CAPE TOWN'S STRATEGIC PUBLIC TRANSPORT NETWORK

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1 INTRODUCTION

Cape Town's public transport system has evolved over time, in response to changed land use patterns and travel characteristics. Until recently, planning for each mode of public transport has been left almost entirely to the various operators. While the local authorities have gradually increased their involvement in the planning process, their role in service provision has been limited. They have also engaged in planning and implementation of interchange facilities. It has been left to operators to implement service changes. Passenger rail services are planned independently by SARCC and Metrorail; minibus-taxi services have grown rapidly, partly within an outdated regulatory framework and partly as an unregulated free-for-all; and the single bus operator (Golden Arrow Bus Services) is trying unsuccessfully to maintain market share in the face of increased competition.

The public transport system is extensive, but poorly structured. It is not well focused either to achieve national policy objectives, or to provide a good level of service to the travelling public. The geographic extent of bus routes is deceptive, as 50% of them are served by only one bus trip in each of the two peak periods. The three primary modes provide transport for half of the commuting public. While this compares favourably with other cities around the world, many of Cape Town's public transport passengers have no alternative mode of transport, and are therefore captive riders. Indeed, the perception of many of these passengers is that they do not even have a choice regarding which public mode to use.

The ineffectiveness of the system, and growing dependence on subsidies from central government, have prompted a restructuring initiative. Planning for the transformation of public transport began under the banner of Cape Town's *Moving Ahead* policy investigations, and is continuing now as a project funded jointly by the Province and the City. This paper is based on the findings of a study undertaken for the *Public Transport Restructuring Project*.

The study identified a new strategic network to improve upon the existing public transport network, and drew from existing policy to guide an appraisal of the network system. An existing metropolitan travel demand model was also updated and used to enhance the appraisal process.

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2 OBJECTIVES

All levels of government in South Africa recognise the urgent need to:

- address national and local policy aimed at enhancing the ability of all South Africans to be economically active by broadening their options for accessing opportunities;
- reduce reliance on costly road infrastructure by increasing public transport mode share for commuters and other travellers;
- update the regulatory framework to support the requirements of both the travelling public and operators, and increase compliance with applicable regulations;
- improve levels of safety both on the road and in public transport vehicles; and
- support land development policies and other policies that are affected by transportation.

The restructuring process currently underway marks "a major shift in focus from the 'supply' driven systems of the past, towards an interventionist approach whereby the planning authority, through detailed and well-researched public transport plans, sets out and prescribes the public transport system. This approach entails the total transformation and restructuring of public transport into an efficient, integrated, financially viable and sustainable system based on customer needs". (*CMA Public Transport Restructuring Project: Business Plan 2000, Final Update: Jan 2001.*)

3 PUBLIC TRANSPORT NETWORK DEFINITION

It may be useful to define the term "public transport network". The National Land Transport Transition Act provides legal definitions of public transport terminology, but does not include a definition for "network". For this project, the network was assumed to include the following characteristics of the public transport system:

- route location (roads or rail track used by the service);
- corridor type (activity spine, freeway, urban arterial, etc);
- service type (feeder, line-haul, express, premium, subsidised, unsubsidised, etc).,
- level of service (headway between vehicles, periods of operation);
- passenger mix (commuter, shopper, scholar, tourist, etc); and
- vehicle type (train, bus, midi-bus, minibus).

The above list should not be seen as a formal definition, but rather as an indication of the characteristics that are considered in the formulation of a restructuring strategy. Variations in some of these characteristics were tested using the metropolitan EMME/2 travel demand model. Metered taxis and other unscheduled public transport services were not included, nor were local and inter-city charter services.

The proposed restructuring requires a transformation in the way operators, planners and users of public transport visualise the system as a whole. Historically the system has been fragmented, with planning and operational components based on vehicle type. What is proposed here is a refocusing on service provision from the user's perspective. The vehicle mix will not necessarily be based on which operator is awarded a service contract, but on which vehicles suit the type of service to be provided. This should simultaneously improve the effectiveness of the service, and operator viability.

4 NETWORK POLICIES AND STANDARDS

4.1 Passenger Service, Interchange and Vehicle Charters

The City of Cape Town's Transport Plan, *Moving Ahead*, provides short-term policy for road-based multi-modal operations incorporating charters to provide an indication of minimum desirable standards and levels of service to be provided. The charters are to be updated following user surveys, but currently stipulate requirements relating to:

- trip quality (access to services, and travelling time);
- service information and availability;
- service levels (days and periods of operation, minimum service frequency);
- passenger interchanges (to be managed, and to offer adequate security for passengers); and
- public transport vehicles (should comply with requirements relating to vehicle age, maintenance standards, accessibility for mobility disadvantaged, and branding).

It is anticipated that restructuring will be implemented with the rollout of tendered service contracts. Monitoring programmes will ensure compliance with contract clauses governing service standards. But the Service Charter is also important in structuring the network system as a whole: determining where to locate routes and interchanges, how to ensure that rationalised services provide adequate access in off-peak periods, how to design and manage the system for improved safety and security, and so on.

4.2 Institutional Policy

Institutional policies germane to the restructured network system are to ensure that:

- the system will operate and be managed under the ambit of a Metropolitan Transport Authority;
- the Integrated Transport Plan will form part of and be aligned with the Integrated Development Plan;
- services will be controlled through multi-modal, performance-based contracts;
- services will be regulated in terms of the Rationalisation Plan and the Permissions Strategy;
- integration of services will take place at inter-modal transfer facilities;
- travel demand management strategies will be implemented, including car restraint measures with priority given to public transport;
- rail services will be provided under performance-based concession agreements;
- unscheduled and premium services will be provided by a formalised and restructured minibus-taxi industry, metered taxi industry, or premium bus industry; and
- infrastructure will be provided to support the restructured public transport system and enhance the development of high density transport corridors.

4.3 Project Policy

Policy issues raised in Project Steering Committee meetings include:

- the trade-off between "no parallel subsidy" and passenger choice;
- subsidies currently cannot be shifted between modes;
- taxis are not ready for restructuring, and therefore cannot be included in the first round of tendered service contracts;
- rail focus should be on maintaining the current market share, and on building the perception that it is a permanent and accessible system; and
- there will be a decline in ridership by discretionary passengers if a single-class rail system is introduced.

5 ALTERNATIVE NETWORK OPTIONS

5.1 Short-term options

The project objective was to establish a framework for short-term restructuring. Guided by the policies previously mentioned, the following general assumptions were adopted in the formulation of network system alternatives:

- The existing rail network is well aligned to serve existing demand, and other studies have confirmed the viability or possibility of extending the rail network to serve demand that will grow in response to the attainment of MSDF land development objectives. It is therefore assumed to remain the backbone of the public transport system, in its current form. However, there is concern regarding the lack of investment (or disinvestment) in rail by national government, which is resulting in deteriorating services and eroding the ridership on this mode.
- Road-based systems are primarily in-fill line-haul services where rail is not provided, and feeder services. These will be retained, with route rationalisation and operational changes. However, should the disinvestment in rail continue, road-based systems will have to play a more prominent role as in many South American cities.
- In the short term, trip patterns and land use patterns are not expected to change significantly. Consequently, current patterns are accepted as the basis for short-term restructuring. It was recognised that there are certain distortions inherent in the current market.
- Current travel demand does not reflect a strong system of activity corridors as envisaged in the MSDF. It is a long-term objective to support the development of existing activity corridors, but predominant demand patterns that currently need to be accommodated reflect a pattern of dispersed development nodes with only sparse commercial activity along certain corridors.
- The limitation of existing funds dictates that alternative systems be non-radical in nature.
- A key requirement for the success of restructuring will be changes to institutional and regulatory systems to enable taxi and bus operations to be rationalised and integrated, and subsidies to be applied in a manner that supports the objectives outlined in this paper. It is therefore assumed that these measures will be in place for short-term implementation.

5.2 Network System Definition

There are limited options for short-term rationalisation or restructuring. The EMME/2 model was used to assess the following network scenarios:

Alternative 1: Base. The current network based on 1998 bus (652 routes) and minibus-tax data and 2000 rail data.

Alternative 2: Restructured. The core/feeder system proposal with 98 core and supplementary routes, and 77 feeder routes.

The Alternative 2 proposal is a refinement of the *Moving Ahead* provisional networks. The general concept of Alternative 2 is to provide a clearer structure with a sense of permanence and universal access, to eliminate parallel subsidised services, and to move away from a commuter-based orientation to encompass a broader travel market. This will be achieved through more clearly differentiated networks and services, better integration of networks, services and fare systems, a more appropriate vehicle mix, and a clear hierarchy of stations, stops, termini and interchange facilities.

Currently there is excessive suburban penetration by routes that provide door-to-door (and often meandering) service between origin and destination. As shown in Figure 1 overleaf, there is no apparent hierarchy or form. The proposed network will rationalise these routes into a simplified core network, with supplementary services in the peak periods, and greater reliance on feeder services to improve system access.

Figure 1: Roads currently used for bus routes.

The proposed strategic network (Figure 2) is based on the assumption that:

- the rail system is retained in its present format (most likely option in the short-term);
- the core road-based systems will serve major demand origin-destination routes (line-haul services) that are, in general, not served by rail (they will also connect with the rail system);

- the road-based system will consist of a number of core routes serving major origins and destinations, and where they intersect with train services, transfer nodes will be set up to allow passenger transfers to take place (these core routes would operate at relatively higher frequencies over an extended time period);
- stops along the core network will be restricted to keep journey times as short as possible (consequently, roads on the core network will be candidates for dedicated transit or high occupancy vehicle (HOV) facilities);
- the core road-based system will be supported by a supplementary or in-fill system to provide origin-destination routes for areas not reached by rail or the core system (this route system will tend to operate like the core system during peak periods only);
- supplementary services in the peak periods provide extra capacity for line-haul routes, and also reach deeper into residential areas than the core services (in the off-peak periods these services contract in length, to act as feeder services to the core routes);
- the total number of bus routes will be reduced from 652 to 98 (core and supplementary) routes;
- the core and supplementary road-based public transport system will use standard buses (high capacity) in the main;
- lower capacity feeder services will operate on a district or suburb level and act as the link between local areas and the core services;
- routes on the feeder network will operate within local areas with terminal points on the core network as their focus (feeder routes will radiate from the terminals to local areas); and
- transport subsidies will be adjusted to favour core services, peak-period supplementary services and services which feed the system by means of an integrated ticketing system.

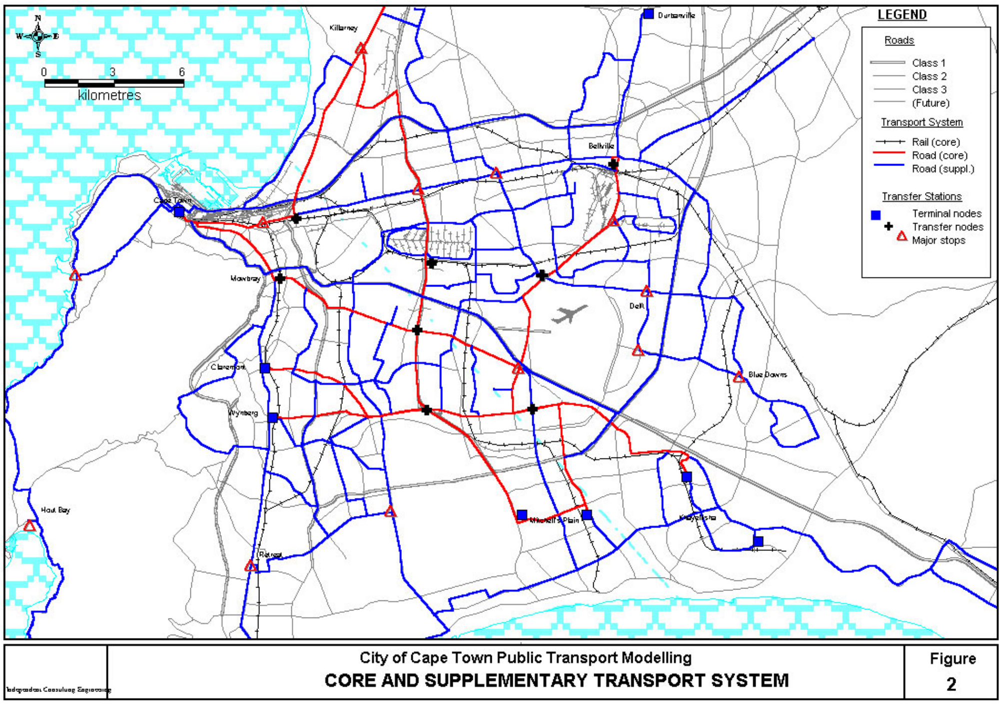

Figure 2: Restructured network (Alternative 2)

5.3 Preliminary Network Modelling

Alternative 1 was the base EMME/2 model network used as a benchmark for modified networks. Before establishing the previously discussed structure for Alternative 2, two other alternatives were modelled to test the sensitivity of the model to reduced numbers of routes and reduced transfer costs, as follows:

Alternative 1a: Rationalised. As in Alternative 1 except the number of bus routes were reduced from 652 to 188 routes, including the addition of seven core routes.

Alternative 1b: Rationalised and Integrated. As in Alternative 1, except the boarding fare (penalty) associated with the core road-based routes system was reduced to zero to replicate free transfers as would occur with an integrated ticketing system.

Alternative 1a cuts out 534 bus routes. The effect on transfers is an increase from 1.37 to 1.48, which is relatively small, compared to the large number of routes omitted from this network. Similarly, the mean travel time increase would be relatively small. Operating costs, however, would be reduced significantly as a result of the dramatic reduction in the number of routes. Bus boardings would drop by 40 per cent with a corresponding shift to both rail and minibus-taxi services.

Alternative 1b, which would allow users to board the core routes without a boarding penalty cost, would show a large shift back to the core bus routes (compared with Alternative 1a). Bus ridership would increase as the mode would be more attractive (lower boarding costs) and the number of boardings would quadruple. Passenger boardings for all the modes combined would increase from 564 000 to 770 000 (compared to Alternative 1a) with a corresponding increase in transfers of 33 per cent. Passengers would make many more transfers to access the core routes. Operating costs per boarding would shift between the modes but would not change significantly overall.

5.4 Operating Costs

Cape Town's current public transport system is costly to operate. Bus subsidies are escalating at an alarming rate as ridership declines, and the rail service operator is plagued by widespread fare evasion. Minibus taxis do not receive government subsidy, but observations suggest that profit margins are inadequate for the provision of safe services on a sustainable basis. Some of these problems stem from factors that cannot be addressed through network restructuring alone, but initial modelling indicates that the proposed system can help improve operator viability.

The EMME/2 model uses route travel times and headways to estimate the number of vehicle trips required per hour – a crude measure that ignores implementation costs and overheads, but one that provides relative operating costs that help compare alternatives. The cost data is summarised in Table 1.

In comparing Alternative 2 with the base case, the model shows that overall operating costs increase due to the higher frequency of core and supplementary services, even though the number of routes is reduced. In the initial comparison, this increase is 20%, but this does not allow for fine-tuning components of the route design as passenger demand responds to the improved system. Headways in particular can have a significant impact on costs. For ease of comparison, the assessments carried out assume total passenger demand to remain constant in terms of the number and distribution of trips. Current distortions are therefore built into the restructured system design, on the basis that these will take some time to work themselves out. Over the medium term, it can be expected that a more responsive system will compensate for the theoretical increase in operating costs.

Under the preferred system (Alternative 2), as the number of passengers using the system are kept constant, the number of boardings increases because of the increased reliance on transfers with fewer routes. (The number of boardings is not equivalent to the number of passengers carried.) The operating cost per boarding therefore decreases. Contrary to this overall increase in boardings, taxi boardings decrease due to their relegation to feeder services. This is not a result of decreased ridership, but because the current taxi system features an exceptionally high number of transfers between taxi routes – illustrating the benefit of high-frequency service.

While bus and rail operators experience a modest increase in cost per passenger, taxi operators experience a dramatic decrease as a result of the elimination of taxi line-haul routes. The system has a greater reliance on taxi feeder services, so taxis reduce trip lengths without sacrificing the total number of passengers. This strengthens the possibility that taxi feeder services can be commercially viable without subsidy.

Table 2: EMME/2 Operating Costs (Rands*)

Alt.	Mode	Operating Cost	Boardings	Cost per Boarding	Cost per Pass-km	No. of Passengers	Cost per Passenger
Alt. 1	Rail	1 569 500	246 500	6.4	0.39	224 814	7.0
	Bus	470 900	162 200	2.9	0.19	60 053	7.8
	Taxi	278 400	125 400	2.2	0.38	119 729	2.3
	All	2 318 800	534 100	4.3	0.32	404 597	5.7
Alt. 1a	Rail	2 069 900	287 000	7.2	0.47	224 814	9.2
	Bus	232 500	109 200	2.1	0.14	60 053	3.9
	Taxi	278 400	168 600	1.7	0.27	119 729	2.3
	All	2 580 700	564 800	4.6	0.36	404 597	6.4
Alt. 1b	Rail	2 069 900	180 500	11.5	0.75	224 814	9.2
	Bus	232 500	457 400	0.5	0.06	60 053	3.9
	Taxi	278 400	132 500	2.1	0.61	119 729	2.3
	All	2 580 700	770 400	3.4	0.37	404 597	6.4
Alt. 2	Rail	2 069 900	339 100	6.1	0.41	224 814	9.2
	Bus	643 100	226 800	2.8	0.26	60 053	10.7
	Taxi	71 500	43 900	1.6	0.75	119 729	0.6
	All	2 784 500	609 800	4.6	0.37	404 597	6.9

Notes:
1. The method used to determine operating costs in EMME/2 is based on the route travel times and headways, which are used to estimate the number of vehicle trips required per hour.
2. * Rands per peak period – for comparative purposes only
3. Cost columns 3, 5 and 6 are based on the EMME/2 assignment outputs, columns 7 and 8 are based on trip matrix data from the Current Public Transport Record
4. Source: City of Cape Town, Public Transport System Development, September 2001.

5.5 Other Implications of the Restructured Network

A concern with restructuring is that rationalising routes may force existing operators to reduce fleet sizes. If the overall number of peak-period passengers remains unchanged, this may be a consequence of a more efficient system. Two factors should minimise this effect, however. One is that the restructuring will be rolled out over a period of time, and is intended to include recapitalisation of current fleets in any case, so fleet sizes could be reduced through a combination of natural attrition and fleet replacement. The other factor is that a more effective system should increase ridership overall.

In the short term, however, the model results suggest that there need not be a dramatic change in bus fleet size, even assuming the fully restructured system were implemented quickly. This is primarily because of the increased frequency of service on the rationalised network of routes.

Fleet size is one issue that impacts on operator commitment to the restructuring process. Other potential constraints have been identified as:

- policy compliance (such as social equity and SMME entry);
- economic and financial constraints (with impacts on subsidy levels);
- independent fare levels and structures (limiting the ability to implement through-ticketing);
- institutional limitations (particularly commitment of current operators);
- regulatory issues (notably delays in formalising the taxi industry and the inability to alter subsidy allocation methods); and
- committed and planned projects (such as HOV lanes, transport interchanges and road corridor plans).

The results of the appraisal of the proposed strategy indicate that a number of these constraints present significant challenges for short-term implementation of the proposed network structure (or any other network restructuring, for that matter).

The appraisal also considered the ability of the proposal to improve public transport system effectiveness and efficiency. In general, it is possible for the proposed network structure to address these concerns. Results show that the proposal has the potential to:

- improve integration of services;
- improve off-peak services;
- increase security by concentrating core services in high-volume corridors;
- maintain current levels of affordability;
- support spatial planning policy;
- allow for differentiation of services;
- improve the vehicle mix for better economics;
- increase viability of high-frequency services; and
- provide a mutually reinforcing effect between road-based core and rail, and between core and feeder services.

Resolution of a number of issues will depend, however, on the next level of planning, when networks, routes and services are designed in more detail.

6 CONCLUSIONS

While the restructured network system assessed in this study is not the only possible one to be considered, it appears to accommodate most of the objectives of the short-term restructuring process. Its primary benefit will be in rationalising and clarifying a system that currently is extensive but not very effective or efficient. Rationalisation could also be achieved in a manner that minimises disruptions to current passengers and operators, although there remain a number of obstacles to transformation.

The basic structure of Alternative 2 is presented in Figure 1. The initial appraisal of this system has shown that it is technically feasible and has the potential not only to provide a more coherent system from the user's perspective, but also to establish an effective framework for incremental implementation of improvements to a number of aspects of service provision.

To ensure success, there are a number of obstacles to overcome, but the following key benefits are inherent to the proposed structure:

- bus operators benefit from reduced competition from taxis, and greater focus in their operations;
- taxi operators benefit from reduced trip distance without reduction in total passengers carried;
- the rail operator benefits from improved feeder services and reduced off-peak competition; and
- passengers benefit from high frequency services and reduced transfer costs, offsetting the inconvenience of an increased number of transfers.

Overall the system operation costs are not likely to dramatically increase or decrease in the short term, but there is a significant short-term benefit in the establishment of a more stable and clearly defined system. The tender process for service contracts can proceed within this system framework. Over a longer period, the system will be adjusted as passenger demand responds to restructuring and other forces.

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