It might not be possible to measure the benefits of a project in financial terms. If you create a system which allows the more accurate recording of data concerning the medical condition of patients, it might contribute to the alleviation of pain and the preservation of life, but it would be difficult to put a money value on these.

The last chapter emphasized that an ICT or software project needed a business case. In this chapter we explain what such a document might contain. A business case may be presented for several potential projects, but there may be money or staff time for only some of the projects. Managers need some way of deciding which projects to select. This is part of *portfolio management*. This chapter will discuss some ways in which projects can be evaluated and compared for inclusion in a project portfolio. The chapter finishes by discussing the way groups of projects which together contribute to a common business objective can be managed as *programmes* of projects.

2.2 A Business Case

The section on the business case draws on B. Hughes (2008) *Exploiting IT for business benefit*. British Computer Society.

Organizations may have different titles such as a *feasibility study* or a *project justification* for what we call the business case. Its objective is to provide a rationale for the project by showing that the benefits of the project outcomes will exceed the costs of development, implementation and operation (or production).

Typically a business case document might contain:

1. Introduction and background to the proposal
2. The proposed project
3. The market
4. Organizational and operational infrastructure
5. The benefits
6. Outline implementation plan
7. Costs
8. *The financial case*
9. *Risks*
10. Management plan

These sections will now be described in more detail.

Introduction and background

This is a description of the current environment of the proposed project. A problem to be solved or an opportunity to be exploited is identified.

The proposed project

A brief outline of the proposed project is provided.

In Section 2.3 we will explore further the difference between new product development and renewal projects.

The market

This is needed when the project is to create new product or a new service capability. This would contain information like the estimated demand for the product or service and any likely competitors.

Organizational and operational infrastructure

This describes how the structure of the organization will be affected by the implementation of the project. This is of most relevance where the project is implementing or modifying an information system as part of a broader business change project. It would also be relevant if a tailored production or distribution system has to be set up when a new product is designed.

Benefits

Where possible, a financial value should be put on the benefits of the implemented project. For commercial organizations this could be related to increased profits caused either by increasing income or by making savings on costs. For not-for-profit organizations we would try to quantify the benefits even if we cannot quote a precise financial value. In an example we used earlier relating to an IT system that improved the diagnosis of a particular disease, an increase in the rate of diagnosis might be quoted.

Outline implementation plan

In addition to the ICT aspects of the project, activities such as marketing, promotion and operational and maintenance infrastructures need to be considered. One consideration will be which project activities can be outsourced and which are best kept in-house.

This will also detail the management of the implementation. The responsibilities are allocated for the tasks identified in the outline implementation plan. Key decision points or milestones, where a health-check on the state of the implementation is taken, should be identified. As we will see, for a large implementation a number of projects may be needed which can be managed as a programme.

Costs

Having outlined the steps needed to set up the operations needed by the proposal, a schedule of expected costs associated with the planned approach can now be presented.

There will clearly be some uncertainties about some of the costs, especially as the details of the requirements have not yet been worked out.

The financial case

There are a number of ways in which the information on income and costs can be analysed and these will be the subject of the section on evaluation techniques later in this chapter.

Risks

Once again a more detailed discussion of risks will follow in a later section. We note here that many estimates of costs and, more particularly, benefits of the project will be speculative at this stage and the section on risk should take account of this. In the last chapter we distinguished between project and business objectives. We can similarly distinguish project risk – relating to threats to successful project execution – from business

risk – relating to factors threatening the benefits of the delivered project. In the business case the main focus is on business risk.

2.3 Project Portfolio Management

Quite a good introduction to the concepts of portfolios can be found in B. De Reyck et al. 'The impact of project portfolio management on information technology projects' (2005) *International Journal of Project Management* 23 524–37.

Portfolio project management provides an overview of all the projects that an organization is undertaking or is considering. It prioritizes the allocation of resources to projects and decides which new projects should be accepted and which existing ones should be dropped.

The concerns of project portfolio management include:

- identifying which project proposals are worth implementation;
- assessing the amount of risk of failure that a potential project has;
- deciding how to share limited resources, including staff time and finance, between projects – one problem can be that too many projects are started given the resources available so that inevitably some projects will miss planned completion dates;
- being aware of the dependencies between projects, especially where several projects need to be completed for an organization to reap benefits;
- ensuring that projects do not duplicate work;
- ensuring that necessary developments have not been inadvertently been missed.

The three key aspects of project portfolio management are *portfolio definition, portfolio management* and *portfolio optimization*. An organization would undertake portfolio definition before adopting portfolio management and then proceeding to optimization.

Project portfolio definition

Warren McFarlan's (1981) 'Portfolio approach to information systems' *Harvard Business Review* 59(5) 142–50 introduced the portfolio concept to information systems.

An organization should record in a single repository details of all current projects. A decision will be needed about whether projects of all types are to be included. Should just ICT projects be included in the repository, or should other projects such as the setting up of a new warehouse also be included? One problem for many organizations is that projects can be divided into *new product developments* (NPD) where the project deliverable is a product, such as a computer game, that is sold to customers, and *renewal* projects which improve the way an organization operates – information systems projects are often like this. The distinction is not always clear-cut. For example, a new information system could be used to provide a customer service such as recording the details of people buying a new insurance product.

NPD projects are often more frequent in organizations which have a continuous development of new goods and services. Renewal projects may be less frequent and thus inherently more risky as there is less experience of these types of project. NPD projects find attracting funding easier with their clear relationship between the project and income. Where both types of project call upon the same pools of resources, including finance, the argument for a common portfolio is strong.

Project portfolio management

Once the portfolio has been established, more detailed costings of projects can be recorded. The value that managers hope will be generated by each project can also be recorded. Actual performance of projects on these performance indicators can then be tracked. This information can be the basis for the more rigorous screening of new projects.

Project portfolio optimization

The performance of the portfolio can be tracked by high-level managers on a regular basis. A better balance of projects may be achieved. Some projects could potentially be very profitable but could also be risky. In the case of an e-commerce site, for example, sales may not be as great as hoped because established competitors reduce prices. Other projects could have modest benefits, such as those cutting costs by automating processes, but have fewer risks. The portfolio ought to have a carefully thought-out balance between the two types of project.

Some problems with project portfolio management

An important role of project portfolio management is sharing resources between projects. There can be problems because while apparently full-time staff are allocated to a project, they may effectively be part-time because they still have routine work to do. This is particularly so with users, and with developers who may on occasion be called away from project work to deal with support tasks.

The official project portfolio may not accurately reflect organizational activity if some projects are excluded. A formal decision may be made that only projects over a certain level of cost will be recorded in the portfolio.

The 'below the line' projects could in fact consume substantial staff effort and bleed away effort from the official projects. It can be argued that all projects should be included in the official portfolio.

Interesting insights into the practical problems of portfolios can be found in B. S. Blichfeldt and P. Eskerod (2008) 'Project portfolio management – there's more to it than management enacts' *International Journal of Project Management* 26: 357–65.

However, there are advantages in allowing these tasks. It allows small ad hoc tasks to be done, such as quick fixes to systems to deal with externally imposed changes. They reduce work for higher management by saving them from having to process a large number of small work requests. Developers may find these small tasks rewarding: dealing with these small requests is an easy way to keep users happy. Thus when allocating resources to projects, a margin should be set to allow first-line managers some judgement in accepting non-planned work.

2.4 Evaluation of Individual Projects

We will now look more closely at how the feasibility of an individual project can be evaluated.

Technical assessment

Technical assessment of a proposed system consists of evaluating whether the required functionality can be achieved with current affordable technologies. Organizational policy, aimed at providing a consistent hardware/software infrastructure, is likely to limit the technical solutions considered. The costs of the technology adopted must be taken into account in the cost–benefit analysis.

Cost–benefit analysis

Any project aiming at a return on investment must, as a minimum, provide a greater benefit than putting that investment in, say, a bank.

Even where the estimated benefits will exceed the estimated costs, it is often necessary to decide if the proposed project is the best of several options. Not all projects can be undertaken at any one time and, in any case, the most valuable projects should get most resources.

Cost–benefit analysis comprises two steps:

1. *Identifying all of the costs and benefits of carrying out the project and operating the delivered application* These include the development costs, the operating costs and the benefits expected from the new system. Where the proposed system is a replacement, these estimates should reflect the change in costs and benefits due to the new system. A new sales order processing system, for example, could only claim to benefit an organization by the increase in sales due to the use of the new system.
2. *Expressing these costs and benefits in common units* We must express each cost and benefit – and the *net benefit* which is the difference between the two – in money.

Most direct costs are easy to quantify in monetary terms and can be categorized as:

The different types of benefits will be discussed in greater detail in the context of benefits management later in this chapter.

- *development costs*, including development staff costs;
- *setup costs*, consisting of the costs of putting the system into place, mainly of any new hardware but also including the costs of file conversion, recruitment and staff training;
- *operational costs* relating to operating the system after installation.

EXERCISE 2.1

Brightmouth College is considering the replacement of the existing payroll service, operated by a third party, with a tailored, off-the-shelf computer-based system. List some of the costs it might consider under the headings of:

- Development costs
- Setup costs
- Operational costs

List some of the benefits under the headings:

- Quantified and valued benefits
- Quantified but not valued
- Identified but not easily valued

For each cost or benefit, explain how, in principle, it might be measured in monetary terms.

Typically products generate a negative cash flow during their development followed by a positive cash flow over their operating life. There might be decommissioning costs at the end of a product's life.

Cash flow forecasting

As important as estimating the overall costs and benefits of a project is producing a cash flow forecast which indicates when expenditure and income will take place (Figure 2.1).

We need to spend money, such as staff wages, during a project's development. Such expenditure cannot wait until income is received (either from using software developed in-house use or from selling it). We need to know that we can fund this development expenditure either from the company's own resources or by borrowing. A forecast is needed of when expenditure, such as the payment of salaries, and any income are to be expected.

The difficulty and importance of cash flow forecasting is evidenced by the number of companies that suffer bankruptcy because, although they are developing profitable products or services, they cannot sustain an unplanned negative cash flow.

Accurate cash flow forecasting is difficult, as it is done early in the project's life cycle (at least before any significant expenditure is committed) and many items to be estimated (particularly the benefits of using software) might be some years in the future.

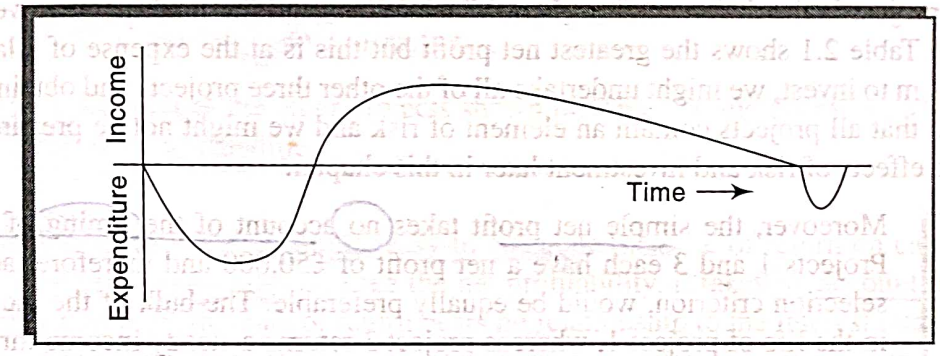

FIGURE 2.1 Typical product life cycle cash flow

When estimating future cash flows, it is usual to ignore the effects of inflation. Forecasts of inflation rates tend to be uncertain. Moreover, if expenditure is increased due to inflation it is likely that income will increase proportionately.

2.5 Cost–benefit Evaluation Techniques

We now take a look at some methods for comparing projects on the basis of their cash flow forecasts.

Table 2.1 illustrates cash flow forecasts for four projects. In each case it is assumed that the cash flows take place at the end of each year. For short-term projects or where there are significant seasonal cash flow patterns, quarterly, or even monthly, cash flow forecasts could be appropriate.

TABLE 2.1 Four project cash flow projections – figures are end of year totals (£)

Year	Project 1	Project 2	Project 3	Project 4
0	–100,000	–1,000,000	–100,000	–120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit	50,000	100,000	50,000	75,000

EXERCISE 2.2

Consider the project cash flow estimates for four projects at JOE shown in Table 2.1. Negative values represent expenditure and positive values income.

Rank the four projects in order of financial desirability and make a note of your reasons for ranking them in that way before reading further.

Net profit

The net profit of a project is the difference between the total costs and the total income over the life of the project. Project 2 in Table 2.1 shows the greatest net profit but this is at the expense of a large investment. Indeed, if we had £1 m to invest, we might undertake all of the other three projects and obtain an even greater net profit. Note also that all projects contain an element of risk and we might not be prepared to risk £1 m. We shall look at the effects of risk and investment later in this chapter.

Cash flows take place at the end of each year. The year 0 represents the initial investment made at the start of the project.

Moreover, the simple net profit takes no account of the timing of the cash flows. Projects 1 and 3 each have a net profit of £50,000 and therefore, according to this selection criterion, would be equally preferable. The bulk of the income occurs late in the life of project 1, whereas project 3 returns a steady income throughout its life. Having to wait for a return has the disadvantage that the investment must be funded for longer. Add to that the fact that, other things being equal, estimates in the more distant future are less reliable than short-term estimates and we can see that the two projects are not equally preferable.

Payback period

The *payback period* is the time taken to break even or pay back the initial investment. Normally, the project with the shortest payback period will be chosen on the basis that an organization will wish to minimize the time that a project is 'in debt'.

EXERCISE 2.3

Consider the four project cash flows given in Table 2.1 and calculate the payback period for each of them.

The advantage of the payback period is that it is simple to calculate and is not particularly sensitive to small forecasting errors. Its disadvantage as a selection technique is that it ignores the overall profitability of the project – in fact, it totally ignores any income (or expenditure) once the project has broken even. Thus the fact that projects 2 and 4 are, overall, more profitable than project 3 is ignored.

Return on investment

The *return on investment* (ROI), also known as the *accounting rate of return* (ARR), provides a way of comparing the net profitability to the investment required. There are some variations on the formula used to calculate the return on investment but a straightforward common version is:

$$\text{ROI} = \frac{\textit{average annual profit}}{\textit{total investment}} \times 100$$

EXERCISE 2.4

Calculating the ROI for project 1, the net profit is £50,000 and the total investment is £100,000. The return on investment is therefore calculated as

$$ROI = \frac{\textit{average annual profit}}{\textit{total investment}} \times 100$$

$$= \frac{50{,}000}{100{,}000} \times 100 = 10\%$$

Calculate the ROI for each of the other projects shown in Table 2.1 and decide which, on the basis of this criterion, is the most worthwhile.

The return on investment provides a simple, easy-to-calculate measure of return on capital. Unfortunately, it suffers from two severe disadvantages. Like the net profitability, it takes no account of the timing of the cash flows. More importantly, this rate of return bears no relationship to the interest rates offered or charged by banks (or any other normal interest rate) since it takes no account of the timing of the cash flows or of the compounding of interest. It is therefore, potentially, very misleading.

Net present value

The calculation of *net present value* is a project evaluation technique that takes into account the profitability of a project and the timing of the cash flows that are produced. This is based on the view that receiving £100 today is better than having to wait until next year to receive it. We could, for example, invest the £100 in a bank today and have £100 plus the interest in a year's time. If we say that the *present value* of £100 in a year's time is £91, we mean that £100 in a year's time is the equivalent of £91 now.

Net present value (NPV) and internal rate of return (IRR) are collectively known as discounted cash flow (DCF) techniques.

The equivalence of £91 now and £100 in a year's time means we are discounting the future income by approximately 10%. If we received £91 now and invested it for a year at an annual interest rate of 10%, it would be worth £100 in a year's time. The annual rate by which we discount future earnings is known as the *discount rate* – 10% in the above example.

Note that this example uses approximate figures.

Similarly, £100 received in two years' time would have a present value of approximately £83 – in other words, £83 invested at an interest rate of 10% would yield approximately £100 in two years' time.

A rate of 10% may be unrealistic but is used here for ease of calculation.

The present value of any future cash flow may be obtained by applying the following formula

$$\textit{Present value} = \frac{\textit{value in year } t}{(1+r)^t}$$

where r is the discount rate, expressed as a decimal value, and t is the number of years into the future that the cash flow occurs.

Cash flow × discount factor = PV.

Alternatively, and rather more easily, the present value of a cash flow may be calculated by multiplying the cash flow by the appropriate discount factor. A small table of discount factors is given in Table 2.2.

More extensive or detailed tables may be constructed using the formula *discount factor* $\frac{1}{(1+r)^t}$ for various values of r (the discount rate) and t (the number of years from now).

The NPV for a project is obtained by discounting each cash flow (both negative and positive) and summing the discounted values. It is normally assumed that any initial investment takes place immediately (indicated as year 0) and is not discounted. Later cash flows are normally assumed to take place at the end of each year and are discounted by the appropriate amount.

NPV = discounting each cash flow & summing the discounted values.

TABLE 2.2 NPV discount factors

Year	Discount rate (%)					
	5	6	8	10	12	15
1	0.9524	0.9434	0.9259	0.9091	0.8929	0.8696
2	0.9070	0.8900	0.8573	0.8264	0.7972	0.7561
3	0.8638	0.8396	0.7938	0.7513	0.7118	0.6575
4	0.8227	0.7921	0.7350	0.6830	0.6355	0.5718
5	0.7835	0.7473	0.6806	0.6209	0.5674	0.4972
6	0.7462	0.7050	0.6302	0.5645	0.5066	0.4323
7	0.7107	0.6651	0.5835	0.5132	0.4523	0.3759
8	0.6768	0.6274	0.5403	0.4665	0.4039	0.3269
9	0.6446	0.5919	0.5002	0.4241	0.3606	0.2843
10	0.6139	0.5584	0.4632	0.3855	0.3220	0.2472
15	0.4810	0.4173	0.3152	0.2394	0.1827	0.1229
20	0.3769	0.3118	0.2145	0.1486	0.1037	0.0611
25	0.2953	0.2330	0.1460	0.0923	0.0588	0.0304

EXERCISE 2.5

Assuming a 10% discount rate, the NPV for project 1 (Table 2.1) would be calculated as in Table 2.3. The net present value for project 1, using a 10% discount rate, is therefore £618. Using a 10% discount rate, calculate the net present values for projects 2, 3 and 4 and decide which, on the basis of this, is the most beneficial to pursue.

TABLE 2.3 Applying the discount factors to project 1

Year	Project 1 cash flow (£)	Discount factor @ 10%	Discounted cash flow (£)
0	–100,000	1.0000	–100,000
1	10,000	0.9091	9,091
2	10,000	0.8264	8,264
3	10,000	0.7513	7,513
4	20,000	0.6830	13,660
5	100,000	0.6209	62,090
Net Profit:	£50,000	NPV: £618	

It is interesting to note that the net present values for projects 1 and 3 are significantly different – even though they both yield the same net profit and both have the same return on investment. The difference in NPV reflects the fact that, with project 1, we must wait longer for the bulk of the income.

The main difficulty with NPV for deciding between projects is selecting an appropriate discount rate. Some organizations have a standard rate but, where this is not the case, then the discount rate should be chosen to reflect available interest rates (borrowing costs where the project must be funded from loans) plus some premium to reflect the fact that software projects are normally more risky than lending money to a bank. The exact discount rate is normally less important than ensuring that the same discount rate is used for all projects being compared. However, it is important to check that the ranking of projects is not sensitive to small changes in the discount rate – have a look at the following exercise.

EXERCISE 2.6

Calculate the net present value for each of the projects A, B and C shown in Table 2.4 using each of the discount rates 8%, 10% and 12%.

For each of the discount rates, decide which is the best project. What can you conclude from these results?

TABLE 2.4 Three estimated project cash flows

Year	Project A (£)	Project B (£)	Project C (£)
0	–8,000	–8,000	–10,000
1	4,000	1,000	2,000
2	4,000	2,000	2,000

(Contd)

(*Contd*)

3	2,000	.7938	4,000	6,000
4	1,000	.7350	3,000	2,000
5	500	.6806	9,000	2,000
6	500	.6302	−6,000	2,000
Net Profit	4,000		5,000	6,000

Alternatively, the discount rate can be thought of as a target rate of return. If, for example, we set a target rate of return of 15% we would reject any project that did not display a positive net present value using a 15% discount rate. Any project that displayed a positive NPV would be considered for selection – perhaps by using an additional set of criteria where candidate projects were competing for resources.

Internal rate of return

One disadvantage of NPV as a measure of profitability is that, although it may be used to compare projects, it might not be directly comparable with earnings from other investments or the costs of borrowing capital. Such costs are usually quoted as a percentage interest rate. The internal rate of return (IRR) attempts to provide a profitability measure as a percentage return that is directly comparable with interest rates. Thus, a project that showed an estimated IRR of 10% would be worthwhile if the capital could be borrowed for less than 10% or if the capital could not be invested elsewhere for a return greater than 10%.

The IRR is calculated as that percentage discount rate that would produce an NPV of zero. It is most easily calculated using a spreadsheet or other computer program that provides functions for calculating the IRR. Microsoft Excel, for example, provides IRR functions which, provided with an initial guess or seed value (which may be zero), will search for and return an IRR.

One deficiency of the IRR is that it does not indicate the absolute size of the return. A project with an NPV of £100,000 and an IRR of 15% can be more attractive than one with an NPV of £10,000 and an IRR of 18% – the return on capital is lower but the net benefits greater.

Another objection to the internal rate of return is that, under certain conditions, it is possible to find more than one rate that will produce a zero NPV. However, if there are multiple solutions, it is always appropriate to take the lowest value and ignore the others.

NPV and IRR are not, however, a complete answer to economic project evaluation.

- A total evaluation must also take into account the problems of funding the cash flows – will we, for example, be able to repay the interest on any borrowed money at the appropriate time?
- While a project's IRR might indicate a profitable project, future earnings from a relatively risky project might be far less reliable than earnings from, say, investing with a bank. We might undertake a more detailed risk analysis as described below.
- We must also consider any one project within the financial and economic framework of the organization as a whole – if we fund this one, will we also be able to fund other worthy projects?

EXERCISE 2.7

Check if the projects *A*, *B*, and *C* shown in Table 2.4 are worth taking up when the rate of interest on borrowed capital is 15%.

2.6 Risk Evaluation

Every project involves risk. We have already noted that *project* risks, which prevent the project from being completed successfully, are different from the *business* risk that the delivered products are not profitable. Project risks will be discussed in Chapter 7. Here we focus on business risk.

Risk identification and ranking

In any project evaluation we should identify the risks and quantify their effects. One approach is to construct a project risk matrix utilizing a checklist of possible risks and classifying risks according to their relative importance and likelihood. Importance and likelihood need to be separately assessed – we might be less concerned with something that, although serious, is very unlikely to occur than with something less serious that is almost certain. Table 2.5 illustrates a basic project risk matrix listing some of the business risks for a project, with their importance and likelihood classified as high (H), medium (M), low (L) or exceedingly unlikely (—). So that projects may be compared, the list of risks must be the same for each project assessed. It is likely, in reality, that it would be longer than shown and more precise.

The project risk matrix may be used as a way of evaluating projects (those with high risks being less favoured) or as a means of identifying and ranking the risks for a specific project.

TABLE 2.5 A fragment of a basic project/business risk matrix for an e-commerce application

Risk	Importance	Likelihood
Client rejects proposed look and feel of site	H	—
Competitors undercut prices	H	M
Warehouse unable to deal with increased demand	M	L
Online payment has security problems	M	M
Maintenance costs higher than estimated	L	L
Response times deter purchasers	M	M

Risk and net present value

Where a project is relatively risky it is common practice to use a higher discount rate to calculate net present value. This risk premium might, for example, be an additional 2% for a reasonably safe project or 5% for a fairly risky one. Projects may be categorized as high, medium or low risk using a scoring method and risk

premiums designated for each category. The premiums, even if arbitrary, provide a consistent method of taking risk into account.

Cost–benefit analysis

A rather more sophisticated approach to the evaluation of risk is to consider each possible outcome and estimate the probability of its occurring and the corresponding value of the outcome. Rather than a single cash flow forecast for a project, we will then have a set of cash flow forecasts, each with an associated probability of occurring. The value of the project is then obtained by summing the cost or benefit for each possible outcome weighted by its corresponding probability. Exercise 2.8 illustrates how this may be done.

EXERCISE 2.8

BuyRight, a software house, is considering developing a payroll application for use in academic institutions and is currently engaged in a cost–benefit analysis. Study of the market has shown that, if BuyRight can target it efficiently and no competing products become available, it will obtain a high level of sales generating an annual income of £800,000. It estimates that there is a 1 in 10 chances of this happening. However, a competitor might launch a competing application before its own launch date and then sales might generate only £100,000 per year. It estimates that there is a 30% chance of this happening. The most likely outcome, it believes, is somewhere in between these two extremes – it will gain a market lead by launching before any competing product becomes available and achieve an annual income of £650,000. BuyRight has therefore calculated its expected sales income as in Table 2.6.

TABLE 2.6 BuyRight's income forecasts

Sales	Annual sales income (£) i	Probability p	Expected value (£) $i \times p$
High	800,000	0.1	80,000
Medium	650,000	0.6	390,000
Low	100,000	0.3	30,000
Expected Income			500,000

Development costs are estimated at £750,000. Sales levels are expected to be constant for at least four years. Annual costs of marketing and product maintenance are estimated at £200,000, irrespective of the market share. Would you advise going ahead with the project?

This approach is frequently used to evaluate large projects such as the building of motorways, where variables such as traffic volumes, and hence the total benefit of shorter journey times, are uncertain. The technique, of course, relies on being able to assign probabilities of occurrence to each scenario, which requires extensive research.

When used to evaluate a single major project, the cost–benefit approach, by 'averaging out' the negative and positive outcomes of the different scenarios, does not take full account of 'worst-case scenarios'. Because

of this, it is more appropriate for the evaluation of a portfolio of projects where overall profitability is the primary concern, more successful projects can offset the impact of less successful ones.

Risk profile analysis

An approach which attempts to overcome some of the objections to cost–benefit averaging is the construction of risk profiles using sensitivity analysis.

This involves varying each of the parameters that affect the project's cost or benefits to ascertain how sensitive the project's profitability is to each factor. We might, for example, vary one of our original estimates by plus or minus 5% and recalculate the expected costs and benefits for the project. By repeating this exercise for each of our estimates in turn we can evaluate the sensitivity of the project to each factor.

By studying the results of a sensitivity analysis we can identify those factors that are most important to the success of the project. We then need to decide whether we can exercise greater control over them or otherwise mitigate their effects. If neither is the case, then we must live with the risk or abandon the project.

Using decision trees

The approaches to risk analysis discussed previously rather assume that we are passive bystanders allowing nature to take its own course – the best we can do is to reject over-risky projects or choose those with the best risk profile. There are many situations, however, where we can evaluate whether a risk is important and, if it is, decide a suitable course of action.

Such decisions will limit or affect future options and, at any point, it is important to be able to assess how a decision will affect the future profitability of the project.

As an example, say a successful company is considering when to replace its sales order processing system. The decision largely rests upon the rate at which its business expands – if its market share significantly increases (which it believes will happen if rumours of a competitor's imminent bankruptcy are fulfilled) the existing system might need to be replaced within two years. Not replacing the system in time could be an expensive option as it could lead to lost revenue if it cannot cope with increased sales. Replacing the system immediately will, however, be expensive as it will mean deferring other projects already scheduled.

It is calculated that extending the existing system will have an NPV of £75,000, although if the market expands significantly, this will be turned into a loss with an NPV of –£1 00,000 due to lost revenue. If the market does expand, replacing the system now has an NPV of £250,000 due to the benefits of being able to handle increased sales and other benefits such as improved management information. If sales do not increase, however, the benefits will be severely reduced and the project will suffer a loss with an NPV of –£50,000.

The company estimate the likelihood of the market increasing significantly at 20% – and, hence, the probability that it will not increase as 80%. This scenario can be represented as a tree structure as shown in Figure 2.2.

The analysis of a decision tree consists of evaluating the expected benefit of taking each path from a decision point (denoted by D in Figure 2.2). The expected value of each path is the sum of the value of each possible outcome multiplied by its probability of occurrence. The expected value of extending the system is therefore £40,000 (75,000 × 0.8 – 100,000 × 0.2) and the expected value of replacing the system £10,000 (250,000 × 0.2 – 50,000 × 0.8). The company should therefore choose the option of extending the existing system.

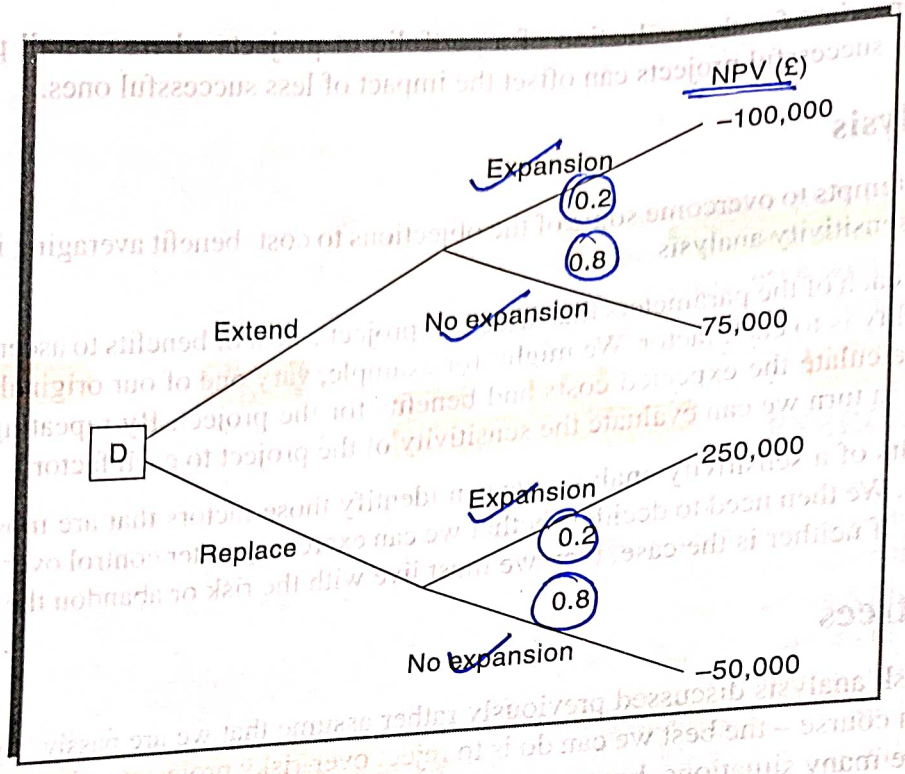

FIGURE 2.2 A decision tree

2.7 Programme Management

...ms' paper appeared ...the International ...Journal of Project ...Management August 1991.

It should now have been made clear that there will be an element of risk with any single project. Even where projects produce real financial benefits, the precise size of those benefits will often be uncertain at the start of the project. This makes it important for organizations to take a broad view of all its projects to ensure that while some projects may disappoint, organizational developments overall will generate substantial benefits.

We introduced project portfolios in Section 2.3. We will now examine how careful management of programmes of projects can provide benefits. D. C. Ferns defined a programme as *'a group of projects that are managed in a coordinated way to gain benefits that would not be possible were the projects to be managed independently'*.

Programmes can exist in different forms, as can be seen below.

Business cycle programmes

The collection of projects that an organization undertakes within a particular planning cycle has already been discussed under the topic of project portfolios. We have seen that many organizations have a fixed budget for ICT development. Decisions have to be made about which projects to implement within that budget within the accounting period, which often coincides with the financial year.

TABLE 2.7 Programme managers versus project managers

Programme manager	Project manager
Many simultaneous projects	One project at a time
Personal relationship with skilled resources	Impersonal relationship with resource type
Need to maximize utilization of resources	Need to minimize demand for resources
Projects tend to be similar	Projects tend to be dissimilar

and who fills that role does not matter. The programme manager has a number of individual systems analysts under his or her control whose deployment has to be planned.

When a project is planned, at the stage of allocating resources, programme management will be involved. Some activities in the project might have to be delayed until the requisite technical staff are freed from work on other projects. Where expensive technical staff are employed full-time, then you would want to avoid them having short periods of intense activity interspersed with long periods of idleness, during which they are still being paid. It is most economic when the demand for work is evenly spread from month to month.

As will be seen in Chapter 9 on monitoring and control, when a project is executed activities can take longer (or sometimes even less time) than planned. Delays can mean that specialist staff are prevented from moving on to their next project. Hence it can be seen that programme management needs continually to monitor the progress of projects and the use of resources.

2.9 Strategic Programme Management

A different form of programme management is where a portfolio of projects all contribute to a common objective. Take, for example, a business which carries out maintenance work for clients. A customer's experience of the organization might be found to be very variable and inconsistent. The employee who records the customer's requirements is different from the people who actually carry out the work and different again from the clerk who deals with the accounts. Often a customer has to explain to one company employee a problem that has already been discussed at length with some other employee. A business objective might be to present a consistent and uniform front to the client. This objective might require changes to a number of different systems which until now have been largely self-contained. The work to reorganize each individual area could be treated as a separate project, coordinated at a higher level as a programme.

Recall that OGC is the Office of Government Commerce which was formerly the Central Computing and Telecommunications Agency or CCTA.

These types of programme are most often needed by large organizations which have a large and complicated organizational structure. Government departments are typical examples and it is not surprising that the OGC, the United Kingdom government agency which was responsible (as the CCTA) for the introduction of PRINCE2 project management standards, has directed its attention to guidelines for effective programme management. The approach now described is based on the OGC guidelines.

Strategic programmes

Several projects together can implement a single strategy. For example, the merging of two organizations' computer systems could require several projects each dealing with a particular application area. Each activity could be treated as a distinct project, but would be coordinated as a programme.

Infrastructure programmes

Organizations can have various departments which carry out distinct, relatively self-contained, activities. In a local authority, one department might have responsibilities for the maintenance of highways, another for refuse collection, and another for education. These distinct activities will probably require distinct databases and information systems. In such a situation, the central ICT function would have responsibility for setting up and maintaining the ICT infrastructure, including the networks, workstations and servers upon which these distinct applications run. In these circumstances, an infrastructure programme could refer to the activities of identifying a common ICT infrastructure and its implementation and maintenance.

Research and development programmes

Truly innovative companies, especially those that are trying to develop new products for the market, are well aware that projects will vary in terms of their risk of failure and the potential returns that they might eventually reap. Some development projects will be relatively safe, and result in the final planned product, but that product might not be radically different from existing ones on the market. Other projects might be extremely risky, but the end result, if successful, could be a revolutionary technological breakthrough that meets some pressing but previously unsatisfied need.

Alan Webb (2001) 'When project management doesn't work' *Project Management Today* May.

A successful portfolio would need to be a mixture of 'safe projects' with relatively low returns and some riskier projects that might fail, but if successful would generate handsome profits which will offset the losses on the failures.

Innovative partnerships

Companies sometimes come together to work collaboratively on new technologies in a 'pre-competitive' phase. Separate projects in different organizations need to be coordinated and this might be done as a programme.

2.8 Managing the Allocation of Resources within Programmes

We are now going to examine in more detail programmes where resources have to be shared between concurrent projects. Typically, an ICT department has pools of particular types of expertise, such as software developers, database designers and network support staff, and these might be called upon to participate in a number of concurrent projects.

In these circumstances, programme managers will have concerns about the optimal use of specialist staff. These concerns can be contrasted with those of project managers – see Table 2.7.

The comparison is based on G. Reiss (1996) *Programme Management Demystified*, Chapman & Hall.

The project managers are said to have an 'impersonal relationship' with resource types because, essentially, they require, for example, a competent systems analyst

2.10 Creating a Programme

The programme mandate

The OGC envisages that the planning of a programme will be triggered by the creation of an agreed *programme mandate*. Ideally this should be a formal document describing:

- the new services or capabilities the programme should deliver;
- how the organization will be improved by use of the new services or capability;
- how the programme fits with corporate goals and any other initiatives.

At this point, a *programme director* ought to be appointed to provide initial leadership for the programme. To be successful, the programme needs a champion who is in a prominent position within the organization. This will signal the seriousness with which the organization takes the programme.

The programme brief

A *programme brief* is now produced which outlines the business case for the programme. It will have sections setting out:

- a preliminary *vision statement* which describes the new capacity that the organization seeks – it is described as 'preliminary' because this will later be elaborated;
- the *benefits* that the programme should create – including when they are likely to be generated and how they might be measured;
- risks and issues;
- estimated costs, timescales and effort.

The vision statement

The programme brief should give the sponsors enough information to decide whether to request a more detailed definition of the programme. This stage would justify the setting up of a small team. A *programme manager* with day-to-day responsibility for the programme would be appointed.

This group takes the vision statement from the project brief and refines and expands it. It should describe in detail the new capability that the programme will give the organization. If estimates for costs, performance and service levels cannot be provided, then there should at least be an indication of how they might be measured; for example, one might be able to say that repeat business will be increased, even if the precise size of the increase cannot be provided.

The blueprint

The achievement of the improved capability described in the vision statement can come only through changes to the structure and operations of the organization. These are detailed in the *blueprint*. This should contain:

- business models outlining the new processes required;
- organizational structure – including the numbers of staff required in the new systems and the skills they will need;
- the information systems, equipment and other, non-staff, resources that will be needed;

- data and information requirements;
- costs, performance and service level requirements.

To return to the example of the organization which wants to present a consistent interface to its customers, while this aspiration might be stated in the vision statement, the way that it is to be achieved would have to be stated in the blueprint. This might, for example, suggest:

- the appointment of 'account managers' who could act as a point of contact for the client throughout their business transactions with the company;
- a common computer interface allowing the account manager to have access to all the information relating to a particular client or job, regardless of the computer system from which it originates.

The blueprint is supported by *benefit profiles* which estimate when the expected benefits will be experienced following implementation of the enhanced capability. One principle is that a programme should deliver tangible benefits. Being provided with a capability does not guarantee that it will be used to obtain the benefits envisaged. For example, as a part of the programme above, the marketing department might be provided with sales and demographic information which allows them to target potential customers more accurately. This should improve the ratio of sales revenue to advertising costs. However, just because this information is available does not mean that the marketing staff will necessarily make effective use of it. Hence the need for evidence of actual business benefits. The timing of the benefits needs to be carefully considered. Thus marketing campaigns that target particular customers might take time to plan and organize and the benefits in increased sales and/or lower advertising costs could take some months to become apparent.

The management structure needed to drive this programme forward would also need to be planned and organized.

A preliminary list of the projects needed to achieve the programme objectives will be created with estimated timescales. This *programme portfolio* will be presented to the programme sponsors.

Communication plans are considered in more detail in Chapter 12.

A major risk is that some of those whose work will be affected by the programme will not be drawn into the programme effectively. A *stakeholder map* identifying the groups of people with an interest in the project and its outcomes and their particular interests could be drawn up. This can be used to write a *communications strategy* and *plan* showing how the appropriate information flows between stakeholders can be set up and maintained.

We noted back in Chapter 1 that with conventional project planning, it is not usually possible to plan all the phases of a project at the outset, as much of the information needed to produce the detailed plans will not be available. This is more so with programmes. However, at the initial programme planning stage, a preliminary plan can be produced containing:

- the project portfolio;
- cost estimates for each project;
- the benefits expected (including the appropriate benefits profile);
- risks identified;
- the resources needed to manage, support and monitor the programme.

This information allows a *financial plan* to be created. This enables higher management to put in place the budget arrangements to meet the expected costs at identified points in time. These will be tied to points in the programme when higher management review progress and authorize further expenditure.

2.11 Aids to Programme Management

Dependency diagrams

There will often be physical and technical dependencies between projects. For example, a project to relocate staff from one building to another cannot start until the project to construct the new building has been completed. Dependency diagrams, which are very similar to activity networks at project level, can show these dependencies. However, where projects run concurrently in a programme and products interchange, the dependency diagrams could become quite complicated.

Figure 2.3 shows a dependency diagram for a programme to merge two organizations, the constituent parts of which are explained below.

A *Systems study/design* A project is carried out which examines the various existing IT applications in the two old organizations, analyses their functionality, and makes recommendations about how they are to be combined.

B *Corporate image design* Independently of Project A, this project is designing the corporate image for the new organization. This would include design of the new logo to be put on company documents.

There will be interdependencies between C and D that will need to be managed.

C *Build common systems* Once Project A has been completed, work can be triggered on the construction of the new common ICT applications.

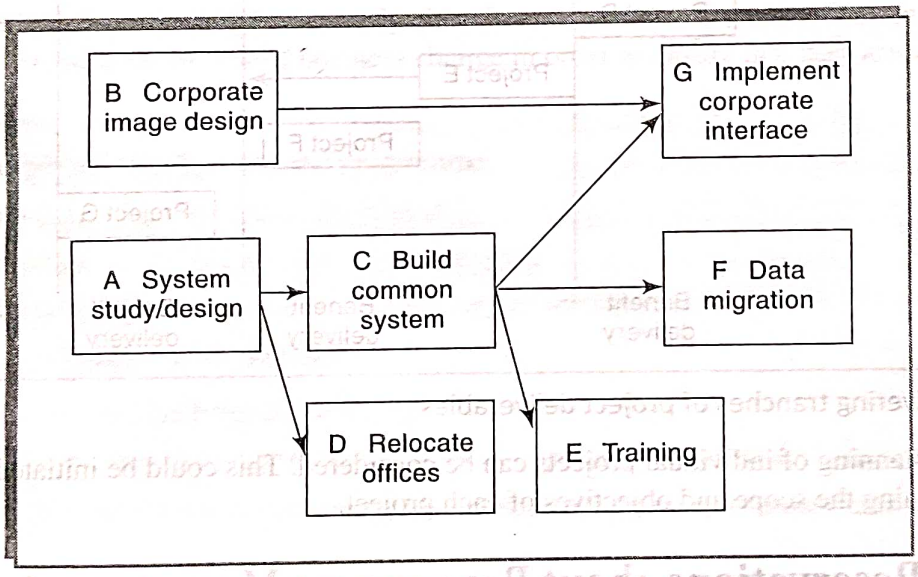

FIGURE 2.3 An example of a dependency diagram

D *Relocate offices* This is the project that plans and carries out the physical co-location of the staff in the two former organizations. In this scenario, this has to wait until the completion of Project A because that project has examined how the two sets of applications for the previous organizations could be brought together, and this has repercussions on the departmental structure of the new merged organization.

E *Training* Once staff have been brought together, perhaps with some staff being made redundant, training in the use of the new systems can begin.

F *Data migration* When the new, joint, applications have been developed and staff have been trained in their use, data can be migrated from existing databases to the new consolidated database.

G *Implement corporate interface* Before the new applications can 'go live', the interfaces, including the documentation generated for external customers, must be modified to conform to the new company image.

Delivery planning

The creation of a delivery dependency diagram would typically lead to the definition of *tranches* of projects. A tranche is a group of projects that will deliver their products as one step in the programme. The projects in a tranche should combine to provide a coherent new capability or set of benefits for the client. A consideration in scheduling a tranche will be the need to avoid contention for scarce resources.

Figure 2.4 shows how the programme's portfolio of projects can be organized into tranches, each of which delivers some tangible benefits to the user.

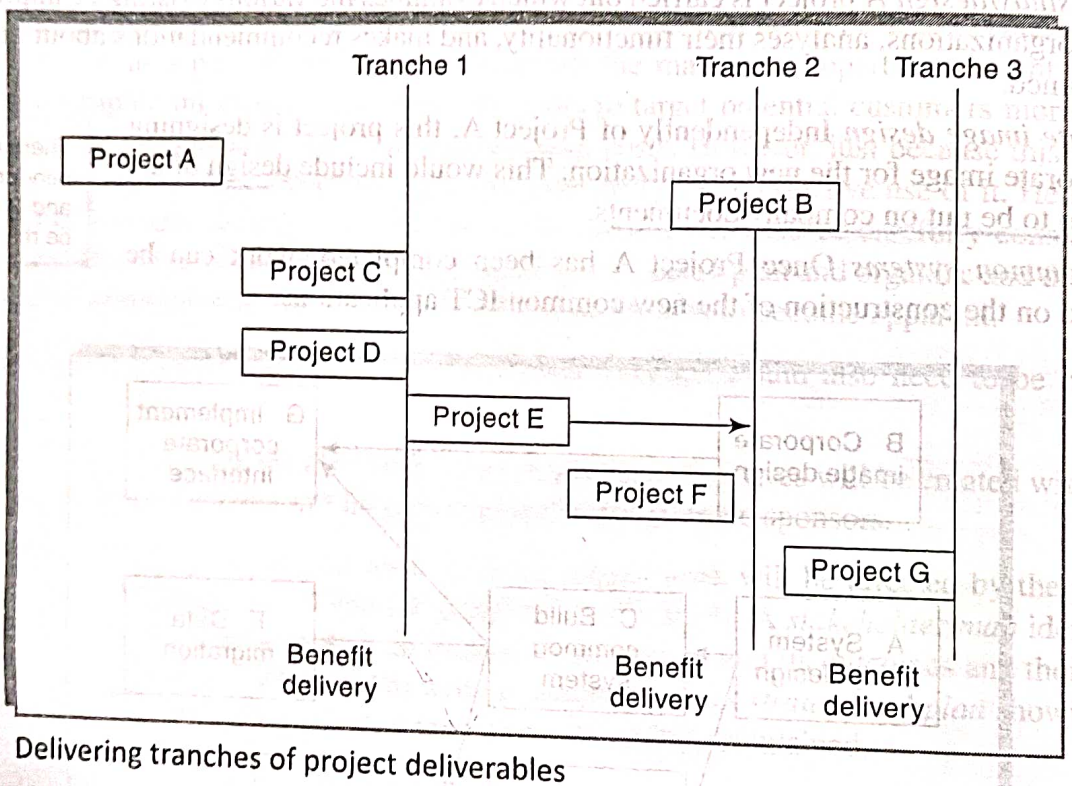

FIGURE 2.4 Delivering tranches of project deliverables

At this point, the planning of individual projects can be considered. This could be initiated by the writing of *project briefs*, defining the scope and objectives of each project.

2.12 Some Reservations about Programme Management

Some writers on project management have expressed reservations about the way they see the ideas of programme management being presented. It is argued that approaches like the one we have described above focus on *structure* – for example, who reports to whom – at the expense of *process* – for example, the basis on which decisions are made.

The main concern is that the programme may be seen as some kind of 'super-project'. This could lead to two problems: first, that programme management may exert an unnecessary control over the subordinate projects leading to bureaucratic obstruction. The second is that programmes should be seen as the means by which the objectives of the business are converted into action at the level of projects. The business environment is constantly changing and as a consequence programmes need to evolve and be modified during the course of

their execution. If the super-project idea predominates then too much planning at the beginning plus a reluctance to change the scope of the programme may lead to inflexibility.

As we have seen in the case of the company merger programme, the projects within a programme may be very different from one another. Also, some programmes – for example where engineering integration is important – may need to be quite tightly coordinated, whereas other programmes could afford a more flexible regime.

The main lessons here seem to be:

- programme management is *not* simply a scaled-up project management;
- different forms of programme management may be appropriate for different types of project.

2.13 Benefits Management

Thomas K. Landauer (1995) *The Trouble with Computers: Usefulness, Usability and Productivity*, MIT Press, explores the issues of the 'productivity paradox' in IT.

We have already noted that providing a capability does not guarantee that the capability will be used to deliver the planned benefits. Businesses have become aware of the lack of evidence of some investments in ICT increasing the productivity of organizations. Even with *business process re-engineering* (BPR), the radical reorganization of businesses to deliver improvements in efficiency and effectiveness, there are many reported cases where the expected benefits have not materialized.

Benefits management is an attempt to remedy this. It encompasses the identification, optimization and tracking of the expected benefits from a business change in order to ensure that they are actually achieved.

To do this, you must:

- define the expected benefits from the programme;
- analyse the balance between costs and benefits;
- plan how the benefits will be achieved and measured;
- allocate responsibilities for the successful delivery of the benefits;
- monitor the realization of the benefits.

Benefits can be of many different types, including;

- *Mandatory compliance* Governmental or European legislation might make certain changes mandatory.
- *Quality of service* An insurance company, for example, might want to settle claims by customers more quickly.
- *Productivity* The same, or even more, work can be done at less cost in staff time.
- *More motivated work force* This might be because of an improved rewards system, or through job enlargement or job enrichment.
- *Internal management benefits* (for instance, better decision making) To take an insurance example again, better analysis of insurance claims could pinpoint those categories of business which are most risky and allow an insurance company to adjust premiums to cover this.

Job enlargement and enrichment will be discussed in Chapter 11.

- *Risk reduction* The insurance example might also be applicable here, but measures to protect an organization's networks and databases from intrusion and external malicious attack would be even more pertinent.

- *Economy* The reduction of costs, other than those related to staff – procurement policies might be in place which encourage the consolidation of purchasing in order to take advantage of bulk-buying discount.
- *Revenue enhancement/acceleration* The sooner bills reach customers, the sooner they can pay them.
- *Strategic fit* A change might not directly benefit a particular group within the organization but has to be made in order to obtain some strategic advantage for the organization as a whole.

A change could have more than one of these types of benefit. In fact, benefits are often inter-linked. An example of this is an insurance company which introduced a facility whereby when settling claims for damage to property, they directly arranged for contractors to carry out the remedial work. This improved quality of service for customers as it saved them the trouble of locating a reputable contractor, reduced costs to the insurance company because they could take advantage of the bulk purchase of services, and improved staff morale because of the goodwill generated between the insurance company's front-line staff and the customer.

Quantifying benefits

We have already seen that benefits can be:

- quantified and valued – that is, a direct financial benefit is experienced;
- quantified but not valued – for example, a decrease in the number of customer complaints;
- identified but not easily quantified – for example, public approval of the organization in the locality where it is based.

A particular activity might also have *disbenefits*. For example, increased sales might mean that more money has to be spent on expensive overtime working.

There can be controversy over a whether a business change will lead to the particular benefits claimed for – for example that a new company logo will improve staff morale. Some key tests have been suggested in order to sound out whether a putative benefit is likely to be genuine:

- Can you explain in precise terms why this benefit should result from this business change?
- Can you identify the ways in which we will be able to see the consequences of this benefit?
- If the required outcomes do occur, can they be attributed directly to the change, or could other factors explain them?
- Is there any way in which the benefits can be measured?

We mentioned earlier the need for *benefit profiles* that estimate when and how benefits will be experienced. Specific staff have to be allocated responsibility for ensuring that the planned benefits actually materialize. These will often be *business change managers*.

Benefits cannot normally be monitored in a purely project environment because the project will almost certainly have been officially closed before the benefits start to filter through.

In our view, benefits management brings to the fore the powerful idea that developers and users are *jointly* responsible for ensuring the delivery of the benefits of projects.