An Empirical Approach to Improve Social Equity when Providing Roads

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Abstract:

Engineering and certain economic criteria have tended to dominate road investment decisions in the past. Nevertheless, a transition is now in progress to accommodate social equity when providing roads. It is shown here, that such objectives can be achieved if the road planners are equipped with workable empirical approaches and appropriate guidelines.

The paper suggests an empirical approach to simultaneously account for social equity and other factors that are traditionally used in making road investment decisions. This empirical approach is illustrated by applying it to a sample of present and future road proposals from Western Australia.

The paper also examines the extent of incorporation of social equity factors in the past and the impact on road investment in rural and urban regions.

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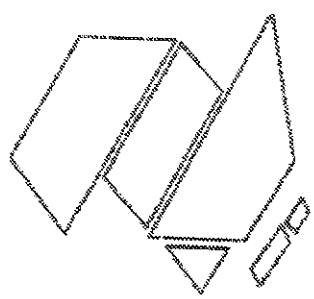


1. Introduction

Until recently, road authorities in Australia and in most developed countries have tended to rely heavily on rather narrowly based benefit cost analysis (BCA) techniques to make road investment decisions. Such approaches generally involve assigning monetary values to traffic related user-costs and user-benefits to determine net benefits due to road investments. As such approaches result in only an aggregate estimate of net benefits across a certain community, they fail to provide information that is required for equitable distribution of benefits (c.f. Nijkamp, Rietveld,and Voogd, 1990) from road investments thus resulting in communities and industries reliant on roads sufferring from lost opportunities.

In the appraisal of road projects, the range of costs and benefits that can be readily quantified are generally limited and are usually confined to savings in travel time, operating costs, accident costs and maintenance costs. There is more to the benefits of roads than these, and in many instances the benefits that are ignored due to the inadequacy of the appraisal technique are important and relevant to the decisions about road investments. Inclusion of such benefits is shown to significantly alter the priority of allocation of resources. A further disadvantage of narrowly based BCA techniques is their lack of strength to make complex choice decisions involving trade-offs between incompatible objectives or to make such choice decisions transparent to road users, communities and others concerned about the use of road funding in general (c.f. Kinhill, 1990; McKenzie, 1991).

A transition is now in progress to meaningfully accommodate efficiency, social equity and a number of hitherto ignored objectives when providing roads. Nevertheless, the strategy planners have encountered a number of problems -especially in simultaneously capturing social equity and distributional objectives together with those other objectives that are normally incorporated in making road investment decisions. This paper aims to explore the use of an empirical multi-objective decision making procedure that could alleviate the problems confronting road authorities in the ongoing transition from the orthodox single dimensional BCA type investment appraisals. The plan of the paper is as follows. The next section outlines key reasons for choosing a multi-objective decision approach for the present study. Section 3 discusses how the social equity dimension is introduced in to the multi-objective model. Section 4 outlines the sequential empirical modelling procedure and illustrates its application to a sample of 35 present and future road proposals for Western Australia, while section 5 shows the sensitivity of the model outcome. Some concluding remarks follow in section 6.

2. Choice of a Multi-Objective Decision Procedure

Only a limited number of procedures are available to make decisions when objectives conflict. The methodology underlying these procedures involve eliciting from decision makers their relative preferences or weights reflecting the importance of each objective and seeking solutions in which the weighted sum of objectives is maximised (Westman, 1985; Voogd, 1990). These procedures are generally known as multi-objective decision procedures and for the purpose of this study, a procedure known as multi-criteria analysis

(MCA) is chosen This choice is supported by the fact that multi-criteria analysis facilitates road investment decisions in recognition of a wider spectrum of objectives than could normally be accommodated in other methods The nature of objectives, whether they are qualitative, quantitative or contrasting, is no barrier for comparing trade-offs using this model The present study explores these features of MCA to better address the social equity issues.

Based on such factors as simplicity of the method, the ability to meaningfully accommodate a **multitude** of criteria and whether or not the criteria weights are determined through direct numerical means, a version of MCA known as the *'rating method'* is chosen This version enables the direct translation of preferences to **numerical terms** by eliciting the preferences that the community attaches to a chosen set of criteria Unlike other methods, the rating method is mathematically less complex Voogd (1983:p105) notes that in urban and regional planning, the rating method "*is considered the most attractive approach to determine criteria weights*" Unlike complete or partial ranking methods, this method retains the level of accuracy of results irrespective of the number of criteria used in assessing a proposal Although somewhat more complex than the paired comparison method, this method is much more appealing from the points of view of the time spent in obtaining weights, and the sensitivity of the method to level of abstraction (Voogd 1983) Unlike most other methods, this method provides an excellent overview of criteria that the respondents are asked to assess and hence is largely contributory to the accuracy of results.

As compared to other versions, the rating method lends itself to a greater degree of public presentation and consultation in reaching conclusions

3. Adding the Social Equity Dimension

In a recent study into the expectations of rural people in Australia, McKenzie (1991:p1) noted that "70 percent of those living in non-urban areas believed an inadequate transport system was one of the major reasons why their quality of life was demonstrably worse than those living in urban communities" In a similar vein, 61 percent of the respondents nominated transport as the single public service, if improved, would have the **greatest** possible impact on their lives (McKenzie, 1991) Findings of Bruce McKenzie complement findings of other researchers (c f. Kinhill, 1990), that transport is undoubtedly an important indicator of quality of life of Australians, especially of those living in rural and remote areas These reasons suggest that transport -in particular road transport, is extremely important in achieving social equity goals Especially because of findings similar to these, a number of road authorities in Australia have explored consistent approaches to assess and prioritise road proposals to facilitate rural-urban equity in road funding The choice of a number of road authorities have been to adopt "periphery in" rather than "centre out" types of approaches to formulate their road strategies This essentially means laying more emphasis on the improvement of transport needs of rural people rather than seeking to facilitate urban based access to rural resources which in the past has increased economic and social activity flows towards urban areas Therefore the "periphery in" approaches help to achieve the objective of rural-urban equity by **increasing the capacity** of rural and remote people to live and

work in their environment As noted earlier, the conventional BCA approach fails to do this because it is mostly biased towards economic efficiency and accounts for benefits that are only traffic dependent. Where the traffic volumes are markedly low, benefit-cost ratios (BCRs) calculated with emphasis on traffic volumes invariably work to the disadvantage of rural communities, industries and the rural sector in general Similarly, many of the other reasons for inequitable distribution of road funds between rural and urban regions can be traced back to the heavy reliance of road authorities on BCRs and NPVs to assess and prioritise road proposals. In instances where the BCRs and NPVs are high, which invariably are characteristic of urban proposals as was evident for the road proposals reviewed for Western Australia, the use of single dimensional appraisals (e.g BCA) are likely to give rise to a high degree of urban bias. The opposite however is true for most rural road proposals

There are many ways to capture social dimensions in a multi-objective decision environment. In this study, the following are adopted:

- the use of a full array of criteria to reflect goals, attitudes and priorities of rural and urban sectors;
- eliciting relative preferences for criteria (that is determining criteria weights) using a representative sample of rural and urban sectors; and
- standardising BCRs and Net Present Values (NPVs), so that rural road proposals having extremely low BCRs and NPVs are not unduly disadvantaged

These three methods complement each other and are applied simultaneously in this study to achieve the best results. The latter approach is discussed below and the first and the second are discussed under stages 1 and 2 respectively of the MCA model in section 4.

As illustrated in Figure 1 using NPVs, the influences of these extreme values of NPVs and BCRs can be adjusted by

a. scaling down the extremely high NPVs and BCRs to minimise dominance of urban proposals that may otherwise adversely lower the relative position of rural proposals in a priority list;

b scaling up extremely low NPVs and BCRs to include rural proposals that may otherwise be eliminated from the priority list; and

c accommodate all non-extreme NPVs and BCRs with minimal adjustments.

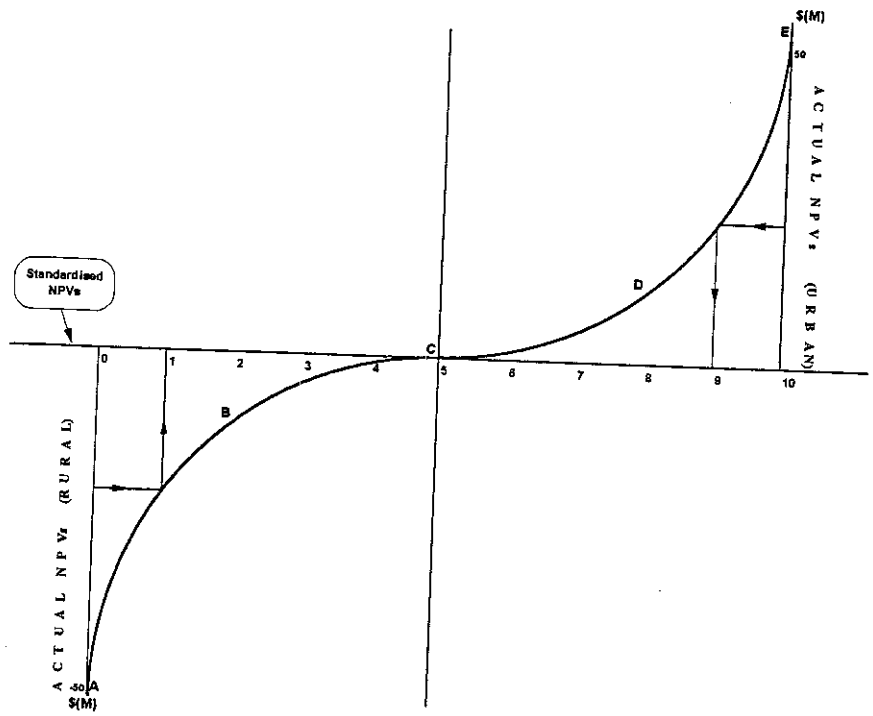


Figure 1. Standardisation of Extreme Values of NPVs.

In Figure 1, the horizontal axis corresponds to the set of 'standardised NPVs' The left and right vertical axes denote the negative and positive NPVs The NPVs for a typical set of rural proposals are denoted by the segment ABCD of the NPV curve The NPVs for urban proposals are denoted by the segment BCDE As shown there, extremely negative NPVs of $(M)-50 or less are scaled up to $(M) 0 on the horizontal axis and extremely positive NPV of $(M) 50 or more are scaled down to $(M) 10 The NPVs that are around zero get adjusted to an NPV of $(M) 5 and are the least adjusted

4. The Modelling Process

The following sequential steps were followed in developing the empirical MCA model: (a) identification of criteria; (b) determination of criteria weights; (c) determination of criteria scores; (d) calculation of proposal scores; and (e) ranking proposal scores according to relative merits

Identification of Relevant Criteria

The implementation of periphery in approaches noted precedingly involve direct assessment of road proposals for their ability to improve accessibility to isolated communities, contribution to development of new economic activities like mining and agriculture, opening up of new tourist developments, improving efficiency with which freight originating in existing agricultural and mining areas can be transported for export; and stimulating inter-regional trade. As shown in Figure 2, a number of criteria were identified to enable this and in general to make road investments to contribute towards accomplishing global objectives like maximising environmentally sensitive and socially equitable gains per dollar invested. To ease collection and analysis of data, these criteria were classified into four groups.

In identifying these criteria, every effort was made to observe the following quality characteristics: clarity; the ability to relate to the needs of people (as high as 26 out of the 29 criteria satisfy community and user needs, 13 satisfy State Government needs and five satisfy the needs of Federal Government), suitability for public presentation; ease of comprehension and participation by the public; consistency in the assessment of alternative road proposals; representatives of relevant policy objectives; contribution to regional equity; and the ability to minimise double counting.

Determining Criteria Weights

This stage of modelling involves translation of subjective judgements to criteria weights. There are several widely used procedures to do this (Lichfield, Kettle, and Whitbread, 1975). Most of these involve seeking information on what public's perceived needs and priorities are, by eliciting weights reflecting the importance that they attach to each criterion. This procedure was used here and involved the following three steps (c.f. Hill, 1968; Symons, Tagell, and Bauer, 1989).

First, the relative preferences (Wo) for the four policy objectives were determined based on a survey. Next, a survey was conducted to determine relative preferences for criteria (Wc) that must be satisfied to achieve each policy objective. The final criteria weights (W) were then estimated by taking the product of Wo and Wc.

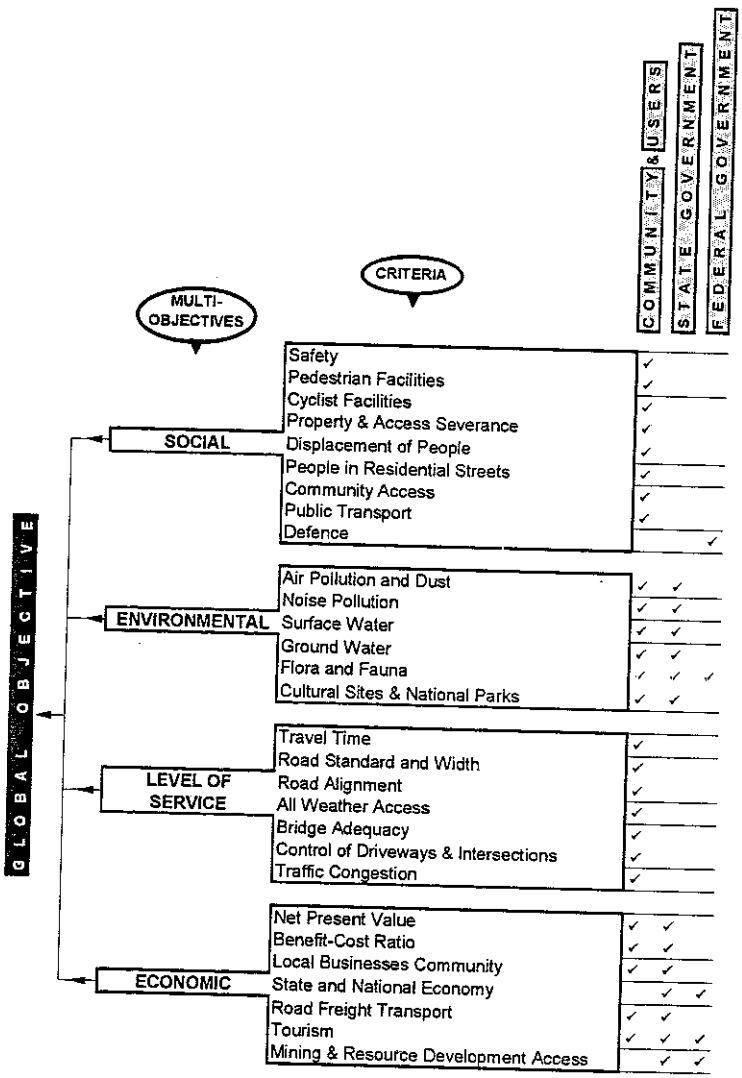


Figure 2. Selection of Criteria to Meet the Needs of Players.

Each survey had a sample of 68 persons chosen from a population that had the benefit of exposure to opinions and advice from a wide range of individuals in the rural and urban communities, rural and urban industries and various interest groups It was thought that such a sample would meaningfully and correctly represent the objectives, needs and desires of all players who would benefit or be affected by road proposals This sample constituted 27 persons representing the rural sector and 41 persons representing the urban, industrial and government sectors

The group weightings were determined by asking the respondents to **assign weights** directly according to their preferences. A **direct approach** like this appeared more appropriate for group weighting because the number of items to be weighted according to preferences were quite small. Under this method, the respondents were asked to assign values out of 100 to reflect their relative preferences. For instance, a group that was given a weight of 30 was considered more preferable to a group which got 25

Where the number of criteria to be weighted are generally large, as in the case of individual criteria within a group, an **indirect approach** was adopted because "it has been shown that the human brain is capable of holding about seven criteria in short term memory" (c.f. Aboul-Ela, et al., 1982:p283). According to this approach the respondents were asked to rank the criteria to reflect preferences rather than assigning weights to them. For example, a criterion which is ranked number one is the most preferred out of the lot and qualifies for the highest criterion weight. If there were only 6 criteria within the group, then the criterion which is assigned number one qualifies for a weight of 28.57. The criterion which is ranked two qualifies for a weight of 23.81 and so on. The relative preferences expressed by a respondent of the second survey for environmental criteria are shown in the 2nd row of Table 1.

Table 1. An Example of Translating Relative Preferences to Criteria Weights.

Criteria	Air Pollution	Surface Water	Cultural Sites	Flora & Fauna	Noise Pollution	Ground Water	Total
Assigned Numbers	1	2	3	4	5	6	
Corresponding Weights	28.57	23.81	19.05	14.29	9.52	4.76	100

The advantage of the first method is that the values assigned by respondents directly reflect their preferences and exhibit a wide and non-uniform separability between items (an item here means either a policy objective or a criterion). In the latter case, the separability depends to a large extent on the size of the sample and the interval between weights are uniform.

Simple statistical tests suggest that for all practical purposes, the survey samples chosen for this study are adequately representative of all the interest groups.

About 30 percent of the respondents of the first survey preferred social and economic objectives alike in judging the suitability of road investment options. The second survey shows the preferences for individual criteria within a group. For instance, within the 'environmental' group of criteria, the highest preference appeared to be for *Flora and Fauna* and the least for *Cultural Sites and National Parks* and within the 'economic' group of criteria, the highest preferences were for *Benefit-Cost Ratio* (BCR) and *State and National Economies* and the least was for *Tourism*. *Safety* and *Defence* were respectively, the most and the least preferred criteria in the 'social' group of criteria. In the 'level of service' group of criteria, the most and the least preferred were *Road Standard and Width* and *Traffic Congestion* respectively. Normalisation of survey results was done by multiplying the product of Wc and Wo and dividing it by 1,000. This

procedure directly expresses criteria weights as a percentage The list of criteria weights in descending order is shown in Table 2.

Table 2. The Criteria Weights in the Descending Order.

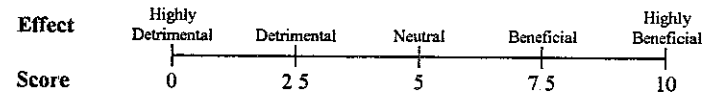
CRITERIA	W
Safety	6.47%
Benefit-Cost Ratio	5.87%
State and National Economy	5.86%
Local Business Community	4.52%
People in Residential Streets	4.45%
Public Transport	4.12%
Traffic Congestion	4.07%
Net Present Value	4.03%
Road Freight Transport	4.03%
Property & Access Severance	3.70%
Pedestrian Facilities	3.68%
Flora and Fauna	3.55%
Ground Water	3.52%
Tourism	3.47%
Air Pollution and Dust	3.43%
Surface Water	3.25%
Road Standard and Width	3.16%
Travel Time	3.12%
Community Access	3.09%
Cyclist Facilities	2.82%
Control of Driveways & Intersections	2.59%
Bridge Adequacy	2.53%
Noise Pollution	2.44%
Road Alignment	2.42%
Mining & Resource Development Access	2.21%
All Weather Access	2.11%
Cultural Sites & National Parks	1.99%
Displacement of People	1.82%
Defence	1.67%
TOTAL	100%

Determining Criteria Scores

Determining criteria scores or assigning numerical values to reflect the various impacts of road proposals is the third step in the MCA process. It involves individual assessment of each road proposal against each of the 29 criteria identified earlier Criteria scoring is a subjective process Therefore, unless precautions are taken to minimise personal biases, considerable errors may occur in the ranking of road proposals

Towards this end, efforts were made (a) to collect and review all relevant information about the areas affected by road proposals; (b) have a good conception about performances of various road proposals; and (c) to exercise unbiased judgement in assessing proposals to avert any risks of overestimation or underestimation of road proposal effects and that the scoring procedure applies uniformly to all proposals This task was made easy by following a set of carefully prepared guidelines on criteria scoring.

In assessing proposals, it was assumed that the impact of a road proposal could be either highly detrimental, detrimental, neutral, beneficial or highly beneficial Once the nature of impact was determined, the measurement scale given below was refereed to find out the score that corresponds to it. For instance, if the effect was midway between beneficial and highly beneficial, a score around 8.5 to 9 was assigned.



In this scale, all numerical values above five denote positive effects and the negative effects are denoted by values below five. Where the effect of a proposal is neutral, it is assigned a value of five

The criteria scoring process is illustrated in the remainder of this section using a National Highway Bypass proposal. This road proposal is aimed at constructing a 13.4 km long single carriageway on a new alignment with 9.0 m seal carrying 3 road over road bridges, 2 road over rail bridges and 3 road over river bridges. The detailed process of assessing the proposal against criteria and assigning scores (as illustrated in Table 3) utilises economic criteria. This process was repeated for all criteria groups and their scores are presented in column 2 of Table 4

Table 3. An Illustration of Criteria Scoring

Criterion	Assessment of the Effect	Score
Net Present Value	The cost of implementing this proposal exceeds the aggregate benefits of reduced accident costs, travel time, operating and maintenance costs by about $15 million. The appropriate score for this criterion is determined by referring to the lookup table prepared for this study.	2 0
Benefit-Cost Ratio	As per lookup table provided in the guidelines for criteria scoring, this proposal has been assigned a BCR score to reflect its below unity benefit-cost ratio.	4 6
Local Business Community	The proposal will have a detrimental effect on the local business community as it reduces passing traffic and decreases the business activity in the area.	4 0
State and National Economy	It is expected that there will be benefits to both State and National Economy as a result of this proposal. Particularly in a State like W A , the proposal will lead to increased industry output, income and employment.	8 0
Road Freight Transport	Improving road freight transport is the highlight of this proposal. In this regard, the proposal is highly beneficial and is given the full positive score.	10 0
Tourism	Tourism also benefits as a result of this proposal as it improves services to tourists enabling them to increase their utility per dollar spent.	7 0
Mining & Resource Development Access	This proposal does not improve nor deteriorate the welfare standards of those dependent on mining and other resource based industries For this reason, the proposal has a neutral effect.	5 0

Calculation of Proposal Scores

Table 4 shows how the 29 criteria scores for the National Highway Bypass are weighted by the relevant criteria weights (the 29 criteria weights are in Table 1) to determine *weighted criteria scores* or **suitability scores**. These suitability scores are aggregated to calculate the total proposal score or **total suitability Score** for the National Highway Bypass This process was repeated for all 35 road proposals

Table 4. Calculation of Proposal Scores

CRITERIA	Criteria Score	Weighted Score
Air Pollution and Dust	6	2 02
Noise Pollution	7	1 64
Surface Water	2	0 65
Ground Water	5	1 73
Flora and Fauna	3	1 06
Cultural Sites and National Parks	4	0.80
Travel Time	10	1 91
Road Standard and Width	7	2 16
Road Alignment	9	2.02
All Weather Access	5	1 07
Bridge Adequacy	10	2 44
Control of Driveways and Intersections	9	2 48
Traffic Congestion	10	3.79
Safety	10	6 47
Pedestrian Facilities	7	2 48
Cyclist Facilities	8	2 26
Property and Access Severance	3	1 08
Displacement of People	4	0 73
People in Residential Streets	8	3 53
Community Access	5	1 41
Public Transport	7	2 88
Defence	9	1.50
Net Present Value	2	0 74
Benefit - Cost Ratio	4 6	2 70
Local Business Community	4	1 78
State and National Economy	8	4 69
Road Freight Transport	10	3 68
Tourism	7	2 39
Mining and Resource Development Access	5	1 12
PROPOSAL SCORE FOR THE [redacted] BYPASS		64.20

Prioritising Road Proposals

Ideally, prioritising involves arranging the total suitability scores or the proposal scores in the descending order Such a procedure yields meaningful results only if the relative

differences or separability between consecutive proposals are significant As in the present study, if the differences in consecutive scores are only marginal, it is advisable to group proposals having similar scores and present those groups in the descending order of importance Table 5 shows the prioritising of the 35 current and future road proposals for Western Australia

Table 5. Grouping of Proposals in the Descending Order of Priority.

PRIORITY GROUP	ROAD PROPOSAL	BCR	Sector
Very High	Construct major new metropolitan highway	10 8	Urban
	Construct and seal [redacted] road (mining access)	2 9	Rural
	Construct and seal [redacted] road (mining & community access)	2 0	Rural
	Construct major extension of outer metropolitan highway	9 4	Urban
	Realign and widen [redacted] road (6 8m seal to 10 0m)	2.6	Rural
	Construct State road bypass of large country town	5.0	Rural
	Construct [redacted] bypass of large country town	0.6	Rural
High	Dualling of metropolitan highway (4 lanes to 6)	5.1	Urban
	Widen bridge on metropolitan highway (4 lanes to 6)	11 2	Urban
	Construct and gravel [redacted] road (community & tourist access)	3.2	Rural
	Construct and seal [redacted] road (tourist access)	1 0	Rural
	Construct new ramps to improve access to metropolitan freeway	9 2	Urban
	Construct and seal [redacted] road (community access)	1 5	Rural
	Construct [redacted] road bypass of large country town	1.7	Rural
Medium	Construct and seal new [redacted] road (community & tourist access)	1 5	Rural
	Dualling of outer metropolitan [redacted] Highway	6 9	Urban
	Realign [redacted] road with new bridge	2 8	Rural
	Realign and widen [redacted] road (6 2m seal to 9 0m)	2 2	Rural
	Dualling of outer metropolitan arterial road	63 9	Urban
	Widen major bridge on [redacted] road (single lane to 2)	0 4	Rural
	Realign and gravel [redacted] road (50km distance saving)	2.0	Rural
Low	Construct State road bypass of small country town	1 5	Rural
	Dualling of arterial road in large country town	2 3	Rural
	Widen [redacted] Highway (6 2/6 8m seal to 9.0m)	1.0	Rural
	Replace and upgrade metropolitan bridge on [redacted] road	0 7	Urban
	Widen [redacted] Highway (3 7/5.6m seal to 8 0m)	0 5	Rural
	Widen [redacted] road (3 7m seal to 7.0m)	0 7	Rural
	Widen [redacted] road (5.6/6.2m seal to 8.0m)	0.9	Rural
Very Low	Construct new bridge & widen State road (5 9m seal to 9 2m)	0 3	Rural
	Widen [redacted] road (3 7/5 6m seal to 7 0m)	0 3	Rural
	New passing lane on State road	2 0	Rural
	Widen [redacted] Highway (6.2/6 8m seal to 9 0m)	0 7	Rural
	Widen crests and curves on [redacted] road (5 6m seal to 7 4m)	0 5	Rural
	Widen [redacted] road (6 2m seal to 8.0m)	0 5	Rural
	Widen [redacted] road (6.8m seal to 8.6m)	0.4	Rural

Table 5 shows the rural-urban distribution of road proposals Many of the rural proposals and a few of the urban proposals shown in this table may have had very little scope of reaching a higher level of priority under a prioritisation procedure which dominantly relies on BCRs

5. Sensitivity Testing

The priority list of road proposals was tested for its stability to changes in the weights of criteria within the Level of Service; Economic; Environmental and Social objectives. Criteria weights within each of these four objective categories were raised two fold and each time, the changes to the relative positions of proposals in the priority list were measured The changes were measured by taking the number of proposals that remained within each priority group and expressing it as a percentage of the number of proposals in the original priority group As shown in Table 6, only 40 percent of the original proposals remained in the five priority groups when changes were made to economic criteria That is, the relative positions of proposals are most sensitive to changes in the weights of economic criteria than to changes in other objective categories. The list was least sensitive to changes in the weights of social criteria As shown in Table 6, those proposals in the 'very high' priority grouping are most stable under changes to the weights of all criteria

Table 6. The Number of Proposals of the Original List that Remains After Changes to Objective Weightings.

PRIORITY GROUP	2 x Level of Service	2 x Economic	2 x Environmental	2 x Social
Very High	86%	71%	86%	100%
High	71%	43%	86%	86%
Medium	43%	14%	86%	71%
Low	43%	14%	43%	71%
Very Low	86%	57%	57%	86%
Overall	**69%**	**40%**	**72%**	**83%**

6. Conclusion and Summary

Road transport is seen as an important means of raising the socio-economic standards of rural and remote communities The road transport needs of these communities can be met by adopting either a "centre out" or a "periphery in" type approach -but the extent to which the desired social equity levels are achieved under the two approaches are quite different As noted by Bruce McKenzie, by adopting a centre out approach rather than a periphary in approach, "we are seeking to facilitate urban based access to rural resources rather than examining the transport needs of rural people". What is wrong with this? Afterall, transport links are meant to be a two way process At a glance, there does not

appear to be anything specially wrong with this approach Nevertheless, as McKenzie notes it results in a predominat and increasing economic and social activity flow towards the urban area The consequences are that, wealth, cash flow and social choice of rural Australian communities continue to diminish This amply justifies changes to transport planning approachs that ignore social equity issues or to adopt measures that do not wittingly or unwittingly place higher priority on costs and benefits that are valued on monetary terms This is not a new finding In the recent past, road authorities have attempted to improve social equity when providing roads Nevertheless, their attempts have been frustrated due to the lack of any systematic approaches to accommodate social equity issues.

The paper presented a proposal evaluation procedure which (a) accommodates equity needs as percieved from a community viewpoint; (b) reduces reliance on BCA techniques which works to the disadvantage of rural communities and (c) recognises the potential that exists in rural communities to contribute to the development of new economic activity such as mining and the opening up of new tourist developments, improving efficiency with which established agricultural and mineral output can be transported for export; and stimulating inter-regional trade As demonstrated here, this method can be successfully utilised to improve social equity when providing roads

It must however be noted, that the approach developed here has very little effect in the presense of overriding criteria or objectives. For instance, certain environmental criteria may override all other criteria irrespective of how strong an influence these other criteria may have towards the economic development or enhanced social equity. As a consequence, instances are not rare in which it is beyond the powers of road authorities to be able to always apply procedures similar to the one developed in this study or to achieve social equity goals Decisions of similar nature are often taken due to overriding political and financial reasons as well

References

Hill, M (1968) A Goal Achievement Matrix for Evaluating Alternative Plans, *Journal of the American Institute of Planners* 25, 19-29

Kinhill (1990) *Task Force on Road Funding: Assessment of Economic and Social Importance of Roads,* A report submitted to Main Roads Western Australia Perth: Kinhill Engineers Pty Ltd

Lichfield, N, Kettle, P and Whitbread, C (1975) *Evaluation in the Planning Process* Oxford: Pergamon Press

Main Roads (1991) *Report on Road Funding Needs and Issues in Western Australia,* A report prepared by the 'Task Force on Road Funding' for Main Roads Western Australia May 1991

McKenzie, B (1991) *Transport and Social Justice in Rural and Remote Areas,* A paper presented to the Transport in Rural and Remote Australia Conference, Alice Springs, 24 - 26 March

Aboul-Ela, M T Stevens, A M and Wilson, F R (1982) A Multiple Criteria Decision Making Methodology for Transportation Policy Analysis *The Logistics and Transportation Review* 18, 279 - 290

Nijkamp, P N, Rietveld, P and Voogd, H (1990) *Multicriteria Evaluation in Physical Planning* Amsterdam: North-Holland

Symons, N R Tagell, M T and Bauer, R J (1989) *The "Goal Achievement Method" Experience (G A M E.) of Setting Roadwork Priorities in the Tamuar Region of Tasmania,* Paper presented at the 1989 National Transport Conference, 23-25 May 1989

Vooged, H (1983) *Multicriteria Evaluation for Urban and Regional Planning* London: Pion Limited

Westman, W E (1985) *Ecology, Impact Assessment and Environmental Planning* New York: John Wiley and Sons