A CRITICAL REVIEW OF COST BENEFIT ANALYSIS IN USE FOR BOTH PUBLIC AND PRIVATE PROJECTS

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Abstract
Value analysis has long been used by surveyors in evaluating the client's objectives and so is cost-benefit analysis. With the focus on economic objectives, the industry has become more demanding in this modern era where global policies and environmental issues are dominating the minds of the decision-makers. Not only public clients and corporate clients, private clients today also pay attention to cost-benefit analysis in their development in meeting stringent rules and complying with regulatory measures in respect of cost accountability. In analyzing the literature relating to cost benefit analysis, this paper attempts to address the economic perspective of cost-benefit analysis and its unique significance of social costs for the human well-being. Some key issues that are important in cost-benefit analysis but are seldom noticeable in the preliminary stage of project planning are identified in the analysis. Two case examples are given to briefly illustrate the usage of CBA. The findings are useful for those who are working with cost-benefit analysis, irrespective of whether they are serving public clients or private clients.

Keywords: construction clients, cost accountability, cost-benefit analysis, cost factors, public projects

INTRODUCTION

Value analysis has long been used for evaluating the client's objectives, and its eventual purpose is to comply with the economic objectives of the proposed project – cost accountability. The questions always asked are 'why we are paying so much for this and for that', and for a public project, the budget approval process is further queried by stakeholders of the opportunity costs. While the industry has become more demanding in this modern era and global policies and environmental issues are dominating the minds of the decision-makers, project clients tend to pay more attention to cost-benefit analysis in order to meet stringent rules and compile with regulatory measures in their

development. Since the traditional value analysis is function-oriented, it is related to design theories. To fulfill the clients' needs means to fulfill the requirements of the performance standard. However, for most projects, it is no longer the clients' objectives that count, the stakeholder value judgements are also important in the analysis as stated in the following:

"Value Management is concerned with improving and sustaining a desirable balance between the needs and wants of stakeholders and the resources needed to satisfy them. ***Stakeholder value judgements*** *vary, and VM reconciles differing priorities to deliver best value for all stakeholders…."* (IVM, 2013)

This raises the significance of using cost benefit analysis in acquiring value in a society to fulfill clients' needs. For this, we need to re-look at cost benefit analysis which conventionally enables us to help clients to develop cost accountability also of social objectives, in particular for public clients. Now that private clients may also have to abide with social responsibility, cost benefit analysis is of equal importance to both public and private clients. This paper provide a critical review of the developing trend of cost benefit analysis for construction projects.

COST BENEFIT ANALYSIS

Cost benefit analysis (CBA) is conventionally known as a method to assess the relative desirability of competing alternatives in terms of their economic worth to society (Sinden & Thampapillai, 1995). In simple words, CBA is a technique used to determine whether a planned action will turn out to be good or bad. It concerns efficient use of resources by estimating and totaling up the equivalent money value of the benefits and costs of a project to establish whether the project is worthwhile. It is commonly used for infrastructure projects like dams and highways, or system projects like health care systems. Benefits are intangible. Therefore, a value and a weighting has to be assigned to each of the "social" benefits such that a quantitative comparison can be made (Layard and Glaister, 1994). Problems arise in assigning these weightings and values as weightings and values are considered as judgmental and is therefore subjective.

CBA was first developed by a French economist Depuit in 1884. In the 1970s. Seeley (1976) included CBA in the section of environmental economics and suggested to have building constraints or restricting factors in the application of CBA to building proposals besides the usual practice of CBA in transport proposals, river and harbour projects and flood control schemes.

In the 1980s, Ferry and Brandon (1980) considered CBA as a technique to justify the spending of money on public projects, and they put forward the problem of attaching money value to things which cannot be quantified. They pointed out that CBA was only valid when it was restrict to the cost comparison of those things which were capable of being quantified honestly, and suggested to assess the scheme result by making subjective decisions on the remaining factors when quantification is impossible or would be socially unjust. Ward and Litchfield (1980) mentioned CBA when they referred the weighting problem in value analysis and queried about the subjectivity and objectivity in performing CBA. They questioned about the ***cost of compliance*** when excessive environmental and safety regulations are in place.

In the 1990s, Sinden & Thampapillai (1995) acknowledged the usefulness of CBA even though they once raised a concern about its application to real world issues, particularly in respect of valuing unpriced benefits and costs. However, they agreed that the systematic procedures can improve the information for decisions based on relevant economic theories and concepts. For this reason, they changed CBA into BCA (benefit-cost analysis). They also brought in the concept of constraints and accepted them as the nature of the society, echoing Seeley's first mentioning of constraints for building projects in the 1970s.

In the 2000s, Ashworth (2002) considered that the problem of CBA was due to the fact that the community at large had relatively unlimited wants, needs and desires when compared with the resources available to satisfy them in an economic proposition. Therefore, the difficulty in applying the technique is pricing the benefits. Ashworth (2002) points out that for public projects, it is open to manipulation of political ends. In the 2010s, Brandon and Lombardi (2011) embedded CBA concept into their evaluation of sustainability development.

From the economics perspective, Mishan and Quah (2007) refers CBA as an assembly of concepts and techniques culled from mainstream economic theory, in particular from that branch known as Welfare Economics. The theories being used range from consumer surplus and shadow pricing, and the techniques applied range from net present value, internal rate of return and weightings. Butter (2012) refers CBA as a quantification of the welfare effects of government policy and *the direct welfare costs* or benefits for various stakeholders have to be quantified, whereas some *indirect costs and benefits* are difficult to assess. Those indirect costs and benefits are thus listed as a pro memori (pm) post because of their uncertainty and hence difficulty in assessment. While this is the case, cost-benefit analysis are commonly criticized as being

judgemental and not objective enough. However, a step forward is a systematic approach to the *direct and indirect cost* procedures in the evaluation of benefits.

Mishan and Quah (2007) point out that there are common error in some popular treatments of CBA and this clearly reflects the case of subjectivity. Even though the steps are clearly listed in most CBA such as Msihan and Quah (2007), Tao et al. (2011), Nas (1996), Walshe and Daffern (1990), the systematic approach does not all count for a comprehensive and errorless CBA, but it does improve the extent of availability and quality of information for decision-makers to select an optimal solution.

SCOPE OF APPLICATION

Cost–benefit analysis is often used by governments to evaluate the desirability of a public construction project. It provides an analysis of the cost effectiveness of different alternatives in order to see whether the benefits outweigh the costs. The aim is to gauge the efficiency of the added value relative to the status quo. The public body is to take account for all the costs and benefits which affect the welfare of individuals in a community as a whole. To facilitate comparison and assessment, the non-monetary items (benefits, welfare) are to be translated into monetary terms (cost). Thus, items involving social costs or environmental costs are to be evaluated on the basis that the expected benefits will exceed the expected costs. For example, the valuation of travelling time may be assessed as the time lost for production or a time reduction of leisure hours.

Besides infrastructure projects, policy making, environmental policies, planning, application of CBA can be seen in many other areas. For example, evaluating journals use in special libraries, bringing in 'utility' measures to assess the cost per use of a journal to evaluate the appropriateness of continuing subscription (Sridhar, 1988); the valuation of historical buildings in identifying all relevant costs and benefits of a project, giving a financial value, discounting to present-day costs, and providing weighting in terms of their perceived importance of different heritage values (RICS, 2013); and establishing a CBA framework for evaluating social (public) housing in sustainable development (RICS, 2013). Guidelines for CBA have already been developed by some government bodies such as Australia and Canada, and OECD (2006) also produces a more updated approach of CBA for working towards environmental policy.

PROBLEMS IN THE APPLICATION OF CBA

The problem areas of CBA are usually the non-monetized benefits and costs, such as visual impacts, landscape and social amenities impacts, cohesion heritage or cultural impacts, human capital impacts, life and injury impacts (Tao et al. 2011,) Monetary value is hardly realized without data support, and in many instances there are no past data references.

One other problem of CBA is that the computation of components of benefits and costs tends to be intuitively obvious, but intuition fails to suggest methods of measurement for many of the items. It has been suggested that the basic valuation principles should be followed: (1) Common unit of measurement-benefits and costs of a project have to be expressed in terms of equivalent money value at a particular time; (2) Valuations should represent consumers or producers actual behaviour; (3) Benefits are usually measured by market choices.

As valuation of benefits and costs should reflect preferences revealed by choices which have been made, cases for transportation projects frequently involve saving time. The question is how to measure the money value of that time saved. The value should not be merely what transportation planners think time should be worth or even what people say their time is worth. The value of time should be what time is worth to the public through choices involving tradeoffs between time and money.

COST FACTORS FOR CBA

As early as the 1970s, Seeley (1976) brought to the attention of surveyors the social costs, private costs and external costs. There he defined social costs as the sum total of costs involved as the result of an economic action; private costs as those which affected the decisions of the performers (production costs); and external costs as those costs not met by the industrialists. He referred the external costs or externalities as the side effects.

Social cost

According to OECD (2006), social benefits essentially refer to increases in human wellbeing (utility) and social costs are valued as reductions in human wellbeing (OECD, 2006), and thereby incur both gain and loss. From an economic perspective, social costs are the sum of private costs and external costs. It refers to both the private costs and any other external costs to society arising from the production or consumption of a good or service. If there is a negative externality, then social costs will be greater than private costs. Environmental pollution is an example of a social cost that is seldom borne completely by the polluter, thereby creating a negative externality. If there is a positive externality, then one will have higher social benefits than private benefits. For example,

if a producer can avoid the cost of air pollution control equipment allowing the firm's production to impose costs (health or environmental degradation) on other parties that are adversely affected by the air pollution, then the benefit to society is a negative externality (Ison and Wall, 2007; Layard and Glaister, 1994)

Social Costs = Private Costs + External Costs

In above equation, if external costs are above 0, then private costs are less than social costs. This means that the society tends to price the good or service too low, and produces or consumes too much of the good or service.

Private cost

In economics, private costs are the costs that the buyer of a good or service pays the seller. It is what a producer of a good, service, or a firm pays to purchase capital equipment, hire labour, and buy materials or other inputs with actual market price. This can also be described as the costs internal to the firm's production function. Examples of private costs can be cost of land, cost of construction, costs of running the plant when it has been built, transport costs of materials and completed products. Private benefits can thus be the money made from the sale of the products. The private costs will lead to a socially efficient rate of output if there are no external costs. If market prices of polluting fuels do not include values that reflect the environmental costs, the prices will be lower than the social cost.

External cost

External costs, known as externalities, are the costs that people other than the buyer are forced to pay as a result of the transaction. The difference between private costs and total costs to society of a product, service, or activity is the external cost. The bearers of such costs can be either particular individuals or the society at large (Ison & Wall, 2007; Flyvbjerg et al. 2002). Examples of external costs are shown in the Table below.

Table 1 Examples of External Costs

External costs	External Benefits
Waste products will cause pollution	Jobs will be created
Smoke and fumes may damage the health of residents	Other firms may move into the area to provide services to the firm producing smoke and fumes
Parkland cannot now be used by local residents	Important chemicals will be produced to benefit society

However, Seeley (1976) added further issues on externalities for which he called them constraints. Projects are frequently subject to a variety of constraints or restricting factors which require valuation. These constraints are categorized as physical constraints, legal constraints, administrative constraints, uncertainties and distributional and budgetary constraints, which are still sound for today.

KEY ISSUES IN ASSIGNING AN ECONOMIC VALUE TO SOCIAL OBJECTIVES

With detailed analysis of the present trend of CBA, the following areas are identified and are considered as the key issues that a comprehensive CBA should cover to make sense of the social aspect of cost in the costs and benefits scenarios.

The yes project and no project perspective

Butter (2012) takes the view that null alternative or no regulation should also be considered in a CBA, as the effects of a regulation may only materialize in the long-run. Although he generally refers to government regulation and transaction costs, Butter quotes an example of the credit crisis of 2007-2010 in the financial market as a consequence of the regulation issues that the effect can be so drastic as to bring great recession. The yes project and no project perspective has been brought up in the third runway at Sydney airport (Sinden & Thampapillai,1995) and in the final judgement of the judicial review of the HZMB case based on environmental rules (Lau, 2013).

The second-best theorem

Mishan and Quah (2007) point out that there is a problem of the second-best theorem. The second-best theorem is based on the concept that when one additional constraint is imposed on the welfare function, the necessary conditions that emerge from the maximizing procedure are different from those identified with the marginal-cost pricing rule. There is a tendency of choosing the second best when there are several alternatives. Usually though the first best is the ideal, but it is impossible to prove that the second best is not an optimal choice as the conditions are different. This is primarily based on an optimal allocation of resources, and a slight adjustment of the constraints will give rise to different solution. Conducting sensitivity analysis will help.

Market price against shadow price

Shadow pricing is about a value assigned to non-marketed goods when performing different types of cost-benefit analyses. It usually applies to external cost, and works in line with opportunity cost. External costs are most often non-monetary and problematic to quantify for comparison with monetary values, e.g. pollution. They refer to what society will likely have to pay for in some way or at some time in the future, but are not usually included in the transaction prices. External costs are based on market prices, but the eventual judgment of market prices can only be made with shadow prices.

When consumers make purchases at market prices they reveal that the things they buy are at least as beneficial to them as the money they relinquish. Consumers will increase their consumption of any commodity up to the point where the benefit of an additional unit (marginal benefit) is equal to the marginal cost of that unit, or the market price. Therefore for any consumer buying a commodity, the marginal benefit is equal to the market price. The marginal benefit will decline with the amount consumed just as the market price has to decline to get consumers to consume a greater quantity of the commodity. A demand schedule, duly prepared to indicate the relationship between the market price and the quantity consumed, will be an useful information about marginal benefit that is needed to place a money value on an increase in consumption.

The value for gain and loss

In order to reach a conclusion as to the desirability of a project, all aspects of the project, *positive and negative*, must be expressed in terms of a common unit; that is, there must be a "bottom line". Since the most convenient common unit is money, benefits and costs are often expressed in monetary terms, and are adjusted for the time value so that all flows of benefits and flows of project costs occurring at different points of time are expressed on a common basis in terms of their “present value” (Hanley & Spash,1993; Layard & Glaister, 1994). However, in considering the value of gain and loss in a society, it must be considered at the same time who gains and who loses on an equity basis (OECD, 2006).

The public interest issue

Public interest described in Dictionary refers to the "common well-being" or "general welfare." Public interest theory is generally grounded on public choice in regulating the market as a justification for regulatory intervention in private activity, thus limiting the exercise of private power, in pursuit of objectives valued by the community (King, 2007). The policy makers need to address the human nature in order to avoid "unintended consequences" (Fukuyama, 1999; Ho, 2012), and for this, policy makers

have to address the public's foremost needs and anticipate how people may respond to specific designs in policy (Ho, 2012). In respect of policy making, Ho (2012) points out that there is a hierarchy of policy goals which some are more long-standing, more fundamental goals that can easily be hidden by immediate benefits via political expediency. The question is what the costs are to society if a policy that serves a specific goal is implemented and whether the benefits justify the costs (Ho, 2012:p.27). The issue is further compounded by human nature when people are pursuing personal interests at the same time. Therefore, the difficulty in applying the technique is pricing the benefits, and for public projects, it is open to manipulation of political ends Ashworth, 2002).

Accounting for risk and uncertainty

Walker and Greenwood (2002) raise a question of 'where do construction risks come from'? They list five sources of construction risks: political/regulatory, technical and physical, conceptual, organizational and operational. They propose a closed system and an open system view to explain risks in the project environment. In an open system, the political and regulatory type of risks covering government, planning, contractual, pressure groups, health and safety, and environment. A project facing an environment external to the projects can be as open as the whole society. The projects that are large, of long duration, complex, of high level of subcontracting and labour-intensive tend to be inherent with risks of this kind (Walker and Greenwood, 2002). In this respect, the impact of risks is no longer design oriented or labour-oriented, and the project will be exposed to claims for compensation of all sort.

Population as the denominator

Since CBA involves social cost, for calculation purpose, there must be a value involving the number of population, which acts as a denominator for the society at large. This value makes a simple representation of the social cost. In economics, a cost is an alternative that is given up as a result of a decision. When a transaction takes place, it typically involves both private costs and external costs. For a project or policy to qualify on cost-benefit grounds, its social benefits must exceed its social costs, where "Society" represents the sum of individuals (OECD, 2006). This means that a society is better off when production and consumption decisions are based on social costs that include external costs.

THE CASE EXAMPLES

Two case examples from Hong Kong are extracted to provide a general scenario of the use of CBA today for public projects.

The Hong Kong-Zhuhai-Macao Bridge (HZMB)

HZMB is a mega-sized infrastructure project, complex in nature and difficult to build. The construction of the overall facilities is estimated to be over 70 billion Hong Kong Dollars. In evaluating the benefits in general, the CBA is done by the transport experts. It is considered that there would be reduction in distance and travelling time from Zhuhai of more than 60% to Kwai Chung and more than 80% to the Airport in Hong Kong. Economic benefits were also seen in traffic projection in terms of increased usage by vehicles and passengers. For economic growth, it is expected that Zhuhai and Zhongshan will achieve a GDP growth of 10-11% in 20 years.

To value economic benefits, CBA is carried out according to OECD standards, which includes but not limited to savings in transport costs, value of time saved for travelers, induced traffic volume generated between the three territories, and value of time saved for goods on road. The benefits are then apportioned to the three territories taking into account the places of origin and destination of the traffic. The economic benefit is later found to be 57.8%, 32.6%, and 9.6% respectively for Hong Kong, Mainland and Macao for which apportioning of cost responsibilities is based (HKSAR, 2007).

CBA of the High-speed Rail Link

The analysis comprises of internal cost and external cost. The internal costs is the cost estimation of the project which include infrastructure costs and operating costs with a life expectancy of 50 years. The external cost refers to the environmental costs based on the negative environmental effects in terms of land resumption, barrier effects, visual intrusion, noise, air pollution and contribution to global warming. The benefits are economic evaluation of ticket revenue, travel time savings, pollution reduction, reliability improvement and safety improvement. All costs are discounted to Net Present Value. (Tao et al. 2011)

CONCLUSION

The analysis originated from the study of CBA provides a recent development of CBA and the extent it applies to construction projects. Yet it is found that CBA is not in its

full use at the present stage even though both public clients, corporate clients and private clients now pay more attention to cost-benefit analysis in their development in meeting stringent rules and regulatory measures in respect of cost accountability. However, some key issues that are important to cost-benefit analysis in project planning are identified in the analysis. This includes the yes and no project perspective, the second-best theorem, market price against shadow price, the value for gain and loss, public interest issue, accounting for uncertainty and risk, population as the denominator. The findings are useful for those who are working with cost-benefit analysis, irrespective of whether they are serving public clients or private clients.

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