### Project management techniques guide

### Within budget!

### **Financial appraisal techniques**

### **Within budget!**

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### On time!

### Required quality!

Within budget!  
Financial appraisal techniques

# Introduction

A project is usually considered successful if it is completed:

1. on time;
2. within budget;
3. to the required quality.

This second guide in the “Project management techniques” series looks at some common techniques that help us ensure that projects meet their budgeted costs.

A project’s budget is almost always related to the expected benefits of what it produces. If the product - say an working information system - is expected to produce net benefits of only £100,000, the project must cost significantly less than that to be worthwhile running. So the main aim of this guide is to establish ways of evaluating costs and benefits of a project, and thus derive a workable project budget.

# Background

As individuals, when faced with a choice of actions, we might take into account a great many factors. Which course of action makes me look best? Which is most convenient? Which will be best in the long run?

Similarly when organisations make a decision, a great many factors may have to be taken into account. Will one option have a more beneficial effect on product quality? Which one will give the biggest improvement in customer relations? That option allows us to reduce stock levels, but this one will reduce delivery lead times; which is better?

If we can evaluate all competing factors using a common measure, it is relatively easy to decide which is the best option. By far the most widely used common measure is money. Ideally, if all the benefits and drawbacks can be quantified in monetary terms, we can simply choose the one with the greatest financial benefits. This is known as *financial appraisal.*

A financial appraisal will help us to decide:

1. whether to proceed with the project; and
2. which option we should choose if there are several possible ways to proceed.

There are several financial appraisal techniques. The three described here are:

1. pay-back period;
2. discounted cash flow, sometimes called net present value; and
3. internal rate of return.

Later in this guide we shall discuss some of the complexities of identifying and quantifying costs and benefits. First, let’s first apply the three financial appraisal techniques to an illustrative case study.

# The case study

A project manager and an accountant have examined three options available to them, and added up the various costs and benefits as follows. (For now, don't be too concerned about the details. Just compare the *Difference* lines of the three options.)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Year | **0** | **1** | **2** | **3** | **4** | **5** | **Net value** |
| **Option 1** £ |  |  |  |  |  |  |  |
| Hardware | -300,000 |  |  |  |  |  |  |
| Software | -300,000 |  |  |  |  |  |  |
| IS Staff | -600,000 | -100,000 | -100,000 | -100,000 | -100,000 | -100,000 |  |
| Maintenance |  | -50,000 | -50,000 | -50,000 | -50,000 | -50,000 |  |
| Consumables |  | -50,000 | -50,000 | -50,000 | -50,000 | -50,000 |  |
| **Costs** | **-1,200,000** | **-200,000** | **-200,000** | **-200,000** | **-200,000** | **-200,000** |  |
|  |  |  |  |  |  |  |  |
| Increased profit |  | 800,000 | 800,000 | 200,000 | 200,000 | 200,000 |  |
| **Benefits** | **0** | **800,000** | **800,000** | **200,000** | **200,000** | **200,000** |  |
|  |  |  |  |  |  |  |  |
| **Difference** | **-1,200,000** | **600,000** | **600,000** | **0** | **0** | **0** | **0** |
|  |  |  |  |  |  |  |  |
| **Option 2** £ |  |  |  |  |  |  |  |
| Hardware | -400,000 |  |  |  |  |  |  |
| Software | -400,000 |  |  |  |  |  |  |
| IS Staff | -400,000 | -200,000 | -200,000 | -200,000 | -200,000 | -200,000 |  |
| Maintenance |  | -150,000 | -150,000 | -150,000 | -150,000 | -150,000 |  |
| Consumables |  | -50,000 | -50,000 | -50,000 | -50,000 | -50,000 |  |
| **Costs** | **-1,200,000** | **-400,000** | **-400,000** | **-400,000** | **-400,000** | **-400,000** |  |
|  |  |  |  |  |  |  |  |
| Increased profit |  | 800,000 | 800,000 | 800,000 | 800,000 | 800,000 |  |
| **Benefits** | **0** | **800,000** | **800,000** | **800,000** | **800,000** | **800,000** |  |
|  |  |  |  |  |  |  |  |
| **Difference** | **-1,200,000** | **400,000** | **400,000** | **400,000** | **400,000** | **400,000** | **800,000** |
|  |  |  |  |  |  |  |  |
| **Option 3** £ |  |  |  |  |  |  |  |
| Hardware | -400,000 |  |  |  |  |  |  |
| Software | -400,000 |  |  |  |  |  |  |
| IS Staff | -400,000 | -200,000 | -200,000 | -200,000 | -200,000 | -200,000 |  |
| Maintenance |  | -150,000 | -150,000 | -150,000 | -150,000 | -150,000 |  |
| Consumables |  | -50,000 | -50,000 | -50,000 | -50,000 | -50,000 |  |
| **Costs** | **-1,200,000** | **-400,000** | **-400,000** | **-400,000** | **-400,000** | **-400,000** |  |
|  |  |  |  |  |  |  |  |
| Increased profit |  | 800,000 | 800,000 | 800,000 | 400,000 | 1,200,000 |  |
| **Benefits** | **0** | **800,000** | **800,000** | **800,000** | **400,000** | **1,200,000** |  |
|  |  |  |  |  |  |  |  |
| **Difference** | **-1,200,000** | **400,000** | **400,000** | **400,000** | **0** | **800,000** | **800,000** |

The three options are for different types of computer network, software from various suppliers and so on. All three have an up-front cost of £1.2 million, and initially provide benefits to the tune of £800,000 each year.

1. Option 1 costs less to run, but has no net benefit from year 3 onwards.
2. Options 2 and 3 have higher running costs, but both continue to give benefits through to year 5 (though their benefits differ slightly in the later years).

# Three financial appraisal techniques

We have to choose the best of these three options. What results do the various financial appraisal techniques give?

## Technique 1. Pay-back period

This technique says, “Choose the option that repays initial investment soonest.” Using this rule in the above scenario, we would choose option 1. Here are the *Difference* lines from the three options.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | **0** | **1** | **2** | **3** | **4** | **5** |
| **Option 1** £ | -1,200,000 | 600,000 | 600,000 | 0 | 0 | 0 |
|  |  |  | Payback ^ |  |  |  |
|  |  |  |  |  |  |  |
| **Option 2** £ | -1,200,000 | 400,000 | 400,000 | 400,000 | 400,000 | 400,000 |
|  |  |  |  | Payback ^ |  |  |
|  |  |  |  |  |  |  |
| **Option 3** £ | -1,200,000 | 400,000 | 400,000 | 400,000 | 0 | 800,000 |
|  |  |  |  | Payback ^ |  |  |

**Question [[1]](#footnote-1).** What problem does this approach give us? (Clue: the case study has been designed specifically to demonstrate this problem.)

### Making decisions

Rule: Proceed only if there is full pay-back in the projected life of the system. Choose the option with the shortest pay-back period.

Philosophy: IS is a necessary evil. Get back our money as quickly as possible.

Advantage: Simple technique.

Disadvantage: May lead you to make decisions that lead to little or no overall benefit. May lead you to proceed with a project that does not generate enough income to cover loan interest charges. Does not help you when all options make a net loss (for example, a project to satisfy a new legal requirement).

Although pay back period is widely used, the following two techniques are more likely to give a satisfactory result.

## Technique 2. Discounted cash flow (DCF)

Before considering DCF, let’s think of a simple improvement to pay-back period. Just comparing the overall net profit (i.e. benefits – costs) would ensure that we chose the option that was best *in the long run*.

### Net profit

Net profit is simple approach, though rarely used. In the case study, both options 2 and 3 give a better result; they both yield a net benefit of £800,000. This means we can ignore option 1, since it yields no benefit at all.

**Question [[2]](#footnote-2).** What factor does this approach ignore?

There are many reasons why saving money in the future isn’t as valuable as saving it now:

1. we could gainfully invest the savings in the meantime;
2. or with the savings we might avoid having to borrow money at high interest rates;
3. there is a risk that future savings might not materialise (all other things being equal, I’d rather have the money today than wait - and perhaps never receive it);
4. inflation devalues money over time.

### Discounting the cash flows

In practice, almost everyone discounts cash flows in the future, rather than use straight net profit. (Net profit is described here only as a stepping stone to DCF.)

Each future year’s cash flow is multiplied by a discount factor that is less than 100%. The factor gets lower with the years. We then add up each year’s discounted figure to produce a single figure for each option: the *net present value* or *NPV.*

Here are the DCFs for the three options in the case study:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Year | **0** | **1** | **2** | **3** | **4** | **5** | **Net present value** |
| **Option 1** £ | -1,200,000 | 600,000 | 600,000 | 0 | 0 | 0 |  |
| Factor | 1 | 0.87 | 0.76 | 0.66 | 0.57 | 0.5 |  |
| Present value | -1,200,000 | 522,000 | 456,000 | 0 | 0 | 0 | -222,000 |
|  |  |  |  |  |  |  |  |
| **Option 2** £ | -1,200,000 | 400,000 | 400,000 | 400,000 | 400,000 | 400,000 |  |
| Factor | 1 | 0.87 | 0.76 | 0.66 | 0.57 | 0.5 |  |
| Present value | -1,200,000 | 348,000 | 304,000 | 264,000 | 228,000 | 200,000 | 144,000 |
|  |  |  |  |  |  |  |  |
| **Option 3** £ | -1,200,000 | 400,000 | 400,000 | 400,000 | 0 | 800,000 |  |
| Factor | 1 | 0.87 | 0.76 | 0.66 | 0.57 | 0.5 |  |
| Present value | -1,200,000 | 348,000 | 304,000 | 264,000 | 0 | 400,000 | 116,000 |

Each year’s discount factor is calculated as 1 / (1 + r) i , where *r* is the discount rate and *i* is the year (starting from zero). In this example we have used a discount rate of 15% p.a., which is typical of appraisals in the private sector. The public sector is likely to use a much lower discount rate, often around 5% or 6%. p.a. (e.g. HM Treasury, 1991).

**Question [[3]](#footnote-3).** Why does the public sector use a lower discount rate than the private sector?

**Question [[4]](#footnote-4).** What effect would a higher rate have on the outcome of the calculation?

Net present value can be expressed as this formula:

where *Ci* is the cash flow (cost or saving) in year *i*, and *n* is the number of years under consideration. Although it looks complex, it is relatively easy to calculate using a spreadsheet.

### Do nothing

We might choose one option just because it appears better than the others. In some situations it might be better simply to do nothing. There are two ways of ensuring that the “do nothing” option is considered.

1. Always calculate the NPV of doing nothing. This may not be zero, since you will continue to employ staff, continue to use old procedures, and so on.  
  
**Simplified example:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mainframe | Network | Do nothing |
| Net saving (NPV) | + £800,000 | + £700,000 | - £300,000 |
| Better than do nothing | £1,100,000 | £1,000,000 | - |

2. Cost the various options *in comparison with* “doing nothing”, so if the NPV is positive it must be better than doing nothing.  
  
**Simplified example:**

|  |  |  |
| --- | --- | --- |
|  | Mainframe | Network |
| Basic net saving | + £800,000 | + £700,000 |
| Also avoid | £300,000 | £300,000 |
| NPV | + £1,100,000 | +£1,000,000 |

Don’t fall into the trap of doing *both* of these; if you include savings over doing nothing, *and* calculate the NPV of “Do nothing”, the project’s benefits will be double-counted.

### Making decisions

Rule: Proceed only if the NPV is positive (or NPV is higher than “do nothing”). Choose the option with the highest NPV.

Philosophy: We need to optimise our investment by choosing the most fruitful option.

Advantages: Widely used and understood. Takes into account the relative value of money over time. Can allow for risk by varying discount rates, or using NPVs in a decision tree. Works even when all options make a net loss.

Disadvantage: May lead you to make decisions that are no better than “doing nothing.” The results will vary depending on how many years you take into account (you must calculate the figures only for the useful life of the system). Typically, PC-based systems will be appraised over 3 to 5 years, mini-computer systems around 5 to 7 years, and mainframe systems up to 10 years.

## Technique 3. Internal rate of return (IRR)

This technique is similar in some ways to discounted cash flow. Instead of calculating the return for a given discount rate, it seeks to find the worth of the project. This is rather like establishing the “interest rate” of the investment.

IRR searches for the discount rate that yields a zero NPV. An option with a good return will yield a high discount rate (IRR); a poor option will yield a low discount rate.

We might be helpful to distinguish between DCF and IRR as follows:

1. DCF: all options have the same discount rate, we choose the highest NPV;
2. IRR: all options have the same NPV (zero), we choose the best discount rate (IRR).

Applying IRR to the case study, we need to find a discount rate that gives a zero NPV:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Year | **0** | **1** | **2** | **3** | **4** | **5** | **Net present value** |
| **Option 1** £ | -1,200,000 | 600,000 | 600,000 | 0 | 0 | 0 |  |
| Rate **0%** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |  |
| Present value | -1,200,000 | 600,000 | 600,000 | 0 | 0 | 0 | 0 |
|  |  |  |  |  |  |  |  |
| **Option 2** £ | -1200000 | 400,000 | 400,000 | 400,000 | 400,000 | 400,000 |  |
| Rate **20%** | 1.00 | 0.83 | 0.70 | 0.58 | 0.48 | 0.40 |  |
| Present value | -1,200,000 | 333,729 | 278,438 | 232,307 | 193,819 | 161,707 | 0 |
|  |  |  |  |  |  |  |  |
| **Option 3** £ | -1,200,000 | 400,000 | 400,000 | 400,000 | 0 | 800,000 |  |
| Rate **19%** | 1.00 | 0.84 | 0.71 | 0.60 | 0.50 | 0.42 |  |
| Present value | -1,200,000 | 337,030 | 283,973 | 239,268 | 0 | 339,729 | 0 |

As with DCF, option 2 is revealed as the best option. Many spreadsheets include an IRR function. Alternatively you could use the “Goal seeking” or “Solver” feature; aim to set each option’s NPV to zero by varying its discount rate. The software will try different values for the discount rate, and keep varying it until the NPV is zero. You will have to repeat this for each option, and compare their discount rates (IRRs). (Note: IRR is sometimes called *DCF Yield.)*

### Making decisions

Rule: Proceed only if the Internal Rate of Return is better than other places to invest our money. Chose the option with the highest IRR.

Philosophy: Although a proposal might be a useful investment, it has to compete with other investment opportunities.

Advantages: Takes into account the relative value of money over time. Comparison with “do nothing” option is built into the method.

Disadvantage: Not well understood, especially as calculating the IRR is time-consuming without software support.

# Identifying and quantifying benefits

In the case study, we have used a set of costs and benefits that were specifically designed to demonstrate the relative advantages of the three financial appraisal techniques. In real life, identifying benefits can be a little difficult; putting a monetary value to them may be impossible.

## Intangibles and unquantifiables

It is rarely a problem to put a monetary value to the *costs* of a project. People providing the resources of a project will make sure you are charged! *Benefits* are not always so easy to identify or quantify.

Some benefits are *intangible*, that is, we know the effect is good, but we can’t exactly say how the organisation will benefit. An example is where a project allows us to improve customer service. We might be able to quantify it as “10% fewer complaints” but cannot express the benefit in money terms. Similarly, the project may result in improved job satisfaction for the employees, but how can we put a value to it?

Some benefits are *unquantifiable*, that is, the benefit should be measurable in monetary terms but we don’t know how much it is worth. An example is where a project allows us to provide a new service. We are sure it will be profitable, but will it be worth £1 or £1,000,000 ?

Worse still are benefits that are intangible *and* unquantifiable: even if we could quantify it, it wouldn’t be a monetary figure. So we have a grid of four possible types of benefit.

|  |  |  |
| --- | --- | --- |
|  | Quantifiable | Unquantifiable |
| Tangible | 1 | 2 |
| Intangible | 3 | 4 |

**Question [[5]](#footnote-5).** Looking at this grid, into which zone would we want all the benefits to appear?

A useful technique to turn intangibles into tangibles is to ask of each benefit, “So what?” Customer service has improved; so what? They are more likely to remain loyal customers and more likely to recommend us to others; so what? Sales will improve; so what? Profits will increase. This is a tangible benefit as it can be measured in monetary terms.

Tackling unquantifiables often requires records of similar benefits in the past. For example, we usually find about 10% of our customers tried out a new service like this, so we can calculate sales and thus profits.

### Desiderata Ranking

In the end some intangible and unquantifiable benefits may remain. Even if the NPV is negative, management may nevertheless decide to “spend” this money in order to gain these other benefits.

Desiderata Ranking is used to decide among options that have intangible and unquantifiable benefits (Coombs & Jenkins, 1994). A multidisciplinary team of managers decides on the requirements, or desiderata, of the project. They agree a weighting according to their perceptions of the relative importance of each. Each alternative option is then given a score as to how well it achieves each requirement, or desiderata. The option’s value is calculated by multiplying each score by it’s weighting, then adding them up, as follows:

where *v* is the option’s value, *n* is the number of desiderata, *wi* is the weighting of desiderata *i*, and *si* is that desiderata’s score.

One problem with this technique is that it can be used only to rank options; users can’t easily compare a given option with the “Do nothing” option. Also, this technique is inherently subjective, because the desiderata, their weightings, and their scores are decided on by individuals.

An on-line evaluation system (focussed on evaluating learning methods) that is based on Desiderata Ranking principles can be found at http://www.ltss.bris.ac.uk/jcalt/

## Other problems with financial appraisals

### Legislation and cash flow

It may be unacceptable to cost some options, such as those that ignore or disregard new legislation. In particular the “Do nothing” option is sometimes untenable.

It may be that the most favourable option has to be rejected simply because the organisation cannot raise the money needed at the time it is needed. For instance, a project requires £5 billion up-front and that much money can’t be raised in time.

### Boundaries

A common problem with financial appraisal is establishing the boundary of the study. What costs and benefits are beyond the scope of the project? A typical example is where a project results in staff reductions. Obviously salary savings should be counted, but should we calculate redundancy payments? On the other hand, the released staff might fill vacancies elsewhere in the organisation, so we would save on recruitment costs instead. How is the project manager to know which of these will happen? In extreme cases projects in central government might need to include ongoing welfare payments (and reduced income tax) for those made redundant, and the impact on the local economy.

In general, a *financial appraisal* is narrowly focused on immediate costs and benefits; redundancy, recruitment, welfare and so on are ignored. A study that accounts for these wider costs is called a *cost‑benefit analysis* (Mott, 1993).

### Taxation and grants

Financial appraisals have to calculate the (complex) taxation implications of each investment proposal. On the one hand we have to calculate the increased tax burden from increased profits; on the other we may gain from additional tax allowances which in effect reduce tax commitment. Similarly some projects will benefit from government grants.

Since the rules for taxation and grant payments change frequently, detailed consideration is not given here. Project managers ought to seek expert assistance with these matters.

### Risk

One option may give a clearly superior Net Present Value, but be a riskier option; there is a strong chance that it might not deliver any benefits at all. A technique called a “decision tree” can be used to factor in the relative risks of each option. An alternative approach is to use different discount rates for the various options to reflect their relative riskiness.

### Marginal and absorption costing

It is a widely accepted principle that costs and benefits are calculated on an absorption basis. For instance, staff salaries are calculated with an allowance for overheads such as superannuation contributions, accommodation costs, central administration, and insurance. In practice, adding a few extra staff or saving a few staff will not make much difference to the organisation’s expenditure on accommodation or central administration.

Before embarking on a lengthy financial appraisal, the project manager should be clear about whether to use absorption or marginal costing

### Sunk costs and residual values

**Question [[6]](#footnote-6).** Suppose a feasibility study had been completed before a project. Should the project manager include the cost of the study in the financial appraisal? Why?

Costs incurred in the past are called *sunk* costs. The dilemma of ignoring sunk costs is most acute near the end of a badly run project. Suppose that after spending £1 million, a revised DCF shows that projected benefits will be only £500,000 and that there is still £100,000 of work to complete. With the benefit of hindsight we might wish we had never embarked on the project, but it is not worth cancelling the project now (assuming the latest DCF is reliable).

On the other hand, it is common to include residual values of capital equipment as a benefit at the end of a project. Bear in mind, though, that old computer equipment is almost worthless.

### Estimating

Estimating is a major factor in ensuring that the financial justification for a project - and hence its budget - is accurate and workable. The fourth guide in this series, “On time and within budget! (Estimating techniques),” provides guidelines for producing good estimates.

# Budgeting and monitoring

The financial appraisal figures are used to cost-justify a project. However, the story doesn’t end there.

### Budgets

The costs identified will form the basis of the project budget. The project manager should ensure that the project remains within the projected costs.

As mentioned above, most financial appraisals use absorption costing principles, where overheads etc. are included on a *pro rata* basis. A project budget might have to be set on a more formal footing.

**Question [[7]](#footnote-7).** Suppose the project manager realises that additional hardware is required. Would it be acceptable to reduce spending on project team staff costs to “pay” for the hardware? Give your reasons.

Normally the project budget will have a *tolerance,* that is, an upper and lower boundary within which spending projections may vary without seeking a revised budget from senior management.

**Question [[8]](#footnote-8).** Why should we allow a tolerance? Why can’t we expect the project manager to meet the budget exactly?

### Post-completion audits

It is all too easy to make wild claims of expected benefits in a financial appraisal. Many organisations now hold a *Post-completion Audit*, sometimes called a *Post Implementation Review*, to examine how accurate were the cost and benefit projections. The person responsible for the financial appraisal may be held accountable for shortfalls in the hoped-for benefits. The results of the audit should be fed back to estimators to help improve financial appraisals in the future.

# Bibliography

Coombs, H. M. & Jenkins, D. E. (1994) *Public Sector Financial Management,* Chapman & Hall

HM Treasury (1991) *Economic appraisal in Central Government*, HMSO

Irvine, G (1987) *Modern cost-benefit methods*, Macmillan

Mott, G (1993) *Investment appraisal,* 2nd Ed, Pitman

1.  Pay back period can lead us to choose options that provide no overall benefit. In the case study, option 1 would be chosen, but the net benefit is zero. Realistically, options 2 and 3 are much better, as they provide overall net benefits in later years. [↑](#footnote-ref-1)
2.  Money spent or saved in the future isn’t worth as much as money spent or saved now. We need a means of “devaluing” cash flows in future years to get them on the same basis as today’s cash flows. That way we can compare like with like. [↑](#footnote-ref-2)
3.  The public sector can borrow money more cheaply than the private sector, mainly because it offers a low risk to lenders, but also because government borrows directly so avoids the profit margins of lending institutions. [↑](#footnote-ref-3)
4.  Future cash flows will have an even lower present value. Since most software projects involve up-front costs, and the benefits accrue only in later years, a high discount rate will make it much less likely that a project proposal will be cost justified. [↑](#footnote-ref-4)
5.  Ideally we want all benefits to be in zone 1: tangible and quantifiable [↑](#footnote-ref-5)
6.  No. Expenditure in the past are considered *sunk* costs. This money has been spent and could not be recovered even if the project were cancelled. [↑](#footnote-ref-6)
7.  No, we could not allow a project manager to transfer *(vire)* budget from staff salaries to capital expenditure in order to pay for more hardware. (1) There is a fundamental difference between current and capital expenditure, since one is an expense and the other an investment. (2) It is unlikely that reduced staff hours would result in any real cost savings (they will still be paid at the end of the month and the overheads would remain), but the hardware would cost real money. [↑](#footnote-ref-7)
8.  Suppose the project manager were to reassess the spending projections a few weeks after the project commenced, and found that the project is heading for an underspend of £1. Without a tolerance, he or she would have to seek senior management approval for a budget change. Suppose that a few weeks later a revised projection shows and overspend of £2. Another budget change would have to be approved. Clearly any sensible project manager wouldn’t bother with such small amounts, but just how big a variance can the project manager accept? This is what the tolerance specifies. [↑](#footnote-ref-8)