

Chapter 12

Capital budgeting applications

Real world case 12.1

This case study shows a typical situation in which management accounting can be helpful. Read the case study now but only attempt the discussion points after you have finished studying the chapter.

Although in some markets we have moderated our rate of growth in space, overall we have chosen to sustain strong growth in selling area – and this will continue. With reductions in site, build and fitting costs for stores – these have fallen substantially since last year – we are able to use our capital more efficiently, and this should be helpful to long-term returns. At the end of February, our operations in Asia and Europe were trading from 1,911 stores, including 608 hypermarkets, with a total of 55.0m sq ft of selling space. This year, we plan to open 320 new stores with a total of 5.4m square feet of sales area in these markets and a further 0.6m sq ft is planned to open in the USA.



...

In our fast moving business, trading is tracked on a daily and weekly basis financial performance is reviewed weekly and monthly, and the Steering Wheel is reviewed quarterly. Steering Wheels are operated in business units across the Group, and reports are prepared of performance against target KPI s on a quarterly basis enabling management to measure performance. All major initiatives require business cases normally covering a minimum period of five years. Post-investment appraisals, carried out by management, determine the reasons for any significant variance from expected performance.

Source: Tesco plc Annual Report 2009 pp. 10 and 49.

Discussion points

- 1 What are the benefits expected from the capital expenditure on growth in store space?
- 2 How does the company monitor the outcome of its investment appraisal?

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Learning outcomes

After reading this chapter you should be able to:

- Explain how discounted cash flow methods are used to evaluate situations of capital rationing and mutually exclusive projects.
- Explain how cash flows are budgeted for discounting cash flows, including the treatment of working capital, taxation, inflation, depreciation and interest charges.
- Explain why a range of methods of capital budgeting and investment appraisal may be observed in practice.
- Explain the control procedures available for authorisation and review of investment projects.
- Explain how advanced manufacturing technologies lead to a demand for new ways of evaluating investment projects.
- Describe and discuss examples of research into the application of capital budgeting.

12.1 Introduction

Chapter 11 has explained the basic methods used for investment appraisal. In particular, it has described net present value and internal rate of return as two methods of evaluating a stream of future cash flows by taking into account the time value of money. Arithmetically these two methods are equivalent and will lead to the same decision on whether to invest. In practice some care may be needed in identifying the future cash flows for planned projects. It is also important to review the project after it has started, in order to be satisfied that the conditions expected at the initial investment appraisal are being met in the outcome. The process of estimating, evaluating and monitoring the cash flows expected from an investment project is called **capital budgeting**.

Definition

Capital budgeting is a process of management accounting which assists management decision making by providing information on the investment in a project and the benefits to be obtained from that project, and by monitoring the performance of the project subsequent to its implementation.

12.2 Capital rationing

Capital rationing means that there is not sufficient finance (capital) available to support all the projects proposed in an organisation. In an ideal world any project which can earn a positive net present value or earn an internal rate of return greater than the cost of capital should be able to find a source of finance because there are rewards to the providers of capital.

12.2.1 Types of capital rationing

However, the world is not ideal and there may be restrictions on capital for any of the following reasons:

- 1 There may be temporary uncertainty in the economy (perhaps over rates of interest or rates of foreign currency exchange) and lenders are limiting the amount that they will provide as long-term finance until the uncertainty is resolved. This is called 'external' capital rationing because it is beyond the control of the management of the organisation.
- 2 The managers of the organisation may want to impose some overall limits to the extent of expansion or development in the organisation as a whole, perhaps to control the risk profile of the organisation as a whole. This is called 'internal' capital rationing because it is imposed from within the organisation.
- 3 In the public sector the government may wish to control the overall amount of borrowing by the public sector as a whole and accordingly it sets limits for financing new investment projects in each activity of the public sector.

There are two questions to ask at the outset:

- 1 What type of capital rationing exists?
- 2 Are the proposed projects divisible?

Type of capital rationing - single period or multiple period?

- Is the capital rationing only imposed at the start of the project? This means there is a shortage of funds at one point in time only. It is described as **single-period capital rationing**.
- Is the capital rationing imposed continuously over time? This is described as multiple period capital rationing.

In practice, for internal capital rationing, the second is more likely but is also more complex to solve mathematically. This section will explain methods of appraising single-period capital rationing. This is capital rationing which occurs in one period only during the life of a project (usually in the first period).

Divisible or non-divisible projects?

Is it essential to carry out the entire project that is planned? Could part of the project be started now and the rest deferred until capital is available? If the project is a **divisible project** then the separate parts may be evaluated separately. If the proposed project is a **non-divisible project** then it must be evaluated in total.

12.2.2 Decisions under capital rationing

The aim of evaluating projects under capital rationing is to obtain the highest possible net present value for the capital available. It may not be possible to obtain as much net present value as would be available in the absence of capital rationing. The managers of the organisation must therefore ask: 'what is the greatest benefit obtainable for the capital that we have available?'

Profitability index

If the business has the aim of maximising net present value, then managers will find it helpful to calculate a ratio which compares the present value of the expected cash inflow with the intended amount of investment. This ratio is called the **profitability index**. Any project having a profitability index of 1.0 or higher is acceptable.

Definition

The **profitability index** is the present value of cash flows (discounted at the cost of capital) divided by the present value of the investment intended to produce those cash flows.

The decision rule is that the projects should be ranked in order of profitability index, with the highest being the most attractive, and accepted in that sequence until the capital available is used up.

Definition

Decision rule: capital rationing. In situations of capital rationing, rank projects in order from highest to lowest profitability index and accept projects in that sequence until the capital available is used up, provided the profitability index is greater than or equal to 1.0.

12.2.3 Mutually exclusive projects

An organisation may need to make a choice between two projects which are mutually exclusive. This means that choosing one eliminates another, perhaps because there is only sufficient demand in the market for the output of one of the projects, or because there is a limited physical capacity which will not allow both. Some care is then required in using the net present value and the internal rate of return as decision criteria. In many cases they give the same answer on relative ranking, but occasionally they may give different answers, as shown in the following case example.

Case study: whisky distillery

A distillery is planning to invest in a new still. There are two plans, one of which involves continuing to produce the traditional mix of output blends and the second of which involves experimentation with new blends. The second plan will produce lower cash flows in the earlier years of the life of the still, but it is planned that these cash flows will overtake the traditional pattern within a short space of time. Only one plan may be implemented. The project is to be appraised on the basis of cash flows over three years. The cash flows expected are shown in Table 12.1. The cost of capital is 12 per cent per annum. At this discount rate the net present values are shown in the lower part of Table 12.1. The internal rates of return are also shown in that part of the table.

Table 12.1
Cash flows, NPV and IRR for two mutually exclusive projects

Project	Initial investment £	Cash flows		
		Year 1 £	Year 2 £	Year 3 £
A	120,000	96,000	48,000	12,000
B	120,000	12,000	60,000	108,000

Project	NPV at 12% £	IRR
A	12,521	20.2%
B	15,419	17.6%

It may be seen from Table 12.1 that, looking at the net present value of the cost of capital, project B appears the more attractive with the higher net present value. Looking at the internal rate of return, project A appears most attractive. Both are acceptable because they give a positive net present value and the ideal answer would be to find the resources to undertake both projects. In this example, the two are mutually exclusive (which means that taking on one project excludes the possibility of the other).

The project with the highest profitability index will give the highest net present value for the amount of investment funding available. Taking the data in Table 12.1, the profitability index calculations are:

$$\text{Project A: Profitability index} = \frac{132,521}{120,000} = 1.10$$

$$\text{Project B: Profitability index} = \frac{135,419}{120,000} = 1.13$$

This confirms that, of the two, project B is preferable at a cost of capital of 12 per cent. Where the investment in both projects is of the same amount, as in this case, the profitability index confirms what is already obvious, but where there are competing projects of differing initial investment, it is a useful device for ranking projects to maximise net present value.

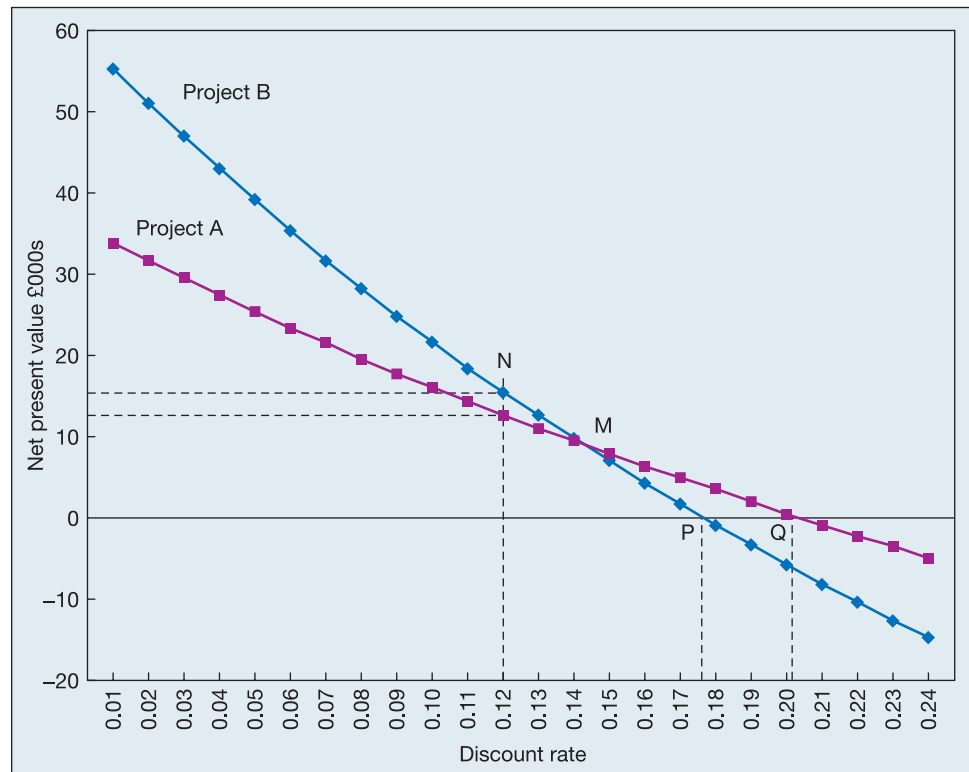
Activity 12.1

Explain how a project having a positive net present value will also have a profitability index greater than 1.0.

12.2.4 Sensitivity to changes in the discount rate

To understand the apparently different conclusions from the NPV and IRR approaches, it is helpful to plot a graph of the net present value of each project against a range of discount rates. The graph is shown in Figure 12.1.

Figure 12.1
Net present value of competing projects using a range of discount rates



From Figure 12.1, it will be seen that, for both projects, the net present value decreases as the discount rate increases, but that the net present value of project B decreases more rapidly. Starting at the left-hand side of the graph, the net present value of project B is higher than that of project A at all discount rates above the point, M, at which they intersect (around 14.2 per cent). In particular, project B has a higher net present value than project A at the cost of capital 12 per cent (point N on the graph). For discount rates above 14.2 per cent, the net present value of project B is always higher than that of project A. The internal rate of return of each project is the discount rate at which they cross the line of zero net present value (i.e. at point P for project B and point Q for project A).

How does this help the decision maker? If it is absolutely certain that the cost of capital will remain at 12 per cent throughout the life of the project, then the net present value method correctly leads to a choice of project B in preference to project A. On the other hand, 12 per cent is quite close to the point of intersection at 14.2 per cent, where project A takes over. If there is a chance that the cost of capital will in reality be higher than the 12 per cent expected, then it might be safer to choose project A. The line of the graph for project A is less steep and this project is said to be less sensitive to changes in the discount rate. There is therefore no clear-cut answer to the

problem and the final decision will be based on an assessment of sensitivity. Looking at Figure 12.1, the different ranking by net present value and by internal rate of return was a useful clue to the need to consider the relative sensitivities as shown in the graph.

12.3 Cash flows for discounting calculations

This section describes some of the questions that may arise when estimating cash flows for discounting calculations. It describes the inclusion of amounts to cover working capital requirements, the effect of taxation on cash flow projections, the effect of inflation on capital budgeting calculations, and the exclusion of depreciation and interest charges.

Activity 12.2

Consider a project to start a business selling shoes from a chain of shops. Explain how the business would plan its working capital requirements.

12.3.1 Working capital requirements

When managers are forecasting the cash flows for a project, they will consider the expected revenues and costs, but they must also include an estimate for working capital requirements. The working capital will be required in period 1 to allow the business to acquire inventories and build up debtors (receivables) to the extent that these are not matched by trade. The working capital will be recovered at the end of the project when the inventories are sold, cash is collected from customers, and final payments are made to suppliers.

Example

A project is planned to last for three years. Net cash inflows are forecast as £12,000 per year for three years, assumed to arise on the final day of the relevant year. Working capital of £3,000 will be required on the first day of business. The cost of capital is 6 per cent per year. In the calculation shown in Table 12.2 the working capital has to be available at the start of Year 1 (i.e. end of Year 0) but is returned at the end of the project (i.e. end of Year 3).

Table 12.2
Cash flows including working capital requirements

End of year	Year 0	Year 1	Year 2	Year 3
Cash inflows (£)		12,000	12,000	12,000
Working capital (£)	(3,000)			3,000
Net flows (£)	(3,000)	12,000	12,000	15,000
Discount factor 5%	1.000	(1 + 0.05)	(1 + 0.05) ²	(1 + 0.05) ³
Net flows (£)	(3,000)	<u>12,000</u>	<u>12,000</u>	<u>15,000</u>
Discount factor	1.000	(1.05)	(1.1025)	(1.1576)
Net flows (£)	(3,000)	<u>12,000</u>	<u>12,000</u>	<u>15,000</u>
Discount factor	1.000	(1.05)	(1.1025)	(1.1576)
Discounted net flows (£)	(3,000)	11,429	10,884	12,958
Present value	£32,271			

12.3.2 The effect of taxation on cash flows

Taxation has an effect on capital budgeting for two reasons. Tax payments are a cash outflow of the business, so it is important to know when they are payable. The government's tax policy may also try to encourage investment by reducing tax payable (also called tax incentives).

Timing of tax payments

If the company pays tax then the flows in respect of tax payments have to be included. The cash flows must then be discounted at the after-tax cost of capital. UK companies that are *not* classed as 'small' for tax purposes pay their annual corporation tax in four instalments spread across the year, so they have a cash outflow for tax every three months. For such companies the usual assumption in cash flow planning is that the tax outflow takes place in the year in which the profit is earned.

The test of being 'small' is based on the amount of taxable profit. The small UK companies pay their corporation tax in one amount, nine months after the end of the accounting year. Discounted cash flows are usually calculated on an annual basis so these payment dates do not fit easily with an annual cash flow model. Examination questions usually make simplifying assumptions such as assuming the tax payment is made after 12 months rather than nine months.

In the real world, an assumption has to be made about the timing of cash flows. In examination questions you will be given information about the assumption to be made.

Tax incentives: capital allowances

The government may try to encourage investment by making depreciation allowances (called **capital allowances**). The capital allowance will be used to reduce the taxable profit and hence to reduce the tax bill payable. Suppose a business has a taxable profit of £100,000 and the tax rate is 20 per cent. The tax payable is £20,000. However, if a capital allowance of £10,000 is available the taxable profit is reduced to £90,000 and the tax payable becomes £18,000, which is a tax saving of £2,000. As a short cut calculation, the tax saving of £2,000 can be calculated as 20 per cent of the capital allowance. If the tax authorities find later, when the asset is sold, that the tax allowance has been too generous they may apply a balancing charge to recover some of the tax benefit. Different countries have different rules about the timing and amount of the allowances and charges relating to fixed assets so in a real life case it is important to know the tax rules. Examination questions in management accounting usually explain the tax procedures to be applied.

Example

John James is operating a business located in an enterprise zone. This allows him to claim a tax deduction up to 100 per cent of expenditure on workshop buildings. His rental incomes net of cash expenses are expected to be £70,000 per year for three years. The workshop buildings will cost £5,000 at the start of year 1. They will be depreciated for accounting purposes over 10 years. The after-tax cost of capital is 5 per cent per annum. It is expected that the workshop buildings could be sold for £3,500 at the end of three years. Tax at 20 per cent is paid 12 months after the relevant income is earned. A balancing charge is applied when an asset is sold. The cash flows are shown in Exhibit 12.1 with a key below the table to explain each line.

Comment

It can be seen from Exhibit 12.1 that the timing of cash flows is important for investment planning. There is a strong cash flow benefit in the capital allowance for the

Exhibit 12.1**Discounting cash flows with taxation included**

		<i>End of year</i>				
		<i>Year 0</i>	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>
		£	£	£	£	£
Forecast cash flows	<i>a</i>		70,000	70,000	70,000	
Workshop building cost	<i>b</i>	(5,000)				
Tax payable at 20%	<i>c</i>			(14,000)	(14,000)	(14,000)
Tax benefit of allowance	<i>d</i>		1,000			
Sale of workshop building	<i>e</i>				3,500	
Balancing charge	<i>f</i>					(700)
Net cash flow		(5,000)	71,000	56,000	59,500	(14,700)
Discount factor at 5% (from tables)		1.000	0.952	0.907	0.864	0.823
Present value		(5,000)	67,592	50,792	51,408	(12,098)
Net present value		<u>152,694</u>				

Key:

- (a) This line shows the forecast cash flows expected each year for three years. It assumes that the cash flow of each year all occurs on the final day of the year.
- (b) This line shows the immediate outlay required to pay for the workshop building.
- (c) This line shows the tax payable on the forecast cash flows, one year after each cash flow has been earned.
- (d) This line shows the tax saving at 20% of the allowed expenditure of £5,000, amounting to £1,000. It is shown one year after the date of the payment because the tax flows are one year later than the relevant cash inflows or outflows. Line (d) assumes that the £1,000 saving will either be used to reduce a tax bill elsewhere in the organisation or it will be refunded in cash by the tax authorities.
- (e) At the end of three years the workshop building will be sold for £3,500. Originally a capital allowance of £5,000 was given, leaving a written-down asset value of nil. The tax authorities now want to reverse part of that allowance by making a 'balancing charge' equal to the tax rate multiplied by the difference between the proceeds of sale and the tax written-down value. The calculation is 20% of (£3,500 – £0) = 20% of £3,500 = £700. The overall effect is that the organisation has only enjoyed a tax benefit for the part of the asset cost that was used up during the project.

investment at the start because it arises at the end of year 1. Eventually part of this benefit has to be repaid through the balancing charge but that only arises at the end of year 4 and so has a much lower discounted present value.

12.3.3 The effect of inflation

Where inflation is expected during the forecast period, the question arises: do we have to adjust the forecast cash flows to take account of the expected rate of inflation? This section shows how the cash flows and discount rate can be adjusted for inflation, and also shows that it is equally valid to forecast cash flows at constant prices discounted at the inflation-free rate (the 'real' rate) of discount.

Example

Office Cleaners Co earns cash flows from contract cleaning. The directors have forecast cash flows of £10,000 per year at today's prices. The required cost of capital is

Table 12.3
Calculation of present value, discounting at today's prices

Present value					
=	$\frac{\text{Year 1}}{10,000}$	+	$\frac{\text{Year 2}}{10,000}$	+	$\frac{\text{Year 3}}{10,000}$
	$(1+r)$		$(1+r)^2$		$(1+r)^3$
=	$\frac{\text{Year 1}}{10,000}$	+	$\frac{\text{Year 2}}{10,000}$	+	$\frac{\text{Year 3}}{10,000}$
	$(1+0.04)$		$(1+0.04)^2$		$(1+0.04)^3$
=	$\frac{\text{Year 1}}{10,000}$	+	$\frac{\text{Year 2}}{10,000}$	+	$\frac{\text{Year 3}}{10,000}$
	(1.040)		(1.0816)		(1.1249)
=	Year 1	+	Year 2	+	Year 3
	9,615		9,245		8,890
=	£27,750				

4 per cent. Assume cash flows arise on the final day of each year. The calculation of the present value is shown in Table 12.3.

Now assume there is a forecast of 5 per cent inflation each year for the next three years. If the cash flows are adjusted for the effect of inflation then the discount rate must also be adjusted.

The discount rate is adjusted using the formula $(1+i)(1+r)$ where i = the rate of inflation and r = the inflation-free cost of capital.

In this example the calculation is $(1+i)(1+r) = (1.05)(1.04) = 1.092$

(This calculation can be thought of as consisting of 4 per cent return for the cost of capital, plus 5 per cent return for inflation, equalling 9 per cent, plus {5% of 4%} equalling 0.2 per cent for the effect of inflation on the cost of capital itself.)

The discounting of the inflation-adjusted cash flows is shown in Table 12.4.

Table 12.4
Calculation of present value, with adjustment for inflation

Present value					
=	$\frac{\text{Year 1}}{10,500}$	+	$\frac{\text{Year 2}}{11,025}$	+	$\frac{\text{Year 3}}{11,576}$
	$(1+r)$		$(1+r)^2$		$(1+r)^3$
=	$\frac{10,500}{(1+0.092)}$	+	$\frac{11,025}{(1+0.092)^2}$	+	$\frac{11,576}{(1+0.092)^3}$
=	$\frac{10,500}{(1.092)}$	+	$\frac{11,025}{(1.1925)}$	+	$\frac{11,576}{(1.3022)}$
=	9,615	+	9,245	+	8,890
=	£27,750				

Definition

Discounting under conditions of inflation. The discounting calculation will give a correct answer if cash flows are forecast at constant prices (today's prices) and the discount rate is equal to the real (inflation-free) cost of capital.

Where the forecast cash flows are adjusted for inflation then the discount rate must also be adjusted for inflation.

12.3.4 Depreciation and interest charges

Depreciation

Depreciation does not appear in the cash flows to be discounted because it is an accounting expense that does not involve any flow of cash. When a fixed asset is purchased there is a cash outflow at the time of payment and there may be a cash inflow when the asset is eventually sold or scrapped. Those are the only cash flows. In the period of the asset's use within the business an expense of depreciation is reported in the profit and loss account as an accounting estimate of the use of the asset in earning revenues of the period. Depreciation is sometimes called an allocation of cost. It does not cause any cash flow.

Interest charges

Interest charges do not appear in the cash flows to be discounted because the interest cost is included in the cost of capital. The discounting calculation asks: 'will the forecast cash flows from operations provide sufficient return to satisfy the cost of capital and make a surplus for the owners?'. If the net present value is positive, there will be sufficient cash to pay interest charges equal to the cost of capital. If you are not convinced, look back to Chapter 11, where Table 11.5 shows that the project can repay interest and earn a surplus net present value.

Real world case 12.2

This extract from the annual report of Tate and Lyle describes its investment in a new sweetener called Sucralose.

Growing the contribution from value added and consumer branded products is a key element of our strategy and the sucralose ingredients business will be a major contributor. Sucralose is an exciting growth opportunity, ideally placed to meet consumer demands for reduced calorie options in many categories including soft drinks, dairy and confectionery.



The total cash cost including capitalised expenses on the sucralose realignment of US\$137 million (£75 million) remains subject to working capital adjustments. Payment occurred after the March 2004 year-end. The pro forma profit before tax for the year to December 2003 was US\$33 million (£17 million) but we expect, as previously announced, significant one-off costs in the first year of operation. Even after these costs, we expect the return on this investment to exceed the Group's cost of capital in the year to March 2005.

Source: Tate and Lyle Annual Report 2004, p. 6, www.tate&lyle.com.

Discussion points

- 1 Why is a cost adjustment required for working capital?
- 2 What is the company's measure of success of the project in its first year?

12.4 Control of investment projects: authorisation and review

The capital investment projects of an organisation represent major commitments of resources. It would be a mistake to be overenthusiastic about decision-making techniques without considering also how management accounting may help in the subsequent implementation of the project.

The organisation should have in place a procedure by which new project suggestions are investigated and evaluated using the techniques described in this chapter, or suitable alternatives. There should then be a decision-making group, perhaps called the capital budgeting committee or the management review committee, which makes decisions on the projects to be selected. Once the decision has been made and the capital budgeting committee has authorised the project to proceed, the management accountant is again needed in implementing a system for reviewing and controlling the project.

The two important aspects of control and review are:

- (a) controlling the amount of the expenditure needed to make the project operational;
- (b) post-completion audit of cash inflows and outflows.

12.4.1 Controlling capital expenditure

The specification of the project will have included an estimate of the initial outlay required and the timing of that outlay. For simplification, the illustrations used in this chapter assumed a single amount being paid out at the start of the project, but in real life the capital expenditure will be spread over a period of time on an agreed schedule. If the capital expenditure involves constructing a building, there will be a contract for the building work which sets out the dates for completion of each stage and the amount of cash to be paid at that point. The payment will only be made when an expert (such as the architect supervising the project) has confirmed that the work has been carried out according to the specification. If a contract has been drawn up with care, it will contain safeguards to ensure that the work is completed on time and within the original cost estimates. There may be a penalty clause, so that a part of the cash payment may be withheld if the contract is not performed as promised.

Activity 12.3

Write a list of key points to be made in a recommendation to the board of directors on the implementation of an expenditure control process for capital investment plans.

12.4.2 Post-completion audit

A **post-completion audit** involves a review of the actual results of a project in order to compare these with the expectations contained in the project proposals. It is called an audit because it requires an independent assessment and involves a more flexible approach than would be found in management accounting evaluations of short-term plans (as covered in Chapters 9 and 10). The post-completion audit might require a view of the wider implications of the project rather than concentrating too much on annual cash flows item by item. A project might take a different turn from that envisaged at the outset and a longer-term view would be required of the likely outcome of that different turn. In real life, uncertainty is a factor which cannot easily be built into the project plans and the audit may have to take account of factors which could not have been foreseen at the outset.

There could be dangers in such an audit process if managers of projects see themselves as being held to blame for a subsequent failure to meet expectations. They might be motivated to put forward only those projects which they saw as safe but unadventurous. The review process has to be flexible to allow for the unknown, but also to discourage unrealistic or overenthusiastic plans.

Questions that might be asked in a post-completion audit:

- What methods were used to collect a sufficiently wide range of project proposals?
- What methods were applied in evaluating the proposed project?
- How was sensitivity analysis applied to cash flow projections and cost of capital estimates?
- How was the project authorised for implementation?
- Was there an adequate amount of supervision by senior management?
- How did the annual performance compare to the projected costs and cash inflows?
- What lessons may be learned for the next project?

The value of post-completion audit lies in the lessons learned for the future. Each new project will be different from any previous project but the analysis will help identify those managers who can plan a project and then achieve what was planned. The risk of imposing an audit process is that managers may be more conservative in their initial proposals because they do not want to show an adverse performance in the post-completion audit.

12.5 Advanced manufacturing technologies

Advanced manufacturing technologies (AMTs) have been developed by engineers as a means of competing more effectively. To compete, organisations need to manufacture innovative products of high quality at low cost. The product life cycle may be short, demand may be changing more rapidly and international competition creates a further element of uncertainty. As with any business activity, these changes represent new approaches to the management of the business, and management accounting must keep pace with the change in management approach.

12.5.1 Types of new technology

Engineers have produced new technology of four main types:

- (a) design innovations;
- (b) planning and control techniques;
- (c) execution; and
- (d) overarching technologies.

Each of these new technologies is considered in turn.

The *design innovations* have covered computer-aided design (CAD), computer-aided engineering (CAE), computer-aided process planning (CAPP) and design for manufacture and assembly. CAD uses computers to evaluate various designs of the product, while CAE includes design but also encompasses evaluation and testing so that the initial design becomes a working product. CAPP uses computers to plan the detailed processes required to manufacture the design proposed. Finally, the computer can also be used to design a system which makes the manufacture and assembly process meet the demand for the output.

Planning and control techniques have covered materials requirements planning (MRP), manufacturing resource planning (MRP II), enterprise resource planning (ERP) and statistical process control (SPC). MRP involves matching stock levels to the production

process and controlling incoming customer orders to match the availability of materials. MRP II applies similar controls to all resources used in the manufacturing process. They both use computers to break down a customer's order into various stages which can be matched against resource availability. ERP is a system of software modules that are integrated to support the business processes of the organisation. It supports production, purchasing, inventory control, customers' orders, human resource planning and finance functions. SPC uses statistical analysis to identify the most likely causes of bottlenecks in the manufacturing process, which can then be corrected before a crisis arises.

Execution means converting raw materials and components into finished goods. The technologies have included robotics, automated guided vehicles (AGVs), flexible manufacturing systems (FMS) and automated storage and retrieval systems (ASRS). These titles are self-descriptive of the activities involved.

The *overarching technologies* are those which take a total perspective of the organisation. They include just-in-time (JIT), total quality management (TQM), focused factory and computer-integrated manufacturing (CIM). JIT is described in Chapter 18, TQM in Chapter 19.

12.5.2 Capital investment appraisal of AMT projects

The conventional methods of investment appraisal have been presented as payback, accounting rate of return, net present value and internal rate of return. These techniques have considerable benefit for many situations where a fixed investment is made and the outcome may be projected forward. However, they are not capable of taking into account the flexibility which management may have in some situations. As flexible technology takes over from fixed inflexible capital equipment, there are options facing the business manager which must be considered in project evaluation.

In particular, there are options to make modifications to projects or add on new aspects. Abandonment may be less difficult where technology is flexible. Companies may feel that they can afford to wait and learn before investing. A project can be scaled down if there are changes in demand for a product. These options make project development quite exciting but they also offer a challenge to the management accountant in making sure the options are evaluated.

Fiona McTaggart describes an example of capital investment in an AMT situation:



FIONA: *One case I encountered was that of a flexible manufacturing system being used to machine metal into engineering components. There was hardly a person in sight on the production line. Computer controlled machines were each performing one part of the treatment of the metal. Cutting tools were making metal shapes, transport systems were moving components around and then, depending on where the shapes were delivered, there were more machines to turn, mill, polish and shape. The whole process was controlled by a host computer and was sufficiently flexible that if the transport system was revised, then the activities performed on the metal changed as well.*

The company adapted its investment appraisal methods by involving the engineers and the management accountants as a team. Essentially they evaluated reduced labour costs, increased effectiveness in utilisation of machines, cost saving through just-in-time control of materials and the reduction in indirect costs. Discounted cash flows were included in order to take account of the longer term but the emphasis was more strongly on the short term and the flexibility for change if conditions changed.

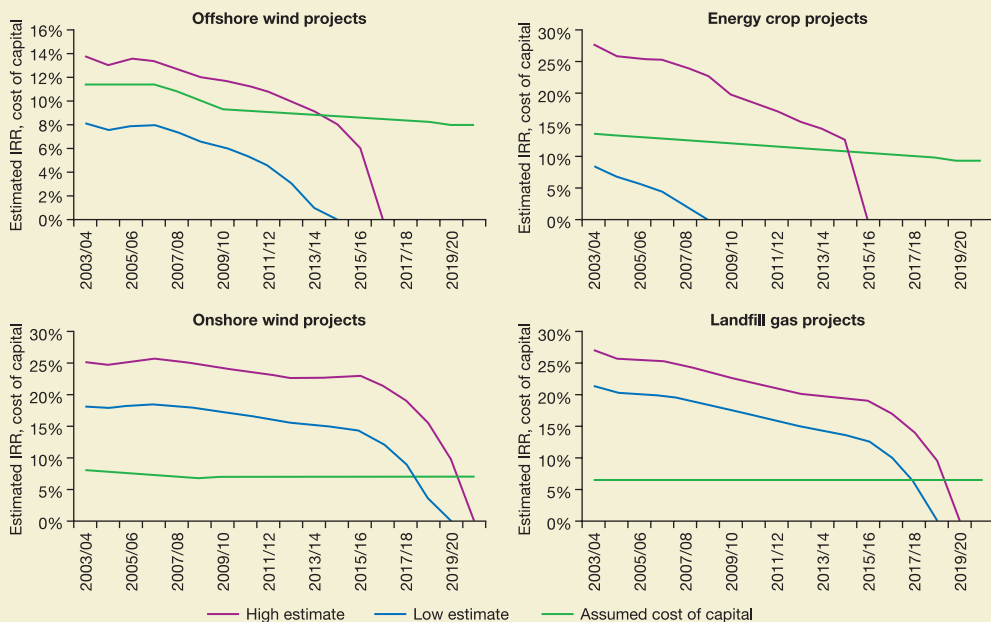
The debate on the role of capital budgeting techniques in relation to advanced manufacturing technologies is a useful example of the wider point that management accounting must continually be changing to adapt to changed circumstances. A textbook can present basic ideas, but those ideas will only work effectively in a practical situation if moulded to meet the needs of the situation.

Real world case 12.3

The Renewables Obligation (RO) is a programme of the UK government that requires electricity suppliers to create more of their sales from renewable sources. Businesses that do this receive a Renewables Obligation Certificate (ROC), which they can sell. This extract describes a way of evaluating the projects.

The figures show the evolution of IRRs through time for two expensive technologies (offshore wind and energy crops) and two cheap technologies (onshore wind and landfill gas), along with the expected cost of capital used for each technology. Two cost assumptions have been used – high and low – covering a range of assumptions about the initial level and the subsequent possible evolution of capital and operating costs. The figures

suggest that there will be some tendency for the cost of capital required for the most risky technologies to decline over time. This is a reflection of an assumed reduction in risk as the market becomes more comfortable with investments of this kind. In all cases, the estimated IRR tends to fall through time: build costs fall over time and ROC prices also decline from their highest levels during the early years of the RO. Under the high electricity price scenario, new offshore wind and energy crop plant would cease to be built from 2013/14 or so, whereas onshore wind and landfill would cease to be built from 2018/19. Under the low electricity price scenario, there would be no offshore wind or energy crop build, and onshore wind and landfill plant construction would cease a year or so earlier. It might be thought that declining build costs would lead to an increase in rates of return over time, but the merit of the RO is that, as generation costs fall, and with a static target, the ROC price falls below the buy-out price. Thus, the scheme manages to extract these gains for the consumer.



Source: Economic analysis of the design, cost and performance of the UK Renewables Obligation and the capital grants scheme, www.nao.org.uk/publications/ © National Audit Office.

Discussion points

- 1 Why has IRR been used to compare the projects?
- 2 How does the calculation of IRR allow for sensitivity to a range of economic conditions?

12.6 What the researchers have found

12.6.1 Capital budgeting where owner and manager are separate

Guiding (2003) reported a study of a range of hotels located in Australia's Gold Coast. The owner of each hotel held legal ownership of the building and its contents but a separate operator managed the day-to-day activities by providing a general manager and financial controller to run the hotel. Hotel staff were employed by the owner. This separation of ownership and operation provided an interesting situation for capital budgeting plans. The general manager was required to put a proposal to the owner for investment in an improvement to the hotel or its fixtures and fittings. The owner would want to be sure that there would be sufficient return on the investment. In this situation, formal procedures for capital budgeting were commonly found. Guiding explained the need for such formal procedures as a mechanism of the principal-agent relationship where the owner (as principal) wanted to control the manager (as agent). The managers tended to bias their cash flow projections upwards to encourage the owners to invest in new projects. There was relatively little use of ex-post monitoring so the managers knew that it was unlikely that the owners would match the actual outcome against the cash flow projections.

12.6.2 Enterprise resource planning

Newman and Westrup (2003) describe a survey of CIMA members to collect their experiences of enterprise resource planning (ERP). Respondents described the change to an ERP system which integrates all aspects of the operations of a business. It was an initial shock for some to find that purchasing, production, inventory and finance were all linked for the first time. There were practical problems where different parts of an organisation worked in different ways, such as where the inventory controller kept records in kilogrammes while the production units measured in tonnes. Data entry originated in more than one location so the management accounting function had to learn to cope with having less control over the information used for accounting purposes. The accounting records were more up to date than they had previously been, but contained a greater number of small inaccuracies.

The change to ERP was a major investment project for those involved. Baker (2003) asked whether companies had gained maximum value from their investments in ERP systems. He noted that the average cost of one system was around £10 million. Despite the size of the investment very few companies produced a business case and even where this was done, a post-completion audit was rare. Baker described a case study undertaken by the chief executive of a UK subsidiary of a major US manufacturing company, in investigating the potential for introducing an ERP system. The tangible benefits identified were reductions in administrative staff and overhead savings. Intangible benefits were increased revenue and improved cash flow from smarter working. External consultancy was reduced. Costs and benefits were quantified and discounted at the cost of capital to give an estimated net present value and a payback period. Further consideration suggested that the cost-benefit analysis had underestimated training costs. Based on the evaluation the company decided not to proceed with ERP because it would not have sufficient resources to implement the change and maintain activity in its operations.

12.6.3 The Private Finance Initiative in the NHS

Broadbent *et al.* (2004) reported on the nature, emergence and role of management accounting in decision making and post-decision project evaluation in PFI projects.

These projects were joint arrangements between a public-sector National Health Service Trust and a private developer. They found that value for money was assessed by a discounted cost comparison of the PFI option relative to procuring the same service through a traditional public-sector-financed route. The authors felt that the accurate calculation and allocation of cost and quantitative transferred risks had to be matched with qualitative shared risks and benefits in order to make decisions. They found that at the time of their study the quantitative matters were more persuasive than the non-financial.

12.7 Summary

Key themes in this chapter are:

- **Capital rationing** means that there is not sufficient funding available to take up all projects that have a positive NPV.
- **Mutually exclusive** projects are found wherever a choice is needed because of limited resources of capital, labour, materials, or any other constraint.
- The **profitability index** may be used to rank projects in situations of capital rationing or mutually exclusive projects.
- **Capital budgeting** depends on careful forecasting of cash flows. In particular:
 - Cash will be needed for **working capital** at the start but will be recovered at the end of the project.
 - *Taxation* will cause outflows of cash; fiscal incentives may provide cash flow savings. In both cases the timing is important, as well as the amount. The discount rate must represent the after-tax cost of capital.
 - *Inflation* may be allowed for by discounting the inflation-adjusted cash flows at the inflation-adjusted cost of capital, or by discounting the real cash flows (measured at current prices) at the inflation-free cost of capital.
 - *Depreciation* does not appear in capital budgeting calculations because it does not represent a flow of cash.
 - *Interest charges* do not appear in capital budgeting because they are represented in the cost of capital.
 - The methods of capital budgeting used in practice will depend on the size of the project, the importance of early recovery of cash invested, and the benefits of accurate evaluation compared to the cost of the exercise.
- Effective **capital budgeting** requires control procedures to be in place for establishing the suitability of a project and for post-completion audit to evaluate the success of the project.
- **Advanced manufacturing technologies** have led to a demand for new ways of evaluating investment projects because new projects may require continuous investment of resources rather than a single outlay at the outset.

Further reading and references

- Baker, M. (2003) 'Benefit gigs', *Financial Management*, July/August: 28–9.
- Broadbent, J., Gill, J. and Laughlin, R. (2004) *The Private Finance Initiative in the National Health Service*, CIMA Research Report. CIMA Publishing.
- Guilding, C. (2003) 'Hotel owner/operator structures: implications for capital budgeting process', *Management Accounting Research*, 14: 179–99.
- Newman, M. and Westrup, C. (2003) 'Perpetrators', *Financial Management*, February: 32–3.

QUESTIONS

The Questions section of each chapter has three types of question. ‘**Test your understanding**’ questions to help you review your reading are in the ‘A’ series of questions. You will find the answer to these by reading and thinking about the material in the textbook. ‘**Application**’ questions to test your ability to apply technical skills are in the ‘B’ series of questions. Questions requiring you to show skills in ‘**Problem solving and evaluation**’ are in the ‘C’ series of questions. The symbol **[S]** indicates that a solution is available at the end of the book.

A Test your understanding

- A12.1** What is ‘capital budgeting’ (section 12.1)?
- A12.2** What is ‘external capital rationing’ (section 12.2.1)?
- A12.3** What is ‘internal capital rationing’ (section 12.2.1)?
- A12.4** What is ‘single period’ capital rationing (section 12.2.1)?
- A12.5** What is ‘multiple period’ capital rationing (section 12.2.1)?
- A12.6** What is the profitability index (section 12.2.2)?
- A12.7** What is the decision rule based on the profitability index (section 12.2.2)?
- A12.8** What is meant by ‘mutually exclusive projects’ (section 12.2.3)?
- A12.9** Why might the NPV method of appraisal give an apparently different decision from the IRR method when evaluating mutually exclusive projects (section 12.2.4)?
- A12.10** How is the working capital requirement included in cash flows for capital budgeting (section 12.3.1)?
- A12.12** How may taxation rules affect cash flow projections in capital budgeting (section 12.3.2)?
- A12.13** How may the effect of inflation be included in capital budgeting (section 12.3.3)?
- A12.14** Why are (a) depreciation and (b) interest charges not found in the cash flow projections for capital budgeting (section 12.3.4)?
- A12.15** Explain the processes necessary for authorisation and review of capital projects (section 12.5).
- A12.16** Explain what is meant by post-completion audit (section 12.5.2).
- A12.17** Explain what is meant by Advanced Manufacturing Technologies (section 12.6.1).
- A12.18** Explain why present value techniques may not be suitable for project evaluation where a business uses Advanced Manufacturing Technologies (section 12.6.2).

B Application

Note: In answering these questions you may need to use the discount tables in the Appendix to Chapter 11, pp. 287 to 288.

B12.1 [S]

Peter Green is planning a new business operation. It will produce net cash flows of £80,000 per year for four years. The initial investment in fixed assets will cost £90,000. The business is located in an enterprise zone and so is entitled to claim a tax deduction up to 100 per cent of the cost of the fixed assets. It is expected that the fixed assets will sell for £10,000 at the end of four years. The corporation tax rate is 20 per cent. Corporation tax is payable 12 months after the relevant cash flows arise. The after-tax cost of capital is 6 per cent per annum.

Required

Calculate the net present value of the project.

B12.2 [S]

Foresight Ltd plans an investment in fixed assets costing £120m. The project will have a three-year life, with the predicted cash flows as:

Year 1	£55m
Year 2	£71m
Year 3	£45m

Finance for inventories and debtors amounting to £75m will be required at the start of the project. Trade credit will provide £45m of this amount. All working capital will be recovered at the end of year 3. The expected scrap value of fixed assets at the end of year 3 is £15m. The cost of capital is 10 per cent. Taxation is to be ignored.

Required

- Calculate the net present value of the project.
- Show that the project can pay interest at 10 per cent per annum on the capital invested and return a surplus equivalent to the net present value calculated in (a).

B12.3 [S] [CIMA question]

A company has an annual post tax money cost of capital of 18%.

If inflation is 5% per annum, the company's annual post tax real cost of capital is closest to:

- 12%.
- 13%.
- 23%.
- 24%.

CIMA Paper P2 – Management Accounting – Decision Management November 2008, Question 1.1

B12.4 [S] [CIMA question]

The table below summarises data that have been extracted from the cost accounting records of SV Limited. The data show the cost and the inflation index relevant to the period in which the costs were incurred.

<i>Output level</i>	<i>Total cost</i>	<i>Inflation index</i>
3,000 units	£9,167	1.03
4,000 units	£11,760	1.05

The uninflated variable cost per unit of output to be used when predicting future costs is closest to:

- £2.30.
- £2.59.
- £2.80.
- £2.97.

CIMA Paper P2 – Management Accounting – Decision Management November 2008, Question 1.3

B12.5 [S] [CIMA question]

A company has only \$700,000 available for investment during the coming year. It has identified the following four investment opportunities, all of which are divisible, and have the same life.

<i>Investment</i>	<i>Capital required</i>	<i>Net present value</i>
	\$	\$
J	400,000	650,000
K	250,000	450,000
L	300,000	480,000
M	350,000	550,000

Calculate the correct rank order for these investments (best first).

CIMA Paper P2 – Management Accounting – Decision Management November 2008, Question 1.4

C Problem solving and evaluation

Note: In answering these questions you may need to refer to the discount tables in the Appendix to Chapter 11, pp. 287 to 288.

C12.1 [S]

Offshore Services Ltd is an oil-related company providing specialist firefighting and rescue services to oil rigs. The board of directors is considering a number of investment projects to improve the cash flow situation in the face of strong competition from international companies in the same field.

The proposed projects are:

<i>Project</i>	<i>Description</i>
ALPHA	Commission an additional firefighting vessel.
BRAVO	Replace two existing standby boats.
CHARLIE	Establish a new survival training course for the staff of client companies.
DELTA	Install latest communications equipment on all vessels.

Each project is expected to produce a reduction in cash outflows over the next five years. The outlays and cash benefits are set out below:

	<i>End of year</i>	<i>ALPHA</i> £000s	<i>BRAVO</i> £000s	<i>CHARLIE</i> £000s	<i>DELTA</i> £000s
Outlay	–	(600)	(300)	(120)	(210)
Cash flow benefits:					
	1	435	–	48	81
	2	435	–	48	81
	3	–	219	48	81
	4	–	219	48	81
	5	–	219	48	81
Internal rate of return		28.8%	22.0%	28.6%	26.8%

Any project may be postponed indefinitely. Investment capital is limited to £1,000,000. The board wishes to maximise net present value of projects undertaken and requires a return of 10 per cent per annum.

Required

Prepare a report to the board of directors containing:

- calculations of net present value for each project; and
- a reasoned recommendation on maximisation of net present value within the £1,000,000 investment limit.

C12.2 [S]

The directors of Advanced plc are currently considering an investment in new production machinery to replace existing machinery. The new machinery would produce goods more efficiently, leading to increased sales volume. The investment required will be £1,150,000 payable at the start of the project. The alternative course of action would be to continue using the existing machinery for a further five years, at the end of which time it would have to be replaced.

The following forecasts of sales and production volumes have been made:

Sales (in units)

<i>Year</i>	<i>Using existing machinery</i>	<i>Using new machinery</i>
1	400,000	560,000
2	450,000	630,000
3	500,000	700,000
4	600,000	840,000
5	750,000	1,050,000

Production (in units)

<i>Year</i>	<i>Using existing machinery</i>	<i>Using new machinery</i>
1	420,000	564,000
2	435,000	637,000
3	505,000	695,000
4	610,000	840,000
5	730,000	1,044,000

Further information

- The new machinery will reduce production costs from their present level of £7.50 per unit to £6.20 per unit. These production costs exclude depreciation.
- The increased sales volume will be achieved by reducing unit selling prices from their present level of £10.00 per unit to £8.50 per unit.
- The new machinery will have a scrap value of £150,000 after five years.
- The existing machinery will have a scrap value of £30,000 at the start of Year 1. Its scrap value will be £20,000 at the end of Year 5.
- The cost of capital to the company, in money terms, is presently 12% per annum.

Required

- Prepare a report to the directors of Advanced plc on the proposed investment decision.
- List any further matters which the directors should consider before making their decision.

C12.3

The board of directors of Kirkside Glassware Ltd is considering the following proposed investment projects:

<i>Project</i>	<i>Nature</i>
A	Establishment of a staff training scheme
B	Major improvements to the electrical system
C	Installation of a computer
D	Development of a new product
E	Purchase of a warehouse space, presently leased

It is estimated that each product will provide benefits in terms of reduced cash outflows, measured over the coming five years. The outlays and cash flow benefits, net of taxation, are set out below:

	<i>End of year</i>	<i>Project A</i>	<i>Project B</i>	<i>Project C</i>	<i>Project D</i>	<i>Project E</i>
		£	£	£	£	£
Outlay	–	(40,000)	(70,000)	(180,000)	(100,000)	(200,000)
Cash flow benefits:						
	1	16,000	27,000	66,000	–	145,000
	2	16,000	27,000	66,000	–	145,000
	3	16,000	27,000	66,000	73,000	–
	4	16,000	27,000	66,000	73,000	–
	5	16,000	27,000	66,000	73,000	–
Internal rate of return		28.65%	26.82%	24.32%	22.05%	28.79%

Each project has two separate phases of equal cost and providing equal cash flow benefits. The board is willing to consider adopting the first phase of any project without the second, if this appears necessary. Any project or phase not undertaken immediately may be postponed indefinitely. Capital available for investment is limited to £300,000. The board aims, as far as possible, to maximise the net present value of projects undertaken.

The company requires a return of 10 per cent per annum based on the net cash flows of any project.

Required

Prepare a report to the board of directors:

- setting out a decision rule which could be applied in ranking the investment projects; and
- listing other factors which the board of directors might wish to consider when selecting projects for implementation.

C12.4 [S] [CIMA question]

Under examination conditions there would be 45 minutes allocated to this question.

A restaurant company is considering further investment in order to increase its seating capacity. The company prepares its accounts to 31 December each year and, if accepted, the proposed investment would be made on 1 January Year 9 and will become operational immediately.

Based on the actual results for the year to date, the latest forecast income statement for the company for the year to 31 December Year 8 is as follows:

	£000	£000
Food sales	180	
Drink sales	<u>150</u>	
		330
Food costs	125	
Drink costs	70	
Staff costs	55	
Other costs*	<u>45</u>	
		<u>295</u>
Profit		<u>35</u>

*These other costs include rent, light and heat, power and administration overheads. 30% of these costs vary in proportion to the value of sales and the remainder are fixed costs.

The proposed investment

At present the restaurant is not able to exploit the growing demand from customers because it does not have sufficient seating capacity. The restaurant is considering the investment of £40,000 on 1 January Year 9. It is expected that this will increase the seating capacity of the restaurant by 30% compared to the present level. The lease of the current business premises ends at the end of Year 12. At that time the £40,000 investment will have no residual value. Of this total investment, £30,000 will qualify for 100% tax depreciation in Year 9 and the remainder

will qualify for 20% tax depreciation per year, commencing in Year 9, calculated on a reducing balance basis. Any balancing tax charge will be made or allowance will be available at the end of Year 12.

Sales

It is expected that the additional sales of food and drink will be proportional to the seating capacity increase and that the mix of food sales and drink sales will not change.

Costs

It is expected that apart from the effects of inflation (see below):

- Food costs and drink costs will continue to be the same percentages of food sales and drink sales as they are in the forecast income statement shown above.
- Staff costs are step costs and are expected to increase by 20% from their forecast value for 2008 if there is any capacity increase.
- The variable element of other costs is expected to increase in proportion to the capacity increase; the fixed cost element is expected to increase by £10,000 if there is any capacity increase.

Inflation

Cost inflation is predicted to be 4% per annum for each of the years Year 9 to Year 12 whereas selling prices are only expected to increase by 3% per annum during the same period.

Taxation

The company pays tax on its profits at 20%. This is payable one year after the profit is earned.

Cost of capital

The company's post tax money cost of capital for evaluating this investment is 8% per annum.

Required:

- (a) Prepare calculations to show whether the investment is worthwhile assuming that the 30% increase in seating capacity is fully utilised and recommend whether the investment should proceed. *(14 marks)*
- (b) Calculate and interpret the Internal Rate of Return (IRR) of the proposed investment. *(6 marks)*
- (c) Calculate the sensitivity of your recommendation to changes in the percentage capacity utilisation. *(5 marks)*

(Total for Question = 25 marks)

CIMA Paper P2 – Management Accounting – Decision Management November 2008, Question 1.4

Case studies

Real world cases

Prepare short answers to Case studies **12.1**, **12.2** and **12.3**.