider some of these issues in an example shortly.

MACRS—A NOTE ON DEPRECIATION

The U.S. government lets companies use *accelerated depreciation* when computing income for tax purposes. Under an accelerated method, depreciation is shifted forward in an asset's life, so more is taken in the early years and less later on with no change in the total. This means taxable income and taxes due are lower in the early years and higher later on. In essence the scheme *defers* taxes.

This is an advantage because of the time value of money. To understand that, think of taking a dollar of deferred tax and putting it in the bank until it has to be paid several years later, and keeping the interest earned in the meantime.

Accelerated depreciation creates a problem, however, because companies don't like to show lower profits in the short run even if they'll be made up later on. As a result companies generally don't use accelerated depreciation to calculate the earnings shown to stockholders and the public. It's important to understand that it's perfectly legitimate to use two sets of accounting rules like this, one for *tax* purposes and one for *financial* purposes.

Recall that depreciation is a noncash expense item. It represents a fictitious allocation of cost over time intended to make financial results match physical activity. It doesn't represent actual spending. Also recall that in capital budgeting we're interested in cash flow, not accounting results. Hence, the only reason we include depreciation in capital budgeting calculations is because of its effect on taxes, which are real cash flow items.

Therefore, if a firm uses accelerated depreciation for tax purposes, it should use that depreciation in capital budgeting calculations. We haven't shown this detail in our examples to keep things simple for illustrative purposes, but you should be aware of how this feature of the tax system works.

Modified Accelerated Cost Recovery System

Many accelerated methods are available to spread depreciation over an asset's life. The tax code, however, dictates exactly how it's to be done. The method is called the **Modified Accelerated Cost Recovery System**, generally abbreviated **MACRS**. First the system classifies assets into different categories and specifies a depreciation life for each. Then it provides a table showing the percentage of the asset's cost that can be taken in depreciation during each year of life. The classification rules are fairly extensive as are the tables, so we'll just show a representative sample consisting of three-, five-, and seven-year assets as follows.

Class	Representative Equipment
3-year	Research equipment
5-year	Automobiles and computers
7-year	Furniture and equipment

	Depreciation as a Percent of Cost Property Class		
Year in Life	*3-year*	*5-year*	*7-year*
1	33.3%	20.0%	14.3%
2	44.4	32.0	24.5
3	14.8	19.2	17.5
4	7.5	11.5	12.5
5		11.5	8.9
6		5.8	8.9
7			8.9
8			4.5

Notice that there's depreciation in an extra year in each column, and the first entry in each column is smaller than the second. Both oddities are due to the *half-year convention*, which assumes assets are placed in service in the middle of the year in which they're acquired. Hence, the first entry in each column represents a half year of service and leaves another half year to be recognized at the end of the class life period.

MACRS applies only to equipment. Buildings (real estate) are depreciated straight line over 27.5 years if they're residential and over 39 years otherwise. (31.5 for some older properties.) Land isn't depreciated.

ESTIMATING CASH FLOWS FOR REPLACEMENT PROJECTS

Replacement projects generally have fewer elements to consider than new ventures, but identifying what is incremental can be trickier. It can be especially hard to specify what will happen if you don't do the project. For example, suppose a production machine is getting old and needs to be replaced. Do we compare the performance of the new machine with the current performance of the old one, or assume that the old one will continue to deteriorate? If the latter, how much additional cost will the deterioration bring about? Tax effects are also complicated in replacement projects.

Example 11.2

Harrington Metals Inc. purchased a large stamping machine five years ago for $80,000. To keep the example simple we'll assume that the tax laws at the time permitted straight line depreciation over eight years and that machinery purchased today can be depreciated straight line over five years. The machine has not performed well, and management is considering replacing it with a new one that will cost $150,000. If the new machine is purchased, it is estimated that the old one can be sold for $45,000. The quoted costs include all freight, installation, and setup.

The old machine requires three operators, each of whom earns $25,000 a year including all benefits and payroll costs. The new machine is more efficiently designed and will require only two operators, each earning the same amount.

The old machine has the following history of high maintenance cost and significant downtime.[1]

1. "Downtime" refers to periods during which the machine isn't operable, usually due to maintenance or repair.

	Year				
	1	2	3	4	5
Hours down	40	60	100	130	128
Maintenance expense ($000)	In warranty	$10	$35	$42	$45

Downtime on the machine is a major inconvenience, but it doesn't usually stop production unless it lasts for an extended period. This is because the company maintains an emergency inventory of stamped pieces and has been able to temporarily reroute production without much notice. Manufacturing managers estimate that every hour of downtime costs the company $500, but have no hard data backing up that figure.

The makers of the replacement machine have said that Harrington will spend about $15,000 a year maintaining their product and that an average of only 30 hours of downtime a year should be expected. However, they're not willing to guarantee those estimates after the one-year warranty runs out.

The new machine is expected to produce higher quality output than the old one. The result is expected to be better customer satisfaction and possibly more sales in the future. Management would like to include some benefit for this effect in the analysis, but is unsure of how to quantify it.

Estimate the incremental cash flows over the next five years associated with buying the new machine. Assume Harrington's marginal tax rate is 34%, and that the company is currently profitable so that changes in taxable income result in tax changes at 34% whether positive or negative. Assume any gain on the sale of the old machine is also taxed at 34%, since corporations don't receive favorable tax treatment on capital gains.

SOLUTION: There are two kinds of cash flow items in this problem: those that can be estimated fairly objectively and those that require some degree of subjective guesswork. Let's consider the objective items first.

The initial outlay is a relatively straightforward matter. The new machine will cost $150,000 less whatever proceeds come from the sale of the old one. The old machine has a market value of $45,000, but sale at that price will result in a taxable gain. The unit was originally purchased for $80,000 and is being depreciated straight line over eight years at $10,000 per year. It's now five years old, so the remaining book value is $30,000. The after-tax proceeds are calculated as follows ($000).

Sale price	$45.0	$ 45.0
Book value	30.0	
Gain on sale	$15.0	
Tax @ 34%	5.1	(5.1)
Net cash proceeds of sale		$ 39.9

The project's initial outlay is as follows.

Cost of new machine	$150.0
Less proceeds from sale of old machine	39.9
Initial outlay	$ 110.1

Now we'll consider incremental cash flows during the five-year planning period. The straightforward items are the tax implications of a new depreciation pattern and the labor savings due to requiring one less operator.

Purchasing the new machine will alter the depreciation tax shield as follows ($000).

	Year				
	1	2	3	4	5
New depreciation	$30.0	$30.0	$30.0	$30.0	$30.0
Old depreciation	10.0	10.0	10.0		
Net increase in depreciation	$20.0	$20.0	$20.0	$30.0	$30.0
Cash tax savings @ 34%	$ 6.8	$ 6.8	$ 6.8	$10.2	$10.2

The labor savings come from just the cost of one employee.

	Year				
	1	2	3	4	5
Labor savings	$25.0	$25.0	$25.0	$25.0	$25.0

Subjective benefits based on opinions are hard to quantify and lead to biases when estimated by people who want project approval.

from the **CFO**

The **financial analyst** should ensure that only **reasonable estimates** of unprovable benefits are used.

Now we have to deal with the subjective items in the estimate. Three effects have to be considered. These are the differences between the new machine and the old in maintenance expense, downtime, and product quality. Each clearly has a value, but it's hard to say how much.

It is at this stage of the analysis that the role of the financial analyst is most crucial. The people putting together the proposal to buy the new machine are likely to be very optimistic about the subjective benefits. It's the job of the finance department to be the voice of reason in the decision-making process, and to make sure that only realistic estimates of subjective benefits are included.

Let's consider the issues in this example one at a time. The most concrete is the maintenance cost. We have to forecast the *difference* in the cost of maintenance on the new machine and on the old one. Looking at the record, we can see that the old machine's cost increased steadily for several years, but has recently leveled off at about $45,000. The question is whether to assume it will stay there or resume its increase as the machine gets older. The new machine offers a one-year warranty and promises a cost of $15,000 a year thereafter. However, that figure is not guaranteed. The issue is whether to believe the $15,000 or assume a higher number. We'll lay out a set of maintenance cost figures that reflects maintenance on the old machine continuing at $45,000 and the new machine performing as promised.

	Year				
	1	2	3	4	5
Old machine	$45.0	$45.0	$45.0	$45.0	$45.0
New machine	In warranty	15.0	15.0	15.0	15.0
Savings	$45.0	$30.0	$30.0	$30.0	$30.0

The difference between the two maintenance estimates represents the cash savings due to replacing the machine. Notice that it's possible to manipulate the analysis by varying the assumptions about either or both estimates. If we want to make the project look good, we can assume the old machine's costs will get worse and the new one's will hold at $15,000. If we assume the new machine will cost more while the old one holds at $45,000, the project looks worse.

The point is that there's a great deal of latitude in the forecast, and reasonable estimates of the maintenance cost savings can vary by quite a bit. For purposes of the example, we'll use the one shown here.

Next let's look at the downtime estimate. Here two variables are considered: how much downtime will actually be saved by the new machine and how much each hour is worth. The questions involved in estimating the hours saved are similar to those asked in dealing with the maintenance cost. The old machine has been experiencing about 130 hours of downtime a year, while the new one promises 30 for a saving of 100 hours. Good arguments can be made for raising or lowering that figure by quite a bit. The compounding question, however, is how much an hour of saved downtime is worth. It clearly should have some value, but it's difficult to say how much. This is a very common problem. We know there's a cost or benefit to something, but we're not able to estimate its value with any precision.

Manufacturing management's subjective estimate of $500 is likely to be on the high side because of the biases we discussed earlier. *A conservative approach, on the other hand, might be to refuse to include anything in the analysis for the saved downtime because its value can't be documented. Anything in between is also possible.*

from the **CFO**

In situations like this, most people favor a middle-of-the-road approach. That implies giving some value to the saved downtime, but choosing a value substantially lower than that recommended by manufacturing. In this case, $200 per hour is probably reasonable. Combining that figure with the saved time estimate of 100 hours yields an estimated cash flow savings of $20,000 per year.

Next we'll examine the most subjective claim in favor of the new machine, increased quality of output. Once again, this issue is very common when people are trying to justify a project. The issue isn't whether the output actually will be of higher quality. That should be ascertainable as a matter of fact by testing the output of a demo machine against the output of the old one. The question is whether an increase in the quality of certain component parts will significantly increase customer satisfaction, and whether that will translate into more future sales.

Several scenarios are possible. If customers or service technicians have been actively complaining about the parts from the old machine, it's easier to argue that higher quality will have a future sales impact than if the old parts weren't a problem. But even then, the impact is likely to be very difficult to estimate. As a general rule, when the connection between a project and the claimed cash flow impact is this tenuous, financial people tend to want to leave it out of the analysis. That's what we'll do in this case.

Now we can summarize the cash flows in the years after installation of the new machine.

	Year				
	1	*2*	*3*	*4*	*5*
Labor savings	$25.0	$25.0	$25.0	$25.0	$25.0
Maintenance savings	45.0	30.0	30.0	30.0	30.0
Downtime savings	20.0	20.0	20.0	20.0	20.0
Total	$90.0	$75.0	$75.0	$75.0	$75.0
Tax	30.6	25.5	25.5	25.5	25.5
Net after tax	$59.4	$49.5	$49.5	$49.5	$49.5
Tax savings on depreciation	6.8	6.8	6.8	10.2	10.2
Cash flow	$66.2	$56.3	$56.3	$59.7	$59.7

Combining these with the initial outlay yields the project's estimated cash flow stream.

C_0	C_1	C_2	C_3	C_4	C_5
$(110.1)	$66.2	$56.3	$56.3	$59.7	$59.7

INSIGHTS

ETHICS

Ethics in Cash Flow Estimation

We've just seen that strong departmental interests can attach to capital budgeting decisions, and that wide ranges of inputs can be accepted in making those decisions. It's also true that people stretch the truth to get what they want. What are the ethical issues of knowingly providing biased information to a decision-making process to get an outcome that's favorable to your own department?

In answering, recall that in ethical situations one group often has power over another (page 19). Is information power? Who benefits and who gets hurt if the company buys the new machine in Example 11.2 based on manufacturing's claims if those claims are exaggerated?

Here's another interesting situation. Imagine that an executive puts together a proposal for a new venture. It's common for the person proposing something like that to get to run the start-up. Then, if it's successful he or she moves up the management ladder rapidly and makes a lot of money. Do you see a motivation for the executive to overstate the project's benefits and understate its negatives? Is the executive's gamble one sided in that he or she has a lot to gain and little to lose? Who loses if the project is undertaken and fails?

QUESTION

1. The typical cash flow pattern for business projects involves cash outflows first, and then inflows. However, it's possible to imagine a project in which the pattern is reversed. For example, we might receive inflows now in return for guaranteeing to make payments later. Would the payback, NPV, and IRR methods work for such a project? What would the NPV profile look like? Could the NPV and IRR methods give conflicting results?

BUSINESS ANALYSIS

1. You are a new financial analyst at Belvedere Corp., a large manufacturing firm that is currently looking into diversification opportunities. The vice president of marketing is particularly interested in a venture that is only marginally connected with what the firm does now. Other managers have suggested enterprises in more closely related fields. The proponents of the various ideas have all provided you with business forecasts from which you have developed financial projections, including project cash flows. You have also calculated each project's IRR with the following results.

Project	IRR	Comments
A	19.67%	Marketing's project, an almost totally new field
B	19.25	Proposed by manufacturing, also a very different field
C	18.05	Proposed by engineering, a familiar field

You are now in a meeting with senior managers that was called to discuss the options. You have just presented your analysis, ending your talk with the preceding information.

After your presentation the vice president of marketing stands, congratulates you on a fine job, and states that the figures clearly show that project A is the best option. He also says that your financial analysis shows that project A has the full backing of the finance department. All eyes, including the CFO's, turn to you. How do you respond?

2. Most top executives are graded primarily on their results in terms of net income rather than net cash flow. Why, then, is capital budgeting done with incremental cash flows rather than with incremental net income?

3. Creighton Inc. is preparing a bid to sell a large telephone communications system to a major business customer. It is characteristic of the telephone business that the vendor selling a system gets substantial follow-on business in later years by making changes and alterations to that system. The marketing department wants to take an *incremental* approach to the bid, basically treating it as a capital budgeting project. They propose selling the system at or below its direct cost in labor and materials (the incremental cost) to ensure getting the follow-on business. They've projected the value of that business by treating future sales less direct costs as cash inflows.

   They maintain that the initial outlay is the direct cost to install the system, which is almost immediately paid back by the price. Future cash flows are then the net inflows from the follow-on sales. These calculations have led to an enormous NPV and IRR for the sale viewed as a project.

   Both support and criticize this approach. (*Hint:* What would happen if Creighton did most of its business this way?)

4. Webley Motors, a manufacturer of small gas engines, has been working on a new design for several years. It's now considering going into the market with the new product, and has projected future sales and cash flows. The marketing and finance departments are putting together a joint presentation for the board of directors that they hope will gain approval for the new venture. Part of the presentation is a capital budgeting analysis of the project that includes only estimated future costs and revenues. Dan Eyeshade, the head of investor relations, insists that calculations shown to the board include the money spent on research in the past several years. He says that to ignore or omit those costs would be deceiving the board about the true cost of the project, which would be both unethical and legally dangerous. Comment on Dan's position. If you disagree, prepare an argument that will convince him to change his mind, and suggest an alternative presentation that will satisfy you both.

5. The Capricorn Company is launching a new venture in a field related to but separate from its present business. Management is proposing that financing for the new enterprise be supplied by a local bank, which it has approached for a loan. Capricorn's finance department has done a capital budgeting analysis of the venture, projecting reasonable cash flows and calculating an NPV and an IRR that both look very favorable.

   The bank's loan officer, however, isn't satisfied with the analysis. She insists on seeing a financial projection that calculates interest on cumulative cash flows, incorporates that interest as a cost of the project, and shows the buildup and decline of the debt necessary to accomplish the proposal. She essentially wants a business plan complete with projected financial statements.

Reconcile the bank officer's position with capital budgeting theory.

6. Wilson Petroleum is a local distributor of home heating oil. The firm also installs and services furnaces and heating systems in homes and small commercial buildings. The customer service department maintains sales and service records on current customers, who number about 400. Detailed customer records are kept manually in file cabinets, and a small computer system holds all customer names and addresses for mailing and billing purposes. One full-time clerk maintains all the records and handles all billing and customer inquiries. Customers occasionally complain if delivery or service is late, but only one or two mild complaints are received each month. Delays are primarily a result of problems in the field rather than problems in assigning calls in the service department.

   A consultant has proposed a new computer system that will completely automate the customer service function. It will provide on-line billing and immediate access to all customer records. The cost of the proposed system is $50,000 initially plus about $7,000 a year for maintenance and support. It will still take a person to run it. The consultant says the new system will provide faster service and superior insight into the needs of the customer base, which will result in better customer relations and more sales in the long run.

   Discuss the pros and cons of the consultant's proposal. What further justification should management demand before buying? Could the consultant have made the proposal for reasons that aren't in Wilson's best interest? Could the consultant be well meaning yet biased? Explain.

PROBLEMS

1. A project that is expected to last six years will generate a profit and cash flow contribution before taxes and depreciation of $23,000 per year. It requires the initial purchase of equipment costing $60,000, which will be depreciated over four years. The relevant tax rate is 25%. Calculate the project's cash flows. Round all figures within your computations to the nearest thousand dollars.

2. Auburn Concrete Inc. is considering the purchase of a new concrete mixer to replace an inefficient older model. If purchased, the new machine will cost $90,000 and is expected to generate savings of $40,000 per year for five years at the end of which it will be sold for $20,000. The mixer will be depreciated to a zero salvage value over three years using the straight line method. Develop a five year cash flow estimate for the proposal. Auburn's marginal tax rate is 30%. Work to the nearest thousand dollars.

3. Flextech Inc. is considering a project that will require new equipment costing $150,000. It will replace old equipment with a book value of $35,000 that can be sold on the secondhand market for $75,000. The company's marginal tax rate is 35%. Calculate the project's initial outlay.

4. Tomatoes Inc. is planning a project that involves machinery purchases of $100,000. The new equipment will be depreciated over five years straight line. It will replace old machinery that will be sold for an estimated $36,000 and has a book value of $22,000. The project will also require hiring and training 10 new people at a cost of about $12,000 each. All of this must happen before the project is actually started. The firm's marginal tax rate is 40%. Calculate C_0, the project's initial cash outlay.

5. The Olson Company plans to replace an old machine with a new one costing $85,000. The old machine originally cost $55,000 and has 6 years of its expected 11-year life remaining. It has been depreciated straight line assuming zero salvage value and has a current market value of $24,000. Olson's effective tax rate is 36%. Calculate the initial outlay associated with selling the old machine and acquiring the new one.

6. A four-year project has cash flows before taxes and depreciation of $12,000 per year. The project requires the purchase of a $50,000 asset that will be depreciated over five years straight line. At the end of the fourth year the asset will be sold for $18,000. The firm's marginal tax rate is 35%. Calculate the cash flows associated with the project.

7. Voxland Industries purchased a computer for $10,000, which it will depreciate straight line over five years to a $1,000 salvage value. The computer will then be sold at that price. The company's marginal tax rate is 40%. Calculate the cash flows associated with the computer from its purchase to its eventual sale including the years in between. (*Hint:* Depreciate the difference between the cost of the computer and the salvage value. At the end of the depreciation life, a net book value remains that is equal to the salvage value.)

8. Resolve the previous problem assuming Voxland uses the five-year Modified Accelerated Cost Recovery System (MACRS) with no salvage value to depreciate the computer. Continue to assume the machine is sold after five years for $1,000. (*Hint:* Apply the MACRS rules for computers on pages 468–469 to the entire cost of the computer. Notice, however, that there will be a positive net book value after five years because MACRS takes five years of depreciation over six years due to the half-year convention.)

9. Harry and Flo Simone are planning to start a restaurant. Stoves, refrigerators, other kitchen equipment, and furniture are expected to cost $50,000, all of which will be depreciated straight line over five years. Construction and other costs of getting started will be $30,000. The Simones expect the following revenue stream. ($000)

Year	1	2	3	4	5	6	7
Sales	$60	$90	$140	$160	$180	$200	$200

Food costs are expected to be 35% of revenues, while other variable expenses are forecast at 25% of revenues. Fixed overhead will be $40,000 per year. All operating expenses will be paid in cash, revenues will be collected immediately, and inventory is negligible, so working capital need not be considered. Assume the combined state and federal tax rate is 25%. Do not assume a tax credit in loss years, and ignore tax loss carryforwards. (Taxes are simply zero when EBT is a loss.) Develop a cash flow forecast for the Simones' restaurant.

10. Sam Dozier, a very bright computer scientist, has come up with an idea for a new product. He plans to form a corporation to develop the idea and market the resulting product. He has estimated that it will take him and one employee about a year to develop a prototype and another year to bring a working model to market. There wil be no income during those years. After that he expects sales to grow rapidly, estimating revenues of $700,000, $1,500,000, and $5,000,000 in the third, fourth, and fifth years, respectively.

Starting the project will require *research equipment* costing about $500,000 which will be depreciated for federal tax purposes under the MACRS system (see page 469). Beyond that it will take another $400,000 in tax deducible expenses to get going.

Sam thinks he can fund the development work including supporting himself and paying an employee with about $200,000 per year. Once sales begin in the third year, direct costs will be 40% of revenues and indirect costs, including salaries for Sam and all employees, will be $300,000, $500,000, and $1,800,000 in the third, fourth, and fifth years, respectively. The nature of the business is such that working capital requirements are minimal. A net investment of $200,000 in the third year is expected to suffice. Sam has $1,500,000 saved which he thinks is enough to launch and operate the business until it begins to generate income.

Sam plans to sell the business at the end of the fifth year. He thinks it will be worth $2,500,000 at that time.

The business will be a C-type corporation subject to federal corporate income taxes (see page 48). Sam will be the sole stockholder and will be subject to federal (personal) capital gains tax when he sells the company (assume the top capital gains rate discussed on pages 43–44). Ignore state taxes.

a. Develop a cash flow estimate for Sam's business. Include the effect of tax loss carry forwards as well as any capital gains taxes he will pay on its sale. Does Sam have enough cash to fund this venture without contributions from outside investors?
b. Calculate the project's NPV and IRR (a financial calculator is recommended). Assume the cost of capital is 12%. Is the venture a good investment of Sam's time and money?

11. The Leventhal Baking Company is thinking of expanding its operations into a new line of pastries. The firm expects to sell $350,000 of the new product in the first year and $500,000 each year thereafter. Direct costs including labor and materials will be 60% of sales. Indirect incremental costs are estimated at $40,000 a year. The project will require several new ovens that will cost a total of $500,000 and be depreciated straight line over five years. The current plant is underutilized, so space is available that cannot be otherwise sold or rented. The firm's marginal tax rate is 35% and its cost of capital is 12%. Assume revenue is collected immediately and inventory is bought and paid for every day, so no additional working capital is required.

    a. Prepare a statement showing the incremental cash flows for this project over an eight-year period.
    b. Calculate the payback period, NPV, and PI.
    c. Recommend either acceptance or rejection.
    d. If the space to be used could otherwise be rented out for $30,000 a year, how would you put that fact into the calculation? Would the project be acceptable in that case?

12. Harrington Inc. is introducing a new product in its line of household appliances. Household products generally have 10-year life cycles and are viewed as capital budgeting projects over that period. Harrington's working capital forecast for the project is as follows:

    - $1.0 million will be invested in inventory before the project begins.
    - Inventory will increase by $100,000 in each of the first six years.
    - Accounts receivable will increase by $150,000 in each of the first four years and by $100,000 in each of the next two years.

- Accounts payable will increase by $110,000 in each of the first six years.
- During the last four years, the balance in each of these accounts will return to zero in four equal increments.
- Accruals are negligible.

Calculate the cash flows associated with working capital from the initial outlay to the end of the project's life.

13. Meade Metals Inc. plans to start doing its own deliveries instead of using an outside service for which it has been paying $150,000 per year. To make the change, Meade will purchase a $200,000 truck that will depreciate straight line over 10 years to a $40,000 salvage value. Annual operating expenses are estimated at $80,000, including insurance, fuel, and maintenance on the truck, as well as the cost of a driver. Management plans to sell the truck after five years for $100,000. Develop the project's five-year cash flows.

14. Assume that Meade Metals Inc. of the previous problem is replacing an old truck with a new one instead of replacing an outside delivery service. The old truck was purchased eight years ago for $120,000. It has been depreciated straight line based on a 10-year life and a $20,000 salvage value. The old truck's annual operating expenses are $110,000, and it has a market value of $40,000. Develop a five-year cash flow projection for this replacement project.

15. Shelton Pharmaceuticals Inc. is planning to develop and introduce a new drug for pain relief. Management expects to sell 3 million units in the first year at $8.50 each and anticipates 10% growth in sales per year thereafter. Operating costs are estimated at 70% of revenues. Shelton will invest $20 million in depreciable equipment to develop and produce this product. The equipment will be depreciated straight line over 15 years to a salvage value of $2.0 million. Shelton's marginal tax rate is 40%. Calculate the project's operating cash flows in its third year.

16. Olson-Jackson Corp. (OJC) is considering replacing a machine that was purchased only two years ago because of dramatic improvements in new models. The old machine has been depreciated straight line anticipating a 10-year life based on a cost of $240,000 and an expected salvage value of $20,000. It currently has a market value of $180,000. If the old machine is kept five more years, it would have a market value of $60,000 at the end of that time. A new machine would cost $350,000 and would be depreciated straight line over five years to a salvage value of $50,000, at which time it would be sold at that price. Develop a cash flow projection showing the difference between keeping the old machine and acquiring the new one. (*Note:* A complete cash flow projection for the project would include the financial benefits of the better performance of the new machine as well as a comparison of the operating costs of the two models. In this problem we're just focusing on the cost of the equipment.)

17. The Catseye Marble Co. is thinking of replacing a manual production process with a machine. The manual process requires three relatively unskilled workers and a supervisor. Each worker makes $17,500 a year and the supervisor earns $24,500. The new machine can be run with only one skilled operator who will earn $41,000. Payroll taxes and fringe benefits are an additional third of all wages and salaries.

    The machine costs $150,000 and has a tax depreciation life of five years. Catseye elects straight line depreciation for tax purposes. A service contract covers all maintenance for $5,000 a year. The machine is expected to last six years, at which time it will have no salvage value. The machine's output will be

virtually indistinguishable from that of the manual process in both quality and quantity. There are no other operating differences between the manual and the machine processes. Catseye's marginal tax rate is 35%, and its cost of capital is 10%.

a. Calculate the incremental cash flows associated with the project to acquire the machine.
b. Calculate the project's payback and NPV. Would you accept or reject the project?
c. Suppose there is no alternative but to lay off the displaced employees, and the cost of severance is about three months' wages. How would you factor this information into the analysis? Does it change the project's acceptability?
d. How would you characterize this project's risk?

18. Blackstone Inc. manufactures western boots and saddles. The company is considering replacing an outmoded leather processing machine with a new, more efficient model. The old machine was purchased for $48,000 six years ago and was expected to have an eight-year life. It has been depreciated on a straight line basis (ignore partial-year conventions). The used machine has an estimated market value of $15,323. The new machine will cost $60,000 and will be depreciated straight line over five years. All depreciation assumes zero salvage.

The new machine is expected to last eight years (its economic life), and then will have to be replaced. Assume it has no actual salvage value at that time.

Assume Blackstone's marginal tax rate is 35%.

Operating cost savings are summarized as follows.

	Old	New
Annual maintenance cost	$2,000 increasing $200 in each future year	None for two years, $1,500 thereafter
Cost of fixing production defects	$3,000	$1,000
Operators	2 @ $20,000	1.5 @ $24,000

The shop supervisor feels the new machine will produce a higher quality output and thus affect customer satisfaction and repeat sales. She thinks that benefit should be worth at least $5,000 a year, but doesn't have a way to document the figure. Losses generate tax credits.

a. Calculate the relatively certain incremental cash flows associated with the new machine over its projected economic life of eight years and the NPV at a cost of capital of 12% based on those cash flows. (Round to whole dollar.)
b. Suppose the foreman's $5,000 quality improvement estimate were to be included. How big an impact would it have in relation to the other numbers? Comment.

19. The Ebitts Field Corp. manufactures baseball gloves. Charlie Botz, the company's top salesman, has recommended expanding into the baseball bat business. He has put together a project proposal including the following information in support of his idea.

- New production equipment will cost $75,000 and will be depreciated straight line over five years.

- Overheads and expenses associated with the project are estimated at $20,000 per year during the first two years and $40,000 per year thereafter.
- There is enough unused space in the factory for the bat project. The space has no alternative use or value.
- Setting up production and establishing distribution channels before getting started will cost $300,000 (tax deductible).
- Aluminum and wood bats will be produced and sold to sporting goods retailers. Wholesale prices and incremental costs per unit (direct labor and materials) are as follows.

	Aluminum	Wood
Price	$18	$12
Cost	11	9
Gross margin	$ 7	$ 3

- Charlie provides the following unit sales forecast (000).

	Year					
	1	*2*	*3*	*4*	*5*	*6*
Aluminum	6	9	15	18	20	22
Wood	8	12	14	20	22	24

The sixth year sales level is expected to hold indefinitely.

- Receivables will be collected in 30 days, inventories will be the cost of one month's production, and payables are expected to be half of inventories. Assume no additional cash in the bank or accruals are necessary. (Use one-twelfth of the current year's revenue and cost for receivables and inventories, respectively.)
- Ebitts Field's marginal tax rate is 35% and its cost of capital is 12%.

a. Develop a six-year cash flow estimate for Charlie's proposal. Work to the nearest $1,000.
b. Calculate the payback period for the project.
c. Calculate the project's NPV assuming a six-year life. Is the project acceptable?
d. Is the cost of capital an appropriate discount rate for the project considering its likely risk relative to that of the rest of the business? Why?
e. What is the project's NPV if the planning horizon is extended to eight years? (Add the incremental PV from two more years at year 6's cash flow.)
f. What is the NPV if management is willing to look at an indefinitely long time horizon? (*Hint:* Think of the cash flows in year 6 and beyond as a perpetuity.)
g. Comment on the results of parts (e) and (f).

20. Segwick Corp. manufactures men's shoes, which it sells through its own chain of retail stores. The firm is considering adding a line of women's shoes. Management considers the project a new venture because there are substantial differences in marketing and manufacturing processes between men's and women's footwear.

The project will involve setting up a manufacturing facility as well as expanding or modifying the retail stores to carry two products. The stores are leased, so modification will involve leasing larger spaces, installing new leasehold improvements, and writing off some old leasehold improvements.[2]

The expected costs are summarized as follows.

Asset Items

New manufacturing equipment, depreciated over five years (straight line)	$ 750,000
Acquisition of a facility for design and manufacturing	
Land (no depreciation)	480,000
Building, depreciated over 31.5 years straight line	630,000
	$1,110,000
Leased retail space	
Net new lease expense, per year	$ 40,000
New leasehold improvements depreciated over the next five years straight line	200,000
Write-off of old improvements	90,000
Depreciation reduction due to written off improvements per year for three more years	30,000

Expense Items

Cost of hiring and training new people	150,000
Initial advertising and promotion	200,000
Yearly advertising and promotion	50,000
Yearly sales salaries	900,000
Additional corporate overhead ($000/yr.)	$20, $42, $60, $80, $80, $80

Revenue and Cost

The unit sales forecast is as follows in thousands.

Year	Units	Average Price
1	30	$65
2	40	68
3	50	70
4 and on	60	75

Direct cost excluding depreciation is 40% of sales.

Working Capital

Sales are to retail customers who pay with checks or credit cards. It takes about 10 days to clear both of these and actually receive cash.

Inventories are estimated to be approximately the direct cost of two months' sales.

Payables are estimated as one quarter of inventories.

2. Leasehold improvements are assets added to leased premises by the tenant. They are generally depreciated over the remaining life of the lease.

Estimate the current accounts based on the current year's sales and cost levels.

Assume incremental cash is required equal to 2% of revenues.

Accruals are insignificant.

Other Items

Management expects a few of the company's current male customers to be lost because they won't want to shop in a store that doesn't exclusively sell men's shoes. The gross margin impact of these lost sales is estimated to be $60,000 per year.

The company has already purchased designs for certain styles of ladies' shoes for $60,000.

Segwick's cost of capital is 10%. Its marginal tax rate is 35%.

a. Develop a six-year forecast of after-tax cash flows for Segwick.
b. Calculate the project's payback period, NPV, IRR, and PI, and make a recommendation about acceptance.
c. Assume you are told that the men's shoe industry is very stable, being served by the same manufacturers year after year. However, firms enter and leave the ladies' shoe business regularly. Would this knowledge make you more or less comfortable with the analysis you've done of this project? Why?

INTERNET PROBLEM

21. Do a cash flow sensitivity analysis on some problems of your choice at the end of the chapter. (You can download the spreadsheet template for Microsoft Excel™ on this Web page.) The spreadsheet template can be customized to meet your needs. For additional information, click on the link for *Some Cash Flow What-Ifs*. http://www.toolkit.cch.com/tools/cfsens_m.asp

COMPUTER PROBLEMS

22. The Paxton Homes Co. is a successful builder of moderate to high-priced houses. The firm is currently considering an expansion into light commercial construction in which it would build shopping centers and small office buildings. Management considers the idea a new venture because of the major differences between commercial and residential construction.

    Getting into the new line of business will require an investment of $12.5 million in equipment and $3 million in expenses. The equipment will be depreciated over five years. Part of the start-up money will come from the sale of some old trucks and cranes. These have a total market value of $1.8 million and an NBV of $600 million. Selling the equipment will result in a depreciation reduction of $200 million per year for three years.

    Revenue from the commercial line is expected to be $6 million in the first year and to grow by $2 million in each succeeding year until it reaches $20 million. After that, growth is uncertain and may be anywhere from 0 to 6% per year. Costs and expenses, including incremental overhead, will be 110% of revenues in the first year, 85% in the next two years, and 70% thereafter. Economies of scale in

materials purchasing are expected to save the residential business about $250,000 per year but not until the fourth year. Net working capital requirements are estimated at 10% of revenue. The combined federal and state tax rate on the incremental business will be 40%. Losses can be offset against other profits and can therefore be viewed as earning a tax credit at the same rate. Paxton's cost of capital is 12%.

You are a financial analyst assigned to evaluate the commercial construction proposal. Use the CAPBUD program to analyze the project and prepare a presentation in which you will make a recommendation either favoring or opposing its undertaking. Here are some ideas for approaches to your presentation.

a. Establish a base case using the information given. Forecast into the future until the numbers stop changing (eight years). Assume a terminal value based on a continuation of the eighth year's cash flows with no further growth. Is the project acceptable based on NPV and IRR given these assumptions?
b. Test the sensitivity of the base case analysis to the terminal value assumption by varying the growth rate to 3 and 6%.
   (1) Comment on the difference the terminal growth rate assumption makes.
   (2) Construction is a cyclical industry in that it is very subject to the ups and downs of the economy. In good times growth is enormous, but in bad times the industry and the firms in it shrink rapidly. Given that fact, how do you feel about the terminal value assumption?
   (3) Evaluate the project's NPV and IRR assuming a 10-year planning horizon—that is, assuming zero cash flows after the tenth year. Does this approach make more or less sense to you than the terminal value assumptions used in part (a)?
c. Test the sensitivity of the analysis to changes in revenue growth. For example, suppose revenue grows by only $1 million per year instead of two until the eighth year. Is the project a good idea then? What if cost/expense is a higher percentage of revenue than anticipated?