NSW TREASURY

Office of Financial Management

GUIDELINES
FOR ECONOMIC APPRAISAL

TPP 97-2

Treasury Policy and Guidelines Paper

June 1997

PREFACE

The NSW Government *Guidelines For Economic Appraisal* provide important information to decision-makers at various levels within Government. They promote a consistent approach to the assessment of potential capital works projects across all public sector agencies.

The *Guidelines For Economic Appraisal* have been regularly reviewed and this edition incorporates the most recent amendments. Their application ensures that required reporting and appraisal standards are satisfied when new capital works projects are being considered. This will lead to better resource allocation decision making.

In general, an economic appraisal is required for all individual projects with a total cost in excess of $500,000. The *Guidelines* are not intended to address the specific issues of each agency. They do, however, establish the requirements for the evaluation of capital works, adapted to the characteristics and scale of the projects.

Your attention is also drawn to a companion document, *Economic Appraisal of Capital Works - Principles and Procedures Simplified*, which presents a summary of these guidelines.

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June 1997

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The full Guidelines and the associated Summary document can be accessed from Treasury's Internet site [http://www.treasury.nsw.gov.au/]. For printed copies contact the Publications Officer, 9228 4426.

CONTENTS

EXECUTIVE SUMMARY

1. Introduction

The New South Wales public sector is a major component of the State economy. The efficiency with which it uses resources can have a significant impact on the overall performance of the State economy and the welfare of its residents.

It is therefore important that the most efficient way of meeting particular service objectives are identified and implemented.

With the objective of improving public sector resource allocation, the Government decided in December 1988 that economic appraisal techniques should be applied to all capital works proposals.

The Guidelines on Economic Appraisal of Assets were first published in 1988. They were revised following a review by the Economics and Revenue Division in Treasury and the Capital Works Unit in Premier's Department in 1990. This edition incorporates further refinement following a review by Treasury in 1995.

2. Overview

The Guidelines are intended to establish a framework for all public sector agencies to undertake economic appraisals on a consistent basis. The framework covers both the reporting requirements for the Cabinet Standing Committee on the Budget (the Budget Committee) and the structure of appraisal required by the Committee.

However, these Guidelines are not intended as a manual to address the specific issues of each agency. Agencies should apply these general principles to their particular situation, and develop procedures for undertaking appraisals in their field of operation.

While primarily written with capital works proposals in mind, the principles outlined in the Guidelines are appropriate for the application of economic appraisal to other areas such as asset management, plan and program evaluation, and regulation review proposals.

3. Economic Appraisal

Economic appraisal is a way of systematically analysing all the costs and benefits associated with the various ways of meeting an objective.

Economic appraisal provides important information to decision makers at various levels within Government. Not only does it assist the Government at the highest level of decision making but it also helps individual agencies as they formulate their own capital works programs.

Clearly the results of the economic appraisal will not be the only factors taken into account when making a decision. Nevertheless, it provides vital information on the effects of each possible decision.

The use of economic appraisal techniques is encouraged in all relevant areas of public sector activity including asset management, plan and program evaluation, regulation review, in addition to new capital works. The process of undertaking economic appraisals of projects should interact with the review of strategic plans within agencies on an ongoing basis.

In respect of capital works decisions, economic appraisal will assist in the choice between projects. The choice can occur at two levels:

(1) the choice between alternative project options designed to achieve the same objective; and

(2) the choice between a range of projects, directed at a variety of objectives, which cannot all proceed due to resource constraints.

An economic appraisal differs from a financial appraisal in that it considers a wider range of costs and benefits.

Financial appraisal concentrates on benefits and costs accruing to the agency sponsoring the project, whereas economic appraisal considers wider effects, such as those accruing to other parts of the public sector, to private sector companies or to individuals. Benefits and costs may not all be reflected in cash transactions. For example, some services are provided free, while some projects may impose costs on individuals for which no compensation is received. Economic appraisal takes all these benefits and costs into account, and thereby goes one stage further than financial analysis.

4. The Guidelines

The Guidelines cover two methods of economic appraisal - cost benefit analysis (CBA) and cost effectiveness analysis (CEA). Both techniques require as many as possible of the benefits and costs to be quantified in money terms.

CEA is used when the major benefits cannot be valued in dollar terms, or when it would be unduly expensive to undertake the valuation. CEA is most often used in areas such as education, health, law and order and the environment, where CBA economic appraisal can prove more difficult. Longer term research may improve information standards in these areas.

While monetary valuation of effects is important, the methodology outlined explicitly takes unquantifiable benefits and costs into account. These will often be very important in public sector projects, and their identification is vital to the process of economic appraisal.

An important feature of economic appraisal is that various methods of achieving the stated objective are assessed.

Economic appraisal is most effective when it becomes a routine part of capital works planning, incorporated from the early stages of project development.

In order to ensure that a consistent approach is used by all public sector agencies, Treasury sets certain key parameters to be used in appraisals, such as the discount rate and the rate of real earnings growth.

Important features of the analysis, such as the definition of a project (neither too aggregated nor too disaggregated), the treatment of inflation, the valuation of impacts and the project period are all addressed in the Guidelines. Issues such as the valuation of benefits may create particular problems for certain agencies. In some cases problems may be shared by more than one agency and there is scope for cooperation across agencies to address some of these issues.

The Guidelines discuss the arithmetic of discounting and set certain key measures of worth which can be used for summarising the quantifiable benefits and costs and then used in conjunction with the available information on the unquantifiable effects. The preferred criteria are the Net Present Value (NPV), Benefit Cost Ratio and the Net Present Value per unit of capital invested (NPVI). The latter measure is designed to reflect the fact that capital may be considered a scarce resource from the point of view of the public sector as a whole.

The outcome of most capital works projects is affected by risk and uncertainty. This is recognised and the Guidelines stress the need for assessing the outcomes of projects under different scenarios.

5. Reporting Requirements

The Guidelines establish requirements for the evaluation of capital works, tailored to the characteristics and scale of the projects. The overall rule is that an economic appraisal will have to be undertaken for all individual projects with a total cost in excess of $500,000. The procedures used to assess projects below $500,000 should be appraised on a regular basis by each agency.

The Budget Committee will not require the economic appraisal to be submitted to them in all cases. There will be no additional reporting requirements for projects with a total cost under $1 million. Summary sheets only will be required for projects between $1 million and $5 million. Full appraisals will only be required for projects over $5 million. In addition, the Budget Committee will require special studies of some capital works, and may also attach special reporting requirements to certain projects.

All public sector agencies are responsible for undertaking economic appraisals and submitting them as part of their capital works bids.

Part I - Overview and Reporting Requirements

1. INTRODUCTION

The New South Wales public sector is a major component of the State economy. The efficiency with which it uses resources can have a significant impact on the overall performance of the State economy and the welfare of its residents.

Expenditure on capital works by State Departments and Government Trading Enterprises (GTEs) is over $5 billion annually. This expenditure is important not only because of its size, but also because it provided the economic and social infrastructure which is fundamental to the economic development of the State and the well being of its population.

This is particularly true in view of the major burden which debt servicing costs place on the budget. Debt servicing costs have been accounting for an increasing proportion of the Budget. The Government is therefore taking action to limit the level of borrowing. In this situation, it is vital to closely evaluate capital works proposals so as to ensure that the 'best value for money' is achieved and that scarce resources are allocated in a manner which reflects the Government's priorities.

While $5 billion is being spent on capital works this year, this is only the tip of the iceberg when the total stock of assets managed by the State is considered. The value of the capital stock of State Deaprtments and GTEs is estimated to be $100 billion.

It is clear that the issue is not simply one of new capital expenditure but of the effective and efficient management of the existing stock of assets. Economic appraisal is also appropriate in other areas of public sector activities, including plan and program evaluation and the review of regulation proposals.

Economic appraisal is a way of analysing all the costs and benefits associated with a particular project. While economic appraisal techniques seek to place monetary values on those costs and benefits whenever possible, the techniques also make explicit allowance for the many costs and benefits which cannot be valued. These will often be critical to the decision, and economic appraisal allows explicit account to be taken of them.

A number of public sector agencies have already devoted considerable resources to the economic evaluation of capital programs and asset management. The attention given to these techniques reflects their value to public sector agencies in internal decision making. These Guidelines are not intended to replace the approach followed by these agencies. Rather, it is intended to extend economic appraisal to all public sector agencies and achieve a more consistent approach. While economic appraisal does aid internal decision making, it can also assist in external review. These Guidelines therefore also aim to improve the information available to the Budget Committee.

The Guidelines cover several areas. They:

- establish requirements for the evaluation of capital works, tailored to the characteristics and scale of the specific projects;

- provide a methodology to facilitate the ongoing efficient and effective management of assets;

- encourage public sector agencies to evaluate all feasible options as early as possible in the planning process, including for example private sector involvement;

- provide guidance on identifying the full range of costs and benefits from the overall State perspective;

- set requirements for reporting the results of the evaluation to the Budget Committee; and

- provide a mechanism for setting consistent key parameters such as the discount rate.

The Government approved the application of the Guidelines to all capital works proposals from 1989-90 onwards. Economic appraisals of proposals are required as part of capital works bids from public sector agencies, as set out in these Guidelines.

Late in 1989 a review was carried out of the Guidelines and the way they had operated in the first twelve months after their introduction. A further review was carried out in 1995 and this edition of the Guidelines incorporates refinements following both reviews.

2. ECONOMIC APPRAISAL TECHNIQUES

2.1 INTRODUCTION

The basic feature of economic appraisal is a systematic examination of all the advantages and disadvantages of each practicable alternative way of achieving an objective such as solving a problem or overcoming a deficiency. This is economic appraisal's main strength.

While the techniques have been developed mainly in the context of investment decisions, the principles apply to any specific proposal for the use of resources or for spending or saving money. Economic appraisal sets the framework for thinking rationally about the use of resources through a systematic approach to capital expenditure and asset management decisions. The techniques of economic appraisal are also applicable to decisions with regard to the disposal of assets, the design or provision of standards or the assessment of plans (eg security of supply of services, environmental standards or Land and Water Management Plans).

Economic appraisal is applicable to the full range of public sector agencies ranging from self funding commercial public enterprises to budget sector departments whose output is not traded in markets or for which revenue is not received. (The former agencies also employ financial analysis). Where outputs cannot be valued in money terms, economic appraisal can still show the lowest cost way of providing a given output, or what different levels of output or levels of service would cost.

A range of recognised economic appraisal techniques exist. The major distinction between these techniques is the extent to which benefits are quantified.

2.2 THE MAJOR ECONOMIC APPRAISAL TECHNIQUES

2.2.1 Cost Benefit Analysis

Cost Benefit Analysis (CBA) is the most comprehensive of the economic appraisal techniques. It quantifies in money terms all the major costs and benefits.

CBA can be applied to most, if not all, public agencies that cover costs with revenue and to Agencies which do not fully cover costs by revenue but which produce traded outputs. The technique is also applicable in varying degrees to social infrastructure such as schools, hospitals and public housing.

The key strength of CBA is that it considers on a consistent basis the benefits and costs of alternatives. Thus the outcomes for a range of options are translated into comparable terms which facilitate evaluation and decision making. Against this CBA does not by itself provide direct consideration of the distribution of benefits and costs and can require considerable data for satisfactory implementation. Further, the concentration on valuation of impacts can sometimes lead to the overlooking of impacts which cannot be valued quantitatively, although CBA does allow for the incorporation of such impacts.

Overall, CBA is most easily applied to public sector agencies producing outputs that generate revenue (for example water supply and electricity) or else where the major benefits can be quantified fairly readily (for example roads).

2.2.2 Cost Effectiveness Analysis

Where the output of a project is not readily measurable in monetary terms (using either actual or proxy values) such as in certain areas of health, education or social welfare, it may not be possible to apply CBA.

An alternative approach is available, that of Cost Effectiveness Analysis (CEA). This type of appraisal compares the costs of different initial project options with the same or similar outputs. CEA is applicable to a wide range of public sector agencies with strong community or social welfare objectives. For example, in the health sector, CEA could be used to assess the relative merits of alternative treatments for severe kidney problems in terms of relative cost for given increases in life expectancy. Of course the quality of this additional life expectancy would need to be considered in qualitative terms.

It should be noted that CEA cannot be used directly to compare projects with different objectives. Nevertheless, the fact that the costs and benefits are all identified will allow more informed subjective decisions to be made.

It should also be noted that while some benefits may be difficult to assess in monetary terms, the technique still requires the valuation of as many benefits of the project as possible.

Careful identification and analysis of **all** the benefits and costs remains a key element of CEA. The temptation to list the benefit of a project as "improved service provision" (or something similar) should be resisted. In all cases some better indicator of the benefits will be available.

2.2.3 CBA or CEA ?

It is rare to find a project where either all the benefits or none of the benefits can be valued. It is also hard to define what is meant by "can be valued": most benefits can be valued if sufficient resources are devoted to the task, although there may still be no real consensus about the valuations produced.

CBA is usually used where the major benefits of a project (as well as the costs) can be valued. This permits the decision maker to compare projects of different kinds. CBA is ideal in cases where there is sound information on which to base the analysis and where the scale of the investment justifies the work entailed.

CEA, on the other hand, is used where the major benefits cannot be valued in money terms. Instead, the costs involved in achieving some desired effect or output are compared. CEA therefore only allows a decision maker to compare options that have similar objectives. However, this enables CEA to be more readily applied to the bulk of social and community service programs (as opposed to economic services).

In summary whether CBA or CEA is the most appropriate form of analysis is dependent on:

- the overall size/importance of both the project as a whole and the "difficult to quantify" benefits; and

- the effort required to value the "difficult to quantify" benefits and the likely accuracy of the valuation.

Chapter 5 provides more specific guidance to the use of the techniques in the context of the State's capital works program.

Either technique provides a framework within which all the benefits and costs of a proposal can be considered, whether they are monetary or non-monetary, and whether they accrue to the sponsor of the proposal or some other enterprise or individual. It should be noted that neither technique provides direct information on the distribution of costs and benefits, and in certain cases it may be necessary to draw special attention to the distribution of impacts.

For example, in certain cases, where the main beneficiaries of a publicly funded project may be a small number of private sector commercial enterprises, the distribution of benefits and costs among the public/private sector parties should be assessed to assist decision making.

2.3 FINANCIAL ANALYSIS

The economic evaluation techniques outlined above have much in common with financial analysis. However, there are significant differences.

Firstly, a traditional financial analysis examines a project from the narrow perspective of the entity undertaking the project. It does not take account of effects on other enterprises or individuals. Thus, a proposal put forward by one Government agency may inflict costs (or confer benefits) on other Government agencies, on private sector enterprises or on individuals. These external costs and benefits must be taken into account. Similarly, a strictly financial analysis does not consider the opportunity cost of using resources in the case where the actual price paid by or to the entity is not a good indicator of the real value in terms of alternative uses.

Secondly, economic evaluation does not consider directly the payment of interest. Rather real resource flows are shown and time preference is taken into account by the use of a discount rate.

Thirdly, in economic analysis capital expenditure is recognised as a resource cost at the time it is incurred whereas in financial analysis it may be shown amortised over the life of the project for taxation and other purposes.

In the public sector the fundamental requirement is for an economic appraisal. However it should be noted that the undertaking of an economic appraisal does not remove the need for a financial analysis. The financial analysis will show the demands on cash flow which will result from the project - an important factor when managing the State's finances. It will also show the rate of return from the project which is important for commercial agencies.

2.4 OTHER APPRAISAL TECHNIQUES

A variety of other techniques of varying degrees of usefulness exist. Among those which may prove useful adjuncts to the Guidelines presented in this paper are:

- incidence analysis;
- input - output (multiplier) analysis; and
- multiple objective programming.

Incidence analysis disaggregates the overall impacts of the options according to the impact on individual community groups. The disaggregation is commonly undertaken in terms of the income grouping of those affected by a specific development. As such it provides valuable information to decision-makers. However, like multiplier analysis, it is not an alternative to CBA or CEA but rather provides information on the distribution of benefits and costs.

Input-Output (Multiplier) Analysis is commonly used to assess the regional impacts of a project. In the simplest form of input-output analysis, input-output multipliers are applied to measures of direct impact to determine estimates of flow-on impacts in terms of income and employment. All such analysis is subject to significant limitations, and extreme care should be taken in its interpretation.

First and foremost, input-output analysis is concerned with measuring economic activity, and is not a tool for the evaluation of projects. Input-output analysis does not take account of the alternative uses (opportunity costs) of resources. Therefore, input-output analysis will always indicate positive impacts - activity - without providing guidance as to whether such impacts correspond with net benefits. Poor investments, perhaps in heavily subsidised fields of endeavour, could be associated with greater levels of activity than good investments.

Second, published impact multipliers are inappropriate for assessing impacts associated with additional marginal investment. Published multipliers measure the overall linkages between an industry and the remainder of the economy, and are therefore concerned with average rather than marginal impacts.

Other concerns include:

- the often poor quality of the data on which regional input-output models are based;
- double counting of impacts - value added, income and employment impacts are alternative measures of the level of activity, and should not be added together;
- the application of multipliers to measures of gross output - again, this leads to double counting; and
- the application of inappropriate multipliers - for example, employment multipliers indicate the employment flow-on effects associated with final demand, not with employment.

Multiple Objective Programming is particularly valuable in the assessment of options which have several objectives which cannot be quantified in monetary terms. In such circumstances the results of CEA can be quite complex. Multiple Objective Programming uses mathematical programming techniques to select projects based on explicit objectives. Constraints to action and costs such as minimum levels of output or expenditure limits are modelled explicitly.

This techniques offers a basis for assisting a wide range of project or regulatory decisions. In its ideal form it fully reflects the goals and constraints of the decision process and permits the quantification of implicit costs of constraints. However, the results are only as good as the inputs to the model. In particular, the estimation of the weights for the various objectives in the decision function may be particularly tenuous. Consequently, the characterisation of the decision process may be unrealistic. In essence this technique assists in evaluating the results of complex applications of CEA.

3. BENEFITS OF ECONOMIC APPRAISAL

3.1 THE ROLE AND LIMITATIONS OF ECONOMIC APPRAISAL

The prime contribution of economic appraisal is to provide the best possible information to decision makers at various levels within Government. In respect of capital works decisions, it will assist in the choice between projects. This choice can occur at two levels: one is the choice between alternative projects (or options) for achieving the same objectives; and the second is the choice between a range of projects, directed at a variety of objectives, which cannot all proceed due to resource constraints.

The tools of economic appraisal can also play an important role in the development of options and the design and implementation of the selected options. In this context it can assist in the choice of the most efficient option.

In regard to the existing capital stock, economic appraisal techniques assist in evaluating the optimal economic life of assets, evaluating whether assets should be redeployed, refurbished or replaced.

While economic appraisal is an important aid to decision making, the results of such appraisals will not be the sole determinant of decisions. A financial analysis will clearly be important as it will demonstrate the cash flow requirements of the project as well as the financial return to the agency concerned. A wide range of other objectives also feed into the decision process and a number of these cannot be effectively included in the analysis.

However if economic appraisal is to be fully effective it should be:

- normal practice in all areas of capital works planning and approval and asset management;

- carried out as early as possible in the development and approval stage for new capital expenditure and continued through the design and tender stage; and

- carried out in sufficient detail and with examination of sufficient options consistent with the nature of and size of expenditure involved.

It may be beneficial for economic appraisal, value management, and financial analysis of a particular project to be undertaken concurrently, particularly in early planning stages. For large projects, preliminary analysis may be required, and subsequently updated as planning proceeds.

3.2 BENEFITS OF ECONOMIC APPRAISAL

As noted above the ultimate benefit of a system of economic appraisal of assets is an improvement in the allocation of public sector resources to ensure the Government's objectives are met to the fullest extent possible and the benefits to the community are maximised. In achieving a better pattern of resource allocation future growth will be improved.

While economic appraisal techniques will contribute to the achievement of these community wide benefits, the Guidelines are also of direct benefit to the participants in the capital works process. This is reflected in the efforts made by a number of public sector agencies in the development and implementation of appraisal techniques.

3.2.1 Benefits to public sector agencies

The Guidelines can be expected to assist public sector agencies in the following ways:

- by identifying and measuring all costs to an agency, economic appraisal provides the framework for consideration of the total costs of providing particular services, and thereby encourages the pursuit of low-cost solutions;

- by considering both up-front capital costs and ongoing recurrent costs, it can assist public sector agencies to evaluate the best mixture of capital and recurrent costs;

- by focusing on the systematic evaluation of alternatives, the discipline of economic appraisal can encourage new approaches at all stages in the development of a project from the concept stage to the final decision to proceed;

- by emphasising the quantification of benefits, it encourages managers of public sector agencies to question and re-examine the strategic objectives of the agency in undertaking the project; and

- by requiring an ongoing assessment and management of the stock of assets, not just focusing on the new capital expenditure decision, economic appraisal can ensure that the State's public sector infrastructure is effectively and efficiently utilised.

3.2.2 Benefits to Budget Committee/Government

The Guidelines will assist the Government in the following ways:

- by quantifying the net contribution of projects in a standard manner, the information base for decisions is improved, thereby assisting in the assessment of relative priorities;

- by quantifying and reporting all benefits and costs, it can help the Budget Committee ensure that projects are consistent with Government objectives;

- by including costs and benefits falling outside the agency (for example, reduced hospital costs associated with better roads), economic appraisal helps to maximise net benefits to society and capture the various linkages between projects (for example the relationship between road and public transport decisions); and

- by broadening the focus for new capital expenditure decisions to consider the utilisation of the existing stock of infrastructure, economic appraisal links new capital expenditure decisions to decisions about capital replacement, refurbishment and maintenance.

4. STEPS IN PREPARING A FULL ECONOMIC EVALUATION

Maximum effectiveness of the Guidelines is dependent upon clear and unambiguous objectives, an appropriate strategic planning framework and well developed performance indicators and program evaluation. Such techniques are, of course, already part of recent initiatives in public sector management and the introduction of economic evaluation of assets will reinforce these initiatives. The key steps in economic evaluations are summarised in this chapter and are covered in greater detail in Part II.

Where projects are considered by agencies to be absolutely essential (for example, due to urgent health/safety reasons) and no realistic alternatives are available, a full economic appraisal may not be required. However, such cases must be discussed with Treasury at the outset and will require detailed justification.

The following discussion outlines the steps which must be followed when preparing a standard economic evaluation. Within each stage a number of options are available. Each of the steps listed is relevant to CBA and CEA, though, with step 6, CEA does not express all benefits in monetary terms. The steps are outlined below:

4.1 DEFINE OBJECTIVES **(refer to Chapter 7)**

Every proposal to spend money must have an underlying objective. The importance of specifying objectives when considering investment proposals cannot be over-stated. The worth of an investment can only be evaluated in terms of its objective(s).

This objective should be related to the performance of a particular function, be clearly and unambiguously stated and be compatible with the broader Department, group or corporate objectives.

In certain circumstances, the achievement of an objective is essential (for example, meeting the statutory requirement to provide education services). This does not necessarily imply that expenditures to achieve essential objectives will be without choice, as various alternative methods of meeting the objectives are usually available. It may also be possible to vary the level or quality of service provided.

4.2 IDENTIFY OPTIONS (refer to Chapter 7)

It is necessary to identify the widest possible range of realistic options at the earliest possible stage of the planning process. One alternative that should be considered is the possibility of the objective being met by the private sector.

In developing alternative solutions, the first option to be considered is the base case of "do nothing", ie retain the status quo. This is not to say the base case will not involve costs; in many cases doing nothing (for example, continuing with a low maintenance program) will result in cost penalties. One of the benefits of "doing something" may be the avoidance of these costs.

Options might include refurbishing existing facilities, variations in staging an investment (demand and population growth forecasts should be reviewed), demand management or maintenance by the private sector. Appraisals should report on all feasible options and clearly explain cases where potential options may not have been evaluated.

4.3 IDENTIFY BENEFITS (refer Chapter 8, 9)

There are five separate types of benefits which may be relevant:

- **avoided costs** - incremental costs which are unavoidable if nothing is done to solve a particular problem, but may be avoided if action is taken.

- **savings** - verifiable reductions in existing levels of expenditure if a program proceeds. Where manpower savings are claimed, the clear identification of the areas of such savings and costs saved is necessary so that any post audit review can judge whether they have actually been achieved.

- **revenues** - incremental revenues which result directly or indirectly from a particular program. Revenue changes which would have occurred regardless of the program must not be included.

- **benefits to consumers not reflected in revenue flows**. For a variety of reasons, such as the nature of the service provided or equity considerations in pricing policies, the user of a service may not be charged a price which reflects the benefits received (for example, recreational use of national parks). While it may prove difficult, attempts should be made to quantify such benefits wherever possible. If quantification proves impossible, as much detail of the benefits as possible should be included in the report.

- **benefits to the broader community.** Benefits of services such as police services flow to the community as a whole rather than to individual consumers. Alternatively, an activity may have secondary or subsidiary effects on groups or industries other than the direct recipient (for example, urban public transport can reduce pollution levels). Commonly the price will not reflect the benefits received and hence alternative means of valuing the benefits must be developed.

4.4 IDENTIFY COSTS (refer Chapter 8, 9)

All economic evaluations should be based on incremental costs and benefits associated with a particular program. All **relevant** cost items which can be identified, quantified or estimated must be included. The stream of costs should cover the full project period which will be based on the economic life of the building or equipment. Assumptions underlying all estimates should be made explicit in the evaluation.

There is a danger that while great efforts will be made to identify both primary and secondary benefits, less attention may be paid to identifying all the costs of a proposal. It must be remembered that a project may impose secondary costs on the community, or groups within it, and attempts should be made to identify and value these costs.

4.5 IDENTIFY QUALITATIVE FACTORS (refer Chapter 8, 9)

Documentation of the economic evaluation should also include other relevant information which can affect the recommendation/decision. The costs and benefits which can be quantified are only part of an economic evaluation. Other aspects, such as environmental considerations, industrial relations, social or regional impact, safety, public relations, resource availability, etc, will also have to be taken into account in choosing between competing options.

In every case these qualitative factors should be identified and where possible given a subjective weighting. The initiating Department will have the best knowledge of what and how important these additional factors are.

4.6 ASSESS NET BENEFITS (refer Chapters 10,11)

Once all costs and benefits over the life of the program have been identified and quantified, they are expressed in present value terms in CBA. For CEA a present value is only provided for costs. In doing these:

- costs and benefits should be valued in real terms: that is they should be expressed in constant dollars and increases in prices due to the general rate of inflation should not be included in the values placed on future benefits and costs.

- the stream of costs and benefits (expressed in real terms) should be discounted by a real discount rate of 7 per cent, with sensitivity testing using discount rates of 4 per cent and 10 per cent.

Using the discounted stream of costs and benefits, the following decision measures should be calculated:

- net present value (NPV);
- net present value per $ of capital outlay (NPVI);
- benefit-cost ratio (BCR);
- internal rate of return (IRR).

4.7 SENSITIVITY TESTING (refer Chapter 12)

There will always be some degree of risk or uncertainty surrounding the outcome of an appraisal.

In addition to the preparation of the most likely estimate of costs and benefits, **projected outcomes under alternative scenarios should be prepared**. The purpose of such scenario analysis is to test the sensitivity of results and provide information on the robustness of the project to adverse movements in the range of variables determining its viability.

While one option might excel in some scenarios, it might produce devastating results under other scenarios. An alternative option might produce satisfactory results under all sets of assumptions. This option could well be considered the best solution to the problem.

While optimistic and pessimistic scenarios should be presented, particular emphasis should be given to the pessimistic alternatives.

The aim should be to select a realistic range of possible values for the major cost or benefit variables that could most significantly affect the project outcome.

4.8 POST IMPLEMENTATION REVIEW (refer Chapter 13)

A selection of the major projects undertaken by an agency should be subject to ex-post evaluations. In addition, major ongoing programs which may involve a series of smaller projects should be subject to such ex-post evaluations. These evaluations would involve:

- re-evaluation of the benefits and costs of the selected option to assess whether the anticipated benefits were realised and the forecast costs kept to;
- reconsideration of alternative options;
- examination of the project design and implementation to assess the scope for improvement to the option adopted.

By examining these issues ex post evaluations will assist in the development and evaluation of future projects.

In addition, public sector agencies should implement procedures for ongoing asset management and assessment.

5. APPLICATION OF ECONOMIC APPRAISAL TECHNIQUES

5.1 INTRODUCTION

The purpose of this chapter is to set out the proposed broad procedures for applying economic appraisal to the Capital Works Program and the stock of public sector assets.

Further details of the methodology to be used are given in Part II.

5.2 THE ROLE OF THESE GUIDELINES

These Guidelines are intended to establish a framework within which public sector agencies can undertake their appraisals. The framework covers both the reporting requirements for the Budget Committee and the structure of appraisal which is required by the Committee. However, these Guidelines are not intended as an economic appraisal manual which could be applied in each agency, nor could a single document fulfil that purpose. Each agency will need to concentrate on the application of these general principles to their particular situation. Consultants may be helpful in this process (see Section 5.7)

5.3 AREAS WHERE ECONOMIC APPRAISAL TECHNIQUES SHOULD BE USED

The applicability of the Guidelines extend beyond new or replacement capital expenditure.

The Guidelines are capable of being applied to each of the following decision areas:

- **Assessment of New or Replacement Capital Expenditure, or Major Maintenance**

This is the principle area of application of the Guidelines and an area of direct concern to the Budget Committee of Cabinet.

A distinction should be drawn between the evaluation of a new project and the replacement of an existing asset. While in the non commercial area it may be difficult to quantify certain benefits from new projects, the benefits from asset replacement, whether in the commercial or non commercial /social infrastructure area, should be capable of quantification.

When evaluating capital expenditure options, full consideration needs to be given to recurrent costs involved in the various options. Different options may have different staffing and maintenance requirements. There may be a choice between different levels of capital intensity in achieving a given objective.

Recognition also needs to be given to the issue of demand management and in particular whether the current pricing structure for services provided is appropriate or whether alteration of the structure is desirable in order to change the level and composition of demand and hence influence the capital expenditure decision.

- **Asset Management**

The Guidelines cannot simply be applied to investment decisions in isolation from consideration of the stock of assets in operation. For example, in the area of transport rolling stock, be it buses, freight wagons, passenger carriages or locomotives, an assessment needs to be made of the optimal economic life of assets or classes of assets. Even where economic appraisal techniques are applied at the stage of the acquisition of an asset and an economic life established, this will need to be kept under review in the light of actual operating conditions and the alternative provided by replacement.

One aspect of asset management is the ongoing review of utilisation of existing fixed assets. Public sector agencies need to evaluate their holding of assets in terms of the opportunity cost of disposing of the asset versus maintaining it in current use. For example, surplus land involves an opportunity cost which needs to be balanced against the planned use of the land. Since the original version of these Guidelines was published the Government has produced a Total Asset Management Manual which incorporates a range of complementary analytical procedures to assist efficient asset management. These should be used in conjunction with economic appraisal.

- **Assessment of the Appropriateness of Design, Operating and Other Standards**

While standards are a useful form of guideline, an ongoing assessment needs to be made as to appropriateness in the context of changing demand patterns, technology and other external factors. It needs to be recognised that excessively rigid or demanding standards impose a cost in terms of the use of resources that could be employed in other areas.

- **Other Areas of Application**

It is recommended that economic appraisal as outlined in these Guidelines be applied to other areas as appropriate, such as Program Evaluation and Regulation Proposals and Review.

5.4 APPLICATION OF GUIDELINES TO THE CAPITAL WORKS PROGRAM

The definition of 'capital works' used in the State budgeting system does not in general accord with the distinction between capital and recurrent expenditure used in the private sector. However, the principles of economic appraisal are equally applicable to capital and recurrent expenditure. The Guidelines given below are therefore based on the size of the project rather than its nature.

Economic appraisal of projects being submitted by agencies as part of their capital works bid is required. Nevertheless, it would clearly be inefficient to undertake a full, formal appraisal for even the smallest capital work. An agency might have many hundreds of these in a single year, and even the paper work involved in appraisals would be overwhelming.

Guidance is therefore needed on what scale of appraisal is required in any particular case. The development of exact rules is difficult. While a $500,000 project might be regarded as

very small by one agency, it could be a major capital works project to another. And while the capital costs involved in a project might be small, the associated recurrent costs could be substantial. Or the secondary benefits (and costs) associated with a project could be significant.

While a general guide is given below on when appraisals should be undertaken, there will therefore always have to be scope for flexibility. The Budget Committee may decide that lower or higher thresholds are appropriate in some cases. Public sector agencies should discuss their position with Treasury if they have any doubts about their situation.

In principle, capital works projects can be split into various types. The following categories of works have been established for general guidance:

(1) 'One-off' projects with total cost under $500,000

Small one-off projects are unlikely to merit a full, formal appraisal. However the criteria which are used to assess them should be appraised to ensure that all possibilities are being considered, and that relevant factors are not being ignored. Such an appraisal should be undertaken at regular intervals: at least every five years. These procedure appraisals should be submitted to the Budget Committee.

(2) Projects with total cost under $500,000 which are part of an on-going program

If a small project is part of an on-going program, then the program should be formally appraised at regular intervals: at least every five years. The appraisal would consider the program as a whole, assessing its benefits and its costs. Individual projects within the program would then have to be considered only to ensure that they accord with the criteria laid down for the program as a whole. These program appraisals should be submitted to the Budget Committee.

(3) Projects with total cost of $500,000 or over

A large project should be the subject of a full appraisal in its own right. However even for larger projects it may be useful to undertake some form of "program" evaluation where this is appropriate, for example the benefits of programs to reduce water pollution. Such appraisals are likely to be the best way to generate values of key parameters to be used in individual project appraisals.

When applying these Guidelines, a key issue will be the definition of a project. This is discussed in more detail in Chapter 7. Care must be taken to avoid excessive disaggregation.

5.5 CHOICE OF TECHNIQUE

As discussed in Chapter 2, a decision needs to be made on the appropriate appraisal technique to be applied.

In essence there are two criteria that should be applied to determine whether CBA or CEA is the relevant technique for a specific project:

(1) the ease with which benefits can be valued

Benefits can be valued by:

- market prices for the outputs of commercial agencies such the electricity distributors and the various water suppliers;

- valuations based on imputed benefits to the community such as travel time savings with improved roads; and

- market research estimates based on revealed preference of customers in areas such as visits to national parks or art galleries.

Any of the above three approaches is a legitimate method for placing a value on benefits for CBA, whilst each will require a different level of resources and, in each case, the resulting figure will differ in its degree of accuracy. In some cases valuation would be extremely expensive and the resulting figures very uncertain.

The ease of valuation of benefits is related to both market relationships and the degree of externalities in the benefits provided.

However, while a necessary condition for CBA, ability to value benefits is not a sufficient condition.

(2) relative importance of the project and the quantifiable benefits provided

Due to the informational demands of CBA, the project and the benefits have to be of reasonable significance to justify the resources required for CBA. Factors to be considered here include:

- the overall size of the project;

- the relative importance of those benefits that can be valued relative to the total benefits of the project; and

- the importance of the quantifiable benefits relative to the overall objectives of the agency.

For example, the recreational benefits of both a local picnic ground or the Darling Harbour project can be valued, but only the scale of the latter would justify the use of CBA.

To summarise, CBA will normally be used where the major benefit can be readily valued. CEA will be used where this is not the case.

An assessment has been made of all significant areas of capital expenditure, based on the twin criteria of ease of valuation of benefits and relative significance. In very broad terms, it is proposed that CEA should be used in the areas of education, health, welfare, the environment and law and order, while CBA should be used in all other areas.

Where any doubt exists concerning the application of economic appraisal principles, early contact should be made with Treasury.

5.6 SETTING OF KEY PARAMETERS

It is essential that there is a consistent approach to the setting of key parameters for otherwise it will not be possible to compare results between agencies.

Treasury produces on an annual basis, key economic, physical and resource variable projections. These will include:

- **Macro economic variables**
  - constant price growth rate for GDP
  - constant price growth rate for Gross State Product (NSW)
- **Physical**
  - level of and growth in State population
  - level of and growth in household numbers
  - levels of and growth in State labour force and employment
- **Prices**
  - real wage growth
  - real energy cost growth
  - real discount rate

The currency of a set of parameter values will be one budget cycle, so that all appraisals submitted for a budget will use the same set of forecasts. Where appropriate, alternative scenarios will also be produced (see Chapter 12).

5.7 CONSULTANCY SERVICES

While a number of agencies have developed expertise in the area of economic appraisal, not all public sector agencies will have had experience in this area. Some may therefore wish to employ consultants, either to establish a general procedure for appraisals in a particular agency or to undertake individual appraisals.

In other cases an agency may not have the in-house resources available from time to time to conduct all appraisals and will hire consultants to bridge the gap.

Considerable benefit is seen from obtaining outside assistance in terms of providing a fresh view on possible options and other matters. While not mandatory, public sector agencies are encouraged to consider external resources, at least for selected projects where the size, complexity, or importance justifies their use. Government agencies should aim to spread their economic appraisals among a range of consultants in order to gain the benefit of different approaches to particular problems.

5.8 INDIVIDUAL AGENCY GUIDELINES/MANUALS

Some Government Agencies have established procedures and parameters to cover economic appraisals in their particular field.

This can be a desirable approach where there is consensus about the appropriate procedures for valuing costs and benefits, as the setting of parameters in a given area can simplify and reduce the effort and cost of economic appraisal.

Agencies who wish to establish general procedures for their appraisals (perhaps after undertaking research of the type outlined in Section 14.5) should submit drafts of proposed guidelines or manuals to Treasury at an early stage. This is to ensure consistency with the Treasury Guidelines and, where appropriate, consistency between individual Agencies in related areas in terms of values of commonly used parameters.

Such Agency guidelines should be reviewed over time.

5.9 POOLING OF KNOWLEDGE

Some public sector agencies will face similar problems in undertaking economic appraisals. There is therefore a great deal to be gained through knowledge pooling.

For instance, it might be appropriate for two or three agencies to undertake a joint research program, perhaps into issues such as benefit valuation. This will both reduce costs and encourage a consistent approach to issues.

It is recommended that such issues be raised with Treasury in the first instance to assist coordination.

6. REPORTING REQUIREMENTS AND PROCEDURES

6.1 INTRODUCTION

Economic appraisals are used both by agencies and Ministers (in deciding on the projects to include in their annual capital program bids) and the Budget Committee (in deciding between bids).

The Budget Committee has overall responsibility for formulating the State's capital program each year and as part of this process undertakes a review and approval role in respect of new capital project proposals. In undertaking this role the committee is greatly assisted by it's consideration of the results of economic appraisals of new capital project proposals. However, a balance needs to be struck between giving the necessary information and avoiding excessive demands on the Committee through the volume of submissions.

This chapter sets out procedures and reporting requirements based on the scale, sensitivity and characteristics of the projects involved. It can also be anticipated that the Committee will want to make exceptions to the reporting requirements laid down below in those cases where it feels that the provision of more information is desirable.

6.2 TREASURY'S ROLE AND CONTACT POINTS

The roles of Treasury in respect of economic appraisal of new capital projects and the relevant contact points are given below:

Treasury - Office of Financial Management

- **Economics and Revenue Division**
  Contact: Danny Graham (Manager Infrastructure Assessments)
  Tel. 9228 3213, Fax. 9228 4041
  - Maintains Guidelines.
  - Contact point for technical matters.

- **Budget Sector Division - Policy and Research**
  Contact: Roger Sayers (Senior Financial Analyst)
  Tel.9228 4641, Fax.9228 4148
  - Reviews economic appraisals for consistency with Guidelines (projects over $5M)
  - Provides advice to Budget Committee on micro-economic aspects
  - Contact point for individual project appraisals over $5M.

- **Budget Sector Division**
  Contact: Individual Agency Relationship Manager
  - Reviews appraisals for consistency with Guidelines (mainly projects between $1m and $5m).
  - Provides advice to Budget Committee on funding aspects.
  - Ensures economic appraisals have been submitted in respect of all relevant new capital projects included in annual forward capital program bids by agencies.

6.3 EARLY LIAISON

It is strongly recommended that in cases where economic appraisals may involve contentious issues, or for advice on issues that should be addressed in a particular appraisal, early contact be made with Treasury.

6.4 TIMING

The Budget Committee will review the capital program for the coming year in the period January and February of each year. The Committee will meet regularly during the year to monitor the program.

It is mandatory that economic appraisals have been completed for all new capital projects included in program bids for the coming year.

Economic appraisals, especially of major projects, should be submitted during the course of the year prior to the annual capital program bid being submitted to Treasury. The purpose of this is to ensure that any matters requiring discussion are resolved before budget submissions. However, if necessary, reports may accompany annual capital bids.

Where projects come within categories (2), (3) or (4) below, early contact should be made with Treasury to inform them of the project review.

6.5 REPORTING OF RESULTS OF THE ANALYSIS

In addition to other budgetary reporting requirements, the following information will be required to accompany submissions to the Budget Committee.

(1) Projects with a total cost under $1m

There are no additional reporting requirements, though it would be expected that economic appraisal techniques will be applied according to the outline given in Chapter 5. Naturally the degree of accuracy and size of the study should be related to the significance of the project. The Committee may from time to time review specific areas that fall outside normal reporting requirements.

(2) Projects with a total cost of at least $1m but less than $5m

Submissions to the Budget Committee will be required to include summaries of the results of the economic appraisal undertaken in accordance with the Guidelines. The summaries should be sent to the relevant area of Treasury's Budget Sector Division.

Pro formas for use in the preparation of summaries are provided in Appendix 6.1 for CBA and in Appendix 6.2 for CEA.

The appraisal will not be the subject of external review as a matter of course, although the Budget Committee may request copies of the appraisal or their review by Treasury or an outside expert.

(3) Projects with a total cost of $5m or over.

Submissions to the Budget Committee will be required to include a copy of the appraisal in support of the bid for capital funds, in addition to summaries of the results of economic appraisal in accordance with the pro formas (see Appendix 6.1 and 6.2).

Copies should be sent to Treasury's Budget Sector Division.

Submission of economic appraisals should be accompanied by a Ministerial letter which indicates support or otherwise for the findings and recommendations of the study.

Where external consultants have been employed to assist with an appraisal, the formal terms of reference for the study are to be included with the appraisal.

The Budget Committee may request assessments of these appraisals from Treasury.

(4) Designated Projects

The Budget Committee may identify certain projects as designated projects and assign specific reporting conditions to those projects.

(5) Essential Projects

Where projects are deemed to be essential (for example, for health or safety reasons) a full economic appraisal may be superfluous. However, it is still necessary to fully consider the project objective and all feasible options to produce the desired outcome in the most cost-effective manner. If an agency wishes to claim an exemption on these grounds, early contact should be made with Treasury. Subsequent submissions will need to provide the justification for not undertaking a full economic appraisal.

(6) Special Studies of Capital Works Programs

Under this category, reviews will be undertaken of areas of the Capital Works Program where it would not be practical to review individual capital items. Examples could include public housing, police stations, schools etc. This would include reviews undertaken under sections 1 and 2 of Section 5.4.

(7) Ex post Evaluation

The Budget Committee will specify certain projects for ex post evaluation reporting. This subject is covered in Chapter 13. It is expected that public sector agencies will institute procedures for ongoing review of assets to determine if they are most effectively deployed.

6.6 RECURRENT COSTS

It would be expected that where a capital proposal qualifies for additional recurrent funding, the extent of funding required would be determined by reference to the economic appraisal.

In any event changes in recurrent costs associated with new capital project proposals should be separately identified in appraisal reports.

APPENDIX 6.1: SUMMARY SCHEDULES FOR COST BENEFIT ANALYSIS

The aim of these schedules is to assist in outlining the basic results of the appraisal. Schedule A is designed to give an outline of the objectives of the proposal, since a proposal cannot be judged without knowledge of its objective.

Schedule B summarises the various options considered, covering both the financial summary statistics which can be calculated and those factors on which a monetary valuation cannot be placed (these should be listed under 'special considerations'). The Schedule also asks for the reasons for choosing the preferred option.

Schedule C details the assumptions which have been built into the appraisal. Some assumptions will have been provided by Treasury. Others will have been developed by the agency in the context of the particular proposal.

Schedule D should only be completed when the program concerned is revenue generating.

SCHEDULE A: PROJECT DESCRIPTION

1. Project/Investment Name:

2. Physical Location:

3. Project/Investment Description and Objectives:

4. Project/Investment Context:

(Specify how the project relates to the agency's capital and recurrent expenditure structure, ie programs and administrative units and whether there are options to refurbish existing assets or alter pricing structure as an alternative to the capital expenditure proposal).

5. Relationships/Interdependencies

(Specify how the project relates to other projects or programs both within the agency and with respect to other agencies).

6. Description of the Benefits Expected

(Specify in qualitative terms the level and type of benefits and their distribution)

7. Were consultants used in the preparation of this appraisal?

If yes, give the name of the consultant.

SCHEDULE B: SUMMARY OF EVALUATION RESULTS FOR OPTIONS CONSIDERED

Specify the range of options considered in order to meet the project objectives.

OPTION 1 (Preferred Option)

Description:

Life: (Years)
NPV:
NPV per $ of Capital Outlay:
BCR:
IRR:
Present Value of Costs:
Brief Results of Sensitivity Analysis:
Special Considerations (both quantitative and qualitative):

OPTION 2

Description:

Life: (Years)
NPV:
NPV per $ of Capital Outlay:
BCR:
IRR:
Present Value of Costs:
Brief Results of Sensitivity Analysis:
Special Considerations (both quantitative and qualitative):

OPTION 3

Description:

Life: (Years)
NPV:
NPV per $ of Capital Outlay:
BCR:
IRR:
Present Value of Costs:
Brief Results of Sensitivity Analysis:
Special Considerations (both quantitative and qualitative):

OTHER OPTIONS:

REASONS FOR PREFERRING OPTION 1:

SCHEDULE C: EVALUATION ASSUMPTIONS

Assumptions	Time Period		
	1996/97	1997/98	etc
Real Charges/Rates			
Real Labour Costs			
Real Energy Costs			
Demand Growth			
Other (please specify)			

SCHEDULE D: EFFECT ON ACCOUNTING INCOME

(To be completed only by commercial agencies)

1. Income Statement Projections Without Project

2. Income Statement Projections With Project

3. Cash Flow Projections Without Project

4. Cash Flow Projections With Project

APPENDIX 6.2: SUMMARY SCHEDULES FOR COST EFFECTIVENESS ANALYSIS

The summary schedules for cost effectiveness analysis are very similar to the first three schedules for cost benefit analysis. Schedule B has, however, been amended to show different summary statistics.

SCHEDULE A: PROJECT DESCRIPTION

As per statement A of Appendix 6.1

SCHEDULE B: SUMMARY OF EVALUATION RESULTS FOR OPTIONS CONSIDERED

Specify the range of options considered in order to meet the project objective

OPTION 1 (Preferred Option)

Description:

Life: (years)
Measure of Benefits:
Present Value of Costs:
Special Considerations (both qualitative and quantitative):

OPTION 2

Description:

Life: (years)
Measure of Benefits:
Present Value of Costs:
Special Considerations (both qualitative and quantitative):

OPTION 3

Description:

Life: (years)
Measure of Benefits:
Present Value of Costs:
Special Considerations (both qualitative and quantitative):

OTHER OPTIONS:

REASON FOR PREFERRING OPTION 1:

SCHEDULE C: EVALUATION ASSUMPTIONS

As per statement C of Appendix 6.1

Part II: Economic Appraisal in Detail

7. DEFINING OBJECTIVES AND PROJECTS

7.1 CLARIFICATION OF OBJECTIVES

The starting point, and in many ways the most crucial aspect, for the evaluation of an investment proposal is the specification of the objectives of the proposal and their relation to the overall objectives of the agency. No appraisal of the project can be meaningful unless the objectives are clearly defined. Obviously, the recommended project should be shown to contribute to the overall objectives of the organisation. The economic appraisal will demonstrate that the proposal is the most effective means of achieving these objectives.

The specification of objectives will provide the starting point for, and give guidance to, the development of proposals. It should be noted that an excessively narrow definition of objectives may focus on means rather than ends and so unnecessarily exclude innovative alternatives. For example, if the objective of a proposal specifies that a particular agency provide a service, then the possibility may not be considered that the service could be provided more effectively by another agency or by the private sector. Conversely, excessively broad objectives may not provide the degree of focus necessary.

Key elements in this process are the corporate (or strategic) planning and program evaluation mechanisms in place within the agency. Because strategic planning mainly deals in the broadest context, the criteria to be applied at this level commonly differ from those used to evaluate individual investments at the micro level. However, the economic appraisal process should interact with the strategic planning process within the agency, indicating the need for review of aspects of corporate objectives over time.

Consistency with Government and agency strategic objectives should be the first screening device in determining the suitability of a particular investment proposal for inclusion in a strategic plan. Investments which pass this initial screening should then be subjected to the evaluation process outlined below.

7.2 SCOPE OF PROJECT

The scope of the project to be evaluated is also an important issue. Projects or programs will contain a range of elements related to one another and the point at which a discrete project can be identified will require careful judgement.

Three tendencies should be avoided.

(1) Excessive Disaggregation

A project may consist of a series of component parts. In such circumstances it is the evaluation of the larger project which is critical and it is essential that this be provided, not just an evaluation of the individual component parts. Of course, the evaluation of sub-components can play an important role in the development of the most cost effective overall solution but the analysis of sub-components should not be undertaken in lieu of the analysis of the wider project, to ensure that the project as a whole is of net benefit.

Project interdependencies may also arise in which the costs or benefits of one project are dependent on whether or not a second project or group of projects, goes ahead. The appropriate response is to evaluate projects as a single project (see also Section 3 below).

(2) Excessive Aggregation

If the analysis is too aggregated, some sub-components may be justified (in the analysis) not necessarily because of their own merit but because of the overwhelming net benefits of other components. In these cases there may be components with distinct objectives which are in fact independent of other elements and should be evaluated independently.

An example could be the case of upgrading a stretch of road involving two sets of roadworks, each of which could proceed independently of the other. Suppose Project A has benefits of $20M and costs of $5M and Project B has benefits of $5M and costs of $5M. If the roadworks are considered jointly, then the benefit to cost ratio (BCR) is 2.5 (total benefits of $25M, total costs of $5M) but Project B has a BCR of only 1, considerably below the BCR for the projects considered jointly.

(3) Failure to Account for Linkages to Other Projects

All Works or expenditures necessary for the achievement of the project's objective should be included in the evaluation. If the project involves an expansion of an agency's outputs, it may place pressures on other areas of the agency's activities or those of other agencies and require increased expenditures in these areas. Such expenditures should be included. For example, resolution of a bottleneck within the road system may require expenditures on feeder roads to achieve the benefits to motorists of eliminating the bottleneck.

Overall, the principles to be adopted are:

- **Projects should be evaluated at a decision point equivalent to the minimum level of aggregation consistent with the existence of independent alternative ways of directly achieving the objectives of the agency.**

- **The project to be evaluated should include all work necessary for the achievement of the objective. Components which are not necessary for the achievement of the objectives should not be included.**

- **The evaluation of subsidiary components may assist an agency to develop a more effective option at the aggregate level and is encouraged.**

- **component evaluations do not reduce the need for the evaluation of the total project.**

7.3 ALTERNATIVES TO BE CONSIDERED

An appraisal of a single option generally will not meet the standards set in these Guidelines. Alternatives should be considered, canvassing the main options that will meet the objectives. The alternatives considered should, wherever possible, cover:

(1) Various means of achieving the stated objectives - Options

Often there will be a large number of options and it will not be feasible to evaluate all these options. However, commonly options can be grouped on the basis of like characteristics and the range of alternatives considered structured so as to include a representative option from each grouping. In some cases an iterative analysis may be undertaken. First, the most promising groups may be selected from a broad range of options using a more broad-brush analysis. Subsequently, further evaluations are carried out to fine tune the alternatives and choose the best available variation within the group of options.

"Do Nothing" option

One option, which should always be included as the base against which other options are to be compared is the "do nothing" option. The benefits and costs of the proposals are derived through the comparison with this base case. It is important that the "do nothing" case is carefully specified and its costs and impacts are fully quantified. The "do nothing" option may prove to be the preferred option.

In specifying the base case, care should be exercised to ensure that it is a realistic "do-nothing" case. It is not a "spend nothing" policy but rather is based on the continuation of current services. In the case of asset replacement decisions it may involve deferral of replacement and continued maintenance and/or eventual replacement with a new asset of comparable standard to that being replaced. In the case of system augmentation or an expansion of activities, the base case would represent a continuation of the existing system or policies.

Possible errors are, firstly, a failure to fully specify the costs of the base case and so implicitly reduce the services that can be provided. At the other extreme the specification of large elements as "essential" may see the base case so broadly defined as to be, in practice, another project case.

Option development

Investment decisions where there are no realistic choices are rare. The challenge is to generate and specify a realistic set of alternatives. The following list of questions may be useful in generating such options:

- Could the operation be scaled down or closed, releasing resources for other uses? (In which case an option requiring less expenditure than the base case would be considered). This option could be particularly important in cases where the replacement of an existing asset is under consideration. The appraisal should consider whether replacement is justified before considering the options for the nature and the timing of the replacement.

- Could the operation be contracted out?

- Are different sizes or quality of operation possible?

- What is the sensitivity of demand to the level and structure of pricing? Is it a realistic alternative to capital expenditure to vary the pricing structure?

- What is the effect of varying the design life of the scheme?

- What alternative locations are possible?

- Are there choices of technique involving a trade-off between (say) labour and capital or capital and maintenance costs?

- Are there different materials, which would cost less or need less maintenance? Would better training of staff reduce manpower requirements?

- Are all elements of the operation equally justified? Would removing some of them increase the NPV?

- Could the operation be combined with another or divided into parts to advantage?

It is possible that these questions might prompt some redefinition of the objectives.

(2) Alternative time paths and output levels for the implementation of the options

An important aspect of the construction of the alternatives is the variation in the timing of investment projects. It is through the investigation of such alternatives that the optimal timing for the project may be discerned.

The optimal date for commencing an investment project can be estimated by calculating the NPV of the project for different starting times. This can be presented graphically by plotting investment project NPV as a function of time of commencement; this will allow the optimal starting date to be determined by inspection.

Furthermore, options may exist for the staging of proposals for increased capacity.

For many public sector agencies, each investment project may be one of a sequence of projects that will be undertaken over time. There is therefore an option concerning how large the projects in the sequence are to be built (in terms of, say, the annual output capacity of the project). An excellent example of this issue is the construction of power stations.

In determining how large to make each increment or project (and the timing of that increment), agencies should consider the following basic facts, which are nearly always in conflict:

- It may pay to build large increments to the system because there are often cost savings (economies of scale) involved with increasing project size;

- The commitment to capacity that will not be used for a long time is costly and often entails greater risks. It may therefore pay to defer investment.

- The importance of maintaining maximum flexibility.

In view of the interaction of these factors, a range of options for the staging of proposals should be considered. It should be stressed that in view of the chronic uncertainty about the future state of the world, the flexibility of smaller scale investment may be a particularly important benefit.

(3) Apparent constraints

In practice, selection and consideration of options is the step in the evaluation process where many constraints are taken as given without much questioning. For instance, options which are technically feasible may appear to be ruled out by legal, financial or political constraints. However, although undue time and effort should not be spent on evaluating such options, constraints of this kind can be changed and should not always be taken for granted. On the same note, technical constraints and standards may have been set without full consideration of the costs they impose. It is often possible for technical constraints to be overcome at a cost.

7.4 CONCLUSION

In defining the scope of the project and the alternatives to be considered:

- **The objectives for the project should be defined in terms of the overall objectives of the agency;**

- **The scope of the project evaluated should be such that the project is a discrete whole - although separate evaluation of subsidiary components is encouraged as it can assist in the development of the most effective solution;**

- **The options considered should include alternative means of providing the services required, alternative levels of output and alternative time paths for their implementation.**

8. ASSESSMENT OF PROJECT PERIOD

8.1 MATTERS AFFECTING PROJECT PERIOD

All costs and benefits attributable to a project should be included in the evaluation and hence the period covered by the evaluation needs to be long enough to capture them. The appropriate determinant of the project period will normally be the assessed economic life of the major asset involved in the investment proposal. Once a project period of, say, 20 years has been reached, the analysis will be relatively insensitive to the choice of a longer project period due to the discounting of future costs and benefits. In view of this and the difficulty of forecasting costs and benefits over such long periods, caution should be exercised in adopting a project period, longer than 20 years. Certainly the project period should not exceed 30 years.

In practice an investment proposal is likely to be composed of assets with a range of economic lives. Hence, the renewal and replacement of assets with a shorter economic life should be included in the analysis, while a residual value should be assigned to assets with a longer life.

Frequently the investment proposals being compared in the evaluation will have varying lives for the principal assets. For example, different lifetimes may be encountered in deciding whether to make a product or provide an in-house service versus buying the product or service from an outside organisation; or to replace existing plant and equipment with new plant.

Three approaches have often been used to make choices under these circumstances. One method is based on the assumption that each option with a shorter lifetime will be repeated at the end of its life until the end of the assessed project period for the evaluation which may be based on the option with the longer lifetime. A second approach is to make the options comparable by converting the net cost/benefit streams of each option to an equivalent annual figure (eg equivalent annual cost). The third approach is to calculate the annual cost of each option in perpetuity.

It is generally considered that the first approach is acceptable and provides a simpler form of analysis. However, a piece of plant or equipment would be continually replaced by similar equipment. Due allowance should be made when this assumption is not valid.

It is difficult to quantify the benefits of the lower level of risk which may be associated with assets with shorter lives. Commonly, the capital costs of the asset with a shorter life are lower, hence sunk costs are lower. The greater frequency of replacement enables the benefits of improved technology to be incorporated in the production process more quickly and may facilitate adjustment to changes in the quantity and type of service required.

While these benefits of greater flexibility and lower risk associated with shorter asset lives may be difficult to quantify, the costs which are involved in obtaining these benefits can be quantified by comparison of the equivalent annual cost of each option. Such a comparison should be undertaken where the benefits of a shorter asset life are considered likely to be significant. This is most likely to be the case in sectors where the pace of technological change is relatively rapid, demand is volatile or there is a particularly large difference in asset lives.

8.2 CONCLUSION

- **The project life adopted for the analysis should reflect the expected economic life of the principal asset. However, with assets which have a very long life (eg. dams) a cut off point should be imposed and a residual value for the asset calculated. In such cases a project life of preferably 20 years, but no more than 30 years, should be used.**

- **Where the assets being evaluated have differing lives, the cost of replacement of assets with lives shorter than the project period should be incorporated in the analysis.**

- **Where the benefits of reduced risk and increased flexibility for options which have shorter asset lives are considered significant, the cost of accessing such benefits should be calculated by comparing the annual cost of each option.**

9. IDENTIFICATION AND VALUATION OF COSTS AND BENEFITS

9.1 INTRODUCTION

A critically important input to an economic appraisal is the identification of resource requirements or savings and their translation into monetary values, wherever possible.

It must be noted that there is an important distinction between the costs and benefits involved in a financial analysis and those included in an economic analysis.

Financial analysis, whether used in the public or private sector, implies the notion of the agency maximising its net financial surplus over time. This will generally differ from the maximisation of the economic "surplus" generated for the community as a whole whenever prices do not fully reflect the benefits or costs associated with an activity (in some cases there may not even be any prices because benefits and costs are not traded).

In the case of the more commercial agencies the differences between financial appraisal and economic evaluation will commonly be comparatively small. It is emphasised that an economic appraisal must be conducted in all cases. However, for agencies with significant community service obligations, financial appraisal can be suitably applied only in a narrow range of decision choices. Thus in the economic evaluation of a public road not subject to a toll, financial appraisal will not be of much assistance. Similarly, in choosing between two sites for a hospital, not only should the costs of building on the two sites be considered, but also the level of transport costs and length of travel time incurred by patients and visitors to the hospital.

Thus in estimating the economic costs and benefits of a project, the analyst will have to estimate values where no direct price is charged and will generally have to consider a wider range of costs and benefits than occurs in a financial appraisal.

9.2 IDENTIFICATION OF COSTS AND BENEFITS - THE 'WITH-WITHOUT' PRINCIPLE

This is the basic principle of any type of project evaluation. In practice, it means that an attempt should be made to estimate "the state of the world" as it will exist with the project in existence. This should be contrasted with the "state of the world" that would have existed in the absence of the project (the "do nothing" option). That is, an attempt should be made to compare outcomes, with and without the project, in all relevant dimensions.

This principle has two important implications.

First, economic evaluation must not simply be a comparison of "before project" conditions with "after project" conditions because such comparison would attribute the contribution of all pre-existing trends and external factors to the project itself. For example, reductions in on-going costs due to changed work practices should not be attributed to savings from an

investment in new plant if the changes in work practices would have been introduced regardless of the investment decision.

Second, the analysis should include all impacts, both beneficial and otherwise, of the proposal being evaluated. In particular, not only should the intended effects or benefits which are the objectives of the project be included, but also the subsidiary or indirect effects.

There are a range of types of benefits and costs which must be considered, and they accrue to different people: some accrue directly to the user or provider of the service, while others will accrue to outsiders (these are known as "externalities").

The case of the evaluation of a dam whose primary purpose is the provision of irrigation for commercial crops can be used as an example. The impacts to be included in the analysis would be:

- the provision of irrigation water for cropping (the primary objective and a traded benefit);
- the provision of urban water (a traded benefit);
- flood mitigation benefits (a quantifiable non-traded benefit which is external to the users and providers of the water);
- recreational benefits offered by the dam (a quantifiable non-traded benefit external to the consumers of the water); and
- environmental effects on native fauna and flora (an external effect which may be difficult to quantify even in physical terms).

The importance of the "with-without" principle cannot be overstated. Failure to adopt it may lead to meaningless results.

9.3 VALUATION OF COSTS AND BENEFITS

9.3.1 Introduction

When considering how impacts should be valued in practice, it may be convenient to classify impacts into three categories.

1. Costs and benefits which can be readily identified and valued in money terms (eg. value of additional electricity supplies to users, travel time savings).

2. Effects which can be identified and measured in physical terms but which cannot be easily valued in money terms because of the absence of market signals and consequential disagreement as to the rate of valuation (eg. museums, reduction in pollution).

3. Impacts which are known to exist but cannot be precisely identified and accurately quantified, let alone valued (eg. crime prevention effects of police programs, comfort improvements in new trains, aesthetic effects of beautification programs).

   It should be stressed that **these categories are not rigid.** The wide range of tools now available will enable the valuation of the great majority of effects if sufficient effort and time is invested in the analysis. For example it would be possible to value the benefit of increased comfort on new trains using experimental choice data. Whether this effort would be warranted would depend on the extent of the replacement program and the importance of the other benefits considered in the evaluation. Nevertheless there may be areas where knowledge will gradually be acquired, and appraisal will become more sophisticated over the coming years.

9.3.2 Costs and Benefits which can be readily valued

Costs and benefits which can be expressed in money terms will normally include estimated initial outlays and running expenses on the cost side and, estimated receipts and cost savings on the benefit side. In practice, the items to be included on the cost and benefit sides of the monetary calculations will include:

Cost Side

- capital costs (estimates of the cost of land, buildings and equipment)
- operating costs (running costs for the whole life of the option).

Benefit Side

- revenue from traded output generated by the asset
- revenue from non-traded outputs
- benefits to users of the service **not reflected in the price paid** but which can be valued.
- cost savings
- residual value of asset (if any)
- benefits to the broader community which can be valued.

Care must be taken to ensure that all investment-related costs and benefits are included, even those which do not actually involve spending or receiving cash. Section 9.4 discusses some widely accepted methods for valuing outputs which are not traded commercially.

9.3.3 Benefits and costs which can be quantified but not readily valued

There are many areas where some quantification can be achieved, but it is very difficult to place monetary values on them. For example, the number of children passing through a school or the number of people entering a national park can be measured, but valuation is far more difficult.

In some cases these benefits or costs may be regarded as relatively minor in terms of the project. In these cases they can simply be described and taken into account in a subjective manner. Further consideration needs to be given to these benefits and costs when they represent the main or a major impact of a project. This is discussed further in Chapter 14.

9.3.4 Benefits and Costs which cannot be quantified

In the public sector there are many areas where it is impossible even to measure the benefits and costs. Examples are the effect on law and order of the courts or the aesthetic impact of a sewage works in an area of natural beauty. Again these items can simply be described if they are relatively minor. The treatment of major unquantifiable benefits is discussed further in Chapter 14.

9.3.5 Parallel treatment of costs and benefits

When considering benefits and costs which either cannot be valued or cannot be quantified, there can be a tendency to concentrate on the benefits and ignore the costs. This should be resisted. Costs which cannot be valued are just as important as benefits which cannot be valued, and should be accorded an equal treatment.

9.3.6 Choice of Technique

Chapter 5 discussed the application of the different techniques. In summary, whether CBA or CEA is the appropriate technique will depend mainly on the nature of the costs and benefits involved in the project. If the large part of the benefits and costs of a project can be readily valued, then the project is amenable to CBA. However, if significant benefits cannot be valued, then CEA is the most appropriate form of analysis.

It should be noted that CBA does not require valuation of each and every benefit and cost involved in the project, only the major ones. While valuation (and quantification) are encouraged where possible, unquantified benefits and costs will not be ignored when appraisals are considered. In many cases they will be crucial factors, and an appropriate priority will be attached to them.

This is also true of CEA. But the fact that the major benefit is unquantifiable does not remove the need for the analysis. Full details of the costs remain necessary (whether quantifiable or not). A particular unquantifiable benefit may be considered to be worthwhile, but not at any cost. The provision of cost data in dollar terms and a discussion of benefits in unquantified terms will allow these subjective judgements to be made.

As mentioned above, improvements in techniques for quantification and valuation of benefits and costs should be aimed at wherever possible. This will mean that the appropriate form of analysis may change over time. Projects which today are subjected to CEA may later be the subject of CBA as techniques for the valuation of the major benefits are developed.

9.3.7 Assessment Of Environmental Impacts

Since the publication of the last edition of the Guidelines there have been substantial advances in the technique of valuing environmental impacts. An Annexure has been provided to this edition of the Guidelines to assist in the incorporation environmental impacts into appraisals.

The Annexure does not establish any new reporting requirements. The economic assessment of environmental impacts is already part of the normal appraisal process.

9.4 VALUATION METHODS

Where valuation is possible, two key concepts need to be appreciated by practitioners.

9.4.1 The Opportunity Cost Principle

Underlying the valuation of inputs to a project or activity is the principle of opportunity cost.

The use of resources (manpower, finance or land) in one particular area will preclude their use in any other. Hence the basis for valuing the resources used is the "opportunity cost" of committing resources; ie the value those resources would have in the most attractive alternative use.

The adoption of this principle reflects the fact that the economic evaluation of public sector projects should be conducted from the perspective of society as a whole and not from the point of view of a single agency.

Commonly, the price paid for new capital, labour or other inputs will reflect the opportunity cost of the resources. The position may be less clear in the case of the use of existing land owned by the agency. However, in general it is considered that a cost equivalent to its maximum market value under current or likely land-use zoning should be placed on such land.

The general principle applies even where the public sector may have access to an input at a cost different from its market value. For example, coal supplied from the an electricity generator's own collieries should be priced at the market price for comparable coal rather than the costs of supply, reflecting the fact that the coal has an alternative use.

In certain cases, where a resource has a market price, that price may not reflect the marginal social cost of using the resource. Such cases are reasonably rare and are discussed in section 9.5.4 below.

9.4.2 Willingness-to-Pay Principle

Underlying the valuation of the benefits of a particular project or activity is the willingness-to-pay principle.

In valuing the benefits of a project the aim is to place a monetary value on the various outputs of the project. Typically such outputs will include:

- benefits for which a price is paid; and
- benefits for which no price is paid.

Where the services are freely bought and sold it is generally presumed that the price paid is a reasonable proxy for the value of the service to the consumer. This principle will hold most closely where the changes in output and price levels associated with the investment are relatively small (ie marginal). Where output changes are significant then it may be desirable to take account of changes in 'consumer surplus' (the excess over the market price which the

consumer would have been willing to pay). This will require knowledge of the price elasticity of demand (ie sensitivity of demand to changes in price).

However, where the service is **not freely traded** or there is no price charged, or indeed where the benefits fall broadly on the community rather than individual users, more indirect measures_of the willingness-to-pay for the benefits need to be derived. A variety of techniques are available including:

- the use of data on expenditure by consumers in seeking to participate in benefits (eg costs incurred in visiting a national park);

- price data from related goods and services (eg variations in house prices due to the impact of noise levels to assess the costs of airport noise); and

- choice experiments (eg experimental choice between a variety of existing and new amusement/recreation amenities to infer a value for a new amenity). Some non-traded outputs (eg travel time savings in the case of road construction) have long established methods of estimation and valuation.

Where no established framework exists, **valuation of non-traded outputs will have to be approached on a case by case basis.** The issues may be common to a number of projects or agencies or they may recur within an agency. As more experience is accumulated within an agency, and throughout the public sector generally, there will be substantial cross-referencing and more consensus will be established in valuing non traded-outputs. In all cases, the value assigned to each unit of output should be clearly spelled out in the evaluation. Often there is debate over the precise value that each particular unit of a given output can assume and a range of values is commonly suggested. A possible range of values should be specified and, where the benefit is comparatively significant, sensitivity analysis should be undertaken.

The Environmental Protection Authority, through its database of environmental estimates, has created ENVALUE. This computer package provides an anthology of abstracts from studies, in which estimates of willingness to pay have been made. These estimates cover a wide range of valuations from various parts of the world and are accompanied by instructions to aid in transferring them to local circumstances.

Decisions about the appropriate amount of time to be invested in benefit valuation will depend on factors such as the relative cost of the proposal being considered and whether the impact to be measured is part of the agency's prime objectives. Thus, in the end the manner of treatment will be dependent on the judgement of the analyst, subject to it being satisfactory to the users of the analysis.

Some Government services have been provided at subsidised prices and this introduces distortions into the market. Therefore the use of customer charges to value benefits is likely to understate benefits. As with services for which no price is charged, additional effort is needed in the appraisal to estimate the additional benefits, either from externalities or consumer surplus. It is not sufficient to argue that a project is justified because consumers are "willing to pay" a price when that price does not cover the costs of the service.

9.5 SPECIFIC ISSUES

9.5.1 Avoidance of Double Counting or Overstating of Benefits

In enumerating the costs and benefits of a proposal, care should be taken to avoid **double counting.** The danger of double counting is particularly great where an effect of the project, be it beneficial or otherwise, is incorporated in subsequent valuations of assets or prices.

For example, the construction of a dam may increase the value of the land which is to be irrigated as a result of the increased ability of the land to grow crops. The increased value of the land merely reflects the market's capitalisation of the increased output stream. Inclusion of both the net value of the increased output and the increased land value would count the same benefit twice.

Another danger is the overstatement of benefits by attributing the total output of a process to a single input. Where infrastructure is provided which enables the expansion of an industry the gross output of that industry should not be attributed to the provision of the infrastructure. Account has to be taken of the other resources used in production in the "downstream" industry.

In the example above, the total value of the crops made available by the water irrigation project should not be attributed to the project. Rather the net value of the additional production should be derived by deducting all additional input costs from the value of the additional output; ie the costs of labour, capital and other inputs such as fertiliser and fuel should be deducted from the value of the output. Measured in this way the value of net output, subject to provision for a "normal" profit, provides a measure of the "willingness-to-pay" for water. Hence, the inclusion of this benefit would also require adjustment for actual payments made for the water provided.

9.5.2 Treatment of Inflation

Due to inflation, costs and benefits which occur later will be higher in cash terms than similar costs or benefits which occur earlier.

There are two different ways to tackle this issue. Either nominal values can be used for each time period and then discounted with a nominal discount rate, or real cash flows can be used discounted by a real discount rate. There is no inherent reason to choose one rather than the other as both will provide the same answer, but the important factor is that real and nominal cash flows and discount rates must never be mixed in the one evaluation. Where cash flows are in real or unescalated terms, only the real discount rate should be used and where nominal or escalated cash flows are used the nominal discount rate must be used.

In practice, however, there are strong merits in adopting a uniform basis of analysis and it is considered that the use of real cash flows and discount rates may simplify the forecasting and calculation processes. **Hence, analysis should use costs and benefits valued in real terms and discounted by a real discount rate.** The base date for the calculations should be the same as that used for any accompanying financial analysis.

The procedure used should therefore be to express cash flows in real terms and only adjust for differential price effects where a specific resource price is expected to move at a rate different from the general inflation rate. For example, if labour costs are projected to increase by 8% per annum and the CPI 7% per annum, the real increase in labour costs is the compound differential between these two rates, ie 0.9% per annum.

9.5.3 Timing of Cash Flows

The conventional approach to preparing cash flows is to set the initial cash outflow at year zero and centre all future inflows and outflows at 12-monthly intervals from that date. This regular 12-monthly "gap" simplifies the discounting of future cash flows to their present values.

The reality is that cash flows will not be evenly spaced with a 12-monthly gap nor can they necessarily be centred at 12-month intervals without some distortion to their true pattern. However, the above approach to the cash flow timing problem will not introduce unacceptable distortions for programs which are long term (five years or longer).

Where within year variations in timing will make a significant difference in the evaluation, it is suggested that a two stage discounting procedure be followed. Initially within year cash flows are discounted to the same month in each year (the month in year zero that the project is deemed to commence). The annual cash flows can then be discounted back to the base year in the normal way.

9.5.4 Use of Shadow Prices

As noted above, the general principle is that where market prices are available, they should provide the basis for the measurement of the opportunity cost of inputs or the willingness to pay for outputs.

However, in some cases such prices may contain distortions which require the use of shadow prices. (The term is also sometimes used in relation to outputs for which no prices are charged but the discussion in this section excludes this usage).

It is generally considered that the problems of measurement of shadow prices may often be substantial and the size of the impact on the analysis comparatively small. Hence, this level of sophistication in the analysis will not generally be warranted as it will introduce unnecessary controversy.

It is not intended to prohibit the use of shadow prices but rather to ensure that they are used with due care and only where their introduction is justified. Should shadow prices be thought appropriate due to the special circumstances in a particular appraisal, Treasury should be consulted before they are used.

Where a successful case has been made for the use of shadow prices in a particular area, it is intended that the accepted prices be distributed to other public sector agencies so as to standardise the use of prices wherever possible.

Instances where the use of shadow prices rather than market prices are most commonly advocated are where:

(1) taxes and subsidies drive a wedge between costs of production and prices

While taxes and charges introduce distortions it is not considered that these will have a significant impact on the analysis unless one of the key inputs or components of the benefits is subject to an especially large excise duty/sales tax or subsidy. In particular, prices of goods and services provided by the Government have often been set at levels that do not reflect their true resource costs.

It is sometimes considered that an adjustment should be made for the substantial duties and charges levied on petroleum products, which can be a significant input or component of benefits such as fuel savings. However, a major component of the levies imposed on petroleum products is the crude oil levy. As this levy was intended to align domestic oil prices with overseas prices, it would be inappropriate to remove the effect of this levy.

(2) the resources used would otherwise be unemployed

It can be argued that in times of unemployment the opportunity cost of labour employed on a project is less than the wage costs, and project costs and benefits should be adjusted accordingly. However, in practice such adjustments are not generally made and are not recommended.

Uncertainty exists as to what represents the "full employment" level of output and employment in the economy. The degree of full employment would need to be assessed by occupation and region and forecast over the project period. An adjustment for unemployed resources assumes that the resources employed are not at the expense of the employment of other resources. Where macroeconomic parameters act to constrain the overall level of activity in the economy and/or the funds available for capital works such an assumption is not appropriate.

9.5.5 Valuation of Specific Cost Items

Land and Pre-existing Buildings/Plant

While a project may use land, buildings or plant already owned by an agency for which no payment will be made, the opportunity costs of these assets should be included.

In regard to land and buildings the value used should be an up-to-date valuation based on the most profitable alternative use likely to be allowed under land use regulations. This will require realistic assessment of potential alternative uses and of the likelihood that amendments to existing land use regulations would be permitted by the relevant authorities. For example, land owned by the State Rail Authority within commercial centres is commonly zoned "general use" but if it has development potential should be valued accordingly.

Where valuation of land is expected to be contentious, it is suggested that discussions be held with the Treasury. Expert advice on land valuation is available from the Valuer General's Department.

In regard to plant transferred to the project the value placed on the plant should reflect its value in an alternative use. While sale value may be used for highly marketable assets (eg motor vehicles) markets may not exist for the resale of many items of plant. In the latter case plant may be valued by the lower of:

- the estimate of the present value of its savings or revenue earnings potential in its current location or activity; or
- the current replacement value of the plant adjusted for the residual life of the existing plant where appropriate.

Labour

In assessing labour costs, the value of existing labour resources transferred to the project, as well as additional labour required, should be included.

While, theoretically, transferred employees should be valued at their alternative use, conventionally this is assumed to be equal to the total cost of the employees to the agency.

Labour on-costs are incremental, unavoidable costs and, as such, must be added to direct labour costs and included in the cost figures (and also in the savings estimates if labour savings are involved on the benefits side).

Overheads

Labour related overheads such as supervision, transport costs, administrative costs, printing and stationery etc., are also included if the with/without comparison shows that they differ between project alternatives and the base case. By the same criteria material overhead costs associated with purchasing, storing and transporting materials needed for the investment project will also be relevant.

Residual Values

At the end of the planning horizon or project life, some assets may still be of value. Such assets may not have reached the end of their economic life and may still be of use to the agency or may be resaleable. In this case the value of an asset may be assessed at a level pro rata to its remaining economic life although this is not entirely satisfactory. Alternatively the asset may have reached the end of its economic life but have a scrap value. This value is a benefit to the project and should be included in the evaluation. Certain assets are non-depreciable, such as land, and can be valued at opportunity cost.

9.5.6 Costs To Be Excluded from Analysis

A number of items which are included as costs in accounting reports or financial appraisals should not be included in an economic evaluation of an investment proposal.

Sunk Costs

In an evaluation, all costs must relate to future expenditures only. The price paid 10 years ago for a piece of land or a plant item is of no relevance; it is the opportunity cost in terms of

today's value (or price) which must be included. All past or sunk costs are irrelevant and should be excluded.

Depreciation

Depreciation is an accounting means of allocating the cost of a capital asset over the years of its estimated useful life. It does not directly reflect any opportunity cost of capital.

The economic capital cost of a project is incurred at the time that labour, machinery and other inputs are used for construction, or in the case of an existing asset, when it is diverted from its current use to use in the project being evaluated. These project inputs are valued at their opportunity cost.

Hence, depreciation should not be included in the economic evaluation.

Interest

As future cash flows are discounted to present value terms in economic evaluations, the choice of the discount rate is based on various factors which include the rate of interest and associated finance charges. The discounting process removes the need to include finance charges in the cash flows.

9.6 CONCLUSION

- **The key to the analysis is a complete and accurate enumeration of all the costs and benefits associated with a project. Where such benefits and costs cannot be valued they should be expressed in physical terms wherever possible and discussed. Any benefits which cannot be quantified should still be discussed, and they will be taken into account when decisions are made.**

- **Cost effectiveness analysis should be used only where the major benefit from the project cannot be quantified.**

- **The analysis should be undertaken in real terms using a real discount rate.**

- **Costs and benefits should be compared between the world with the project and without it.**

- **Market prices should be used to value costs and benefits whenever suitable market prices are available - exceptions to this rule are expected to be relatively rare. Treasury must be consulted if the use of shadow prices is being considered.**

- **In particular:**
  - **land should be valued at its likely market value;**
  - **labour costs should include on-costs and unavoidable overheads; and**
  - **sunk costs, depreciation and interest costs should be excluded.**

10. DISCOUNTING OF FUTURE COSTS AND BENEFITS

10.1 THE CONCEPT OF DISCOUNTING

The costs and benefits flowing from an investment decision are spread over time. Initial investment costs are borne up front while benefits or operating costs may extend far into the future. Even in the absence of inflation, a dollar received now is worth more than a dollar received at some time in the future. Conversely, a dollar's cost incurred now is more onerous than a dollar's cost accruing at some future time. This reflects the concept of time preference which can be seen in the fact that people normally prefer to receive cash sooner rather than later and pay bills later rather than sooner. The existence of real interest rates reflects this time preference.

In order to compare the costs and benefits flowing from a project it is necessary to bring them back to a common time dimension. This is done by discounting the value of future costs and benefits in order to determine their present value. The process of discounting is simply compound interest worked backwards.

10.2 THE RECOMMENDED DISCOUNT RATE

Private sector entities sometimes require that the rate of return on a particular project exceeds the return expected on an alternative project which might otherwise be undertaken. Or they might stipulate a return somewhat in excess of the cost of borrowed funds.

Public sector decision-makers will be encouraged to invest in projects which generate returns greater than the government's test discount rates. Three alternative bases for the setting of the discount rate have been proposed:

- social time preference;
- opportunity cost of capital; and
- cost of funds.

The first two concepts of the discount rate relate to the **opportunity cost** of the resources used in the public sector investment projects. Resources could be used elsewhere and the discount rate attempts to measure such opportunities foregone. In principle the social time preference rate and the opportunity cost of capital should be the same. However, for various reasons such as private sector profit and capital constraints in the public sector, the two will differ. Typically the opportunity cost of capital will be greater than the social time preference rate.

Resources devoted to public investment will be at the expense of current consumption or private sector investment. In a growing economy with rising living standards, a dollar's consumption today will be more valued than a dollar's consumption at some future time for, in the latter case, the dollar will be subtracted from a higher income level. This so-called **marginal social rate of time preference** is, of course, not easy to measure.

If alternatively, public investment takes place at the expense of private investment then, from an economic efficiency viewpoint, public investments of an economic nature should not be sanctioned if they are expected to earn significantly lower rates of return than those same resources might earn (before tax) in the private sector (the so-called **marginal social opportunity cost**).

This concept is also difficult to measure accurately. The concern is not with the **average** rate of return in the private sector, but with the marginal rate - that is with the rate which would be earned by the private sector if additional capital allowed further private investment to occur. In theory a perfectly competitive capital market will see equality of the consumer's marginal rate of time preference, the investor's rate of return on the marginal project and the market rate of interest. In practice interest rates provide limited guidance to the estimation of discount rates on these bases.

Commonly, estimates of social time preference rates are around 2 to 4 per cent while estimates of the social opportunity costs are around 7 to 10 per cent. These figures are, at best, approximate.

In the face of the difficulty of measuring discount rates on these bases, it has sometimes been argued that the appropriate rate of return or discount rate should be derived from the interest rate at which government borrows funds in the market. But given the dominant position of government in the capital market, the variability of interest rates and the wide range of factors which impact on interest rates this is quite an inadequate way of deriving the appropriate discount rate.

While there may be no universally accepted "correct" discount rate, interpretation of appraisal results will be impossible if different agencies use different discount rates. The solution is the application of a standard set of real discount rates of 4 per cent, 7 per cent and 10 per cent to see if the outcome is sensitive to such variations and, if it is, to make the critical 'break-even' rate clear to the sponsors. The central real discount rate is therefore 7% with sensitivity tests on the use of 4% and 10%.

10. 3 THE ARITHMETIC OF DISCOUNTING

The following section presents a number of examples of the discounting technique. Of course, in practice, there are a number of computer packages which will perform discounting functions.

10.3.1 Present Values

In practice the activity of discounting will be performed through a computer package but the basic arithmetic of discounting is most readily explained using a simple compound interest rate problem as the starting point.

Suppose the sum of $100 is invested at 7 per cent for 2 years. At the end of the first year the initial $100 will have earned $7 interest and the augmented sum ($107) will earn a further 7 per cent (or $7.49) in the second year. Thus at the end of 2 years the $100 invested now will be worth $114.49.

The discounting problem is simply the converse of this compound interest problem. Thus, $114.49 receivable in 2 years time, and discounted by 7 per cent, has a present value of $100.

This can be calculated by the equation:

$$\text{Present value} = \frac{1}{(1+r)^n} X \$Y \qquad (1)$$

where $Y is the money sum whose present value is to be calculated, r is the discount rate expressed as a decimal (eg 0.07) and n represents the number of years before the sum is received (or the cost paid) - in this case 2 years. Thus:

$$\text{Present value} = \frac{114.49}{(1+0.07)^2} = \frac{114.49}{(1.07 x 1.07)} = \frac{114.49}{(1.1449)} = \$100$$

Alternatively the future sum can be multiplied by a **discount factor** to derive the present value. In this case by:

$$\frac{1}{(1+0.07)^2} = 0.8734$$

and $114.49 multiplied by a discount factor of 0.8734 = $100.

Equation (1) is the basic formula for calculating present values. Other formulae which are likely to be of use are outlined below.

10.3.2 Equivalent Annual Costs

Evaluation results for most investment projects, especially those which involve comparison of options with different lifetimes, can be calculated and presented as annualised values or "equivalent annual costs" rather than as present values.

In addition to being useful for comparing options with different lifetimes, as discussed above, equivalent annual costs can also be useful as a way of costing the use of capital assets. By expressing the capital value of the asset as an equivalent annual cost over the asset's life, it is possible to set charges so as to recoup this cost.

Equivalent annual costs are calculated as follows. The annual payment, made for n years starting in year 1, when discounted at r% with a present value at the middle of year 0 of $Y is given by:

$$A_n = \frac{r}{1 - \frac{1}{(1+r)^n}} x \$Y$$

where: A_n is the equivalent annual cost of $Y

For example: a payment of $1,000 in year 0 is equivalent to 10 mid-year annual payments, discounted at 7% and starting in year 1, of

$$\$1000 \text{ x } \frac{0.07}{1 - \frac{1}{(1.07)^{10}}} = \$1000 \text{ x } 0.1424 = \$142.40$$

10.3.3 Present Value of Equal Annual Payments

The present value, in year 0, of a stream of equal annual payments of $Y starting year 1, is given by the reciprocal of the equivalent annual cost. That is, by:

$$\text{Present value} = \frac{1 - \frac{1}{(1+r)^n}}{r} X \ \$Y \qquad (2)$$

For example: 12 annual payments of $500, starting in year 1, have a present value at the middle of year 0 when discounted at 7% of:

$$\$500 \text{ x } \frac{1 - \frac{1}{(1.07)^{12}}}{0.07} = \$500 \text{ x } 7.9427 = \$3971$$

10.3.4 Present Value of Annual Payments Starting Later than Year 1

The present value, in year 0, of m annual payments of $Y, starting in year n + 1, can be calculated by combining discount factors for a payment in year n and the factor for the present value of m annual payments.

$$\text{Present value} = \$Y \text{ x } \frac{1 - \frac{1}{(1+r)^m}}{r} \text{ x } \frac{1}{(1+r)^n}$$

For example: 12 annual mid-year payments of $250 in years 5 to 16 have a present value in year 4 of $250 × 7.9427 = $1986 when discounted at 7%. Therefore in year 0, 4 years earlier, they have a present value of $250 × 7.9427 × 0.7629 = $1515.

10.4 IMPACT OF DISCOUNT RATES ON PROJECT RANKING

It should be noted that the choice of the discount rate is an important issue as it can have a significant impact on the ranking of options/projects and hence their choice. In general, as the discount rate rises projects with larger initial outlays and lower ongoing outlays become relatively less attractive compared with projects with lower initial outlays and higher ongoing outlays. Thus, a higher discount rate would favour maintenance options as against asset replacement.

Similarly in the case when net benefits are spread far into the future, the higher the discount rate, the more net benefits far in the future are downgraded in present value terms relative to net benefits closer to hand.

Thus, short lived options are favoured by higher discount rates relative to long-lived options.

Commonly an agency does not have sufficient funds to undertake all worthwhile projects. In such circumstances, an agency may be tempted to use a higher discount rate to ration capital funds. However, due to the biases an excessively high discount rate may introduce, this procedure should not be employed. Appropriate decision rules under capital rationing are discussed in Chapter 11 below.

It is also sometimes argued that the discount rate should be made dependent on the degree of risk associated with the project: high risk projects would be allocated high discount rates and low risk projects low discount rates. This argument presupposes that risk increases over time. This is clearly not necessarily the case - the risk may be introduced by an event due to occur in the near future or may be the same throughout the life of the project. Adjustments to the discount rate should therefore not be made because of the risk associated with the project. Appropriate treatment of risk and uncertainty is discussed in Chapter 12.

10.5 CONCLUSION

- **The stream of assessed benefits and costs should be discounted so as to enable comparison over time.**

- **The discount rate to be used is 7 per cent in real terms. Sensitivity testing should be undertaken using real discount rates of 4 per cent and 10 per cent to test the robustness of the results to changes in the discount rate.**

- **It is essential that the net present value of the stream of benefits and costs be calculated. In certain circumstances it may also be useful to calculate the equivalent annual costs.**

11. DECISION CRITERIA

11.1 INTRODUCTION

It is possible to calculate key statistics and develop decision criteria based on them. Such statistics will only take account of benefits and costs on which a value has been placed and can only therefore provide part of the picture to the decision maker. The unquantified effects will also need to be considered. While this chapter discusses various decision criteria, the importance of the unquantified benefits and costs must not be forgotten.

Investment decision-making is primarily concerned with three types of processes:

1) **the screening process,** whereby the decision-maker, faced with a range of independent projects and adequate resources, must accept or reject the individual projects.

2) **the choice process between mutually exclusive projects,** whereby the decision-maker must choose from a range of mutually exclusive projects (commonly directed at similar objectives).

3) **the ranking process,** whereby the decision-maker is faced with resource constraints which prevent all acceptable projects from being proceeded with - hence the projects must be ranked in an objective manner.

Various investment criteria are available to assist in reaching decisions in each of these circumstances. Commonly used criteria are the Net Present Value (NPV); Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR) and Net Present Value per constrained unit of input (NPV/I).

Acceptance or rejection of investment proposals is the simplest decision normally encountered in investment decision-making. However, it is rare for investment decisions to involve only a choice between acceptance or rejection since investment can rarely be isolated from other alternatives.

The ranking decision is far more complex, particularly with regard to situations where the volume of funds for investment in a given period is limited.

11.2 ALTERNATIVE DECISION RULES

11.2.1 Net Present Value

Net Present Value is the sum of the discounted project benefits less discounted project costs. Formally it can be expressed as follows:

$$NPV = \sum_{n=0}^{N} \frac{B_n - C_n}{(1+r)^n}$$

where B_n = project benefits in year n expressed in constant dollars
C_n = project costs in year n expressed in constant dollars
r = real discount rate
N = number of years that costs and/or benefits are produced

Under this decision rule, a project is potentially worthwhile (or viable) if the NPV is greater than zero; ie the total discounted value of benefits is greater than the total discounted costs. If projects are mutually exclusive, the project which yields the highest NPV would be chosen.

11.2.2 Benefit-Cost Ratio

The Benefit-Cost Ratio (BCR) is the ratio of the present value of benefits to the present value of costs. In algebraic terms it can be expressed as follows:

$$BCR = \sum_{n=0}^{N} \frac{B_n}{(1+r)^n} \Big/ \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

A project is potentially worthwhile if the BCR is greater than 1; ie, the present value of benefits exceed the present value of costs. If projects are mutually exclusive, this rule would indicate that the project with the highest BCR should be chosen.

It has become conventional to split costs into two types when calculating BCRs: initial capital costs and ongoing costs. Ongoing costs are normally deducted from benefits in the year incurred to make a net benefit stream, while initial capital costs are used as the denominator.

For consistency, the above approach should be adopted in project appraisals for consideration by the Budget Committee of Cabinet. In cases where appraisals may also be undertaken for consideration by other parties for funding (eg Commonwealth Government) and a different basis of calculating BCR is required under their Guidelines, calculation of BCR on **both** bases should be shown and **clearly identified**.

11.2.3 Internal Rate of Return

The Internal Rate of Return (IRR) is the discount rate at which the net present value of a project is equal to zero, ie discounted benefits equal discounted costs. In algebraic terms the IRR is the value of r which solves the equation:

$$0 = \sum_{n=0}^{N} \frac{(B-C)_n}{(1+r)^n}$$

A project is potentially worthwhile if the IRR is greater than the test discount rate. If projects are mutually exclusive, this rule would suggest that the project with the highest IRR should be chosen.

11.3 EVALUATION OF DECISION RULES

11.3.1 Screening of Worthwhile Projects

The NPV and BCR provide equally acceptable criteria for showing whether an individual project is worthwhile, when taken in isolation. Both clearly show when, for a given discount rate, the project benefits exceed costs and the results of the rules will not conflict with each other.

While in many cases the IRR will also yield simple and unambiguous results, care needs to be exercised in the use of IRR. In cases of non-conventional cost-benefit streams (ie where there are substantial discontinuities or breaks in the net benefits stream over time) more than one quite different IRR may be calculated. An example of a non-conventional cost-benefit stream is where a project incurs net costs initially followed by net benefits over a number of years and then net costs again.

11.3.2 Choice Between Mutually Exclusive Projects

A simple use of NPV, BCR and IRR will not yield the same results for the more complex choice between mutually exclusive projects. The project with the highest NPV may not have the highest IRR or the highest BCR. In the latter case this is because the ratio can be affected by the inclusion of costs as negative benefits, or different balances between initial costs and ongoing costs. This makes it difficult to compare across projects.

Where there are no constraints on inputs, such as capital resources, the choice between projects should be made on the basis of maximisation of NPV; ie the project with the highest NPV should be preferred. This will ensure that the project which provides the largest potential contribution to welfare is adopted.

11.3.3 Ranking Under Constraints

In practice decision-makers operate in environments where constraints are commonplace. Indeed constraints on capital funds are almost universal. In order to ensure the Government's Budgetary objectives are met, such constraints will clearly heavily influence decision making on projects. The problem facing decision-makers is to rank projects in terms of return to the constrained input and then choose projects so as to maximise the NPV of the total program.

None of the three decision criteria discussed above take capital constraints explicitly into account, although the BCR calculation as indicated in 11.2.2 implicitly does so. However, use of the NPV per dollar of total capital would result in the choice of that combination of projects which maximises the total NPV obtained from a limited capital works budget.

It can be readily calculated as follows:

$$NPVI = \sum_{n=0}^{N} \frac{(B-C)_n}{(1+r)^n} \Big/ \sum_{n=0}^{N} \frac{I_n}{(1+r)^n}$$

where I_n = capital investment in the project in year n

C_n = I_n + operating costs in year n

Note that the capital investment is discounted to its present value in the same way as are the net benefits.

Using this measure, projects with the highest NPV per dollar of total capital are selected until the budget is exhausted.

This means that the expenditure constraint may be a factor in the choice of an investment option which does not have the highest NPV, if the option with the highest NPV requires very high expenditure. In such circumstances the return on the incremental expenditure may be relatively low. This procedure seeks to maximise aggregate NPV from the available funds.

11.4 CONCLUSION

The preferred measures of the "worth" of a project are:

- **The net present value (NPV);**
- **The benefit/cost ratio (BCR - calculated using initial capital cost as the denominator or in cases where the basis required for other Governments is different, calculation on both bases should be undertaken and clearly identified); and**
- **The net present value per dollar of capital required (NPV/I).**

These measures should be highlighted in presenting the results of an appraisal.

Another decision criteria which assists in the presentation of results is the internal rate of return (IRR).

Agencies should note that NPV/I and BCR will be important considerations in respect of projects submitted for capital funding consideration to the Budget Committee.

12. RISK AND UNCERTAINTY

12.1 THE CONCEPTS OF RISK AND UNCERTAINTY

Risk can be distinguished from uncertainty. Risk refers to situations with known probabilities. That is, the number and size of each possible outcome is known and the chance of each outcome occurring can be objectively determined. For example, in the case of throwing unbiased dice, the number of possible outcomes and their probabilities are known prior to the event.

In practice, it is rarely possible to define the probability associated with each outcome, and the distinction between risk and uncertainty is not likely to be completely clear. The discussion in this chapter introduces a number of important concepts; but in practice these may not always be able to be used.

Data may be available in some circumstances. For example, information about the probability of a flood occurring is generally available from hydrological data. Hence, it is possible, in theory at least, to predict for any given size of protective works the probability of a particular flood event. One difficulty in this and similar cases is that major floods, which are critical to such assessments, occur infrequently and the probability estimates are accordingly unreliable.

Uncertainty, on the other hand, refers to situations with unknown probabilities. That is, the number and size of each outcome may or may not be known, but the chance of any single outcome occurring cannot be objectively determined. For example, the demand for new services is dependant on many factors and the relative influence of these factors may vary over time in an unpredictable manner.

A degree of uncertainty will be associated with almost any significant capital project. The problem is particularly acute in regard to public sector investments which are often comparatively long lived and of a substantial size, with little recoverable value.

For most organisations the shape of the operating environment in 15 or 20 years cannot be known, nor indeed can objective probabilities be attached to the various scenarios. Even the attachment of subjective probabilities is difficult and such attempts at quantification run the risk of creating a false sense of security. Uncertainty is therefore likely to be more prevalent than risk in capital projects in the public sector.

However, decisions with lasting consequences have to be made in this environment and in so doing scenarios or projections have to be used. Implicitly, or explicitly, each decision is based on a view of the future. It is considered that decision making, and project evaluation, under these circumstances will be greatly assisted if it occurs within a strategic planning framework which is integrated with scenario development. This will ensure that importance is placed on flexibility in developing solutions for the provision of service.

NSW Government agencies are required to apply a formal assessment of risk in planning new projects and major capital asset activities valued in excess of $5 million. Guidelines have been published as part of the Total Asset Management manual.

12.2 THE TRADITIONAL TREATMENT OF RISK IN THE PUBLIC SECTOR

Past practice in the public sector has generally been to ignore the degree of volatility of the cost and benefit streams on the grounds that many public projects have costs and benefits which are very widely spread (risk pooling). Each individual is only therefore bearing a relatively small risk.

This would suggest that investment proposals could be judged on the basis of their expected NPV at the test discount rate, where the expected NPV is calculated as the sum of the NPV for each possible outcome weighted by the assessed probability (where available). As an example, a project might have a 70% probability of producing a NPV of $1 million and a 30% probability of producing a NPV of $2 million. The expected net present value (ENPV) would be calculated as:

$$ENPV = 0.7 \times \$1m + 0.3 \times \$2m = \$1.3m$$

This project could be compared with another which has a 50% probability of resulting in a NPV of $1.25 million and a 50% chance of producing a NPV of $1.35 million. The ENPV would be calculated as:

$$ENPV = 0.5 \times \$1.25m + 0.5 \times \$1.35m = \$1.3m$$

The ENPV is the same in both cases, but the variability of the result is obviously very different.

While risk-neutrality has been the traditional position in undertaking public sector evaluations, increasingly it is recognised that a more explicit allowance for risk is desirable in a number of cases. These include large investment projects where the risk borne by any individual will still remain large or where risks are correlated with income (eg power stations where the demand will depend on consumers' incomes) and small targeted projects where the costs or benefits are concentrated on a small group of individuals so that the risks are not spread widely.

Furthermore, the move towards the application of more commercial objectives to government trading enterprises suggests that these enterprises may wish to move away from the position of risk neutrality which is traditionally espoused for the public sector.

In addition to assessing the effects of risk on the results of the economic appraisal attempts should also be made to reduce risk through project design (even though a cost may be involved). At the evaluation stage, this might include:

(a) Use of an independent expert to check reasonableness.
(b) Comparison of estimates with final costs and time scales for similar completed projects. If a consistent pattern emerges it could be assumed that current estimates may follow past patterns.
(c) Use of historical contingency allowances to provide a guide to present contingency allowances.

There are many well-known techniques for risk reduction in project design which will normally be considered as part of the technical appraisal of a project, such as the practice of spreading orders around components suppliers, the use of alternative fuels and changing the project design so as to accept lower performance in return for greater reliability.

12.3 METHODS OF ASSESSING RISK AND UNCERTAINTY

In cases of straightforward risk, where all the possible outcomes and the probability of each outcome is known, the extent of risk is clearly apparent.

In general, however, it is more realistic to assume that there will be at least some, usually substantial, doubt about both the range of possible outcomes and the probabilities attached to them. The techniques of sensitivity analysis and scenario planning are then appropriate.

Sensitivity analysis and scenario planning do not necessarily make use of explicit probabilities of the different possible outcomes of an investment proposal. That is, they do not on their own provide a specific measure of risk, and the task of weighting the various possible outcomes falls on the decision-maker. Nevertheless, they are useful techniques for assessing the impact of uncertainty.

12.3.1 Sensitivity Analysis

Sensitivity Analysis is used to assess the possible impact of uncertainty. It illustrates what would happen if the assumptions made about some or all of the key variables proved to be wrong and shows how changes in the values of various factors affect the overall cost or benefit of a given investment project.

A key practical role of sensitivity analysis is to incorporate different views about one or more key assumptions which can reasonably be held by the different people involved in the assessment process.

It is a useful means of indicating the critical elements on which the outcome of the project depends. This allows management to focus on these areas during project implementation or to divert further resources to the improvement of cost and benefit estimates and the reduction of uncertainty. (It is a necessary part of any investment appraisal.)

If a major project cost or benefit cannot be estimated with a high degree of confidence, clearly it would be desirable if the evaluation result was insensitive to movements in this value. If, however, the evaluation was sensitive, the level of uncertainty surrounding the estimate becomes important. Indeed it may be large enough to recommend that the project does not proceed despite having a positive NPV when the standard cost and benefit estimates are used (or alternatively depending on the direction of uncertainty, does proceed despite a negative NPV).

The steps in undertaking appropriate sensitivity tests are outlined below.

(1) Decide plausible range of values for factors subject to uncertainty:

eg
- real energy cost + or - 20 per cent
- real wages + 4 to +12 per cent
- exchange rate + 50 to -30 per cent

(2) Determine relationships between the sensitivities for the various variables (eg nominal wages and inflation). If correlations exist these may be tackled by:

- moving to a higher level of aggregation (eg consider the movement of real wages rather than nominal wages and inflation).
- looking at the underlying source of uncertainty.
- specifying a set of mutually consistent assumptions for relevant factors under a number of different scenarios. This approach has developed into a complete method of approaching risk and uncertainty and is covered in the discussion of scenario planning below.

(3) Calculate the effect of plausible changes on the decision criterion (the NPV). The range of values taken by many variables may not be large enough to alter the decision and may therefore be eliminated, thus reducing the number of variables under consideration.

If sensitivity analysis is to be useful to decision-makers it needs to be undertaken systematically and presented clearly. There is no value in examining a large number of sensitivities chosen in an arbitrary way. Although a detailed examination could be simply carried out with the aid of computers it should not be presented in this way as it would merely produce an arbitrary set of possible outcomes. The choice of sensitivities should be made carefully having regard to the uncertainty of particular factors, particularly those that are more uncertain than others or where uncertainty is not symmetrical. Account should also be taken of any important relationships between factors.

Switching values may also be used as an alternative approach to sensitivity analysis when changes in only one variable are being considered. The 'switching value', is the critical value of a particular variable at which the calculated net benefit of the investment project changes sign. The idea is to calculate the value of that variable at which the NPV of an investment option becomes zero, or at which two options change rank. Having done this, the problem is reduced to deciding whether the variable is more likely to take on values above or below the switching value.

12.3.2 Scenario Planning

Sensitivity analysis only considers what would happen if one of the assumptions in the appraisal proved to be incorrect. This may prove to be either too time-consuming (if there are many assumptions in the appraisal, each of which needs to be varied) or too narrow in its focus. An alternative is scenario planning.

Scenario planning is the process of looking at the consequences of various possible states of the world or future scenarios. Scenarios have been used in practice to not only analyse large individual investment projects but also entire corporate strategies. Scenarios should be developed so that they are mutually exclusive. Scenario construction should avoid the temptation to average any two scenarios, or to choose the central or the most likely one of a number.

Scenarios usually consist of descriptions of the future socioeconomic environment which, while being logical and internally consistent, differ in crucial respects. The idea is to set up two or possibly three scenarios so as to draw the attention of senior management to the technical, economic, political, or other uncertainties upon which the success of the investment project depends. Scenarios are not forecasts, they are an aid to understanding the mechanisms at work. In fact, scenario planning has grown from disenchantment with the results of traditional methods of forecasting.

In constructing scenarios, the following practical issues may be encountered by investment evaluation practitioners:

- persuading decision makers accustomed to short-term horizons to take long-term scenarios seriously.

- specifying the particular scenarios consistently. This means that scenarios should be internally and mutually consistent.

Scenario planning can be a particularly effective means of encapsulating the inherent uncertainty facing decision makers and ensuring the importance of flexibility in planning is addressed.

12.4 DECISION CRITERIA UNDER RISK AND UNCERTAINTY

Decision criteria using the results of sensitivity analysis and scenario planning can be grouped into three categories:

1) Presentation of the net present values for the options under a range of sensitivities or scenarios with the judgement across sensitivities and scenarios left to the decision maker.

2) Presentation of the net present values for the options under a range of sensitivities or scenarios and the calculation of decision criteria such as the maximin payoff (option chosen which maximises the minimum return) or a simple average of results weighted by an index of pessimism.

3) Allocation of probabilities to different sensitivities/scenarios and calculation of decision criteria such as the expected net present value and the degree of dispersion in the expected net present value.

The first approach is the approach most commonly used. In particular, it incorporates the case where a most likely outcome is specified and the recommendation is based on the net present value for the options under this outcome, without incorporating the results under other outcomes in the decision criteria. This approach is adequate for many projects, but for large projects, the outcome of which can have a major impact on the finances and service delivery of the sponsoring body, and smaller, but closely targeted, projects a more thorough analysis of the impact of uncertainty and risk is needed.

When probabilities cannot be attached to different outcomes, the expected net present value is not a feasible decision criterion. However, a number of criteria have been developed which provide some guidance in these circumstances.

- **Maximin Pay-off Criterion**

This criterion seeks security by maximising the return when the most adverse conditions are encountered. For each strategy the minimum NPV for the range of sensitivities/scenarios is found and the strategy with the highest minimum NPV is chosen.

- **Minimax Regret Criterion**

This criterion seeks security by minimising the maximum loss which could result from selecting a particular option. The NPV for each option in each scenario is compared with the NPV which could have been achieved for that scenario if the outcome had been known in advance and the most appropriate option chosen. The difference is taken to measure "regret" and that option is chosen which has the lowest regret over all scenarios.

The decision rules for handling uncertainty are less satisfactory than those for handling risk. This reflects the fact that uncertainty is, because of its nature, less amenable to simple solutions. The "minimax regret" and "maximin NPV" rules will probably be considered too conservative and risk averse for many decision makers. However, they do provide additional information for decision-makers. Under conditions of uncertainty a judgemental approach will be required. But, such an approach is facilitated by the generation of results for carefully selected sensitivities/scenarios and their interpretation using rules such as those outlined above.

Where probabilities can be ascribed to particular outcomes, the present value of the investment project can be calculated for each particular outcome and weighted by its probability of occurring. The decision can then be based on the ENPV.

Although it is often difficult to obtain explicit probability estimates it may be possible to obtain some information about the likelihood of an outcome. Instances where such information is available in the public sector include flood protection, road accidents and repair frequencies for standard pieces of equipment.

It is sometimes also possible to obtain objective information about probabilities by looking at historical data and then calculating the frequencies of various events. However, obtaining probability estimates for variables with limited historical data is very difficult. For these variables it is often necessary to fall back on subjective judgements.

Users of this procedure should note that being an average value, the ENPV contains no indication of the possible range of outcomes around the average value.

The ENPV may therefore not be adequate for agencies who may want to sacrifice some expected value for a reduction in the dispersion of possible outcomes about the mean. Decision rules under risk therefore require the consideration of the various ways of quantifying the dispersion around the expected value.

Dispersion around the mean may be quantified by the:

- range
- variance
- coefficient of variation.

The range (the difference between the biggest and smallest possible outcomes) is not recommended as it takes no account of the fact that various outcomes have different probabilities and is determined by extreme values that may be unlikely to occur.

The variance (the average 'squared' difference between each possible outcome and the expected value) is a much more useful statistic in risk analysis. In practice, the standard deviation (the positive square root of the variance) is generally quoted by analysts. The standard deviation however, may be insufficient as a risk measure when comparing projects with different expected values.

In comparing projects with different expected values the coefficient of variation (the standard deviation divided by the expected value) is more appropriate as this statistic measures the riskiness per unit of cost or benefit (it allows for differences in the size of projects) and is also independent of the units for the calculations.

12.5 CONCLUSION

Problems of risk and uncertainty will almost inevitably be encountered in investment appraisals. Procedures which should be adopted in tackling these problems are as follows:

- **Risks should be minimised as far as possible through careful estimation of costs and benefits, reference to ex post evaluations of previous projects and the use of risk management techniques in the design of the project;**

- **Sensitivity analysis or scenario planning should be undertaken to test the robustness of the analysis to forecast errors. This analysis would show the impact of alternative outcomes in those areas subject to the greatest uncertainty;**

- **Where probabilities can realistically be assigned to the alternative outcomes the expected net present value should be calculated, as well as the coefficient of variation;**

- **Where probabilities cannot be assigned to the possible outcomes (the more common case):**

  - **switching values should be calculated ie the value which a variable must attain for the ranking of the alternatives to change;**
  - **a matrix showing the NPV for each option under a selected range of sensitivity tests or scenarios should be presented; and**
  - **these decision criteria should only be used as a guide to the preferred option.**

13. EX POST EVALUATION

13.1 INTRODUCTION

Ex post evaluation of projects is undertaken for three important reasons:

(1) Reassessment of Economic Appraisal Approach

Any economic appraisal is based on a series of assumptions about costs and benefits that may or may not be fully realised in practice.

An ex post evaluation enables the ex ante evaluation procedure to be fine tuned. In effect there should be an ongoing feedback process between the operating results of existing infrastructure and the assumptions used to evaluate new capital expenditure decisions.

(2) Control on Ex Ante Evaluation Thoroughness

Where there is an established process of ex post evaluation, an extra discipline is imposed on the economic appraisal process.

(3) Ongoing Asset Management

It is not enough to review projects after implementation to determine if the ex ante assumptions were realistic or not. The effectiveness of the stock of infrastructure is a function of a complex series of factors including changes and shifts in demand, technological change, movements in relative prices of inputs and asset values and a host of other factors. Public sector agencies should introduce procedures to keep under review the utilisation of assets and of alternatives such as redeployment to ensure that resources are allocated in the most effective manner.

13.2 GUIDELINES

- **Scope of Reviews**

A distinction needs to be made between ongoing asset management reviews and reviews of specific projects. It is assumed that public sector agencies will institute procedures to monitor the utilisation of existing assets. In addition to these procedures it is necessary to review individual projects as a means of fine tuning future capital expenditure decisions.

The decision of which projects will be subject to ex post evaluation will be dependent on the scale, risk and strategic importance of the project.

As a broad guide only 1 in 10 major projects would need to be the subject of a full ex post evaluation, though all major projects should be the subject of some form of review in terms of assumptions versus reality.

All projects of a size greater than $10 million should be the subject of a review.

Where an agency's projects are not of sufficient scale to require an individual ex post evaluation the agency should undertake an ex post evaluation of a representative project at least once every five years.

- **Timing**

Ex post evaluation needs to be undertaken once the project is fully complete and experiencing normal operating conditions. Accordingly, it is suggested that the evaluation should be undertaken about two years after commencement of the operating phase. For select projects further evaluation should then occur over the economic life of the project to determine if there are significant variations in operating expertise.

- **Responsibility**

The ex post evaluation should not be undertaken by the same personnel responsible for the initial economic appraisal, though of course the expertise and knowledge of those initially involved should be called on as required.

13.3 CONCLUSION

All public sector agencies should establish procedures for ongoing monitoring of the stock of assets and selective ex post evaluation of major capital works projects.

14. COST EFFECTIVENESS ANALYSIS

14.1 INTRODUCTION

Most of what has been said in the preceding chapters applies equally to CBA and CEA. CEA is, indeed, often regarded as a limited (and less rigorous) version of CBA, as it does not attempt to place a value on the major benefits of the proposal.

Nevertheless CEA would more appropriately be regarded as the more difficult area. The reason for this is not so much the nature of cost effectiveness techniques but more the difficulties caused by the areas where they are applied. These Guidelines propose the use of CEA in areas such as law and order, education, health and the environment. These are areas where quantification and valuation are inherently difficult, where it may be difficult to even identify the effects of the proposal, and where the techniques of economic appraisal are often regarded with suspicion.

This should not be the case. To answer one common charge, economic appraisal does not ignore unquantifiable benefits; they remain a vital part of the report on any appraisal and their identification and description is one of the difficult parts of CEA. But even when all the major benefits cannot be valued, there remains a need to place a value on those benefits (and costs) which can be valued, if Ministers are to make decisions on which projects should go ahead.

Decisions have to be made both between projects in the same area (a new wing to a hospital versus a heart transplant unit) and between projects in different areas (a new hospital versus a new school). Such decisions cannot be made with total disregard for the cost of the various projects. And neither can they be made with total disregard for the effects of the projects. Hence the use of CEA, to ensure a full comparison of the costs and effects of various projects.

While CEA is a minimum requirement, there is, however, no room for complacency. The fact that a benefit cannot be valued at the current time does not necessarily indicate that the techniques will never exist to value the benefit. Opportunities to extend the analysis in this way should always be watched for.

14.2 OUTPUT VERSUS EFFECTIVENESS

A careful distinction has to be made between the outputs of a project and the effectiveness of a project.

The outputs of a scheme may often be directly measured - 136 students attend a TAFE course, 5000 people attend an exhibition. The aim of economic analysis is **not** to compare costs and output. Effectiveness is a way of comparing the output of a project against the objectives specified for the project. The objectives may have been to produce a TAFE course and target it at a particular group of students. So one needs to ask how many of the 136 students attending the course came from the target group. The course may have failed totally in terms of effectiveness if none of the 136 belong to the target group. The exhibition may

have had the objective of stimulating investment in New South Wales. Has it been effective? The fact that 5000 people attended it does not tell us.

This distinction is an issue in both CBA and CEA, but the distinction between output and effectiveness is often more difficult in those areas applying CEA and it is easier to lose sight of the objectives. This is particularly important when trying to compare projects achieving similar objectives; projects with similar outputs may have very different degrees of effectiveness.

14.3 TREATMENT OF BENEFITS

While certain areas (such as education, health, the environment and law and order) obviously lend themselves to CEA rather than CBA, care should be taken not to assume that benefits from projects in these areas can neither be quantified nor valued. And even if this is the case at the present time, there is no reason to believe that it should always be the case.

As discussed in Chapter 9, benefits in some areas can be quantified but not valued. Research has been undertaken in the past in some of these areas, largely by academic groups. Research is to be encouraged, but care must be taken when using the output of these studies. Clearly these are difficult areas in which to work and, in the course of research, very different views are often initially put forward. Unless there is some degree of consensus about a particular view, it might be misleading to base appraisal results on these figures.

It is therefore suggested that the introduction of valuations in these areas should be a gradual process. Initially it might be necessary to rely on non-monetary measures of the effects. But simultaneously, a program of work on the development of valuation methodologies should be undertaken in those areas where these impacts are significant.

Work undertaken by one agency could well be of assistance to other agencies. Before embarking on a work program, agencies may well want to consider whether they should join forces with another agency facing similar problems. This would allow the costs of the work to be shared, and help formulate a consensus between agencies on the appropriate treatment of these impacts. In addition, Treasury should be kept informed of the work being undertaken, so that it can play a coordinating role.

Similar comments can be made about benefits which cannot even be quantified. In many of these areas, there may be little prospect of introducing any quantification. Nevertheless, consideration should be given to this possibility. In particular, the introduction of a more objective ranking system may be possible. This might enable more definite comments to be made on the priority which should be attached to various projects within a given area, although it would obviously not allow comparisons to be made across areas.

Again a work program might be involved in order to introduce these improvements. Results may not appear quickly, but any improvements made would assist agencies in the prioritisation of their projects and Ministers in their decisions.

Two means of providing information on benefits to assisting decision making on projects covered by Cost Effectiveness Analysis are:

- **Relating The Cost Difference Between Options To Expected Benefits:-**

Where CEA is used to support a funding request for a project, normally it is claimed that the unquantifiable benefits exceed the project's costs.

Assessment of the reasonableness of this claim should be attempted, using indirect measures.

For example, a proposal may have a Net Present Cost of $10m which equates to a cost of $1 per user over the life of the project.

It may be considered that this amount represents a reasonable estimate of the value customers would place on the project's (free) services. In effect, users might be "willing to pay" $1 (but realistically would not pay say $100). This approach assesses the lower limit of the "band" of values users place on the benefits.

Hence it may reasonably be assessed that the project's unquantifiable benefits would exceed its costs.

Simply relating the total cost difference between options to the **primary** expected benefit can assist informed decision making. For example a $2M present value difference in Option A compared to Option B, expected to result in "improved level of service provision" may result in a different decision than if the present value difference were $20M.

- **Weighting Qualitative Aspects**

Objective consideration by say groups of customers and service providers of a facility, in terms of the qualitative benefits of different options, eg layout impact on service efficiency, relationship to other facilities, likely waiting time, etc can provide additional information to assist decision making.

Individual attributes can be assigned weights. Aggregate scores for each (on a scale of 1 to 10) can be produced for each option evaluated.

14.4 PROCEDURE

The process of conducting a CEA is very similar to that of conducting a CBA. The stages outlined in Chapter 4 still apply, and the issues raised in earlier chapters should be considered.

The first stage is to define the objectives. The issues here are the same as for CBA, although it is recognised that determination of the objectives may be more difficult.

The next stage is to identify the options and the benefits accruing from each. CEA is easiest when all options have the same degree of effectiveness (the exercise then approximates a cost minimisation exercise). However, this is not always possible. For example, if an expansion

of an existing program is being considered, the "do nothing" option will necessarily provide a lower level of service. Similarly, different approaches to meeting an objective may have different degrees of success by their very nature.

Clearly, there is no easy solution to this problem. Wherever possible, options with similar degrees of effectiveness should be considered. If this is impossible, an attempt to quantify the effectiveness of each option is desirable. The costs of the option can be compared more easily if one option can be said, for example, to be twice as effective as another. Suggestions in 14.3 may also assist.

In some cases, however, neither of these options will be possible. In these cases, the only solution is to describe as fully as possible the effectiveness of each option and leave the decision maker to make a subjective judgement.

Just as with CBA, care should be taken to consider all reasonable options. There is a natural tendency to concentrate on the types of solutions that have been attempted in the past. This should be resisted as it can lead to potentially successful options being dismissed at an early state.

It may be possible to place a value on some benefits accruing from the project. If so, they should be valued in the normal way along with all the costs on which a value can be placed. The present values of the cost and benefit streams can then be calculated as described in earlier chapters.

The benefits and costs for which no valuation is possible then need to be discussed as they are in CBA. In the case of CEA, however, these may be far more important.

Sensitivity analysis will also be required, as it is in CBA. Indeed it is likely to be particularly important in the case of CEA where there may be considerable doubt about the effectiveness of the various proposals. Where possible, the sensitivity analysis should be undertaken in numeric terms, but in other cases a descriptive analysis will have to suffice.

Finally, a post-implementation review is again going to be particularly important, as it will give important information to assist in future appraisals.

14.5 CONCLUSION

The difficulties of CEA result not from the technique itself as from the areas in which it is applied. A careful distinction between output and effectiveness is required in these areas.

Attempts should be made to value (or, at least, quantify) benefits and costs wherever possible, but this should not be achieved by the use of arbitrary values. Agencies should remove undertake longer term research to value benefits if there is no current consensus about their valuation. In this regard the discussion in Sections 9.3.1, 9.3.2 and 9.3.6 is relevant.

Particular care will need to be taken in the identification and description of benefits and costs when CEA is used, as well as in testing the sensitivity of the results to particular assumptions.

ANNEX 1

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ANNEX 2

SUMMARY OF CHANGES FROM FIRST EDITION (December 1988) TO PRODUCE 1990 EDITION

1. Rename as "NSW Government Guidelines for Economic Appraisal".

2. Encourage the use of the Guidelines in all relevant areas of economic appraisal in the public sector.

3. Emphasise that the objective of a project is not to be so narrowly defined as to preclude consideration of all viable options.

4. Emphasise that all practical options to meet an objective must be considered at the earliest possible stage in planning, including for instance private sector provision of a service.

5. Provide scope for agencies not to undertake appraisal of projects which are essential on health, safety or other grounds or for which no real alternative exists - following contact with the central agencies in the first instance with a case supporting the exemption.

6. Clarify and explain that the more commercially oriented agencies are not exempt from the requirement for economic appraisal. This does not remove the requirement for financial analysis since both types of assessment are aids to decision making at the individual agency and central agency levels.

7. Clarify procedures and emphasise the need, where relevant for:

   (a) appraisals to be submitted throughout the year to avoid bunching with submission of bids in March each year;

   (b) appraisals to be accompanied by a Ministerial letter indicating support or otherwise for the findings;

   (c) liaison with central agencies at an early stage (contact points provided), particularly where difficult or contentious issues may be involved;

   (d) copies of appraisals to be sent to the appropriate area of Budget Division, Treasury, and to the Capital Works Unit, Premier's Department;

   (e) a copy of the terms of reference to be submitted with the appraisal; and

   (f) incremental recurrent costs to be shown separately, by year, to assist forward Budget planning.

8. Amend requirements for accreditation of consultants through:

   (a) removing the distinction which presently exists between accreditation of some consultants for cost benefit analysis only and others for cost benefit analysis and cost effectiveness analysis;

   (b) introduction of an accreditation scheme for Departments and Authorities wishing to undertake in-house economic appraisals;

   (c) suggesting that consultancy work should not be over-concentrated with individual consultants to ensure that fresh approaches are not overlooked; and

   (d) requiring formal terms of reference to be drawn up and submitted with the appraisal.

9. Clarify certain technical matters:

   (a) the valuation of land for the purpose of estimating opportunity cost should be based on maximum market value under likely land zoning (in consultation with central agencies and Valuer General's Department, where appropriate);

   (b) the use of "shadow prices" in appraisals to value inputs and outputs may be appropriate in certain areas (in consultation with central agencies);

   (c) the importance of the "with/without" principle (what the world would be with and without the project), other than in exceptional circumstances, in assessing the benefits and costs of a project relative to the "do nothing" case;

   (d) explain application of "willingness to pay" principle in regard to projects involving subsidised charges; and

   (e) emphasise the need for research to be undertaken, as a special study where necessary, in relation to those areas of significance where currently it is difficult to quantify in money terms the main costs and benefits of projects.

ANNEX 3

SUMMARY OF CHANGES FROM SECOND EDITION (January 1990) TO PRODUCE 1995 EDITION

Most changes were of an editorial nature. However, the opportunity was taken to clarify the following matters:

1. assessment of distribution of benefits among public/private sector parties;

2. requirements relating to essential projects and environmental assessment;

3. pooling of knowledge among agencies dealing with similar projects;

4. central agency roles and contact points;

5. timing of submission of economic appraisals;

6. basis of calculation of benefit cost ratio;

7. the preferred measures to be reported in economic appraisal results;

8. discussion of benefits of projects evaluated by Cost Effectiveness Analysis to assist decision making;

9. reference to the simplified version of the Guidelines to assist readers; and

10. removal of the accreditation system.

ANNEX 4

ILLUSTRATIVE EXAMPLE OF ECONOMIC APPRAISAL

DEPARTMENT OF MAIN ROADS

GORE HILL FREEWAY:
ECONOMIC EVALUATION
REVISED FINAL REPORT

TRAVERS MORGAN PTY LTD
NOVEMBER 1986
REF: 878

TABLE OF CONTENTS

1. SUMMARY OF RESULTS

The Options

This Report presents the results of an economic evaluation of the Gore Hill Freeway Options. It uses as inputs the results of a traffic analysis which was carried out by the Investigations Section of the Department of Main Roads. The options considered in this report are:

Option 1: 6-Lane Surface Arterial Road
Option 2: 4-Lane Freeway
Option 3: 6-Lane Freeway

The results in this report supercede those presented in earlier versions, dated May 1986 and August 1986.

Summary of Results

Table 1.1 summarises the results of the benefit cost analysis. It shows the benefit/cost ratio (BCR) and net present value (NPV) for the three options, under conditions of low, medium and high traffic growth scenarios and discount rates of 4%, 7% and 10%.

The results shown in Table 1.1 indicate that for the 6-Lane Surface Arterial Road alternative (option 1) the benefits exceed costs under all conditions except at the 10% discount rate under low and medium traffic growth scenarios. The BCR for this option ranges between 0.85 at the low growth rate and high (10%) discount rate, and 2.56 at the high growth rate and 4% discount rate.

For the 4-Lane and 6-Lane Freeway options (options 2 and 3) the benefits exceed costs under all conditions. The BCR's for those two options range from 1.37 to 4.11 and 1.28 to 3.83 for the 4-Lane and 6-Lane options respectively.

The BCR's for the 4-Lane Freeway are marginally higher than for the 6-Lane Freeway, which are in turn consistently higher than for the Surface Arterial option.

Table 1.2 shows the incremental present value of costs and benefits of the 4-Lane Freeway alternative over the 6-Lane Surface Arterial alternative. The table shows that under all conditions of traffic growth rates and discount rates, while the costs of the 4-Lane Freeway alternative exceed those of the Surface Arterial, the present value of benefits are considerably greater also. In terms of net user benefits the Freeway option gives a better economic return when compared with the 6-Lane Surface Arterial Road.

TABLE 1.1: ECONOMIC VALUE OF ALTERNATIVE SCHEMES ($1986)

GROWTH/ DISCOUNT RATE	OPTION 1 6 LANE SURF. ART.		OPTION 2 4 LANE FREEWAY		OPTION 3 6 LANE FREEWAY	
	NPV($m)	BCR	NPV($m)	BCR	NPV($m)	BCR
LOW GROWTH						
4%	39.73	1.75	107.42	2.83	108.96	2.63
7%	8.82	1.18	49.12	1.91	47.68	1.78
10%	-6.80	0.85	18.51	1.37	15.64	1.28
MEDIUM GROWTH						
4%	58.83	2.11	140.92	3.40	144.51	3.17
7%	19.25	1.40	67.40	2.25	67.07	2.09
10%	-0.70	0.98	29.19	1.59	26.98	1.48
HIGH GROWTH						
4%	82.48	2.56	182.38	4.11	188.51	3.83
7%	31.92	1.66	89.61	2.66	90.64	2.48
10%	6.57	1.15	41.94	1.84	40.50	1.72

TABLE 1.2: INCREMENTAL VALUE OF 4 LANE FREEWAY (OPTION 2) OVER 6 LANE SURFACE ARTERIAL ROAD (OPTION 1). ($1986

	LOW GROWTH			MEDIUM GROWTH			HIGH MEDIUM		
	4%	7%	10%	4%	7%	10%	4%	7%	10%
Incremental PV of Costs ($m)	5.8	5.3	4.9	5.8	5.3	4.9	5.8	5.3	4.9
Incremental PV of Benefits($m)	73.5	45.6	30.2	87.9	53.5	34.8	105.7	63.0	40.3
Incremental NPV ($m)	67.7	40.3	25.3	82.1	48.1	29.9	99.9	57.7	35.4
Incremental B/C Ratio	12.7	8.6	6.2	15.2	10.1	7.1	18.3	11.8	8.2

TABLE 1.3: INCREMENTAL VALUE OF 6 LANE FREEWAY (OPTION 3) OVER 4 LANE FREEWAY (OPTION 2). ($1986)

	LOW GROWTH			MEDIUM GROWTH			HIGH MEDIUM		
	4%	7%	10%	4%	7%	10%	4%	7%	10%
Incremental PV of Costs ($M)	8.0	7.4	6.8	8.0	7.4	6.8	8.0	7.4	6.8
Incremental PV of Benefits($m)	9.6	5.9	3.9	11.6	7.0	4.6	14.1	8.4	5.3
Incremental NPV ($M)	1.5	-1.4	-2.9	3.6	-0.3	-2.2	6.1	1.0	-1.4
Incremental B/C Ratio	1.2	0.8	0.6	1.4	1.0	0.7	1.8	1.1	0.8

Table 1.3 shows the incremental present value of costs and benefits of the 6-Lane Freeway alternative over the 4-Lane Freeway. The table shows that the 6-Lane Freeway generates additional user benefits but at an increased cost over the 4-Lane option. The incremental NPV of the 6-Lane scheme ranges from -$2.9 million (under conditions of low traffic growth and 10% discount rate) to $6.1 million (under the high growth and 4% discount rate scenario). Consequently, the incremental BCR of the 6-Lane alternative only exceeds 1.0 under conditions of medium/high traffic growth and discount rates of 7% or less. Under other conditions the increased costs of the 6-Lane proposal would not be compensated by the additional benefits.

2. METHOD

The economic evaluation has been carried out using benefit cost analysis. This compares the user benefits of an option with its cost over the life of the project. Costs and benefits are measured relative to a situation in which the proposed road is not built (the Base Case). The time streams of cost and benefits are aggregated into 'present values' using discounted cash flow techniques.

For purposes of the analysis:

(i) All costs and benefits are expressed at mid-1986 price levels.

(ii) The evaluation period used was taken to be the construction period, plus 30 years of operation. For evaluation purposes the construction period was taken to be 1988 to 1990 for both options, with 1991 the year of opening.

(iii) To derive present value all costs and benefits were discounted to their present values as in 1986.

(iv) The principal results are based on application of a base discount rate of 7%. But the sensitivity of the results to alternative discount rates of 4% and 10% are also shown.

Costs

The project costs included in the evaluation are the value of land used (including land already in DMR ownership), and the construction costs (including design, utility relocation and construction).

Benefits

Annual user benefits have been estimated as the sum of:

- vehicle operating cost savings
- travel time savings
- accident cost savings, less
- increase in annual road maintenance costs

The three user benefits have been estimated, based on travel savings estimated by the DMR Investigations Section using the TRANPLAN travel model of Sydney. The various parameter values used to value vehicle operating costs, travel time savings and accidents are consistent with those used for other road projects currently being evaluated by the DMR and are described in Section 4.

The travel model has provided results for each option assuming 1986 traffic levels. These were then factored up to future year levels. A range of results has been estimated for possible growth in user benefits.

Based on historical trends in traffic growth in the area, there should be an overall growth in daily traffic within and through the study region. Based on TRANPLAN estimates of AM peak flows in the year 2011, there will be only very minor growth (0.5% p.a.) in peak hour traffic in the study region. There will be however a larger growth in off-peak travel since the network has a higher spare capacity off-peak compared to the peak periods. Consequently this analysis has considered a range of growth estimates, and has taken that annual benefits will grow in line with traffic growth as follows:

-Low Growth	0%
-Medium Growth	1%
-High Growth	2%

In addition, the perceived value of time and of accidents by the community is expected to increase over time with increases in economic well-being, as measured by GDP per capita. The analysis has assumed an increase in the real value of these benefits of 2% p.a.

The detailed results are presented in Appendices A to C.

3. COSTS

The costs of the three options are shown in Table 3.1. The figures cover total project costs, including value of land and construction costs. For evaluation purposes it was assumed that the schedule of costs for both options would be incurred in equal proportions over the three construction years, as shown in Table 3.2.

TABLE 3.1: COSTS OF PROPOSED OPTIONS ($ MILLION $1986)

	OPTION 1 6 LANE SURFACE ARTERIAL	OPTION 2 4 LANE FREEWAY	OPTION 3 6 LANE FREEWAY
Earthworks	3.0	5.1	5.8
Pavement	8.0	6.9	8.4
Viaduct	9.0	11.0	13.8
Utilities	8.0	8.0	8.0
Pacific Highway Bridge	-	3.0	4.0
Baden Powell Bridge	-	1.0	1.0
Hampden Road Bridge	1.5	1.5	2.0
Reserve Road Bridge	-	1.5	2.0
Railway Underpass	4.0	4.0	4.0
Properties	16.0	19.0	21.0
Miscellaneous	10.0	5.0	5.0
	59.5	**66.0**	**75.0**

TABLE 3.2: SCHEDULE OF COSTS ($ Million, $1986)

Option	1988	1989	1990	Total
6-Lane Surface Arterial	19.8	19.8	19.9	**59.5**
4-Lane Freeway	22.0	22.0	22.0	**66.0**
6-Lane Freeway	25.0	25.0	25.0	**75.0**

4. USER BENEFITS

4.1 Introduction

This Section describes the parameters and assumptions used in the calculation of user benefits of the two options.

Annual user benefits were estimated as the sum of:

- vehicle operating cost savings
- travel time savings
- accident cost savings
  less
- increase in annual road maintenance costs.

The derivation of each is described below.

4.2 Vehicle Operating Cost Savings

Vehicle operating costs (VOC's) were estimated using the following formula(1):
VOC = 9.62 + 168.86/V cents/veh-km
where V = Speed (km/hr).

Unit VOC's (per vehicle-km) were calculated for the base case and the three options. Total VOC's were then calculated, as the product of the unit cost and total vehicle-kms. The data are summarised in Table 4.1.

4.3 Value of Travel Time Savings

Three factors determine the mean value of time savings per vehicle-hour:

- value of time savings per person-hour for private and business travel,
- vehicle occupancy rates,
- traffic composition (including car trip purpose mix), and
- car trip purpose mix.

For this evaluation time savings were valued at $4.58 per vehicle-hour, derived from the data assumptions shown in Table 4.2.

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(1) Source: Based on Bayley and Both, **Evaluation Procedures for Urban Arterial Road Projects**, Proceedings, 8th Conference Australian Road Research Board, 1976. Coefficients updated to $1986 using CPI. The VOC formula is for car traffic only, as the TRANPLAN assignments do not include commercial vehicle trips.

TABLE 4.1: VEHICLE OPERATING UNIT COSTS AND COST SAVINGS 1986 a.m. PEAK (1)($1986)

	Base Case	Option 1 6 Lane S.Arterial	Option 2 4 Lane Freeway	Option 3 6 Lane Freeway
Unit Costs (cents/km)(2)	14.55	14.53	14.53	14.53
Average Speed (km/hr)	34.25	34.36	34.41	34.43
Vehicle-km (3)(000)	6408.19	6408.42	6407.49	6407.50
Total VOC's ($000)	932.39	931.45	930.80	930.70
Saving from Base ($000)	-	0.94	1.59	1.69

Notes:
(1) Figures refer to a.m. 2-hour peak period. Figures subject to rounding.
(2) Unit VOC's calculated using formula described in text.Average speed calculated from TRANPLAN outputs.
(3) Vehicle-km data from TRANPLAN outputs.

TABLE 4.2: VALUES OF TIME SAVINGS USED ($1986)

Vehicle Class	Proportions a.m. peak (1)	Vehicle Occupancy	Value of Time Savings	
			$/person-hr (2)	$/vehicle-hr
Business Car	.05	1.4	7.8	10.9
Private Car	.85	1.4	2.6	3.6
Light Commercial	.07	1.3	7.8	10.1
Heavy Commercial	.03	1.0	7.8	7.8
TOTAL	**1.00**	**-**	**-**	**$4.58**

Notes:
(1) Vehicle type proportions based on vehicle classification survey data for the study area.
(2) Based on parameters presented in the DMR Year 2000 evaluation outline, but adjusted to mid-1986 values.

4.4 Values of Accident Cost Savings

Accident costs cover three types of accident: fatality, injury and property damage. They are calculated from the average cost and rate of occurrence for each type of accident.
The rates of occurrence depend in turn on the type of road.

For this evaluation accident costs for surface streets and freeways have been valued at $39,003 and $11,010 per million vehicle-km respectively, based on the unit costs and rates shown in Table 4.3.

TABLE 4.3: ACCIDENT RATES AND UNIT COSTS ($1986)

	Rates and Costs (1) per million vehicle-km)	
	Surface Streets (2)	**Freeways (3)**
Fatality Accidents		
Rate	0.036	0.013
Cost ($)	13,265	4,823
Injury Accidents		
Rate	1.216	0.315
Cost ($)	15,804	4,095
Property Damage Accidents		
Rate	4.515	0.951
Cost ($)	9,934	2,092
Total Cost (per million vehicle-km) p.a.	**$39,003**	**$11,010**

Notes:
(1) Accident rates and costs per accident from DMR “Year 2000” evaluation outline(Table 4), but adjusted to mid $1986 values.
Costs per accident used (rounded):
- Fatality costs: $371,000
- Injury costs: $13,000
- Property damage: $2,200

(2) Surface Street rates and costs derived from weighted average of local streets, arterial-undivided and arterial-divided roads.

(3) Freeways defined as TRANPLAN network link classes 8 and 9 (expressway links),and 10 and 11 (freeway links).

4.5 Road Maintenance Costs

Additional road maintenance costs were assumed to be $13,500 per lane-km of new capacity, per annum(1). Road maintenance costs would thus be increased under each option by the following amounts:

Option 1 - $270,000 p.a.
Option 2 - $216,000 p.a.
Option 3 - $270,000 p.a.

4.6 Annual Expansion Factor

The factor used for expansion of 2 hour a.m. peak benefits to annual benefits was 1,400 which is consistent with the evaluation of DMR "Year 2000" projects. This factor includes an allowance (of 10%) for benefits to commercial vehicles, which are not included in the TRANPLAN assignments.

4.7 Calculation of User Benefits

Table 4.4 shows the modelled 1986 traffic flow (vehicle-km and vehicle-hours) by road type on the Sydney network in the a.m. peak, in the Base Case. Tables 4.5 to 4.7 show the corresponding data for Options 1, 2 and 3 respectively. The tables also show the costs of vehicle operations, travel time, and accidents, for the a.m. peak and per annum. All costs are shown in mid-1986 price levels.

The benefits of each option are measured as the difference in annual total network costs(of vehicle operations, travel time and accidents) between the case without the proposed scheme (Table 4.4) and with the particular scheme implemented (Tables 4.5 to 4.7).

Comparison of Tables 4.5, 4.6 and 4.7 with the Base Case results (Table 4.4) shows that traffic-km would increase under the Surface Arterial option but decrease under the two Freeway options. Vehicle-hours would decrease under all three options. Overall the drop in traffic-hours would produce net savings in travel time costs under all options.

Vehicle operating cost savings and accident cost savings could also be expected from all options, due to savings from the increased vehicle-km on freeway roads and reduced flows on surface streets.

The overall savings from the three options are as follows ($1986):

Option 1: 6-Lane Surface Arterial	$5.02m
Option 2: 4-Lane Freeway	$8.77m
Option 3: 6-Lane Freeway	$9.31m

The savings from the Freeway options are greater than those from the 6-Lane Surface Arterial option, because of larger travel time savings and reduced flows on surface streets under the Freeway schemes.

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(1) Based on data presented in DMR Submission to Warringah Transport Inquiry, 1981(p160).

ANNEX 5

ECONOMIC ASSESSMENT OF ENVIRONMENTAL IMPACTS

1 Introduction

Purpose

The purpose of this annexure is to extend the framework of the *Guidelines* to include valuation of environmental impacts. The framework is being extended in light of the advances made in methodology and technique, and increased interest in this area since the *Guidelines* were last published in 1990.

Economic appraisal of environmental impacts should be seen as an integral part of the broader economic appraisal process described in the *Guidelines*.

The extended economic appraisal framework does not require any additional or separate reporting to that for the economic appraisal of capital projects.

The extended framework does not replace the Environmental Impact Statement (EIS) process. It may rely on input from, and in turn provide input to, the EIS process. It should be emphasised, however, that the economic appraisal of environmental impacts, for the purposes of these *Guidelines,* is a requirement separate from the EIS process.

Unless otherwise stated, regard should be had to the:

- main body of the *Guidelines* (Treasury);
- *Economic Assessment of Environmental Impacts* (Aquatech)*;* and/or
- *Economic Impact Statement Manual* (DUAP).

Underlying Concepts

The purpose of economic appraisal is to identify and help achieve a socially efficient allocation of scarce resources. A socially efficient allocation is one which maximises the return on the total (including environmental) capital stock in order to maximise the economic welfare over time of all citizens.

This requires that:

- benefits are valued on the basis of the amount that consumers are willing to pay for them, measured by the market price actually paid; and
- costs are valued on the basis of what other suppliers would be willing to pay for the resources employed:

and also that:

- externalities, such as pollution, are also accounted for, along with the above private benefits and costs, as part of the total social benefits and costs.

These concepts underlie the methodologies and techniques of economic appraisal of environmental impacts presented below.

A fuller discussion of these concepts is available in numerous publications, including the Commonwealth Department of Finance's *Handbook of Cost-Benefit Analysis*.

2 Procedures

The steps in project design and evaluation are summarised in the **flow chart** on page 7.

Economic appraisal is an important tool used throughout this process. The methodologies and techniques used are strongly influenced by the stage of a project. Generally, the closer a project is to being commissioned, the more involved and exacting the economic appraisal needs to be.

It should be noted that the EIS process occurs late in the project design and evaluation process specified for major projects. The EIS also requires economic appraisal. This appraisal, in the case of NSW Budget Sector agencies, is usually an updated version of the one presented to the Budget Committee of Cabinet.

The discussion immediately below focuses on the procedures involved in performing an economic appraisal of environmental impacts. This should be read in conjunction with the project procedures **flow chart** on page 7.

Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) should be taken into account at all stages of a project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes according to the four inter-related principles and programs presented in *s 6.(2)* of the *Protection of the Environment Administration Act 1991* and restated in *Schedule 2* of the *Environmental Planning and Assessment Regulations 1994*:

1. **precautionary principle** - if there are threats of serious or irreversible environmental damage then lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (this can be put into practice by reference to a safe minimum standard discussed below);
2. **inter-generational equity principle** - the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
3. **biodiversity principle** - conservation of biological diversity and ecological integrity; and
4. **valuation principle** - improved valuation and pricing of environmental resources.

The valuation principle of ESD is the focus of this annexure.

Environmental Impacts

Economic appraisal of environmental impacts firstly involves identifying and describing the impact as well as the probability of its occurrence *ie* risk.

A risk assessment of a potential environmental impact should include:

- identifying its nature and source;
- quantifying its relation with actions; and
- defining its scale, scope and timing.

Particular attention should be paid to compliance with legal or policy standards, such as set levels of pollution or waste disposal, and irreversible impacts (*ie* an impact that so transforms an environmental state that, regardless of future decisions and changes, the original state cannot be recovered).

After the risk of an environmental impact has been assessed, the next step is to compare assigned probabilities to the safe minimum standard (where one exists). If the probability of impact is above the particular standard then a project should not proceed in its present format. If the probability of impact is below that standard then the next step is to value it.

Regard should be had to:

- *Environmental Planning and Assessment Act 1979* (*EP&A Act*);
- *Schedule 2* of the *EP&A Regulations*; and
- *Risk Management Guidelines* (NSW Public Works).

An EIS may be relied on, where applicable, as a source of information, supplemented where necessary by additional scientific or technical input.

Valuation of Environmental Impacts

Environmental benefits and costs can be assessed using the methodologies and techniques discussed below. The intention is to internalise environmental externalities into the decision-making process on the basis that the environment is not free.

Sensitivity & Threshold Analyses

Given the uncertainty surrounding environmental impacts and their values, sensitivity analysis should be performed in order to identify those factors with the greatest influence on a project's overall net present value (NPV). Those factors to which the NPV is highly sensitive might be investigated in further detail by say varying the forecast by $\pm$ 20%

Threshold analysis is a form of sensitivity analysis. It involves a process of comparing the environmental impacts, which are not reasonably quantifiable, with the quantifiable net benefits/costs to determine a hurdle level. If the costs (or benefits) of these impacts are reasonably expected to be larger than the quantifiable net benefits (or net costs) then this may lead to a decision not to proceed (or proceed).

Note that benefit transfer techniques (see p. 5) may be of use in providing information on the magnitude of the initially unquantifiable values. The NSW Environment Protection Authority's (EPA's) database on environmental valuation studies (*ENVALUE*) is an excellent source for this purpose.

Ex-Post Evaluation

It is only after a project has been implemented that its actual impacts can be observed and the actual benefits and costs measured. Government agencies are strongly urged to undertake an ex-post evaluation of a project so that forecasts can be compared with observed outcomes. This will generally help to improve future economic appraisals of environmental impacts and, for some NSW Budget Sector projects, it may, in fact, be a condition for Budget Committee approval.

3 Methodologies

The major problem in valuing environmental impacts is that they are, generally, not traded in the market and therefore do not have a market value. Values must be imputed using the methodologies and techniques discussed below. (These are discussed at greater length and detail in *Chapter 5* of Aquatech).

There are benefits and costs associated with each of the different methodologies and techniques. The level of assessment should therefore be commensurate with the project's benefits/costs *eg* $1 000 should not be spent where benefits/costs are reasonably estimated to be $100.

Numerous methodologies can be employed for economic appraisal of environmental impacts including:

1. **benefit-cost analysis**;
2. **risk-benefit analysis**;
3. **cost-effectiveness analysis** (**CEA**);
4. **multi-criteria analysis** (**MCA**);
5. **decision analysis** (**DA**); and
6. **the Delphi method**.

1. Benefit-Cost Analysis (BCA)

BCA is the preferred methodology for economic appraisal of environmental impacts.

It can be used to assess the total and net benefits and costs of a project and, thus, its effect on economic welfare.

It is broader than financial analysis which focuses on cash flows not welfare improvements.

Pros:

+ covers social as well as private benefits/costs;
+ use of dollar values, allowing for direct comparisons; and
+ use of real values.

Cons:

– often difficult to quantify external benefits/costs.

2. Risk-Benefit Analysis (RBA)

RBA is essentially BCA in the context of risk and uncertainty. Risk and uncertainty is discussed in detail in the *Risk Management Guidelines*.

Pros:

+ a more comprehensive version of a BCA.

3. Cost-Effectiveness Analysis (CEA)

CEA is a form of economic appraisal that tends to be used when most of the benefits of a project are not readily measurable in (actual or proxy) dollar terms. This may occur in areas such as health, education, law and order, and social welfare.

Pros:

+ similar to BCA in terms of cost analysis; and
+ particularly useful for analysing environmental mitigation, abatement or protection.

Cons:

– does not measure benefits; and
– benefits/outcomes must be reasonably similar.

4. Multi-Criteria Analysis (MCA)

MCA is a collection of mathematical techniques designed to facilitate the ranking of mutually exclusive options according to a predetermined set of decision criteria. The relative importance of criteria are represented by weights. (An example of MCA can be found in *Appendix 3* of Aquatech.)

Pros:

+ can complement BCA/RBA or CEA;
+ may be used as a substitute for BCA/RBA or CEA if these are not feasible; and
+ particularly useful for assessing ESD.

Cons:

– no dollar values;
– weightings are subjective; and
– less rigorous than BCA/RBA or CEA.

5. Decision Analysis (DA)

DA is a less sophisticated version of MCA. It requires the construction of a 'decision tree' identifying each stage of the project and expected outcomes from each action. The information can then be used to construct a 'payoff matrix' to compare the outcomes from mutually exclusive decisions.

Pros:

+ can complement BCA/RBA , CEA or MCA; and
+ may be used as a substitute for BCA/RBA, CEA or MCA if these are not feasible.

Cons:

– no dollar values;
– quite subjective; and
– less rigorous than MCA.

6. Delphi Method

Delphi is a method of organising a group decision-making process using a panel of analysts (the Delphi panel), who are usually experts and/or stakeholders, to consider complex issues that do not lend themselves to monetary assessment *eg* urban development.

Pros:

+ may be used as a substitute for BCA/RBA, CEA, MCA or DA if these are not feasible.

Cons:

– no dollar values;
– highly subjective; and
– less rigorous than BCA/RBA or CEA.

4 Techniques

There are four broad categories of techniques for measuring the economic value of environmental impacts as part of a **BCA/RBA** or **CEA**:

1. **market-based**;
2. **surrogate market**;
3. **hypothetical market**; and
4. **benefit transfer**.

All of these techniques attempt to measure the total economic value of a project's impact on the environment by producing a proxy market value.

It is important to note, however, that market prices themselves do not always reflect the true private resource cost. This is because of the existence of market failures, such as monopoly provision, and/or government distortions, such as subsidies or anti-competitive regulation.

ENVALUE, can be consulted regardless of which technique is used, although, reference to it is of most importance for benefit transfer.

Using these techniques to value environmental impacts reinforces the fact that the environment has both use and non-use value. The former consists mainly of the environment's value as an input into the production and provision of goods and services, and as a directly consumed good or service. The non-use value of the environment is its intrinsic value.

1. Market-Based

Market-based valuation techniques are used when the market has, in part, valued an environmental impact (albeit imperfectly). The partial market valuation is then used to estimate the entire value of the environmental impact.

Partial market valuations are usually derived from:

- **productivity changes in physical capital** (see *Appendix 4* of Aquatech);
- **productivity changes in human capital** (see *Appendix 1* of Aquatech);

opportunity cost of foregone benefits (see *Appendix 5* of Aquatech);

- **preventive expenditures**; and
- **corrective expenditures** on repair, replacement, compensation or relocation.

Pros:

+ relatively rigorous compared to techniques 2 and 3 below; and
+ relatively inexpensive compared to techniques 2, 3 and 4.

Cons:

– ignores some impacts *eg* pain and suffering in the cost of human illness.

2. Surrogate Market

Surrogate-market valuation techniques recognise that the value of an environmental impact can be embedded within the cost of a good or service. They, thus, try to dissect the value of the environmental impact from the total value of the good or service.

These techniques focus on:

- **property values** using hedonic pricing - *eg* the value of a house under a flight path will be lower than an otherwise identical one elsewhere;
- **travel costs** - *eg* the expenditure on travel to a recreational site with no access fee; and
- **wage differentials** - *eg* the wage premium for working in an underground coal mine.

Pros:

+ more rigorous than techniques 3 and 4.

Cons:

– generally less rigorous than technique 1;
– generally more expensive than technique 1; and
– difficult to separate out environmental impact *eg* flight path noise on house prices.

3. Hypothetical Market

A hypothetical market for environmental impacts is developed, where no markets exist, through the use of consumer surveys (see *Appendix 2* of Aquatech).

Contingent Valuation Method (CVM) can be used to elicit consumers':

- willingness to pay to prevent an environmental impact; or
- willingness to accept compensation in order to allow an environmental impact:

through survey questions.

CVM is subject to a wide range of potential biases, thus particular attention must be given to the design and means of conducting a survey, and survey questions should be made available as well as the results.

Pros:

+ generally less expensive than technique 2; and
+ only way to directly measure existence values.

Cons:

– not revealed preferences *ie* people overvalue willingness to pay;
– generally less rigorous than techniques 1 and 2;
– generally more expensive than technique 1; and
– subject to a wide range of potential biases.

Contingent ranking, which ranks alternative combinations of environmental and non-environmental attributes, and the Delphi approach may be used respectively when CVM is not feasible.

4. Benefit Transfer

Benefit transfer is the only one of the four major valuation techniques not to involve original studies. It draws upon previous studies with similar:

- projects;
- environmental impacts; and
- consumers or suppliers.

The first 'port-of-call' should be *ENVALUE*.

Pros:

+ generally the least expensive of the four techniques.

Cons:

– often data is not readily transferable; and

dependent on quality of study results.

5 Ancillary Matters

Advice *may* be sought on any of the matters discussed above from the following NSW Government agencies.

Treasury

Treasury has responsibility for advising the Budget Committee on the economic and financial aspects of Government projects.

Treasury can provide an agency with advice on:

- economic appraisal, particularly appropriate assessment methodologies and valuation techniques as well as related work, or where to find related work, by other Government agencies;
- financial appraisal;
- Government budgetary policy and strategy; and
- Loan Council implications.

Note: Government agencies, and their consultants, are strongly encouraged to consult with Treasury in the early stages of project design and appraisal in order to minimise the chances of failing to meet Treasury requirements.

Contact:
D Graham
Manager, Infrastructure Assessments
(02) 9228 3213

Environment Protection Authority

The Environment Protection Authority (EPA) has responsibility for setting environmental standards which it enforces through licensing and regulation.

The EPA can provide an agency with assistance in:

- evaluating environmental impacts;
- selecting appropriate economic appraisal of environmental impacts methodologies and valuation techniques; and
- the use of *ENVALUE*.

Contact:
H Betts O'Shea
Manager, Economic Evaluation
(02) 9325 5539

Department of Urban Affairs and Planning

The Minister for Urban Affairs and Planning is responsible for approving all projects or activities which are likely to significantly affect the environment and therefore require an EIS under the *EP&A Act*.

The Department of Urban Affairs and Planning (DUAP) can provide an entity with assistance in preparation of an EIS including the economic appraisal of environmental impacts.

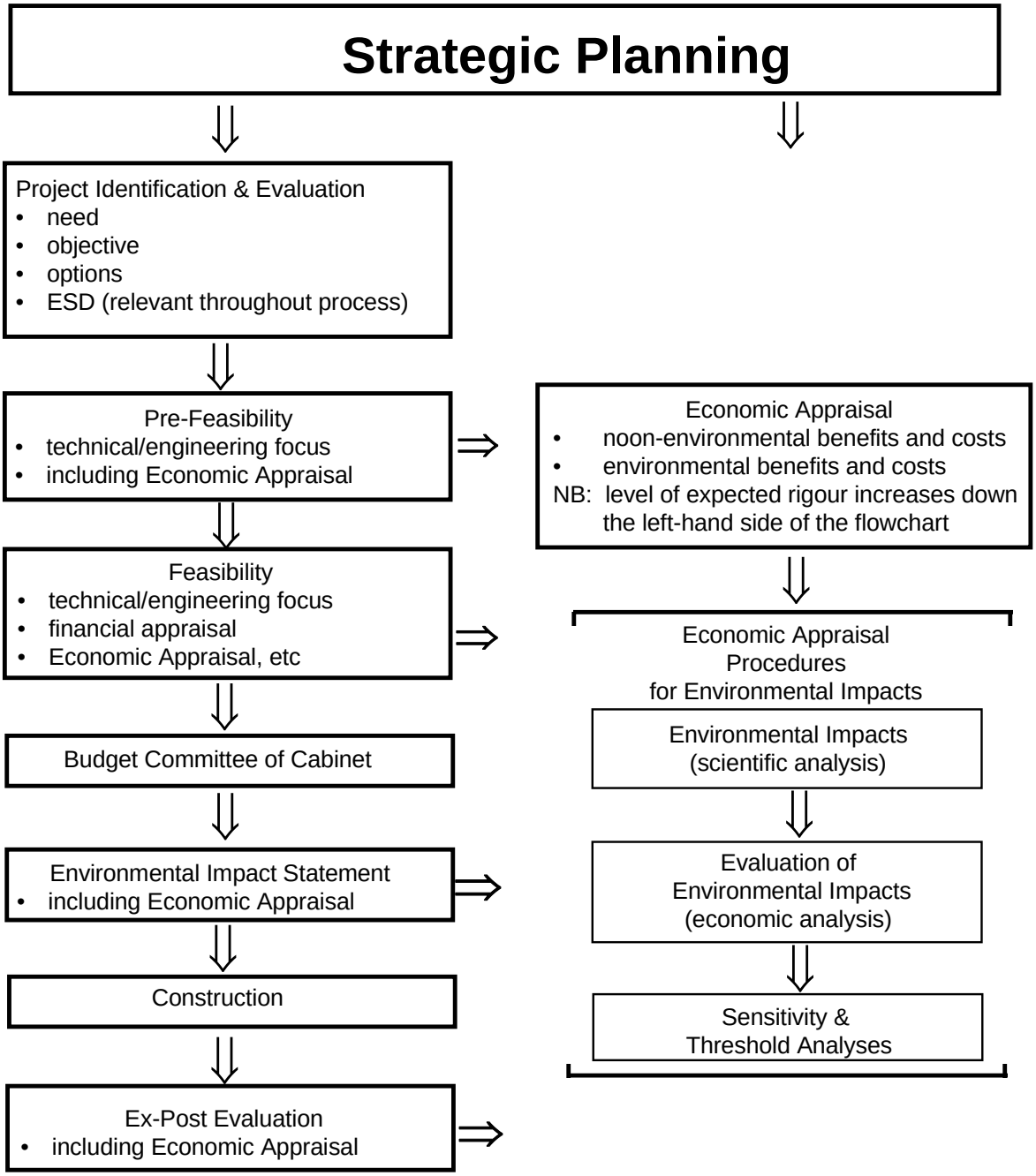
Contact:
N Osborne
Deputy Manager, Major Assessment and Hazards
(02) 9391 2073

6 Bibliography

- *Economic Assessment of Environmental Impacts* (Aquatech, 1996).
- *Economic Impact Statement Manual* (DUAP, 1997). (Note: this contains many additional references).
- *Environmental Planning and Assessment (NSW) Act 1979.*
- *Environmental Planning and Assessment Regulations 1994.*
- *NSW Government Guidelines for Economic Appraisal* (NSW Treasury, 1997).
- *Handbook of Cost-Benefit Analysis* (Cth Dept of Finance, 1994).
- *Protection of the Environment Administration (NSW) Act 1991.*
- *Risk Management Guidelines* (NSW Public Works, 1993).

State Owned Corporations (NSW) Act 1989.

Project Design & Evaluation Flow Chart



ANNEX 6

LISTING OF NSW TREASURY PUBLICATIONS

NSW TREASURY
Office of Financial Management

Listing of Publications

Commencing from May 1996, NSW Treasury has issued its publications within three categories which readily identify the purpose and status of the publication. The categories are:

- ***Treasury Policy and Guidelines Papers*** - Outline Government policy and/or Treasury procedures for the direction or guidance of Agencies.
- ***Treasury Research & Information Papers*** - Aimed at promoting discussion, educating or providing information on research projects undertaken by Treasury officers.
- ***Treasury Working Papers*** - Papers prepared and circulated usually for comment as a precursor to its issue as a formal Policy or Research Paper.

Publications are allocated a reference number according to their category. Particular publications, for example the State's Budget papers, the Treasury Annual Report and Corporate Plan, Treasury Circulars, and similar are not subject to this classification system.

Queries on any of the publications listed below can be directed to the Publications Officer on 9228 4426.

Publications Issued Since May 1996

Number	Title	Date Issued	Status	Available on Internet*
Treasury Policy and Guidelines Papers				
TPP 97-2	Guidelines for Econimic Appraisal	Jun 97	Available	Yes
TPP 96-1	Retail Competition in Electricity Supply	Jun 96	Available	Yes
TPP 96-2	Financial Reporting Code for Budget Dependent Agencies	Nov 96	Available	No
Treasury Research and Information Papers				
TRP 96-1	Contracting of Services in the NSW Public Sector - 1995 Survey Findings	May 96	Available	No
TRP 96-2	The NSW Electricity Supply Industry - the Transition to Full Retail Competition	July 96	Available	Yes
TRP 96-3	Analysis of the 1996-97 Commonwealth Budget	Aug 96	Unavailable	No
TRP 96-4	Implementing Contracting Policy in NSW - Lessons from Initial Experience	Sep 96	Available	No
TRP 96-5	Interstate Comparison of Taxes - 1996-97	Nov 96	Available	No
TRP 97-1	Performance of NSW Government Businesses - Microeconomic Reform: 1995-96	Feb 97	Available	No
TRP 97-2	Contracting for Services in the NSW Public Sector - 1996 Survey Findings	Feb 97	Available	No
TRP 97-3	Using Performance Measures to drive change within the Public Sector	Mar 97	Available	No
TRP 97-4	An Assessment of the Impacts of Restructuring Payroll Taxes	May 97	Available	No
TRP 97-5	Summary of the 1997-98 Commonwealth Budget	May 97	Available	No
Treasury Working Papers				
	(No issues to date)			

Publications Issued Prior to May 1996

Number	Title	Date Issued	Status	Available on Internet? *
	Budget Sector Policy and Procedures			
n.a.	Financial Management Arrangements for Public Service Wide Payments and Services	Dec 87	Historical	No
n.a.	Financial Management Arrangements for Commercial Activities in Departments	Dec 87	Superseded	No
n.a.	Report on the Review of Budget Processes	Dec 88	Historical	No
n.a.	Classification and Control of State Organisations	Jun 89	Withdrawn	No
n.a.	Classification and Control of User Charges Activities within Budget Sector Agencies	Mar 90	Superseded	No
n.a.	Financial Management for Inner Budget Sector Entities	Mar 91	Superseded	No
n.a.	Capital Incentives for Budget Sector Agencies (Draft)	Oct 94	Historical	No
n.a.	State Government Funding of Non Government Organisations -A Guide to Funding Policies and Procedures - Draft	Dec 95	Superseded	No
n.a.	Excellence in Financial Management - Budget Sector Reform	Jun 93	Available	No
n.a.	Competitive Tendering and Contracting in the NSW Budget Sector - 1993 Survey Findings	Dec 93	Superseded	No
n.a.	Budget Procedures Manual	Mar 94	Available	No
n.a.	Competitive Tendering and Contracting in the NSW Budget Sector - 1994 Survey Findings	Dec 94	Superseded	No
	Commercial Sector Policy Framework			
n.a.	A Policy Framework for Improving the Performance of GTEs	Sep 88	Available	No
n.a.	Characteristics of a Fully Corporatised GTE and Checklist for National Stocktake of Reforms	Aug 91	Available	No
n.a.	A Framework for National Performance Monitoring of GTEs	Aug 91	Available	No
n.a.	A Financial Distribution Policy for NSW GTEs	Aug 92	Available	No
n.a.	Monitoring Policy for NSW GTEs	Oct 92	Available	No
n.a.	A Community Service Obligations Policy for GTEs	Apr 93	Superseded	No
n.a.	Guarantee Fees for Commercial Sector Agency Debt	Feb 94	Available	No
n.a.	A Tax Equivalent Regime for NSW GTEs	Jun 94	Available	No
n.a.	A Tax Equivalent Regime for NSW GTEs - Supplementary Document 1 - Rules	Jun 94	Available	No
n.a.	A Tax Equivalent Regime for NSW GTEs - Supplementary Document 2 - Manual	Jun 94	Available	No
n.a.	A Social Program Policy for NSW GTEs	Jul 94	Available	No
n.a.	Capital Structure Policy for NSW GTEs	Aug 94	Available	No
	Accounting Policy and Procedures			
n.a.	Review of Government Risk Management and Insurance Arrangements	Jan 89	Withdrawn	No
n.a.	Accounting Guidelines for Reporting Physical Assets in the Budget Sector	Nov 89	Available	No
n.a.	Internal Audit Guidelines for Government Organisations	May 90	Superseded	No
n.a.	Policy Guidelines for Valuation of Physical Non-Current Assets in NSW Public Sector	Sep 90	Available	No
n.a.	Financial Reporting Code under Accrual Accounting for Inner Budget Sector Entities	Jul 91	Available	No

Publications Issued Prior to May 1996 (Cont'd)

Number	Title	Date Issued	Status	Available on Internet? *
	***Accounting Policy and Procedures** (continued)*			
n.a.	Cash Forecasting and Banking Arrangements for Agencies in the Treasury Banking System	Sep 93	Available	No
n.a.	Guidelines for Capitalisation of Expenditure in the NSW Public Sector	Jan 94	Available	No
n.a.	Excellence in Financial Management: Annual Reports - A Guide for the NSW Public Sector	Mar 94	Available	No
n.a.	Guidelines for the Valuation of Land & Heritage Assets in the NSW Public Sector	May 95	Available	No
n.a.	Statement of Best Practice - Internal Control & Internal Audit	Jun 95	Available	No
n.a.	Internal Control Assessment	Jul 95	Available	No
	Economic Guidelines and Research			
n.a.	NSW Government Guidelines for Economic Appraisal	Jan 90	Superseded	No
n.a.	Public Authority Pricing in NSW - Case Studies	Jan 92	Available	No
n.a.	An Annual Model of the NSW Economy	Sep 94	Available	No
n.a.	Possible Applications of Microsimulation for NSW Treasury	Sep 94	Available	No
n.a.	An Application of the Monash Multi-Regional Forecasting Model - the Economic Impacts of Improving the Productivity of NSW GTEs	Sep 95	Available	No
				No
				No
	Electricity Reform			
n.a.	Electricity Reform Statement	May 95	Available	Yes
n.a.	Electricity Distribution Structure Review	Aug 95	Available	No
n.a.	Electricity Distribution Structure Review Summary Report	Aug 95	Available	No
n.a.	Electricity Generation Structure Review	Aug 95	Available	Yes
n.a.	NSW State Electricity Market - Design Scope	Aug 95	Available	No
n.a.	Sustainable Energy Fund Final Report	Nov 95	Available	No
n.a.	Policy Guidelines For Valuation Of Network Assets Of Electricity Network Businesses	Dec 95	Available	No
n.a.	Retail Competition in Electricity Supply Issues Paper	Feb 96	Available	No
n.a.	Retail Competition in Electricity Supply Interim Report	Feb 96	Available	Yes
	Other			
n.a.	Agency Relations - Guidelines for Agencies and OFM	Feb 94	Available	No