Chapter 10 Cash Flow and Capital Budgeting

Chapter Overview

The *What Companies Do* opening feature looks at Small Business Tax Breaks introduced in Australia. These allowed business to claim a number of depreciation expenses at a much fast rate than had been previously allowed. How did this act help in capital budgeting of new projects?

What Companies Do Discussion Questions

1. What other business elements – besides depreciation – of any industry will have an impact on future cash flows?
2. Once you identify these elements which are the most uncertain aspects of this enterprise?

This chapter looks at:

10-1. Types of Cash Flows
10-2. Incremental Cash Flows
10-3. Cash Flows for Protect IT Ltd
10-4. Special Problems in Capital Budgeting
10-5. The Human Face in Capital Budgeting

Technology

1. **Smart Video** follows Raghu Rajan of the University of Chicago as he looks at the subjective elements in capital budgeting.

2. **Smart Video** features Paul Sevastano, director of Information Technology for Sprint Nextel, talking about the difficulty in quantifying benefits from information technology investment.

3. **Smart Video**. David Nickel, controller for Intel Communications Group, Intel Corp., talks about the role of the capital budgeting function in funding programs.

4. **Smart Video.** Scott Lee of Texas A&M University argues that companies that engage in fraud are punished with lower share prices.

5. **Smart Concepts.** See an NPV analysis of the decision to open a laser eye surgery centre.

6. **Smart Solutions** provide a step-by-step solution to Problem P10-20.

After studying this chapter you should be able to:

- differentiate between cash flow and accounting profit with regard to incremental cash flow, financing costs, taxes and non-cash expenses
- discuss depreciation, fixed asset expenditures, working capital expenditures and terminal value
- understand relevant cash flows and the effects of sunk costs, opportunity costs and cannibalisation
- demonstrate the procedures for determining the relevant cash flows for a capital budgeting problem
- analyse capital rationing decisions, competing replacement projects with unequal lives and excess capacity utilisation projects
- describe how the human element can affect the capital budgeting process and its outcomes.

Lecture Guide

In order to calculate the NPV of a project, you need to know future cash flows and a discount rate. While it is not true that the only function of forecasting is to make astrology look good, it is difficult to project cash flows into the future. The company must look at strategic considerations – does the project fit in with company goals? Can we raise the money for the project? Do we have the capacity to handle the new project? The firm also must look at economic profit – is the project going to add to shareholders' wealth?

This is one of the most relevant, real world chapters in a finance textbook. Every firm has capital budgeting decisions. For some firms, these are multi-billion dollar decisions about building new plants and producing new products. For others, they are as simple as what office furniture to buy. The same techniques can be applied to big and small decisions.

10-1 Types of Cash Flows

10-1a Cash Flow versus Accounting Profit

Cash flows should be evaluated on an after tax basis. The cost of capital is the return required by investors after corporate taxes, in other words, an after-tax weighted cost of capital. There is no simple relationship between the pre-tax and post-tax return. Some companies calculate cash flows on a pre-tax basis, and then use a higher discount rate. Students should be careful with allocating overheads to new projects. Will a cash flow change because of the addition of a project? If the answer is yes, then the cash flow is relevant. If no, then it should not be included. Ask students for clear cut examples of overhead costs that should not be used. Some good examples are the CEO's salary, which would be paid whether or not a new project is accepted. However, often whether or not overhead is allocated is not so clear cut. For example, suppose a company sells multiple products using salesmen, like a pharmaceutical company which has a sales force which visits doctors and sells a variety of drugs. The pharmaceutical company introduces a new drug. Should the new project be charged for the time of the salespeople selling the drug? If a new salesperson must be added to handle the new product, then the choice is easy. However, suppose the existing sales force can handle the new drug in addition to their existing drugs. Is the cost relevant? It may depend on whether they can truly add a new drug and still pay sufficient attention to the other drugs they are selling. Perhaps one new drug would not impact sales of existing drugs, but a second new drug would. The decision about what costs to include in the cash flows of the new project becomes a subjective decision and no longer clear cut.

Focusing on Incremental Cash Flows

It is very important to discount incremental cash flows – only those cash flows that will change if a project is accepted. This is often a difficult thing for students to isolate and an example will help.

Financing Costs and Considering Taxes

When discounting free cash flows using the weighted average cost of capital, the company is capturing financing benefits in the discount rate. The discount rate includes the weights of debt and equity – how much lower cost debt financing the company chooses to use, and the cost of debt and equity. Including financing costs in the cash flows would double count the tax benefits of using debt financing.

Cash Flow and Non-Cash Expenses

It is important to use only actual cash flows – those for which you actually write a check, like labour and raw materials. Depreciation is not a cash flow – you only need to calculate depreciation in order to see the tax impact of depreciation. Accounting numbers only show when revenues are earned and when expenses are accounted for – not when funds actually flow in and out of a firm.

10.1b Depreciation

Again, depreciation itself is not important; it is the tax impact of depreciation that matters in the cash flow forecast. Depreciation is a tax-deductible expense (based on the expected life of an asset).

Table 10.1 Examples of Effective Lives of Assets from July 2010

Australian businesses use either the prime cost of diminishing value method to depreciate assets.

Table 10.2 Depreciating an Asset Using Prime Cost and Diminishing Value

10.1c Fixed Asset

Most of the time, the manager can be reasonably certain about the initial investment of a project. Generally, this is the amount that must be spent to purchase the equipment in order to carry out the project. However, in some notable cases, actual expenses have far exceeded expected initial investments. For example, the Alaska pipeline was expected to cost under $1 billion and actually cost more than $8 billion.

10.1d Net Working Capital

Note that most analyses tie increases in working capital to increases in sales. This is a very reasonable assumption. If a company has higher sales, it will also have higher accounts receivable (unless it changes its collection policies) and higher inventories to produce more of its products, as well has higher cash on hand. It also makes sense that the company will be able to recover working capital either at the end of the project or when sales decline. This section provides a numerical example of calculating increases in working capital that are relevant to the capital budgeting decision.

10.1e Terminal Value

Note that it is very difficult to forecast out too far in the future, and most year by year forecasts last 5 to 10 years. Most cash flow forecasts assume that after a given year, cash flows will grow at a steady rate, often the nominal growth rate, the real growth rate plus an inflation premium. At this point, the growing perpetuity formula can be used to calculate the terminal value of the project.

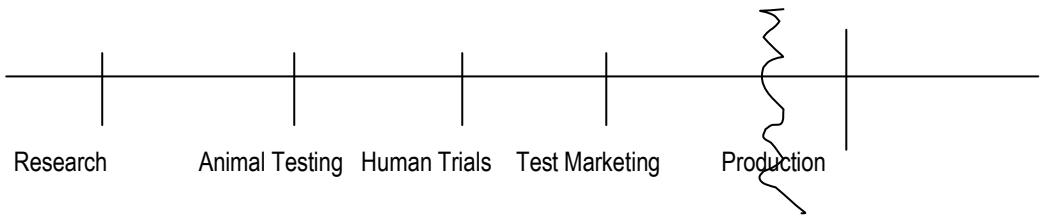
This section details the different ways that terminal value can be calculated: as a growing perpetuity, using a market multiple, and adding up the project's liquidation value. The multiple method assumes, for example, that the firm's price to cash flow (or other common multiple) will be at a certain value at the terminal year. Using the equation, Price (P) = Price/Cash flow $\times$ Cash flow. If you know future cash flow and you can estimate a price to cash flow multiple for the terminal year, then multiplying the two numbers gives the analyst an estimate of value in the terminal year. This can be discounted to a year 0 value and added to the intermediate cash flows provided by the project. Liquidation values generally provide the lowest terminal values. Usually working capital investment can be completely recovered, along with a percentage of fixed assets.

Terminal Value of Tribor Pty Ltd Acquisition

This section provides a numerical example of calculating terminal values.

10-2 Incremental Cash Flows

Capital budgeting rules clearly state that sunk costs are irrelevant and should not be included. Sometimes this is a difficult, subjective decision also. For example, again take the drug company. For every drug that makes it to market there are hundreds of failed drugs that were abandoned before or during the testing phase. The incremental costs of producing a new drug are actually very small. Most drugs use inexpensive commodity chemicals, and it is not that costly to produce syrups and pills. The most expensive part of the process already occurred – researching and extensively testing the drug.



10-2a Sunk Costs
Technically all costs before the production phase are sunk costs. In reality, a company that only covered its production costs and failed to cover its extensive research and testing costs would not stay in business very long. So, how does a company account for these? Typically a company has overhead departments that service the entire company – like research, accounting, marketing, etc. It must price its products to cover these costs, even though they do not directly enter into the accept/reject decision for a particular product. In fact, in the case of pharmaceutical companies, pricing is less dependent on the costs that went into developing the drugs, and more dependent on what value the drug has. For example, if the drug provides a life-saving treatment it will likely be priced much higher than a new antibiotic, for which there are many substitutes.

10-2b Opportunity Costs
There is an opportunity cost every time there is an alternate use for a resource. The resource does not have to be money – it can be time, land, an empty space in a building, etc. Opportunity costs are relevant because the firm is giving up the chance to use the resource differently. The firm must decide which is the most profitable use of each resource.

10-2c Cannibalisation

10-3 Cash Flows for Protect IT Ltd
This section of the chapter follows a cash flow analysis step-by-step through the entire process. It is worth going through this example carefully to show students the 'how to' of cash flows. It begins with the process for years 0-2 (sections 10.3a-10.3c), then covers terminal value (section 10.3d) and project NPV (section 10.3e).

Table 10.3 Projections for Protect IT's Investment Project

Table 10.4 Annual Net Cash Flow Estimates for Protect IT's Investment Project

10-4 Special Problems in Capital Budgeting

10-4a Capital Rationing
A Fundamental Question: If there are multiple projects with positive NPVs, why not accept all of them? Finance theory states that a firm with positive net present value projects will be able to get all the financing it needs. Lenders and equity investors are always willing and able to invest in positive net present value projects. While this is a very nice theory, in reality, many firms are capital rationed. They cannot get sufficient funds to finance all of their positive net present value projects. After taking on debt, lenders may be reluctant to lend more or the company may not be willing to accept a downgrade in bond rating that might accompany more debt. Firms may be reluctant to issue equity because of the negative signal sent when an existing firm issues new equity. The firm is in essence signalling that its share price is high, and typically firms experience a decline in market value when they announce a new secondary equity offering.

A firm facing capital rationing can use the profitability index (PI) to select projects. PI adjusts for scale, or size of the initial investment. The decision criteria are to take the project with the highest PI first, then the next highest, and so on.

10-4b Equipment Replacement and Equivalent Annual Cost
Note to students that equivalent annual cost is generally the easiest way to compute cost differences. Note that you do not need to know revenues. You can assume that revenues will be the same under either choice of machines, and the answer that is the least negative is the best. While it is time consuming to compute a problem like this using a replacement chain, sometimes a simple example can illustrate why it is necessary to make an adjustment for unequal lives or scale.

For example, suppose you have a choice of two projects with the following cash flows:

Year	0	1	2
Project A cash flow	–50	100	200
Project B cash flow	–100	50	175

Assuming a 10% discount rate, project A has an NPV of $40.9. Project B has an NPV of $62.8. Since 63 is greater than 41, Project B looks like it is a better project. However, you could do two project As for the price of one project B. Two times Project A's NPV is 40.9 x 2 = $81.8. Project A is the better project. The same applies if projects have unequal lives – you want to know the costs or cash flows on a present value basis per year in order to make the correct, most value-adding decision.

Table 10.5 Capital Rationing and the Profitability Index (12% Required Return)

Table 10.6 Operating and Replacement Cash Flows for Two Devices (All Values are Outflows)

10-4c Excess Capacity

This is another example of an opportunity cost. Just because a resource is available does not mean that it is free. Typically an asset like a warehouse is sufficient only for a given range of sales. At some point, as the firm increases its sales, and therefore its inventory, it will need more storage space.

10-5 The Human Face of Capital Budgeting

Student Interaction: Ask them to think of mistakes they have seen made in businesses that were public in nature. Point out to students that it is very difficult to admit that a past decision you made as a manager isn't working out well, and should be abandoned. Similarly, a manager would not have proposed a project if he/she did not think it was great idea. Managers tend to be more optimistic and protective of their own ideas. This is why it is important to be able to articulate the company's competitive advantage – a qualitative explanation of why a project has positive NPV. Similarly, if a computation shows a negative NPV, and it appears that the company does have a real competitive advantage, then the negative result should be questioned.

Cash Flow and Capital Budgeting Summary

A financial manager needs to consider all aspects of a capital budgeting decision. In the real world there are many uncertainties that make this a complex and difficult decision.

Enrichment Exercise

Have students work in groups to solve a capital budgeting problem. Give confidential assignments to each group member. In the discussion following, talk about the group process as well as the answer to the capital budgeting problem. Some examples of confidential assignments include:

1. Your confidential assignment is to try to get all group members to express their opinions. Draw out other members and encourage minority points.
2. Your confidential assignment is to try to get the group to consider differing points of view. To do this, try to disagree with the group as it develops consensus and force an alternative perspective.
3. Your confidential assignment is to participate in the group interactions, as you would do normally. However, as your group makes a decision, try to observe any distinct patterns of interaction and/or styles of decision-making.
4. Your confidential assignment is to try to get the group to come to a decision as quickly as possible.
5. Have students search for capital budgeting investments that were published in the news or on the Internet. Have each member discuss the potential benefits and costs of these projects.

Answers to Concept Review Questions

1. a. It's important for financial analysts to focus on incremental cash flows so that the analysts can properly evaluate the costs and benefits of a capital investment project. A manager must be able to identify the additional cash inflows and outflows that will result solely from acceptance of the project, so only the incremental CFs are important.

   b. An analyst should ignore financing costs for individual projects, and instead should use a single weighted average cost of capital for evaluating all capital investment projects that have the same risk as the firm's other assets. Otherwise, the analysts will be entangling investment and capital structure (the mix of long-term debt and equity) decisions.

   c. Analysts should consider taxes' influence the capital budgeting decision because taxes can change the net value of cash flows received or paid out that result from accepting a project. Taxes on cash inflows reduce the value of these receipts, while tax credits and deductions that result from accepting a project increase its attractiveness.

   d. Analysts must recognise the importance of non-cash expenses if these expenses reduce the taxes that must be paid on incremental cash inflows. The most important non-cash expense for most firms is depreciation, and this deduction works to reduce the tax liabilities of profitable firms.

2. Changes in net working capital are generally more important than the absolute level of working capital associated with a project. The company starts out with a certain amount of working capital – since it already has this, it is not relevant to the cash flow equation. If it needs to change the amount of working capital that it has, those changes in cash inflows or outflows are more relevant to the cash management of the firm..

3. The higher the growth rate of cash flows, the higher the terminal value of the project. A project for which cash flows level off in time will have a much smaller terminal value than would a project that requires continually larger cash flows over time.

4. A *sunk cost* is a cost that has already been paid and is therefore not recoverable. *Cannibalisation* is the 'substitution effect' that frequently occurs when a firm introduces a new product. Typically, some of the new product's sales will come at the expense of the firm's existing products. While sunk costs are irrelevant and should be ignored when determining an investment's incremental cash flows, the incremental cash outflows from existing product sales that are cannibalised by a newer product should be taken into consideration when considering a new investment.

5. The cost to the real estate company or using the space itself is the opportunity cost of not renting those 2 stories of the office building out to a new tenant. It will lose the rentals it could have gained if it chooses to occupy the space with its own offices.

6. NPV based on net income could be higher if the company has low depreciation and high additional working capital and ongoing capital expenditures needed for the project. NPV based on net income could be lower if the company had a substantial depreciation expense that was not added back into cash flows.

7. Cannibalisation is not likely in this case because the new product line is quite different from the existing product line. Customers cannot substitute a cover design for a tablet device for one designed for a cell phone.

8. Section 10-3d takes us through the three different ways that Protect IT could estimate the terminal value of the project:

a) Protect IT could make assumptions about future cashflows – it might have assumed a stable perpetuity, rather than a growing perpetuity, which would have given it a lower terminal value.
b) Protect IT could assume that the terminal value of the project simply equals the book value at the end of year 6.
c) Protect IT could multiply the project's expected sales, earnings or cash flow in year 6 by a market multiple based on comparable companies.

9. If Protect IT could depreciate its investment faster, cash flows would be higher in the early years and lower in the latter years, so the project's NPV would rise.

10. When managers are constrained by the availability of funds and they cannot invest in every project that has a positive NPV, they face so-called *capital-rationing*. Whenever managers have to choose from a set of possible investments they must choose a combination of projects that maximises shareholder wealth, subject to the constraint of limited funds. The *profitability index (PI)* is very functional in such situations. Once managers rank projects, they select the investment with the highest *PI.* If the total amount of capital available has not been fully exhausted, then managers invest in the project with the second-highest *PI*, and so on until no more capital remains to invest. By following this routine, managers will select a portfolio of projects that in aggregate generates a higher *NPV* than any other combination of projects.

    However, this method may not maximise shareholder wealth when capital is rationed not only at the beginning of an investment's life, but also in all subsequent periods. This method can also lead to suboptimal decisions when projects are interdependent – that is, when one investment is contingent on another.

11. Using *equivalent annual cost (EAC*) *method* to compare substitutable projects with different lives is more efficient when it would take a large number of repetitions of the NPV calculations in order to find a value. For example, suppose one project lasts 11 years and a second project lasts 13 years. You would have to replicate this project over a 13 x 11 = 143 years in order to find a common time horizon.

12. You could compute two NPVs – now and a year from now, with appropriate changes in the cash flows. You could also look at the opportunity cost of investing now vs. later. If the company chooses to wait a year, are there projects it could fund now and still be able to receive positive NPV from the original project if it began it in a year? If so, then waiting could be the best decision.

13. The cost of excess capacity would be zero if there were no current or future uses for that excess capacity. For example, if sales in the original product were not expected to increase, or perhaps even decline, so therefore the original product would never be able to make use of the excess capacity.

14. Managers tend to be favourably biased toward projects stemming from their own ideas. They may consciously or unconsciously manipulate the projects they favour to show positive cash flows when in fact such results might be questionable. This optimism could cause a negative NPV project to be accepted.

Answers to Self-Test Problems

ST10-1. Claross Ltd wants to determine the relevant operating cash flows associated with the proposed purchase of a new piece of equipment having an installed cost of $10 million, an expected life of five years and is to be depreciated using the diminishing value method. The company's financial analyst estimated that the relevant time horizon for analysis is six years. She expects the revenues attributable to the equipment to be $15.8 million in the first year and to increase at 5% per year through year 6. Similarly, she estimates all expenses, other than depreciation attributable to the equipment, to total $12.2 million in the first year and to increase by 4% per

year until year 6. She plans to ignore any cash flows after year 6. The company has a marginal tax rate of 30% and its required return on the equipment investment is 13%. (*Note:* Round all cash flow calculations to the nearest $0.01 million.)

a. Find the *relevant incremental cash flows* for years 0 to 6.
b. Using the cash flows found in part (a), determine the *NPV* and *IRR* for the proposed equipment purchase.
c. Based on your findings in part (b), would you recommend that Claross Ltd. purchase the equipment? Why?

A: a. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

b. NPV at 13% = $4.26 million
IRR = 27%

c. Accept the project because the NPV is greater than zero and the IRR is greater than 13%.

ST10-2. Tektek Industries wants to determine whether it would be advisable for it to replace an existing, fully depreciated machine with a new one. The new machine will have an after-tax installed cost of $300,000 and will be depreciated under a 3-year diminishing value schedule. The old machine can be sold today for $80,000 after taxes. The company is in the 30% tax bracket and requires a minimum return on the replacement decision of 15% The company's estimates of its revenues and expenses (excluding the depreciation) for both the new and the old machine (in $thousands) over the next four years are given below.

	New Machine		Old Machine	
Year	**Revenue**	**Expenses (excl. depr**	**Revenue**	**Expenses (excl. depr.)**
1	$ 925	$740	$625	$580
2	990	780	645	595
3	1,000	825	670	610
4	1,100	875	695	630

Tektek also estimates the values of various current accounts that would be impacted by the proposed replacement. They are shown below for both the new and old machine over the next four years. Currently (at time 0) the company's net investment in these current accounts is assumed to be $110,000 with the new machine and $75,000 with the old machine.

	New Machine			
Year:	**1**	**2**	**3**	**4**
Cash	$20,000	$25,000	$ 30,000	$ 36,000
Accounts rec.	90,000	95,000	110,000	120,000
Inventory	80,000	90,000	100,000	105,000
Accounts pay	60,000	65,000	70,000	72,000

	Old Machine			
Year:	**1**	**2**	**3**	**4**
Cash	$15,000	$15,000	$15,000	$15,000
Accounts rec.	60,000	64,000	68,000	70,000
Inventory	45,000	48,000	52,000	55,000
Accounts pay.	33,000	35,000	38,000	40,000

Tektek indicates that after four years of detailed cash flow development, it will assume that the year 4 incremental cash flows of the new machine over the old machine will grow at a compound annual rate of 2% from the end of year 4 to infinity.

a. Find the incremental *operating cash flows* (including any working capital investment) for years 1 to 4 for Tektek's proposed machine replacement decision.
b. Calculate the *terminal value* of Tektek's proposed machine replacement at the end of year 4.
c. Show the cash flows (initial outlay, operating cash flows, and terminal cash flow) for years 1 to 4 for Tektek's proposed machine replacement.
d. Using the cash flows from part (c), find the *NPV* and *IRR* for Tektek's proposed machine replacement.
e. Based on your findings in part (d), what recommendation would you make to Tektek regarding its proposed machine replacement?

A:

a. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

b. Year 5 operating CF = $\$98{,}222 \times (1+.02)^1 = \$100{,}186$

Terminal value at end of Year 4 = $\frac{\$100{,}186}{0.15 - 0.02} = \$770{,}665$

c. Relevant cash flows:

Total year 4 CF = \$98,222 + \$770,665 = \$868,888

Year	Cash Flow
0	–\$220,000
1	150,000
2	122,000
3	67,167
4	868,888

d. NPV @ 15% = \$543,637
IRR = 78.4%

e. Tektek should undertake the proposed machine replacement because the *NPV* of \$543,637 is greater than \$0 and the *IRR* of 78.4% is above the firm's 15% required return.

ST10-3. Performance100 Ltd is faced with choosing between two mutually exclusive projects with differing lives. It requires a return of 12% on these projects. Project A requires an initial outlay at time 0 of \$5,000,000 and is expected to require annual maintenance cash outflows of \$3,100,000 per year over its two-year life. Project B requires an initial outlay at time 0 of \$6,000,000 and is expected to require annual maintenance cash outflows of \$2,600,000 per year over its three-year life. Both projects are acceptable investments and provide equal quality service. The company assumes that the replacement and maintenance costs for both projects will remain unchanged over time.

a. Find the *NPV* of each project over its life.
b. Which project would you recommend based on your finding in part (a)? What is wrong with choosing the best project based on its *NPV*?
c. Use the *equivalent annual cost (EAC)* method to compare the two projects.
d. Which project would you recommend based on your finding in part (c)? Compare and contrast this recommendation with the one you gave in part (b).

A: a. Project A *NPV* = –$10,239,158
Project B *NPV* = –$12,244,761

b. Project A would be recommended because it has the lower cost *NPV*. The problem with this comparison is that Project A provides service for only 2 years versus Project B's three-year service life.

c. *EAC* for Project A = $6,058,490
EAC for Project B = $5,098,094

d. B is preferred based on its lower *EAC*, which means that when costs are viewed on an annual basis it is less expensive than Project A. This recommendation is superior to the one made in part b because by looking at annual cost it resolves the issue of differing service lives when the replacement and maintenance costs are assumed unchanged over time.

Answers to End-of-Chapter Questions

Q10-1. In capital budgeting analysis, why do we focus on *cash flow* rather than *accounting profit*?

A10-1. Accounting numbers may not accurately reflect when revenues are received or when payments are made. Net present value focuses on when money is actually received or paid and then discounts these cash flows at an appropriate rate to find whether a project adds value to a company. This emphasis recognises that whatever accounting earnings a company has, it must generate sufficient cash to pay its bills or it will not stay in business very long.

Q10-2. To finance a certain project, a company must borrow money at 10 per cent interest. How should it treat interest payments when it analyses the project's cash flows?

A10-2. Interest expense should be ignored and should not be treated as a cash outflow. The discount rate already captures the costs associated with financing a project, and deducting these costs from the project's cash flows would be double counting.

Q10-3. Does depreciation affect cash flow in a positive or negative manner? From a net present value perspective, why is accelerated depreciation preferable? Is it acceptable to utilise one depreciation method for tax purposes and another for financial reporting purposes? Which method is relevant for determining project cash flows?

A10-3. Depreciation positively impacts cash flow. Depreciation reduces taxable income. The lower the taxable income, the lower the taxes paid, which are a real cash outflow. Cash flow from operations is net income with depreciation added back in. Higher depreciation means higher cash flow. From a net present value perspective, the faster depreciation is taken the better. More depreciation in the early years of a project means higher cash flows and higher net present value for a project. Many companies use accelerated depreciation for cash flow/net present value purposes and straight line depreciation for reporting purposes. This ensures that the depreciation method used does not impact reported earnings per share; however, it does allow the company to take maximum tax advantage of depreciation and reduce its tax bill.

Q10-4. In what sense does an increase in accounts payable represent a cash inflow?

A10-4. An increase in accounts payable is a cash inflow in the sense that the firm is asking its creditors to finance more of its purchases. The creditor is providing non-interest bearing financing for the firm's working capital needs. The company is able to purchase more current assets since it has less of a need to pay its creditors.

Q10-5. List several ways to estimate a project's *terminal value*.

A10-5. Terminal value can be calculated using the growing perpetuity model, which states that terminal value = $CF_{t+1}/(r - g)$. Terminal value can also be calculated by multiplying the final year's cash flow by a market multiple such as price-to-cash-flow ratio. One could also use an investment's book value or its expected liquidation value to estimate terminal value.

Q10-6. What are the tax consequences of selling an investment asset for more than its book value? Does this have an effect on project cash flows that must be accounted? What is the effect if the asset is sold for less than its book value?

A10-6. If an investment is sold for more than its book value, then the firm has a capital gain on the difference between market price and book value and must pay capital gains taxes on that difference. The cash flows are the market price of the investment sale minus the additional taxes. If an asset is sold for less than book value, then the company can claim a tax credit on the difference between the market price and the book value. This credit is the difference between market value and book value times the tax rate. The cash flows are the market price of the asset plus the tax credit.

Q10-7. Why must *incremental after-tax cash flows* rather than total cash flows be evaluated in project analysis?

A10-7. Incremental cash flows matter because the project evaluator is looking at what will change if the project is accepted. Any existing expenses that the company would pay whether or not it accepted the project are not relevant to the decision at hand. The evaluator must look at what changes will occur if a project is accepted.

Q10-8. Differentiate between *sunk costs* and *opportunity costs*. Which of these costs should be included in incremental cash flows, and which should be excluded?

A10-8. Sunk costs should not be included in a cash flow analysis. These are costs that have already been paid. Accepting or rejecting the project will not impact these costs. These are not incremental to the project. Opportunity costs are relevant. If a company accepts a project, it may have to forego income from another, alternative use of a resource. If this is the case, then this opportunity cost is relevant and should be included in the cash flow analysis.

Q10-9. Why is it important to consider *cannibalisation* in situations where a company is considering adding substitute products to its product line?

A10-9. Cannibalisation is the 'substitution effect' that frequently occurs when a firm introduces a new product. Typically, some of the new product's sales will come at the expense of the firm's existing products. Therefore it is very important to consider the incremental cash outflows from existing product sales that are cannibalised by a newer product since they will affect the calculation of the new investment's incremental cash flows, respectively the attractiveness of the venture.

Q10-10. Before entering graduate school, a student estimated the value of earning an MBA at $300,000. Based on that analysis, the student decided to go back to school. After completing the first year, the student ran the *NPV* calculations again. How would you expect the *NPV* to look after the student has completed one year of the program? Specifically, what portion of the analysis must be different than it was the year before?

A10-10. After one year, all of the out-of-pocket costs of the program, as well as one year's lost wages, are sunk costs. Therefore, the NPV of getting the degree is probably much higher.

Q10-11. Furry Taxidermy Ltd (FT) operates a chain of taxidermy shops across NSW, with a handful of locations in the Victoria. A rival company, Heads Up Ltd., has a few NSW-based locations, but most of its shops are located in the Victoria. FT and Heads Up decide to consolidate their operations by trading ownership of a few locations. FT will acquire four Heads Up locations in the NSW, and will relinquish control of its Victorian locations in exchange. No cash changes hands up front. Does this mean that an analyst working for either company can evaluate the merits of this deal by assuming that the project has no initial cash outlay? Explain.

A10-11. There are two ways to approach this problem. First, each company could estimate the cash value of the stores that it is giving up. This is the cash price that the firm might obtain from another buyer, and therefore represents the opportunity cost of this deal. This could be treated as the initial cash outflow. Next, analysts would compare this cash outflow to the present value of cash inflows generated by the stores it is acquiring to determine the overall NPV.

But what about the cash inflows that the company loses on the stores it gives up? Isn't that another opportunity cost? The answer is that it depends. If analysts treat the opportunity cost of selling the stores for cash as an initial outflow, then they should ignore subsequent cash inflows from operating these stores. That's because the company would not receive these cash inflows if it sold the stores for cash. Therefore, the only other relevant future cash inflows are those from the stores that the company acquires.

On the other hand, the company could approach the analysis by ignoring the opportunity to sell their current stores for cash. In that case, the future cash inflows from these stores is the relevant opportunity cost, so the project NPV would simply take the net cash flows from the stores that the company receives and subtract those from the stores that it sells.

Q10-12. What is the only relevant decision for independent projects if an unlimited capital budget exists? How does your response change if the projects are mutually exclusive? How does your response change if the firm faces *capital rationing*?

A10-12. If the capital budget is unlimited, managers should rank the available projects according to their PIs and invest in all projects with a PI > 1, respectively all projects with a NPV >0. If the projects are mutually exclusive though, managers should chose the one with the highest NPV, since the ranking according to PI and NPV may differ due to the scale of the projects , and invest in it if there is sufficient capital. If the company faces capital rationing, it should invest in the projects based on its PI ranking.

Q10-13. Explain why the *equivalent annual cost (EAC) method* helps companies evaluate alternative investments with unequal lives.

A10-13. The EAC method provides a present value per year. This means one can look at the yearly contribution of an investment, rather than just the total investment. In other words, it might be more profitable to take a project that provides a higher yearly NPV for fewer years, and then reinvest again when that project ends than to take a longer-term project that provides a lower NPV per year.

Q10-14. Why isn't excess capacity free?

A10-14. Excess capacity is not free. It was originally accounted for when the project was first chosen – that size equipment that produced the excess capacity was included in those project cash flows. If there truly is no use for excess capacity, now or in the future, for the original project, then a new project could use that excess capacity at no additional charge to the project. However, if using excess capacity for a new project means that the original project will have to add more capacity at some time in the future, this should be charged to the new project.

Answers to End-of-Chapter Problems

Types of Cash Flows

P10-1. Calculate the present value of depreciation tax savings on a depreciable asset with a purchase price of $5 million and zero salvage value, assuming a 10 % discount rate, a 30 % tax rate, and prime cost depreciation over the following periods:
a. The asset is depreciated over a 3-year life.
b. The asset is depreciated over a 7-year life.
c. The asset is depreciated over a 20-year life.

A10-1.

a., b., c. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

P10-2. A certain piece of equipment costs $32 million plus an additional $2 million to install. This equipment will be depreciated over 5 years using the diminishing value method. For a company that discounts cash flows at 12 % and faces a tax rate of 30 %, what is the present value of the depreciation tax savings associated with this equipment? By how much would that number change if the company could treat the $2 million installation cost as a deductible expense rather than include it as part of the depreciable cost of the asset?

A10-2.

See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

P10-3. Taylor United is considering overhauling its equipment to meet increased demand for its product. The cost of the equipment overhaul is $3.8 million plus $200,000 in installation costs. The company will depreciate the equipment modifications under the prime cost method using a five-year recovery period. Additional sales revenue from the overhaul should amount to $2.2 million per year, and additional operating expenses and other costs (excluding depreciation) will amount to 35% of the additional sales. The company has an ordinary tax rate of 30%. Answer the following questions about Taylor United for each of the next six years.
a. What additional earnings, before depreciation and taxes, will result from the overhaul?
b. What additional earnings after taxes will result from the overhaul?
c. What incremental operating cash flows will result from the overhaul?

A10-3.

Installed cost of equipment: $3,800,000 + $200,000 = $4,000,000
a. $2,200,000 × (1 – .35) = $1,430,000 each year

b. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

c. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

P10-4. Wilbur Corporation is considering replacing a machine. The replacement will cut operating expenses by $24,000 per year for each of the five years the new machine is expected to last. Although the old machine has a zero book value, it has a remaining useful life of five years. The depreciable value of the new machine is $72,000. Wilbur will depreciate the machine under the prime cost method using a 5-year recovery period and is subject to a 30 % tax rate on ordinary income. Estimate the incremental operating cash flows attributable to the replacement.

A10-4. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

P10-5. Advancedtronics Corporation is considering purchasing a new packaging machine to replace a fully depreciated packaging machine that will last five more years. The new machine is expected to have a 5-year life and depreciation charges of $4,000 in year 1; $6,400 in year 2;

$3,800 in year 3; $2,400 in both year 4 and year 5; and $1,000 in year 6. The firm's estimates of revenues and expenses (excluding depreciation) for the new and old packaging machines are shown in the following table. Advanced Electronics is subject to a 30 % tax rate on ordinary income.

	New Packaging Machine		Old Packaging Machine	
Year	**Revenue**	**Expenses (excluding depreciation)**	**Revenue**	**Expenses (excluding depreciation)**
1	$50,000	$40,000	$45,000	$35,000
2	$51,000	$40,000	$45,000	$35,000
3	$52,000	$40,000	$45,000	$35,000
4	$53,000	$40,000	$45,000	$35,000
5	$54,000	$40,000	$45,000	$35,000

a. Calculate the operating cash flows associated with each packaging machine. Be sure to consider the depreciation in year 6.
b. Calculate the incremental operating cash flows resulting from the proposed packaging machine replacement.
c. Depict on a time line the incremental operating cash flows found in part (b.).

A10-5.

a.

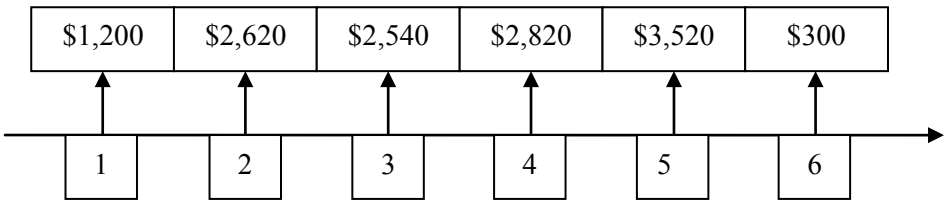
New Machine	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Sales		$50,000	$51,000	$52,000	$53,000	$54,000	$ 0
– Expenses		40,000	40,000	40,000	40,000	40,000	0
– Depreciation		4,000	6,400	3,800	2,400	2,400	1,000
Taxable income		$ 6,000	$ 4,600	$ 8,200	$10,600	$11,600	$–1,000
– Taxes (30%)		1,800	1,380	2,460	3,180	3,480	–300
Earnings		$ 4,200	$ 3,220	$ 5,740	$ 7,420	$ 8,120	$ –700
Operating CFs (Earn+Depr)		$ 8,200	$ 9,620	$ 9,540	$ 9,820	$10,520	$ 300

Old Machine	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Sales		$45,000	$45,000	$45,000	$45,000	$45,000	0
– Expenses		35,000	35,000	35,000	35,000	35,000	0
– Depreciation		0	0	0	0	0	0
Taxable income		$10,000	$10,000	$10,000	$10,000	$10,000	0
– Taxes (30%)		3,000	3,000	3,000	3,000	3,000	0
Earnings		$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	0
Operating CFs (Earn+Depr)		$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	0

b. Incremental operating cash flows

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
New Machine		$8,200	$9,620	$9,540	$9,820	$10,520	$300
– Old Machine		7,000	7,000	7,000	7,000	7,000	0
Difference		$1,200	$2,620	$2,540	$2,820	$ 3,520	$300

c.



End of Year

P10-6. Primary Wines, a producer of medium-quality wines, has maintained stable sales and profits over the past eight years. Although the market for medium-quality wines has been growing by 4 % per year, Primary Wines has been unsuccessful in sharing this growth. To increase its sales, the firm is considering an aggressive marketing campaign that centres on regularly running ads in major food and wine magazines and airing TV commercials in large metropolitan areas. The campaign is expected to require an *annual* tax-deductible expenditure of $3 million over the next five years. Sales revenue, as noted in the following income statement for 2012, totalled $80 million. If the proposed marketing campaign is not initiated, sales are expected to remain at this level in each of the next five years, 2013-2017. With the marketing campaign, sales are expected to rise to the levels shown in the sales forecast table for each of the next five years. The cost of goods sold is expected to remain at 75 % of sales; general and administrative expense (exclusive of any marketing campaign outlays) is expected to remain at 15 % of sales; and annual depreciation expense is expected to remain at $2 million. Assuming a 30 % tax rate, find the *cash flows* over the next five years associated with Primary Wines' proposed marketing campaign.

Primary Wines Income Statement
for the Year ended
December 31, 2012

Sales revenue		$80,000,000
Less: Cost of goods sold (75%)		60,000,000
Gross profit		$20,000,000
Less operating expenses:		
General and administrative expense (15%)	$12,000,000	
Depreciation expense	2,000,000	
Total operating expenses		14,000,000
Net profits before taxes		$ 6,000,000
Less: Taxes (rate = 30%)		1,800,000
Net profits after taxes		$ 4,200,000

Primary Wines
Sales Forecast

Year	Sales Revenue
2012	$82,000,000
2013	$84,000,000
2014	$86,000,000
2015	$90,000,000
2016	$94,000,000

A10-6. Incremental operating cash flows:
See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

The proposed campaign would not generate enough in new sales revenues to justify the additional advertising expense.

Incremental Cash Flows

P10-7. Identify each of the following situations as involving *sunk costs*, *opportunity costs,* and/or *cannibalisation*. Indicate what amount, if any, of these items would be relevant to the given investment decision.

a. The investment requires use of additional computer storage capacity to create a data warehouse containing information on all of your customers. The storage space you will use is currently leased to another company for $37,500 per year under a lease that can be cancelled without penalty by you at any time.
b. An investment that will result in producing a new lighter-weight version of one of the company's best-selling products. The new product will sell for 40% more than the current product. Because of its high price, the company expects the old product's sales to decline by about 10% from its current level of $27 million.
c. An investment of $8 million in a new venture that is expected to grow sales and profits. To date you have spent $135,000 researching the venture and performing feasibility studies.
d. Subleasing 100 parking spaces in your company's parking lot to the tenants in an adjacent building that has inadequate off-street parking. You pay $20 per month for each space under a non-cancellable 50-year lease. The sublessee will pay you $15 per month for each space. You have advertised the spaces for over a year with no other takers and you do not anticipate needing the 100 spaces for many years.
e. The company is considering launching a completely new product that can be sold by your existing sales force, which is already overburdened with a large catalogue of products to sell. On average, each sales rep sells about $2.1 million per year. You expect that given the extra time involved in selling the new product, your sales reps will likely devote less time to selling existing products. Although you forecast that the average sales rep will sell

about $300,000 of the new product annually, you project a decline of about 7% per year in existing product sales.

A10-7. a. $37,000 per year until the lease would have expired by itself is the opportunity cost to the investment and it is relevant to the investment decision

b. Cannibalisation of the existing product by the new, light-weight products. $2.7 million of lost revenue from cannibalisation is relevant to the investment decision.

c. Sunk costs of $135,000 on research. Even if you do not make the investment in the new venture the sunk costs have already been spent and there will be no way to recover them. Therefore, they are not relevant to the investment decision.

d. $20 $\times$ 100 = $2,000 sunk cost per month since the lease is non-cancellable.

e. Cannibalisation of the existing products by the new one, even though they are not related, because the sales force will be overburdened and therefore invest less time in selling the existing products. The relevant cash flow due to cannibalisation is 0.07 $\times$ $2,100,000 = $147,000 loss in sales of existing products.

P10-8. Barans Manufacturing is developing the incremental cash flows associated with the proposed replacement of an existing stamping machine with a new, technologically advanced one. Given the following costs related to the proposed project, explain whether each would be treated as a *sunk cost* or an *opportunity cost* in developing the incremental cash flows associated with the proposed replacement decision.

a. Barans could use the same dies and other tools (with a book value of $40,000) on the new stamping machine that it used on the old one.
b. Barans could link the new machine to its existing computer system to control its operations. The old stamping machine did not have a computer control system. The company's excess computer capacity could be leased to another company for an annual fee of $17,000.
c. Barans needs to obtain additional floor space to accommodate the new, larger stamping machine. The space required is currently being leased to another company for $10,000 per year.
d. Barans can use a small storage facility, built by Barans at a cost of $120,000 three years earlier, to store the increased output of the new stamping machine. Because of its unique configuration and location, it is currently of no use to either Barans or any other company.
e. Barans can retain an existing overhead crane, which it had planned to sell for its $180,000 market value. Although the crane was not needed with the old stamping machine, it can be used to position raw materials on the new stamping machine.

A10-8. a. Using the same dies and tools is not an incremental expense. This is a sunk cost and not relevant to the project cash flows.

b. The $17,000 is an *opportunity cost* and is relevant. If the company accepts the project, it will forego $17,000 in leasing revenue. The company is using some of its excess capacity that it would have otherwise leased.

c. The $10,000 in floor space is an *opportunity cost*. The company will forego $10,000 in revenues in order to provide floor space for the new project.

d. The storage space is a *sunk cost* and should not be charged to the new project. The company has no other use for this space and it has already paid for the facility.

e. Foregoing the sale of the crane is an *opportunity cost*. The $180,000 in lost equipment sales revenue should be charged to the new project.

P10-9. Blueberry Electronics is exploring the possibility of producing a new handheld device that will serve both as a basic PC with Internet access and as a cell phone. Which of the following items are incremental costs for the project's analysis?

a. Research and development funds that the company has spent while working on a prototype of the new product.
b. The company's current-generation product has no cell phone capability. The new product may therefore make the old one obsolete in the eyes of many consumers. However, Blueberry expects that other companies will soon bring to market products combining cell phone and PC features, which will also reduce sales on Blueberry's existing products.
c. Costs of ramping up production of the new device.
d. Increases in receivables and inventory that will occur as production increases.

A10-9. Sunk costs include:

a. Research and development funds already spent

Incremental costs include:

b. The impact on other products produced by the company. However, since it is expected that the competition will erode sales if Blueberry does not do so itself, then a case could be made that the firm should have included cannibalisation of sales into its forecasts of existing products when the decision was originally made to accept those projects.
c. Costs of ramping up production of the new device. This is incremental to the new project.
d. Increases in inventory and receivables that will occur because of the acceptance of the new project.

P10-10. Big Apple Pizza is considering replacing an existing oven with a new, more sophisticated oven. The old oven was purchased three years ago at a cost of $20,000, and this amount was being depreciated under the diminishing value method using a 5-year recovery period. The oven has five years of usable life remaining. The new oven being considered costs $30,500, requires $1,500 in installation costs, and would be depreciated under the diminishing value method using a 5-year recovery period. The old oven can currently be sold for $22,000 without incurring any removal or clean-up costs. The company pays taxes at a rate of 30 per cent on both ordinary income and capital gains. The revenues and expenses (excluding depreciation) associated with the new and the old machines for the next five years are given in the following table.

	New Oven		Old Oven	
Year	Revenue	Expenses (excluding depreciation)	Revenue	Expenses (excluding depreciation)
1	$300,000	$288,000	$270,000	$264,000
2	$300,000	$288,000	$270,000	$264,000
3	$300,000	$288,000	$270,000	$264,000
4	$300,000	$288,000	$270,000	$264,000
5	$300,000	$288,000	$270,000	$264,000

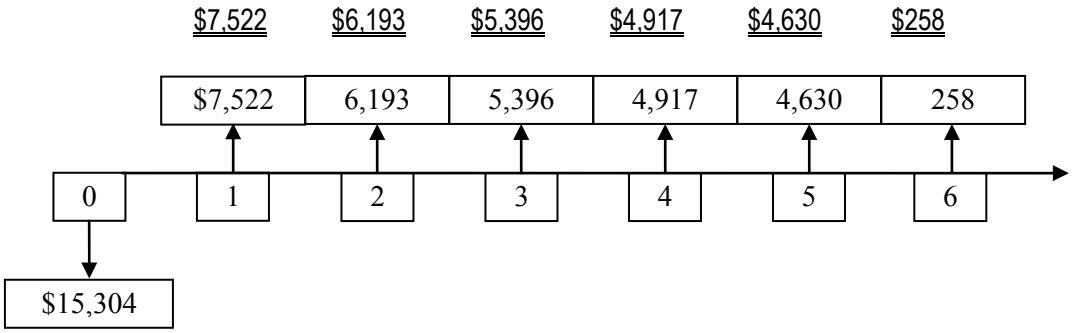
a. Calculate the initial cash outflow associated with replacement of the old oven with a new one.
b. Determine the incremental cash flows associated with the proposed replacement. Be sure to consider the depreciation in year 6.
c. Depict on a time line the incremental cash flows found in parts (a) and (b) associated with the proposed replacement decision.

A10-10. a.

Cost of new oven		$30,500	
+ Installation costs		1,500	
Total installed cost			$32,000
Proceeds from Sale of old oven		$22,000	
Less tax on sale of old oven:			
Sale price	$22,000		
Book value = Adjusted Tax Value at the end of Year 3 (see depreciation table for the old machine in P10-10b)	4,320		
Gain on sale of old oven	$117,680		
× Tax rate 30%			
Tax on sale of old oven		5304	
After tax proceeds from sale of old oven			(16,696)
INITIAL CASH OUTFLOW			$15,304

b. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

c.



P10-11. Speedy Auto Wash is contemplating the purchase of a new high-speed washer to replace the existing washer. The existing washer was purchased two years ago at an installed cost of $120,000; it was being depreciated under the diminishing value method using a 5-year recovery period. The existing washer is expected to have a usable life of five more years. The new washer costs $210,000 and requires $10,000 in installation costs; it has a 5-year usable life and would be depreciated under the diminishing value method using a 5-year recovery period. The existing washer can currently be sold for $140,000 without incurring any removal or clean-up costs. To support the increased business resulting from purchase of the new washer, accounts receivable would increase by $80,000, inventories by $60,000, and accounts payable by $116,000. At the end of five years, the existing washer is expected to have a market value of zero; the new washer would be sold to net $58,000 after removal and clean-up costs and before taxes. The firm pays taxes at a rate of 30 % on both ordinary income and capital gains. The estimated *profits before depreciation and taxes* over the five years for both the new and the existing washer are shown in the following table.

Profits before Depreciation and Taxes

Year	New Washer	Existing Washer
1	$86,000	$52,000
2	$86,000	$48,000
3	$86,000	$44,000
4	$86,000	$40,000
5	$86,000	$36,000

a. Calculate the initial cash outflow associated with the replacement of the existing washer with the new one.
b. Determine the incremental cash flows associated with the proposed washer replacement. Be sure to consider the depreciation in year 6.
c. Determine the terminal cash flow expected at the end of year 5 from the proposed washer replacement.
d. Depict on a time line the incremental cash flows, found in parts (a) and (b), associated with the proposed replacement decision.

A10-11. a.

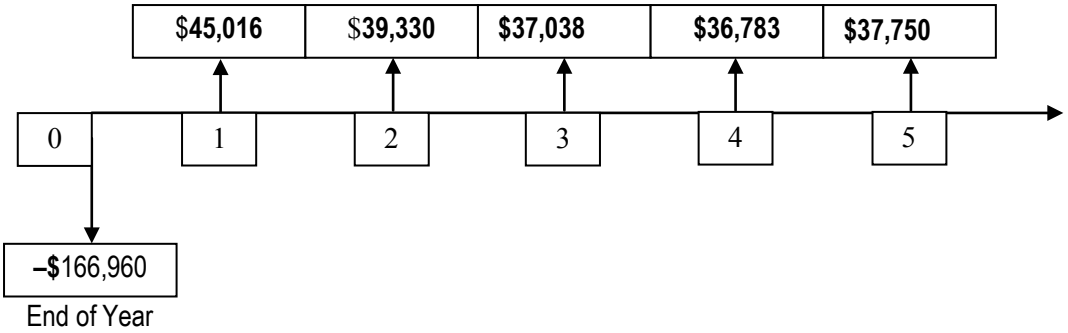
Cost of new washer		$210,000	
+ Installation cost		10,000	
Total installed cost			$220,000
Proceeds from sale of existing washer		$140,000	
Less tax on sale of existing washer:			
Sale Price	$140,000		
– Book Value = Adjusted Tax Value at the end of Year 2 (see depreciation table for the old machine in P10-11b)	43,200		
Gain on sale of existing washer	$ 96,800		
× Tax rate (30%			
Tax on sale of existing washer		29,040	
After tax proceeds from sale of existing washer			(190,960)
+ Initial working capital investment			
Increase in current assets:			
Accounts receivable	$ 80,000		
Inventories	60,000		
Total current assets increase		$140,000	
Less increase in current liabilities:			
Accounts Payable	$116,000		
Total current liabilities increase		116,000	
Initial working capital investment			24,000
INITIAL CASH OUTFLOW			$166,960

b. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]
c. Terminal value of new washer in year 5

Sale price	$58,000
– Book value = Adjusted Tax Value at the end of Year 6 (see depreciation table for the new machine in P10-11b)	10,264
Gain on sale	$47,736
– Taxes (30%)	14,321
Terminal value (sale price – taxes)	$43,679

Incremental cash flows:

d. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]



P10-12. PanPac Shipping is considering replacing an existing ship with one of two newer, more efficient ones. The existing ship is three years old, cost $32 million, and is being depreciated under the diminishing value method using a 5-year recovery period. Although the existing ship has only three years of effective life remaining under the diminishing value method, it has a remaining usable life of five years. Ship A, one of the two possible replacement ships, costs $40 million to purchase and $8 million to outfit for service. It has a 5-year usable life and will be depreciated under the diminishing value method using a 5-year recovery period. Ship B costs $54 million to purchase and $6 million to outfit. It also has a 5-year usable life and will be depreciated under the diminishing value method using a 5-year recovery period. Increased investments in net working capital will accompany the decision to acquire ship A or ship B. Purchase of ship A would result in a $4 million increase in net working capital; ship B would result in a $6 million increase in net working capital. The projected *profits before depreciation and taxes* with each alternative ship and the existing ship are given in the following table.

	Profits before Depreciation and Taxes		
Year	**Ship A**	**Ship B**	**Existing Ship**
1	$21,000,000	$22,000,000	$14,000,000
2	$21,000,000	$24,000,000	$14,000,000
3	$21,000,000	$26,000,000	$14,000,000
4	$21,000,000	$26,000,000	$14,000,000
5	$21,000,000	$26,000,000	$14,000,000

The existing ship can currently be sold for $18 million and will not incur any removal or clean-up costs. At the end of five years, the existing ship can be sold to net $1 million before taxes. Ships A and B can be sold to net $12 million and $20 million before taxes, respectively, at the end of the 5-year period. The company is subject to a 30 % tax rate on both ordinary income and capital gains.

a. Calculate the initial outlay associated with each alternative.
b. Calculate the operating cash flows associated with each alternative. Be sure to consider the depreciation in year 6.
c. Calculate the terminal cash flow at the end of year 5 associated with each alternative.
d. Depict on a time line the incremental cash flows associated with each alternative.

A10-12. a.

			Ship A	Ship B
Cost of new ship			$40,000,000	$54,000,000
Installation			8,000,000	6,000,000
Total installed cost			$48,000,000	$60,000,000
Less proceeds from selling existing ship		$18,000,000		
Less tax on sale of existing ship:				
Sale price	$18,000,000			
– Book value Value = Adjusted Tax Value at the end of Year 2 (see depreciation table for the old ship in P10-12b)	11,520,000			
Gain on sale of existing ship	$ 6,480,000			
× Tax rate (30%)				
Tax on sale of existing ship		1,944,000		
After-tax proceeds from sale of existing ship			(4,536,000)	(4,536,000)
+ Initial working capital investment			4,000,000	6,000,000
INITIAL CASH OUTFLOW			$8,536,000	$10,536,000

b. See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

c.

Terminal value of Ship A in year 5:

Sale price	$12,000,000
– Book value = Adjusted Tax Value at the end of Year 6 (see depreciation table for the new machine in P10-11b)	2,239,488
Gain on sale	$ 9,760,512
Taxes (30%)	2,928,154
Terminal value (sale price – taxes)	$ 6,832,358

Terminal value of Ship B in year 5:

Sale price	$20,000,000
– Book value = Adjusted Tax Value at the end of Year 6 (see depreciation table for the new machine in P10-11b)	2,799,360
Gain on sale	$17,200,640
Taxes (30%)	5,160,192
Terminal value (sale price – taxes)	$12,040,448

Terminal value of existing ship in year 5:

Sale price	$1,000,000
– Book value = Adjusted Tax Value at the end of Year 6 (see depreciation table for the new machine in P10-11b)	$214,991
Gain on sale	$785,009
Taxes (30%)	$235,503
Terminal value	$ 549,506

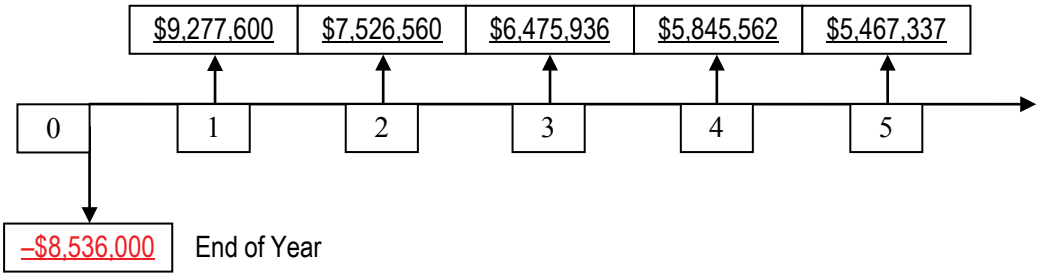
d)

Incremental cash flows for Ship A:

See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

The time lines for Ship A:

Ship A:

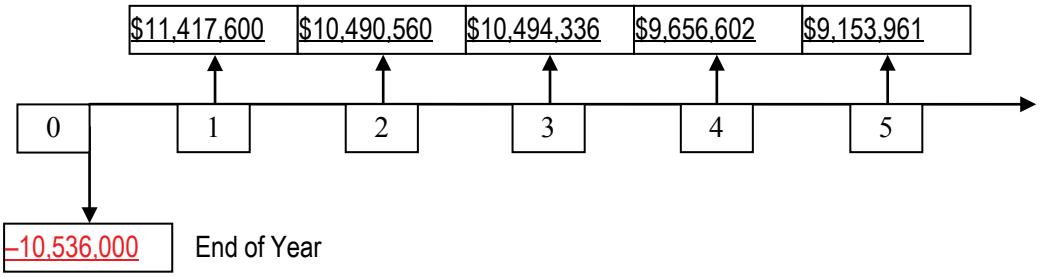


Incremental cash flows for Ship B:

See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

The time lines for Ship B:

Ship B:



P10-13. The management of Cybuy is evaluating replacing their large mainframe computer with a modern network system that requires much less office space. The network would cost $500,000 (including installation costs) and, due to efficiency gains, would generate $125,000 per year in operating cash flows (accounting for taxes and depreciation) over the next five years due to efficiency gains. The mainframe has a remaining book value of $50,000 and would be immediately donated to a charity for the tax benefit. Cybuy's cost of capital is 10 per cent and tax rate is 30 %. On the basis of *NPV*, should management install the network system?

A10-13.

Year:	0	1	2	3	4	5
Network cost	$–500,000					
Operating cash flows		$125,000	$125,000	$125,000	$125,000	$125,000
– Donate old computer*	15,000					
Cash flows	$–485,000	$125,000	$125,000	$125,000	$125,000	$125,000
NPV at 10%	$ –11,151.65					

* Loss = Sale price – Book value = $0 – $50,000 = $–50,000
Tax benefit from loss = $50,000 × .30 = $15,000

The NPV is negative. The new system should not be installed.

P10-14. Pointless Luxuries Inc. (PLI) set up as a sole trader and produces unusual gifts targeted at wealthy consumers. The company is analysing the possibility of introducing a new device designed to attach to the collar of a cat or dog. This device emits sonic waves that neutralise airplane engine noise, so that pets traveling with their owners can enjoy a more peaceful ride. PLI estimates that developing this product will require up-front capital expenditures of $10 million. These costs will be depreciated on a straight-line basis for five years. PLI believes that it can sell the product initially for $250. The selling price will increase to $260 in years 2 and 3 before falling to $245 and $240 in years 4 and 5, respectively. After five years the company will withdraw the product from the market and replace it with something else. Variable costs are $135 per unit. PLI forecasts sales volume of 20,000 units the first year, with subsequent increases of 25% (year 2), 20% (year 3), 20% (year 4), and 15% (year 5). Offering this product will force PLI to make additional investments in receivables and inventory. Projected end-of-year balances appear in the following table.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Accounts receivable	$0	$200,000	$250,000	$300,000	$150,000	$0
Inventory	0	500,000	650,000	780,000	600,000	0

The firm faces a tax rate of 34 per cent. Assume that cash flows arrive at the end of each year, except for the initial $10 million outlay.

a. Calculate the project's contribution to net income each year.
b. Calculate the project's cash flows each year.
c. Calculate two *NPV*s, one using a 10 per cent discount rate and one using a 15 per cent discount rate.
d. A PLI financial analyst reasons as follows: 'With the exception of the initial outlay, the cash flows from this project arrive in more or less a continuous stream rather than at the end of each year. Therefore, by discounting each year's cash flow for a full year, we are understating the true *NPV*. A better approximation is to move the discounting six months forward (discount year-1 cash flows for six months, year-2 cash flows for 18 months, and so on), as if all the cash flows arrive in the middle of each year rather than at the end.' Recalculate the *NPV* (at 10% and 15%) maintaining this assumption. How much difference does it make?

A10-14. a and b.

Year:	1	2	3	4	5
Units sales	20,000	25,000	30,000	36,000	41,400
× Price/Unit	$250	$260	$260	$245	$240
Revenue	$5,000,000	$6,500,000	$7,800,000	$8,820,000	$9,936,000
– Variable cost ($135/unit)	2,700,000	3,375,000	4,050,000	4,860,000	5,589,000
– Depreciation ($10 million ÷ 5)	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Net income	$ 300,000	$1,125,000	$1,750,000	$1,960,000	$2,347,000
After-tax income [Net income × (1 – .34)]	$ 198,000	$ 742,500	$1,155,000	$1,293,600	$1,549,020
+ Depreciation	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Operating CF	$2,198,000	$2,742,500	$3,155,000	$3,293,600	$3,549,020
Working capital*	–700,000	–200,000	–180,000	330,000	750,000
Cash flow	$1,498,000	$2,542,500	$2,975,000	$3,623,600	$4,299,020

c and d.

	1	2	3	4	5	NPV at 10%	NPV at 15%
Year-end PV @ 10%	$1,361,818	$2,101,240	$2,235,162	$2,474,968	$2,669,353	$ 842,541	$–609,607
Mid-year PV @ 10%	$1,428,287	$2,203,799	$2,344,257	$2,595,768	$2,799,641	1,371,752	70,074
				Difference with mid-year discounting		$ 529,211	$ 679,681

P10-15. TechGiant Infosys (TGI) is set up as a sole trader and evaluating a proposal to acquire Fusion Chips, a young company with an interesting new chip technology. This technology, when integrated into existing TGI silicon wafers, will enable TGI to offer chips with new capabilities to companies with automated manufacturing systems. TGI analysts have projected income statements for Fusion five years into the future. These projections appear in the following income statements, along with estimates of Fusion's asset requirements and accounts payable balances each year. These statements are designed assuming that Fusion remains an independent, stand-alone company. If TGI acquires Fusion, analysts believe that the following changes will occur.

1. TGI's superior manufacturing capabilities will enable Fusion to increase its gross margin on its existing products to 45 %.
2. TGI's massive sales force will enable Fusion to increase sales of its existing products by 10 % above current projections (for example, if acquired, Fusion will sell $110 million, rather than $100 million, in 2012). This increase will occur as a consequence of regularly scheduled conversations between TGI salespeople and existing customers and will not require added marketing expenditures. Operating expenses as a percentage of sales will be the same each year as currently forecasted (ranges from 10% to 12%). The fixed asset increases currently projected through 2016 will be sufficient to sustain the 10 % increase in sales volume each year.
3. TGI's more efficient receivables and inventory management systems will allow Fusion to increase its sales as previously described without making investments in receivables and inventory beyond those already reflected in the financial projection. TGI also enjoys a

* Year-to-year change in investment in A/R and inventories

higher credit rating than Fusion, so after the acquisition, Fusion will obtain credit from suppliers on more favourable terms. Specifically, Fusion's accounts payable balance will be 30 per cent higher each year than the level currently forecast.

4. TGI's current cash reserves are more than sufficient for the combined company, so Fusion's existing cash balances will be reduced to $0.
5. Immediately after the acquisition, TGI will invest $50 million in fixed assets to manufacture a new chip that integrates Fusion's technology into one of TGI's best-selling products. These assets will be depreciated on a straight-line basis for eight years. After five years, the new chip will be obsolete, and no additional sales will occur. The equipment will be sold at the end of year 5 for $1 million. Before depreciation and taxes, this new product will generate $20 million in (incremental) profits the first year, $30 million the second year, and $15 million in each of the next three years. TGI will have to invest $3 million in net working capital up front, all of which it will recover at the end of the project's life.
6. Both companies face a tax rate of 34 %.

Fusion Chips Income Statements
($ in thousands for years ended December 31)

	2012	2013	2014	2015	2016
Sales	$100,000	$150,000	$200,000	$240,000	$270,000
− Cost of goods sold	60,000	90,000	120,000	144,000	162,000
Gross profit	$ 40,000	$ 60,000	$ 80,000	$ 96,000	$108,000
− Operating expenses	12,000	17,250	22,000	25,200	27,000
− Depreciation	12,000	18,000	24,000	28,800	32,400
Pre-tax income	$ 16,000	$ 24,750	$ 34,000	$ 42,000	$ 48,600
− Taxes	5,440	8,415	11,560	14,280	16,524
Net income	$ 10,560	$ 16,335	$ 22,440	$ 27,720	$ 32,076

Fusion Chips Assets and Accounts Payable
($ in thousands on December 31)

	2011	2012	2013	2014	2015	2016
Cash	$ 400	$ 400	$ 525	$ 600	$ 600	$ 600
Accounts receivable	6,000	7,000	10,500	14,000	16,800	18,900
Inventory	10,000	12,500	18,750	25,000	30,000	33,750
Total current assets	$16,400	$19,900	$29,775	$39,600	$47,400	$53,250
Plant and equipment						
Gross	$80,000	$113,000	$166,500	$226,000	$283,200	$336,900
Net	$50,000	$71,000	$106,500	$142,000	$170,400	$191,700
Total assets	$66,400	$90,900	$136,275	$181,600	$217,800	$244,950
Accounts payable	$7,500	$13,500	$20,250	$27,000	$32,400	$36,450

Note: The 2011 figures represent the balances currently on Fusion's balance sheet.

a. Calculate the cash flows generated by Fusion as a stand-alone entity in each year from 2012 to 2016.
b. Assume that by 2016, Fusion reaches a 'steady state,' which means that its cash flows will grow by 5% per year in perpetuity. If Fusion discounts cash flows at 15%, what is the present value as of the end of 2016 of all cash flows that Fusion will generate from 2017 forward?
c. Calculate the present value as of 2011 of Fusion's cash flows from 2012 forward. What does this *NPV* represent?
d. Suppose TGI acquires Fusion. Recalculate Fusion's cash flows from 2012 to 2016, making all the changes previously described in items 1–4 and 6.

e. Assume that after 2016 Fusion's cash flows will grow at a steady 5 per cent per year. Calculate the present value of these cash flows as of 2016 if the discount rate is 15%.
f. Ignoring item 5 in the list of changes, what is the *PV* as of 2011 of Fusion's cash flows from 2012 forward? Use a discount rate of 15%.
g. Finally, calculate the *NPV* of TGI's investment to integrate its technology with Fusion's. Considering this in combination with your answer to part (f), what is the maximum price that TGI should pay for Fusion? Assume a discount rate of 15%.

A10-15. a.

($ in thousands)

	2012	**2013**	**2014**	**2015**	**2016**
Net income	$10,560	$ 16,335	$ 22,440	$27,720	$32,076
+ Depreciation	12,000	18,000	24,000	28,800	32,400
– Δ in current assets	3,500	9,875	9,825	7,800	5,850
– Δ in gross final assets	33,000	53,500	59,500	57,200	53,700
+ Δ Accounts payable	6,000	6,750	6,750	5,400	4,050
Cash flow	$–7,940	$–22,290	$–16,135	$ –3,080	$ 8,976

b. Cash flow 2017 = 1.05 × $8,976 = $9,424.80

g = 5%, r = 15%

$$PV_{2016} = \frac{CF_{2017}}{r-g} = \frac{\$9{,}424.80}{.15-.05} = \$94{,}248$$

c.

End of Year	**Cash Flow**	**PV of CF beyond 2014**	**Total Cash Flow**
2012	$ –7,940		$ –7,940
2013	–22,290		–22,290
2014	–16,135		–16,135
2015	–3,080		–3,080
2016	8,976	94,248	103,224

PV Total Cash Flow @15% at the end of 2011= $15,192

d.

Fusion Chips
Income Statement
($ thousands)

	2012	2013	2014	2015	2016
Sales (+10%)	$110,000	$165,000	$220,000	$264,000	$297,000
– COGS (1–.45)	60,500	90,750	121,000	145,200	163,350
Gross profit (45%)	$ 49,500	$ 74,250	$ 99,000	$118,800	$133,650
– Oper. expenses	13,200	18,975	24,200	27,720	29,700
– Depreciation	12,000	18,000	24,000	28,800	32,400
Pre-tax income	$ 24,300	$ 37,275	$ 50,800	$ 62,280	$ 71,550
– Taxes (34%)	8,262	12,674	17,272	21,175	24,327
Net income	$ 16,038	$ 24,601	$ 33,528	$ 41,105	$ 47,223
+ Depreciation	12,000	18,000	24,000	28,800	32,400
– ΔCurrent assets*	3,100	9,750	9,750	7,800	5,850
– ΔGross fixed assets	33,000	53,500	59,500	57,200	53,700
+ ΔAccts. pay (+30%)	10,050	8,775	8,775	7,020	5,265
Cash flow	$ 1,988	$ –11,874	$ –2,947	$ 11,925	$ 25,338

e. Cash Flow 2016 = 1.05 × $25,338 = $26,604.90

g = 5% r = 15%

$$PV_{2016} = \frac{CF_{2016}}{r-g} = \frac{\$26{,}604.90}{.15-.05} = \underline{\underline{\$266{,}049}}$$

f.

End of Year	Cash Flow	PV of CF beyond 2014	Total Cash Flow
2012	$ 1,988		$ 1,988
2013	–11,874		–11,874
2014	–2,947		–2,947
2015	11,925		11,925
2016	25,338	$266,049	291,387

P.V. total cash flow @15% at end of 2011 = $142,502

* Reflects reduction of cash balances to $0

g.

Fusion Chips
Cash Flows from Technology Integration
($ thousands)

	2011	2012	2013	2014	2015	2016
ΔPBDT		$20,000	$30,000	$15,000	$15,000	$15,000
– Depr. ($50,000/8)		6,250	6,250	6,250	6,250	6,250
ΔPBT		$13,750	$23,750	$ 8,750	$ 8,750	$ 8,750
– Tax (34%)		4,675	8,075	2,975	2,975	2,975
ΔPAT		$ 9,075	$15,675	$ 5,775	$ 5,775	$ 5,775
+ Depr.		6,250	6,250	6,250	6,250	6,250
Operating Cash flow		$15,325	$21,925	$12,025	$12,025	$12,025
– Invest in FA	–50,000					
– Invest in NWC	–3,000					
+ Proceeds sale of FA						1,000
+ Tax savings from Sale*						6,035
+ Recovery of NWC						3,000
Project CF	$–53,000	$15,325	$21,925	$12,025	$12,025	$22,060

NPV of Project CF @ 15% at end of 2011 = $2,654

Maximum price ($ thousands):

P.V. total cash flow (from part f)	$142,502
+NPV of tech. integ. project	2,654
Maximum price	$145,156

P10-16. A project generates the following sequence of cash flows over six years:

Year	Cash Flow ($ in millions)
0	−59.00
1	4.00
2	5.00
3	6.00
4	7.33
5	8.00
6	8.25

a. Calculate the *NPV* over the six years. The discount rate is 11%.
b. This project does not end after the sixth year, but instead will generate cash flows far into the future. Estimate the *terminal value*, assuming that cash flows after year 6 will continue at $8.25 million per year in perpetuity, and then recalculate the investment's *NPV.*
c. Calculate the *terminal value*, assuming that cash flows after the sixth year grow at 2 per cent annually in perpetuity, and then recalculate the *NPV.*
d. Using market multiples, calculate the *terminal value* by estimating the project's market value at the end of year 6. Specifically, calculate the terminal value under the assumption that at the end of year 6, the project's market value will be 10 times greater than its most recent annual cash flow. Recalculate the *NPV.*

* 1,000 – 18,750BU = 17,750 Loss × .34 = $6,035

A10-16. a. NPV at 11% = –32.96 million

b. Terminal value as of year 6 = $\frac{\$8.25 \text{ million}}{0.11}$ = \$75 million New NPV = \$7.13 million

c. Terminal value as of year 6 = $\frac{8.25 \text{ million} \times 1.02}{0.11 - 0.02}$ = \$93.50 million
New NPV = \$17.02 million

d. Terminal value = 10 × \$8.25 million = \$82.5 million New NPV = \$11.14 million

Special Problems in Capital Budgeting

P10-17. You have a \$10 million capital budget and must make the decision about which investments your firm should accept for the coming year. Projects 1, 2, and 3 are mutually exclusive, and Project 4 is independent of all three. The firm's cost of capital is 12 %.

	Project 1	**Project 2**	**Project 3**	**Project 4**
Initial cash outflow	−\$4,000,000	−\$5,000,000	−\$10,000,000	−\$5,000,000
Year 1 cash inflow	1,000,000	2,000,000	4,000,000	2,700,000
Year 2 cash inflow	2,000,000	3,000,000	6,000,000	2,700,000
Year 3 cash inflow	3,000,000	3,000,000	5,000,000	2,700,000

a. Use the information on the *three mutually exclusive projects* to determine which of those three investments your firm should accept on the basis of *NPV*.
b. Which of the *three mutually exclusive projects* should the firm accept on the basis of *PI*?
c. If the *three mutually exclusive projects* are the only investments available, which one do you select?
d. Now given the availability of Project 4, the independent project, which of the mutually exclusive projects do you accept? (*Note*: Remember there is a \$10 million budget constraint.) Is the better technique in this situation *NPV* or *PI*? Why?

A10-17. a. Project 1: NPV = −4,000,000 + 1,000,000/(1.12) + 2,000,000/$(1.12)^2$ + 3,000,000/$(1.12)^3$
= −4,000,000 + 892,857 + 1,594,388 + 2,135,341
= \$622,586

Project 2: NPV = −5,000,000 + 2,000,000/(1.12) + 3,000,000/$(1.12)^2$ + 3,000,000/$(1.12)^3$
= −5,000,000 + 1,785,714 + 2,391,582 + 2,135,341
= \$1,312,637

Project 3: NPV = −10,000,000 + 4,000,000/(1.12) + 6,000,000/$(1.12)^2$ + 5,000,000/$(1.12)^3$
= −10,000,000 + 3,571,429 + 4,783,163 + 3,558,901
= \$1,913,493

Project 3 has the highest NPV and should be accepted.

b. Project 1: PI = 4,622,586/4,000,000 = 1.156
Project 2: PI = 6,312,637/5,000,000 = 1.263
Project 3: PI = 11,913,493/10,000,000 = 1.191

Project 2 has the highest PI and should be accepted

c. Project 3 should be selected because it is a large-scale project and is the one that will most enhance shareholder value.

d. Project 4: NPV = −5,000,000 + 2,700,000/(1.12) + 2,700,000/$(1.12)^2$ + 2,700,000/$(1.12)^3$
= −5,000,000 + 2,410,714 + 2,152,423 + 1,921,807
= −5,000,000 + 6,484,944
= $1,484,944

Project 4: PI = 6,484,944/5,000,000 = 1.297

With the availability of the independent Project 4, Project 2 should be selected from the mutually exclusive ones. If we compare the projects on the basis of NPV, Project 3 has the highest. However it will exhaust all the available 10,000,000 due to its scale. Therefore, in this case PI is a better measure and Project 4 has the highest PI of all four projects, while Project 2 has the highest PI of the three mutually exclusive projects. By using the PI measure, the company will maximise the total NPV available to shareholders, since both projects require initial outlay of $5,000,000, which is possible with the current $10,000,000 budget requirement.

P10-18. Semper Mortgage wishes to select the best of three possible computers, each expected to meet the firm's growing need for computational and storage capacity. The three computers – A, B, and C – are equally risky. The firm plans to use a 12 % cost of capital to evaluate each of them. The initial outlay and annual cash outflows over the life of each computer are shown in the following table.

	Cash Flows		
Year	**Computer A**	**Computer B**	**Computer C**
0	–$50,000	–$35,000	–$60,000
1	–$7,000	–$ 5,500	–$18,000
2	–$7,000	–$12,000	–$18,000
3	–$7,000	–$16,000	–$18,000
4	–$7,000	–$23,000	–$18,000
5	–$7,000		–$18,000
6	–$7,000		–$18,000

a. Calculate the *NPV* for each computer over its life. Rank the computers in descending order based on *NPV.*
b. Use the *equivalent annual cost (EAC)* approach to evaluate and rank the computers in descending order based on the EAC.
c. Compare and contrast your findings in parts (a) and (b). Which computer would you recommend that the firm acquire? Why?

A10-18. a. and b.

Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Computer A	–$50,000	–$7,000	–$7,000	–$7,000	–$7,000	–$7,000	–$7,000

NPV at 12% = –$78,780
EAC = NPV/PV factor annuity, 12%, 6 years = –$19,161

Year:	**0**	**1**	**2**	**3**	**4**
Computer B	–$35,000	–$5,500	–$12,000	–$16,000	–$23,000

NPV at12% = –$75,482

EAC = NPV/PV factor annuity, 12%, 4 years = –$24,851

Year:	0	1	2	3	4	5	6
Computer C	–$60,000	–$18,000	–$18,000	–$18,000	–$18,000	–$18,000	–$18,000

NPV at12% = –$134,005
EAC = NPV/PV factor annuity, 12%, 6 years = –$32,593

Rank descending order based on NPV: Computer B, Computer A, Computer C
Rank descending order based on EAC: Computer A, Computer B, Computer C

c. Computer B is least expensive based on NPV, but on the basis of EAC, Computer A is the least costly (on an annual basis). Therefore, the firm should acquire Computer A.

P10-19. Seattle Manufacturing is considering the purchase of one of three mutually exclusive projects for improving its assembly line. The firm plans to use a 14 % cost of capital to evaluate these equal-risk projects. The initial outlay and annual cash outflows over the life of each project are shown in the following table.

	Cash Flows		
Year	**Project X**	**Project Y**	**Project Z**
0	–$156,000	–$104,000	–$132,000
1	$34,000	$56,000	$30,000
2	$50,000	$56,000	$30,000
3	$66,000	–	$30,000
4	$82,000	–	$30,000
5	–	–	$30,000
6	–	–	$30,000
7	–	–	$30,000

a. Calculate the *NPV* for each project over its life. Rank the projects in descending order based on *NPV.*
b. Use the *equivalent annual cost (EAC)* approach to evaluate and rank the projects in descending order based on the EAC.
c. Compare and contrast your findings in parts (a) and (b). Which project would you recommend that the firm purchase? Why?

A10-19. a and b.

Year:	0	1	2	3	4
Project X	–$156,000	–$34,000	–$50,000	–$66,000	–$82,000

NPV at 14% = −$317,397
EAC = NPV/PV factor annuity, 14%, 4 years = −$108,932

Year:	0	1	2
Project Y	–$104,000	–$56,000	–$56,000

NPV at 14% = –$196,213
EAC = NPV/PV factor annuity, 14%, 2 years =–$119,158

Year:	0	1	2	3	4	5	6	7
Project Z	−$132,000	–$30,000	–$30,000	–$30,000	–$30,000	–$30,000	–$30,000	–$30,000

NPV at 14% = −$260,649
EAC = NPV/PV factor annuity, 14%, 7 years = −$60,781

Rank – Descending Order Based on NPV: Project Y, Project Z, Project X
Rank – Descending Order Based on EAC: Project Z, Project X, Project Y

c. Based on NPV, Project Y is least expensive, but on the basis of EAC, Project Z is least costly (on an annual basis). Therefore, the firm should undertake Project Z.

P10-20. As part of a hotel renovation program, a company must choose between two grades of carpet to install. One grade costs $22 per square yard, and the other, $28. The costs of cleaning and maintaining the carpets are identical, but the less expensive carpet must be replaced after six years, whereas the more expensive one will last nine years before it must be replaced. The relevant discount rate is 13 %. Which grade should the company choose?

A10-20.

	Low Cost	**High Cost**
Present Value (cost/yd)	$22.00	$28.00
EAC @13%	5.50	5.46

The 9-year, higher grade carpet provides a lower EAC (NPV of cost per year) and therefore is preferred.

P10-21. Gail Dribble is a financial analyst at Hill Propane Distributors. Gail must provide a financial analysis of the decision to replace a truck used to deliver propane gas to residential customers. Given its age, the truck will require increasing maintenance expenditures if the company keeps it in service. Similarly, the market value of the truck declines as it ages. The current market value of the truck, as well as the market value and required maintenance expenditures for each of the next four years appears below.

Year	**Market Value**	**Maintenance Cost**
Current	$7,000	$ 0
1	5,500	2,500
2	3,700	3,600
3	0	4,500
4	0	7,500

The company can purchase a new truck for $40,000. The truck will last fifteen years and will require end-of-year maintenance expenditures of $1,500. At the end of fifteen years, the new truck's salvage value will be $3,500.

a. Calculate the *equivalent annual cost (EAC)* of the new truck. Use a discount rate of 9%.
b. Suppose the firm keeps the old truck one more year and sells it then rather than now. What is the opportunity cost associated with this decision? What is the present value of the cost of this decision as of today? Restate this cost in terms of year-1 dollars.
c. Based on your answers to (a) and (b), is it optimal for the company to replace the old truck immediately?
d. Suppose that the firm decides to keep the truck for another year. Gail must analyse whether replacing the old truck after one year makes sense or whether the truck should stay in use another year. As of the end of year 1, what is the present value of the cost of using the truck and selling it at the end of year 2? Restate this answer in year-2 dollars. Should the firm replace the truck after two years?
e. Suppose that the firm keeps the old truck in service for two years. Should it replace it rather than keep it in service for the third year?

A10-21. a. $$\text{PV of costs} = \$40{,}000 + \frac{\$1{,}500}{1.09^1} + \ldots + \frac{\$1{,}500}{1.09^{15}} - \frac{\$3{,}500}{1.09^{15}} = \$51{,}130$$

Equivalent Annual Cost (EAC) for 15 years at 9% = $6,343

b. $$\text{PV of costs} = \$7{,}000 + \frac{\$2{,}500}{1.09^1} - \frac{\$5{,}500}{1.09^1} = \$4{,}248$$

One year later, this equals $4,630 (1.09 x $4,248). The opportunity cost is the lost $7,000 the firm would get if it sells the old truck right away. The firm pays that cost, plus $2,500 in maintenance cost one year later, but it does get the salvage value of $5,500 at the end of year 1.

c. The cost (in year-1 dollars) of using the old truck one more year is $4,630. The cost (in year-1 dollars) of replacing the old truck now is $6,343, so the firm should not replace the old truck immediately.

d. $$\text{PV of costs} = \$5{,}500 + \frac{\$3{,}600}{1.09^1} - \frac{\$3{,}700}{1.09^1} = 5{,}408$$

Cost in end-of-year 2 dollars = $5,408$(1.09)^1$ = $5,895

The end-of-year 2 cost of keeping the old truck in service through year 2 of $5,895 is still less than the EAC of $6,343 for the new truck, so do not replace the truck at the end of year 2.

e. $$\text{PV of costs} = \$3{,}700 + \frac{\$4{,}500}{1.09^1} = \$7{,}828$$

Cost in end-of-year 3 dollars = $7,828 (1.09) = $8,533

At this point, the end of year 3 cost of keeping the old truck through the end of year 3 of $8,533 is greater than the EAC of $6,343 for the new truck, so the firm is better off buying the new truck at the end of year 2.

P10-22. A firm that manufactures and sells ball bearings currently has excess capacity. The firm expects that it will exhaust its excess capacity in three years. At that time it will spend $5 million, which represents the cost of equipment as well as the value of depreciation tax shields on that equipment, to build new capacity. Suppose that this firm can accept additional manufacturing work as a subcontractor for another company. By doing so, the firm will receive net cash inflows of $250,000 immediately and in each of the next two years. However, the firm will also have to spend $5 million two years earlier than originally planned to bring new capacity on line. Should the firm take on the subcontracting job? The discount rate is 12%. What is the minimum cash inflow that the firm would require (per year) to accept this job?

A10-22. $$\text{NPV} = \$250{,}000 + \frac{\$250{,}000}{1.12^1} + \frac{\$250{,}000}{1.12^2} - \frac{\$5{,}000{,}000}{1.12^1} + \frac{\$5{,}000{,}000}{1.12^3} = -\$232{,}872$$

$$\$232{,}872 = x + \frac{x}{1.12^1} + \frac{x}{1.12^2}$$

$$\frac{\$232{,}872}{1.12} = \$207{,}921 = \frac{x}{1.12^1} + \frac{x}{1.12^2} + \frac{x}{1.12^3}$$

$$x = \$86{,}568$$

$$\$250{,}000 + \$86{,}568 = \$336{,}568$$

$$\text{NPV} = \$336{,}568 + \frac{\$336{,}568}{1.12^1} + \frac{\$336{,}568}{1.12^2} - \frac{\$5{,}000{,}000}{1.12^1} + \frac{\$5{,}000{,}000}{1.12^3} = 0$$

The minimum cash flow per year is $336,568.

Answer to MiniCase

Cash Flow and Capital Budgeting

Aus Car Execs (ACE) is set up as a sole trader and is analysing whether to enter the discount used rental car market. This project would involve the purchase of 100 used, late-model, mid-sized automobiles at the price of $9,500 each. In order to reduce their insurance costs, ACE will have a LoJack Stolen Vehicle Recovery System installed in each automobile at a cost of $1,000 per vehicle. ACE will also utilise one of their abandoned lots to store the vehicles. If ACE does not undertake this project they could sublease this lot to an auto repair company for $80,000 per year. The $20,000 annual maintenance cost on this lot will be paid by ACE whether the lot is subleased or used for this project. In addition, if this project is undertaken, net working capital will increase by $50,000.

For taxation purposes, the useful life of the automobiles is determined to be 5 years, and they will be depreciated using the diminishing value method. Each car is expected to generate $4,800 a year in revenue and have operating costs of $1,000 per year. Starting 6 years from now, one-quarter of the fleet is expected to be replaced every year with a similar fleet of used cars. This is expected to result in a net cash flow (including acquisition costs) of $100,000 per year continuing indefinitely. This discount rental car business is expected to have a minimum impact on ACE's regular rental car business where the net cash flow is expected to fall by only $25,000 per year. ACE expects to have a marginal tax rate of 32%.

Assignment

Based on this information, answer the following questions.

1. What is the initial cash flow (fixed asset expenditure) for this discount used rental car project?
2. Is the cost of installing the LoJack System relevant to this analysis?
3. Are the maintenance costs relevant?
4. Should you consider the change in net working capital?
5. Estimate the depreciation costs incurred for each of the next 6 years.
6. Estimate the net cash flow for each of the next 6 years.
7. How are possible cannibalisation costs considered in this analysis?
8. How does the opportunity to sublease the lot affect this analysis?
9. What do you estimate as the terminal value of this project at the end of year 6 (use a 12% discount rate for this calculation)?
10. Applying the standard discount rate of 12% that ACE uses for capital budgeting, what is the *NPV* of this project? If ACE adjusts the discount rate to 14% to reflect higher project risk, what is the *NPV*?

Answers

1. The initial cash flow of the discount used rental car project is $1,100,000.
   Initial Cash Flow:

Number of cars	100	
Purchase price per car	× $9,500	
Total purchase price		$ 950,000
Installation cost per car	$1,000	
Total installation costs		100,000
Change in NWC		50,000
Total initial cash flow		$1,100,000

2. The cost of installing the LoJack System is relevant to this analysis since it is part of the cost of undergoing the project and should be considered as part of the fixed cost expenditure.

3. The maintenance costs are not relevant to this analysis since they are paid regardless of whether the project is undertaken or not.

4. Yes, the change in working capital should be considered and included in the fixed cost expenditure.

5. Depreciation Schedule
Depreciable Basis = $1,050,000.00 (Cost of auto fleet + LoJack installation)

   See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

6. The net cash flow for each of the next 6 years are as follows.

   See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]

7. Include the $25,000 annual loss in business to ACE's regular business as cannibalisation costs and consider when calculating the annual net cash flows.

8. Include the $80,000 annual sublease revenue that is forgone when calculating the annual net cash flows.

9. The Terminal Value of this project is calculated as the present value in year 6 of a perpetuity that begins in year 7. (Terminal Value = Annual CF / Discount Rate)

Discount Rate	**Annual CF**	**Terminal Value**
12%	$100,000	$833,333.33

10. Using the standard discount rate of 12% the NPV of this project is $255,234.67.
Using the standard discount rate of 14% the NPV of this project is $115,539.10.
Remember the terminal value in year 6 changes to $714,285.71 ($100,000/.14).

    See associated spreadsheet [**Graham_Smart 1e_IM_Ch10_Calculations.xlsx**]