You'll Love Every Course.

11 Estimating Incremental Cash Flows

"Never underestimate the value of cold cash."

—Gregory Nunn

Saving Money?

Company X is a large multinational corporation with many facilities throughout the United States and the rest of the world. Employees at a variety of U.S. sites frequently are required to travel to the home office in Headquarters City. On a typical day there may be a dozen or more employees traveling to Headquarters City from any given satellite city site.

Company X has many corporate jets at airports throughout the United States near the larger satellite cities. Senior executives routinely fly on these corporate jets when traveling to Headquarters City. Middle-level managers fly on commercial aircraft, usually located at a much greater distance from the workplace. The reason for this is that the department of the traveling employee is "billed" $800 if the corporate jet is used. This $800 expense goes into the financial report of that department, which goes to corporate headquarters. Managers can frequently find commercial airfares under $300 for employees traveling to Headquarters City.

Because each department would rather be charged $300 a trip instead of $800 when reporting its financial performance, only a few of the most senior executives fly the corporate jets. This means that each corporate jet typically has a dozen empty seats for its daily flights to Headquarters City.

It is clearly in the interest of each department manager to keep his or her expenses down. Is it in the interests of the stockholders to have mostly empty planes fly each day to Headquarters City? The cost of adding an additional

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passenger, or 12 additional passengers, to a corporate jet is almost zero. A very small amount of additional fuel would be consumed. The stockholders would save $300 for each additional person who took an otherwise-empty seat on a corporate jet instead of flying on a commercial airline.

Consider the interests of the department managers and those of the stockholders of Company X as you read Chapter 11.

Learning Objectives

After reading this chapter, you should be able to:

1. Explain the difference between incremental cash flows and sunk costs.
2. Identify types of incremental cash flows in a capital budgeting project.
3. Explain why cash flows associated with project financings are not included in capital budgeting analysis.

Chapter Overview

In Chapter 10, we applied capital budgeting decision methods, taking the cash flow estimates as a given. In this chapter, we see how financial managers determine which cash flows are incremental and, therefore, relevant to a capital budgeting decision. We define incremental cash flows and distinguish incremental cash flows from sunk costs. We also examine how financial managers estimate incremental initial investment cash flows and incremental operating cash flows in the capital budgeting decision. Finally, we explore how the financing cash flows of a capital budgeting project are factored into the capital budgeting decision.

Incremental Cash Flows

The capital budgeting process focuses on cash flows, not accounting profits. Recall from our discussion in Chapter 1, it is cash flow that changes the value of a firm. Cash outflows reduce the value of the firm, whereas cash inflows increase the value of the firm.

In capital budgeting, incremental cash flows are the positive and negative cash flows directly associated with a project. They occur if a firm accepts a project, but they do not occur if the project is rejected.

For instance, suppose that the chief financial officer of Photon Manufacturing, Mr. Sulu, is analyzing the cash flows associated with a proposed project. He finds that the CEO hired a consultant to assess the proposed project's environmental effects. The consultant will be paid $50,000 for the work. Although the $50,000 fee is related to the project, it is not an incremental cash flow because the money must be paid whether the project is accepted or rejected. Therefore, the fee should not be included as a relevant cash flow of the expansion project decision. Cash flows that have already occurred, or will occur whether a project is accepted or rejected, are sunk costs.

Financial managers carefully screen out irrelevant cash flows, such as sunk costs, from the capital budgeting decision process. If they include irrelevant cash flows in their capital budgeting decision, then their calculations of a project's payback period, net present value (NPV), or internal rate of return (IRR) will be distorted and inaccurate. The calculations may be so distorted that they lead to an incorrect decision about a capital budgeting project.

Types of Incremental Cash Flows

To accurately assess the value of a capital budgeting project, financial managers must identify and estimate many types of incremental cash flows. The three main types of incremental cash flows are *initial investment cash flows, operating cash flows,* and *shutdown cash flows.* We examine these three types of incremental cash flows in the sections that follow.

Initial Investment Cash Flows

Generally, financial managers begin their incremental cash flow estimates by assessing the costs of the initial investment. The negative cash flow associated with the initial investment occurs only if the project is accepted. Initial investment cash flows include the purchase price of the asset or materials to produce the asset, the installation and delivery costs, and the additional investment in net working capital.

Purchase Price, Installation, and Delivery Financial managers usually obtain quotes on the purchase price and installation and delivery costs from suppliers. These figures, then, can usually be estimated with a high degree of accuracy.

Changes in Net Working Capital Aside from the setup costs and purchase price of a proposed capital budgeting project, a company may have to invest in changes in net working capital. As explained in Chapter 4, net working capital is defined as current assets (working capital) minus current liabilities. If a proposed capital budgeting project will require a positive change in net working capital (the most likely scenario), the cash outlay needed to finance this must be included in the cash flow estimates.

Recall that working capital consists of cash, accounts receivable, and inventory, along with other current assets if any. Companies invest in these assets in much the same way they invest in plant and equipment. Accepting a new project often triggers an increased need for cash, accounts receivable, and inventory investments. Working capital investments tie up cash the same way as investment in a new piece of equipment.

Table 11-1 Change in McGuffin Company Net Working Capital If New Project Is Accepted

Current Asset Changes	Current Liability Changes
$5,000 Increase in Cash	$8,000 Increase in Accounts Payable
$7,000 Increase in Receivables	$2,000 Increase in Accruals
$15,000 Increase in Inventory	
Total Current Asset Changes: $27,000	Total Current Liability Changes: $10,000
Increase in Needed Net Working Capital (NWC): $27,000 – $10,000 = $17,000	
Incremental Cash Flow Due to the Increase in NWC = –$17,000	

A company's current liabilities—such as accounts payable, accrued wages, and accrued taxes—may also be affected if a firm accepts a capital budgeting project. For example, if a plant is expanded, the company may place larger orders with suppliers to accommodate the increased production. The increase in orders is likely to lead to an increase in accounts payable.

Increases in current liabilities create cash inflows. It is unlikely that current liabilities will increase sufficiently to finance all the needed current asset buildup. This is the reason that an investment in net working capital is almost always required.

Table 11-1 shows an example of the incremental changes in net working capital that might occur with a proposed capital budgeting project for the McGuffin Company.

As Table 11-1 indicates, the McGuffin Company project has an estimated increase of $27,000 in needed current assets and a $10,000 increase in new current liabilities, resulting in a $17,000 change in needed net working capital. That is, the firm will have to spend $17,000 to increase its net working capital by this amount—a negative cash flow.

Once financial managers estimate the initial investment incremental cash flows, they analyze the operating cash flows of a capital budgeting project. We turn to those cash flows next.

Operating Cash Flows

Operating cash flows are those cash flows that the project generates after it is in operation. For example, cash flows that follow a change in sales or expenses are operating cash flows. Those operating cash flows incremental to the project under consideration are the ones relevant to our capital budgeting analysis. Incremental operating cash flows also include tax changes, including those due to changes in depreciation expense, opportunity costs, and externalities.

Taxes The change in taxes that will occur if a project is accepted is part of the incremental cash flow analysis. Tax effects are considered because a tax increase is equivalent to a negative cash flow, and a tax decrease is equivalent to a positive cash flow. In a capital budgeting decision, then, financial managers must examine whether and how much tax the firm will pay on additional income that the proposed project generates during

Table 11-2 Net Operating Cash Flows for New Project

1. New Project Sales (cash inflow)	$100,000
2. New Project Cash Operating Expenses (cash outflow)	– 50,000
3. New Project Depreciation Expense (noncash expense)	– 10,000
4. Net New Project Taxable Income	40,000
5. Taxes on New Project Income (40%) (cash outflow)	– 16,000
6. Net New Project After-Tax Income	24,000
7. Plus Depreciation Expense (added back)	+ 10,000
8. Net Incremental Cash Flow	$ 34,000

a given period. They must also see whether and how much taxes will decrease if the project increases the firm's periodic operating expenses (such as payments for labor and materials), thereby creating additional tax deductions.

Depreciation and Taxes Financial managers estimate changes in depreciation expense as part of the incremental cash flow analysis because increases in depreciation expense may increase a firm's cash flow. How? Depreciation expense is deductible for tax purposes. The greater the depreciation expense deduction, the less tax a firm must pay, and the less cash it must give to the IRS. Financial managers estimate the amount of depreciation expense a capital budgeting project will have, therefore, to see how much the firm's taxable income and taxes owed will decrease.

Incremental depreciation expense is the change in depreciation expense that results from accepting a proposed capital budgeting project. Incremental depreciation expense affects the change in taxes attributable to a capital budgeting project.

To illustrate how incremental depreciation expense changes taxes due, recall how we converted after-tax net profits into operating cash inflows in Chapter 4. We added all noncash charges (including depreciation) that were deducted as expenses on the firm's income statement to net profits after taxes. Once the tax effects of a project's depreciation expense are calculated, we add this incremental depreciation expense back to the project's net profits after taxes.

The following example, illustrated in Table 11-2, demonstrates how to estimate the incremental depreciation expense of a capital budgeting project. Suppose your firm is considering a project that is expected to earn $100,000 in cash sales in year 1. Suppose that, in addition to the sales increase, the project is expected to increase cash operating expenses by $50,000 and new depreciation expense will be $10,000. Assume your firm's marginal tax rate is 40 percent. First, compute the net operating cash flows from the project for this year, as shown in Table 11-2.

Compare line 3 and line 7 in Table 11-2. Note that once we used the new project incremental depreciation expense of $10,000 to make the tax change calculations, we added the $10,000 depreciation expense back to the new project's after-tax net income to calculate the incremental operating cash flow for this year from the new project. The incremental depreciation expense affected cash flow only because of its effect on taxes.

Opportunity Costs Sometimes accepting a capital budgeting project precludes other opportunities for the firm. For instance, if an industrial mixer already owned by a toy company is used to make a new product called Slime #4, then that mixer will not be available to make the Slime #2 currently produced in that mixer. The forgone benefits of the alternative not chosen are opportunity costs.

Opportunity costs are incremental cash flows that financial managers consider in a capital budgeting decision. In our example, the opportunity cost comes from the lost use of the industrial mixer for other products our firm makes. If our cash flows decrease by $30,000 due to the decrease in sales of Slime #2 that we can no longer make, then this $30,000 is the opportunity cost of choosing to produce the new product, Slime #4.

Externalities In estimating incremental operating cash flows, financial managers consider the effect a capital budgeting project might have on cash flows related to other parts of the business. Externalities are the positive or negative effects on existing projects if a new capital budgeting project is accepted.

For instance, suppose that a tennis ball manufacturer decides to start making tennis racquets but does not want to hire any additional managers. The current managers may become overworked because the expansion project requires manager time and oversight. This is a negative externality. Existing projects suffer due to manager inattention, but it is difficult to measure the size of those incremental costs.

On the other hand, the new racquet project may give the company more visibility than it had before and increase sales of its existing tennis ball business, thereby leading to an increase in cash flows. Because these cash flows from the increased tennis ball sales are incremental to the tennis racquet project under consideration, they should be considered in the capital budgeting analysis. This is a positive externality. Here again, however, the costs associated with the positive externalities are likely to be difficult to measure.

If the impact of externalities can be measured, they should be incorporated in the capital budgeting analysis. If the cost of externalities cannot be measured precisely—as is likely the case—most firms use a subjective analysis of externalities before making a project's final accept or reject decision. For example, if the NPV of a project is only slightly greater than zero, company officials may reject the project if they believe significant unmeasured negative externalities are present.

Interactive Module

Go to the Interactive Spreadsheets you downloaded for chapter 11. Follow the instructions there. Incremental cash flows are sometimes calculated using what is called the "with and without rule." What is meant by this? Move through the spreadsheets shown to assist you in learning this important concept.

Shutdown Cash Flows

Financial managers estimate the shutdown cash flows that are expected to occur at the end of the useful life of a proposed capital budgeting project. Shutdown cash flows may include those from the project's salvage value, taxes tied to the sale of the used asset, and the reduction of net working capital.

If a project is expected to have a positive salvage value at the end of its useful life, there will be a positive incremental cash flow at that time. However, this salvage value incremental cash flow must be adjusted for tax effects.

Four possible tax scenarios may occur when the used asset is sold, depending on the asset's sale price. First, the asset may be sold for more than its purchase price. In this instance, the difference between the purchase and the sale price is taxed at the capital gains tax rate. (The capital gain is the portion of the sale price that exceeds the purchase price.) In addition, the purchase price minus depreciation book value is taxed at the ordinary income rate.

Table 11-3 Tax Effects of the Sale of an Asset at the End of Its Useful Life

Type of Sale	Tax Effect
The asset is sold for more than its purchase price.	This difference is taxed at the capital gains rate. In addition, the purchase price minus the depreciation book value is ordinary income and is taxed at the ordinary rate.
The asset is sold for less than its purchase price but for more than its depreciation book value.	The sales price minus the depreciation book value is ordinary income and is taxed at the ordinary income tax rate.
The asset is sold for its depreciation book value.	There is no tax effect.
The asset is sold for less than its depreciation book value.	The depreciation book value minus the sales price is an ordinary loss and reduces the firm's tax liability by that amount times the ordinary income tax rate.

Second, the asset may be sold for less than the purchase price but for more than its depreciation book value. The amount that the sales price exceeds the depreciation book value is ordinary income, so it is taxed at the ordinary income tax rate.

Third, the asset may be sold for its depreciation book value. In that case the asset sale has no tax effects.

Fourth, the asset may be sold for less than its depreciation book value. The amount by which the depreciation book value exceeds the sales price is an ordinary loss. The firm's tax liability is reduced by the amount of the loss times the ordinary income tax rate.

The situation is summarized in Table 11-3.

Financing Cash Flows

Suppose a company planned to borrow or sell new common stock to raise part or all of the funds needed for a proposed capital budgeting project. The company would receive a cash inflow on receipt of the loan or the sale of new common stock. Conversely, the company must make the interest and principal payments on the loan, or may make dividend payments to stockholders. Financing cash flows are the cash outflows that occur as creditors are paid interest and principal, and stockholders are paid dividends.

If a capital budgeting project is rejected, financing cash flows will not occur, so they are relevant cash flows in the capital budgeting decision. However, as we saw in Chapter 10, financing costs are factored into the discount rate (required rate of return) in the NPV calculation. Those costs are also included in the hurdle rate of the IRR decision rule. Therefore, to avoid double counting, we do not include financing costs in our operating incremental cash flow estimates when we make capital budgeting decisions. If we did include financing costs as part of the incremental operating cash flows, then the NPV or IRR analysis would be distorted. That distortion could lead in turn to a poor capital budgeting decision.

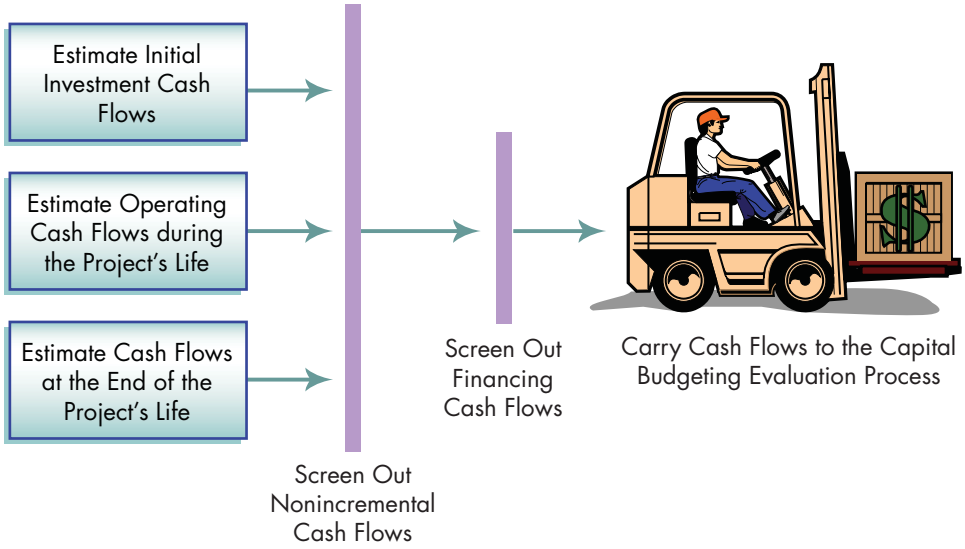

Figure 11-1 The Cash Flow Estimation Process

Figure 11-1 summarizes the cash flow estimation process and its role in capital budgeting.

Incremental Cash Flows of an Expansion Project

To practice capital budgeting cash flow estimation, let's examine a proposed expansion project. An expansion project is one in which the company adds a project and does not replace an existing one. Imagine a company called Photon Manufacturing, which makes torpedoes. It is considering a project to install $3 million worth of new machine tools in its main plant. The new tools are expected to last for five years. Photon operations management and marketing experts estimate that during those five years the tools will result in a sales increase of $800,000 per year.

The Photon Manufacturing CEO has asked Mr. Sulu, the company CFO, to identify all incremental cash flows associated with the project, and to calculate the project's NPV and IRR. Based on the incremental cash flow analysis and Sulu's recommendation, the company will make an accept or reject decision about the project.

Sulu's first step is to identify the relevant (incremental) cash flows associated with the project. He begins with the initial investment in the project, then looks at the operating cash flows, and finally the shutdown cash flows.

Initial Investment Cash Flows The cash flows that will occur as soon as the project is implemented (at t0) make up the project's initial investment. The initial investment includes the cash outflows for the purchase price, installation, delivery, and increase in net working capital.

Sulu knows that its tool supplier gave Photon a bid of $3 million to cover the cost of the new tools, including setup and delivery. Photon inventory and accounting specialists estimate that if the tools are purchased, inventory will need to increase by $40,000, accounts receivable by $90,000, and cash by $10,000. This is a $140,000 increase in current assets (working capital).

Table 11-4 Photon Manufacturing Expansion Project Initial Investment Incremental Cash Flows at t_0

Cost of Tools and Setup	$3,000,000
+ Investment in Additional NWC	110,000
= Total Initial Cash Outlay	$3,110,000

Also, Photon experts estimate that if the tools are purchased, accounts payable will increase by $20,000 as larger orders are placed with suppliers, and accruals (wages and taxes) will increase by $10,000—a $30,000 increase in current liabilities. Subtracting the increases in current liabilities from the increases in current assets ($140,000 – $30,000) results in a $110,000 increase in net working capital associated with the expansion project.

Sulu concludes after extensive research that he has found all the initial investment incremental cash flows. Those cash flows are summarized in Table 11-4.

Operating Cash Flows Now Sulu examines the operating cash flows, those cash flows expected to occur from operations during the five-year period after the project is implemented (at t_1 through t). The Photon expansion project operating cash flows reflect changes in sales, operating expenses, and depreciation tax effects. We assume these cash flows occur at the end of each year.

Sulu learns from the vice president of sales that cash sales are expected to increase by $800,000 per year because the new tools will increase manufacturing capacity. If purchased, the tools will be used to perform maintenance on other equipment at Photon, so operating expenses (other than depreciation) are expected to decrease by $100,000 per year.

Depreciation is a noncash expense, but remember that Sulu must use depreciation to compute the change in income tax that Photon must pay. After taxes are computed, Sulu then will add back the change in depreciation in the operating cash flow analysis.

To calculate depreciation expense, Sulu looks at MACRS depreciation rules and finds that the new manufacturing tools are in the three-year asset class. According to the MACRS rules, 33.3 percent of the new tools' $3 million cost will be charged to depreciation expense in the tools' first year of service, 44.5 percent in the second year, 14.8 percent in the third year, and 7.4 percent in the fourth year.[1] Now Sulu summarizes the incremental operating cash flows for the Photon capital budgeting project in Table 11-5.

Sulu is not quite through yet. He must include in his analysis additional shutdown cash flows that occur at t_5, the end of the project's life.

Shutdown Cash Flows Photon company experts estimate that the actual economic life of the tools will be five years, after which time the tools should have a salvage value of $800,000. Under MACRS depreciation rules, assets are depreciated to zero at the end of their class life, so at t_5 the book value of the new tools is zero. Therefore, if the tools are sold at the end of year 5 for their salvage value of $800,000, Photon Manufacturing will realize a taxable gain on the sale of the tools of $800,000 ($800,000 – $0 = $800,000). The income tax on the gain at Photon's marginal tax rate of 40 percent will be $800,000 × .40 = $320,000.

[1]Depreciation expenses for the tools are spread over four years instead of three because the MACRS depreciation rules apply a half-year convention—all assets are assumed to be purchased and sold halfway through the first and last years, respectively. If an asset with a three-year life is assumed to be purchased halfway through year 1, then the three years will be complete halfway through year 4.

Table 11-5 Photon Manufacturing Expansion Project Incremental Operating Cash Flows, Years 1–5

		t_1	t_2	t_3	t_4	t_5
+	Change in Sales	+ 800,000	800,000	800,000	800,000	800,000
+	Reduction in Nondepreciation Operating Expenses	+ 100,000	100,000	100,000	100,000	100,000
–	Change in Depreciation Exp.	– 999,000	1,335,000	444,000	222,000	0
=	Change in Operating Income	= (99,000)	(435,000)	456,000	678,000	900,000
–	Tax on New Income (See Note)	– (39,600)	(174,000)	182,400	271,200	360,000
=	Change in Earnings After Taxes	= (59,400)	(261,000)	273,600	406,800	540,000
+	Add Back Change in Dep. Expense	+ 999,000	1,335,000	444,000	222,000	0
=	Net Incremental Operating Cash Flow	= 939,600	1,074,000	717,600	628,800	540,000

Note: Taxes at t_1 and t_2 are negative amounts, which means earnings after taxes on the lines above for those years is increased by the amount of the taxes saved. Operating losses in year 1 of $99,000 and in year 2 of $435,000 cause a decrease in the taxes Photon owes during years 1 and 2 of $39,600 and $174,000, respectively due to the value of the offset of these amounts against taxable income elsewhere in the company.

The net amount of cash that Photon will receive from the sale of the tools is the salvage value minus the tax paid:

$800,000	Salvage Value
– 320,000	Taxes Paid
$480,000	Net Proceeds

The net proceeds from the tool sale at the end of year 5, then, are $480,000.

Finally, if the new tools are sold at t_5, Sulu concludes (based on sales department information) that Photon's sales will return to the level they were before the new tools were installed. Consequently, there will be no further need for the additional investment in net working capital that was made at t_0. When the $110,000 investment in net working capital is recaptured,[2] that amount is recovered in the form of a positive cash flow.

The additional incremental cash flows from the sale of the tools and the change in net working capital are summarized in Table 11-6.

Cash Flow Summary and Valuation Tables 11-4, 11-5, and 11-6 contain all the incremental cash flows associated with Photon Manufacturing's proposed expansion project. Sulu's next step is to summarize the total incremental net cash flows occurring at each point in time in one table. Table 11-7 shows the results.

Table 11-7 contains the bottom-line net incremental cash flows associated with Photon's proposed expansion project. The initial cash flow at t_0 is –$3,110,000. The operating cash flows from t_1 to t_5 total $4,490,000. The sum of all the incremental positive and negative cash flows for the project is $1,380,000.

Now Sulu is ready to compute the NPV, IRR, and MIRR of the expansion project based on the procedures described in Chapter 10.

[2]Current assets, in the amount by which they exceed current liabilities, are sold and not replaced because they are no longer needed.

Table 11-6 Photon Manufacturing Expansion Project Shutdown Cash Flows at t_5

	Salvage Value	800,000
–	Taxes on Salvage Value	– 320,000
=	Net Cash Inflow from Sale of Tools	= 480,000
+	Cash from Reduction in NWC	+ 110,000
=	Total Additional Cash Flows at t_5	= 590,000

Assuming that Photon's discount rate is 10 percent, Sulu computes the NPV of the project using Equation 10-1 as follows:

Initial Investment at t_0: $3,110,000

Net Incremental Cash Flows:

t_1	t_2	t_3	t_4	t_5
$939,600	$1,074,000	$717,600	$628,800	$1,130,000

$$NPV = \frac{\$939,600}{(1 + .10)^1} + \frac{\$1,074,000}{(1 + .10)^2} + \frac{\$717,600}{(1 + .10)^3} + \frac{\$628,800}{(1 + .10)^4} + \frac{\$1,130,000}{(1 + .10)^5} - \$3,110,000$$

$$= \frac{\$939,600}{1.1} + \frac{\$1,074,000}{1.21} + \frac{\$717,600}{1.331} + \frac{\$628,800}{1.4641} + \frac{\$1,130,000}{1.61051} - \$3,110,000$$

$$= \$854,182 + \$887,603 + \$539,144 + \$429,479 + \$701,641 - \$3,110,000$$

$$= \$302,049$$

Assuming a discount rate of 10 percent, the NPV of the project is $302,049.

Next, Sulu uses Equation 10-2 and the trial-and-error method described in Chapter 10 to find the IRR of the project:

$$NPV = 0 = \frac{CF_1}{(1 + k)^1} + \frac{CF_2}{(1 + k)^2} + \frac{CF_3}{(1 + k)^3} + \frac{CF_4}{(1 + k)^4} + \frac{CF_5}{(1 + k)^5} - \text{Initial Investment}$$

$$0 = \frac{\$939,600}{(1 + k)^1} + \frac{\$1,074,000}{(1 + k)^2} + \frac{\$717,600}{(1 + k)^3} + \frac{\$628,800}{(1 + k)^4} + \frac{\$1,130,000}{(1 + k)^5} - \$3,110,000$$

trial rate = 13.78%:

$$0 = \frac{\$939,600}{(1 + .1378)^1} + \frac{\$1,074,000}{(1 + .1378)^2} + \frac{\$717,600}{(1 + .1378)^3} + \frac{\$628,800}{(1 + .1378)^4} + \frac{\$1,130,000}{(1 + .1378)^5} - \$3,110,000$$

$$0 = \frac{\$939,600}{1.1378} + \frac{\$1,074,000}{1.294589} + \frac{\$717,600}{1.472983} + \frac{\$628,800}{1.67596} + \frac{\$1,130,000}{1.90691} - \$3,110,000$$

$$0 = \$825,804.18 + \$829,607.03 + \$487,174.61 + \$375,187.89 + \$592,582.47 - \$3,110,000$$

$0 = \$356.17$, which is close enough for our purposes. Therefore IRR = .1378, or 13.78%.

Table 11-7 Photon Manufacturing Expansion Project Summary of Incremental Cash Flows

	t_0	t_1	t_2	t_3	t_4	t_5
For Purchase and Setup	(3,000,000)					
For Additional NWC	(110,000)					
From Operating Cash Flows		939,600	1,074,000	717,600	628,800	540,000
From Salvage Value Less Taxes						480,000
From Reducing NWC						110,000
Net Incremental Cash Flows	(3,110,000)	939,600	1,074,000	717,600	628,800	1,130,000

Finally, Sulu uses the method described in Chapter 10 to find the MIRR of the project:

Time	Cash Flow	FV of Cash Flow at t_5 If Reinvested @ 10% Cost of Capital (per Equation 8-1a)
t_1	$ 939,600	x $(1 + .10)^4$ = $1,375,668
t_2	$1,074,000	x $(1 + .10)^3$ = $1,429,494
t_3	$ 717,600	x $(1 + .10)^2$ = $ 868,296
t_4	$ 628,800	x $(1 + .10)^1$ = $ 691,680
t_5	$1,130,000	x $(1 + .10)^0$ = $1,130,000
		Terminal Value: $5,495,138
		Initial Investment: $3,110,000

MIRR per Equation 8-6:

$$k = \left(\frac{\$5,495,138}{\$3,110,000}\right)^{\frac{1}{5}} - 1$$

$$k = .121, \text{ therefore MIRR} = .121, \text{ or } 12.1\%$$

Because the project's NPV of $302,049 is positive, the IRR of 13.78 percent exceeds the required rate of return of 10 percent, and the MIRR of 12.1 percent exceeds the required rate of return, Sulu will recommend that Photon proceed with the expansion project.

In this discussion we examined how a firm determines the incremental costs of an expansion project, and the project's NPV, IRR, and MIRR. We turn next to replacement projects and their incremental costs.

Asset Replacement Decisions

Often a company considers replacing existing equipment with new equipment. A replacement decision is a capital budgeting decision to purchase a new asset and replace and retire an old asset, or to keep the old asset. Financial managers identify the *differences* between the company's cash flows with the old asset versus the company's cash flows if the new asset is purchased and the old asset retired. As illustrated in Figure 11-2, these differences are the incremental cash flows of the proposed new project.

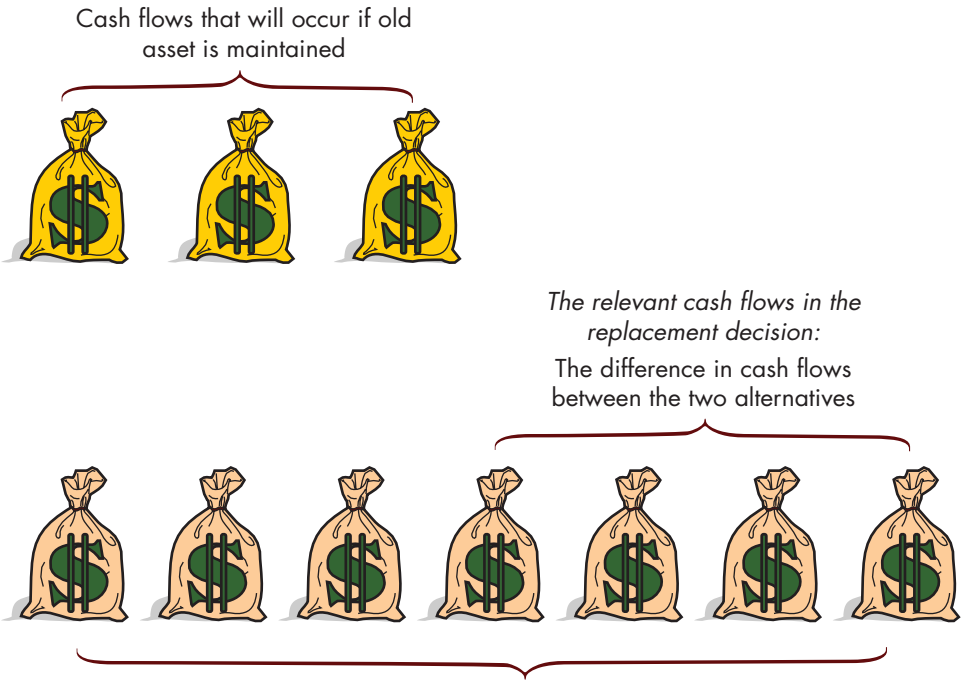

Figure 11-2
Comparing Cash Flows: Replacing an Asset vs. Keeping It

Figure 11-2 illustrates how firms compare the difference between the cash flows of replacing an old asset with a new one or keeping the old asset.

Real Options

Externalities and opportunity costs are not the only elements of the capital budgeting decision that are difficult to reduce to an incremental cash flow estimate. Many projects have options embedded in them that add to the value of the project and, therefore, of the firm. For example, a project may provide management with the option to revise a capital budgeting project at a later date. This characteristic is called a real option. It is a real option because it is related to a real asset such as a piece of equipment or a new plant. You may already be familiar with financial options (calls and puts) that give the holder the opportunity to buy or sell financial assets such as stocks or bonds at a later date. Real options are similar except that their value is related to the value of real assets rather than to the value of financial assets. Note that the word *option* indicates that the future alternative does not have to be taken. It will be taken only if it is seen as adding value.

The flexibility that is provided by a real option to revise a project at a later date has value. This option may be to expand a project, to abandon it, to create another project that is an offshoot of the current project, or something else. For example, a restaurant with room to expand is more valuable than one that is confined to its original fixed space, other things being equal. A project that can be shut down before its scheduled useful life if it turns out to be a failure is more valuable, other things being equal, than a similar failed project that must continue operating while it is losing money. An investment in a research laboratory that might develop a wonderful new drug that is completely unknown to us now is more valuable, other things being equal, than an investment in another project that has no potential future spin-offs.

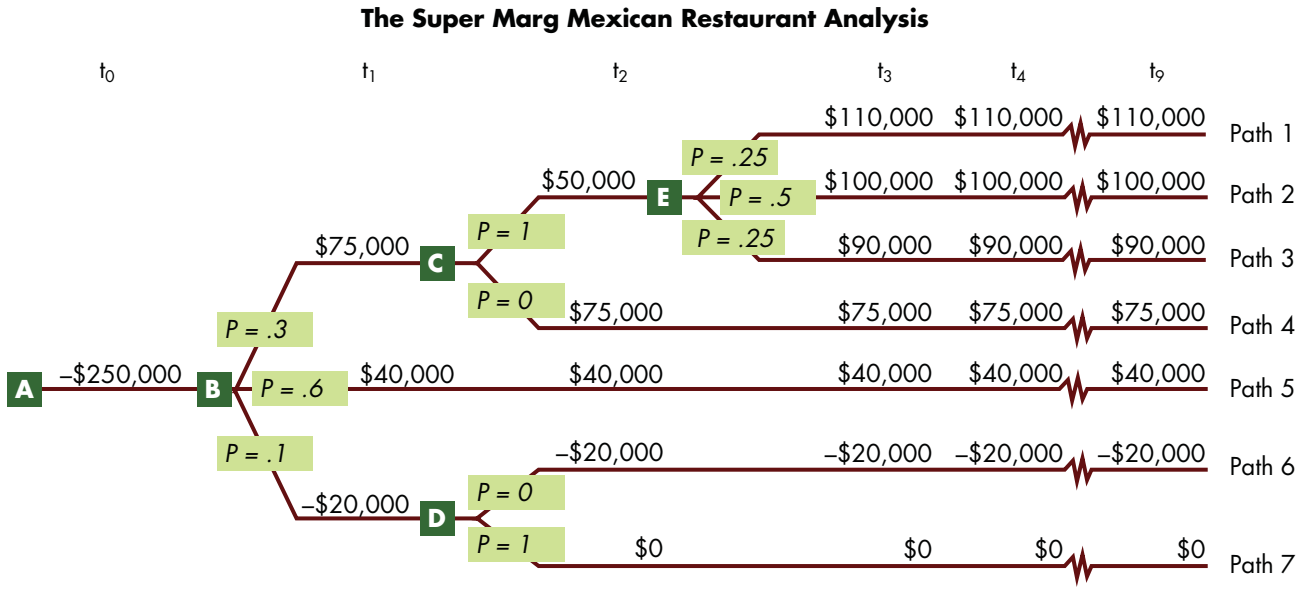

Figure 11-3 A Real Options Decision Tree

Traditional NPV and IRR analysis often overlooks the value that may come from real options because this value cannot be reduced to a simple incremental cash flow estimate. Faced with this difficulty, managers usually omit from capital budgeting analysis real options that are part of a project. This causes the NPV and IRR figures to be understated. As a result, the value real options add to the firm and the increase in the project rates of return they provide are not recognized.

The NPV process can be modified to reflect the value that real options add to the firm. This involves computing the traditional NPV and then adding today's value of any real options that may be present. The following paragraphs illustrate the mechanics of the process.

Real options can be incorporated into the capital budgeting process by using *decision trees*. Decision trees show the different paths a project could take, including the various options that may be available. Each place at which the decision tree branches is called a node. There are two kinds of nodes, decision nodes and outcome nodes.

- A decision node is one that shows the alternatives available for management at that point in time.
- An outcome node is one that shows the various things that can happen once a decision path is chosen.

Let's go through an NPV analysis using a decision tree and real options to illustrate how the process works. Suppose that Jason and Jennifer are business partners who think their hometown of Fort Fun would support a new Mexican restaurant, which they have decided to call Super Marg. Figure 11-3 shows the decision tree for Super Marg Mexican Restaurant. In Figure 11-3, A, C, and D are decision nodes, whereas B and E are outcome nodes.

Jason and Jennifer's first expenditure is the $250,000 investment required to build the restaurant. This initial cash outflow is shown at the left side of Figure 11-3. This is decision node A. Once the new restaurant is built, customers will determine how

successful it is. According to Jason and Jennifer's estimates, the probability is .3 that it will be a smash hit, .6 that it will be moderately successful, and .1 that it will be a bomb. Outcome node B shows these three possibilities. Note that all the probabilities associated with a node must sum to 1.0. If the restaurant is a smash hit, operating cash flows of $75,000 in year 1 are expected. If it is a smash hit, Jason and Jennifer will expand the business after one year of operation, making an additional investment of $50,000 at t_2. Decision node C indicates where the management decision to expand the business would be made. Paths 1, 2, and 3 show the possible outcomes if the business is expanded. Path 4 indicates the path that would not be taken if the expansion option is pursued. Jason and Jennifer can do better than this if the restaurant is a smash hit.

After expansion, the probability is .25 that subsequent operating cash flows will be $110,000, .50 that they will be $100,000, and .25 that they will be $90,000. Each of these cash flow streams would continue for seven years, until t_9. Outcome node E in Figure 11-3 shows these three possibilities.

If the restaurant is moderately successful, operating cash flows of $40,000 per year for nine years are expected. Path 5 shows this cash flow stream. If the restaurant is a bomb, an operating cash flow of –$20,000 at t_1 is expected. This outcome would cause Jason and Jennifer to abandon the business after one year. Decision node D shows this abandonment option. Note that the probability is 1.0 that Jason and Jennifer will abandon the project if cash flows in t_1 are –$20,000. Path 6 shows the negative cash flows from t_2 to t_9 that are avoided if the project is abandoned. Path 7 shows the $0 cash flows that are preferred to the –$20,000 cash flows that would have occurred.

Once all the decisions, outcomes, and probabilities are plotted on the decision tree, the net present value and joint probability of each path can be computed. Note in Figure 11-3 that there are seven possible paths the operation can take. The probabilities associated with each possible path are multiplied together to give a joint probability for that path. The sum of the joint probabilities is 1.0. When the net present value for each path is multiplied by its joint probability and these results added, the expected net present value for the entire deal is obtained.

Table 11-8 shows the NPV calculations for the Super Marg Restaurant project, assuming that Jason and Jennifer's required rate of return is 10 percent. The NPV of each of the seven paths is calculated using Equation 10-1a. In the far right-hand column of Table 11-8, the NPVs of each path are multiplied by the joint probability of that path occurring to give a composite score for each path called the *product*. The sum of the products, $15,161, is the expected NPV of the project. Because the expected NPV is greater than zero, the project would be accepted. Note that Path 5 has a higher probability than any of the other six paths and it has a negative NPV. The overall expected NPV is positive, however, due to the very good outcomes from Paths 1–3.

Interactive Module

Go to the Interactive Spreadsheets you downloaded for chapter 11. Follow the instructions there. Why does oil in the ground have a positive value even if it currently costs $40 per barrel to retrieve oil that has a current market price of $30 per barrel? See how real options can add to the value of a capital budgeting project.

What's Next

In this chapter, we learned how financial managers estimate incremental cash flows as part of the capital budgeting process. We described the difference between sunk costs and incremental cash flows. We also discussed various types of incremental cash flows. In Chapter 12 we examine business valuation.

Table 11-8 Real Options NPV Analysis for the Super Marg Mexican Restaurant

Real Options NPV Analysis	Cash Flows										Joint Probability of Occurrence	NPV	Product
	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9			
Path 1	($250,000)	$75,000	($50,000)	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	0.075	$219,443	$ 16,458
Path 2	($250,000)	$75,000	($50,000)	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	0.15	$179,208	$ 26,881
Path 3	($250,000)	$75,000	($50,000)	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	0.075	$138,973	$ 10,423
Path 4	($250,000)	$75,000	$75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$0	$181,927	$0
Path 5	($250,000)	$40,000	$40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	0.60	($ 19,639)	($ 11,783)
Path 6	($250,000)	($20,000)	($20,000)	($ 20,000)	($ 20,000)	($ 20,000)	($ 20,000)	($ 20,000)	($ 20,000)	($ 20,000)	0	($365,180)	$0
Path 7	($250,000)	($20,000)	$0	$0	$0	$0	$0	$0	$0	$0	0.1	($268,182)	($ 26,818)
											Sum = 1.0	Exp NPV =	$15,161
												Required rate of return (k) =	10%

Take Note
If you are reading this on your computer screen using the Adobe Reader program, click on View/Rotate View/Clockwise to read this table in proper orientation. When you are finished reading the table, click on View/Rotate View/Counterclockwise to return to the regular page orientation.

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Summary

1. Explain the difference between incremental cash flows and sunk costs.

Incremental cash flows are the cash flows that will occur if a capital budgeting project is accepted. They will not occur if the investment is rejected. Sunk costs are costs that will occur whether a project is accepted or rejected. Financial managers must screen out sunk costs from the capital budgeting analysis to prevent distortion in cash flow estimates. Any distortion in these estimates will, in turn, lead to inaccurate NPV or IRR values and could result in poor capital budgeting decisions.

2. Identify types of incremental cash flows in a capital budgeting project.

Financial managers must examine three main types of cash flows to estimate the incremental cash flows of a proposed capital budgeting project. First, they must assess the cost of the initial investment: the purchase price, the installation and delivery costs, and any change in net working capital. Then the financial manager must analyze incremental operating cash flows. These may include tax changes due to changes in sales and depreciation expense, opportunity costs, and externalities. Finally, a financial manager must examine the project shutdown cash flows, such as those cash flows from the project's salvage value, the reduction of net working capital, and the tax-related cash flows from the sale of the used asset.

3. Explain why cash flows associated with project financing are not included in incremental cash flow estimates.

Incremental operating cash flows are treated separately from incremental financing cash flows. The latter are captured in the discount rate used in the NPV calculation and in the hurdle rate used when applying the IRR decision rule. Financial managers do not include financing costs as incremental operating cash flows to avoid distorting the NPV or IRR calculations in the capital budgeting process. Double counting would result if financing costs were reflected in both the operating cash flows and the discount rate.

Self-Test

ST-1. Fat Tire Corporation had $20,000 in depreciation expense last year. Assume its federal marginal tax rate is 36 percent, whereas its state marginal tax rate is 4 percent. How much are the firm's taxes reduced (and cash flow increased) by the depreciation deduction on federal and state income tax returns?

ST-2. Skinny Ski Corporation had net income of $2 million and depreciation expense of $400,000. What was the firm's operating cash flow for the year?

ST-3. Powder Hound Ski Company is considering the purchase of a new helicopter for $1.5 million. The company paid an aviation consultant $20,000 to advise them on the need for a new helicopter. The decision about buying the helicopter hasn't been made yet. If it is purchased, what is the total initial cash outlay that will be used in the NPV calculation?

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ST-4. Rich Folks Ski Area is considering the replacement of one of its older ski lifts. By replacing the lift, Rich Folks expects sales revenues to increase by $500,000 per year. Maintenance expenses are expected to increase by $75,000 per year if the new lift is purchased. Depreciation expense would be $100,000 per year. (The company uses the straight-line method.) The old lift has been fully depreciated. The firm's marginal tax rate is 38 percent. What would the firm's incremental annual operating cash flows be if the new lift is purchased?

ST-5. Snorkel Ski Company is considering the replacement of its aerial tram. Sales are expected to increase by $900,000 per year, and depreciation expense is also expected to rise by $300,000 per year. The marginal tax rate is 32 percent. The purchase will be financed with a $900,000 bond issue carrying a 10 percent annual interest rate. What are the annual incremental operating cash flows if this project is accepted?

Review Questions

1. Why do we focus on cash flows instead of profits when evaluating proposed capital budgeting projects?
2. What is a sunk cost? Is it relevant when evaluating a proposed capital budgeting project? Explain.
3. How do we estimate expected incremental cash flows for a proposed capital budgeting project?
4. What role does depreciation play in estimating incremental cash flows?
5. How and why does working capital affect the incremental cash flow estimation for a proposed large capital budgeting project? Explain.
6. How do opportunity costs affect the capital budgeting decision-making process?
7. How are financing costs generally incorporated into the capital budgeting analysis process?

Build Your Communication Skills

CS-1. Pick a company and obtain a copy of its recent income statement, balance sheet, and statement of cash flows. Compare its profit and cash flow for the period covered by the income statement. Use the statement of cash flows to describe where the firm's cash came from and where it went during that period. Examine the balance sheet to assess the cash position of the firm at that point in time. Submit a written report that analyzes the firm's cash position.

CS-2. Stock market analysts often compare a firm's reported quarterly earnings and its expected quarterly earnings. Quarterly earnings that come in below expectations often mean a drop in the stock price, whereas better than expected earnings usually mean a stock price increase. Is this consistent with the view that cash flows and not accounting profits are the source of firm value? Divide into small groups and discuss these issues with the group members for 15 minutes. Select a spokesperson to present the group's key points to the class.

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Problems

Expansion Project, Initial Investment Cash Flows

11-1. Tru-Green Landscaping is shopping for a new lawn mower. The purchase price of the model the company has selected is $6,000. However, Tru-Green plans to add some special attachments that will cost $5,000, and painting the company's name on the side of the mower will cost $300. Building a garage and maintenance facility for the mower and several other items of new equipment will cost $12,000. What is the total cash outflow at t_0 for the mower?

Salvage Value Cash Flows

11-2. An asset falling under the MACRS five-year class was purchased three years ago for $200,000 (its original depreciation basis). Calculate the cash flows if the asset is sold now at

a. $60,000

b. $80,000

Assume the applicable tax rate is 40 percent.

Operating Cash Flows

11-3. Mr. Van Orten is evaluating the purchase of new trenching equipment for Scorpio Enterprises. For now, he is only figuring the incremental operating cash flow from the proposed project for the first year. Mr. Van Orten estimates that the firm's sales of earth-moving services will increase by $10,000 in year 1. Using the new equipment will add an additional $3,000 to their operating expenses. Interest expense will increase by $100 because the machine will be partly financed by a loan from the bank. The additional depreciation expense for the new machine will be $2,000. Scorpio Enterprises' marginal tax rate is 35 percent.

a. Calculate the change in operating income (EBIT) for year 1.

b. Calculate the cash outflow for taxes associated with this new income.

c. What is the net new after-tax income (change in earnings after taxes)?

d. Calculate the net incremental operating cash flow from this project for year 1.

e. Are there any expenses listed that you did not use when estimating the net incremental cash flow? Explain.

Expansion Project, Operating Cash Flows

11-4. Ever-Fresh Landscaping bought a large-sized golf course mower for $20,000. With this new machine, the company was able to increase its business, raising its annual revenue from $250,000 to $350,000 each year. Operating costs went up as well, however, from $70,000 to $100,000 annually. The mower falls in the MACRS five-year class for depreciation expense, and the company's combined federal and state income tax rate is 35 percent.

What is the net incremental operating cash flow in year 1 for the new lawn mower investment?

Expansion Project, Terminal Cash Flows

11-5. Never Brown Landscaping has a lawn mower that it bought three years ago for $10,000. The mower has an actual operating life of six years, at the end of which the mower can be sold for $2,000. For depreciation purposes, the mower is in the MACRS five-year class. Never Brown's combined federal and state income tax rate is 35 percent. What are the terminal cash flows associated with the mower investment?

11-6. Mr. Phelps, a financial analyst at Rhodes Manufacturing Corporation, is trying to analyze the feasibility of purchasing a new piece of equipment that falls under the MACRS five-year class. The initial investment, including the cost of equipment and its start-up, would be $375,000. Over the next six years, the following earnings before depreciation and taxes (EBDT) will be generated from using this equipment:

Estimating Cash Flows

End of Year	EBDT ($)
1	120,000
2	90,000
3	70,000
4	70,000
5	70,000
6	70,000

Rhodes's discount rate is 13 percent and the company is in the 40 percent tax bracket. There is no salvage value at the end of year 6. Should Mr. Phelps recommend acceptance of the project?

11-7. Assume the same cash flows, initial investment, MACRS class, discount rate, and income tax rate as given in problem 11-6. Now assume that the resale value of the equipment at the end of six years will be $50,000. Calculate the NPV and recommend whether the project should be accepted.

Estimating Cash Flows

11-8. George Kaplan is considering adding a new crop-dusting plane to his fleet at North Corn Corner, Inc. The new plane will cost $85,000. He anticipates spending an additional $20,000 immediately after the purchase to modify it for crop-dusting. Kaplan plans to use the plane for five years and then sell it. He estimates that the salvage value will be $20,000. With the addition of the new plane, Kaplan estimates revenue in the first year will increase by 10 percent over last year. Revenue last year was $125,000. Other first-year expenses are also expected to increase. Operating expenses will increase by $20,000, and depreciation expense will increase by $10,500. Kaplan's marginal tax rate is 40 percent.

Initial Investment, Operating Cash Flows, and Salvage Value

a. For capital budgeting purposes, what is the net cost of the plane? Or, stated another way, what is the initial net cash flow?

b. Calculate the net incremental operating cash flow for year 1.

c. In which year would the salvage value affect the net cash flow calculations?

11-9. Ghost Squadron Historical Aircraft, Inc. (GSHAI) is considering adding a rare World War II B-24 bomber to its collection of vintage aircraft. The plane was forced down in Burma in 1942, and it has remained there ever since. Flying a crew to Burma and collecting the wreckage will cost $100,000. Transporting all the parts to the company's restoration facility in Texas will cost another $35,000. Restoring the plane to flyable condition will cost an additional $600,000 at t_0.

Evaluating an Expansion Project

GSHAI's operating costs will increase by $40,000 a year at the end of years 1 through 7 (on top of the restoration costs). At the end of years 3 through 7, revenues from exhibiting the plane at airshows will be $70,000. At the end of year 7, the plane will be retired. At that time the plane will be sold to a museum for $500,000.

The plane falls into the MACRS depreciation class for seven-year assets. GSHAI's combined federal and state income tax rate is 35 percent, and the company's weighted average cost of capital is 12 percent. Calculate the NPV and IRR of the proposed investment in the plane.

Changes in Net Working Capital

11-10. The management of the local cotton mill is evaluating the replacement of low-wage workers by automated machines. If this project is adopted, production and sales are expected to increase significantly: Norma Rae, the mill's financial analyst, expects cash will have to increase by $8,000 and the accounts receivable will increase by $10,000 in response to the increase in sales volume. Because of the higher level of production, inventory will have to increase by $12,000, with an associated $6,000 increase in accounts payable. Accrued taxes and wages, even with the decrease in the number of laborers, are estimated to increase by $2,500.

a. Calculate the change in net working capital if the automation project is adopted.

b. Is this change in NWC a cash inflow or outflow?

c. Given the limited information about the duration of the project, in what year should this change affect the net incremental cash flow calculations?

Cash Flows and Capital Budgeting

11-11. Sunstone, Inc., has entrusted financial analyst Flower Belle Lee with the evaluation of a project that involves buying a new asset at a cost of $90,000. The asset falls under the MACRS three-year class and will generate the following revenue stream:

End of Year	1	2	3	4
Revenues ($)	50,000	30,000	20,000	20,000

The asset has a resale value of $10,000 at the end of the fourth year. Sunstone's discount rate is 11 percent. The company has an income tax rate of 30 percent. Should Flower recommend purchase of the asset?

Replacement Decision and Cash Flows

11-12. Moonstone, Inc., a competitor of Sunstone, Inc., in problem 11-11, is considering purchasing similar equipment with the same revenue, initial investment, MACRS class, and resale value. Moonstone's discount rate is 10 percent and its income tax rate is 40 percent. However, Moonstone is considering the new asset to replace an existing asset with a book value of $20,000 and a resale value of $10,000. What would be the NPV of the replacement project?

Changes in Net Working Capital

11-13. You have just joined Moonstone, Inc. as its new financial analyst. You have learned that accepting the project described in problem 11-12 will require an increase of $10,000 in current assets and will increase current liabilities by $5,000. The investment in net working capital will be recovered at the end of year 4. What would be the new NPV of the project?

Challenge Problem

11-14. You have been hired by Drs. Venkman, Stantz, and Spenler to help them with NPV analysis for a replacement project. These three New York City parapsychologists need to replace their existing supernatural beings detector with the new, upgraded model. They have calculated all the necessary figures but are unsure about how to account for the sale of their old machine. The original depreciation basis of the old machine is $20,000, and the accumulated depreciation is $12,000 at the date of the sale. They can sell the old machine for $18,000 cash. Assume the tax rate for their company is 30 percent.

a. What is the book value of the old machine?

b. What is the taxable gain (loss) on the sale of the old equipment?

c. Calculate the tax on the gain (loss).

d. What is the net cash flow from the sale of the old equipment? Is this a cash inflow or an outflow?

e. Assume the new equipment costs $40,000 and they do not expect a change in net working capital. Calculate the incremental cash flow for t_0.

f. Assume they could only sell the old equipment for $6,000 cash. Recalculate parts *b* through *e*.

Cash Flows and Capital Budgeting

11-15. Mitch and Lydia Brenner own a small factory located in Bodega Bay, California. They manufacture rubber snakes used to scare birds away from houses, gardens, and playgrounds. The recent and unexplained increase in the bird population in northern California has significantly increased the demand for the Brenners' products. To take advantage of this marketing opportunity, they plan to add a new molding machine that will double the output of their existing facility. The cost of the new machine is $20,000. The machine setup fee is $2,000. With this purchase, current assets must increase by $5,000 and current liabilities will increase by $3,000. The economic life of the new machine is four years, and it falls under the MACRS three-year depreciation schedule. The machine is expected to be obsolete at the end of the fourth year and have no salvage value.

The Brenners anticipate recouping 100 percent of the additional investment in net working capital at the end of year 4. Sales are expected to increase by $20,000 each year in years 1 and 2. By year 3, the Brenners expect sales to be mostly from repeat customers purchasing replacements instead of sales to new customers. Therefore, the increase in sales for years 3 and 4 is estimated to only be $10,000 in each year. The increase in operating expenses is estimated to be 20 percent of the annual change in sales. Assume the marginal tax rate is 40 percent.

a. Calculate the initial net incremental cash flow.

b. Calculate the net incremental operating cash flows for years 1 through 4. Round all calculations to the nearest whole dollar. Use Table 5-2 to calculate the depreciation expense.

c. Assume the Brenners' discount rate is 14 percent. Calculate the net present value of this project. Would you recommend the Brenners add this new machine to their factory?

Cash Flows and Capital Budgeting

11-16. The RHPS Corporation specializes in the custom design, cutting, and polishing of stone raw materials to make ornate building facings. These stone facings are commonly used in the restoration of older mansions and estates. Janet Weiss and Brad Majors, managers of the firm, are evaluating the addition of a new stone-cutting machine to their plant. The machine's cost to RHPS is $150,000. Installation and calibration costs will be $7,500. They do not anticipate an increase in sales, but the reduction in the operating expenses is estimated to be $50,000 annually. The machine falls under the MACRS three-year depreciation schedule. The machine is expected to be obsolete after five years. At the end of five years, Weiss and Majors expect the cash received (less applicable capital gains taxes) from the sale of the obsolete machine to offset the shutdown and dismantling costs. The RHPS cost of capital is 10 percent, and the marginal tax rate is 35 percent.

a. Calculate the net present value for the addition of this new machine. Round all calculations to the nearest whole dollar.

b. Would you recommend that Weiss and Majors go forward with this project?

Comprehensive Problem

11-17. The Chemical Company of Baytown purchased new processing equipment for $40,000 on December 31, 2004. The equipment had an expected life of four years and was classified in the MACRS three-year class. Due to changes in environmental regulations, the operating cost of this equipment has increased. The company is considering replacing this equipment with a more-efficient process line at the end of 2006. The salvage value of the old equipment is estimated to be $4,000. The marginal tax rate is 40 percent.

a. Calculate the cash flow from the sale of this equipment. Assume the sale occurred at the end of 2006. Use Table 4-1 to calculate the depreciation.

b. The new process line has a higher capacity than the old one and is expected to boost sales. As a result, the cash requirement will increase by $1,000, accounts receivable by $5,000, and inventory by $10,000. It will also increase accounts payable by $6,000 and accrued expenses by $3,000. Calculate the incremental cash flow due to the change in the net working capital.

c. The new equipment will cost $180,000, including installation and start-up costs. Calculate the net cash outflow at the end of 2006 if the new process line is installed and is ready to operate by the end of the year.

d. Beginning in January 2007, this new equipment is expected to generate additional sales of $60,000 each year for the next four years. It will have an economic life of four years and will fall under the MACRS three-year classification. Being more efficient, the new equipment will reduce yearly operating expenses by $6,000. Calculate the net incremental operating cash flows for 2007 through 2010. Assume the marginal tax rate will remain at 40 percent. Round calculations to the nearest whole dollar.

e. At the end of its economic life, the new process line is expected to be sold for $20,000. The cost of capital for the company is 6 percent. Calculate the net present value and the internal rate of return (only if you have a financial calculator) for this project. Round calculations to the nearest whole dollar. Recommend whether the replacement project should be adopted or rejected. (Hint: Preparation of a summary of incremental cash flows similar to Table 11-5 may be helpful.)

f. Draw an NPV profile for the project.

Real Options Approach

11-18. Joe and Tim are business partners who are considering opening a brewpub in Breckinridge, Colorado. It is to be called J&T's Double Diamond Brewhouse. Joe and Tim's first expenditure is the $300,000 investment required to build the brewpub. Once it is built, customers will determine how successful it is. According to Joe and Tim's estimates, the probabilities are .25 that it will be a smash hit, .50 that it will be moderately successful, and .25 that it will be a bomb.

If the brewpub is a smash hit, operating cash flows of $200,000 at the end of years 1 and 2 are expected. In that case, Joe and Tim will expand the business at the end of year 2 at a cost of $100,000. After expansion, the probabilities are .50 that subsequent operating cash flows at the end of year 3 will be $400,000, .30 that they will be $200,000, and .20 that they will be $90,000. Each of these cash flow streams would continue in years 4 and 5.

If the brewpub is moderately successful, operating cash flows of $100,000 per year at the end of years 1 through 5 are expected.

If the brewpub is a bomb, operating cash flows of –$40,000 per year at the end of years 1 through 5 are expected. This outcome would cause Joe and Tim to abandon the business at the end of year 1. The probability is 1.0 that Joe and Tim will abandon the project if cash flows at the end of year 1 are –$40,000.

a. Plot the decisions, outcomes, and probabilities associated with the new project on a decision tree similar to Figure 11-3.

b. Calculate the NPV and joint probability of each path in the decision tree. Assume that Joe and Tim's required rate of return is 14 percent.

c. Calculate the expected NPV of the entire deal. Again, assume that Joe and Tim's required rate of return is 10 percent.

Answers to Self-Test

ST-1. $20,000 × (.36 + .04) = $20,000 × .40 = $8,000 tax savings

ST-2. $2,000,000 + $400,000 = $2,400,000 operating cash flow

ST-3. $1,500,000 total initial cash outlay (The $20,000 for the consultant is a sunk cost.)

ST-4. ($500,000 – $75,000 – $100,000) × (1 – .38)
= $325,000 × .62 = $201,500 incremental net income
$201,500 + $100,000 depreciation expense
= $301,500 incremental cash flow

ST-5. ($900,000 – $300,000) × (1 – .32)
= $600,000 × .68 = $408,000 incremental net income
$408,000 + $300,000 depreciation expense
= $708,000 incremental operating cash flow

(The finance costs are not part of operating cash flows. They will be reflected in the required rate of return.)

Extra Credit Rocks

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