Mass Transit – Is It Feasible for Johannesburg, South Africa?

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Abstract: - This paper examines the possibility of developing a realistic estimate of demand for mass transit in the metropolitan region of Johannesburg, South Africa. Public transportation in this area is almost non-existent. Since the end of apartheid in 1994, the focus of the new government has been on redevelopment. The Reconstruction and Development Program is a nationwide government effort to develop a suitable infrastructure for the people. The composition of the paper will address cultural, economic and competitive analysis of the affected region. The paper will then offer a conclusion and recommendation of the proposal for mass transit.

Key-Words: - Mass Transit; South Africa; Public Transportation; Personal Rapid Transit (PRT); Taxi 2000 Corporation
1 Introduction
The purpose of this forecast is to develop a realistic estimate of demand for mass transit in the metropolitan region of Johannesburg, South Africa. Public transportation in this area is almost non-existent. What is available is unsafe and unreliable. Private transportation companies, such as minivans and taxis, have overtaken public services as the most popular mode of transport. These vehicles have a high accident rate, no standards of maintenance, no schedule and no advanced booking. They simply wait until full. Since the end of apartheid in 1994, the focus of the new government has been on redevelopment. One of the most overpowering problems facing the city today is an unemployment rate of over 40%. More than 700,000 people flock to the city each year because the rural areas can no longer support them. To add to the problem is an estimated 4 million illegal immigrants who have flooded the job market. The city is surrounded by satellite townships which are inadequately serviced by medical care, schools, stores, and transportation. It is estimated that approximately 80% of the city’s population lives in these towns.

The Reconstruction and Development Program (RDP) is a nationwide government program to provide a suitable infrastructure for the people. Initially, the program will focus on housing, water, electricity, clinics, and schools. Eventually, the city will need to face the problem of public transportation to support these services and to make them accessible to all. The government is committed to this reconstruction and the economy is open to foreign trade and investment. Incentives are offered to potential investors and there appears to be great entrepreneurial opportunities [1].

There is talk of Johannesburg hosting the Summer Olympics in the future. Cities that don’t have some type of mass transit system are at an extreme disadvantage. Atlanta’s mass transit system moved 25.3 million people in 17 days during the 1996 summer games.

To completely and sincerely support equal opportunity, to handle the unprecedented growth, and to evolve into the economic powerhouse that it has the potential to be, the city will have to consider mass transit as the missing link.

2 Problem Formulation
The Republic of South Africa is rich in diversity. It is a bewildering mix of culture and language. And it is a paradox of sunny, peaceful landscapes with clusters of violent, crime-ridden cities. The area itself encompasses 474,000 square miles, 41 million people, and 11 official languages. It is 5 times the size of the United Kingdom and ranges in altitude from sea level to 11,178 feet. It is a natural wonder with everything from rainforests to deserts, mountains, to prairies, and 1,800 miles of coastline.

The country is divided into 9 provinces and 3 capitals: Capetown, the former British capital, is the home of the legislature; Pretoria is the administrative capital; and the judiciary branch is located in Bloemfontein, capital of the Orange Free State.

Almost every mention of South Africa is associated with memories of Apartheid. It is therefore necessary to include in this section a historical background. Early recorded history goes back to the Portuguese and the establishment of the trade route to India. Eventually the Portuguese lost their dominant trading position to the Dutch and the British and in 1682 the first white community established a settlement in the Cape. Over the years the Dutch were joined by Germans and French Huguenots. By the 1770’s, many settlers (Voortrekkers) had moved far beyond the original boundaries in their quest for land and independence from British control, and eventually came into contact with more indigenous people. Many tribes joined together into defensive alliances. The presence of the settlers led to violence and horrible battles. Not only was their conflict with the native peoples, these “Boers” were fighting with the British who were attempting to establish a federation in southern Africa. When gold was discovered in 1886 the Transvaal became the richest and most powerful nation in southern Africa and the British eventually took control of the whole of
modern South Africa and its mineral wealth. In 1910 the Union of South Africa was created. The colonial government elected only whites and English and Dutch became the official languages. With the additional discovery of the gold mines this poor and little-known country became rich, powerful and famous. The lives of the wealthy contrasted greatly with the increasing poverty of the rural poor.

The country was involved in several wars between 1881 and 1902, the majority of which were between the British and the Boers. Ultimately the British gave limited self-government to the Boer republics. By 1918 the Afrikaner (Boers) and the British joined together in the idea that the superior white race should assist others towards a goal of reintegration. In 1920 the Native Affairs Act established the principle of political segregation. In 1948 the word "apartheid" was coined when a new political program instituted separate beaches, benches, building entrances, and public lavatories. Group areas were defined as White, Black, Indian, or Colored (mixed race). People lived where the state told them to live. The outside world was gradually made aware of the atrocities in South Africa and in 1986 international sanctions were imposed. Finally, in 1990, President F. W. de Klerk denounced the concept of apartheid and repealed the discriminatory laws. But true political emancipation was finally realized with the election of Nelson Mandela in 1994 [2].

Since 1994 the economy, battered by the effect of the sanctions, has been slowly recovering. Sanctions are gone and exports are rising. The South African government must proceed skillfully and delicately. Whites, who are the majority of taxpayers, cannot understand why they are paying more and receiving less. The Black community is waiting for its slice of the cake [2]. Of course the image of white against Black is far too simplistic and unrealistic. Today, many cultures and races live and work side by side. And everyone is waiting to see what will happen in this new South Africa. It is going to take time for the political, educational and economic institutions to change.

This Rainbow Nation is estimated to be 3.5 million white, 3 million of mixed race, 1 million Indian and 33.5 million black. The black population is further divided into tribal grouping based on language. They are descendents of original inhabitants, immigrants from mid and northern Africa and imported slaves from the East Indies. Most whites are Afrikaner or English. Afrikaans is the first language (15 percent of the population) followed by English (9 percent) followed by the nine main black languages. English is the main language of government and business. There are Afrikaans and English newspapers, radio and television stations.

The majority of the population is Christian with the most common being the Dutch Reformed Church. Other churches include the Church of England, Roman Catholic, Methodists and the Church of Zion. There is also a large Jewish population. No matter what the faith, South Africa is characterized by a religious and conservative people [3].

More than 80 percent of the population lives in towns located around the cities. These shanty towns consist of homes of plastic and cardboard which often house more than one family. Schools and medical care are scarce [1]. Further statistics include:

- 20% have no education
- 16% live in shacks
- 62% earn less than $300/year
- 50% have no toilet
- 55% have no running water in their homes
- 35% have less than 9 years of education

Outside of the major cities, most of South Africa seems empty. Only tribal homelands still exist. South Africa is a large sugar producer, along with wheat and corn. Grapes are an important crop. Much of the fruit that is grown is exported to the Northern Hemisphere during their winter. The agriculture sector is regulated by the government who assists in pricing and financial help.

Since the discovery of gold, mining has been a major factor in the migration of workers to the city. Another growing industry is tourism. The government-run international information bureau encourages and coordinates tourism. Tourism is up 24% since 1994 and is considered a catalyst of economic growth. It is estimated
that one permanent job is created for every eight tourists.

South Africa is served by three major international airports. The country’s South African airways serves over 500 destinations and has won numerous awards in the past year [4].

The postal service is good and the telephone system is adequate but most residents rely on mobile communications. Most hotels and businesses have fax and telex and can usually arrange for e-mail connections [5].

The cities have a tremendous problem with crime and there are large segments of Johannesburg that are considered extremely unsafe. Travel is discouraged after dark and precautions are necessary at all times.

2.1 Economic Analysis

The South African economy is comparable to the South American and upper African economies in World Bank statistics. It, alone, accounts for 25% of the GNP of the African continent. It is one of the largest producers of gold and diamonds and is one of the world’s major trading nations. It is a wealthy nation, but it is also a nation of incredible poverty, high unemployment, and increasing crime [6].

**GNP:**

South Africa is an upper-middle income country, having per capita GNP of US $3,160 in 1995. The rate of real per capita GNP growth over the 1985-95 period was –1.1% p.a., reflecting negative rates from 1990 to 1992. Since 1994, real GDP growth has been healthy, if uneven, led by the manufacturing and tourism sectors [3].

For many years, the country has relied on gold as a major source of its export income and the ensuing tax revenue. The importance of mining has made South Africa dependent on world mineral prices and has created some instability in the economy. The country is looking at expanding its manufacturing capabilities. South Africa has one of the most sophisticated manufacturing industries in Africa. Agriculture is diverse. Many fruits and vegetables are grown and exported. However, mining and agriculture are on the wane – manufacturing and services now accounts for 40% of the GDP.

The political situation of the 80’s devastated the economy. The GDP had a falling growth rate from 1960 through to the new elections of 1994. The politics of these years contributed to the migration of many trained professionals out of the country. The labor force fell short of skilled workers. The country now faces a situation where the majority of the skilled labor is white (in short supply), and the majority of the unskilled labor force is black (an oversupply with low education) [7]. Total workforce (excluding agriculture) in 1995 was 14,497,000, with 27.1% employed in government, 14.4% in trade, 12.3% in mining, 7.6% in construction, 6.4% in services, 4.2% in public corporations and 28% in manufacturing. The unemployment rate was officially 33% in early 1996; these figures do not include rural underemployment. Jobs in the formal sector are fiercely competed for. Numerous labor problems have resulted in poor productivity. One half of the labor force is unionized. The labor movement has been highly politicized which has made industrial relations more complicated.

The reform of the education system in South Africa is a priority of the new government. As stated in the annual report of the Council for Higher Education: “South Africa cannot tolerate a decline in enrollments in public higher education or a weakened public system. The social and economic consequences would be severe” [8]. The managing director of IBM South Africa, Dennis Hearon, emphasizes the importance of education to the economy: “Education and economic growth are a cycle, one feeding the other. ….any gain in the one area will feed the other and make the next success easier to achieve” [9]. South Africa’s Labour Minister, Membathisi Mdlalana says the low skills base is one of the reasons for the poor levels of investment in the economy. He believes the answer lies in raising investment from the current 17% of GDP to at least 20% [7].

The South African Schools Bill, passed in 1996, introduces compulsory schooling to redress inequalities. It is hoped that by the year 2000 pupil-teacher ratios will be reduced to 40:1 in primary schools and 35:1 in high schools. The new National Curriculum, planned for 1998, focuses on a learning outcomes approach, with a
special focus on technology education [10]. The South African Human Sciences Research Council estimates an illiteracy rate 50%; the international estimate is 18%.

The business of townships is organized along less structured lines than those in the city centers. These townships run most small businesses. Contribution by this informal sector to the GDP is 10-20%; for example, the private black taxi industry has overtaken the public bus service as the most popular mode of transport. The private sector is fairly capital intensive. More than ½ of expenditure on GDP is by private consumption. Private sector ownership is dominated by a few large companies that, through subsidiaries, dominate the market. Seventy-five percent of the GDP is owned by the private sector.

Since sanctions have been lifted opportunities have increased. South Africa has great potential and actively encourages foreign investment [11]. The economy is open to foreign trade. There is a system of exchange control, but dual exchange rates have commonly been used to encourage foreign investment. Incentives are offered to potential investors. The commitment of the government to reconstruction and development has created a great entrepreneur opportunity [12]. Some of the current incentive initiatives include:

- Exemption from some excise duties
- Tax-free cash subsidies based on export turnover
- Subsidies for building in certain areas (to encourage higher employment)
- Free export promotion by the Department of Trade and Industry

New business has minimum legislative interference due to the Business Act of ’91 that abolished trading licenses and restrictions on trading hours. South Africa is indeed keen on diversifying its market and maximizing trade [13].

The new generation of South African leaders seeks to create a caring society that can successfully meet the material needs of its people [14]. The basic goals of the new government are to achieve sustainable growth, development and improved standards of living. This goal of growth and development is central to the country’s transformation. The nation’s wealth base must be increased as the quality of life is increased. Implementation of programs is necessary for the redistribution of wealth and income for the inclusion of all. Job creation, in particular, is emphasized as a major tool of the redistribution of income. Economic growth requires an industrial policy that ensures more investment in infrastructure, transport, telecommunications, and housing. It is vital for the government to attract investment capital and that this capital be used to address the industrial needs of the country while also directing resources to rural and poverty-stricken areas. It is the government’s belief that public resources should be used to expand the economic base and to provide affordable services to all people [14]. The center of the financial system is the reserve bank. Technically, it is a private company but is, in reality, an arm of the government. Companies are classified as either domestic or external. External companies are taxed at 35% on income sourced from South Africa but profits can be disbursed to the non-resident company with no withholding of taxes. The other alternative is for a non-resident to establish a locally incorporated subsidiary. Then the profits are taxed at the standard rate of 35% and dividend payments are subject to a 15% withholding tax in the form of non-resident shareholders tax. There is no social security but employers must pay workmen’s compensation and unemployment insurance. The reduction of the corporate tax rate has increased profitability [15].

The Growth, Trade, and Investment Statistics for South Africa for 1996 through mid-1999 is in Table 1.

<table>
<thead>
<tr>
<th>Table 1</th>
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<tbody>
<tr>
<td><strong>ECONOMIC INDICATORS</strong></td>
</tr>
<tr>
<td>1996</td>
</tr>
<tr>
<td>Real GDP Growth (%)</td>
</tr>
<tr>
<td>Real Fixed Investment (%)</td>
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<td>Real GDE Growth (%)</td>
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<tr>
<td>Main Imports (Rm)</td>
</tr>
<tr>
<td>Machinery</td>
</tr>
<tr>
<td>Oil-Mineral Products</td>
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<tr>
<td>Chemical Products</td>
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<tr>
<td>Main Exports (Rm)</td>
</tr>
<tr>
<td>Precious Metal/Gems</td>
</tr>
<tr>
<td>Base Metal</td>
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<tr>
<td>Mineral Products</td>
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Table 1 Continued

<table>
<thead>
<tr>
<th>ECONOMIC INDICATORS</th>
<th>GROWTH, TRADE, AND INVESTMENT STATISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance of Payment</td>
<td></td>
</tr>
<tr>
<td>Physical Imports</td>
<td>118 658</td>
</tr>
<tr>
<td>Physical Exports</td>
<td>130 206</td>
</tr>
<tr>
<td>Service Imports</td>
<td>42 722</td>
</tr>
<tr>
<td>Service Exports</td>
<td>26 252</td>
</tr>
<tr>
<td>Net Transfers</td>
<td>-3 206</td>
</tr>
</tbody>
</table>

Current Account Balance

<table>
<thead>
<tr>
<th>Financial Capital Movements</th>
</tr>
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<tbody>
<tr>
<td>-4 128</td>
</tr>
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</table>

Other Adjustments

<table>
<thead>
<tr>
<th>Foreign Reserves Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>-7 184</td>
</tr>
</tbody>
</table>

2.2 Competitive Analysis

2.2.1 The Product

According to Todd Litman of the Victoria Institute, increased mobility from transit provides economic benefits by allowing individuals access to education, jobs, and public services [16]. Limited mobility of non-drivers contributes to several social problems, including incomplete education, unemployment, social isolation, and ill health, which impose economic as well as other costs. This implies that employers are unable to obtain the best workers for their needs, and that disadvantaged communities may be missing economic development opportunities. Public transit can provide these benefits, including job creation, local expenditures and productivity gains. Automobile expenditures tend to provide relatively little regional economic activity because they are capital intensive and mostly imported from other regions, while transit services are largely locally produced and labor intensive. A 1999 Texas case study found that a 1% shift in regional travel from automobile to public transit causes a $2.9 million in regional income, resulting in 226 additional regional jobs [17].

Research for the World Bank indicates that automobile dependency reduces regional economic development, while transit investments can increase regional productivity. Macroeconomic research indicates that transit improvements can provide twice the return of highway investments. However, any transportation investment only contributes to economic development if conditions are ripe. A new or improved rail line or station can provide a catalyst to local economic development.

A study sponsored by the American public Transit Association found that each $1 million spent on public transit:

- Creates 31.4 jobs if spent on capital investments.
- Creates 57 short run local jobs if spent on operations.
- Provides $3 million in business sales.
- Provides $1.5 million in transportation savings (reduced congestion and vehicle costs).
- Increases long run business output by $3.1 million, and personal income by $1.8 million.

Possible products that could meet the demand for mass transit include bus, bicycle, above ground light rail systems. However, most countries realize that public transport has a central role in the development of a sustainable transport system. It is considerably more energy efficient and creates more jobs than the private car and it covers longer daily distances that walking and cycling [18].

Competition

According to a DOT report, only 18 percent of national roads are regarded as being in very good condition [19]. Most are considered reasonable except in poor black rural areas. The taxi industry is still largely informal and existing regulations are difficult to enforce. Province-run bus services have suffered – mostly from under-investment and the trade war between them and the privately owned minibuses, the ‘black taxis’. A substantial rail network serves not only South Africa with its mining and heavy industries but also neighboring countries. Services were privatized in 1990. Transnet is the transport company which owns the major domestic and international airline (South African Airways), the railways, a major coach tour operator, scheduled coach services, and a number of tourist attractions. Spoornet, a division of Transnet, runs the rail network, including mainline passenger traffic and freight. Rail commuter service, predominantly trains, take 2.1 million workers into six city centers each weekday and these trains remain under state control. Commuter trains have become a
sensitive political issue as, during the pre-independent troubles, terrorists used the packed commuter trains for random mass killings with terrible effect. Autonet, another concern, operates a reliable and competitive road transport system. It has been a separate commercial undertaking since April 1988 operating on a countrywide basis and competing in the passenger and freight transport markets [20].

2.2.2 The Market

Demographics
Population: 37,859,000 (preliminary figure, 1996 census), at an average density of 34 per sq km, and increasing at 2.4% p.a. (1985-95 average). Birth rate 31 per 1,000. Life expectancy (1995) is 66 years (68 for women and 63 for men). The population is ethnically mixed: in 1995, black people were estimated to constitute 76.5%, whites 12.6%, coloreds (mixed race) 8.5% and Asians 2.4%. The African linguistic groups comprise Zulu (38.5%), Xhosa (11.6%), Sotho (27.2%), Tswana (6.6%), Shangaan/Tsonga (6.7%), Swazi (4.4%), and several smaller groups.

Age structure: 0 - 14 years: 34% (male 7,541,840; female 7,403,235); 15 - 64 years: 61% (male 13,180,925; female 13,312,917); 65 years and over: 5% (male 798,825; female 1,188,644) (1999 est.).


Labor force – by occupation: services 35%, agriculture 30%, industry 20%, mining 9%, other 6% [21].

In Table 2 is a demographic profile for the Johannesburg/Pretoria area (Gauteng Province) as offered by the Human Sciences Research Council [22]. It shows that this area is largely urban with only the fringe being rural. In the southeast the Farmlands lifestyle segmentation dominates. The Miners’ Glory lifestyle category occurs in the western and northern parts of the province and has lower per capita and household incomes. The urban areas surrounding greater Johannesburg and Pretoria are distinctly different in lifestyle categories with the Highbrow dominating in Johannesburg while the Jongens dominate in Pretoria and in the east and west Rand. Both categories have a high per capita and household income. The Highbrow category is dominated by English speaking people; the Jongens is dominated by Afrikaans. The Highbrow category also tends to be younger. The townships all tend to form part of the African Ngani lifestyle category. In Atteridgeville the African Ngani lifestyle category predominates with Mjondolas and Yokels also occurring. Mjondolas are the informal settlements and Yokels are the hostels that are often associated with African townships.

<table>
<thead>
<tr>
<th>Jongens</th>
<th>Highbrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population size</td>
<td>Population size quite low</td>
</tr>
<tr>
<td>Household income</td>
<td>Household income in the R30 000-R150 000 range</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Predominantly western-style houses with a few townhouses</td>
</tr>
<tr>
<td>Predominantly</td>
<td>High number of full paid off houses with many half paid off dwellings</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Household size between 1-6 with 2/4 person family dominating</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Highest number of employers</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Quite low unemployment and people not working</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Mostly females</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Predominantly Whites with a few Africans</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Per capita income is between R15 000-R30 000</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Population age group between 15-49 years</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Predominantly English speakers with quite a few Afrikaans</td>
</tr>
<tr>
<td>Predominantly</td>
<td>Highest education levels with most number of university graduates</td>
</tr>
</tbody>
</table>

Table 2

Yokels

<table>
<thead>
<tr>
<th>Large population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households earn income in the R20 000-R70 000 range</td>
</tr>
<tr>
<td>Predominance of hostel-type dwellings</td>
</tr>
<tr>
<td>Predominant household size 6 people</td>
</tr>
<tr>
<td>Predominantly employees</td>
</tr>
<tr>
<td>Low unemployment or people not working</td>
</tr>
</tbody>
</table>
Yokels
- Predominance of males
- African population
- Per capita income R7 000-R10 000
- Dominant age is between 25-39 years
- Mainly Zulu and Xhosa speaking people
- Few with no education
- Many with education up to Standard 7
- Urban area

Miondolas
- Populated
- Households earn income in the R2 000-R15 000 range
- Predominance of informal settlement dwellings
- Household size 2-6 people
- Many not working with relatively few unemployed
- More males than females
- Mostly African population
- Average per capita income is between R1 000-R1 5000
- Young population of ages below 24 years
- Zulu and Xhosa speakers predominate with some Tswana and South Sotho speakers
- Education levels up to Standard 3
- Many with no education
- Urban area

African Ngani
- Populated
- Households earn income in the R7 000-R30 000 range
- Mostly western-style houses with many rented
- Household size 2-6 people
- Many not working with relatively few unemployed
- More females than males
- Mostly African population
- Average per capita income is between R2 000-R15 000
- Predominantly Zulu-speaking with some North Sotho speakers
- Education up to Standard &
- Many with no education
- Predominantly townships

Promotion Opportunities
Newspapers: Six daily nationals (four English, two Afrikaans) and four Sunday nationals (three English and one Afrikaans) are published, most carrying magazine and/or other supplements. Twenty-one other daily/national weeklies (17 English and four Afrikaans) are published in major centers. About 220 other newspapers are published, mostly community newspapers in the country areas. The majority (about 90) are weekly with the rest monthly or bi-monthly.

Magazines: Three financial weeklies and a total of about 700 magazines are published in the RSA. In addition, over 100 titles are published annually. All the magazines are published mainly in English and/or Afrikaans.

Radio and Television: The South African Broadcasting Corporation (SABC) was created by an act of parliament in 1936 as a statutory organization. Today the SABC broadcasts 22 internal radio program services in 11 languages, one external radio service in seven languages and two official television services in seven languages. A third service, utilizing the spare capacity of the official services, is also broadcast.

The country is also capable of producing first class advertising. South Africa is considered on par with the best in the industry of sophisticated media production [23].

Pricing
Pricing would be competitive with current systems and, in all likelihood, would be government regulated. The government has set forth criteria that any public transit system would be able to provide an appropriate and affordable standard of accessibility to work, commercial, and social services in rural areas. Additionally, any public transport system must be affordable, with commuters spending less than about 10 percent of disposable income on transport.

A key link between transport supply and demand is the price that is paid for access to transport. A characteristic of transport in cities everywhere is that the price of transport (especially on congested roads) rarely reflects full social costs, since elements such as congestion, noise, and pollution are not recognized by users. Since no mode covers its full costs, fares on public transport cannot cover operating and capital costs. Planning will therefore need to take place in the recognition that public transport fares will not produce 100 per cent cost recovery, and that much public transport infrastructure will be provided at taxpayers’, not users’, expense. However, where there is scope for private sector involvement in the provision or support of infrastructure, that opportunity should be sought.

3 Problem Solution

3.1 Potential Market Demand
South Africa has inherited a public passenger transport system that is under-performing
against its obligation to achieve national goals such basic mobility, basic access, and social integration. Workforce mobility is restricted, creating friction around national efforts to create employment opportunities. The current system leaves residents unable to access key services that they need, and the system’s overall inefficiency is creating high requirements for subsidy. The South African Department of Transportation recognizes public passenger transport as a basic need and has established certain goals to meet this need, some of which are:

- To promote the use of public transport over private car travel.
- To ensure that passenger transport services address user needs, including those of commuters, pensioners, the aged, scholars, the disabled, tourists, and long distance passengers.
- To improve accessibility and mobility, limiting walking distances to less than about one kilometer in urban areas.
- To promote safe and secure, reliable and sustainable passenger transport.

The public passenger transport system in South Africa should be based on regulated competition. Where public transport services require government funding support, competition should take the form of tendered contracts so as to encourage competition.

The findings of the intensively data-driven Moving South Africa Project have established a set of key strategic problems and challenges which, taken together, provide the framework for public passenger transport in South Africa. (See Table 3)

### Table 3

<table>
<thead>
<tr>
<th>National Objective</th>
<th>Gap</th>
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<tbody>
<tr>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td>Stranded cannot afford to travel</td>
<td>Cost: 1996 = 23%, 2020 = 25%</td>
</tr>
<tr>
<td>Most survival spend more than 15% of income</td>
<td>Cost: 1996 = 12%, 2020 = 13%</td>
</tr>
<tr>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>30% of DoT subsidized bus trips exceed 40 Km target</td>
<td>Cost: 1996 = 17%, 2020 = 19%</td>
</tr>
<tr>
<td>12% exceed target</td>
<td>Cost: 1996 = 9%, 2020 = 10%</td>
</tr>
<tr>
<td>4% exceed target</td>
<td>Cost: 1996 = 9%, 2020 = 10%</td>
</tr>
<tr>
<td>Public Transport Share</td>
<td></td>
</tr>
<tr>
<td>Motorized trips by public transport = 80% of total</td>
<td>Cost: 1996 = 23%, 2020 = 25%</td>
</tr>
<tr>
<td>Currently 47% of motorized trips by public transport</td>
<td>Cost: 1996 = 12%, 2020 = 13%</td>
</tr>
</tbody>
</table>

When viewed as a whole, the South African urban transport system is performing relatively poor against the needs of key groups of customers, as well as against overall national objectives. The Stranded and Survival segments are particularly badly served in terms of cost, travel times, and choice. One segment that is well served, however, is the Stubborn, which benefits from high-income levels and a good road network for their cars. Even though the Stubborn are somewhat dissatisfied with the convenience of the system, by international and local standards they are exceptionally well served.

#### 3.1.1 Feasibility

Rising levels of car use create additional congestion. A car – even carrying four occupants – is far less efficient than any other mode. Commuter rail and buses, at full capacity, offer the greatest capacity per meter. Thus, in an environment where funding and other resources for expanding road capacity are severely constrained, car use significantly impedes getting maximum value for public infrastructure investment. In order to discourage the use of private vehicles, there must be acceptable alternatives. Some choices are upgrading of bus fleets, developing a more effective metered taxi industry, or allowing the use of HOV lanes by multiple-occupant cars [24].

#### 3.1.2 Estimated Market Size

The market size can be subdivided into six separate categories as differentiated in the Moving South Africa report shown below in Table 4 [25].

### Table 4

<table>
<thead>
<tr>
<th>Customer Segments</th>
<th>Key Transport Needs (prioritized)</th>
<th>% of SA Urban Population</th>
<th>Number in 1996</th>
<th>Growth to 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Stranded</td>
<td>Convenience</td>
<td>Cost</td>
<td>1996 = 23%</td>
<td>2020 = 25%</td>
</tr>
<tr>
<td>• Strider</td>
<td>Convenience</td>
<td>Cost</td>
<td>1996 = 12%</td>
<td>2020 = 13%</td>
</tr>
<tr>
<td>• Sensitive</td>
<td>Convenience</td>
<td>Speed, Choice</td>
<td>1996 = 9%</td>
<td>2020 = 10%</td>
</tr>
<tr>
<td>• Selective</td>
<td>Convenience</td>
<td>Speed, Choice</td>
<td>1996 = 9%</td>
<td>2020 = 10%</td>
</tr>
<tr>
<td>• Stubborn</td>
<td>Convenience</td>
<td>Speed, Choice</td>
<td>1996 = 9%</td>
<td>2020 = 10%</td>
</tr>
<tr>
<td>• Survivor</td>
<td>Convenience</td>
<td>Speed, Choice</td>
<td>1996 = 9%</td>
<td>2020 = 10%</td>
</tr>
</tbody>
</table>

TOTAL Urban Population: 21.4 million (38% (1.4% pa))
The cost of providing affordable access to the Stranded is substantial and has been calculated to be an additional 50% of the existing subsidy payments.

The average age of existing commuter rail equipment is 25 years old, creating steadily increasing maintenance costs and resulting in slower speeds and increased travel time for customers. No new stock has been added to the fleet in the last five years and maintenance costs have escalated sharply. Reinvestment in the amount of $5 million (US dollars) or more per annum is required to halt rising costs and improve operational safety.

In the early 1990’s, the Buenos Aires commuter rail system was in poor condition. After decades of under investment combined with inefficient operations, infrastructure and equipment was dilapidated, service was poor and the system operated at a very high cost. In 1993, the Argentine government opted to split up the system and to contract the parts to private operators. The savings totaled $150 million per annum compared to over $500 million before the concessioning. The result is that the winning bidders have improved the performance of the system substantially. Ridership has increased and the condition of the system has improved.

Although Argentina and South Africa have very different prevailing conditions and unique urban environments, the example from Buenos Aires provides instructive lessons on stabilizing commuter rail systems. Additionally, the example illustrates that the involvement of private companies and competition can be beneficial. Some suggestions include:

- Create a playing field in which businesses are self-sufficient financially.
- Create competition wherever possible.
- Recover full costs from users but do not charge users above the full cost in order to support infrastructure and operations that do not provide them with benefits. This could be phased in over time as unemployment drops.

### 3.1.3 Estimated Revenue/Sales

A comparative evaluation of the options must consider a range of issues including:

- Potential passenger demand and the capacity of each option to accommodate it.
- The cost of construction.
- The cost of operating the system.
- Other impacts, including the environment, land use, safety, accessibility for mobility impaired people.

According to the Bureau of Transportation Statistics, transit costs can be estimated as follows [26]:

<table>
<thead>
<tr>
<th></th>
<th>Bus</th>
<th>Trolley</th>
<th>Light Rail</th>
<th>Heavy Rail</th>
<th>Commuter Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Expenses (m)</td>
<td>$8,995</td>
<td>$135</td>
<td>$440</td>
<td>$3,402</td>
<td>$2,284</td>
</tr>
<tr>
<td>Capital Funding (m)</td>
<td>$1,020</td>
<td>$19.1</td>
<td>$847</td>
<td>$2,228</td>
<td>$1,690</td>
</tr>
<tr>
<td>Total Expenses (m)</td>
<td>$10,915</td>
<td>$154</td>
<td>$1,287</td>
<td>$5,630</td>
<td>$3,984</td>
</tr>
<tr>
<td>Passenger Fare Revenue (m)</td>
<td>$3,446</td>
<td>$55</td>
<td>$1,143</td>
<td>$5,308</td>
<td>$1,145</td>
</tr>
<tr>
<td>Subsidy (m)</td>
<td>$7,469</td>
<td>$99</td>
<td>$1,287</td>
<td>$3,984</td>
<td>$2,839</td>
</tr>
<tr>
<td>Vehicle Revenue Miles (m)</td>
<td>$1,577</td>
<td>13.1</td>
<td>36.7</td>
<td>527</td>
<td>221</td>
</tr>
<tr>
<td>Total Expenses Per Revenue Mile</td>
<td>$6.92</td>
<td>$11.75</td>
<td>$34.78</td>
<td>$10.68</td>
<td>$18.03</td>
</tr>
<tr>
<td>Annual Passenger Miles (m)</td>
<td>16,802</td>
<td>184</td>
<td>955</td>
<td>11,530</td>
<td>8,350</td>
</tr>
<tr>
<td>Average Vehicle Occupancy</td>
<td>10.7</td>
<td>14.0</td>
<td>26.0</td>
<td>21.9</td>
<td>37.7</td>
</tr>
<tr>
<td>Total Expenses Per Passenger Mile</td>
<td>$0.65</td>
<td>$0.84</td>
<td>$1.35</td>
<td>$0.49</td>
<td>$0.48</td>
</tr>
<tr>
<td>Revenue Per Passenger Mile</td>
<td>$0.21</td>
<td>$0.30</td>
<td>$0.15</td>
<td>$0.20</td>
<td>$0.14</td>
</tr>
<tr>
<td>Subsidy Per Passenger Mile</td>
<td>$0.44</td>
<td>$0.54</td>
<td>$1.20</td>
<td>$0.29</td>
<td>$0.34</td>
</tr>
</tbody>
</table>

In his paper, Todd Litman estimates public transit subsidies as depicted in Figure 1.

**Figure 1**

1997 Public Transit Subsidies

This figure illustrates the source of transit funding.
Table 6 illustrates a use of the Transit Benefit Matrix with data on the value of U.S. transit benefits in 1990-1993. The measurement approach is in parentheses. A few cells overlap. Total transit costs in 1990 were approximately $17 billion. Fine-tuned for local conditions, the public choice transit benefit matrix can be used for any transit system or project. The Lewis and Williams book explains in detail the concepts and methodology.

Table 6
Public Choice Transit Benefit Matrix
Suggested National Measures

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market Exchanges</td>
</tr>
<tr>
<td>Affordable Mobility</td>
<td>S21 Consumer Surplus for Low Income Households (Econometric Analysis)</td>
</tr>
<tr>
<td>Location Efficiency</td>
<td>S9.6 Avoided Auto Ownership Costs for Nonpoor Households (Survey Data; Census)</td>
</tr>
<tr>
<td>Congestion Management</td>
<td>S4.6 Auto Fuel Time Savings (Transit Models)</td>
</tr>
</tbody>
</table>

It is estimated that in American cities, close to half of all urban space goes to accommodate the automobile, leaving more devoted to cars than to housing. In the Johannesburg/Pretoria areas the explosive number of residents places land at a premium. Additionally, a billion dollars invested in mass transit produces 7,000 more jobs than does the same amount spent on road construction.

4 Conclusion
In its 1996 White Paper on National Transport Policy, the South African DOT defined its mission for land passenger transport as the ability “to provide leadership in the promotion of a safe, reliable, effective, efficient, coordinated, integrated, and environmentally-friendly land passenger transport system in South African urban and rural areas and the Southern African region, managed in an accountable manner to ensure that people experience improving levels of mobility and accessibility”.

Expert opinion provides that buses, light and heavy rail have proven to be troublesome and ineffective. Their productivity is with the result that they are commonly considered uneconomic and unacceptable for needed expansions of transit service in poorly served areas. Systems are needed that can provide significantly better service at significantly lower cost through automation [27].

Financing should not present a problem. As illustrated by the press announcement below, the World Bank recognizes the need to improve mass transit [28].

WASHINGTON, March 5, 1998
The World Bank today approved a US $186 million equivalent Rio de Janeiro Mass Transit loan – which includes up to US $18.6 million in retroactive financing – to help improve the mass transit system of the city of Rio de Janeiro. The project will benefit thousands of low-income households in Rio de Janeiro’s metropolitan region, which has 9.8 million inhabitants, and is one of the largest in the world. The estimated cost of the project financed by the loan is US $373 million. The US $186 million equivalent loan is repayable in 15 years including a grace period of 3 years at the Bank’s fixed interest rate for single currency loans in US dollars.

4.1 Recommendation
Based on all of the above, it is our recommendation that South Africa consider the Personal Rapid Transit (PRT) mode of public transportation [29]. Tremendous scientific and practical advances in ITS (inter-traffic systems) have taken place and today, the subject deserves global attention. One of the biggest challenges ITS professionals will face the next century is the explosive growth in knowledge affecting their discipline [30].

Taxi 2000 is a company which, in conjunction with Raytheon Corporation, has developed a PRT system. A Taxi 2000 system costs $10 million per mile compared $300 million per two-way mile for a
subway. For the same cost as a narrow four-mile strip of subway with five stations, Taxi 2000 would provide 170 stations in a 5.5-mile-by-8.0-mile network with practically all of the area within a one-quarter-mile walk. Operating and maintenance costs for Taxi 2000 will be about 8 cents per passenger-mile compared to 27 cents for the subway, 29 cents for the bus, and 42 cents for the streetcar (light rail) [29].

Why PRT? As the director of the Taxi 2000 Corporation, Dr. J. Edward Anderson, states, PRT (Personal Rapid Transit) systems offer the following advantages:

- Take passengers directly to their destination without stopping at any other stations.
- Operate on demand – not on a schedule where passengers have to wait for service.
- Offer safety, privacy, and personal security.
- Are cost effective, primarily due to low capital and operation costs.
- Are automated, eliminating the cost of drivers and allowing for improved scheduling.
- Require minimal disruption of roadways and businesses along alignments during system construction or expansion.
- Do not take up lanes of traffic on city streets.

No other transportation option currently being considered offers all, or even most, of these advantages. In addition to the direct advantages as a transportation system, PRT systems positively affect a number of other issues, such as:

- Less fatigues and harried employees
- Fewer and shorter street disruptions
- Lower street-repair costs
- Use of land made easily accessible
- More efficient movement of goods
- 24-hour availability
- Less need for expansion
- More efficient use of parking facilities
- Better integration of society
- More livable high-density communities
- Resources freed for other purposes
- Faster accessibility to work, stores, clinics, and schools
- Safe, swift movement of mail, waste, and goods
- Freedom of movement for the handicapped, children, and the elderly

Perhaps the biggest area of concern in this area is with safety. PRT can effectively provide a higher degree of security than any other mass transit system. Each vehicle is occupied by passengers riding alone or together by choice. If someone tries to force his way into a vehicle, a button can be pushed inside the vehicle to alert the police. The stations can be television monitored with two-way voice communication. They are small areas that can be surveyed easily, and infrared detectors can be used to detect the presence of people so that the operator, in slack times, need not constantly view the screen. A video memory unit can make a permanent record of the last passenger to egress from a vehicle [31].

Finally, revenues could be collected by fare, taxes, subsidies, and advertising (at stations and in the cars). PRT systems are already in production and are available immediately. They are the only transit systems which offer many of the advantages of the automobile. Due to this and because of the relatively low cost both to build and to operate PRT systems, transit planners, business and government leaders, and communities around the globe are increasingly coming to realize the advantages of PRT over conventional transit systems [32].

References:
[1] Peter, Joyce, *South Africa*


[5] *South Africa, Land of Splendour*


[20] *South Africa Travel Guide*, Promco

[21] *National Business Institute of South Africa*


