PAST AND PRESENT TRAVEL PATTERNS IN THE GAUTENG CITY-REGION

Research report commissioned by the Gauteng City Region Observatory

Transport Planning Research Group
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We thank Dr Julia Mambo for her input on the GIS maps.
Executive Summary

Transportation infrastructure, in the region, has been moulded to a large degree by the history of the dominant cities found in the region. That said, the provision of infrastructure is crucial to the further economic development of Gauteng, especially in the face of a massive rise in the population of the province, thus, it is critical to understand the effects the current infrastructure has on travel patterns and travel times. Unfortunately, the old - and the new - political regimes of the region, used the ‘predict and provide’ model of transportation design, which has the effect of enhancing road infrastructure, and thereby strengthening road transport (vehicles and trucks) above other forms of transport, rail in particular. Although investment in buses too, has been neglected, despite their dominance in the public transport sector. In this regard, the report recommends that future focus should rather be on travel demand management.

The report focuses on two main research areas: (1) An analysis of the long term transportation trends by comparing four transport studies, the 1975 PWV Survey; the 1985 PWV survey; the 2000 Gauteng Transport Study and the 2003 National Household Travel Survey and (2) Analysis of the results of the 2009 Quality of Life study undertaken by the GCRO. The 1975 and 1985 surveys were racially skewed and so some degree of apprehension must be used when interpreting the results. With regards to the 2009 QoL study, there are limitations to it, as it was not specifically designed as a transport survey. The 2009 QoL survey also has data capturing errors. Demographic skewness is marked, in terms of race, age and education levels. That said, there is a strong corroboration between all five surveys.

This report shows that, systematically there has been an increase in private vehicle ownership and automobile dependence over time. Initially this was confined to the white population, but post 1994 there has been a steady increase across all races, as incomes rise, although car ownership, is still strongly racially based. This report also shows the rise of the ‘quasi public’ transportation system of minibus taxis, especially post 2000. To that end, the minibus taxi industry represents a type of outsourcing of public transport provision, as there has been a clear shift away from trains and buses to minibus taxis. Thus, a clear long term trend is the massive under-provision of an effective, efficient and low cost public transport system, the most glaring poor investment being in rail, with none in light rail at all.

Residents of the region do not shun public transport, however, rather there are just too few buses and trains for them to use. Few use rail, but those who do tend to live within walking distance of railway stations, are usually male, poor and African. The region also lacks an integrated transport infrastructure, so most residents only make use of one transport mode, although those who do use multiple modes, tend to be African males. Modal choice is most strongly influenced by income, not geography. The poorer the
individual, the more likely they are to use minibus taxis, for example. The richer they are, the more likely they are to own a car. Minibus taxis have the added advantage that most people usually only have to walk a maximum of 10 minutes to access one, half the time required to access a bus or train. Overall, there has been an increase in the number of trips individuals make, especially Home-Based-Non-Work trips.

The 2009 QoL survey shows that most people live and work in the same city, with Centurion the only exception. For example, residents of Tshwane tend to work in Tshwane. Inter municipal travel is, thus, the exception rather than the norm. The exceptions being people traveling into Tshwane from Ekurhuleni and from Alberton into the Johannesburg CBD, all of whom have to use private vehicles and minibus taxis to do so. Some Ekurhuleni residents do travel into Johannesburg as well and if they reside in Germiston, they can and do make use of rail, the rest rely on either minibus taxis or private cars.

Those who travel from Tshwane to Johannesburg and into Centurion, are mostly white, male and use private vehicles. This ability (due to finances and car ownership) by white males may be one reason why, despite employment equity, they are more likely to be employed than Africans. Even white females are less likely to own a car and less likely to travel great distances. Overall, all men spend more time travelling than women, a factor strongly linked to distance.

Johannesburg residents spend the least amount of time travelling, residents of the Far East Rand spend the most, even though they are the least likely to own a car, despite the fact that car ownership is strongly linked to employment in places such as Boksburg and Benoni. Worse is that those residents who are the least able to pay are travelling the furthest. Very few people walk to work, but those who do are most likely Sowetans.

This report finds that part of the transportation challenge lies in the character of the cities and towns of Gauteng, as low density urban sprawl is the norm. This means that public transport needs high levels of cross subsidization to make it affordable. Thus, land use planning (to reduce sprawl and improve use of inner city space) needs to be done in conjunction with transport demand management if this is to be rectified. Mixed land use must become the future norm if the negative effect of high transport costs and congestion are to be reduced.
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1. INTRODUCTION

1.1 Background

Transportation infrastructure, and the development thereof, in Greater Johannesburg has been moulded to a large degree by the history of the city. In particular, the informal nature of its founding, thanks to the original Gold Rush, the impact of separate development and later, Apartheid, as well as the dawn of democracy have impacted upon transport-related infrastructure and development. Currently, the Gauteng City Region is the heart of South Africa’s economy and, as such, the provision of infrastructure is crucial to further economic development in the region. Both the old and new political regimes adopted the ‘predict and provide’ method by which important decisions regarding the design and upgrade of transportation networks were made. The new controversial Gauteng Freeway Improvement Project (Toll Roads) are an example of this. However, the predict and provide method relies heavily on the collection of reliable transportation data. One means of collecting such data is through the use of transport surveys. These surveys are then used to predict the challenges facing the transport sector so as to guide the development of solutions to these challenges. The data collected from past surveys also contains invaluable information that can be used to understand trends in travel patterns (and their associated transportation challenges) over a period of time.

Overall, the ‘predict and provide’ method has resulted in government simply providing more road infrastructure, with a specific focus on private vehicles and, as of late, trucking. It is crucial to start to question if this is an effective solution to the challenges facing commuters (Rodrigue et al, 2006). It is argued here that, in order to successfully manage a region’s transport system, greater focus should be placed on implementing travel demand management strategies, which will limit the growth of motor vehicles on the road. The post apartheid rise in a black middle class has exacerbated the number of private vehicles on the road, as this growing middle class both desires the independence granted by private vehicles and needs them to access jobs and
education. One strategy that can address this challenge is increasing the usage of public transport and another is re-thinking the urban planning models that have been in use. A clear trend emerging from research is massive under-provision of an effective, efficient and low cost public transport system, especially for those of limited financial means (Beukes, 2011). This is despite the unveiling of the Bus Rapid Transit (BRT) and the Gautrain. As sustainable urban growth is dependent on efficient public transport, it is imperative that the public transportation system within the region be developed to international standards (Zhao, 2010). A significant challenge to any city government trying to implement such a public transport system is that ridership must be high. In South Africa, where urban areas are characterised by extremely low densities and massive urban sprawl, this will be a serious and significant hurdle to overcome (Shaw, 2006). Thus, another crucial aspect to transport planning in South Africa in general, and Gauteng in particular, is urban land use planning.

1.2 Aim and objectives

This report seeks to examine both past and present commuter trends in the Gauteng City-Region\(^1\). In particular, the intention is to discuss commuting trends in the light of recent developments in the transportation system of the Region. More specifically, this report achieves two broad objectives.

1) An analysis of historical changes in trip generation, trip purpose and modal split in the Gauteng City-Region is undertaken. This analysis is based on the results of the following transportation surveys:
   - the 1975 PWV Transport Study undertaken by the then Transvaal Provincial Administration Roads Department,
   - the 1985 update of the PWV Transport Study,

\(^1\) NOTE: In this report, the Gauteng City-Region is defined in terms of the geographical area across which data was collected in the 2009 Quality of Life survey conducted by the Gauteng City-Region Observatory. This largely accords with the geopolitical boundaries of the Gauteng Province but also extends beyond these borders to include key economic areas outside of the Province, such as Potchefstroom and Rustenburg. The region itself was not defined by the authors but by the GCRO.
• the 2000 Gauteng Transport Study (GTS), and
• the 2003 National Household Travel Survey (NHTS)

2) Thereafter, the results of the 2009 Quality of Life (QoL) undertaken by the Gauteng City Region Observatory (GCRO) are discussed, with the goal of identifying critical transportation corridors within the Gauteng City Region and determining the extent to which the development of new public transportation infrastructure (such as the Gautrain and Bus Rapid Transit) is in line with current commuter trends.

1.3 Limitations of this study

The limitations of using secondary data include (but are not confined to):

• The 2009 data used was not directly collected to answer specific transport questions, but rather the transport data was collected as part of a larger GCRO quality of life survey.

• The authors are of the opinion that field workers engaged for the 2009 QoL Survey may not have been familiar with the challenges relating to interpretation. We are not sure if they fully interrogated the interviewee as to what they meant when certain questions were asked. For example: the issue of time taken to get to work and cost of daily transport.

• The data was collected in 2009 and so there is a time lag between collection and analysis.

Further limitations in analysis of the data are discussed in the relevant chapters that follow.

1.4 Outline

The remainder of this report is structured in line with the broad objectives discussed above. First, the historical datasets are used to illustrate commuter trends in trip
generation, trip purpose and modal split. Thereafter, the results of the GCRO’s 2009 QoL survey are discussed. In a separate section, data obtained from the 2009 QoL survey is used to identify critical transportation corridors in light of recent transportation upgrade projects. Concluding remarks on the current state of mobility in the Gauteng City Region are then offered.
2. Challenges Facing Transportation in South Africa: A Review of The Literature

2.1 Introduction

Transport and education are widely accepted as the two sectors which provide the highest returns, both economically and socially, for the development of a country (Copley, 2010). Thus, there is a need to efficiently and effectively develop the existing transportation network to secure the future growth of the Gauteng City-Region. Currently, the region is characterised by a lack of user friendly, cost effective and integrated transportation infrastructure. The result is a negative impact on economic activity, job creation and cost of living. The unnecessarily high costs of living, is a burden borne especially by the most economically and geographically vulnerable residents of the region.

It is important to recognise that transportation infrastructure is intimately linked to urban spatial planning and land use. For example, India has a very distinctive transportation system due to high urban densities, mixed land use patterns and the resultant spike in short trip demand. In cities like Delhi, for example, high density and mixed land use enables many to walk to their destinations or use non-motorised transportation (Tiwari, 2001). In South Africa, however, there is little doubt that the legacy of spatial apartheid planning has significantly contributed to the many transportation challenges faced by her cities. In particular, past urban planning (or lack thereof) encouraged urban sprawl, low density housing and a lack of mixed land use (Simon, 1992). Thus, South African cities are characterised by inadequate residential planning. This has placed upward pressure on private vehicle demand, resulting in increased automobile dependence and road congestion over time. The predict and provide method then creates a negative feedback loop for this, as more cars demand more (and wider) roads, which are then built and so the process evolves overtime into an unsustainable situation.
2.2 Urban spatial planning in South Africa

Without doubt, the history of Johannesburg has played a crucial role in the development of transport infrastructure. One of the most significant developments has been the decline of the original Johannesburg CBD and the subsequent rise of competing CBDs, almost all the north of the original. That said, post-1960, there was a definite trend to expand shopping centres at least, in a southerly direction as well. This is evident in Figure 1, which depicts the growth of the Johannesburg Central Business District (CBD) from 1900 until 1992.

In addition, racial segregation has long been part of South African history and such discrimination was also practiced in the transportation sector: the use of ‘black’ horse-drawn trams and ‘black’ electric trams was common in Johannesburg in the 1890’s, for example (Pirie, 1989; 1990). These trams were restricted to limited routes which made it difficult for black people to gain easy (and cheap) access to places of work. Where technological advances in transportation were made, these tended to benefit only the white population (Beavon, 2001). In addition, due to segregation laws, policies and traditions, there was an entrenched practice of what amounted to a wholesale ‘dumping’ or relegation of black people to the periphery (where land was cheap). The net result was black people in general were forced to live on the outskirts of the city. For them travel was long, costly and inhibited their ability to access jobs and urban services. The consequence of this legacy is still being felt in the South African urban landscape today.

In 1948, the National Party came to power and launched a more stricter and more enforced form of racial segregation known as “Apartheid”. In particular, spatial segregation, which was the norm albeit not rigidly enforced, became rigid and legalised through the Group Areas Act (No 41) of 1950. One of the consequences of the act was forced removals of people, particularly black people, to the urban periphery. In particular, spatial apartheid entrenched the fact that poor people lived in low density houses on the urban periphery, despite their inability to pay for the transport costs associated with this (Boddy-Evans, 1998). Areas such as Orange Farm, Soweto,
Lenasia and Eldorado Park are just a few of the many places that were established on the urban periphery (Carrim, 1990 cited in Parnell & Beavon, 1996). Thus, South African cities inherited residential areas that are poorly connected in terms of transport, with those least able to pay having to travel the furthest. The following section investigates these challenges and their impact on transportation.

Figure 1: Areal growth of Johannesburg and central Witwatersrand 1900-1992 (source: Whitlow & Brooker, 1995)

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2.3 Urban Sprawl

The effects of poor urban planning can still be seen to be embedded in urban infrastructure today. The result is a huge imbalance in access to transportation and a lack of connectivity between various suburbs, townships, cities and regions. As such, Gauteng has a poorly developed transportation network that is unable to effectively cater for both rich and poor Gauteng residents (Simon, 1992). Unfortunately, urban sprawl has not declined since the abolition of apartheid post 1994. This is partly because of the manner in which our cities are set up and partly because of poor control over urban settlement (both formal and informal). Furthermore, although people can move around freely now, many cannot afford to move house. Thus, for many of the Region’s residents, the daily experience of poverty, overcrowding and unemployment continue to limit their choice of residence and mode of transport.

South Africans in general suffer two indignities: low incomes and high unemployment rates. To some extent this is a consequence of low levels of education and literacy in the general population, a direct consequence of Bantu Education. In part then, low levels of education mean that people either cannot get jobs or can only get poorly paid ones. This affects transport provision as most people do not have sufficient disposable income to spend on transport and housing. Thus, they seek out the lowest cost housing and the lowest cost transport. As it is easier to find low cost housing on the urban periphery, this usually means that they have to pay more for transport than what they can actually afford (Beavon, 2001). It often means that job opportunities are either missed or rejected because ability to get to work is minimal. However, this spawns a vicious circle. Poor people must live on the periphery but become trapped there due to the high cost of transport and often cannot take on low paying work as it would cost more to get to work than what they would earn. They are then forced to remain living on the periphery in conditions of abject poverty. Such people cannot afford public transport which is exceptionally expensive due to low urban densities and high urban sprawl. Because of this, a transport solution cannot be implemented without a deliberate
attempt to change the manner in which the city is laid out. In particular, a policy of densification needs to be followed and the boundaries of the city need to be strictly monitored. The rapid growth of the Gauteng City Region and its ever expanding boundary is thus a key concern for transportation infrastructure development within the region.

Thus, it can be concluded that urban sprawl in South Africa has resulted in poor use of urban land, rural encroachment, automobile dependence, congestion, expensive public transport and limited access to transport by poorer people (Yusuf & Allopi, 2004). Overall, urban sprawl has negatively impacted on the quality of life of all South Africans, whether poor or wealthy.

2.4 Automobile Dependence and Congestion

One of the results of a lack of integration of transportation and land use planning in South Africa has been automobile dependence, a phenomenon that is increasing over time. This has led to increased demand for road construction and parking, which has further led to low density urban expansion and increased development costs. The free reign allotted to cars has fostered uncontrolled urban expansion, resulting in scattered and isolated suburbs. At the same time, recent economic growth has increased motor vehicle usage and cars are no longer viewed as luxuries but necessities. People actively aspire to shift from public to private transport. This shift needs to be curtailed where possible as it simply increases social inequalities and reduces a sense of common community (Burgess, 2000).

A solution put forward to dampen the demand for cars is densification based on Transit-Orientated Development (TOD). TOD is a development style based on mixed residential and commercial areas which are designed to create easily available and readily accessible entry to public transport. This type of development is typically characterised by a centre with a transit station or stop (train station, metro station or bus stop) such as the type which can be found in the new Bus Rapid Transit (BRT) system.
being implemented in Gauteng. The stations are surrounded by high density development with low density developments spreading outward from the centre (which unfortunately is not always found in the case of the Gauteng BRT). TOD must be located within a maximum of 800m from a transit stop, so that pedestrians can easily access transit by foot. A combination of TOD, economically and socially acceptable public transportation and a restitution of the lack of mixed land use, is the most viable and environmentally sustainable approach to attaining densification and a reduction in automobile dependence (Harden, 2011).

The most obvious result of automobile dependence is congestion. According to Chakwizira (2007), congestion can be defined as the intense overload of the road network capacity due to regular or irregular reductions in service quality which is further intensified by travel times or a variation thereof.


- **Recurrent congestion** is caused by factors related to rapid population growth, urbanisation and an increase in car ownership or car dependence. In this scenario, there are too many cars on the road, traffic speed is reduced and travel time significantly increased. Morning and afternoon peak traffic flows are typical of this type of congestion.

- **Non-recurrent congestion** arises due to special or unique conditions, such as road accidents, the transportation of abnormally large products or the maintenance of road surfaces (Banjo, 1984).

The cities of the GCR suffer from BOTH types of congestion, with some days both types overlapping i.e. a unique condition, such as the overturning of a large loaded truck during peak morning or afternoon traffic. In such incidences, a commute time of between 2 and 3 hours is not an uncommon occurrence.
The effects of congestion are vast, ranging from a loss in productivity and time to the degradation of the environment due to noise and air pollutants and a loss of quality of life (Serageldin, 1993). The severe effects of congestion on the individual have led to people relocating their homes, moving their jobs and changing schools (Chakwizira, 2007). Thus, the management of congestion is of paramount importance.

Gauteng, as the economic hub of the country, has an increasing amount of congestion on its key corridors. Figure 2 shows the extent of congestion on the provincial and national road network. Although congestion is one of the signs of a growing economy, if managed poorly, it can reduce economic growth in the long term. This is because congestion leads to a loss of income and a decline in the economic activities of a city. Some of the signs that congestion is excessive are: when it occurs across a large geographic space, when the peak hour extends to numerous hours, when it is a regular occurrence, when users actively plan their days around avoiding congestion and when tolerance levels have reached a nadir. In Gauteng, congestion is increasingly problematic and if not controlled may lead to a decline in the regional economy if it has not already (Garner et al, 2001).

One of the foremost solutions put forward to solve the problem of congestion is travel demand management (TDM). The goal of TDM is to reduce the amount of motorised travel, particularly during peak periods (Del Mistro, 2008). There are many options available for the implementation of TDM. These include: (1) increasing average vehicle occupancy through carpooling, (2) increasing car prices or fuel costs and (3) creating high occupancy vehicle lanes. In short, TDM aims to address congestion by (1) making public transport more attractive price wise compared to other modes and (2) making the use of an alternate mode more feasible (for example, through densification of corridors). Further TDM options include: shortening trip distances, removing the overall need for trips, the introduction of flexible working hours or telecommuting (Garner et al, 2001). To date, in the GCR, only car pooling and high occupancy lanes have been piloted, neither of which have been met with huge success.
Figure 2: Congestion on provincial and national roads in Gauteng (Garner et al., 2001)
2.5 Public Transport in the Gauteng City Region

The current status of the transportation modes used in the Gauteng City Region will be discussed in the following sections of this review.

2.5.1 The Minibus Taxi Industry

The South African taxi industry arose in the 1970’s as a result of a loophole in the Road Transportation Act of 1977 (Schalkwyk, 2008). At present, 65% of the South African work force dependent on public transportation uses minibus taxis to get to work (Department of Transport, 2003). However, the minibus taxi industry is self-regulated (Schalkwyk, 2008). Consequently, the industry is marred by violence, poor safety and low profit margins. Moreover, the unregulated nature of the minibus taxi industry has resulted in overtraded routes thus resulting in low profit margins for operators (Fourie & Pretorius, 2005).

Fourie and Pretorius (2005) contend that a balance between short term profitability and long term sustainability has to be found in order for the industry to survive. They further contend that at present, taxi operators favour short term profitability over long term sustainability which is typical of SMME’s. The result is that many taxis are overloaded and not properly maintained (Govender and Allopi, 2006), many are un-roadworthy (Fourie and Pretorius, 2005 and Browning, 2001) and the typical taxi is 13 years old (Govender and Allopi, 2006). As such, in its current form, the minibus taxi industry is unsustainable (Browning, 2001).

In November 2004, Government approved the revised minibus taxi recapitalisation policy (worth R7.7 billion, see Table 1) (Fourie and Pretorius, 2005). However, Schalkwyk (2008) suggests that this policy is flawed due to the biased nature of the policy formulation process. For example, government wants all minibus taxis to run on diesel, whereas taxi operators oppose this as diesel engines have higher maintenance costs. Moreover, not all role players within the taxi industry (drivers, fare collectors,
cleaners and rank marshals) or the general public, were consulted during the policy implementation phase (Schalkwyk, 2008). Furthermore, the policy is only concerned with replacing fleets to increase road safety, not curbing route overtrading (Fourie and Pretorius, 2005). Consequently, taxi operators are operating their new minibus taxis on the same overtraded routes. The result is costs of the new taxis are higher, but margins are not. Thus, government may be compelled to subsidise this industry, thus stretching the subsidy budget (at R2.9billion) even further, encroaching on monies currently paid to the bus sector (Fourie and Pretorius, 2005; Walters, 2010).

- Improve the quality of service of the taxis
- Improve the safety of travellers
- Provide more affordable operations
- Improve convenience to travellers
- Migrate from a cash-based fare payment system to a cashless fare payment system
- Monitor route operation, usage and revenue
- Monitor critical parameters in the vehicle and report deviations

Table 1: Taxi recapitalisation objectives (Source: Marsland, 2011)

2.5.2 Urban Bus Transport

The formal public transportation sector is led (in terms of passenger numbers) by the urban bus sector (Schalkwyk, 2008). This sector moves 858 000 passengers per day (Department of Transport, 2003). However, the sector is plagued with problems associated with the allocation of subsidies (Walters, 2010). The South African White Paper on National Transport Policy was approved in 1996 and was to be used to provide guidelines for the restructuring of the commuter bus industry (Walters, 2010). The main objectives of this policy were to improve competitiveness within the commuter bus industry through competitive tendering and providing transparency between government and bus operators. Moreover, this policy called for wholesale changes in the awarding of contracts as government wanted to move towards a system where contracts would have to be tendered for (Walters and Cloete, 2008). At present,
however, urban bus transport contracts are divided into ticket based and tender based contracts. Ticket based contracts are contracts wherein government subsidises bus operators based on the number of tickets sold, while tender based contracts are based on kilometres travelled (Walters, 2010).

Ticket based contracts are less than ideal because they do not allow the Department of Transport to fix subsidy budgets for each financial year (Walters, 2010). This is because the number of bus commuters is not fixed. Furthermore, ticket based subsidy systems are difficult to monitor (Walters, 2010). Consequently, it is possible that the Department may pay bus operators more money than necessary due to fraudulent behaviour on the bus operators’ part.

Because of these reasons, the Department of Transport has, since 1996, attempted to implement a commuter bus subsidy which is kilometre based (Walters and Cloete, 2008). However, bus operators have expressed their dislike of such a system (Walters and Cloete, 2008). They maintain that it is too rigid and that it does not cater for increasing passenger demand (Walters, 2010). This is because, once a contract has been awarded, the subsidy amount is fixed for the entire contracting period. Consequently, existing contracts awarded by the Department of Transport between 1997 and 2000 have not been revised since, even with increases of between 15 and 20 percent in commuter numbers. Bus operators have to increase their fleet sizes on high demand corridors to minimise overloading, whilst not receiving any additional subsidy (Walters, 2010). This threatens profit margins and puts businesses at risk of failure.

To address these issues, the negotiated contract system was approved in 1999 for use where bus companies were either owned or operated by the State (Walters, 2010). The negotiated contract system is flexible and allows bus companies to negotiate contract conditions prior to entering into a contract. The Department of Transport is not in favour of this system because it does not promote transparency and does not allow ease of entry into the industry for new bus operators (Walters, 2010). Furthermore, the negotiated contract system is not aligned with the national transport objectives set out in
the South African White Paper on National Transport policy due to its non-transparent and non-competitive nature (Walters, 2010).

Of course, it must be noted that the subsidy debates ensuing in the commuter bus industry at present are a direct result of numerous other issues in the public transport sector. These include: the dominance of the minibus taxi industry, urban sprawl, automobile dependence and poor land use planning. Resolving these issues will be crucial to resolving disputes in the bus industry as it will increase the profitability of the industry as a whole. Ultimately, any transport system that relies on government subsidisation is less than ideal.

2.5.3 Passenger Rail Transport

Kenworthy (2006) argues that cities with strong urban rail infrastructure have the greatest levels of public transport market share. South Africa has a long way to go before that can be achieved. In South Africa, the passenger rail sector carries the least number of commuters, despite it being cheaper than buses or minibus taxis (Shaw, 2006; Schalkwyk, 2008). The sector moves 585 000 passengers per day (Department of Transport, 2003) but accounts for 65% of government’s total annual subsidy budget (Walters, 2008). The main problem facing passenger rail is that it suffers from a lack of integration with other modes of transportation within the current spatial trends of the province (Shaw, 2006; Gauteng Department of Transport, 2007). Consequently, rail commuters travel long distances to access trains, walking up to 30 minutes in some cases. Furthermore, 76% of the South African population does not have access to railway systems (Department of Transport, 2003). Thus, only 5.2% of the population use trains as a mode of transportation (Department of Transport, 2003). This is worrying as trains are most efficient when operating within dense corridors (Shaw, 2006). Consequently, government should look at finding ways to improve access to train infrastructure (Israel and Cohen-Blankshtain, 2010). This will include improving security in and around train stations and trains (Department of Transport, 2003). Furthermore, government needs to invest in new rolling stock. Current passenger rail
rolling stock is on average 31 years old and 39% of the current rolling stock is between 31 and 45 years old (Walters, 2008). Old rolling stock is prone to breaking down and is very expensive to maintain, thus stretching the budget for passenger rail even further.

2.6 CHALLENGES IN THE PUBLIC TRANSPORT SPHERE

2.6.1 A lack of intermodal integration

The challenges of urban sprawl, automobile dependence and high commuting costs are compounded by an un-integrated public transportation system which is unable to meet the transportation needs of the population (Walters, 2008). Burckhart and Blair (2009) argue that public transportation systems (minibus taxi, train, bus) are different and so each is fit for different purposes. Thus, these different systems should be co-ordinated in a manner that allows them to support each other (Shaw, 2006). However, such integration is a problem in South Africa, as 78.7% of taxi commuters, 78.2% of bus commuters and 45.4% of rail commuters do not change modes when going to work (Shaw, 2006). Thus, commuters are not offered an integrated transport system.

2.6.2 Funding and Maintenance

The current provincial roads infrastructure backlog is estimated at R72 Billion (Figures 3 and 4). However, according to the Minister of Transport, Mr Sbusiso Ndebele, the Department of Transport has only managed to secure R22 Billion to cover provincial infrastructure costs for the next two financial years (Ndebele, 2011). It is evident from this that progress on transportation infrastructure is being hindered due to a lack of funds. South African investment in road infrastructure has on average decreased by 1% annually since 1975 (Turok et al, 2011). As a result, most roads within South Africa are past their design life (typically 20 years). As a consequence of this, road infrastructure maintenance costs in South Africa are high and still rising (SAICE, 2011). In addition, bus as well as passenger rail subsidies are currently backlogged (Walters, 2008; Brits, 2010). Currently, approximately only 33% of fuel levy tax is allocated to roads.
infrastructure, the rest goes to cross funding education, housing and health (Brits, 2010).

As a result of this, Sohail and Maunder (2007) suggest that government needs to find ways to increase the involvement of the private sector in transportation initiatives. It is evident from the above that government is under severe financial strain and that private sector involvement is a necessity (Turok et al, 2011).

### 2.6.3 Co-ordination

There needs to be a mutually beneficial relationship between transportation and urban planning associations (Curtis, 2008). This will help reduce urban sprawl throughout South Africa. In addition, it would assist with the development of mixed land use which is a requirement for good public transport (Beukes et al, 2011). However, transportation planning organisations show signs of fragmentation in their current format.
Figure 4: Total Funding Requirement of All provincial Projects-Modes(R million):515,756 (Source: Department of Transport, 2010)

For example, three different spheres of government ‘own’ roads. The South African National Roads Agency Limited (SANRAL) is responsible for national roads and is independent of government. The provincial departments and agencies are responsible for provincial roads. In addition to this, local authorities are responsible for municipal roads (DBSA, 2008). Furthermore, the Department of Transport owns the Passenger Rail Agency of South Africa (PRASA) which replaced the South African Rail Commuter Corporation (SARCC) in 2009 and is currently responsible for passenger rail services (SAICE, 2011).

The implication of this fragmentation is that, in order to integrate transportation systems, various organisational objectives have to be satisfied. This is not easy, given the institutional fragmentation seen in South Africa. Consequently, Obeng-Odoom (2009) suggests that all institutions within the transport planning sector should be under one
umbrella. Moreover, both transportation and urban planning associations should be under one umbrella (Curtis, 2008).

2.7 SUMMARY

Transportation acts as a catalyst to economic growth. It can significantly improve or substantially diminish the economic potential of cities and city regions. As a region grows, there is an escalating demand for housing, employment, shops and services, which results in an increasing demand for movement and accessibility. This can lead to serious peak hour traffic on major corridors, high rates of road accidents and long daily commuting distances (Chittenden, 2001). It is thus important that decision makers consider efficient and effective transportation as a key objective and that this is considered in conjunction with land use planning (Hall and Pfeiffer, 2000). The effective management of congestion in Gauteng will require the combined efforts of a reliable and efficient public transportation system that is safe and cost effective along with a reduction in urban sprawl by means of densification of urban areas. It is through these and many other efforts that the city region will be able to continue its economic growth and mitigate the challenges of segregation caused by the Apartheid regime.

The challenges of suburbanisation, urban sprawl and automobile dependence have meant that the usage of both bus and passenger rail systems has decreased since 1994 thus resulting in the dominance of the minibus taxi industry (Shaw, 2006). Currently, the minibus taxi industry is responsible for transporting 65% of the South African work force reliant on public transportation (Department of Transport, 2003 and Schalkwyk, 2008). However the minibus taxi industry is informal and plagued by various problems. The urban bus system, on the other hand, is marred by conflict between operators and government which has resulted in a decline in the quality of urban bus service provision over the years. This conflict is because of the pending introduction of the tender for contract system which bus operators are generally opposed to (Walters, 2010). Finally, the passenger rail system is characterised by poor as well as ageing infrastructure (Walters, 2008). The issue of funding along with project coordination
between the different spheres of government remains a problem for the future development of transportation systems and infrastructure (Obeng-Odoom, 2009 and Walters, 2010).
3. Longitudinal Trends in Travel In The Gauteng City Region

3.1 Introduction

The development of transportation infrastructure in South Africa has interminably been reliant on the ‘predict and provide’ technique. This process utilises data collected in various surveys to conduct a general analysis of travel patterns and transportation usage in the region. The results of this analysis are then employed to create various situational models for the possible future transportation requirements and infrastructural development in the region. These situational models are based on the transportation land use planning model which comprises of four steps: (1) trip generation; (2) trip distribution; (3) modal split and (4) traffic assignment.

The purpose of this analysis is to conduct a longitudinal analysis of travel patterns in the Gauteng City Region, by examining the two individual aspects of trip generation, which includes trip purpose, and modal split from the Transportation Land Use Planning Model. The data used in the analysis was obtained from:

- the 1975 PWV Transport Study undertaken by the then Transvaal Provincial Administration Roads Department,
- the 1985 update of the PWV Transport Study,
- the 2000 Gauteng Transport Survey (GTS), and
- the 2003 National Household Travel Survey (NHTS).

3.2 Limitations

Transportation engineering and the development of transportation infrastructure relies heavily on trends and predictions of future travel demand. In order to implement an effective transportation strategy, a thorough investigation and understanding of past, present and future travel patterns must be undertaken and comprehended. The basis for such an investigation must be the analysis of data collected from various
transportation surveys. A longitudinal analysis of such data should provide for greater perspective and insight into the effects of historical events, demographic shifts and economic and political changes on travel patterns and transportation infrastructure development within a region.

However, analysis of data is never a simple or straight-forward procedure. This is especially true for longitudinal analysis, which utilizes data sets collected over an extensive period of time and from survey instruments which may have had different aims and purposes. It is thus necessary herein to explore and explain the short falls of each data set used in this investigation.

### 3.2.1 The Data Sets

This section concentrates on the background, characteristics, sampling methods, shortfalls and limitations of the:

- 1975 Transvaal Provincial Administration Roads Department (PWV) transport study
- 1985 Updated Transvaal Provincial Administration Roads Department (PWV) transport study
- 2000 Gauteng Transport Survey (GTS)
- 2003 first South African National Household Travel Survey (NHTS)

For the remainder of this document, any references made to these surveys will use the following format:

- 1975 PWV Survey
- 1985 PWV Survey
- 2000 GTS
- 2003 NHTS
3.2.2 1975 PWV Survey

The 1975 PWV Survey was conducted during a period where extreme racial prejudice was practiced with adverse effects in South Africa. The data collected was biased due to this prejudice and may therefore not be a true reflection of the state of transportation usage, demand and challenges in the country at the time. The survey was conducted according to race and two different surveys were used: one for the White population and one for the Coloured, Asian and Black populations. Data collected for the White population was far more detailed and was conducted over a greater sample size while data collected for the Coloured, Asian and Black populations was less detailed and conducted over a smaller sample group. In addition, the sample for both surveys was drawn from particular geographic areas. Table 2 indicates which areas were surveyed for each race group.

<table>
<thead>
<tr>
<th>Sampled Areas: White population</th>
<th>Sampled Areas: Black, Coloured and Asian population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretoria</td>
<td>Pretoria and Verwoerdburg</td>
</tr>
<tr>
<td>Central Rand</td>
<td>Johannesburg, Randburg and Sandton</td>
</tr>
<tr>
<td>West Rand</td>
<td>Krugersdorp, Randfontein and Roodepoort</td>
</tr>
<tr>
<td>Vaal Triangle</td>
<td>Vereeniging, Vanderbijlpark, Sasolburg and Meyerton</td>
</tr>
<tr>
<td>East Rand</td>
<td>Alberton, Benoni, Boksburg, Brakpan, Germiston, Elsburg, Bedfordview, Edenvale, Kempton Park, Springs and Nigel</td>
</tr>
<tr>
<td>Black population</td>
<td>Mamelodi, Ga-Rankuwa, Atteridgeville, Mabopane, Soweto, Tembisa and Sebokeng</td>
</tr>
<tr>
<td>Coloured population</td>
<td>Eersterus and Eldoradopark</td>
</tr>
<tr>
<td>Asian population</td>
<td>Lenasia and Laudium</td>
</tr>
</tbody>
</table>

Table 2: Sampled areas according to race in the 1975 PWV Study

Due to the limited sample areas included in the survey for the Black, Coloured and Asian population, the data is skewed and must therefore be viewed with a certain amount of apprehension. In addition, in terms of methodology, it is important to note
that only trips taken from Mondays through Thursdays were considered in this survey. The 1975 PWV survey used cordon interviews and road traffic counts to collect data.

### 3.2.3 1985 PWV Survey

Once again, the 1985 PWV Survey was also conducted during a period where extreme racial prejudice was rife. The data is similarly skewed and may not reflect the true state of transportation usage and demand in the region at the time. Very little new data was collected as part of the 1985 PWV survey. The project focused on examining changes in travel patterns and car ownership among the non-white population as compared to the 1975 survey and concentrated on examining the extent to which predictions made in 1975 were borne out in the actual situation in 1985.

### 3.2.4 2000 GTS

The 2000 GTS recorded trips taken across the entire week and sampled all of Gauteng’s cities and municipalities. It made use of home interviews to collect data. When compared to the 2009 Quality of Life survey conducted by the GCRO, it is the survey that represents the greatest commonality in terms of method and focus.

### 3.2.5 2003 NHTS

The 2003 NHTS data must be viewed within the following constraints: (1) the NHTS was a national survey and was thus conducted on a much greater scale (than, for example, the 2000 GTS) hence increasing room for error and decreasing opportunities for detail, and (2) the number of surveys conducted in Gauteng as part of the 2003 NHTS was 14 709 less than that conducted in the 2000 GTS which provided much greater depth. It is also important to note that only trips made between Monday and Friday were considered in the data concerning work trips. In addition, the survey only covered the following regions within the Gauteng province: East Rand, Johannesburg, Pretoria,
Bronkhorstspruit, Cullinan, Carltonville, Krugersdorp, Randfontein, Westonaria, Sterkfontein, Vereeniging, Meyerton and Heidelberg.

3.2.6 Conclusion on Limitations

Longitudinal analysis of the data from the various surveys was undertaken according to the Transportation Land Use Planning Model. This is because this model has long been the basis for transportation development and travel pattern analysis and because it was crucial in informing the surveys under study, particularly the earlier surveys. The Model comprises of four steps, which, according to the 1975 PWV transport study, are defined as:

1. Trip Generation – which estimates the number of person trip ends by purpose in each zone based on land use information.
2. Trip distribution – which estimates the number of person trips between zone pairs.
3. Modal split – which allocates the person trips to the different transportation modes such as private and public modes.
4. Traffic assignment – which estimates the number of vehicles trips on each link in the network.

This model provides insight for a greater overall analysis in travel patterns and the changes thereof in the Gauteng City Region. However, due to the varying purposes and data collection methods employed across the surveys, it was only possible to conduct analysis on trip generation (including trip purpose) and modal split. Trip distribution and traffic assignment models had to be excluded due to the lack of data within in the 2000 GTS and 2003 NHTS. It must also be noted that analysis of trip generation and modal split was not straight-forward and the data required extensive extrapolation and manipulation in order to create a uniform data set that could be used for the intended longitudinal analysis of travel patterns within the region. Due to the difficult nature of skewed data from the 1975 and 1985 PWV survey reports, it is advised that a certain degree of apprehension be used when interpreting the results obtained from this investigation, especially the earlier data.
3.3 Population Growth

Trip generation is directly proportional to population growth which makes this first step in analysing travel patterns vital. The estimated population in each of the above-mentioned surveys is depicted in Figure 5 below. As can be seen in the figure, the estimated population of Gauteng in the NHTS is approximately half a million less than that found in the GTS of 2000. This discrepancy can be attributed to multiple factors. Nevertheless, the population data in the NHTS may not be entirely accurate and, as such, in order to provide a better indication of the population growth trends in the region, the estimated population for the year 2010 was obtained from the Statistics South Africa 2010 mid-year report and included in the figure.

![Population growth for the Gauteng City region](image)

Figure 5: Estimated population growth according to the respective survey reports

It can be seen that the population growth for the Gauteng region has grown linearly between 1975 and 2010. The population has increased by approximately two million
people every ten years. This rapid increase in population has placed a great deal of strain on the transport infrastructure of the region as the increase in population results in a proportional increase in the demand for travel.

3.3 Trip Purpose and Trip Generation

According to the 1975 PWV Transport Study, trip generation is defined as the analysis and estimation of the number of trips produced and attracted in a zone or any part of or entity within the study area in relation to trip purpose. It also measures activity within the area or entity under consideration. For the purpose of this analysis, the study area under consideration is the Gauteng City region. The following terms will be used to categorise various trip purposes:

- **Home-Based-Work (HBW) trips**: These trips either begin at home and end at work or begin at work and end at home.

- **Home-Based-Non-Work (HBNW) trips**: These trips include home-based-shopping trips, home-based-personal-business trips, home-based-social trips and home-based-recreation trips. These trips either begin or end at home.

- **Home-Based-Education (HBE) trips**: These trips either begin at home and end at an education institution such as schools/colleges/universities etc or begin at an educational institution and end at home. HBE trips are incorporated into the home-based-non-work trips category.

- **Non-Home-Based (NHB) trips**: These trips have neither their origin nor their destination as the home of the traveller.

The figure below represents the percentage split of trip purpose for the region. Because it was an update of the 1975 study, the 1985 PWV study did not include data regarding trip generation. As such, it was excluded from analysis relating to trip purpose and trip
generation. In addition, it is important to note the following with regard to the 2003 NHTS:

“The National Household Travel Survey did not aim to collect data on household trip generation or for the modelling of household or personal travel demand. There was, however a question which was applied to all household members relating to their trip purpose on a typical weekday. Results from this question enabled an approximation to be made of household trip generation. The approximation assumed that each person who nominated a trip purpose made an outward and inward home-based trip for the nominated trip purpose (2 trips). Because each person either answered “yes” or “no” to each of the nominated trip purpose (including “other”), and was not asked how many times they made trips for each purpose, it had to be assumed that each household member made only one return journey for each purpose. That is, for a single trip from home, there was a corresponding trip from the destination back to the home.”

(South African National Department of Transport, 2005)

Due to the above mentioned reasons, there were no Non-Home-Based trips in the 2003 data. As such, the data on trip purpose had to be manipulated significantly for it to be formatted such that comparisons across all the surveys could be generated. It is for this reason that the trip purpose and trip generation data from the surveys should be viewed with leniency and should be read as a general indication of trip generation and trip purpose in the Gauteng region.

As can be seen in Figure 6, there has been a linear decrease in the percentage of HBW trips made between 1975 and 2003. However, it must be mentioned that the 1975 data concentrated to a great extent on the white population who would generally have made a greater percentage of HBW trips. The decrease in the percentage of ‘formal’ HBW trips from 2000 to 2003 is a testament to the growing informal economic sector and high unemployment rates in the country as a whole (Chittenden, 2001). It is thus evident that there is a trend towards a greater proportion of HBNW travel when compared to HBW travel. While this may be a testament to increased freedom of movement on the part of the African population since the fall of Apartheid in 1994, it is more likely a result of the fact that whereas a large percentage of trips made in the HBNW category (in the 2000
and 2003 surveys) are Home-Based-Education trips, HBE trips were not a priority in the 1975 study.

Figure 6: Trip Purpose by percentage split from 1975 – 2003

With regard to trip generation (see Figure 7), the average number of person trips per household per day made for the purpose of HBW trips has fluctuated between 1975 and 2003 but in general has remained largely the same. However, it is evident that the average number of HBNW trips has increased dramatically since 1975. This has also meant that the overall number of trips made by the population has increased. This growth in trips made indicates that transportation demand has generally increased in Gauteng over and above what would ordinarily be expected through population growth. This increased demand places added strain on road infrastructure which further reduces transportation capacity, hindering the economic growth and expansion of the city region (Garner et al, 2001).
3.4 Modal Split

According to the 1975 PWV Transport Study, modal split is defined as the process which divides person trips between private and public transport. In this regard, the data from the various surveys was adapted to fit two uniform modal split categories, namely primary modal split and secondary modal split. Primary modal split examined only the split between private transport and public transport, whereas secondary modal split examined the split between the individual modes within these two broad categories: the specific modes investigated were as follows:

- Private transport refers to travel by car or truck (whether as the driver or as a passenger) as well as by metered taxi.
- Public transport refers to travel by taxi, bus or train.
- Other transport refers to travel by walking, motorcycle, bicycle, air transport or animal transport.
The analysis of modal split data concentrated solely on HBW trips in the Gauteng City region. Due to the skewed representation of race groups in the 1975 and 1985 surveys, it was decided that a better indication of the changes in modal split would be attained by separating the data for these surveys according to race. It should also be noted that due to ambiguities in the secondary modal split data from the 1985 PWV Study, this data set was excluded from the analysis in terms of secondary modal split.

With regard to primary modal split (see Figures 8 and 9), it is evident that the white population in both 1975 and 1985 predominantly made use of private modes, while the African population made equally high use of public transport modes. In fact, the primary modal split for the two population groups are almost the inverse of one another. Whereas the percentage of public transport used in 1975 and 1985 by the white population is less than 10%, the use of private modes by the African population at those times was less than 10%. When considering the modal split of the entire population from the 2000 GTS and the 2003 NHTS, it can be seen that public transport has remained the leading mode of transport used in the region, although the percentage by which it exceeds private transport use is small.
Figure 8: Primary Modal split; 1975 and 1985 White Population vs. 2000 and 2003 entire population

Figure 9: Primary Modal split; 1975 and 1985 African Population vs. 2000 and 2003 entire population

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Results for secondary modal split (Figures 10 and 11) again indicate that the white population’s use of private modes far exceeds that of the entire population in 2000 and 2003. When examining secondary modal split for the African population, the most striking point is the clear shift from train and bus usage in 1975 and 1985 to taxi usage in 2000 and 2003.

![Secondary Modal Split](image)

Figure 10: Secondary Modal split; 1975 White Population vs. 2000 and 2003 entire population
Figure 11: Secondary Modal split; 1975 African Population vs. 2000 and 2003 entire population

### 3.5 Conclusion

Trip generation and trip purpose are key factors that should be considered when developing transportation infrastructure in the Gauteng City region. These two factors provide insight into the frequency of trips made by the population on a daily basis in the region. Historical analysis of these two factors has shown that the population in the Gauteng City Region has grown rapidly over the past 30 years and that the expanding population is placing a great deal of strain on the transportation networks in the region. Increased trip making, particularly with regard to Home-Based-Non-Work trips, has outpaced population growth.

In terms of modal split, the challenges facing formal public transport (reduced flexibility and accessibility and increased travel time) have resulted in a shift towards the use of minibus taxis at the expense of buses and trains. Minibus taxis, although an informal mode of public transport, have become the region’s most popular public transport mode. Nevertheless, the results also suggest that the middle class...
(historically, the white population) are heavily reliant on private transport. Car use by this portion of the population has led to a situation where car usage is associated with social status and wealth. This trend will need to be managed in order to effectively reduce congestion.

As Gauteng is subject to rapid urban growth, clearly an effective and efficient transportation system is urgently required. It is recommended that Gauteng strongly consider the promotion of multi-modalism. In particular, development should seek to integrate amenities and transport infrastructure in a manner that promotes public transport and space for pedestrians. Such a strategy should improve the quality of life in Gauteng.
4. MOVEMENT patterns IN THE GAUTENG CITY REGION

4.1.1 Introduction

In this section, the most critical transportation corridors for home-based-work travel, as indicated in the results of the 2009 Quality of Life survey conducted by the Gauteng City Region Observatory, are identified. This was undertaken through the following procedure:

1) First, the areas in each municipality which employed the largest volume of people were listed. The Quality of Life Survey was conducted over 17 municipalities. However, during analysis it was discovered that 72% of the survey respondents lived in the City of Johannesburg, the City of Tshwane or the Ekurhuleni Municipality (see Table 3). Furthermore, residents from other municipalities contributed very little to the cumulative percent of respondents. As such, the decision was taken to focus analysis on these three municipalities. Thus movements to other areas are discussed, detailed review is restricted to the big three.

2) Thereafter, the location of the employees’ residences within the listed areas was determined. This was done according to municipality. In other words, the extent to which individuals working in a particular area commuted from within the same municipality or engaged in inter-municipality travel was ascertained.

3) This allowed for the identification of the most important or critical corridors, along which the greatest proportion of work trips are undertaken.

4) Thereafter, the modal split on each of these corridors was ascertained so as to establish which corridors were particularly reliant on private transport.
5) Finally, the critical corridors identified were compared to current transportation infrastructure improvements, so as to ascertain the extent to which these new developments could/will serve the City Region.

Table 3: Municipalities Surveyed

<table>
<thead>
<tr>
<th>Valid</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tshwane</td>
<td>1230</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>1538</td>
<td>23.2</td>
<td>23.2</td>
<td>41.7</td>
</tr>
<tr>
<td>Johannesburg</td>
<td>2001</td>
<td>30.2</td>
<td>30.2</td>
<td>71.9</td>
</tr>
<tr>
<td>Mogale City</td>
<td>180</td>
<td>2.7</td>
<td>2.7</td>
<td>74.6</td>
</tr>
<tr>
<td>Randfontein</td>
<td>80</td>
<td>1.2</td>
<td>1.2</td>
<td>75.8</td>
</tr>
<tr>
<td>Westonaria</td>
<td>68</td>
<td>1.0</td>
<td>1.0</td>
<td>76.8</td>
</tr>
<tr>
<td>Merafong City</td>
<td>131</td>
<td>2.0</td>
<td>2.0</td>
<td>78.8</td>
</tr>
<tr>
<td>Emfuleni</td>
<td>408</td>
<td>6.2</td>
<td>6.2</td>
<td>84.9</td>
</tr>
<tr>
<td>Midvaal</td>
<td>40</td>
<td>0.6</td>
<td>0.6</td>
<td>85.5</td>
</tr>
<tr>
<td>Lesedi</td>
<td>46</td>
<td>0.7</td>
<td>0.7</td>
<td>86.2</td>
</tr>
<tr>
<td>Kungwini</td>
<td>68</td>
<td>1.0</td>
<td>1.0</td>
<td>87.2</td>
</tr>
<tr>
<td>Nokeng Tsa Taemane</td>
<td>33</td>
<td>0.5</td>
<td>0.5</td>
<td>87.7</td>
</tr>
<tr>
<td>North Western Region (Madibeng)</td>
<td>165</td>
<td>2.5</td>
<td>2.5</td>
<td>90.2</td>
</tr>
<tr>
<td>South Western Region (City of Matlosana)</td>
<td>252</td>
<td>3.8</td>
<td>3.8</td>
<td>94.0</td>
</tr>
<tr>
<td>Southern Region (Mestimaholo)</td>
<td>48</td>
<td>0.7</td>
<td>0.7</td>
<td>94.7</td>
</tr>
<tr>
<td>Eastern Region (Delmas)</td>
<td>244</td>
<td>3.7</td>
<td>3.7</td>
<td>98.4</td>
</tr>
<tr>
<td>North Eastern Region (Dr. JS Moroka)</td>
<td>104</td>
<td>1.6</td>
<td>1.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>6636</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

4.1.2 Data issues

The dataset was assessed in terms of the following criteria:
Data coding and cleanliness – presence of non-response bias as well as coding bias and the presence of missing data.

---

2 NOTE: This final point is addressed in Section 5 of this report and not in this Section.
Validity: comparison with other datasets collected simultaneously, particularly in terms of demographics.
Presence of a technical report from the supplier detailing sampling issues and substitution rates.

Data coding and cleanliness
In terms of data coding, analysts seek no evidence of duplication of codes, adherence to skip and flow instructions and no systematic exclusion of any of the coding categories (such as work from home). A review of the data found that some codes were indeed duplicated (such as Johannesburg as a destination) which presents difficulties when enumerating as analysts cannot be sure if any double counting on the part of the interviewee took place. Skip instructions were not always adhered to, as some respondents answered questions from which prior questions had disqualified them.

Of greatest concern is the potential of non-response bias, that is, the exclusion of particular groups. The lack of data on residents who work from home is of great concern as their travel patterns are not recorded; this field was empty. It cannot be assumed that they are stationary for their entire workday, as they may travel to meetings, educational institutions and similar.

Demographic comparison
The data was compared with AMPS 2009AB’s Gauteng sample. Table 4 demonstrates a potential skew towards women even in the weighted data, as AMPS records 53% males and 41% females. A further skew towards Africans (82% against 64% for the stratified random sample of AMPS); fewer Indian/Asians (1% versus 3% in AMPS) and fewer whites (13% versus 29% in AMPS) is present. AMPS triangulates weighting between BMR, previous AMPS and StatsSA.
Table 4: QoL 2009 gender and population group and AMPS 2009AB

In terms of age distribution, AMPS has a more middle aged people, while the QoL has 50% under the age of 36 (see Table 5). Thus the QoL survey appears to be young and African, while other population measures reflect a more diverse province.

Table 5: QoL 2009 age distribution and AMPS 2009AB

Education levels, correspondingly, finds AMPS representing more secondary schooled nationals, as well as more tertiary educated individuals. The QoL survey, in accordance with its younger and more African reflection, had more individuals with less education. AMPS being a personal at home interview, picked up greater numbers of students, housewives and retirees and fewer unemployed (see Table 6).
Table 6 QoL 2009 education and employment status and AMPS 2009AB

Based on the comparison between QoL and AMPS, AMPS being an area stratified random sample which occurs off a household register every six months, the QoL results must be reviewed as those reflecting the lower end of the commuter population with younger ages, less education, fewer males and less diversity than the bulk of the Gauteng populace. Commuter patterns will be affected accordingly.

Technical report and substitution rates

A technical report was not provided; hence it is difficult to estimate substitution rates and impossible to calculate a margin of error. Indeed without bona fides that this was a random sample (such as AMPS is) it is inadvisable to calculate margin of error.

4.2 Movement Patterns within the Gauteng City Region

4.2.1 Movement into the City of Tshwane

The Tshwane CBD is by far the largest centre of employment within the City of Tshwane (see Figure 12). Together, the Tshwane CBD and Centurion incorporate 79%
of the workforce within the City of Tshwane. Movement into these two employment centres will be discussed below.

![Figure 12: Distribution of Tshwane Workforce](image)

4.2.1.1 Movement into the Tshwane CBD

It is evident in Figure 13 that most people employed in the Tshwane CBD live within the City of Tshwane. Figure 13 also suggests that there is very little inter-municipal travel into the Tshwane CBD.

It is clear from Figure 14 that people living within the City of Tshwane and working in the Tshwane CBD are reliant on both private cars and minibus taxis to get to work. Furthermore, public transportation accounts for 55% work trips made to the CBD. However, use of formal modes of public transport is very low. Feasibility studies will be required in order to determine which areas would benefit most from Bus Rapid Transit on critical corridors into the CBD.

Although the percentage of inter-municipal travel into the Tshwane CBD is comparably low, Figure 15 indicates that most of this travel takes place by means of private cars. This explains the high congestion that this corridor experiences, especially during peak
hours. It is also noted from Figure 15 that public transportation commuters along the Johannesburg – Tshwane corridor are reliant on minibus taxis.

![Figure 13: Employment in Tshane CBD by Municipality](image1)

![Figure 14: Modal split – Movement into the Tshwane CBD from within the City of Tshwane](image2)

With regard to travel between Ekurhuleni and the Tshwane CBD, all of this travel takes place using private vehicles, according to the QoL survey results. Presently there is only one Gautrain station in the Ekurhuleni municipality, but these results suggest that perhaps greater service in Ekurhuleni is required if the Gautrain is to be an integral part of inter-municipal travel into the Tshwane CBD.
4.2.1.1.1 Modality review of Tshwane residents

In terms of race group, travel patterns vary according to groups who have access to private travel, namely whites. As Table 7 demonstrates, not only do 96% of whites have a car in their household, the average number of cars is two. Only 21% of Africans have a car and the average for these is one car per household.

Table 7: Tshwane residents’ household car ownership. Note Asians and Coloureds omitted due to small weighted cell size (n = 6 and n = 32 respectively)

<table>
<thead>
<tr>
<th>Q11.9 Respondent’s household owns a car in working order</th>
<th>A18 Population group to which the respondent belongs</th>
<th>Column N %</th>
<th>Average number of cars in working order</th>
<th>Column N %</th>
<th>Average number of cars in working order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>African</td>
<td>21.2%</td>
<td></td>
<td>White</td>
<td>96.1%</td>
</tr>
<tr>
<td>No</td>
<td>78.8%</td>
<td>1</td>
<td></td>
<td>3.9%</td>
<td>2</td>
</tr>
</tbody>
</table>

Figure 15: Modal split – Movement into the Tshwane CBD from the City of Johannesburg
The increased levels of car ownership among whites reflects also in terms of car variety and fuel source. As Table 8 shows, whites are more likely to have station wagons and SUVs and have a greater incidence of diesel engines (15%). Women are more likely to have station wagons and SUVs while men have more bakkies. Such a profile would translate into a greater ecological footprint for the more affluent.

Table demonstrates further the clear discrepancy between access modality and race in Tshwane, with 57% of Africans relying on taxis, 4% on trains and a further 4% on buses. Whites overwhelmingly rely on private transport with 75% driving a car and a further 10% as passengers. Such a high incidence of car drivers suggests that most of this group do not car pool, electing instead to travel individually.
When Tshwane residents are reviewed further in terms of their access to transport, it is mainly Africans and males who use multiple models of transport (30% and 20% respectively as detailed in Table 10). Whites and males are less likely to use public transport and consequently are either close to public transport (33%) or are too far away from it to consider it in any event (66% have a 20 minute or more walk to find it). Africans will walk in the main for up to 20 minutes to access the public transport on which 83% of them rely.
Table 10: Tshwane residents’ access to modality of transport by population and gender. Note Asians and Coloureds omitted due to small weighted cell size (n = 6 and n = 32 respectively)

4.2.1.1.2 Trip generation and distribution of Tshwane residents

Work trips
Consequently, distance travelled is related to private transport and those who travel from Tshwane to Johannesburg are predominantly white and travel to Sandton, Randburg, Honeydew and Johannesburg central. Areas closer to Tshwane are more prevalent even for this group, with Garsfontein and Midrand outstripping Johannesburg travel. Given the limited modality available to most Africans it is not surprising that those who are resident within the municipality restrict their workplaces to the municipality. Males are more active and are more likely to work further afield than females (see Table 11).
Even though Africans are more likely to restrict their work travel to within the Tshwane borders, their travel time tends to be longer than whites. The travel time for men, who also tend to travel further afield, tends to be longer than that of women (see Table 12).
When it comes to work seeking behaviour, there is a strong preference among Africans for work within the municipality. Whites, however, with access to private transport, are far more willing to seek further afield and will concentrate their efforts on larger municipal areas (see Table 13). Females tend to spread their options across a wider number of areas.

| Q11.7 How long it takes the respondent to reach place of work/study after leaving home | A18 Population group to which the respondent belongs | A19 Gender of the respondent |
|---|---|---|---|---|
| | African | White | Male | Female |
| Do not work, study or look for work | 17% | 23% | 14% | 20% |
| Up to 15 minutes | 21% | 16% | 16% | 22% |
| From 16 minutes to 30 minutes | 25% | 24% | 28% | 24% |
| From 31 minutes to 45 minutes | 20% | 22% | 21% | 19% |
| From 46 minutes to 60 minutes (1 hour) | 12% | 10% | 12% | 11% |
| From 61 minutes to 90 minutes (1 to 1& half hours) | 4% | 2% | 5% | 3% |
| Frm 91 minutes to 120 minutes (1and half to 2 hours) | 1% | 2% | 2% | 1% |
| More than 120 minutes (more than 2 hours) | 1% | 1% | 2% | 0% |
| Work from home | 0% | 1% | 0% | 0% |

Table 12: Tshwane residents’ length of travel time. Note Asians and Coloureds omitted due to small weighted cell size (n = 6 and n = 32 respectively)
Table 13: Tshwane residents’ work seeking locale preferences. Note Asians and Coloureds omitted due to small weighted cell size (n = 6 and n = 32 respectively)

<table>
<thead>
<tr>
<th>Q1.17 If unemployed and looking for work, where do you go to look for work?</th>
<th>A18 Population group to which the respondent belongs</th>
<th>A19 Gender of the respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted count</td>
<td>African</td>
<td>White</td>
</tr>
<tr>
<td>Pretoria</td>
<td>48%</td>
<td>54%</td>
</tr>
<tr>
<td>Tshwane</td>
<td>18%</td>
<td>15%</td>
</tr>
<tr>
<td>Hammanskraal</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>Mabopane</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Centurion</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>Mamelodi</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Potchefstroom</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Akasia</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Atteridgeville</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Pretoria North</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Soshanguve</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Johannesburg</td>
<td>1%</td>
<td>8%</td>
</tr>
<tr>
<td>Daveyton</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Garsfontein</td>
<td>1%</td>
<td>8%</td>
</tr>
<tr>
<td>Winterveld</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Shopping

Given the modal preferences and abilities of different groups, it is not surprising that Africans tend to shop locally – either in their place of work (Tshwane and Pretoria CBD) or within their home locale (see Table 14). White residents are heavily select a few key areas, usually within driving distance of their place of residence.
Table 14: Tshwane residents’ shopping trip destinations. Note Asians and Coloureds omitted due to small weighted cell size (n = 6 and n = 32 respectively)

<table>
<thead>
<tr>
<th>Place</th>
<th>African</th>
<th>White</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1.13 Place where respondent usually does shopping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretoria</td>
<td>27%</td>
<td>34%</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>Tshwane</td>
<td>15%</td>
<td>13%</td>
<td>17%</td>
<td>13%</td>
</tr>
<tr>
<td>Mabopane</td>
<td>13%</td>
<td>0%</td>
<td>8%</td>
<td>12%</td>
</tr>
<tr>
<td>Hammanskraal</td>
<td>10%</td>
<td>0%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Mamelodi</td>
<td>9%</td>
<td>2%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Centurion</td>
<td>6%</td>
<td>21%</td>
<td>10%</td>
<td>7%</td>
</tr>
<tr>
<td>Soshanguve</td>
<td>5%</td>
<td>0%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Atteridgeville</td>
<td>4%</td>
<td>0%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Ga-Rankuwa</td>
<td>2%</td>
<td>0%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Garsfontein</td>
<td>1%</td>
<td>18%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Winterveld</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Potchefstroom</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Temba</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Pretoria North</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Vaalhalla</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Akasia</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Bronkhorstspruit</td>
<td>0%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Midrand</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Irene</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Sandton</td>
<td>0%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

4.2.1.2 Movement into Centurion

It is evident in Figure 16 that most people who work in Centurion travel from elsewhere within the City of Tshwane. Furthermore, inter-municipal travel into Centurion is much higher than that seen above into the Tshwane CBD. However, few trips from the Ekurhuleni municipality into Centurion were observed when compared to trips from Ekurhuleni into the Tshwane CBD.

Figure 17 suggests that most trips taken into Centurion from within the Tshwane municipality are undertaken by private car. Furthermore, public transportation accounts
for only 30% of work trips along this corridor. As a result of this, Centurion is likely to suffer from congestion due to high automobile dependence within the area.

In addition, as seen in Figure 17, passenger rail usage is non-existent in Centurion, and bus transport only accounts for 9% of total trips made along this corridor. As such, it is essential that public transportation be improved significantly in this area. One proposal
would be that a feasibility study be undertaken in this area in order to determine why public transportation is so unpopular and whether Bus Rapid Transit would be successful. The majority of trips made between the City of Johannesburg and Centurion are also made by private car (see Figure 18). No doubt this will be different when the Gautrain is factored in.

Figure 18: Modal split – Movement into Centurion from the City of Johannesburg

4.2.2 Movement into the City of Johannesburg

The Johannesburg CBD is the greatest centre of employment within the City of Johannesburg closely followed by Sandton, Soweto and Randburg (see Figure 19). Movement into each of these areas is discussed below.
4.2.2.1 Movement into the Johannesburg CBD

Most people who work in the Johannesburg CBD are employed within the greater City of Johannesburg (see Figure 20). Furthermore, inter-municipal travel into the Johannesburg CBD is low.

Figure 21 suggests that few people travelling into the Johannesburg CBD from within the City of Johannesburg do so using formal public transport in the form of busses or trains. In total, the formal public transportation sector accounts for 7% of total work trips made.
Furthermore, minibus taxis account for 48% of all trips made into the Johannesburg CBD while private cars account for 27% of trips into the Johannesburg CBD from within the City of Johannesburg. The fact that most trips made into the Johannesburg CBD are made using low occupancy vehicles may result in high congestion.

As can be seen in Figure 22, people who live in the City of Tshwane but work in the Johannesburg CBD are generally reliant on private cars to get to work. Once the Gautrain runs all the way to Park Station, this may change. Formal public transportation, mainly in the form of bus transport, accounts for 20% of trips along this corridor. Minibus taxis and cars together account for 80% of the total trips made along the Tshwane – Johannesburg corridor. Again, this high use of low occupancy vehicles may lead to congestion.
In terms of travel from Ekurhuleni into the Johannesburg CBD, it is evident in Figure 23 that a high number of trips on this corridor are undertaken using train. Minibus taxis account for only 10% of trips made on this corridor whilst private cars account for 50%. There is nonetheless a significant reliance on low occupancy vehicles on this corridor.
4.2.2.1.1 Modality review of Johannesburg residents

Similar to Tshwane, the racial and gender split in car ownership favours whites and males. The greater affluence of Johannesburg, however, is reflected in the 4% higher car ownership among Africans. Nevertheless, although slightly more Africans own cars in Johannesburg, Table 15 demonstrates, the high prevalence of dual car ownership in whites households in comparison to black ones remains in this municipality as well. Females are less likely to own a car in their household, however when they do the average car ownership for the household is higher than for males. This is probably due to dual income families and lifestages whereby single males are more likely to possess just one vehicle.

<table>
<thead>
<tr>
<th>A18 Population group to which the respondent belongs</th>
<th>A19 Gender of the respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>Asian/Indian</td>
</tr>
<tr>
<td>1651</td>
<td>47</td>
</tr>
<tr>
<td>Yes</td>
<td>25%</td>
</tr>
<tr>
<td>No</td>
<td>75%</td>
</tr>
</tbody>
</table>

Q11.9 Respondent’s household owns a car in working order

Q11.10 Number of cars respondent’s household owns that are in working order

1 2 1 2 1 2

Table 15: Johannesburg residents’ household car ownership

Figure 23: Ekurhuleni Municipality to Johannesburg CBD
The increased levels of affluence in Johannesburg is reflected in greater car variety for all groups in general and more SUV use. Bakkies are less popular among whites than what they were in Tshwane and fuel source tends to be petrol over diesel for all groups. Station wagon characteristics are less marked, with females less likely to own station wagons and whites only marginally more likely (3% over 2% for other groups as evidenced in Table 16 &16).

Table 17 and 18 demonstrate further the clear discrepancy between access modality and race in Johannesburg, with 53% (in comparison to 57% in Tshwane) of Africans relying on taxis, 4% on trains and a further 3% on buses. Whites overwhelmingly rely on private transport with 74% driving a car and a further 10% as passengers. Such a high incidence of car drivers provides evidence that most of this group, like their Tshwane fellow citizens, do not car pool, electing instead to travel individually.

Table 16: Johannesburg residents’ types of cars and fuel sources

The increased levels of affluence in Johannesburg is reflected in greater car variety for all groups in general and more SUV use. Bakkies are less popular among whites than what they were in Tshwane and fuel source tends to be petrol over diesel for all groups. Station wagon characteristics are less marked, with females less likely to own station wagons and whites only marginally more likely (3% over 2% for other groups as evidenced in Table 16 &16).

Table 17 and 18 demonstrate further the clear discrepancy between access modality and race in Johannesburg, with 53% (in comparison to 57% in Tshwane) of Africans relying on taxis, 4% on trains and a further 3% on buses. Whites overwhelmingly rely on private transport with 74% driving a car and a further 10% as passengers. Such a high incidence of car drivers provides evidence that most of this group, like their Tshwane fellow citizens, do not car pool, electing instead to travel individually.
Multiple modes of transport are again the domain of the African populace, although the overall incidence is slightly lower than in Tshwane. Coloureds are also more likely to use multiple modes, as are males. Whites and males are again less likely to use public transport but are the closest to accessing it (57% and 45% respectively). In stark contrast to Pretoria, the average distance to public transport is much closer in Johannesburg, being within 10 minutes walking distance. Coloureds have the longest walk, followed by Africans – significant as these two groups use public transport the most.

<table>
<thead>
<tr>
<th>A18 Population group to which the respondent belongs</th>
<th>A19 Gender of the respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>Asian/Indian</td>
</tr>
<tr>
<td>1651</td>
<td>47</td>
</tr>
<tr>
<td>Q11.6 Respondent uses multiple types of transport to get to work or to look for work or go to school (e.g. bus and train, taxi and Q11.1 Respondent uses public transport)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Q11.4 Distance of the closest access point to public transport from respondent’s house (i.e. taxi stop, bus stop, train station)</td>
<td>Less than 5 minutes walk</td>
</tr>
<tr>
<td></td>
<td>From 5 to less than 10 minutes walk</td>
</tr>
<tr>
<td></td>
<td>From 10 minutes to less than 20 minutes walk</td>
</tr>
<tr>
<td></td>
<td>From 20 minutes or to less than 30 minutes walk</td>
</tr>
<tr>
<td></td>
<td>More than 30 minutes walking</td>
</tr>
</tbody>
</table>

Table 18: Johannesburg residents’ access to modality of transport by population and gender

4.2.2.1.2 Trip generation and distribution of Johannesburg residents

Work trips
Johannesburg residents are far less likely to work outside the municipality and its environs than Tshwane residents. Tshwane ranks fifth with 2% on average working there. In terms of work trips, there whites are more likely to work in Sandton, Roodepoort and further afield in Centurion and Pretoria North while Africans and Coloured are more restricted to Joahnensburg, Sandton, Randburg and Soweto. Coloureds also favour the Westrand (see Table 19).
Table 19: Work destination of residents of Johannesburg.

When travel time is reviewed, times are generally shorter for Johannesburg residents than for their Tshwane colleagues. The median time is 30 minutes for whites but 31 to 45 minutes for other race groups (see Table 20). There is no great difference between males and females.
When it comes to work seeking behaviour, there is a much stronger preference among Africans for work within the municipality (64% versus 33% for whites). Whites, again, with access to private transport, concentrate their efforts on the CBDs in the greater Johannesburg area (Randburg, Roodepoort, Ekurhuleni and Florida). Coloureds concentrated their efforts on the Johannesburg CBD, Lenasia, the West Rand, Roodepoort, Kempton Park and Alberton. Asians/Indians demonstrate a preference for Lenasia.

Table 20: Johannesburg residents’ length of travel time
Given the modal preferences and abilities of different groups, it is not surprising that Africans tend to shop locally – either in their place of work or within their home locale (see Table 22 and 22), like their Tshwane cousins. White residents concentrate on a few key areas, usually within driving distance of their place of residence.
### Table 22: Johannesburg residents’ shopping trip destinations

<table>
<thead>
<tr>
<th>Q1.13 Place where respondent usually does shopping</th>
<th>A18 Population group to which the respondent belongs</th>
<th>A19 Gender of the respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>African</td>
<td>Asian/Indian</td>
</tr>
<tr>
<td>Soweto</td>
<td>1651</td>
<td>47</td>
</tr>
<tr>
<td>Johannesburg</td>
<td>37%</td>
<td>6%</td>
</tr>
<tr>
<td>Roodepoort</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Sandton</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>Alexandra</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>Lenasia</td>
<td>4%</td>
<td>47%</td>
</tr>
<tr>
<td>Randburg</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Midrand</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Honeydew</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Vereeniging</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Tembisa</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Epsom</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Ennerdale</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Westrand</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Ga-Luka</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Tshwane</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Eikenhof</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Florida</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>Kempton Park</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

#### 4.2.2.2 Movement into Sandton

Most people employed in Sandton live within the City of Johannesburg (see Figure 24). Inter-municipal travel into Sandton from Tshwane is more widespread than it is from Ekurhuleni.
As can be seen in Figure 25, only 6% of the people who work in Sandton but live in the City of Johannesburg use formal public transportation (bus and train). Car and minibus taxi travel accounts for 81% of trips made along this corridor. The implication of this is that, as is well-known, Sandton is highly congested during peak hours.

As can be seen in Figure 26, it is evident that the Tshwane – Sandton corridor is critical due to the fact that private cars account for 83% of total trips made on this corridor. However, congestion is high on this corridor because of the large number of low occupancy vehicles (private cars) that travel on this corridor.

In terms of travel between Ekurhuleni and Sandton, there is an even split in total trips made by minibus taxis and private cars along this corridor. In other words, all trips made on this corridor are made using low occupancy vehicles. Thus, it is likely that this corridor experiences high levels of congestion, especially during peak hours.
4.2.2.3 Movement into Soweto

All of the sampled individuals in the QoL survey who worked in Soweto lived in the City of Johannesburg, largely in Soweto itself. As such, a large proportion of people employed in Soweto walk to work (see Figure 27), while those who use motorised transport are largely reliant on minibus taxis.
Most of those employed in Randburg reside in the greater City of Johannesburg (see Figure 28). In contrast, only 1% of people employed in Randburg live in the City of Tshwane, while the Ekurhuleni – Randburg corridor accounts for a sizable proportion of trips made into Randburg.

Figure 29 indicates that 80% of trips made into Randburg from within Johannesburg are made by private car. Formal public transportation, led by urban bus transport, accounts for only 11% of trips made along this corridor. It is thus evident that low occupancy vehicles dominate travel into Randburg. The implication of this may be that routes into Randburg are characterised by congestion and automobile dependence. As such, extending initiatives such as Bus Rapid Transit may go some way towards addressing this problem.
With regard to movement into Randburg from Ekurhuleni, this corridor is also characterised by high automobile dependence (all of those surveyed relied on private car use). Consequently, this corridor may also suffer from high congestion during peak hours. At present, neither the Gautrain nor the BRT address the needs of this corridor directly.
4.2.3 Movement into Ekurhuleni

Employment in Ekurhuleni is generally evenly spread amongst a number of areas (see Figure 30), such as Boksburg, Benoni, Germiston, Alberton and Springs. Movement into these five areas will be discussed below.

![Figure 30: Distribution of Ekurhuleni Workforce](image)

4.2.3.1.1 Modality review of Ekurhuleni residents

Ekurhuleni is not as affluent as either Johannesburg or Tshwane, with lower levels of African car ownership (19%). Whites still dominate cars in household (94%) with Coloureds close behind (72%). There is not much difference between genders and car possession in the municipality (see Table 23).
The decreased levels of affluence in Ekurhuleni reflects less car variety for whites and Africans (see Table 23). Coloureds have the greatest variety of cars and dominate SUV ownership. Bakkies are less popular across the board but more popular among males than females. There are fewer station wagons Table 17 and, unlike Tshwane, no women report one in their household.

Table 23: Ekurhuleni residents’ household car ownership. Note Asians/Indians omitted due to small base (n = 16)

Table 24: Ekurhuleni residents’ types of cars and fuel sources. Note Asians/Indians omitted due to small base (n = 16)

The table demonstrates further both the lower incomes and the clear discrepancy between access modality and race in Tshwane, with 60% (in comparison to 57% in Tshwane and 53% in Johannesburg) of Africans relying on taxis, the highest number of the three municipalities (6%) relying on trains but the lowest (1%) patronage of buses. Whites still rely on private transport although to a lesser degree with 60% driving a car and a further 7% as passengers.
Table 25: Ekurhuleni residents’ type of transport by population group and gender. Note Asians/Indians omitted due to small base (n = 16)

Multiple modes of transport are again the domain of the African populace, with 21% reporting multiple modes. Coloureds are less likely to use multiple modes (11%), as are whites (2%). Coloureds, unlike in Johannesburg, have the shortest walk. Africans too have a shorter walk to transport than in either Johannesburg or Tshwane. The median for Coloureds is less than five minutes and less than ten for Africans. Whites report the longest walk, with a median of ten to twenty minutes (see Table 26).
### Table 26: Ekurhuleni residents’ access to modality of transport by population and gender. Note Asians/Indians omitted due to small base (n = 16)

<table>
<thead>
<tr>
<th>Q11.6 Respondent uses multiple types of transport to get to work or to look for work or go to school (e.g. bus and train, taxi and some walking)</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A18 Population group to which the respondent belongs</td>
<td>African</td>
<td>Coloured</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Yes</td>
<td>21%</td>
<td>11%</td>
</tr>
<tr>
<td>No</td>
<td>79%</td>
<td>89%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q11.4 Distance of the closest access point to public transport from respondent’s house (i.e. taxi stop, bus stop, train station)</th>
<th>Less than 5 minutes walk</th>
<th>From 5 to less than 10 minutes walk</th>
<th>From 10 minutes to less than 20 minutes walk</th>
<th>From 20 minutes or to less than 30 minutes walk</th>
<th>More than 30 minutes walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A18 Population group to which the respondent belongs</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No</td>
<td>80%</td>
<td>20%</td>
<td>39%</td>
<td>61%</td>
<td>2%</td>
</tr>
<tr>
<td>No</td>
<td>20%</td>
<td>80%</td>
<td>61%</td>
<td>39%</td>
<td>18%</td>
</tr>
</tbody>
</table>

| Q11.1 Respondent uses public transport | Yes | No |
| --- | --- |
| A19 Gender of the respondent | Male | Female |
| Yes | 80% | 62% |
| No | 20% | 38% |

| Q11.1 Respondent uses public transport | Yes | No |
| --- | --- |
| A19 Gender of the respondent | Male | Female |
| Yes | 80% | 68% |
| No | 20% | 32% |

4.2.3.1.2 Trip generation and distribution of Ekurhuleni residents

**Work trips**

Work sites are centred in the East Rand for African and white respondents. Coloureds report greater work reliance at the greatest distances – Johannesburg, Tshwane and Alberton (see Table 27). Males have a wider perimeter of workplaces.
When travel time is reviewed, times are generally longer for Ekurhuleni residents than for their Johannesburg colleagues. The median time is 31 to 45 minutes for whites and Africans. Coloureds, with greater work spread (see Table 27) travel further and take longer to do so (see Table 28). Men tend to exhibit longer travel times.
When it comes to work seeking behaviour, Ekurhuleni residents favour both local work as well as that found in Johannesburg, Kempton Park and Alberton (see Table 29). Africans favour the East Rand broadly and Johannesburg, while Coloureds and whites favour Johannesburg and specific locales within the East Rand, such as Boksburg, Geduld and Heidelberg. The preference of white people for Katlehong appears to be a data and sample anomaly and should be investigated further before any decisions are made.
Table 29: Ekurhuleni residents’ work seeking locale preferences. Note Asians/Indians omitted due to small base (n = 16)

<table>
<thead>
<tr>
<th>Location</th>
<th>African</th>
<th>Coloured</th>
<th>White</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benoni</td>
<td>16%</td>
<td>0%</td>
<td>0%</td>
<td>11%</td>
<td>19%</td>
</tr>
<tr>
<td>Germiston</td>
<td>9%</td>
<td>11%</td>
<td>0%</td>
<td>7%</td>
<td>9%</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>8%</td>
<td>22%</td>
<td>0%</td>
<td>9%</td>
<td>8%</td>
</tr>
<tr>
<td>Johannesburg</td>
<td>8%</td>
<td>11%</td>
<td>13%</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Kempton Park</td>
<td>8%</td>
<td>0%</td>
<td>13%</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>Alberton</td>
<td>7%</td>
<td>22%</td>
<td>13%</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Johannesburg</td>
<td>6%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td>7%</td>
</tr>
<tr>
<td>Boksburg</td>
<td>5%</td>
<td>22%</td>
<td>25%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Brakpan</td>
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<td>0%</td>
<td>0%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Springs</td>
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<td>0%</td>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>Vosloosrus</td>
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<td>0%</td>
<td>0%</td>
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<td>3%</td>
</tr>
<tr>
<td>Daveyton</td>
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<td>0%</td>
<td>0%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Tembisa</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Nigel</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Katlehong</td>
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<td>13%</td>
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<td>1%</td>
</tr>
<tr>
<td>Tokoza</td>
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<td>0%</td>
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<td>1%</td>
</tr>
<tr>
<td>Tshwane</td>
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</tr>
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</tr>
<tr>
<td>Tsakane</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Bon Accord</td>
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</tr>
<tr>
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<tr>
<td>Kwa-Thema</td>
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<td>0%</td>
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<tr>
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<td>Bapsfontein</td>
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</tr>
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</tr>
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<td>Elandsfontein</td>
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<td>Kaalfontein</td>
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<tr>
<td>Geduld</td>
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<td>0%</td>
<td>13%</td>
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</tr>
<tr>
<td>Heidelberg (GT)</td>
<td>0%</td>
<td>0%</td>
<td>13%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Shopping**

Given the modal preferences and abilities of different groups, again the pattern of Africans shopping in both townships and local municipalities and whites seeking CBDs and malls in suburban areas is replicated (see Table 30).
Table 30: Ekurhuleni residents’ shopping trip destinations. Note Asians/Indians omitted due to small base (n = 16)

<table>
<thead>
<tr>
<th>Q1.13 Place where respondent usually does shopping</th>
<th>African</th>
<th>Coloured</th>
<th>White</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benoni</td>
<td>12%</td>
<td>0%</td>
<td>11%</td>
<td>10%</td>
<td>13%</td>
</tr>
<tr>
<td>Germiston</td>
<td>9%</td>
<td>11%</td>
<td>8%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>7%</td>
<td>8%</td>
<td>5%</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Kempton Park</td>
<td>7%</td>
<td>0%</td>
<td>10%</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Tembisa</td>
<td>7%</td>
<td>3%</td>
<td>0%</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>Vosloorus</td>
<td>7%</td>
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<td>1%</td>
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<tr>
<td>Alberton</td>
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<td>42%</td>
<td>13%</td>
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</tr>
<tr>
<td>Boksburg</td>
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<td>22%</td>
<td>16%</td>
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</tr>
<tr>
<td>Springs</td>
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<tr>
<td>Katlehong</td>
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<td>Daveyton</td>
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</tr>
<tr>
<td>Brakpan</td>
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<td>Tokoza</td>
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</tr>
<tr>
<td>Johannesburg</td>
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<tr>
<td>Kwa-Thema</td>
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<td>Nigel</td>
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</tr>
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<td>Bedfordview</td>
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</tr>
<tr>
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<tr>
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<tr>
<td>Edenvale</td>
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<tr>
<td>Geduld</td>
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<td>0%</td>
</tr>
<tr>
<td>Randburg</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
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</tr>
<tr>
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<td>4%</td>
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<td>0%</td>
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<tr>
<td>Heidelberg (GT)</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Jameson Park</td>
<td>0%</td>
<td>0%</td>
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<td>0%</td>
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</tr>
<tr>
<td>Pretoria</td>
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<tr>
<td>Strubenvale</td>
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<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 30: Ekurhuleni residents’ shopping trip destinations. Note Asians/Indians omitted due to small base (n = 16)

4.2.3.1 Movement into Boksburg

The vast majority (98%) of work trips into Boksburg originate within Ekurhuleni. Inter-municipal travel is minimal. Figure 31 indicates that most people employed in Boksburg are dependent on private vehicles to get to work. Furthermore, the public transportation sector in this area is dominated by the minibus taxi. There is minimal use of formal public transport (bus and train). Consequently, there is a need to look at ways to
improve the popularity of formal public transportation in order to help reduce congestion within this area.

![Figure 31: Modal split – Movement into Boksburg](image)

4.2.3.2 Movement into Benoni

Benoni reflects a similar case as Boksburg, with 98% of people working in Benoni living in Benoni. Figure 32 indicates that people employed in Benoni are largely dependent on low occupancy vehicles. Furthermore, formal public transport (bus and train) was not utilised among the sampled population. It is thus necessary to find ways to increase the popularity of formal public transportation modes in order to help reduce automobile dependence in this area.

4.2.3.3 Movement into Germiston

People who work in Germiston generally reside in the Ekurhuleni municipality (see Figure 33). While there are very few trips made into Germiston from Tshwane, some 7% of people who work in Germiston travel from the Johannesburg municipality.
Figure 34 indicates that movement into Germiston from within Ekurhuleni is dominated by minibus taxi and private car. However, a significant proportion (12%) of people employed in Germiston make use of passenger rail transport. Nevertheless, there is still high dependence on low occupancy vehicles on routes into Germiston. Thus it is suggested that measures need to be put in place to increase formal public transport use into Germiston.

Figure 32: Modal split – Movement into Benoni

Figure 33: Employment in Germiston by Municipality
In terms of travel between Johannesburg and Germiston, this corridor is dominated by public transport, according to data obtained in the 2009 Quality of Life survey (see Figure 35).

Figure 35: Modal split – Movement into Germiston from the City of Johannesburg

4.2.3.4 Movement into Alberton

People who work in Alberton generally reside in Ekurhuleni (see Figure 36). While travel from Tshwane into Alberton is negligible, some 7% of those employed in Alberton travel from the City of Johannesburg.
Figure 36 indicates that movement into Alberton from within Ekurhuleni is dominated by private car and minibus taxi. This again suggests that attention needs to be paid to finding ways of making formal modes of public transportation more attractive to commuters. Again, this area may be a candidate for Bus Rapid Transit implementation. This is reinforced when considering the fact that movement between Johannesburg and Alberton is dominated by minibus taxis (all of those sampled travelled along this corridor use this mode).

### 4.2.3.5 Movement into Springs

The individuals sampled who work in Springs generally reside in Ekurhuleni (see Figure 38). As was the case in Alberton, travel between Tshwane and Springs is negligible. However, 8% of those employed in Springs reside in the City of Johannesburg.

Figure 39 indicates that movement into Springs from within Ekurhuleni is dominated by private car and minibus taxi. Again, this is the general trend within Ekurhuleni and it is again suggested that attention be paid to finding ways of making formal modes of public transport more attractive to commuters within this municipality.
4.3 Critical Corridors in the Gauteng City Region

Based on the above analysis of movement patterns into the major work destinations across Gauteng, a number of critical corridors (based on traffic volume) can be identified. In this report, focus is placed on the five most critical intra-municipal corridors and the two most critical inter-municipal corridors within the Gauteng City Region. These are listed in Table 31.
Figure 39: Modal split – Movement into Springs from within Ekurhuleni
Table 31: Critical Transportation Corridors within the Gauteng City Region

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Total employed users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-municipal travel</td>
<td></td>
</tr>
<tr>
<td>Into the Tshwane CBD from within the City of Tshwane</td>
<td>22%</td>
</tr>
<tr>
<td>Into the Johannesburg CBD from within the City of Johannesburg</td>
<td>14%</td>
</tr>
<tr>
<td>Into Sandton from within the City of Johannesburg</td>
<td>11%</td>
</tr>
<tr>
<td>Into Soweto from within the City of Johannesburg</td>
<td>8%</td>
</tr>
<tr>
<td>Into Randburg from within the City of Johannesburg</td>
<td>6%</td>
</tr>
<tr>
<td>Inter-municipal travel</td>
<td></td>
</tr>
<tr>
<td>Between the cities of Tshwane and Johannesburg</td>
<td>3%</td>
</tr>
<tr>
<td>Between the cities of Ekurhuleni and Johannesburg</td>
<td>4%</td>
</tr>
</tbody>
</table>

The results in this section suggest that intra-municipal travel is generally dominated by the minibus taxi. Moreover, the formal public transportation sector is to all intents and purposes non-existent in some municipalities. Commuters do not favour formal modes of public transportation and reasons for this need to be identified and remedied as a matter of urgency. With regard to inter-municipal travel, commuters seem to favour private vehicles when travelling from one municipality to another. Private car usage went up as high as 80% in corridors which connected two municipalities. Thus, it is evident that many inter-municipal corridors will indeed suffer from congestion, as a result of this high level of automobile dependence.

It has already been noted in the literature that the use of public transportation systems in South Africa has declined substantially over the past 17 years, with usage decreasing from a 60/40 (public/private) distribution in 1995 to a 47/53 (public/private) distribution in 2002 (Shaw, 2006). A particularly marked decline has been noted in the usage of public buses and trains (Walters, 2008).

However, this situation can be reversed. As Marsay (2007) contends, public transportation infrastructure determines where people live. Furthermore, Marsay (2007)
maintains that suburbanisation typically occurs during periods of good economic growth, as people are increasingly able to afford private cars and are more inclined to move to areas which lie away from the city centre (Beukes et al., 2011 and Motte-Baumvol et al., 2010). Thus, the economic recession offers the GCR an unprecedented opportunity to invest in public transport ahead of the next cycle of suburbanization. In particular, government can be proactive and build infrastructure to establish transportation systems that shape future demand rather than maintain the current knee-jerk reaction to demand (Pflieger et al., 2009). To this end, in this section, it has been shown that, but for a few significant corridors, new transportation developments such as the Gautrain and Bus Rapid Transit are generally placed in ideal locations to try and reduce automobile dependence and congestion (particularly along inter-municipal corridors). However, there is an urgent need for improved intra-municipal public transportation systems.

Nevertheless, both Marsay (2007) and Pflieger et al. (2009) argue that there is no evidence anywhere in the world that suggests that good public transportation systems alone reduce automobile dependency. They argue that it is a combination of mixed land use, high densification as well as good public transportation systems and infrastructure that reduces automobile dependency.

As Gauteng is characterised by fragmented residential areas, imbalanced population distributions and low population densities, public transport is always going to be costly to provide (Turok et al., 2011). The population density of 1 962 people/km² for Johannesburg, for example, is much lower than that of megacities in other parts of the world, such as New York, Tokyo, Paris and Hong Kong where the population density is in excess of 10 000 people/km² (Cooper, 2007). Furthermore, those Gauteng commuters who have a choice elect to use automobiles for their commute. Due to this, vehicle sales have risen annually between 1994 and 2005 by 25% (Shaw, 2006). Consequently, urban bus and passenger rail usage has decreased within the province since 1994 (Shaw, 2006). This has resulted in a vicious cycle of poor demand, poor service levels, declining profitability and increasing costs (Shaw, 2006). Most
importantly, spatial planning has not promoted the development of high density areas and continues to develop housing on the urban peripheries (Turok et al, 2011). Unless the Gauteng province promotes densification, the required economies of scale for sustainable public transport will never be achieved.
5. MOBILITY IN CONTEXT: ANALYSIS OF THE 2009 QUALITY OF LIFE SURVEY RESULTS

5.1 Introduction

In this section, the results of the 2009 Quality of Life survey conducted by the Gauteng City-Region Observatory are analysed and discussed.

In particular, the following issues are discussed:
1) Firstly, the relationship between income and modal choice is investigated.
2) Thereafter, issues of public transport accessibility and travel time will be examined.
3) Finally, existing and future infrastructure development within the Gauteng City-Region will be discussed in relation to key transportation corridors identified in the QoL survey data.

5.2 Income and modal choice

It is evident in the data that low income earners are heavily dependent on public transport but that this is in the form of minibus taxis (see Figure 40). There are a number of reasons as to why the minibus taxi is so dominant in the public transportation sector. Firstly, the minibus taxi is flexible and can adapt to changes in routes and demand quicker and more efficiently than both passenger rail and urban bus transportation. Secondly, the minibus taxi is the most accessible form of public transport (Swanepoel, 2009). This results in minibus taxi dominance over other public transportation modes. In contrast, the middle income group is more likely to own at least one car (see Figure 41). The usage of private vehicles to get to work rises drastically (from 6% to 59%) compared to results for low income earners, whereas

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3 For the purpose of this discussion, low income refers to less than R6 400 per month, middle income to between R6 401 and R25 600 per month and high income to over R25 600 per month.

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public transport usage decreases from 94% to 41% when compared to the low income group.

It is also noticeable that whereas among low income earners passenger rail usage is double that of urban bus usage, among middle income earners, urban bus usage is more than double that of passenger rail usage. The reasons for this may include
distance to rail infrastructure, the poor state of rail infrastructure and lack of security. This means that only the really poor, who have no other options available to them, use rail.

As can be seen in Figure 42, car usage among high income earners increases further from 59% to 83% when compared to middle income earners. It is thus evident that as ones income increases, so too does reliance on private transportation. This could be for two reasons. One is that these people can afford private vehicles so opt for it or that they find private vehicles essential to raising their incomes. In addition, high income earners do not use passenger rail to access places of employment. It is also observable that urban bus usage has decreased compared to the middle income group.

In conclusion, income level plays a significant role in modal choice. The implication of this is that automobile dependence along with high congestion is a problem the Gauteng City Region may be stuck with for the foreseeable future because, as both middle and high income groups increase in number, so too will the number of vehicles on the roads. Moreover, the future of the public transportation sector looks bleak as only the poorest segment of the market uses it, so it will continually have to be subsidized.
5.3 Access to Public Transport

Distance to public transportation nodes is a function of the time it takes to walk the distance from their residence to the node in question. In the GCR, this time varies from less than 5 minutes to more than 30 minutes. Figure 43 illustrates the average walking time to access train services (amongst those who regularly use trains for travel to work).

As can be seen, very few train users walk for longer than 20 minutes which may suggest that access points to this mode are readily available. However, as can also be seen, these train users reside along the rail network. It is likely that these commuters either looked for affordable accommodation in close proximity to train access points or use this mode as it is the most efficient and affordable mode available close to their residence. It should also be noted that a relatively small portion of the respondents use
trains to access their work places. This suggests that, despite what the above figure suggests, train access points are prohibitively far from the vast majority of potential commuters.

Figure 44 shows that respondents using bus as their primary mode of transportation are more widely spread across the GCR, and not as clustered around the central city regions and municipalities. There is slightly higher densification along the new BRT routes which would indicate that this development is well-placed as it is located in an area that already experiences high bus usage. The data again suggests that there few commuters that walk for longer than 20 minutes to access bus services. While this suggests that these commuters may reside close by to bus routes, this can only be verified by accessing vector data for municipal and provincial bus routes.

Figure 44: Closest access point to public transport (Bus)
Finally, with regard to mini-bus taxis, it is evident in Figure 45 that the vast majority of taxi commuters do not walk further than 10 minutes to access taxi services. It is unclear whether these access points referred to in the question refer to formal designated access points like bus stops, taxi ranks or taxi lay-byes, or informal collection points. It is likely, however, that these “access points” are indeed informal points along the road. This is an important and contentious issue as, if a formal integrated transportation plan is to be developed for the GCR, it is important to ensure that all transport modes are safe and reliable.

Figure 45: Closest access point to public transport (Mini-bus Taxi)
5.4 Travel Time

In the QoL survey, travel time was categorised as follows:

- Up to 15 minutes
- From 16 minutes to 30 minutes
- From 31 minutes to 45 minutes
- From 46 minutes to 60 minutes
- From 61 minutes to 90 minutes
- From 91 minutes to 120 minutes
- More than 120 minutes

As can be seen in Figure 46, travel time by private car is predominantly between 15 and 45 minutes. At the extreme, there are some commuters who travel for more than 2 hours in order to get to work, the majority of which hail from the far eastern regions of the GCR.
Figure 46: Time it takes to reach work (Private Car Use)

Figure 47 indicates that the majority of train commuters experience travel times which are below 45 minutes. It should be noted that there is a slight increase in train travel time in the Soweto area, as well as the northern regions of Emfuleni.
No discernable patterns emerge from Figure 48 which could distinguish the data from the above mentioned discussions. There seems to be moderate average travel times for bus commuters (in the region of 15 to 60 minutes), with isolated cases where commuters may experience travel times greater than an hour. With regard to taxi use (see Figure 49), a considerable number of taxi commuters reach their work destinations in under 30 minutes.
Figure 48: Time it takes to reach work (Bus)
This section thus far has addressed questions of income, travel time and accessibility and related each of these to modal choice. Of course, such issues are intimately related to densification which is a crucial pivot around which an effective transportation system hinges. In order to create a more sustainable (that is, accessible, affordable and efficient) public transport industry, therefore, high density areas need to be established along with improvements in the fuel efficiency of public transport equipment, improved regulation and enforcement of such regulation as well as the construction of environmentally friendly mass transit systems (Burgess, 2000). Equally important, however, is the fact that the public transport system must cater for the demands of the population. This includes taking the type of mobility demand and income of the population into account.

Densely settled areas with public transport nodes will enable greater numbers of people to access transport stations, which is a crucial component of a self-sustaining public
transport infrastructure. Such a system will reduce dependence on government subsidies for operation and maintenance. It will also lead to an improved customer experience as economies of scale come into play. Increased reliance on public transport will also enable cities to reduce (and perhaps even re-claim) the amount of space allocated to cars (such as garages, petrol stations and street parking) (Burgess, 2000).

However, densification alone will not solve the integration problems currently facing public transportation systems in urban and suburban areas. Densification has to go hand in hand with mixed land use in order to fully integrate public transport with the urban environment (Beukes et al., 2011). Low densification coupled with uniform land use, as is the case in most parts of Gauteng, is suited to private car use due to long distances having to be travelled to get to city centres, schools, malls and other places of leisure (Beukes et al., 2011). However, mixed land use places city centres as well as places of leisure in close proximity to residential areas, thus promoting the use of public transport as well as other forms of non-motorised transport (Scheiner, 2010). Consequently, mixed land use is in line with the Smart Growth initiative which is being implemented worldwide in order to have a sustainable transportation system which will result in sustainable social and environmental systems. Currently, limited mixed land use within the Gauteng province is typically occurring in suburban areas and not along dominant transport corridors (Shaw, 2006).

5.5 Infrastructure development in the Gauteng City-Region

As stipulated by Landau & Gindrey (2008), human mobility will play a vital component within the province’s socio-landscape if Gauteng intends to maintain its economic importance within the country as well as globally. Figure 50 shows Gauteng’s recent public transportation infrastructure development and how it relates to the Polycentric model developed by the Gauteng City Region Observatory (GCRO). This figure clearly demonstrates an intention to develop transportation infrastructure corridors between the three major nodes within Gauteng: the City of Johannesburg, City of Tshwane and
Ekurhuleni. As this infrastructure development is a response to the current land use within Gauteng, it indicates an attempt on the government's part to address their global planning framework stipulated in the White Paper published in September 1996. There is still potential for future transportation infrastructure development in areas such as the South West of Ekurhuleni and Mogale City.

Figure 51 provides a rose diagram for the three major work destinations, Johannesburg, Pretoria and Tshwane. This figure, as indicated in Section 4, shows that while there is significant inter-municipal travel, especially towards the Tshwane municipality, this does not constitute the bulk of travel in the GCR. Similarly, Figure 52 shows travel into some of the smaller employment centres in the GCR.

There are a few distinct corridors that emerge from these two diagrams. These are:

- Johannesburg to Tshwane
- Ekurhuleni to Tshwane
- Soweto to Johannesburg
- Ekurhuleni to Johannesburg
- Soweto to Sandton
- Randfontein to Randburg

These corridors largely accord with the discussion presented in Section 4 and can be used for further investigation in transportation infrastructure development and integrated land-development planning.
Figure 50: Infrastructure development in Gauteng
Figure 51: Rose Diagram of Major Work Destinations
5.6 Conclusion

This section has demonstrated that the negative consequences of poor urban planning in the past continue to haunt the Gauteng City Region. Importantly, poor land use decisions now strongly determine transport demand and traffic flows. While different land use plans can be implemented for future developments, to a large degree South African cities will have to develop their transportation network around current land use. To do this, and create a well-organised and successful transportation system, will be a huge challenge. Some of the most important points to take into consideration are:

- Current land use needs to be reviewed to take a holistic view of the city in terms of accessibility and connectivity i.e. how can people access the site? As the majority of the population that is affected by a lack of mobility are low-income groups, city planners must plan for public transportation services and
synchronise land use with transportation networks if the needs of this group are to be met (Mazaza, 2002).

- As transport is a long term consideration while land use a temporary one, emphasis should go to transport rather than land use. This will cause conflict with land owners who have vested interests in particular land uses. City planners should manage this conflict.
- The budget for land use is normally smaller than that of transport and it is usually the city that must budget for infrastructure and public transport rather than individual land owners. Thus, long term effects on the city finances must be taken into consideration when approval is granted for land use by the city.
- Long term sustainable land use must be mixed use, rather than single use development. Internationally single use developments are becoming rare and South Africa is far behind this trend.
- It is questionable if the vast number of shopping centres currently operational in the GCR are sustainable. Certainly some are struggling financially. In the long term, it would be better to increase the size of existing centres to capitalize on economies of scale and reduce the number of approvals for the construction of regional and local shopping centres. Shopping centres should be encouraged to combine retail with entertainment, residential and office space.
- The extent to which cities are allowed to grow beyond their existing boundaries should be severely curtailed.
- The gap between the rich, middle class and poor will continue to widen unless the city expands opportunities for poorer residents to access jobs and quality education.
6. CONCLUSION: MOBILITY IN THE GAUTENG CITY REGION

Transportation and land use are invariably intertwined; it is only through sufficient land use planning, the eradication of urban sprawl and the densification of core urban areas that reduced automobile dependence and hence reduced congestion can be attained (Stapelberg, 2006). Achieving this goal will result in increased quality of life. The development of an improved transportation network and infrastructure relies heavily on the achievement of sustainable cities in the Gauteng province. Sustainable cities are based on creating a balance between land development and transportation planning. The principal behind sustainable cities is the integration of the population regardless of wealth and social class and the removal of barriers between the poor and their access to economic activity. Transportation systems in such cities provide easy access for pedestrians, cyclists and cars, minimising congestion on routes that connect places across long distances. If congestion occurs, it is used appropriately to reinforce economic activity (Garner et al., 2001). To reach the goal of creating such cities in South Africa and more specifically in the Gauteng province, a great deal of insight concerning historical land use and travel patterns that have led to the current situation is required.

A sufficient understanding of these historical travel patterns requires the analysis of past trends based on the transportation land use planning model. This model comprises of a four step process inculcating trip generation, trip distribution, modal split and traffic assignment models. The analysis of trip generation and trip purpose helps create transport models which can be used to effectively plan infrastructure, by allocating the correct proportion of infrastructure to cater to demand. Whilst trip generation and trip purpose assist in the planning of infrastructure according to origin and destination, trends in modal split provide insight into the use of private and public transport within a region; thereby assisting in understanding which modes are used to connect locations.

Analysis conducted in this investigation has shown that the Gauteng province is far from reaching the ideal of a sustainable city. Moreover, the contribution of Apartheid to
urban sprawl and hence automobile dependence in the region is significant. The middle class (mainly white) population demonstrates dependence on automobiles. If methods of curbing this increasing trend are not implemented the consequences on the economy may be substantial. Figure 53 below depicts the relationship between transportation management and economic activity. According to the model, increasing use of minibus taxis in the region is a key contributor to congestion thereby reducing speed and indirectly decreasing the size of the labour force. However, to create a permanent shift in modal choice, the formal public transport sector will have to be greatly improved so as to address the current challenges faced by the passenger rail and bus industries. Improvements will have to focus on improving safety, efficiency, accessibility, overall travel time and cost.

![Diagram of the Superior Productivity of Mega Cities](image)

Figure 53: The Superior Productivity of Mega Cities (Garner et al., 2001)

Results from this report suggest that public transportation is generally utilised by the low income population group. Furthermore, the minibus taxi is the most dominant mode of transportation. On the other hand, middle and high income groups are generally dependent on private cars for commuting. The results further suggest that formal modes of public transport (urban bus and passenger rail) are hardly utilised throughout the Gauteng City Region.
Moreover, the results illustrate that the utilisation of public transport systems drops significantly as income increases. In fact, on average, the utilisation of public transport dropped by more than 50% across any two income groups. As such, it is concluded that income is one of the main factors that determines what types of transportation modes people utilise for commuting. The results also demonstrated that intra-municipal travel is dominated by minibus taxis whilst inter-municipal travel is dominated by private car. Moreover, the results illustrated that both intra- as well as inter-municipal travel is dominated by low occupancy vehicles (minibus taxi and private car).
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