# PLANNING OF ROAD CONSTRUCTION PROJECTS WITH A VIEW TO STIMULATING ECONOMIC GROWTH AND DEVELOPMENT

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**Abstract**

This paper provides an outline of how the economic evaluation and selection of road construction projects can be complemented by social evaluation with a view to achieving a more equitable welfare distribution within a developing country. The article commences by elaborating on the general economic benefits that can arise from investment in economically justified road infrastructure. The different classes of non-road-user beneficiaries are idenified and discussed. The operational characteristics of road transport that are conducive to the stimulation of economic activity are identified and described. The present inequality of income distribution in South Africa is dealt with briefly, followed by a discussion and analysis on the use of equity weights in project evaluation to help bring about a more equitable welfare distribution.

**Key Words:** Access, Cost–Benefit Analysis, Equity, Gini Coefficient, Road Construction Projects, Social Evaluation, Utility, Welfare Distribution

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## 1. Introduction

In view of the fact that public roads are supplied and funded by governments, it is necessary to subject all public road investment decision making to cost–benefit analysis* to determine their economic justification. From a viewpoint of allocative efficiency*, a public road construction project is regarded as economically justified when the present worth of future reductions in road-user cost, road maintenance cost and external cost is in excess of its investment cost. (Note that the terms marked with an asterisk in the text are defined in Appendix 1.)

The above-mentioned cost reductions are not the only benefits that economically justified roads offer. They only represent the microeconomic transport-related savings which emanate from making use of a new or improved road rather than the unimproved situation. Economically justified roads also offer non-road-user benefits.

Non-road-user benefits (or general regional economic benefits) can be an important consideration in many decisions about proposed road construction or improvement, especially when a road has the potential of unlocking new areas for economic activity and development, and to help facilitate redistribution of wealth. Non-road-user benefits do not involve savings as user benefits do, but represent a group of returns that are partly the consequence of investments in other sectors of the economy. They can be seen as general economic benefits, above and beyond the direct user benefits, which contribute to the welfare of everyone within the geographical sphere of influence of the facility.

Investment in road infrastructure and services will only underpin economic growth and development if the prerequisite factors of production are available, for example sufficient land, access to raw materials and qualified labour, services and utilities, and entrepreneurs who are able and willing to invest in the service area(s) of such roads. Sometimes these prerequisite ingredients may be present, but road investment is the only absent ingredient needed to induce economic growth and development. At other times, road investment alone may be insufficient to stimulate additional economic growth and development. However, in coordination with non-transport actions, road investment could result in significant economic growth and development. Those other complementary actions could be removing or overcoming limitations of labour force skills and mobility, high business costs, the unavailability of utilities and services, the non-existence of industrial settlement grants, etc. (Weisbrod & Weisbrod, 1997: 1).

## 2. Regional Economic Benefits of Roads

The general economic benefits arising from investment in transport infrastructure can be summarised as follows (Pienaar, 2005: 109):

In market-oriented countries, expenditure on transport projects injects funds into the private sector and promotes production. This, together with an increased demand for transport, can stimulate the economy. If, during an economic upswing, transport infrastructure capacity is able to meet the increased demand for transport, and excessive or frequent congestion can be prevented, the transport network will fully prove its purpose as an economic activator.

The stimulation of economic activities is associated with higher profits and personal incomes, and the resultant increase in taxes boosts government income. In this way non-road-users also help to 'repay' the capital amount invested in transport facilities that originally helped stimulate economic activity, and to maintain these roads.

New and improved transport infrastructure facilities supply access to property, and facilitate mobility and interaction within and between areas which might possess economic growth and development potential, thereby giving rise to more economical land-use patterns and the acceleration of business activities. This increases financial returns to investors and fixed-property owners, which in turn consequently boost land values. Through the increase of taxable land values, the revenue of local authorities from property tax can consequently also increase. Local authorities may as a result have more funds available for the local provision of road infrastructure.

New and improved road infrastructure not only stimulates economic development indirectly, but has a direct impact on the settlement of manufacturers, distributors and utility (service) industries. For example, the proximity of a major road is also important to such road-oriented retail organisations as service stations, food retailers, and lodging and hospitality businesses catering for tourists. These non-road-user groups are looked at in section 3.

## 3. Non-Road-User Beneficiaries

The following five classes of non-road-user beneficiaries can be distinguished (Freeman, 1981: 137):

- The general public
- Land owners and occupants
- Roadside enterprises and advertisers
- Utility enterprises
- Goods consignors and consignees

(1) The general public

It can be argued that everyone benefits from the existence of a road system in that (because of increased accessibility) it enables society to function effectively. Society needs access to economic resources (input related) and to market places (output related), and would be denied a wide range of goods, services and revenue opportunities in the absence of a road network. Roads provide access to land (not just for the occupants, but also for the provision of social and emergency services and amenities); and they facilitate personal and commercial transportation, the administration of law and order, and the fulfilment of government duties and community services. Roads constructed, for example, primarily for strategic or defence purposes could be said to serve the interests of society at large rather than only the relatively small group of users who live in the less densely populated parts of the country where these roads are often located.

(2) Land owners and occupants

The value (and usefulness) of land or fixed property is inseparably linked to its accessibility. In rural areas, new or improved roads can increase the value of land considerably by bringing resources, amenities and markets closer.

(3) Roadside enterprises and advertisers

The survival of many businesses depends on the traffic of a nearby road. Service stations, fuel and food outlets, refreshment vendors, and the hospitality and tourist industries are cases in point.

(4) Utility enterprises

Utility enterprises may enjoy a right of way beneath or above or in the reserve of a road, for example water and gas pipelines, and electric and telephone cables.

(5) Goods consignors and consignees

Goods consignors and consignees may also enjoy benefits in their capacity as non-road-users, for example manufacturers, retailers and other entrepreneurs. These benefits can take the form of shorter order-delivery lead times attainable through shorter trip times, and more reliable goods-flow planning attainable through punctual delivery and improved goods security.

Trip time savings and punctual goods delivery can be beneficial in two ways:

(a) Faster and more punctual deliveries mean lower storage costs and more effective business logistics service provision.

(b) Highly perishable products can be distributed over a wider area.

Improved goods security on paved roads resulting from less dust, vibration and knocks during trips enables the suppliers of agricultural, horticultural and dairy products to retain product quality, while fragile goods suffer less physical damage. The preservation of the quality of freight improves the revenue of consignors. The value of the above-mentioned general economic benefits can be measured in terms of how much consignors and consignees are willing to pay for faster and more punctual deliveries, increased goods security and more reliable distribution.

## 4. Operational Aspects Of Road Freight Transport Conducive To The Stimulation Of Economic Activities

Road freight transport is more flexible and versatile than other modes because of the availability of extensive road networks, and can therefore offer point-to-point service between almost any origin and destination. It is this flexibility and versatility that has enabled road freight transport to become dominant in most countries.

Road freight carriage offers the client reliable service with little damage or loss in transit. It generally provides much faster service than rail transport, and compares favourably with air carriers on short hauls. Many road freight carriers, particularly those involved in just-in-time (JIT) services, operate according to a scheduled timetable, which results in reliable transit times. Road freight carriers are therefore able to compete with air transport for small shipments – i.e. partial loads or less-than-truckload (LTL) consignments – and with rail transport for larger shipments.

Of all forms of transport, road transport has the smallest proportion of fixed to total costs, making this market sector highly competitive and thus less prone to monopoly behaviour. Road freight transport competition ranges from open to oligopolistic. The fixed costs of operators with non-specialised fleets who carry full truckloads and do not own any terminal facilities are very low. The financial barriers to market entry for these operators, especially in cases where their vehicles are hired or leased, and even more so for single-vehicle operations, are very low, and this market segment is highly competitive. Of all freight transport industry segments, the aforementioned non-specialised truckload (TL) road haulage is the closest to perfect competition. Fleet sizes in the road freight market vary between one vehicle (often owner-driver operators) and more than a thousand specialised vehicles. This is an indication that market entry is relatively easy and can take place at low cost, and that road transport entrepreneurs can, through competitive conduct, develop into large transport service suppliers.

Larger road transport carriers who own suitable terminals can achieve considerable economies of scope by sorting and then consolidating heterogeneous part loads effectively into homogeneous containerised shipments, thereby creating an economy of density, which in turn enhances economies of scale. However, none of these potential advantages preclude competition from smaller operators, which indicates that the achievement of economies of scale in road transport is not strong.

Owing to the high capital investment in rail infrastructure (railway lines and terminal facilities, such as administrative buildings, stations, marshalling and classification yards, sheds, goods depots and workshops) and the longevity of rolling stock, such as locomotives and freight wagons, the ratio of fixed to total costs is very high – the second highest of all modes of transport (after pipeline transport). Approximately 75 per cent of rail transport costs are fixed over the short term (Havenga & Pienaar, 2012: 2). Owing to the large initial cost as an absolute quantum and the high ratio of fixed costs in freight rail transport, the breakeven point between revenue and total cost occurs at a very high level of production. This means that a large volume of freight services must be sold before a profit can be realised. This may imply that a profit can only be realised if there is one incumbent rail operator in the market, i.e. a natural monopoly.

Typical strengths of road transport are as follows (Pienaar & Vogt, 2012: 336):

- **Door-to-door service.** Road transport is not limited to a fixed route or terminals. Consignments can be conveyed directly from a shipper to a receiver without the need for special terminals.
- **Accessibility.** Road carriers can deliver in every country or economically active region in the world, therefore deliveries are usually prompt.
- **Freight protection.** As a result of the ability to supply a door-to-door service, little handling and few transhipments take place between origins and destinations.
- **Speed.** This mode maintains short door-to-door transit times, especially over short distances. When delays occur as a result of traffic congestion or other incidents, it is often possible to follow alternative routes.
- **Capacity.** The carrying capacity, although relatively small compared with other modes of transport, is adaptable and can be readily increased.
- **High frequency.** A high frequency of service can be maintained as a result of the small carrying capacity and high speed of road vehicles.

Overland pipeline transport is the cheapest mode for those types of commodities that can be transported by pipeline. Either rail or road transport is the cheapest mode of transport for all those commodities that cannot be carried by pipeline. In view of the fact that rail transport achieves considerable economies of distance, it becomes cheaper than road transport for all classes of freight transport as trip distances increase above approximately 500 kilometres. However, for trips shorter than roughly 150 kilometres, road transport is virtually always cheaper than rail transport. For all types of goods that can possibly be carried either by road or rail transport between the same trip origins and destinations, the equal cost distance lies between approximately 150 and 500 kilometres (Pienaar, 2012: 39).

## 5. Cost–Benefit Analysis of Road Construction Projects

Cost–benefit analysis techniques determine the viability of a project according to the following three specific criteria: (1) minimum total cost, which can be determined through the present worth of cost (PWOC)* technique (expressed as an absolute monetary amount); (2) net advantage, which is determined by the net present value (NPV)* technique (expressed as an absolute monetary amount); and (3) relative advantage, which is usually determined either by the benefit/cost (B/C) ratio* technique or the internal rate of return (IRR)* technique (expressed in relative terms; the former as a ratio and the latter as a percentage).

A familiar critique of cost–benefit analysis is that its reliance on willingness to pay biases the method in favour of the existing distribution of income. Cost–benefit analysis is calculated on the basis of potential compensation, i.e. those who gain can, in principle, compensate those who suffer so that everybody can be better off. Compensation is, however, not normally paid, therefore a government following allocative efficiency criteria could carry out a sequence of projects which benefited high-income groups at the expense of low-income ones, but because compensation was never paid, the net result would be to aggravate the unequal distribution of income.

## 6. Social Evaluation of Road Construction Projects

Transport plays a significant role in the social and economic development of any country. According to the World Bank (1994: 3), infrastructure can deliver major benefits in economic growth, poverty alleviation and environmental sustainability – but only when it provides services that respond to effective demand, and does so efficiently. The social evaluation approach set out below assumes that redistribution of welfare can be more efficiently done through investment in roads than through direct transfer payments, such as subsidies.

The Gini coefficient is a popular indication of income inequality, which varies in value from 1 in the case of total inequality and 0 in the case of total equality. Making international comparisons of income inequality is always fraught with the danger of non-comparability. Data sources are often very different, and definitions of incomes differ. It is nevertheless interesting to make such comparisons and the fact that South Africa frequently has the highest Gini coefficients is evidence of the highly inegalitarian income distribution that characterises the South African economy. The World Bank estimated the Gini coefficient for seven countries in sub-Saharan Africa and South America. Although the World Bank study indicated that the Gini coefficient

for South Africa had, between 1993 and 2000, come down from 0,69 to 0,58, it still ranked second highest among the seven countries reported. The Gini coefficients were as follows: Argentina 0,51; Brazil 0,57; Botswana 0,61; Kenya 0,43; South Africa 0,58; and Zimbabwe 0,50 (Mohr, 2011: 168).

The creation and use of new and improved roads (especially access roads) and other public road transport facilities (e.g. passenger transport terminals and transfer facilities, especially in lower-income areas) can lead to a more equitable distribution of welfare and income. The fundamental point of departure is that additional income is relatively more valuable to lower-income groups than to higher-income ones. The users of public transport facilities and services, for example, are mostly transit-captive travellers as more often than not they do not have the ability to pay for travel on alternative modes of transport, and they are, by implication, the more needy component of the community.

Seeing that the appreciation of lower-income groups of the marginal utility of their income (i.e. the additional utility acquired from one additional unit of income) is considerably higher than that of more prosperous individuals, the net economic benefits that a transport project has for them should be weighted accordingly to reflect its true social benefit. From a distributive efficiency* viewpoint, this will ensure that in selecting a project, the one which can make the greatest net contribution to welfare distribution is chosen for implementation. It is therefore advisable that all transport infrastructure projects should also be evaluated on the basis of a social analysis in order to reveal the effect of the implementation of such projects on a region within the country or a province, such as a metropolitan area or within sub-regions of the latter.

Poverty relief – the attempt to achieve an equitable distribution of consumption among contemporaries – is one of the country's most important economic development objectives. Channelling investments in transport infrastructure in such a way so as to lead to an increase in the consumption expenditure of lower-income population groups and the indigent, or which will at least not affect this negatively, is one of the ways in which this objective may be achieved to a degree.

Social evaluation (based on equity or distributive efficiency) may be performed parallel to economic evaluation (based on economic or allocative efficiency), complementing it – not replacing it. Seen in transport economic terms, the inclusion of equity in the evaluation process is geared to creating equal accessibility and increased mobility for lower-income groups in terms of marginal utility. From a non-transport or general economic point of view, it is geared towards allotting potential economic activity and its returns to lower-income communities.

Any weighting system is subjective and contains value judgements. What is not always realised is that the decision not to use a weighting system is equally so: giving equal weight to all groups is just one weighting system among many, although it does, of course, happen to be the simplest to apply. In economic evaluation, the omission of all explicit weighting is associated with allocative efficiency and the acceptance of the prevailing income distribution, therefore a decision to apply the economic efficiency criterion is itself a value judgement (Snell, 1997: 195).

## 7. Weighting in Project Evaluation to Achieve Equitable Welfare Distribution

Social and economic evaluation can be regarded as sensitivity analyses complementary to one another, therefore if the decision maker is intent on paying due regard to both types of analysis, a project should go ahead if it is shown to be viable both with and without the application of equity weights. Although such weighting usually depends largely on political decision making, it should nevertheless be related to the marginal utility that additional income has for each of the groups (Conningarth Economists, 2003: 55). From an economic viewpoint it would, however, not be prudent if an inefficient project, despite its potentially positive effects on income distribution, is implemented if the redistribution effect can be achieved at lower cost by making use of another form of income transfer, such as direct subsidies.

In practice, redistribution cannot be effected effectively by lump-sum transfers because public subsidies distort consumer behaviour (Black, Calitz & Steenekamp, 2012: 128). In addition, lump-sum transfers normally require taxation, which imposes a burden upon those taxed, representing a loss of efficiency in the economy (Layard & Glaister, 1994: 47). Moreover, there may be political objections to cash redistribution, and it is often administratively difficult to devise a tax which falls specifically on the beneficiaries of a project and a transfer which goes specifically to the losers. If redistribution to offset the losses due to the project is not implemented, then the project cannot be justified on the grounds that it is a Pareto improvement*, since at least some people are worse off. A wider criterion then has to be introduced to decide whether or not the project increases social welfare – a criterion in which the changes of income to each of the parties affected are weighted by the marginal social values attaching to the income of each group.

The question of the criteria for a welfare improvement is discussed in detail by Layard and Glaister (1994: 179–198). They show how welfare changes for individuals can be estimated, but that the question of whether a social gain has occurred cannot be separated for the issue of the social valuation of

benefits to the affluent compared with benefits to the disadvantaged.

The ethical principle on the basis of which the use of weights in project selection can be justified is utility*. The user acquires utility from the application of his or her disposable income. Additional income brought about by a project creates opportunities for increased consumer spending from which the user derives additional utility.

The traditional economic evaluation treats increases in consumption directly caused by a project as cost and/or disbenefits, regardless of the income status of the spender. In cases where the recipients of the benefit of higher consumption live in almost absolute poverty, it can be argued that their additional consumer benefits represent net social benefits rather than net social costs. This argument forms the basis for the use of weighting whereby the benefits related to a project, according to the higher marginal utility of those to whom they accrue, are weighted. The breakeven point above which the benefit of higher consumption represents a net social cost and below which it represents a net social benefit is known as the critical level of consumption. This level is generally regarded as situated at the income level at which the payment of income tax becomes compulsory (Ray, 1984: 17).

Welfare distribution weighting can be calculated on the basis of income or consumption. According to Floor, Pienaar and Botes (1993), the calculation of welfare distribution weights should ideally be based on per capita consumer spending rather than income for the following reasons:

- The relationship between income and utility attainment is not very clear, while per capita consumption expenditure provides a relatively good indication thereof.

- It will take a considerable amount of calculation and brave assumptions to deduce disposable income from total income as all transfer payments to and from individuals are not reported in total income statistics.

- It is difficult to determine the percentage of income transferred to and from the specific area being studied (especially where planned road sections will run through areas of which the per capita income differs markedly).

- Income leakages from small areas where the benefits will accrue (e.g. municipal areas) are almost untraceable.

The welfare distribution weighting can be expressed as follows:

$$Y_w = C_p / C_u \qquad (1)$$

where
$Y_w$ = the welfare distribution weight;
$C_p$ = the average per capita consumer spending of the population; and

$C_u$ = the average per capita consumer spending of those whom the project benefits.

It is clear that the calculated weight will be consistently progressive – the lower the level of consumption spending, the greater the weight. The social benefit of a public transport facility or service can then be determined by multiplying the calculated weight with the economic benefits offered by the facility or service.

## 8. Conclusions

According to traditional cost–benefit analysis, all benefits and costs related to a project are evaluated in terms of their scarcity value. The traditional approach can be supplemented to accommodate a striving for equity. This can be done by weighting the benefits of a project according to weights calculated for specific consumer expenditure groups. In transport economic terms, the inclusion of equity in economic evaluation is geared towards creating, in terms of marginal utility, equal accessibility and increased mobility for lower-income groups. In general economic terms, it is geared towards allocating potential economic activities and returns to lower-income communities. The social analysis must be carried out separately from the economic analysis, and the findings and recommendations with respect to both the analyses must be represented in the project evaluation report.

A project evaluation practice as described in this paper is not suitable for national routes which are financed through toll levies. On the one hand, national roads are primarily long-distance mobility roads connecting relatively developed and prosperous areas. On the other hand, these roads carry large volumes of traffic which lowers the cost of toll collection per vehicle. Furthermore there are alternative transport modes and services available between the terminals of national toll-road routes. The guidelines offered in the paper are mainly applicable to provincial and regional roads that are typically shorter than approximately 150 km. These roads (a) also fulfil an access function; (b) serve rural areas where there are greater development needs than in large urban areas; (c) accommodate trips that are cheaper than rail transport; (d) carry lower traffic volumes, which increases the cost of collection per vehicle' and (e) serve areas where alternative transport modes and services are not generally available. The investigation found that road transport infrastructure and services can (a) serve as mechanisms to gain access to economic activities; (b) trigger economic development; (c) accelerate economic growth; and (d) serve as a catalyst to equalise the distribution of wealth in their areas of influence.

If the decision maker is intent on paying due regard to both economic and social analysis in investment decisions, all *independent projects* within the limits of the available budget should go ahead if they are shown to be viable both with and without the application of equity weights. Although such weighting usually depends on political decision making, economically inefficient projects should go ahead only if their positive effects on welfare distribution are regarded as essential and cannot be achieved at lower cost through alternative forms of transfer.

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## Appendix 1: List of Terms

**Allocative efficiency**: A measure of how the selection of inputs minimises the cost of producing products (i.e. goods and services) to satisfy given wants. (This kind of efficiency is synonymous with 'economic efficiency' or simply 'efficiency'.)

**Benefit/cost (B/C) ratio**: The ratio between the sum of the discounted benefits and the sum of the discounted capital (i.e. investment) costs of a project, where the value of the benefits forms the numerator and the worth of the costs forms the denominator. All proposals with a ratio value greater than one are viable.

**Distributive efficiency**: A measure of how the allocation of economic resources among groups or individuals within a country (or community) contributes to an equitable or a socially desirable distribution of welfare. (Distributive efficiency is usually used synonymously with 'equity'.)

**Internal rate of return (IRR):** The discount rate that will equalise the present worth of the investment costs of a project and the present worth of its benefits, i.e. the discount rate at which the net present value (NPV) of a project will equal a value of zero, or the B/C ratio will equal a value of 1. (A project that yields an IRR greater than the discount rate is regarded as viable.)

**Net present value (NPV)**: Obtained by subtracting the sum of a project's discounted investment costs from the sum of the discounted benefits it will achieve. If a project's discounted future benefits exceed its discounted investment cost, it has a positive net present value and is therefore regarded as viable.

**Pareto improvement**: Making at least one person in a community better off without anyone else being made worse off.

**Present worth of costs (PWOC):** The sum of the present worth of the investment costs and the recurring costs (i.e. all operating costs).

**Utility**: The satisfaction derived from an activity, particularly consumption.