**The Business Case**

The purpose of the business case is to identify the benefits and costs of a project and hence to determine whether it is justified on economic or other grounds. Alternative solutions to an engineering problem can also be compared based on their respective costs and benefits. It is usually necessary to discount the future benefits and costs of a project in order to make comparisons in terms of present value. Various economic criteria have been proposed for the comparison of projects. Each of these has its merits, although the best on theoretical grounds is net present value.

INTRODUCTION

An engineering project involves the transformation of limited resources into valuable final products or outputs. For example, the construction of a dam involves the use of resources such as concrete, steel, human effort, and machine time. The dam is used to produce outputs such as water for domestic and industrial purposes, flood control, and recreation.

The engineer must be concerned not only with the technical feasibility of the project (i.e. will it work?) but also the economic feasibility. Economic evaluation is aimed at assessing whether the value of the final products exceeds the value of the resources used by the project. The values of the outputs when measured in economic terms are called the benefits of the project. Similarly, the values of the resources used in its construction and maintenance when measured in economic terms are called the costs of the project.

In the private sector, benefits and costs are measured by cash flows into and out of the firm, respectively. That is, a conceptual boundary is drawn around the firm and benefits and costs are represented by cash flows across this boundary.

For public sector projects, benefits and costs must be considered for society as a whole. In this case, benefits and costs are not necessarily associated with cash flows. For example, the benefits of a public transport system are not necessarily measured by the revenue which it generates. The government may choose to run the system at a loss for social or environmental reasons. In this case the benefits to the users of the system would probably exceed the revenue generated by it. If, for example, public transport were offered free of charge, few people would argue that the benefits to society were zero.

Sometimes there is a different perception of benefits and costs at various levels of government. For example, the federal government may provide a subsidy of 50% of the capital costs of new sewage treatment plants. When a state government is evaluating a particular plant, it would consider this subsidy as a reduction in the cost of the project. On the other hand, the federal government would consider the subsidy as merely a transfer payment from one branch of government to another and therefore not a true benefit or cost to society as a whole. In fact, the federal government may require the state to provide economic justification for the project in its (i.e. the federal government’s) terms without including the subsidy effect.

THE TIME VALUE OF MONEY

The costs and benefits (or revenue) of an engineering project usually occur over a long time period. For example, consider the construction of a new freeway. A typical time stream of benefits and costs is illustrated in Figure 8.1. Costs will be high during the construction phase which may last for three or four years. These costs could include disruption and inconvenience to users of the existing and adjoining roads. Annual maintenance and repair costs will be low initially, but will increase due to ageing of the pavement, bridges, and other components. The benefits to road users will be primarily due to savings in vehicle operating costs, savings in travel time and a reduction in the number of accidents in relation to the pre-existing road network. These benefits would normally increase with time due to increasing   
volumes of traffic using the freeway.

Diagram

Description automatically generated

In carrying out an economic evaluation of such a project, it must be recognized that benefits or costs incurred in ten years cannot be directly compared with those incurred in the current year. Given the choice between $1000 now and $1000 in 10 years, very few people would choose the latter. In the first place, the effects of inflation are such that fewer goods and services could be purchased with the future sum than at present. However, even in the absence of inflation, human nature is such that there is a preference to consume goods now rather than later, and to postpone costs if possible. This is clearly evidenced by the fact that many individuals are willing to borrow money at an interest rate which exceeds the rate of inflation. Therefore, in carrying out economic evaluation, it is necessary to discount   
future benefits and costs in order to make them directly comparable with benefits and costs incurred now. This is carried out using discounting formulae derived from considerations of compound interest.

DISCOUNTING FORMULAE

In all the economic calculations that follow, there are two basic assumptions:

* there is a single rate of interest (the *discount rate*) that applies into the future for both borrowing and lending;
* interest is paid in a compound fashion; that is, if interest is earned, then it is added to the capital and taken into account for future calculations of interest.   
  Chart, line chart

  Description automatically generated

If one looks at home loan interest rates and how they have varied over time in Australia (see Figure 8.2), it may be thought that the first assumption is questionable. However, despite the fact that rates do vary, it is usual for calculations to be carried out assuming an unvarying rate. If the rate does change at a later time, adjustments are made, again on the assumption of a constant rate into the future.   
  
Present worth – lump sum

If a sum of money P is invested for one year at an interest rate of *i*, then after one year the value will be:

*F=P(1+i)* (8.1)   
  
where *F* is the future sum and *P* the present sum. For example, $100 invested at an interest rate of 5 percent per annum (*i* = 0.05) for one year would yield $105 at the end of the year. If that money is invested for a second year, then the value becomes:   
  
 *F=P(1+i)(1+i) = P(1+i)2* (8.2)   
  
After two years the initial $100 yields $110.25. After a period of *n* years it can be shown that the basic formula to calculate the future worth of a sum of money can be written as:   
  
 *F=P(1+i)n* (8.3)   
  
where *F* is the future sum, *P* the present sum, *i* the interest rate and *n* the number of years (or to be more precise, the number of time periods over which the interest is paid).