ECONOMIC EVALUATION PRINCIPLES FOR SUSTAINABLE MANAGEMENT OF ENVIRONMENTAL PROJECTS

Ajator, Uche O. (Ph.D)
Department of Quantity Surveying and Cost Engineering
Enugu State University of Science and Technology (ESUT), Agbani-Enugu
Mobile: *+234-805-280-0584;* Email: *ucheoajator@yahoo.com*

Abstract

This paper x-rays the basic economic principles employed in evaluating environmental projects. It viewed economic evaluation as a crucial component of capital budgeting used for allocating the financial resources of private and public organizations of a nation in order to achieve sustainable development. It opined that projects development/management strategies must embody full dose of green/sustainability strategies whose private/social costs and benefits cashflows are estimated, strategically projected and discounted to enable projects with highest net social benefits to be implemented. It identifies CBA as a versatile evaluation technique suited for public and major private projects and recommended the bridging of private and social rates of return to serve as a catalyst for private-sector-led social and economic development activities that would ensure sustainability of development.

Introduction

The proper budgeting of available resources of a nation is crucial to its socio-economic and political existence. Economic evaluation is the key element of capital budgeting, which is a process of allocating the financial resources of private and public organizations in a nation in the manner that best achieves the nation's overall goal of sustainable development (Ajator, 1994).

The need for capital budgeting arises when an organization (private or public) has to select the best potentially profitable (social, economic, environmental) investment project strategies from a range of available project strategies for a given set of budget constraints. The selection of the optimal combination of projects from a set of available options and budgeting the available capital is thus critical (Ajator, 1999, 1996).

Misjudged ventures can significantly impair the profitability/sustainability of the organizations and the society development programmes, and the credibility of the agencies in charge of the programmes. The basic approach is to evaluate and rank the projects using any acceptable appraisal techniques and select the best-ranking projects that fit into the capital budget (Ajator, 1996).

Evaluation goes beyond the investment capital, and private costs and benefits of proposed projects to include all externalities, the social costs and benefits to the society at large throughout the project life cycle. The cycle begins with the initial conception of the project and continues through planning, design, procurement, construction start-up, operation and maintenance to final demise/disposal of the facility. For sustainability of the environmental projects the basic

procedural considerations would include the following (Hill and Bowen, 1996; Ajator and Onyeador, 2007):

- Undertake prior assessments of proposed activities;
- Involve people potentially affected by proposed activities in decision-making process in a timely way;
- Promote interdisciplinary collaborations and multi-stakeholders partnerships;
- Recognize the necessity of comparing alternative, courses of action;
- Utilize a lifecycle framework;
- Utilize a system approach (optimality concept);
- Exercise prudence;
- Comply with relevant legislation and regulations;
- Establish a voluntary commitment to continued improvement of performance;
- Manage activities through the setting of targets, monitoring evaluation, feedback and self-regulation of progress;
- Identify synergies between the environment and development;

With these sustainability factors built into the projects proposal, the selection of a balanced set of projects that would meet the goals, resources and constraints of the private/public organizations would follow.

Methods of economic evaluation of facilities

Various criteria for cash flow analysis exist to evaluate the viability of projects and capital expense proposals. The three formulae commonly used by medium to large-sized private/public companies are (Ajator, 1996; Al-Tabtabai and

Alex, 1998; Hendrickson, 2003; Henshaw, 2006) net present value (NPV) and its affiliate models: profitability index (PI) and discounted payback (DPB); internal rate of return (IRR); and Cost-Benefit-Analysis (CBA).

Economic evaluation of facilities refers to the evaluation of the economic/operating cash flows representing the benefits and costs associated with the acquisition and operation of the facility over the planning horizon. We must distinguish between economic evaluation of alternative physical facilities and the evaluation of alternative financing plans for a project, which refers to the evaluation of the cash-flows, representing the incomes and expenditures arising from adopting a specific financing plan for funding the project. In general, economic evaluation and financial evaluation are carried out by different groups in an organization since economic evaluation is related to design, construction, operations and maintenance of the facility while financial evaluations require knowledge of financial assets such as equities, bonds, notes and mortgages available for financing the facilities. Both economic and financial evaluation should be integrated because wrong choice of financing option might affect the profitability and sustainability of the environmental projects.

Basic Steps in Economic Evaluation

A systematic approach for economic evaluation of facilities consist of the following major steps:

- Generate a set of projects or purchases for investment consideration;
- Establish the planning horizon for economic analysis;
- Estimate the cash flow profile for each project;
- Specify the minimum rediscount rate (cost of capital);

- Establish the criterion for accepting or rejecting a proposal, or for selecting the best among a group of mutually exclusive proposals, on the basis of the objective of the investment;
- Perform sensitivity or uncertainty analysis;
- Accept or reject a proposal on the basis of the established criterion.

Often many assumptions and policies, some implicit and some explicit, are introduced in economic evaluation by the decision maker. The decision making process will be influenced by the subjective judgement of the management as much as by the result of systematic analysis.

Cost of capital (interest rate)

The interest rate or cost of capital for appraising projects specified by top management in a private firm reflects the opportunity cost of capital of the firm, the market interest rates for lending and borrowing and the risks associated with investment opportunities. For public projects, the interest rate is specified by a government agency, such as the office of management and budget, the Central Bank and the National Assembly. The public cost of capital (interest rate) specified, reflects social and economic welfare considerations and is referred to as the social rate of discount (SROD).

The SROD is generally lower than the interest rate set by private firms as it is often regarded as a risk-free rate. The cost of capital for economic evaluation of investment proposals is critically important in determining whether any investment proposal is worthwhile. Hence lowering the SROD for public projects while maintaining higher cost of capital for private projects creates the risk of approving more public projects, which have lower social benefits than private

sector projects, which is forced to use the higher commercial discount rate on its future revenue stream. The implication is that more and less beneficial public projects than government budget can handle are approved with high risk of abandonment, while rejecting viable private projects. This might go against the rational policy of catalyzing national development through private sector-driven social/economic development activities.

Costs and benefits of a constructed facility

The basic principle in assessing the economic costs and benefits of new facility investments is to find the aggregate individual changes in welfare of all parties affected by the proposed projects (Hendrickson, 2003). The changes in welfare are generally measured in monetary terms, but there are exceptions, since some effects cannot be measured directly by cash receipts and disbursements. Examples include the value of human lives saved through safety improvements or the cost of environmental degradation. The difficulties in estimating future costs and benefits lie not only in uncertainties and reliability of measurement but also on the estimation of social costs and benefits generated as side effects. Furthermore, proceeds and expenditures related to financial transactions, such as interest and subsidies, must also be considered by private firms and by public agencies.

To obtain an accurate estimate of costs in the cash-flow profile for the acquisition and, operation of a project (Hendrickson, 2003; Chandra, 2002; Patel, 2000), it is necessary to specify the resources required to construct and operate the proposed physical facility, given the available technology and operating policy. Typically, each of the labour and material resources required by the facility is multiplied by its price, and the products are then summed to obtain the total

costs. Private corporations generally ignore external social costs unless required by law to do so. In the public sector, externalities often must be properly accounted for. An example is the cost of property damage caused by air pollution from a new plant. In any case, the measurement of external costs is extremely difficult and somewhat subjective for lack of a market mechanism to provide even approximate answers to the appropriate value.

In the private sector, the benefits derived from a facility investment are often measured by the revenues generated from the operation of the facility. Revenues are estimated by the total of price times quantity sold. The investment cost/depreciation, investment credit allowances, interest and taxes on revenues must be deducted according to the prevailing tax laws. In the public sector, income may also accrue to a public agency from the operation of the facility. However, several other categories of benefits may also be included in the evaluation of public projects. First, private benefits can be received by users of a facility or service in excess of costs such as user charges or price charged. After all, individuals only use a service or facility if their private benefit exceeds their cost. These private benefits or consumer surplus represent a direct benefit to members of the public. In many public projects, it is difficult, impossible or impractical to charge for services provided, so direct revenues equal zero and all users' benefits appear as consumers' surplus. Examples are a park or roadways for which entrance is free. As a second special category of public benefit, there may be external or secondary beneficiaries of public projects, such as new jobs created and profits to private suppliers. Estimating these secondary benefits is extremely difficult. It demands caution since resources devoted to public projects might simply be

displaced from private employment and thus represent no net benefit.

Investment evaluation criterion

Basic characteristics of sound investment evaluation criterion are:

- ❖ It should consider all cash-flow to determine the true profitability of the project
- ❖ It should provide for an objective and unambiguous way of separating good investment projects from bad ones
- ❖ It should help in ranking the projects according to their true profitability.
- ❖ It should recognize the fact that bigger cash-flows are preferable to smaller ones and early cash-flows are preferable to later ones.
- ❖ It should help to choose among mutually exclusive projects, the project which maximizes the shareholders' wealth.
- ❖ It should be a criterion, which is applicable to any conceivable investment project independent of others.

Net present value method: The objective of facility investment in the private sector is generally understood to be profit maximization within a specific time frame. Similarly, the objective in the public sector is the maximization of net social benefit, which is analogous to profit maximization in private organizations. Given this objective a method of economic analysis will be judged by reliability and ease with which a correct conclusion may be reached in project selection. The NPV method discounts back the net inflows over the life of the investment to determine whether they equal

or exceed the investment outlay. The project is accepted if the NPV is greater than zero and profitability index (PI) is greater than 1.

The basic principle underlying the decision for accepting and selecting investment projects is that if an organization can lend or borrow as much money as it wishes at given cost of capital, the goal of profit maximization is best served by accepting all independent projects whose NPVs at the cost of capital are nonnegative, or by selecting the project with maximum nonnegative NPV among a set of mutually exclusive proposals. The NPV makes the conservative assumption that over the years, inflows can be reinvested at the original cost of capital or discount rate. This reinvestment assumption of NPV method allows for consistency (Al-Tabtabai et al, 1998). Inflows from each proposal are assumed to have the same investment opportunity, and it is for this reason that NPV is generally the preferred method (Prall, 1990). The following steps are involved in the calculation of NPV:

- Cash flows of the investment project should be forecasted based on realistic assumptions.
- Appropriate discount rate should be applied to discount the forecasted cash flows. The appropriate discount rate is project's opportunity cost of capital which is equal to the required rate of return expected by investors on investments of equivalent risk
- Present value is calculated as the aggregate of the discounted net cash inflows.
- The net present value (NPV) is then the difference between present value of discounted inflow (benefits) and present value of discounted outflows (costs)

$$NPV = \sum_{t=0}^{n} B_t - C_t\,(1 + r)^{-t} > 0$$

where B is benefit and C is cost and t is time.

The project is accepted if NPV is positive (NPV>0) and rejected if NPV is negative (NPV<0). Where the NPV of a project is positive, it means that by undertaking that project the organization immediately increases its present wealth by the value of the NPV and the rate of return on the project exceeds the cost of capital. The proceeds of the project will yield sufficient funds to repay the initial capital sum plus any additional borrowing to the value of the NPV.

The Internal Rate of Return (IRR): The internal rate of return (IRR) method calculates the interest rate(s) at which the net cash inflows of an investment can be discounted to equal the discounted outflows or capital cost of the project. It is the rate, when used in discounting that makes the NPV equal to zero (NPV = 0). It is obtained through trial and error and use of interpolation model. Like the NPV, it takes into account the magnitude and timing of cash flows. In contrast to the NPV method the IRR method assumes that all inflows can be reinvested at the marginal yield from a given investment. For proposals with a very high IRR, it may be unrealistic to assume that reinvestment will occur at these high rates. Besides the IRR method is rigorous to calculate and may give multiple rate if some cash flows of the project are negative. The decision rule is to accept the project if the IRR is greater than the cost of capital. And, for mutually exclusive projects, to select one with the highest IRR.

IRR Interpolation Model:

$$IRR = \frac{R_1\% + NPV_{R1}}{NPV_{R1} + NPV_{R2}} (R_2 - R_1)\%$$

where

RI = interest rate at which NPV is + Ve

R_2 = interest rate at which NPV is immediately negative.

Cost-Benefit-Analysis (CBA): CBA is essentially an investment appraisal technique, which takes into account not merely the private costs and benefits of an investment project but also the social costs and benefits. CBA is a technique used in either investment appraisal or the review of the operation of a service for analyzing and measuring the cost/benefit to the community of adopting special courses of action and for examining the incidence of these costs and benefits between different sections of the community.

Brown & Howard (1982) defined CBA as an analytical tool in decision making which enables a systematic comparison to be made between the estimated cost of undertaking a project and the estimated value/benefit which may arise from the operation of such a project. CBA is used widely in the areas of public finance and in private sector when large projects are being considered. CBA has the basic objective of identifying and measuring the costs and benefits, which stem from either the investment of monies or the operation of service.

It is concerned with not only examining those costs and benefit which have a direct impact on the providing authority, but also those which are of an external nature and accrue to other persons. Also, the cost and benefits to be measured are those, which accrue throughout the life of the

project. Hence, CBA provides the decision maker with useful guidelines to enable him make decisions based on rigorous appraisal of all the factors involved in the undertaking of a project. He is made aware of the probable range of costs and benefits, which would be experienced to help him consider the complete scenario before making his decision.

Nationally, CBA can be used in allocating scarce resources between such public services as education, environment and health, but its effective use is marred by high level of politics attending such crucial decision of allocation of public resources. CBA is not a new technique, as earlier writers including Foster & Beesley (1963) had indicated. The popularity of use of CBA in decision making originate from its application in U.K. in the study for a third London Airport and Victoria underground line of London transport in the 1960s. And in USA the Tennessee Valley Scheme for the provision of water, Cole (1976 in Brown and Howard, 1982).

The rationalization of the application of CBA to public expenditure derives from its use by welfare states to provide free services in the areas of medical care, school, environmental control, etc. This was to ensure equal opportunities for all regardless of income level, with clear disinclination to apply commercial techniques in investment appraisal. Its narrow application rendered it difficult to evaluate the efficiency of resource allocation in these areas. CBA aims at setting out the factors, which need to be taken into account in making economic choices. Most of the choices to which it has been applied involve investment projects and decisions whether or not a particular project is viable financially, which is the best of several alternative projects, or even when to undertake a particular project. The aim is generally to maximize the present values of all benefits less that of all costs, subject to specified constraints.

CBA incorporates a number of techniques. It draws on the concepts of capital budgeting such as investment criteria, forecasting and risk/ uncertainty. In addition it involves wider issues such as environmental problems, opportunity costs and transfer prices with considerable amount of inputs being subjective. Notwithstanding the subjective nature of data/decisions involved, careful preparation and analysis of such data as an aid to decision-making is superior to decisions made on a "hunch" or intuition. CBA attempts to consider all the consequences, which may arise from undertaking a project. For example a company may be considering the building of a new plant, which, because of its manufacturing process will discharge a considerable amount of effluent into a local river. The normal capital budgeting techniques may show that it will be profitable for the company to operate the plant, but CBA examines all consequences including of course, the effects the effluent discharge may have on the health of the population, on the fishing, swimming, local/scenic beauty, etc. This type of environmental problem is regarded as a social cost and should be an important item in considering a major project. CBA is therefore a precursor to the current Environmental Impact Assessment EIA, that has received wide aclaim as an important tool for sustainability of projects.

Principal Criteria to be Determined: The principal issues to be determined are:

- Which costs and benefits are to be included?
- How are they to be valued?
- At what interest rate are they to be discounted?
- What are the relevant constraints?

Methodology to be Used in Cost Benefit Study: The suitable steps to be used in a cost benefit study are:

- ✓ Define the problems to be studied
- ✓ Identify the alternative courses of action
- ✓ Identify the costs and benefits both to the investor and the external parties
- ✓ Evaluate the costs and benefits and
- ✓ Draw conclusions as to the alternative to be adopted.

Differences Between Costs-Benefits-Analysis and Conventional Investment Appraisal Techniques

The following have been identified as some differences between CBA and conventional investment appraisal techniques:

- CBA include not merely private costs and benefits, but also social costs and benefits in the calculation of annual cash flow of a project.
- The valuation of these costs and benefits is also significantly different. Conventional techniques use, market value, while CBA often use shadow prices.
- The discount rate used to discount these costs and benefits may also be different. Conventional techniques use the cost of capital, while CBA generally uses some sort of social discount rate.

Valuation of Social Costs and Benefits

The problems of forecasting future costs and benefits especially of long-term projects are considerable even with the existence of refined mathematical techniques and computer applications. In CBA the problem is compounded by the need to estimate social costs and benefits, which have no market

price. These costs must be quantified no matter how subjective or relative. For example in road projects, estimates of time/costs saved through decongested traffic and reduced exhaust gas emissions, speedy evacuation of farm product and thriving, small businesses and enhanced property values incident on the road project are measured. Where this is not possible social costs may be ranked in order of preference or indexed to show the category of desirability as a guide to the decision maker.

Alternatively contingency method may be used whereby monetary benefits are subtracted from monetary costs and the decision maker then decides whether the value of the intangibles is worth the difference. In forecasting, three point probabilities estimates of costs and benefits to show the possible worst, most probable and possible best estimates are preferable as they present the probability of cost and revenue being within acceptable limits.

These estimates of project investment cost, life span, running costs, possible scrap values, cost of capital, capital allowances etc provide guide costs (Benchmarks) on which sensitivity or simulation of the impact of changes in these standard costs will have on the overall profitability/sustainability of the environmental project. For example, the effect on project if revenue were increased by say 30% or if the asset life were reduced by 20%. This helps to highlight the assumptions, which are considered to be critical to the project.

This synthesized and projected costs and benefits can then be presented in a simple tabular model of social NPV analysis. The social NPV analysis 1996 – 2000 of oil production projection in Nigeria is illustrated in Table 4.1.

Table 4.1: ***Oil production projection in Nigeria - Social NPV analysis (1996-2000)***

Year	Social disc. Rate 10%	Social costs ($b)	Discounted social costs ($b)	Social benefits ($ b)	Discounted social benefits ($ b)
1996	1	10576	10576	11199	11199
1997	.92	10327	9500	11448	10532
1998	.85	10078	8566	11572	9836
1999	.79	9829	7764	11821	9338
2000	.73	9581	6994	12443	9083
			$43,400b		$49,988b

Sources: Oil Production and Shadow Price Survey, 1996; Nwankwo and Ifeadi (1992)

Social NPV = $ (49988 – 43400) b = $6.588 billion

Conclusion and Recommendation

For sustainability of environmental project management strategies, full range of sustainability factors have to be inbuilt into environmental project planning, development, financing, evaluation and control. The environmental impact mitigating options for major capital private/public projects have to be evaluated using CBA with its multiple evaluation technique derived from capital budgeting such as investment criteria, forecasting, risk and uncertainty simulation and environmental factoring. Appropriate bridging of private cost of capital and the social rate of discount is to be considered, to create impetus for a private – sector – led social and economic activities that will ensure sustainability of national development.

References

Ajator, U.O. (1994), "Financing Environmental Management Activities," Paper presented at the One-day Symposium on Environment and Social Harmony, organised by ESUT and the British Council at the ESUT Education Hall, Enugu, 28th October.

Ajator, U.O. (1996), "Emerging Trends in the Economic use of Ecological Resources," Paper presented at the International Conference on Ecology, Environment and Politics, ESUT, Enugu, 16-19 October.

Ajator, U.O. (1999), "Sustainable Development – An Imperative for Nigerian Construction Practice", *The Quantity Surveyor*, 26: 15-20.

Ajator, U.O. and Onyeador, S.O. (2007), "Sustainable Building Development, Construction and Built Environment in Nigeria and the National Building Code," Paper presented at the 3-Day National Conference on the Anatomy/Implication of National Building Code, ESUT Auditorium, Agbani-Enugu, 27-729 June.

Al-Tabtabai, H. and Alex, A.P. (1998), "An Evolutionary Approach to the Capital Budgeting of Construction Projects, *Cost Engineering*, 40 (10): 28-34.

Brown, J.L. & Howard, L.R. (1982), *Managerial Accounting and Finance*, 4 ed., Britain: Macdonald and Evans.

Cole, W.S. (1976), "A Cost Benefit Approach to the Rationalization of Public Transport Services," *Chartered Institute of Transport Journal*, 33 (10): 12-14.

Chandra, P. (2002), *Project, Planning, Analysis, Selection, Financing, Implementation and Review*, 5 ed., New Delhi: Tata-McGraw-Hill Publishing Co. Ltd.

Foster, C.D, and Beesley, M.E. (1963), "Estimating the Social Benefit of Constructing an Underground Railway in

London," *Journal of the Royal Statistical Society,* 7 (3): 21-24.

Hendrickson, C. (2003), *Project Management for Construction,* Pittsburgh: Department of Civil/Environmental Engineering, Mellon University, Pittsburgh.

Henshaw, E.E. (2006), "Anatomy of Cost Benefit Analysis of Tinapa Projects in Calabar", Paper presented at the NIQS 2nd Biennial Conference and General Meeting, 22-25 November, Channel View Hotel, Calabar, Nigeria.

Hill, R.C. & Bowen, P.A. (1996), "Sustainable Construction: Principles and a Framework for Attainment," *Construction Management and Economics,* London: E. and F.N. Spoon.

Nwankwo, U. & Ifeadi, C.N. (1992), "Case Studies on the Environmental Impact of Oil Production and Marketing in Nigeria," *Environmental Issues and Management in Nigerian Development*, 208-223.

Patel, B.M. (2000), *Project Management: Strategic Financial Planning, Evaluation and Control,* India: Vikas Publishing House PVT Ltd.

Prall, J.R. (1990), "The Capital Budget Decision", *Cost Engineering,* 32 (12): 19-23.