Summary of some cost estimating methods.

Model Category	Description	Advantages	Limitations
Analogy	Compare project with past similar projects	Estimates are based on actual experience	Truly similar projects must exist
Expert Judgment	Consult with one or more experts	Little or no historical data is needed; good for new or unique projects	Experts tend to be biased; knowledge level is sometimes questionable
Bottom-Up	Individuals assess each component and then component estimates are summed to calculate the total estimate	Accurate estimates are possible because of detailed basis of estimate; promotes individual responsibility	Methods are time-consuming; detailed data may not be available, especially early in a program; integration costs are sometimes disregarded
Parametric Models	Perform overall estimate using design parameters and mathematical algorithms	Models are usually fast and easy to use, and useful early in a program; they are also objective and repeatable	Models can be inaccurate if not properly calibrated and validated; it is possible that historical data used for calibration may not be relevant to new programmes.

Example of the Use of A Cost Index

An airframe manufacturer has been asked to produce an airframe, which was last made in November 2017, and for which only general cost information is available. It is now November 2020. The Index number for combined costs of the aerospace industry airframe sector in November 2020 is 322.4. The corresponding index number in November 2017 was 265.6

Relative price increase =

$$\frac{\text{Index number in November 2020}}{\text{Index number in November 2017}} = 322.4/265.6 = 1.214$$

Therefore the cost in November 2020 is 1.214 x the cost in November 2017.

PROJECT APPRAISAL

Project appraisal is a generic term that refers to the process of assessing, in a structured way, the case for proceeding with a project or proposal.

In short, project appraisal is the process of calculating and predicting a project's viability.

Project Appraisal is also sometimes called Project Evaluation but be aware that Project Evaluation can also mean retrospective evaluation

Appraisal is the process of defining objectives, examining options and weighing up the costs benefits, risks and uncertainties of those options before a decision is made.

Appraisals should provide an assessment of whether a proposal is worthwhile, and clearly communicate conclusions and recommendations.

Appraisals are often iterated a number of times before their proposals are implemented in full.

As the stages of an assessment progress, data must be refined to become more specific and accurate.

Some organisations appraise projects before possibly implementing them, and then (retrospectively) evaluates them (e.g. the World Bank).

Evaluation is the retrospective analysis of a project, programme, or policy to assess how successful or otherwise it has been, and what lessons can be learnt for the future. The terms ‘policy evaluation’ and ‘post-project evaluation’ are often used to describe evaluation in those two areas.

Appraisal, done properly, is crucially important and needs to be carried out carefully.

Decisions taken at the appraisal stage affect the whole lifecycle of new policies, programmes and projects.

Similarly, the proper evaluation of previous initiatives is essential in avoiding past mistakes and to enable us to learn from experience.

Economic Appraisals	Financial Appraisals
Focus: • VFM – net present value (NPV)	Focus: • Funding and affordability – cash flow and stock
Coverage: • wide coverage – Government and Society ('UK Ltd')	Coverage: • relevant organisation(s)
Relevant standards: • HM Treasury Green Book and supplementary guidance • discount rate (3.5%) applied	Relevant standards: • organisational accounting rules and standing orders • no discount rate applied
Analysis: • constant (base year) prices • includes opportunity cost • includes all quantifiable costs, benefits and risks to both organisation and wider society • includes environmental costs • excludes all Exchequer 'transfer' payments – for example, VAT • excludes general inflation • excludes sunk costs • excludes depreciation and capital charges.	Analysis: • current (nominal) prices • benefits – cash releasing only • includes capital and revenue costs • includes transfer payments (for example, VAT) • includes inflation • includes depreciation and capital charges.

PROJECT APPRAISAL

JM Keynes wrote in 1935 (General Theory of Employment, Interest and Money);

"Frankly we must admit that in order to estimate the profits on a railroad ten years or even five years hence, or those of a copper mine, a textile mill, a brand of drugs, a transatlantic steamer, or a building in London, the available data boil down to very little and sometimes absolutely nothing."

PROJECT APPRAISAL

Qualitative Methods

eg

1. Renewing Broken Equipment.
2. Replacing Equipment which appears dilapidated or old.
3. By "experience".

- are **UNSATISFACTORY**.

Quantitative Techniques
are more acceptable

1. Payback period
2. Average annual cost.
3. Net Present value (NPV).
4. Internal rate of return.
5. Simulation.
6. Parametric Discounting.
7. Cost-benefit analysis.
8. Decision Trees.

1. Payback period

- The period of time which has to elapse before the returns on an investment equal or exceed the original amount invested - **widely used - but not recommended !**

2. Average annual cost

- The net profit or loss of an investment divided by the time during which the cash flows take place.

2.ii calculation of the return of the investment as a percentage.

i.e. $\frac{\text{Annual Average Cost}}{\text{Initial Capital Cost}} \times 100$

- Average annual cost method does not always provide a means of differentiating between projects which have different total net cash flows.

Average annual cost and payback methods do not take account of the time value of money.

Payback method implies a discount rate of 0 to some time horizon and infinity after that.

Time Horizon - an assumed date beyond which a project produces neither costs or benefits

3. Net Present Value (N.P.V.)

- The present value of the income generated by the investment, less the present value of the costs of the investment.

i.e.

$$\sum_{n=0}^{n=t} \frac{B_n}{(1 + i)^n}$$

WHERE: n is the timing of the cash flow, B_n its value, i the discount rate, t, the time horizon.

4. Internal Rate of return (IRR)

- is the discount rate which would give the project an N.P.V. of 0 this value of the discount rate is sometimes known as the yield of the investment.

The I.R.R. of the project is the compared against a predetermined rate to evaluate how acceptable a project is.

The I.R.R. can be expressed as the value of i when

$$\sum_{n=0}^{n=t} \frac{B_n}{(1+i)^n} = 0$$

(Symbols as before)

Dean (1951) (Capital Budgeting) Columbia Univ. Press sets out decision rules for the I.R.R. method.

- Investments in feasible projects are ranked in order of I.R.R. and are undertaken to the point where the I.R.R. equals a predetermined rate.
- This assumes that there is perfect certainty, perfect capital market, and investment alternatives are independent.

Lorie & Savage (1955) (Journal of Business) defined circumstances where Dean's approach is inadequate.

1. Projects which are not independent.
2. The sum total of capital expenditure is constrained.
3. The stream of returns on a project contains alterations in sign.

The I.R.R. method does not always provide an unique solution for the yield; there may even be several

6. Parametric Discounting

The I.R.R. method is a parametric method: it expresses a value(s) for the discount rate at which the rate is the boundary between a rate at which the project is profitable and one at which it is not.

Parametric discounting in general uses uncertain time horizons, differential cash flows, and results are limits for one parameter (e.g. time horizon) given expected values for the other parameters (e.g. cash flows, discount rate). The most critical parameter can then be assessed and identified, and particular attention paid to these in the evaluation process

5. Simulation

(i) Derive probability distributions for the significant factors in a project - operating cost, fixed costs, useful life, investment required, selling price.

(ii) Select at random sets of these factors.

(iii) Determine a rate of return or N.P.V. for each combination.

(iv) Repeat the process to give a portrayal of the expected outcome and the risk.

PROBABILISTIC N.P.V. CALCULATIONS.

Example:

Suppose a project costs £10,000
Cash Flows will total £14,000

If the project lasts 2 years cash flow is £7,000 a year
If it lasts 3 years cash flow is £4,667 a year
If it lasts 4 years cash flow is £3,500 a year

Probabilities that it lasts 2, 3 or 4 years is 0.3, 0.5 and 0.2. respectively.

The discount rate is 4%

Duration	Probability	NPV*	NPV x Probability
2	0.3	3,203	961
3	0.5	2,931	1,466
4	0.2	2,705	541
		Expected Value	2,968

NPV* - the annual cash flow for each year discounted at 4% for the appropriate number of years, less £10,000.

COST - BENEFIT ANALYSIS (COBA)

1844 - Dupuit "On the measurement of the utility of public works"

1961 - Plowden Committee Report on "Public Investment in Great Britain” called for wider use of accounting and statistical techniques in the allocation of public funds.

COBA

- Provides a means of measuring the economic cost of a scheme against the economic benefits which might be expected to accrue from its implementation.

NB It is economic costs and benefits not accounting cost and benefits that are measured.

- It enables public organisations (Government, local authorities, NHS, etc.) to choose between alternative ways of achieving the greatest benefit at the least cost.

- Profitability is not the main policy objective.

- used to examine future capital investments.

The basic idea of cost-benefit analysis is to weigh up the advantages and disadvantages.

- It is possible to disagree on what are "good" and "bad" effects of a project.

Cost-Benefit analysis purports to be a way of deciding what society prefers. Where only one option can be chosen, CBA should inform the decision maker as to which option of the ones available is SOCIALLY most preferred.

It claims to be democratic - individual preferences count.

-But it relies on the net benefit to society.

Should individual preferences count ? "Democratic" societies do not always allow individuals' preferences to determine outcomes.

Governments often argue that they know best what is good for individuals. e.g. why prevent the public from deciding on capital punishment, but allow them to record their preference for a new road). Beneficiaries on an investment may not have an understanding of its benefits. e.g. education where benefits may accrue in the distant future.

CBA adopts as its criterion of social gain an improvement in social utility (Welfare).

Accounting Prices (also called shadow prices)

Resources are limited.

Their use in one project will entail an opportunity cost (i.e. the benefit they would have yielded in an alternative use).

When prices are used explicitly to exchange items freely, they are called market prices

When the prices are implicit in exchanges they are called "Accounting Prices" or "Shadow Prices".

"Shadow Prices" are not necessarily observed Health and Education are "outputs" but they are not always sold on the market. - There is no observable price, but there is a shadow price since each must have an opportunity cost in terms of some foregone alternative.

Intangibles

- social effects in which there is no market or in which there is no reason to suppose that existing market do not value an effect completely.

Eg

i) No market in the delinquency rate but urban renewal schemes will affect this rate.

(ii) No market in defence.

(iii) No market in disamenities such as noise or pollution, but these can affect property prices.

There is a market in human life -

insurance against death and through accident prevention schemes:- road barriers, lighting, speed limits etc.

Motorway accidents occur, people will die in the process of building the channel tunnel.

If human life had infinite value these projects would not be carried out.

Decision makers are always valuing lives at some " shadow price".

Cost-benefit analysis must find ways.

1. To measure physical costs or benefits where no measure exists already.
2. Finding ways to estimate shadow prices.

The usefulness of accounting prices

Deriving accounting prices is an extremely difficult task - many economists feel that the results do not justify the effort given the degree of arbitrariness involved.

eg The Victoria Line underground railway in London was justified mainly in terms of the benefits to road users in view of the reduced congestion as a result of its construction.

The role of personal judgment is a source of criticism, as this lends a large element of "subjectivity" to a discipline which purports to be objective.

Externalities - also called external effects, secondary benefits and costs, spillovers, repercussion effects, and occasionally linkages.

Cost-benefit analysis differs from a "commercial" appraisal of a project in that it tries to include all costs and benefits, whether they accrue to the investing agency or not.

-The difference between the social returns and commercial returns consist of the "external" effects of the investment.

External effects can be either benefits or costs.

Examples

1 The construction of a reservoir by a water company necessitates dredging downstream by the Rivers Authority. (Technological Externality)

2. Improvement of a road leads to greater profitability of the garages and restaurants on that road, and employment of more labour. (Pecuniary externality)

An irrigation scheme results in an increase in grain production. Benefits are measured as the value of the increase in grain output, less the increase in farmer's costs (harvesting etc.)

Increased output will increase the activity of grain merchants, transport concerns, millers, bakers etc. - improve their profits.

Project Life estimating project life is a subjective activtivity, and is affected by shifts in demand, competing products etc. The effects of any error will depend on the value of future costs or benefits and the rate of discount.

Unemployment when there is unemployment, expenditure on a project by creating a multiplier effect, creates additional income for the rest of the economy.

Governments can choose between public works and other methods of curing unemployment.

Choice of Discount Rate (For NPV calculations)

The social time preference rate (STPR).

Is the STPR the same as the market rate?

Preferences expressed as individuals may not be the same as preferences expressed when they see themselves as part of a community.

In general society has a lower rate of discount in its collective attitude.