Determining Priorities for Passenger Transport Funding: The Needs Assessment Approach

Graham Currie
Manager Victoria
Travers Morgan Pty Limited

Ian Wallis
Managing Director
Travers Morgan (NZ) Limited

Abstract:

The aim of the paper is to define a set of readily applicable techniques for measuring the distribution of passenger transport needs within Australian cities. Planners are often faced with conflicting demands for limited passenger transport resources. These techniques assist in placing priorities on demands in one part of the city compared to others based on travel needs. An international review of techniques used to define and measure transport need is outlined and specific methodology developed for Australian cities using readily available census and planning data. The paper describes how these techniques have been applied in New South Wales, South Australia and Western Australia. It also outlines benefits and problems with the method and potential applications

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Contact Author:

G V Currie
Travers Morgan Pty Limited
Suite 9, 214 Bay Street
BRIGHTON VIC 3186

Telephone: (03) 595 0228 (08) 218 2282
Fax: (03) 596 2538 (08) 211 7614

Introduction

All passenger transport authorities are faced with the problem of conflicting demands for limited funds. A common approach is to prioritise these demands and to address higher order needs first. The ordering of needs is a difficult task and it is not uncommon to find that the needs of those with the most vocal demands are given priority. When planning services for the 'transport disadvantaged' this problem is particularly acute because:

- Although the special travel difficulties of groups such as the disabled, the elderly or those on low incomes are generally well documented, it is often necessary to trade-off the interests of one group against another when deciding funding priorities. This is difficult, particularly when funding is tight, because defining the relative needs between groups or areas is problematic. Authorities can find themselves in a 'no win' situation whatever way they decide to allocate funds.
- Evidence of a need for transport and/or cases of existing transport problems is often anecdotal. This can be useful in explaining how and why needs arise, but is less valuable as a means of setting funding or policy priorities between groups or parts of a city/state.
- Need for transport is not necessarily currently expressed in terms of actual passenger trips. A lack of funds, a shortage of suitable services or even limited expectations for travel are possible reasons why travel may be needed but not expressed. It is therefore difficult to measure the quantity or quality of existing travel and use these as a measure to determine priorities.

This paper concerns the measurement of transport need, and the use of the concept in determining priorities for the provision of services for the transport disadvantaged. It uses examples from overseas and describes the development and application of methods in Australia.

Defining and measuring transport need - a review

"Transport need" is not a clearly defined term. The following concepts of 'need' are found in the literature:

- The use of individual perceptions or *felt need* to determine transport requirements. This is often anecdotal, subjective and hence difficult to measure.
- The use of a defined travel standard or *normative need* resulting from the collective opinion of a body of experts. A good example is the 400 meter catchment of bus routes defined in the level of service standards of public transport operators in many cities. Households located more than 400

meters from a bus route or stop are defined as in need of a better service.

- The use of comparisons of travel quality and/or quantity between groups to determine a *relative need*. Average trip rates per capita are often quoted when comparing travel patterns between cities and between groups in the population. These statistics suggest the relative differences in demand between locations.

Table 1 shows a compilation of measures that have been used to quantify transport need in practice. Aspects of felt need are implied by the use of indicators which measure the size and distribution of groups in the population who are known to have difficulties with transport services and/or travel. For example measures have concerned the elderly, school children or youth, non-car owning households, the unemployed, the disabled and those on low incomes. The use of normative measures is less common since it is difficult to define a precise quantitative measure which is applicable to needs in all cases. Arguably all the measures concern relative needs since a numeric value for need and/or supply is defined for a group of zones and the results compared to assess differences in needs

The following components are reasonably common to many of the indicators used:

- a population measure, which values needs in relation to the size of the target population;
- socio-economic measures, which consider the size and distribution of social groups who are considered to be in need of transport services or are likely to be having problems with transport;
- measures of transport supply. These assess the availability of transport so that needs can be assessed relative to the supply of services; and
- measures of distance, cost or accessibility to facilities e.g. shopping/work locations. These measures reflect the difficulties (impedance) in gaining access to desired facilities, and help to identify situations where accessibility is poor

Development of transport need and supply measures in Australia

The transport need measures discussed here incorporate each of the above components. They have been developed by Travers Morgan over the past 5 years as a result of various studies throughout Australia (Travers Morgan 1988, 1990a, 1990b,1991). In summary the technique involves the measurement of transport need and transport supply in a series of zones or areas. An index value is given to each zone for both transport need and transport supply. When these measures are compared it is possible to determine priorities by identifying areas with a high need index score but low supply index score.

The *transport need index* recently developed for Adelaide consists of a combined and weighted series of readily available statistical indicators (Table 2). These represent components of transport need and were selected from a range of potential variables by correlating each variable with low trip making behaviour using the 1986 Adelaide

Table 1 : A REVIEW OF INDICATORS OF TRANSPORT NEED

No.	Source	Indicators Including Methods of Construction
1.	WINSCONSIN DEPARTMENT OF TRANSPORT (1976)	**SGDI (Demand Index) = M * PM * WPM** Calculated for each area using the following: $M = \frac{A * P * I}{i}$ Where: A = Percent of Non-Car Owning Households; P = Number of Persons/Household; I = Median Income (total); i = Median Income (area) $PM = E + H - C$ Where: E = No. of persons 65 years and over; H = No. of Handicapped; C = No. of Handicapped 65 years and over $WPM = \frac{PM}{PM \text{ (minimum area score)}}$
2	MID-OHIO REGIONAL PLANNING COMMISSION (1977)	As for above except: $M = \frac{B * I}{i}$ Where: B = percent of persons in Non-Car Owning Households
3.	OCHOJNA & BROWNLEE (1977)	DEMAND = (No. Elderly and Unemployed) * (Percent of Non-Car Owning Households) * LLF (LLF = Level of Local Facilities) LLF is computed for each area based on available services. e.g. shopping hotel, doctor, etc, and the no. of visits required per week SUPPLY = No. of service departures and duration of visit at destination are weighted. NEED = Supply/Demand
4.	PEAT MARWICK MITCHELL & Co. (1980)	Trip needs are classified as primary or secondary depending on trip purposes and person type, weighted 1 and 0.5 respectively. Scores are totalled by area.
5	BENWELL & WHITE (1979)	Car availability for seven activities/times is measured and scored 0 (unavailable) 1 (available).
6.	BIRD C. M. (1981)	- Trips Possible by Public Transport/ Population
7.	BIRD C. M. (1981)	- Percent of Elderly School Children and Non-Car Owning Households Weighted by Size (Also uses a subjective weighting factor).
8.	BIRD C. M. (1981)	DEMAND = Percent of Elderly, School Children and Non Car Owning Households/ Average Percent of Whole Area. Score between 0 and 4 are allocated depending on the ratios for each of the three variables SUPPLY = Population/ No. of Peak Hour Buses Demand and Supply Scores Derived for Each Area.
9.	BIRD C. M. (1981)	- Use ONLY DEMAND portion of above.
10	WORTHINGTON H. (1983)	Transit Dependance = H + Y + A + I Where: H = percent transport handicapped; Y = percent under 18 years; A = percent in non-car owning households; I = percent with low income Each component is ranked and added to give a total score.
11	RUCKER G. (1984)	Unmet Need = $\frac{Ei + Ai + Ti + Ji + Pi}{Et + At + Tt + Jt + Pt} \setminus 5$ Where: E = percent 65 years and over; A = percent non-car owning households; T = percent households with less than 2 vehicles; j = percent of workforce with trip to work time greater than 45 mimutes; i = sub area - t = total area
12	SEARLE G. (1987) also MVA (1981) & MOSELEY (1979)	The Lewes Methodology DEMAND = No. of persons in 'needy' groups/ activity categories/ car availability/ availability of services (shopping/recreation etc) SUPPLY = A rating of public transport quality for each of demand groups: Walk Trip/Good-Medium-Bad Public Transport Trip/Trip Impossible

Compiled from a review conducted by Travers Morgan (1988) with the assistance of Dr. Bruno Parolin and updated in Travers Morgan (1990a).

Household Travel Survey (Travers Morgan, 1990a). The weights given to each indicator reflect their relative importance in explaining low levels of trip making. It was recognised that trip rates were not a definitive indicator of transport needs since there is some evidence that low trip rates also reflect other influences such as life style, medical factors or even the weather (Ampt, 1982). However it was hoped to provide a quantitative basis for the use of measures adopted in previous studies (Table 1) and one which enabled weights to be applied to individual measures to present an overview of needs throughout the population.

Table 2 Components of the Transport Need Index (Adelaide)

Component	Source	Weight
- Persons 60 years plus	Census	0.14
- Persons 5 to 9 years	Census	0.12
- Adults without cars	Census	0.19
- Income < $6,000 p.a	Census	0.10
- Not in labour force	Census	0.09
- Students	Census	0.09
- Disabled[1]	DSS[2] Records	0.12
- Accessibility	Requires Analysis	0.15
	Total	1.00

[1] Persons receiving disability related pensions
[2] Department of Social Security
Source: Travers Morgan (1990a)

The accessibility element is arguably a supply rather than a need indicator, however it was included in the need index because needs were considered to vary considerably with distance to facilities. Accessibility measures were also included in the demand or need components of previous studies such as the 'Level of Local Facilities' measure defined by Ochojna and Brownlee (1977). Accessibility is the only need indicator which is not readily available from government statistics. The work in Adelaide (Travers Morgan, 1990a) utilised a previous study of accessibility based on average travel costs to community, shopping and educational facilities (Davidson, 1980). However tests showed that these measures were highly correlated to 'crow flies' travel distances between these zones and the central business district (CBD).

The component indicators were combined into the final transport need index by:

- calculating the proportion of each component indicator in each zone;
- making an index of each component indicator with the highest value being set to 100 and others being scaled relative to this (this is termed 'standardising'); and
- applying the weights to each characteristic by zone, then summing all component indicators for each zone. The summed index is then 'standardised' to 100

The *transport supply index* is used to measure the availability of transport to those experiencing transport need. Measures used are shown in Table 3. The three components each represent different transport services which are available to the public i.e. excluding private car use. They cover the supply of conventional public transport, community transport and taxi subsidy schemes. These forms of transport are important to those without access to private transport.

Table 3 Components of the Transport Supply Index (Adelaide)

Component	Source	Weight
Public Transport Indicator		
- Density of vehicle kilometres during the weekday daytime shopping period. (i.e. Vehicle Kms/Km^2)	Analysis of Timetables/ Maps	0.4
Community Transport Indicator		
- Number of services operating in each zone	Analysis of Social Services/ Council Records	0.4
Taxi Subsidy Scheme		
- Number of subsidised passenger trips	Subsidy Authority Records	0.2
	Total	1.0

Source: Travers Morgan (1991)

The public transport indicator was constructed from an analysis of bus, rail and tram routes. The length of routes in each zone was measured and multiplied by the number of vehicle trips timetabled to travel over the route in the inter-peak or weekday shopping period. The inter-peak was used as this is an important time for travel for those

without private transport (see Travers Morgan, 1991)

Community transport consists of local community minibuses, volunteer car driver schemes and other forms of transport organised by local agencies for those in need. Clearly measuring the amount of transport provided by these agencies is difficult. The measure used was the total number of services available in a given zone.

Taxi subsidy schemes are available in all states in Australia; they provide a subsidy for taxi travel to a variety of passengers including the low paid, the elderly and the disabled. The measure of supply used is the number of passenger trips made on the scheme. While this is more indicative of demand than supply, there is a general correlation between low supply (such as that in outer parts of cities) and low trip making.

Weights applied to the supply indicators are derived from an analysis of modal trip patterns demonstrated in the Adelaide Household Travel Survey (Travers Morgan, 1990a) They are indicative of the importance of these modes to those without private transport, but are not definitive, and could be varied for other cities.

Supply indices were calculated using the same method as the need indices. A value for each indicator was calculated for each zone. These were then weighted and summed to a composite factor and this was then 'standardised'

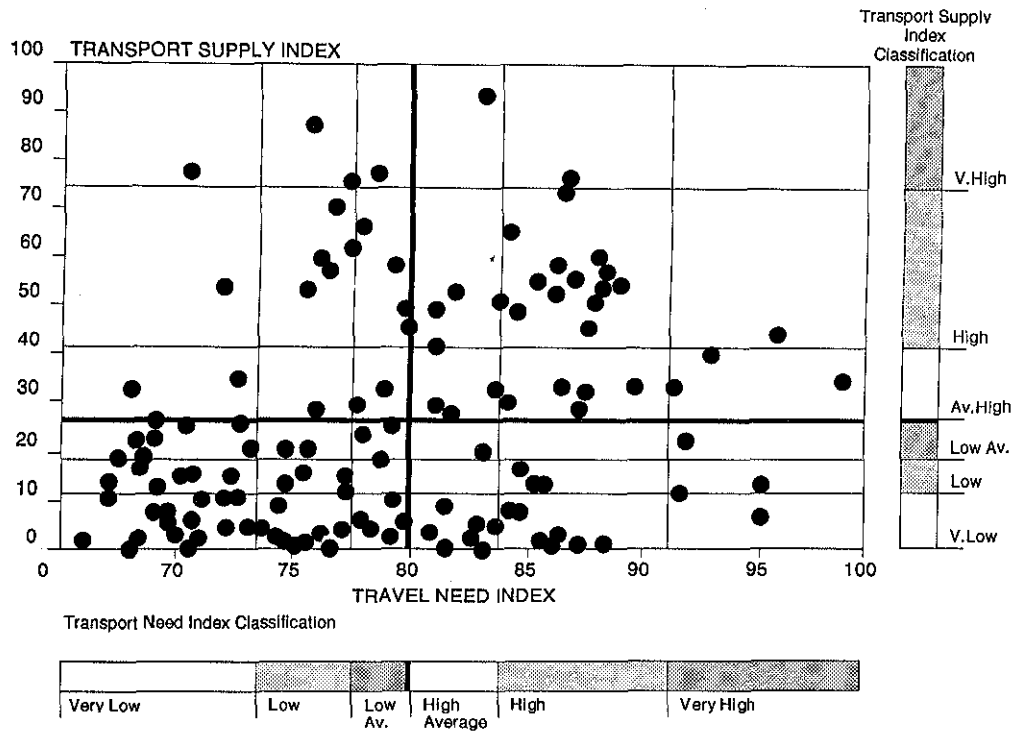
The final step is to classify the composite transport need and transport supply indices into groups. This is achieved by ranking each index from the highest to the lowest values. An average value is also calculated so that all values can be expressed relative to this average. Classification is carried out by looking for 'natural breaks' in the distribution of scores, with six classes being defined; very high, high, high average, low average, low and very low.

Some example results - Adelaide

Figure 1 shows the transport need and transport supply index scores from recent work undertaken for postcode zones in Adelaide (Travers Morgan, 1991) Scores have been grouped into 6 classes for each index (very high, high, high average, low average, low and very low), and 36 for both indices combined. A simpler way of examining the results is to consider 4 classes initially; above and below average scores for each index. Zones scoring below average for both transport need and transport supply can be considered to have a broadly matched supply and demand for services (bottom left hand corner of Figure 1). Those areas with above average transport need and transport supply are also broadly matched in terms of supply and demand (top right hand corner of Figure 1) However scores in the bottom right hand corner of the graph appear *under-supplied* in relation to needs, and those in the top left hand corner of Figure 1 appear relatively *over-supplied*

Figure 2 shows the distribution of these four categories throughout metropolitan Adelaide. This shows that under-supply is indicative of outer parts of the city whilst over-supply is indicative of zones around the CBD or along major radial routes (in the latter case transport is supplied through these areas to provide connections between other zones).

FIGURE 1 :
DISTRIBUTION OF TRANSPORT SUPPLY AND NEED SCORES
(POSTCODE ZONES IN METROPOLITAN ADELAIDE)



Use of the 36 categories shown in Figure 1 would provide a more detailed means of ranking each zone in terms of over and under-supply. Arguably any results far from the Y=X (or 45 degree) line indicate a mis-match between supply and demand. The most obvious areas of concern are those nearest the bottom right hand corner of the graph. This represents areas with high need but low supply; these include zones in the far south of metropolitan Adelaide such as Aldinga Beach and Noarlunga.

The results shown in Figure 1 were used to prioritise transport needs within Adelaide as a means of developing strategies to overcome transport disadvantage (Travers Morgan 1991). A variety of planning measures were assessed in terms of cost and impact on various groups within the population. These measures were targeted at the areas highlighted by the index analysis notably to areas south of Noarlunga.

Other example applications

The technique described above has been considerably refined over the last five years. In 1988 the approach was applied in NSW to assist in determining the distribution of transport funds for the Home and Community Care Program (HACC) (see Travers Morgan, 1988). In 1991 these funds totalled over $6M. The component statistics input to the index reflected the HACC target groups (those who are frail and/or disabled who need additional help to stay in their own home). The technique was applied for the nine HACC regions in NSW as well as three sub-regions. These results were later updated after consultation with local community organisations (Travers Morgan, 1989). This update used the 1986 census data for the new regional HACC boundaries in NSW and included some minor modifications of the method.

The demand index was also applied at local government area level in Adelaide in 1990 (Travers Morgan, 1990a). This project assessed the relative demands for HACC and general community transport services. The community transport index included statistics relating to a wider population group since in theory such services are available to a wider section of the population. No supply indexation was used in this study which was undertaken as a pilot project.

Transport need and supply indices were also used in Perth in 1990 to assess the relative needs and supply of transport in the South West Corridor (Travers Morgan, 1990b). The method was applied at postcode level and included the development of a separate set of indices which considered need and supply for the severely transport handicapped (those who because of disability can only use specially adapted transport services). Results were used to assess the performance of a range of new services and service change options on the distribution of transport needs.

Summary and conclusions

This paper has considered the methods that have been used to measure the need for transport services. All passenger transport authorities are faced with the difficult task of

(Four Classes of transport need and supply indicators over postcode zones in Metropolitan Adelaide)

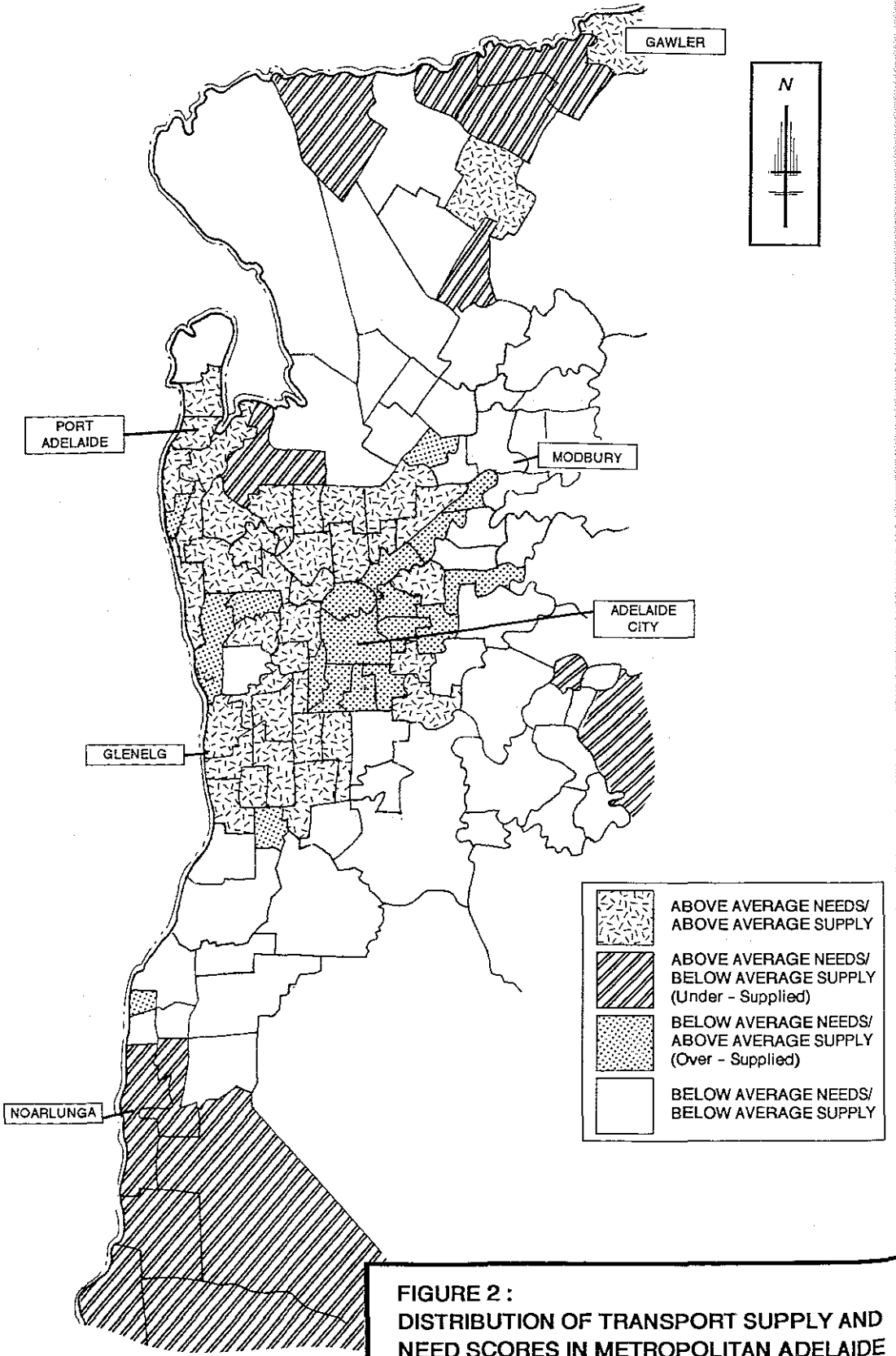


FIGURE 2 :
DISTRIBUTION OF TRANSPORT SUPPLY AND NEED SCORES IN METROPOLITAN ADELAIDE

assessing changes to services and allocating funds for a range of demands. When considering those who are transport disadvantaged, these difficulties are compounded by the need for trade-offs between groups and areas, by the format of requests for funding which are often anecdotal and by transport needs which are often not expressed either verbally or in terms of actual travel. Techniques for measuring needs have been described and a review of how these techniques have been applied in Australia has been given.

Overall the main benefit associated with the use of these methods has been the ability to assess needs in a quantitative, rigorous and defensible manner. This provides a basis for placing priorities on the need for services and has been used to assess various policies to ameliorate transport problems and to allocate government funding between areas. The method is relatively easy to use and incorporates readily available data.

There are a variety of problems with the techniques described, not the least of which is the conceptual difficulties in defining which indicators to use and what weights to apply to each. Trip rate analysis has been a critical element in addressing these difficulties, although low trip making is not an exact measure of transport need. Low trip making has been used given the absence of alternatives and also in the interests of maintaining a relatively easy-to-use technique with readily available data inputs.

An important consideration in the use of census and disability indicators is the possible double counting of certain types of need which can occur when individuals are classified in more than one component indicator. For example many disabled people are on low incomes and will be double counted in the component indicators shown in Table 2. Constructing need indicators in this way implies that their needs are greater than an individual who is classed in only one component indicator. While this may or may not be the case it is important to recognise that need indexation of this kind implies priorities to certain types of need which should be carefully considered in the application of this technique.

Problems in the definition of zoning systems have also been apparent since the size and shape of zone boundaries can dilute specific needs in one area over a much wider area. These problems are related to conceptual difficulties with what we term 'population weighted need' and 'unweighted relative need'. If scores are weighted by the population size, then results show where the largest number of needs occur. However scores unweighted by population show needs as a proportion of the population within each zone (unweighted relative needs). This highlights the dilemma of which is the more important need, a low level of relative need spread throughout an area of high population or a high level of relative need in a sparsely populated area?

Overall, although the methods used are far from perfect, they have considerable merit in helping to define priorities for funding services to assist the transport disadvantaged in situations where many needs are currently not catered for.

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