A STRATEGIC REVIEW OF PUBLIC TRANSPORT USER NEEDS IN THE CAPE METROPOLITAN AREA

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SUMMARY

This paper reviews user needs and current public transport operations in the Cape Metropolitan Area. It shows that public transport services are currently unsustainable in terms of increasing subsidy requirements as well as not effectively meeting user needs. Proposals to restructure the public transport system and to use Stated Preference techniques to identify and address user needs are put forward. At present strategies to restructure the public transport system are being drawn up so there is no evidence on the success or otherwise of these proposals. Clearly therefore effective monitoring strategies will be needed to track the effectiveness of these proposals in meeting policy objectives.

There is clear evidence that Stated Preference (SP) methods offer a cost-effective method of providing appropriate market research information on the likely response of users to changes in the public transport system. In South Africa however, the developing context within which SP methods are to be applied is often significantly different from conditions in developed contexts. SP techniques will therefore frequently require innovative adaptations and sometimes different approaches to those most commonly applied in developed contexts. This will provide fertile grounds for the development and transfer of such adaptations and techniques between developing contexts.

1 INTRODUCTION

The planning, management and operation of public transport in South Africa is currently undergoing fundamental transformation. Driven by National Department of Transport (NDoT) policy initiatives, transport authorities in urban and rural areas will for the first time ever be required to plan for *and implement* integrated, efficient, user responsive public transport systems. This paper reviews the likely long-term evolution of public transport passenger needs in the Cape Metropolitan Area (CMA) from a strategic perspective, taking into account these policy initiatives and their implications for far reaching changes to the current public transport system.

2 THE EVOLVING PUBLIC TRANSPORT POLICY FRAMEWORK

The provision of public transport in South Africa has been the product, as well as instrument of, past apartheid settlement strategies that located townships on the extreme peripheries of cities. Rail and bus infrastructure were developed to link these distant residential areas with more established employment centres and the operating costs of these modes were heavily subsidised to enable workers to be transported over long distances at low fares, other mobility needs being largely ignored. Since the late 1970s, the minibus-taxi industry rapidly grew as a primarily informal response to the inability of heavily subsidised and protected rail and bus services to effectively meet user needs. The minibus-taxi industry has however, become increasingly mired in conflict due to destructive competition within the industry itself as well as with heavily subsidised bus and rail modes.

Since the demise of apartheid, various trends are exacerbating these problems and threatening to entrench the status quo:

- extensive new low cost housing projects are being located on “greenfield sites” on the edge of cities far from established employment and commercial centres
- commercial and industrial development is moving out of established centres and creating a widely dispersed distribution of employment areas which are difficult to serve by public transport
- bus and rail services are still essentially commuter based with few off peak services to meet the mobility needs of shoppers, students, the elderly, tourists and the unemployed.
- operating subsidies are rapidly increasing despite declining passenger numbers – nationally only 40 per cent of those users who are captive to public transport have access to subsidised services
- there is great uncertainty about the funding of public transport, even as far as infrastructure maintenance and rolling stock replacement is concerned
- regulation and enforcement of the minibus-taxi industry remains haphazard and weak
- more and more choice users are switching to private cars for their daily transport needs
- institutional and management structures are still fragmented with no one authority able to plan, raise funds for, implement and enforce an integrated transport system at the metropolitan level of government
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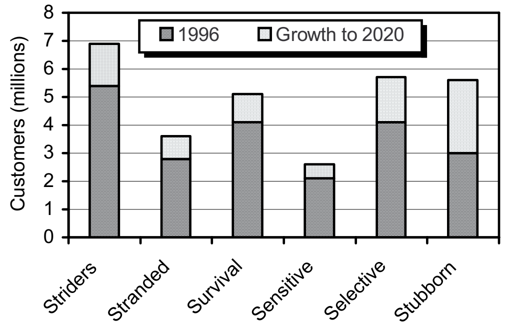
These factors have combined to result in public transport in South Africa having become a poor person’s, “one size fits all” utility. The response of NDoT has been to prepare a set of strategies collectively entitled “*Moving South Africa – the Action Agenda*” (MSA). These ambitious strategies firmly place meeting customer needs as a key objective. To identify and scope customer needs, MSA identified six urban passenger market segments (Table 1).

Table 1: *National urban passenger customer segments*

Segment	Description
Striders	Prefer to walk or cycle
Stranded	No affordable transport available (unemployed + scholars)
Survival	Captive to the cheapest mode of transport
Sensitive	Captive to the best option of public transport
Selective	Can afford a car but willing to use public transport
Stubborn	Will only use car

This analysis clearly shows that approximately 67 per cent of all urban passengers in South Africa are captive to public transport (see Figure 1) and that that by 2020 about 62 per cent of urban passenger customers will be captive to public transport if current trends continue. This means that as a first policy priority, public transport resources, such as subsidies should be allocated to meet the full range of mobility needs of lower income users who are captive to public transport. A second objective should be to ensure that as income levels rise over time, these users find public transport an attractive alternative to car travel.

Figure 1: *Moving South Africa passenger market segments*



MSA is centred on the successful implementation of the following key actions:

- halting further dispersion of land use development
- effectively regulating all public transport providers in terms of integrated transport plans (ITPs)
- empowering customers to demand better services
- planning to replace dispersed route networks with high-volume, all-day corridor operations over those parts of the network where greatest current and potential demand exists
- serving these corridors by feeder services and integrating them through multimodal interchanges
- identifying the mode that can best meet customer needs at the least cost for each corridor and regulating optimal modes by performance based contracts in the case of road-based modes and concessioning in the case of rail services
- integrating transport plans with urban land use planning to ensure that public transport corridors reinforce high density mixed land use corridors and become an important instrument to reintegrate urban areas
- encouraging alternative, unsubsidised, services for more demanding customers where they do not undermine the volumes required for a sustainable optimal mode in a corridor
- implementing tough road space management measures to restrict the unnecessary use of cars where public transport is developed sufficiently to be an attractive alternative to choice users

3 THE URBAN TRANSPORT CONTEX IN THE CAPE METROPOLITAN AREA

Socio economic conditions in the CMA are an essential context for describing its public transport system and user needs. The CMA is a typically developing urban area, with relatively few people having high incomes and the largest proportion of the population with low incomes (see Table 2).

Table 2: *Key socio – economic indicators for the Cape Metropolitan Area*

Socio-economic indicator	
Area (ha)	215 900
Population (1996)	2,7m
Population growth rate p.a. (1996-1999)	3%
GGP per capita (US$, 1998)	$3 700
% pop. living below the poverty datum line	32%
Contribution to SA's GDP	10,6%
GGP growth rate (1997/1998)	1,3%
% unemployment (1996)	20%
% employment in the formal sector (1996)	60%
% employment in the informal sector (1996)	20%

For example, 60% of African and 40% of Coloured workers earn below US$ 1 600 (R9 600) per annum and have only standard 6 education or lower. Unemployment levels are also highest among the poor. High levels of unemployment plus the concentration of very low wages mean that a substantial proportion of the population are not only vulnerable to the hardship of severe poverty but are also largely captive to public transport for access to employment, education, health and other essential urban opportunities.

4 PUBLIC TRANSPORT SUPPLY AND UTILISATION IN THE CAPE METROPOLITAN AREA

Public transport in the CMA is provided by 3 main modes – rail, bus and minibus-taxi. Rail and bus are scheduled services operated by single operators – Metrorail in the case of rail and Golden Arrow Bus Services (GABS). Many operators using 15 seater vehicles provide unscheduled minibus-taxi services. Table 3 summarises key attributes of the public transport system.

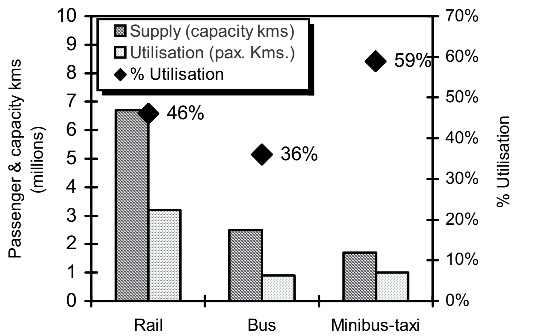
Table 3: *Public transport system characteristics*

Attributes (1998)	
Bus fleet*	±700 buses
No. of bus routes*	±800
Total length of bus routes*	21 000kms
Rail fleet	95 trainsets
Total length of rail track	443 track kms
Minibus fleet	6 700 minibuses
No. of minibus-taxi routes	300
Total length of minibus routes	6 400 kms
No. of minibus-taxi owners	3 500
Metered taxi fleet	550 sedan taxis
Mode split % private : public + walk/cycle (1995, AM peak period)	44 : 56

- ***GABS which have the sole permit to provide fare paying services***

Rail provides the most capacity (seat kilometres and standing kilometres at an acceptable level of crowding) and has the largest market share in terms of passenger kilometres. Both supply and market share for minibus and bus modes fall a long way behind rail (see Figure 2). This is in marked contrast with other metropolitan areas where minibus-taxis have the greatest market share – nationally minibuses have 60% of the public transport commuter market.

Figure 2: *Supply and utilisation of public transport - AM peak period, 1997*



In the CMA minibus-taxi services are the most efficient in terms of passenger utilisation as a percentage of capacity provided. Reasons are that minibuses:

- only leave from loading ranks when they are full
- generally operate shorter routes than bus or rail
- are more flexible and are better able to serve more dispersed origins and destinations than rail or bus services

For all modes, the inefficient and inequitable urban structure created by apartheid settlement policies has fundamentally limited opportunities to achieve higher utilisation rates. Thus in the peak direction utilisation rates are often extremely high, resulting in dangerous levels of overcrowding, while few passengers are carried in the reverse direction. A further constraint is the bus subsidy system that has encouraged a dispersed route network.

5 DEMAND FOR PUBLIC TRANSPORT

Past and current trends

Table 4 shows some key aspects of the current public transport demand. The dominance of rail is clearly highlighted.

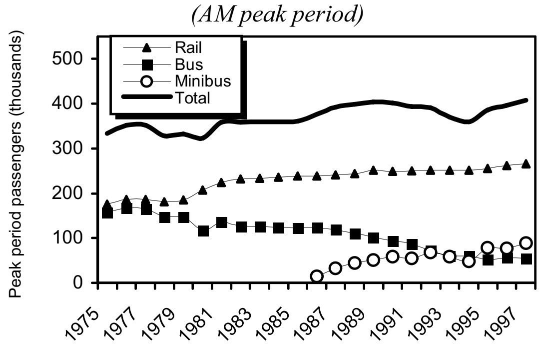
Table 4: *Current demand for public transport (AM peak 2.5 hour period, 1998)*

Mode	Passenger trips	% market share	Av. passenger unbroken one-way trip lengths (kms)
Rail	256 000	63%	12.2
Bus	58 000	14%	15.2
Minibus	94 000	23%	10.6
TOTAL	**408 000**	**100%**	**12.3**

Surprisingly, the average unbroken passenger travel distance by bus is longer than for rail. A reason for this is that the bus subsidy system offers strong incentives to maximise route lengths. More interchanging also takes place on the rail system. Thus although unbroken passenger journeys are shorter for rail, total passenger trip lengths on the rail system are likely to be longer than by bus.

Over the last 20 years there has been a sustained decline in demand for bus services, particularly since the explosive growth in minibus-taxi market share from the 1980's (see Figure 3). Rail has maintained a steady growth in demand,

Figure 3: *Trends in passenger demand (AM peak period)*



its market increasingly dominated by lower income passengers while higher income train passengers are declining. Interestingly over 70% of the minibus-taxi commuter market are women. This is evidence that women are willing to pay generally higher minibus fares and risk higher accident rates, in return for faster journeys and higher levels of personal security relative to bus and rail services.

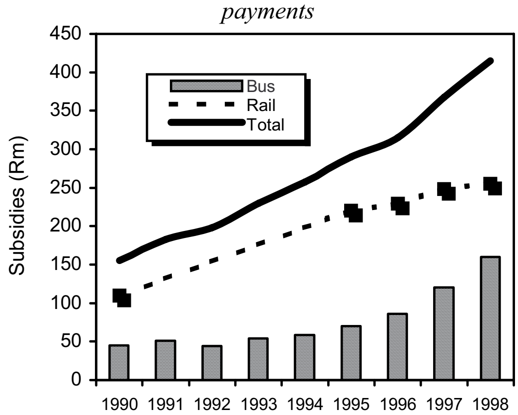
Fares and subsidies

A key factor determining public transport market share is subsidisation and the resulting fare structures. Currently only bus and rail services are directly subsidised. Significantly, Table 4 shows that 77 % of peak period passengers benefit from subsidised transport in the CMA relative to the national average of only 40 %.

Bus and rail subsidy systems are not integrated. Commuter rail services are funded by Central Government in the form of a deficit subsidy - the difference between total costs and passenger revenue. The 1998/99 annual subsidy was about R255 million. This is equivalent to R2,00 subsidy per passenger trip (12km. average), 16,3 cents per passenger kilometre or R900 per annum per commuter. During the 1995/96 financial year 44% of full operating costs were recovered from fare revenues in the CMA, compared with 31% for Johannesburg and Durban.

The NDoT also subsidises GABS by paying the difference between the full economic fare (ECF) claimed by GABS to provide a service and the amount it is believed that passengers can afford to pay for a service. Bus trips shorter than 10 kilometres do not qualify for subsidies. During 1998/99, bus subsidies amounted to R160 million - equivalent to R5,52 subsidy per passenger trip (15km. average), 36,8 cents per passenger kilometre or R3 300 per annum per commuter. The percentage subsidy varies from 27% to 77% of the ECF. For all subsidised routes, the average subsidy is 71 % of the ECF. For all services (subsidised and unsubsidised) in 1997/98 about 40% of operating costs were recovered from fare revenues.

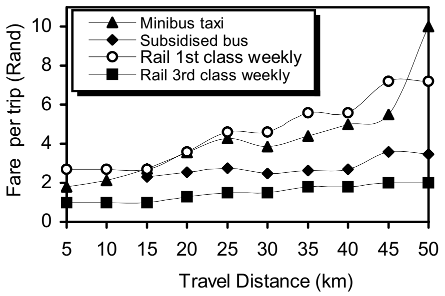
Figure 4: *Trends in commuter subsidy payments*



Over recent years bus and rail subsidies have been growing at an alarming rate – particularly bus subsidies given the low market share of the bus mode (see Figure 4). There are clear indications from NDoT that such increases are unsustainable. These subsides have a fundamental impact on passenger fare systems of the different modes. The commuter rail service issues single, return, and discounted weekly and monthly tickets for 1st and 3rd class passengers. The bus operator issues single tickets, discount-priced ten-ride clipcards and monthly tickets. Passenger subsidies apply only to discount priced tickets actually sold. Minibus-taxi fares are not subsidised and do not provide for special prices on multiple or return trips. Because of subsidies, minibus taxi fares are the most expensive for any given distance, and third class rail the cheapest.

From a user point of view, subsidies have partially succeeded in keeping rail and bus fares affordable for the poor. As mentioned previously, 60% of African and 40% of Coloured workers earn below R9 600 per annum (US$ 1 600 p.a.). Table 5 shows that rail (third class) is the most affordable mode for the poor. Despite heavy subsidisation, expenditure on bus fares exceeds 10% of R9 600 p.a. It is interesting to note that the average minibus fare is cheaper than the average subsidised bus fare. A reason for this is that bus passenger trip lengths are longer than for minibus-taxis.

Figure 5: *Public transport fares (1998)*



This analysis does not take into account the total fare costs of the journey to work for those who use more than one mode. Because there is no through ticketing system in place as yet, people have to pay more than one fare when making linked trips.

Table 5: *Annual fare expenditures (1998)*

Mode	Average fare/trip (R)	Annual fare expenditure (R p.a.)	Expenditure as a % of an annual income of R9600 per annum
Rail (3rd class)	1.50	750	8 %
Subsidised bus	2.80	1400	15 %
Minibus	2.60	1300	14 %

Service reductions and financial cutbacks in the rail services

Despite a sustained increase in demand, government subsidy cut backs have reduced rail services over recent years. Scheduled weekday services have declined by about one third between 1987 and 1999. From a passenger perspective the most negative consequence has been unacceptably high levels of overcrowding on some lines. Figure 7 shows that services over some sections of the Khayelitsha line are at over 150% of their passenger carrying

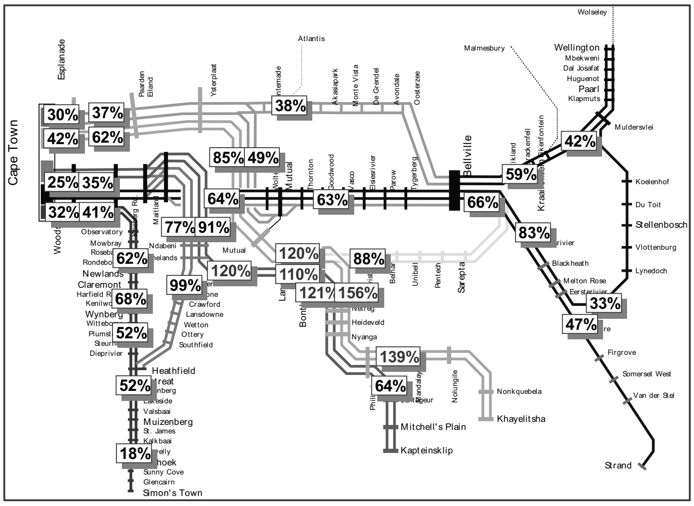


Figure 7: *Morning peak hour rail passenger capacity utilization*

capacity in the peak direction during the peak hour. A very real fear for these grossly overcrowded trains with their ageing rolling stock (average age 30 years and more) is that equipment failure may lead to accidents with potentially horrific consequences. It is a tribute to the operator that such a high safety record has been thus far maintained with increasingly obsolete equipment.

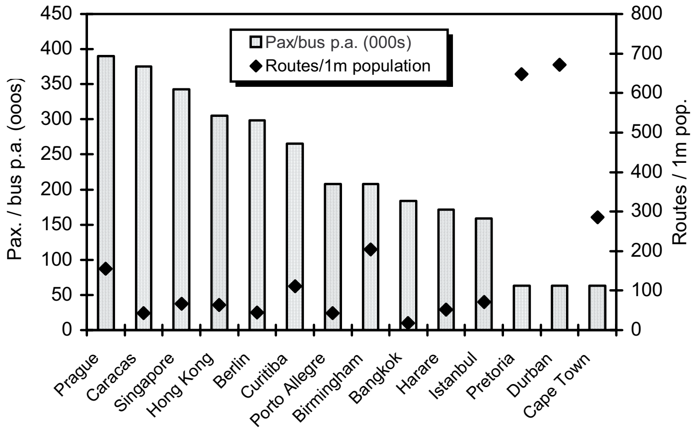
Allied to overcrowding are the problems of fare evasion and a lack of security for passengers. The current rate of injuries and fatalities on the rail system due to crime and violence has followed a disturbingly rising trend over the past five years. Personal security related issues constitute 28% of the sources of complaint about services. This is having a profound effect on travel patterns and people’s choice of transport mode.

Fare evasion is rampant with up to 30% of passengers not paying for their tickets on the rail system in the CMA. On the Khayelitsha line the level of fare evasion was recently estimated to be 70%, on the Mitchells Plain line 40% and approximately 15% on the remaining lines. Fare evasion also contributes to the overall public perception that the system is not under control and encourages lawlessness on the trains. Lost fare revenue translates into increased subsidy levels, and unfair competition between modes.

A widely dispersed, unproductive and infrequent bus service

The bus network in the CMA is widespread with approximately 800 routes being operated in the peak period. The operating environment is defined by relatively long distances, increasingly dispersed destinations, highly peaked demand and intense competition with minibus-taxis and subsidised rail services. Furthermore, the subsidy system gives operators incentives to operate as many long distance routes as possible. These conditions combine to have a devastating impact on bus vehicle utilisation rates and hence on costs and overall bus industry sustainability. Different cities from across the world are compared in Figure 8 in terms of bus productivity (passengers carried per bus per annum), network density (routes / million population). Very clearly South African cities have among the least productive bus systems in the world. Not only are they unproductive, but passenger needs are not being effectively met. Over half the number of routes operated in the CMA have only one bus per day – and that in the peak – which means that bus services only benefit commuters with the off peak travel needs of the many poor who are captive to public transport not being adequately met.

Figure 8: *Bus productivity and network density*



Destructive competition and unsafe operating practices in the minibus-taxi industry

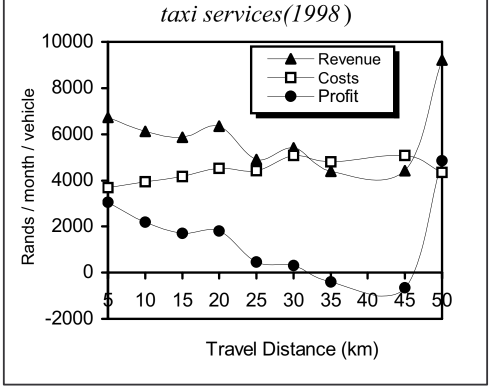
The rapid evolution and growth of minibus taxi transport has clearly demonstrated its ability to respond to user needs and adapt quickly to changing patterns of demand. Because of their small size, minibus taxis are able to provide frequent and viable services at relatively low levels of demand. Often minibuses are the only form of transport able to penetrate the labyrinth of narrow roadways found in many informal settlements. Owner-drivers generally operate minibuses, although there are a few owners who operate large fleets.

In terms of permit conditions, minibuses are required to operate only along specific routes. This was introduced to counter violence in the industry caused by different Associations preying on each others routes. Taxi driver discipline and the quality of driving is often poor. This is mainly the result of intense competition for passengers between minibus-taxi operators themselves, and with heavily subsidised bus and rail services, which places financial operating margins for minibus operators under severe pressure.

Pressure on margins often leads to operators reducing costs by not renewing old, unroadworthy vehicles (the average minibus age is approaching 10 years per vehicle) and spending less than the absolute minimum on preventative maintenance, often with fatal results. During 1998 over 2 500 people were killed in minibus-taxi accidents countrywide. In the CMA two incidents alone in 1998 claimed the lives of 17 people. Operators also reduce costs by not taking out insurance for passengers against possible injury from accidents. Minibus drivers try and maximise fare revenue by making as many trips during peak commuter periods as possible. This frequently leads to excessively fast and reckless driving as well as unacceptable behaviour to passengers and other road users.

Figure 9 shows that minibus services are most profitable over shorter routes. Routes over 25 kilometres are financially unsustainable which is particularly the result of competing subsidised bus and rail services. An exception

Figure 9: *Profitability of minibus-taxi services(1998)*



seems to be routes over 50 kilometres where high profits are being realised. This is a special case where minibus-taxis have a virtual monopoly of higher quality services and are therefore able to charge high fares.

User perceptions of public transport

Not surprisingly, user perceptions of public transport services generally reflect the issues raised above. A recent study to develop a corporate branding identity for public transport in the CMA by Modalink (1997) investigated public transport attitudes towards the present transport system. The surveys drew respondents from varied market segments and included current users of all modes as well as potential users. Perceived negative and positive public transport attributes are shown in Table 6 (two ticks or crosses meant that the attribute was felt to be a very strong feature of the mode while an empty space meant that it was not felt to be characteristic of that particular mode of transport).

Table 6: *Perceived positive and negative public transport attributes*

Attribute	Train	Bus	Mini-bus
Positive attributes			
Convenience	ŏ		ŏŏ
Quick / fast	ŏ		ŏŏ
Comfortable	ŏ	ŏ	
Safer from accidents	ŏ	ŏ	
Sociable	ŏ		ŏ
Reliable	ŏ		
Cheaper			ŏ
Safer from crime		ŏ	
Widely available			ŏŏ
Peaceful / relaxing	ŏ	ŏ	
Negative attributes			
Access to service difficult			
Unreliable			
Incompetent drivers			
Poor driver & staff attitudes			
Poor condition of vehicles			
Lack of insurance for passengers			
Unsafe from accidents			
Problem to other road users			
Crime			
Violence			
Punitive fare structure			
Crowded			
Slow service			
Dirty			

The table is largely self-explanatory, however, comments from respondents about the different modes are highly illuminating:

Rail:
"I will never catch the train alone, I will always take someone with me"
"I immediately think of sardines in a tin"

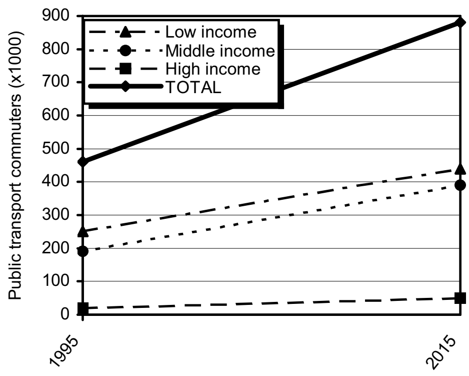
Bus:
"They're so slow you feel you're never going to reach your destination"

Minibus-taxi:
"The taxi is very convenient because it comes where a bus or a train can't pick us up. You can just get on at the corner, whereas with a bus you can't".
"... taxi drivers drive recklessly, they forget that they are carrying people's lives. If you comment about this, the taxi driver tells you the taxi is his"
"Sometimes I close my eyes when I get in the taxi and I don't open them before I get out".
"If you feel like taking a risk, take a couple of taxis"

Future demand trends

In view of policy objectives, targets to reduce car dependence in the CMA have been set. The anticipated successful achievement of these targets, together with the anticipated increase in the number of captive users, is likely to result in the demand for public transport doubling by 2015 (see Figure 10).

Figure 10: *Targets for future public transport demand*



However, these targets are only likely to be achieved if there is political and institutional commitment to implementation of policies aimed at:

- accelerating and sustaining dedicated funding for a vastly improved and expanded public transport system
- reversing the trend towards decentralised and dispersed land uses - both large, multi-use, car driven commercial land uses as well as low income housing projects.
- restricting unsustainable growth in private car use through travel demand management measures

A key aspect of this future growth scenario is that the future demand for public transport is likely to be increasingly concentrated within the low and middle-income market segments who are largely dependent on public transport for work and other essential journey purposes. For example, for every high-income commuter by 2015, it is estimated there will be 20 low and middle income commuters.

6 KEY STRATEGIC CHOICES

Planning professionals, policy makers and the people of the CMA generally agree that a well-utilised, efficient and affordable public transport system is essential for the future social and economic well-being of the region. A much improved, world-recognised public transport system offering a wide variety of integrated and sustainable services is needed, not only for mobility purposes, but also to achieve broader social and developmental objectives, which include:

- The provision of affordable services to the urban poor, for work and other essential journey purposes
- The creation of viable and attractive transport alternatives to car users
- Services which benefit visitors and holiday makers
- Transport for the young, old and mobility disadvantaged
- The strengthening of regional, inter-city transport connections
- The achievement of environmental goals
- The social and economic development and restructuring of the metropolitan area

To fulfil this vision and meet the MSA goals, requires a strategy comprising actions that will best achieve policy objectives. In South Africa resources are limited, but scope for improving service levels and satisfying user needs is unlimited. Transport strategies are therefore essentially about making choices and the key transport choices must address at least two fundamental questions:

- Where do we want to invest scarce resources?
- Which customers do we prioritise to serve?
  - at what level of cost?
  - at which levels of service?

Once these questions have been addressed, then appropriate implementation programmes can be put in place. The following sections reflect on how the CMA intends addressing these questions.

7 INVESTMENT OF SCARCE RESOURCES

One of the principal objectives of government policy is to create integrated metropolitan transport systems which will promote the concept of "seamless" travel between different public transport modes and services. The main aims of modal integration are to:

- provide metropolitan-wide access and mobility in the most cost effective manner
- improve levels of service, while reducing user costs and travel times
- reduce operating costs and subsidies by promoting the optimum use of each mode
- rationalise and control the provision of services by eliminating duplication and parallel subsidies
- eliminate destructive competition between service providers, while guarding against monopolies

To achieve these objectives in the CMA, a metropolitan public transport system needs to be created consisting of a primary network and supplemented by secondary (but regulated) support services. This is a major departure from the present, where rail and road-based modes tend to operate independently.
The primary network would consist of the following broad types of service:

- **Corridor services**: Operating at high frequencies during the morning and afternoon commuter peak and then at lower frequencies in the off peaks for 18 hours per day along semi-exclusive or exclusive rights of way, with relatively frequent stops and moderate speeds. These services are intended to promote metropolitan scale high density, mixed use corridor developments and also provide access to all major metropolitan commercial and business developments.
- **Metropolitan services**: Providing connectivity between remote parts of the metropolitan area and to expand the general coverage and integration of metropolitan services. Also providing dedicated services between major generators such as the city centre and the airport. Frequencies would be high during the peak periods and service schedules would dovetail throughout the day with those of the corridor services.
- **Express direct and limited stop services**: Operating primarily during the peak hours along the same networks as corridor and metropolitan services, with stops only at major interchange points.

In addition to these services, the primary network should incorporate a system of interchanges and termini that will promote modal integration and establish some form of hierarchy in the provision of metropolitan public transport services. Secondary support services should complement the primary public transport system by providing localised services for the benefit of specific communities, interest groups or markets.

The secondary network would consist of the following broad types of service:

- **Feeder services**: connecting residential areas and/or lower order activity centres to a primary service at major rail or bus interchange points
- **Shuttle services**: providing dedicated, short distance services between major activity centres
- **Distribution services**: providing services within a major activity centre such as the Inner City Area
- **Demand responsive services**: whose routes and schedules respond to the needs of individual passengers

An integrated multi-modal public transport system in the CMA can only be achieved by means of a statutory long-term network plan for the area. Such a network has been defined and developed in terms of the following key principles:

- To provide metropolitan-wide access and mobility in the most efficient and cost effective manner
- To maximise the use of existing resources (rail infrastructure, future rail reserves, roads of metropolitan significance and future road reserves)
- To create a strong element of permanence, road-based services should be located in such a manner as to allow

for future upgrading to dedicated ROW operations
- To support corridor and nodal developments
- To promote route continuity
- To promote operations between well defined interchange/terminal points
- To promote metro type operations (high frequencies of service and greater coverage, but fewer direct services with more appropriately-designed interchanges)
- To eliminate parallel subsidised services
- To promote the broader concept of public transport, rather than commuter transport

Conceptually this is shown in Figure 11 and the evolution of the public transport network is described in Table 7.

Figure 11: *Evolution of the public transport network in the Cape Metropolitan Area*

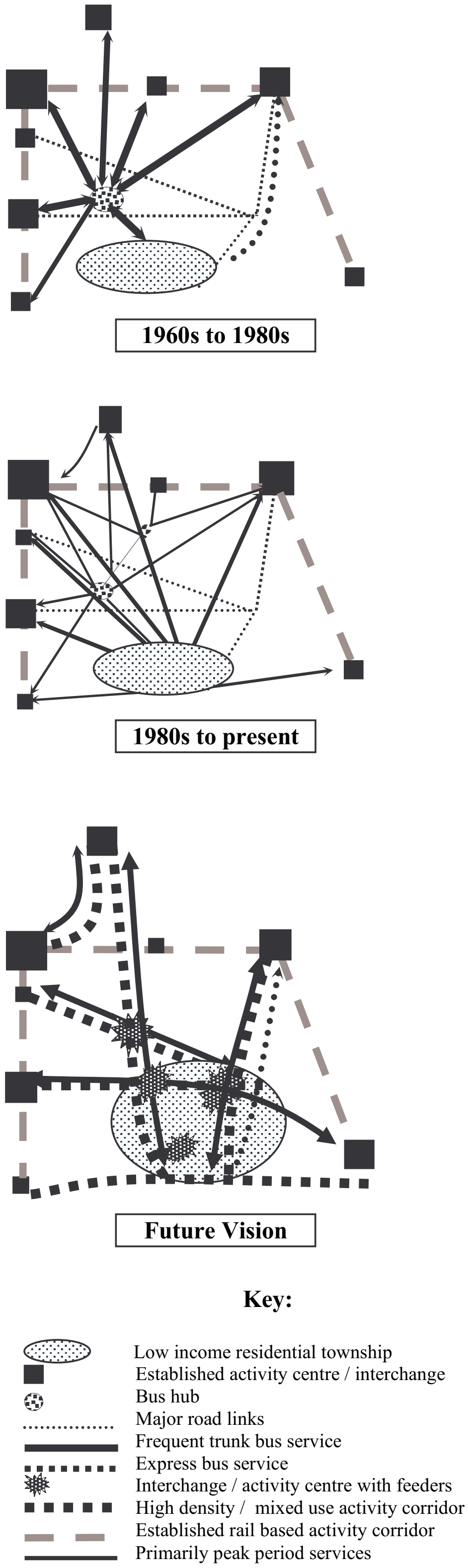


Table 7: *Past and desired future development of public transport services*

Period	Characteristics
1960s to 1980s	‣ Hub and spoke bus network operated at high frequencies to support rail service. ‣ Highly efficient use of buses ±120 m passengers p.a. and 550 peak period buses. ‣ High proportion of passengers required interchanging. ‣ Strict regulation limits competition. ‣ Car travel became increasing attractive. ‣ Hubs located off main public transport arterials due to town planning of cellular suburbs.
1980s to present	‣ Regulation of public transport relaxed. ‣ Increasing competition from minibus taxis and private transport. ‣ More direct bus services to compete with minibus taxis (less interchanging), decline in hub and spoke services and a decline in bus passengers. ‣ Increase in number of bus and minibus routes. ‣ Decline in frequencies of all modes, especially during off peak – many routes have peak period services only. ‣ Changed network more inefficient especially for buses – longer travel distances, higher subsidies and lower passengers / bus operated ± 40 million passengers p.a. and 700 peak hour buses.
Future vision	‣ High frequency, 18 hour trunk road based services along high density mixed use activity corridors not served by rail. ‣ Rail provides the backbone for the public transport system. ‣ Location of major interchanges on activity routes where activity corridors cross. ‣ Regulated competition – competitive tendering for road based contracts and rail concessioning. ‣ Feeder services to main interchanges and activity centres. ‣ Express services along major mobility routes where required. ‣ Competing modes not subsidised unless for reasons of capacity constraint on the primary mode. ‣ Through ticketing and revenue sharing arrangements between different trunk services (including rail) and feeder services. ‣ Marginal cost pricing applied to peak and off peak. ‣ Market segmentation leads to a wide variety of services being supplied. ‣ Dedicated sources of sustainable funding established. ‣ Unitary branding of vehicles and infrastructure.

8 STATED PREFERENCE METHODS FOR DETERMINING USER RESPONSES TO COST AND SERVICE LEVEL CHANGES

The proposed restructuring of the public transport network and services will have potentially significant impacts on how users experience the system. Table 8 shows an assessment of the likely positive and negative impacts of the proposed restructured network on the most common attributes experienced by passengers (Greater Pretoria Metropolitan Council, 1999).

Table 8: *Likely impact of changes in service levels on passengers*

Attribute	Impact	Negative impact	Positive impact
Fare	None	-	-
Walking time	Increase		
Travel time	Decrease		ŏ
Frequency	Increase		ŏ
Number of transfers	Increase		
Travel alternatives	More		ŏ
Information	Better		ŏ
Security	Better		ŏ

In previous sections it was argued that the captive user market should be prioritised. However, to adequately answer the question of at what levels of service and cost, it is necessary to be able to quantify how captive users are likely to respond to changes in service levels and fares - at the end of the day, specific fare levels must be set and service levels provided.

Reliable statistical methods and disaggregate demand models have been developed over a number of years to assess travel choices that people are likely to make in response to alternative transport strategies. However, the application of these methods has often been limited both by the lack of appropriate data required to estimate travel choice models and also the high cost of collecting this data.

Stated Preference (SP) survey methods potentially go a long way towards offering an effective solution to this problem. If properly undertaken, they can provide good quality information on travel behaviour and at reasonable costs. The main feature of SP methods is that they allow transport planners and analysts to *experiment.* This is an important advantage over other modelling techniques because in real life a transport planner or operator cannot easily afford to install a new transport system simply to see if people will use it, or continually alter rail fares or parking prices to see how demand will rise or fall. However, a well designed and executed SP survey can measure people's preferences towards a new transport system (such as an integrated, multimodal system) or policy (such as through ticketing), and in so doing can also take into account qualitative factors such as the standard of safety, security, comfort or information systems.

Characteristics of SP methods

There are two main ways of collecting data to estimate disaggregate travel choice models - Revealed Preference (RP) methods and more recent SP methods. RP surveys observe travel choices and decisions that have actually been made by people. SP surveys on the other hand, use people's statements about how they would respond when faced with different choices. The choices are normally descriptions of transport situations, which are constructed by the researcher. Pearmain et al. (1991) list the following characteristics of SP surveys:

(a) They involve the repeated presentation of hypothetical options (usually 8 to 16).
(b) Each option presents combinations of attributes, which describe a particular service.
(c) The researcher specifies the values of the attributes in each option.
(d) The attributes are usually presented in the context of the actual conditions currently being experienced by the person being interviewed (the respondent).
(e) The options are usually constructed on the basis of an experimental design, the purpose of which is to ensure that the variations in the attributes are statistically independent from one another.
(f) Respondents state their preferences towards each option by either ranking them in order of importance, rating them on a scale indicating strength of preference or simply choosing the most preferred option from a pair or group of options.

Figure 12 shows an example of a typical card used in a SP survey that presents two hypothetical travel options from which a respondent should choose a preferred alternative.

To make your usual journey to work in the morning you could:

OPTION 1	***OPTION 2***
TRAVEL BY CAR	***TRAVEL BY PUBLIC TRANSPORT***
Leave home at: ***06:55***	*Leave home at:* ***08:00***
	Walk to bus stop: ***5 mins.***
	Wait for bus: ***10 mins.***
Travel time: ***20 mins.***	*Total time in bus:* ***20 mins.***
	Interchange: ***4 mins.***
Walk from car to office: ***1 min.***	*Walk from last bus:* ***5 mins.***
Cost of parking: ***R1-50 per day***	*Cost of journey:* ***R2-00 per day***

Figure 12*: Example of an option card used in a SP survey*

Some important criteria which should be considered when deciding which attributes to include, and how their attached values should be varied when describing hypothetical travel choices to respondents are:

(a) Attributes should appear plausible to the respondent.
(b) Attributes should relate to the respondent's experience of each attribute.
(c) Values attached to attributes should ensure that respondents are presented with situations that require them to make trade off decisions.
(e) For attributes of particular interest, at least three levels are recommended.

(Hensher, 1993)

Advantages of SP methods

Some important advantages of SP methods are:

(a) They are easy to control because the researcher defines the conditions being evaluated by the respondents.
(b) They are flexible because they can deal with a wide variety of variables.
(c) They can be cheap to apply as each respondent provides a number of observations for variations in the explanatory variables of interest to the analyst.
(d) Due to the statistical designs, the effects of variables of interest can be isolated from the effects of other factors (ie. multicollinearity can be avoided).
(e) Where a policy is completely new, so that no RP data is available, SP techniques may represent the only practical alternative basis for evaluation and forecasting.
(f) Since the advent of cheap and lightweight portable computers, customised software is available for administration of SP surveys which has allowed great improvements in the quality of recorded data.

(Kroes and Sheldon, 1988. Pearmain et al., 1991).

Disadvantages of SP methods

The principal drawback of SP methods is that people's stated preferences may not correspond closely to their actual preferences. Reasons for divergence include inter alia:

(a) Policy response bias, which occurs if respondents believe that they can influence the outcome of the SP survey and hence any policies based on the survey results.
(b) Fatigue or boredom on the part of the respondent.
(c) The respondent not understanding what is required because of an inexperienced interviewer and/or complexity of the SP survey.
(d) Self-selectivity bias, when the respondents either inadvertently or on purpose, cast their existing behaviour in a better light.

(Ortuzar and Willumsen, 1990. Bates, 1988)

If these types of error are present, then

We are making estimates of relative preferences as expressed in a Stated Preference experiment rather than what would occur in the market.

(Bates, 1988)

Although the presence of such errors does not make estimating the coefficients any more difficult (MVA et al., 1987), the main problem occurs when forecasting. This calls for special care in the design of the SP experiments to reduce respondent fatigue, enhance realism and prevent policy response bias. In addition to these survey design and presentation measures, scaling of the SP coefficients is recommended which is done using additional RP data.

9 INTERPRETING THE RESULTS OF A STATED PREFERENCE STUDY OF MODE CHOICE IN THE CAPE TOWN INNER CITY AREA

Combined mode choice model

A useful review of most SP syuidies undertaken in South Africa is is provided by Clark (1999). In a recent example SP surveys were undertaken to to provide information on the number of car drivers living outside the Inner City Area (ICA) of the CMA that were likely to be attracted to a high quality Inner City Public Transport system (Clark et al. 1997). The results are shown in Table 9 and include the following attributes:

Table 9 : *Combined mode choice model for the Cape Town Inner City Area*

Attribute	Estimated Coefficient	t_ value	Money value (R/hour)
Car drive to work time (minutes)	-0.031	-8.52	41
Car out of pocket cost [R/day (petrol + parking)]	-0.045	-5.86	
PT in-vehicle travel time [mins. (metro + ICS)]	-0.027	-5.98	10
PT out of pocket cost [R/day (metro rail + ICS)]	-0.160	-9.92	
Metro improvements (1:improved, 0:as now)	1.338	13.85	
ASC - IC Spine	0.278	1.24	
Summary statistics:			
LL(0)	-1497.20		
LL(β)	-1314.60		
LL(k)	-1497.10		
Number of observations	2160		
Number of respondents	135		
ρ^2 market share	0,12		

- Total in-vehicle travel time to work by car
- Total out of pocket costs for the journey by car which included daily petrol costs for each respondent captured during the RP survey added to the daily parking costs which was varied during the SP survey
- Total in-vehicle public transport travel time which included time spent in metro rail to the ICA (captured but not varied for each respondent) added to the time spent in the IC Spine travelling to the final destination (was varied in the SP surveys)
- Total public transport out of pocket costs, which included the daily metro rail fare, captured during the RP surveys, added to the IC Spine fare, which was varied in the SP survey
- Metro rail improvements primarily including improved levels of security and high frequencies extended over longer peak periods

All coefficients are highly significant and have intuitively correct signs. Some observations of the model are:

- The magnitude of the coefficient for public transport in-vehicle time is very similar to that of car in-vehicle time. However, people value time when driving by car 4 times greater than they value time when travelling by public transport. This may be evidence that people have more discretionary time when travelling by public transport e.g. they are able to read, chat to friends or do things they cannot do when travelling by car. On the other hand the low value of time when travelling by public transport is somewhat surprising given the high levels of overcrowding on the rail service. One reason for this could be that respondents generally have higher incomes and would tend to travel first class and on lines where crowding is not as severe as on the Khayelitsha line.

- The magnitude of the public transport out of pocket costs coefficient is about three times that of the coefficient for car out of pocket costs. This means that an extra Rand per day increase in public transport out of pocket costs will result in a proportionally greater shift to car commuting than an extra Rand per day increase in car out of pocket costs would result in people shifting to public transport. This difference was also observed for people living in the ICA. A possible reason for this could be that over 80 per cent of respondents do not pay anything for parking as they either receive subsidised parking or else park illegally. Consequently car drivers may perceive public transport fares as being a far less avoidable cost than parking fees.
- The metro rail improvement coefficient has the lowest standard error of all coefficients estimated. This shows the importance of passenger security and frequency of service to users.
- The alternative specific constant (ASC) shows that the IC Spine has a utility that is greater by 0.3 than that for car, other factors being equal. Thus respondents perceive some unspecified benefit from using metro rail and the IC Spine relative to travelling by car.
- The ρ^2 market share of 0.12 indicates an acceptably well-fitted model.

The effect of income and parking subsidies

Recent research both in South Africa and the rest of the world has shown that income, car subsidies and the availability of parking subsidies are important determinants of travel choice. In Cape Town's ICA, employees pay significant parking subsidies to employees - approximately R100 million a year is paid to employees in parking subsidies alone. These subsidies are tax deductible for employers and are only available for parking. They are therefore a powerful incentive for people to drive to work by car. Table 10 shows coefficients estimated from separate logit models to determine these effects.

Table 10: *Comparison of coefficients of income, parking subsidies and car subsidies*

Attribute	Coefficient	t_ value
Income (0:<R4000, 1:>R4000)	0.383	3.89
Parking subsidy (0:No, 1:Yes)	0.321	3.33
Car operating / ownership subsidy (0:No, 1:Yes)	0.189	1.68

The income coefficient is highly significant and shows that the utility of travelling by car for people earning more than R4000 per month is greater by almost 0.4 than the utility of travelling by car for people earning lower than R4000 per month. Clearly income is an important determinant of mode choice within the ICA. People earning higher incomes are far more likely to travel by car than people earning lower incomes are.

The parking subsidy coefficient is highly significant. It is almost as large as the income coefficient and shows that the utility of travelling by car for people receiving a parking subsidy is greater by 0.3 than the utility of travelling by car for people not receiving a parking subsidy. Clearly the availability of parking subsidies is an important determinant of mode choice within the ICA. People receiving parking subsidies are more likely to travel by car than people not receiving parking subsidies are.

The coefficient for the car subsidy is slightly more than half that for a parking subsidy and the t-value is 1.68 indicating that the coefficient was not significant at the 5 per cent level. This is evidence that car subsides are less of an incentive to travel by car than parking subsidies. A possible reason for this is that car subsidies are often a generalised travel allowance that can be used for any mode of travel, while parking subsidies are only available to those that drive and park their cars at work. An important challenge therefore is to redirect parking subsidies towards public transport, thus increasing the travel choices available to ICA car commuters.

Developing quick policy response tools

To provide a strategic level tool to assess the likely attractiveness of an Inner City distribution service and the potential impact of associated transport policies, a simple spreadsheet model was developed from SP data to test different policy and operating scenarios.

Table 12 shows a policy scenario that was tested with the policy attributes that could be varied being shown in large bold type. Each attribute had a coefficient estimated for it using a logit model such as shown in Table 11. The attributes included:

- The daily fare charged on the IC Spine
- The travel time on the IC Spine
- Improvements to the metropolitan rail system
- Parking prices
- Car in-vehicle times

Associated with these variables are a number of other measures calculated by the spreadsheet model including:

- Elasticities
- Cross elasticities
- Total travel times and costs
- Fare and parking revenues

These measures allow the policy analyst to make quick estimates of revenue maximising fares and parking prices on the one hand and ensuring that total journey times and costs remain realistic on the other.

Once the policy analyst is satisfied with the values attached to the policy variables, the spreadsheet provides a range of summary statistics that can be customised to suit the different policy needs. An example is shown in Table 13 which provides the policy analyst with an immediate strategic assessment of key policy outputs including:

- The number of choice users attracted to public transport
- Total fare and parking revenues
- Implications for parking provision

Table 12: *Example of the spreadsheet model input variables*

Attribute	Car	ICS / Public Transport	Elasticity	Cross Elasticity	Revenue choice users (Rm pa)
IC Spine fare (R/day)		***5,00***	-0,39	0,43	24,2
Metro PT fare (R/day)		5,46			
Total PT fare (R/day)		10,46			
IC Spine travel times (minutes)		***5***	-0,18	0,20	
Metro PT times incl. walk, wait, interchange (mins)		47			
Total PT time (mins)		52			
Metro rail improvements (0=as now; 1=improved)		***0***	0,00	0,00	
Additional parking costs (R/day)	***5,00***		-0,42	0,31	16,9
Current parking costs (R/day)	1,90				
Current Petrol costs (R/day)	9,59				
Total car out of pocket costs (R/day)	16,49				
Current car in vehicle times (mins)	32				
Current walk time from parked car (mins)	6				
Additional car in vehicle time change (%)	***50%***		-0,42	0,34	

Table 13: *Example of output summary from the spreadsheet model*

Summary Statistics	Car	ICS / Metro Rail
MODE CHOICE:		
% mode choice car market - choice users	48%	52%
Car choice users am peak (thousands)	18	20
Cars off the road (thousands)		16
Capital cost per commuter attracted to PT (R000s)		50
Parking space saved square metres (thousands)		465
Parking construction cost savings (Rm)		1396
Captive users (thousands)	64	154
Total Users (thousands)	**82**	**174**
Cars driven by choice users (000s)	14	
Cars driven by non-choice users (000s)	49	

Total cars entering ICA from metro area (000s)	63	
Total external mode split (%)	**32%**	**68%**
REVENUE:		
Annual ICS fare revenue Rm		**24,2**
Potential parking revenue from choice car users	16,9	
Potential parking revenue from captive car users	59,2	
Total additional potential parking revenue Rm	**76,1**	
TOTAL ANNUAL REVENUE Rm	**100**	

10 EMERGING STATED PREFERENCE MODELLING ISSUES

International experience

Internationally, hypothetical methods using stated preference choice experiments structured around factorial designs are commonly used. Bradley (1998) observes that this approach has now reached maturity and concludes that although there is much room for improvement, most of these will tend to be marginal rather than fundamental and include:

- Advances in experimental designs.
- More intelligent adaptive experiments.
- Further advances in survey software.
- More extensive use of telecommunications.
- More established methods for combining SP and RP information.
- More comparative studies to consider transferability of preferences across time space and segments of the population.
- More comparative studies to understand how subtle changes in the presentation of hypothetical contexts can affect responses.

Polak and Lee-Gosselin (1997) identified a key shift in the way that transport data is being collected and used. This shift focuses on activity based approaches rather than trip based approaches. Reasons for these changes are:

- A focus on the relationship between travel and the activities generating the demand for travel. For example, whereas in a conventional (trip-based) approach a respondent might be asked to recall all the trips they made yesterday and the purpose of each trip, in an activity oriented approach they would be asked to recall the activities in which they participated and how they traveled between these activities.
- A strong emphasis on issues of the sequencing and scheduling of behaviour. The activity-based perspective emphasises the overall structure of activity/travel relations, both spatial *and* temporal.
- A concern with the dynamics of behaviour in terms of the relationship between different elements of behaviour within a day, the relationship of behaviour on different days and the effect of a wide range of changes in factors (socio- demographic, economic, technological or regulatory) on behaviour in the longer term.
- Household and institutional constraints are key factors influencing travel behaviour. Just as trip making is viewed as part of a wider pattern of activity participation, so the behaviour of the individual is placed within the wider context of household decision making, taking account of the consequent inter-personal and institutional constraints placed upon freedom of action.

Reflecting this shift in approach, Bradley (1998) identified the following areas of potential for extending hypothetical choice research:

- Adaptations in household activity and travel patterns
- Short and longer-term dynamics of travel behaviour
- Adoption and use of new transport technologies
- Interactions between decision makers (households, businesses, traffic systems, etc.)
- Residential and commercial land use and location decisions
- Valuation of environmental and other non-market goods
- Societal preferences across all aspects of transport policy

Observations on the South African experience

In contrast to other countries particularly in Western Europe, Australia and increasingly North and South America, there has been relatively little application of hypothetical choice methods in transport modelling and policy development. The main reasons for this seem to be:

- A history, until recently, of transport being considered as a supply driven process with relatively little attention being given to the needs of users
- A modelling approach focussing heavily on the commuting peak periods using traditional 4 step modelling process requiring calibration using RP data
- A lack of funding being allocated towards research and development of new methods of collecting data

However, the following factors appear to indicate that there will be an increasing role for the development and application of hypothetical choice methods. These include:

- The policy paradigm shift towards meeting and prioritising customer / user needs and preferences as evidenced in "Moving South Africa"
- A lack of funding that requires that new sources of finances be identified and "users pays" policies are introduced
- The implementation of policies to restrain the use of cars and promote public transport
- The restructuring of our cities and the need to increase the opportunities for disadvantaged communities to engage in a full range of urban activities
- Competition in the "global village" and the need to achieve economic efficiency

Given issues in developing, and even maturing, survey contexts such as captive users, joint decision making, low literacy levels (van der Reis, 1997) and a lack of experience with SP surveys, then it is very likely that especially great care and effort should be spent on collecting reliable information about the context within which people make current travel choices and using this as a basis to:

- identify the set of attributes which need to be considered (probably the fewer the better)
- select the measurement unit for each attribute
- specify the number and magnitudes of attribute levels
- decide how best to present SP survey instruments.

Information rich (and hence expensive) methods such as panels and focus groups are likely to have an important role to play in collecting appropriate contextual information for SP surveys. Given the heavy resource requirements of these methods, the trade off is likely to be one of higher quality information from smaller samples, rather than extensive surveys using less intensive information gathering methods.

11 CONCLUSIONS

This paper has reviewed the user needs and current public transport operations in the Cape Metropolitan Area It has shown evidence that the public transport services are unsustainable in terms of increasing subsidy requirements as well as meeting user needs effectively. Proposals to restructure the public transport system and to use SP techniques to identify and address user needs are described. At present strategies to implement these changes are being drawn up so there is no evidence on the success or otherwise of these proposals. Clearly therefore effective monitoring startegies will be needed to track the effectiveness of these proposals in meeting policy objectives.

To develop policies that effectively address the challenges facing transport authorities, problems, issues and strategies need to be identified on the basis of reliable and accurate data. However, conventional methods of collecting that data are often too costly and restricted to examining actual travel choices. While this paper provides some evidence that SP methods offer a cost-effective method of providing appropriate market research information for effective policy development in South Africa, the developing context within which SP methods are to be applied will provide many challenges and require different approaches to those most commonly applied in developing contexts.

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