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1. INTRODUCTION

1.1. Background

When former and late President Nelson Mandela arrived in Soweto after his release from prison in 1990, he was surprised to see the high number of private vehicles that were there since his imprisonment in the early 1960's. The improved living standards (in spite of Apartheid) and poor public transport services had led to an increase in private vehicle ownership by Sowetans. Unlike in other more affluent areas, the majority of vehicles leaving Soweto on any given weekday have at least three occupants and some may even be overloaded. Owing to the high cost of owning and maintaining private vehicles, owners thereof have had to organise lift clubs to share costs with commuters for trips of similar origins and destinations. This form of shared mobility has also been very popular in other parts of South Africa.

The lack of viable mass-transit public transport services in both poor and affluent areas has placed more reliance on private vehicles. Outdated public transport services in cities like Johannesburg are still clustered around old economic nodes like the Johannesburg Central. Rail lines built in the 1960's and 1970's are still based on transporting daily commuters to these central business districts. However, new economic hubs have since mushroomed in commercial districts in the north of Johannesburg in areas like Sandton, Fourways and Rosebank. The relocation in the late 1990's of the Johannesburg Securities Exchange from Johannesburg Central to Sandton proved to be a catalyst to this business migration. Owing to the inflexibility of traditional public transport, mini-bus taxis have had to fill this void for poorer communities.

In cities like Durban, businesses have also migrated to the North and new commercial precincts have developed in areas like Umhlanga Ridge. All of these nodes are not accessible by rail. Daily commuters from areas like Umlazi (the biggest township in Durban) are forced to use other alternative modes of transport like mini-bus taxis and private vehicles to access these new economic nodes. Private vehicle ownership seems to be the most viable and convenient option to commute to and from work. For those who cannot afford to buy a vehicle, the next best option is the use of mini-bus taxis. Unlike rail, this mini-bus transport service does not enjoy government subsidies and does not

move large numbers of commuters in one trip, thus adding to congestion on trunk routes (corridors linking major settlements and commercial nodes).

One of the technological disruptions of modern times is collaborative consumption, which is normally referred to as the sharing economy or colloquially known as the "gig economy". This new economy is characterised by eliminating idle time of an asset by sharing its use with other people in return for a share of costs or a reward. This disruptive new business model has affected a number of industries and the transport industry has not been spared. In the past 5 years, there has been an emergence of shared mobility solutions like vehicle-sharing, ride-sharing, vehicle-pooling and the growing concept of Mobility-as-a-Service (MaaS). In their study, Shaheen & Chan (2016) defined Shared Mobility as "*the shared use of a motor vehicle, bicycle, or other mode that enables travellers to gain short-term access to transportation modes on an as-needed basis.*" Whilst this definition is very broad, the study is confined to shared mobility as an alternative to owning a vehicle for private use.

Shared mobility fits the definition of a perfect disruption in that it did not originate, nor was it initiated, by the incumbent operators within the automotive and broader transport industries. The basis of the business model that vehicle manufacturers have been focused on is that of selling the majority of their vehicles to individual private owners, and fewer ones to fleet owners in the transport industry. Therefore, shared mobility could not have been an "inside job" of the automotive industry. It would not have been in their best interest to embrace this sharing economy that means selling fewer shared vehicles. Even operators like vehicle-rental companies would prefer to rent more vehicles to single-occupant users as opposed to adopting some vehicle-sharing scheme.

In South Africa owning a vehicle for private use has been underpinned by the lack of viable and efficient public transport. Young people entering the job market would prioritise the acquisition of a motor vehicle, not so much as a status symbol, but as a necessity for commuting to work. The rising adoption of shared mobility services like ride-haling, vehicle-pooling, etc. has caused some consternation within the automotive industry. For fear of losing out, some of these major manufacturers have moved beyond just the manufacturing and distribution value chain. Companies like BMW and Daimler have launched vehicle-sharing services, through which they charge a fixed subscription

price. In addition, these transport providers give their clients access to vehicles as and when they need them and they are only charged for the time they use the vehicles and the distance travelled (Bellos, Ferguson, & Toktay, 2017). In Spain, BMW is piloting a vehicle-sharing scheme using the Mini Cooper brand. If such schemes become widely adopted, they could begin to affect private vehicle ownership.

For the majority of households, the acquisition of a motor vehicle is probably the 2nd biggest decision to make after the purchase of a house, yet this asset remains unused most of the time. In a study by Wong, Hensher, & Muller (2017) they found that private vehicles are generally in use for an average of only 5% in any given period. They further found that with various forms of shared mobility such as vehicle-sharing, ride-sharing and vehicle-pooling, vehicle utilisation ranges from 20% to 60%. From this study it can be deduced that shared mobility would reduce the number of vehicles used for the same total distance travelled.

The total cost of owning and operating a vehicle goes beyond the explicit costs of financing, maintenance, parking, insurance, repairs, etc. The implicit or opportunity cost of owning a vehicle includes the cost of a garage that could otherwise be used as an extra bedroom, storage, or a home office. The inconvenience of being stuck in traffic, not to mention road rage and the stress of driving on public roads, negate the joys of owning these fine machines that have so much been adored by their owners. This huge inconvenience and costs associated with owning a vehicle have created the perfect breeding ground for disruption.

Shared mobility and specifically MaaS services present choices for private vehicle owners to switch to more efficient transport services that eliminate the opportunity costs, reduce traffic congestion and make employees more productive. Mobility is evolving into being a service as opposed to being a product. Emerging transport operators are aggregating and integrate user mobility data to offer them more cost-effective options that do not require huge capital outlays like the acquisition of a motor vehicle. Notwithstanding the benefits of shared mobility over private vehicle ownership, vehicle ownership in South Africa is still perceived as the only viable option owing to poor public transport services (Luke, 2018).

Research on international transport markets support some causal relationship between shared mobility and private vehicle ownership, but the South African situation could be different owing to fewer options of shared mobility. It therefore became necessary to explore the possibility that this relationship might exist in the future. The objective of this study is therefore to explore if there is a relationship between the two concepts.

1.2. Problem Statement

1.2.1. Cost of Private Vehicle Ownership

According to the South African departments of transport in all three spheres of government (national, provincial and municipal), private vehicle ownership has been the biggest cause of some of the worst transport problems such as crashes, congestion and emission of greenhouse gases. These transport authorities believe that a shift from the use of private vehicles to public transport or other forms of shared mobility like lift clubs, could reduce the effect of these problems as there would be fewer vehicles on public roads. Their conviction is based on the fact that most private vehicles are driven with single occupants inside, especially during peak travel periods.

In countries where subsidised mass transit public transport systems like buses and trains are well established and run efficiently, the use of private vehicles is kept to a minimum. In the case of South Africa, mass transit public transport services are not run efficiently and most commuters are forced to use private vehicles and other services like minibus services. The rising popularity of the Gautrain service has proven that motorists are open to using public transport if it is run efficiently.

The rising fuel prices and the weakening ZAR/Dollar exchange rate have had a huge impact on the cost of ownership of private vehicles. When a vehicle is not in use, the owner still incurs costs like parking fees, insurance, depreciation, financing costs, etc. In addition to these operational costs, a vehicle owner has to incur capital costs like providing for a garage when building or purchasing a house. Other costs of owning a vehicle are not as obvious when a buying decision is made, and such costs include parking fees wherever the vehicle is driven to, as well as public costs such as carbon emissions. Most of these costs are fixed and are incurred whether or not the vehicle is being used.

These costs are more burdensome for low income vehicle owners who have no other alternatives like public transport.

A study by Hensher (2017) compared private vehicle use and Uber rides and found that the latter is more expensive if one only looked at explicit costs. However, when other implicit costs like that of owning a house with a garage that could otherwise be used as a home office or be rented through sharing platforms like AirBnB, the total cost of vehicle ownership is more than the use of a ridesharing service like Uber. Unfortunately, when prospective vehicle owners make a buying decision they seldom look at these other costs.

1.2.2. Traffic Congestion

Traffic congestion is one of the problems associated with privately-owned vehicles, because there are more vehicles than there should be on South African roads if more high-occupancy public transport services were used. Up to 74% of daily trips undertaken in the provinces of KwaZulu-Natal, Gauteng, and Western Cape are by privately owned vehicles (Statistics South Africa, 2013). The proliferation of private vehicle ownership caused, inter alia, by poor public transport services has led to more vehicles on South African roads. This has resulted in huge traffic congestion during peak hours leading to increased travel time in major cities.

High congestion levels are adding more travel time for South African commuters, which adds to stress levels and frustration. These behavioural problems have manifested themselves into road rage. When one is driving there is very little else one can do whilst driving. However, if the same drivers who are often stuck in traffic were to use shared mobility services like vehicle-pooling and ride-sharing, they could find other activities to engage in with their free time.

Traffic congestion is one of those hidden costs associated with driving one's own vehicle to work because it robs one of valuable time that could be spent with family or doing productive work. In order to discourage drivers from driving at peak travel times, some countries have had to introduce congestion taxes for those driving during these times (Vanoutrive & Zijlstra, 2018). This congestion tax only adds to the cost of private vehicle ownership.

1.3. Research Questions

The purpose of this study is to explore the existence, if any, of a relationship between shared mobility and private vehicle ownership. Benjaarfar, et al (2018) found that as travellers realise the benefits of using shared mobility services, they are expected to dispose of their private vehicles or delay purchase of new vehicles. Whether this is possible in a developing country like South Africa, remains to be seen. The aim of this study is to explore whether the concept of shared mobility will have any bearing on private vehicle ownership in the South African context. In exploring this possibility, the study will seek to answer the following research questions:

a) **Cost of Vehicle Ownership:** How would the rising costs of private vehicle ownership and low utilisation levels lead private vehicle owners to consider shared mobility options like lift clubs and ride-sharing?
b) **Benefits of Vehicle Ownership:** What are the benefits of vehicle ownership that make vehicle owners still insist on owning vehicles instead of exploring other options like shared mobility.
c) **Traffic Congestion:** How do the stresses of traffic congestion negate the benefits of private vehicle ownership to the extent that other forms of travel like shared mobility become attractive to private vehicle owners?

1.4. Significance of the Study

Shared mobility or collaborative consumption on transport has until recently been largely confined to mass-transit transport services like buses and trains. Some shared mobility initiatives have existed, albeit on a very small scale. These services have included lift clubs of commuters with either common trip origins and/or destinations. A group of commuters would take turns in using each other's vehicles on a rotational basis. Alternatively, one motorist would offer commuters going the same direction rides in his or her vehicle in return for them sharing his or her costs.

The objective of this study is to explore the existence of a relationship if any between shared mobility and private vehicle ownership. The study on a possible relationship between shared mobility and private vehicle ownership has huge implications for the automotive industry and city planning authorities, particularly on transport infrastructure. It is every transport planner's dream to see more people using public transport services or other high occupancy vehicles and fewer use of private vehicles. Given the fact that

all public transport services are mass-transit services, their increased use would reduce the number of private vehicles, which would greatly reduce traffic congestion.

The rise of shared mobility has been spurred by technology advancements like big data analytics and the increased use of mobile internet. Through the use of mobile applications, global unicorns like Uber and Lyft have been able to launch shared mobility services like ride-sharing, vehicle-pooling, etc. Vehicle-sharing start-ups like South Africa's very own Locomute[1] gives its members the flexibility of making available a vehicle from a few hours to even longer periods. Locomute members are able to locate a free vehicle in a nearby location and can unlock the vehicle using their smart phones and the keys would be in the vehicle for them to use. Once they have finished using the vehicle, they simply leave the keys in the glove compartment and then lock the vehicle using the mobile application. They are then billed for the time and distance they have used the vehicle.

This study would be of huge importance to other stakeholders whose interests would be affected by a possible reduction in the use of private vehicles. These stakeholders include passenger and freight transport operators, traffic authorities, etc. For cities that are choking with traffic congestion during peak travel periods, a reduction of private vehicles in favour of public transport and/or shared mobility services would be welcomed. Private vehicle owners who do not normally use public transport would have the option of using these shared mobility services, thus reducing the number of single-occupancy vehicles during peak periods. Currently, a private vehicle used by an office-bound person lies idle for most of the day, whilst an Uber vehicle can be used throughout the day, thus reducing the number of commuter trips per day.

This study would also be of interest to environmentalists who are concerned about emission levels in city centres that are worsened by traffic congestion. In 2010 the global transport sector contributed up to 23% of all carbon dioxide emissions, with road transportation accounting for 74% of that share (Kodjak, 2009). Unlike free-flowing traffic, vehicles stuck in traffic congestion tend to emit more greenhouse gases due to intermittent stops and accelerations. In South Africa this issue has been of huge interest

[1] A South African vehicle sharing start-up company that lets users to book short vehicle rental using an app on their smart phones.

given the country's Paris Climate Agreement obligations to reduce the emission of greenhouse gases (UNFCCC, 2016).

For the automotive OEMs, the rise of shared mobility services threatens their business model which is sustained by the sale of vehicles to individual owners rather than to fleet owners. An increase in the adoption of shared mobility services could reduce the number of trips undertaken, which in turn could decrease the demand for privately owned vehicles in the long term. Furthermore, shared mobility services do not use privately owned vehicles. Other interested parties for this report would include freight companies, which experience low productivity levels due to traffic congestion.

Finally, the significance of this study could help unpack the concept of shared mobility in South Africa and its possible link with vehicle ownership, as well as how transport authorities in all spheres of government should respond thereto. This study will contribute to the body of knowledge in the transport industry and how shared mobility will shape the future of mobility and the South African transport industry.

Notwithstanding its perceived benefits, shared mobility may fail to yield the same result as those in developed regions like Europe and Northern America where commuters have always been less dependent on private vehicles. Commuters in these regions have always been spoilt for choice where cheap bus and rail services are run very efficiently and cover most areas. Furthermore, South Africans may be reluctant to let go of their vehicles for reasons other than total cost of ownership and the inconvenience of traffic congestion. Nevertheless, this study will help provide some insights into how South Africans are responding to shared mobility.

1.5. Delimitations of the Study

Whilst shared mobility may have an impact on a number of factors like congestion and emissions, the scope of this study will be limited to testing its relationship with private vehicle ownership. There are other factors that may be affected by the rise in the adoption of shared mobility services, but they are beyond the scope of this study. These include the impact of shared mobility on the emission of greenhouse gases, cost of travel, impact on the automotive industry, etc.

1.6. Definition of Terms

AirBnB:	An app-based platform that allows home owners to rent free rooms in their homes for a fee.
Bike-Sharing:	This is a shared mobility service wherein a transport operator rents our bicycles on an on-demand basis. Users able to locate free bicycles using an app on their smart phones, which also works as a payment platform.
Disruption:	For the purpose of this study, it refers to an entry of start-up company or companies into an industry and capturing market share from incumbent well-established companies.
Lyft:	A ride-hailing company based in the United States and a competitor of Uber.
Mass-Transit:	Transport services using high-occupancy vehicles like buses and trains
Micro-Transit:	A feeder transport system that supports mass-transit systems.
Micro-transit:	Transport services that connects riders with mass-transit services like trains and bus services, also defined as first and last mile of travel.
Millennials:	This refers to the generation of young people that were born between the early 1980's and early 1990's.
Mobility-as-a-Service:	MaaS is the integration of various forms of transport services into a single mobility service accessible on demand (MaaS Alliance, 2018).
OEMs:	Original Equipment Manufacturers, in this study this refers to automotive manufacturers.
Opportunity Cost:	In the context of this study, opportunity cost is the financial benefit of what a private vehicle owner misses out on by owning a vehicle instead of using a shared mobility service.

Peer-to-Peer:	When individual consumers or users of a product share its use amongst themselves.
Ride-Hailing:	A phrase use for ride-sharing services offered by companies like Uber and Taxify.
Ride-Sharing:	This is an on-demand taxi services that offers rides through an app on users' smart phones. Examples of these services are Uber and Taxify.
Shared Mobility:	Shared use of various transport modes that include vehicle-sharing, bike-sharing, ride-sharing, vehicle-pooling, etc.
Single-Occupancy:	Refers to vehicles driven with no passengers.
Unicorn:	This is a start-up private company that is valued at US$1 billion and above.
Vehicle-Pooling:	This is a commuter lift club through which a vehicle owners offer rides for passengers going the direction. Advanced vehicle-pooling service

2. LITERATURE REVIEW

Although shared mobility is a relatively new concept in South Africa, the country has quickly caught up with other countries with the launch of Uber in 2014. Prior to this launch, South Africans had been following with interest the spread of Uber in American cities and then in Europe, owing to the controversies it generated. The skirmishes that Uber operators had with incumbent metered taxi services in other global cities are very well documented.

2.1. Conceptual Model

The ultimate objective of this study is to explore if there would be any relationship between shared mobility and private vehicle ownership in South Africa. Based on the literature review below, there are reasons to believe that that shared mobility would ultimately have an effect on private vehicle ownership. However, the possibility of this being true in the case of South Africa is the basis of this study.

2.2. Cost of Private Vehicle Ownership

The ride-hailing services changed how travellers perceived the metered taxi services by causing massive disruptions that have led to sporadic violent clashes. A San Francisco vehicle-sharing scheme, City Vehicle Share, seems to have affected vehicle ownership patterns for its users (Cervero & Tsai, 2004). According to this study, about 30% of members that were surveyed had sold one or more of their vehicles and up to 66% chose not to purchase vehicles. In Clewlow, et al (2017) it was found that 26% of ride-sharing users had reduced personal driving and 9% had disposed of their vehicles. Whilst these results are plausible in more developed nations, the impact of shared mobility in South Africa may yield different results.

A typical vehicle-sharing scheme was launched in the City of Portland, USA, as a public-private partnership and was branded as Flexvehicle. A survey conducted by Katzev (2003) on the impact of this service, revealed that subscribers would travel less than they would with their privately owned vehicles because of more awareness on individual trip costs. Not only did this vehicle-sharing scheme discourage vehicle ownership, it lead to fewer kilometres travelled. The unintended consequence of vehicle-sharing is reduced traffic congestion due to fewer vehicles on the road. Furthermore,

subscribers or members of a vehicle-sharing scheme do not incur opportunity costs in that they are seldom stuck with an idle asset. Since there are no fixed costs, all costs are variable and can be better managed by subscribers.

A Singapore study by Spieser, et al (2014) found that an "Automated-Mobility-on-Demand" or AMoD, a form of Mobility-as-a-Services, made it far more cheaper to access mobility than through conventional means based on private vehicle ownership. The study also found that Singapore would need only one third of the vehicles in operation, if all travellers used AMoD. This meant that up to two thirds of the owners of vehicles in operation in Singapore are incurring opportunity costs of owning their vehicles. The effect of the reduction in the overall cost of travel in schemes like the Mobility-as-a-Service or AMoD tends to increase the amount of distance travelled by users of these services (Spieser, et al., 2014).

Owners of vehicles are often not aware of the cost of each trip and hence are unable to easily calculate the benefits associated with shared mobility. However, when they shift to any form of shared mobility they become aware of the cost per trip and sometimes for each kilometre or minute of travel. In a study by Benjaafar, et al (2018) comparisons were made between shared mobility and travel using privately owned vehicles. The results showed that the cost of a shared platform was the main determinant of whether the subjects would still continue owning their vehicles or switch to shared mobility platforms. Whilst cost may be one of the factors that would influence switching from vehicle ownership to shared mobility, there are still other factors like the profitability of the shared mobility platform and the number of users that could still influence behaviour.

In his study, Hensher (2017) argues that the reason vehicle owners are not quick to migrate in large numbers to shared mobility services like Uber has to do with the perceived costs. These vehicle owners simply look at the costs of Uber rides and simply compare these costs with the explicit costs like fuel, maintenance and insurance. They tend not to consider other hidden costs like wear and tear, road tolls and above all, lost productivity of being stuck in traffic congestion and not being able to do any work. Other indirect costs of ownership include the renting of a parking space where a vehicle is parked overnight or owning a house that has a garage that could otherwise be rented out through AirBnB, converted into a home office, or used as an extra bedroom.

In cities where public transport is well developed, owning a vehicle is not only an inconvenience, but tends to cost more. One such city is London, where it is difficult and time-consuming to drive around the city centre any time of the day, not to mention during peak periods. In a research article by Kamargiani, et al (2018) the majority of respondents said that owning a vehicle adds to their time of travel due to congestion and the time it takes to find parking. About 32% of the respondents said that they would prefer to have access to a vehicle only when they need it, but without having to own one.

According to Cohen & Kietzmann (2014), congestion and idle vehicles represent some form of market failure. From an economics point of view, market failures also present an opportunity for businesses. Shared mobility services are meant to address this void in the economy. The assertion by these authors is that the markets will be in equilibrium once costs and benefits are spread equitably to users and owners of vehicles. In a perfect shared mobility environment vehicle owners would naturally be transport operators and not individuals. Transport operators with large fleets are able to get more preferential prices in the acquisition and maintenance of vehicles than private owners would. Naturally, these lower costs of ownership would be passed on to users of share mobility schemes.

Owing to their less favourable economic situation, some millennials are finding it difficult to own vehicles and are settling for shared mobility schemes (Klein & Smart, 2016). These millennials are very conscious of the costs of mobility which influence where they live. Furthermore, millennials are growing up in an environment of sharing, which older generations were not exposed to. For this market segment, owning a vehicle may not be the best mobility option.

As South Africans face tough economic times with slow economic growth and rising fuel costs and other vehicle running expenses, households will be looking for alternative modes of travel. This explains the mushrooming of start-up companies offering various app-based transport solutions. These companies could have been inspired by the rise of ride-sharing services such as Uber and Taxify. Some notable start-ups include GoMetro (ride-sharing), UGoMyWay (vehicle-pooling), and CarTrip (vehicle-pooling).

2.3. Traffic Congestion

Traffic congestion is one of the wicked problems associated with private vehicle ownership, given the fact that the majority of vehicles on South African roads are single-occupancy private vehicles. For South Africa, this situation is exacerbated by the poor or lack of public transportation.

In his study, Hensher (2017) supports shared mobility to the extent that is not just vehicle-centric, but supports other ancillary modes like shared bikes, scooters, etc. It is for this reason that shared mobility should not just be about reducing the number of vehicles on the roads, but it should also consider why and when those trips are undertaken. For instance, poor city and transport planning might be the root cause of traffic congestion. Some traffic congestion could be resolved by simply switching lane directions during morning and afternoon peak periods. Furthermore, efficient movements of mass-transit vehicles along trunk routes and possibly on dedicated lanes could discourage single-occupancy vehicles during peak periods.

Much has been said about the potential for ride-sharing services to reduce traffic congestion. However, this would hold true if these services are able to move more than one traveller at a time, otherwise this would be replacing single-occupancy vehicles with single-passenger ride-hailing vehicles. In South Africa, there has been anecdotal reports of Uber and Taxify services causing more traffic congestion during peak periods. In the United States, Uber and Lyft offer ride-pooling services and also use bigger vehicles, all of which make a case for the reduction of traffic congestion.

A study undertaken by Li, et al (2016) examined the impact of ride-sharing services on traffic congestion in major American cities. They found that the entry of Uber and other ride-sharing services in a city had an effect of reducing traffic by up to 25%. In this study the authors also argued that ride-sharing services like Uber influence the reduction of single-occupancy vehicles in favour of ride-sharing. This is made possible by the fact that an Uber vehicle could transport multiple riders whilst a single-occupancy private vehicle can only be used by one person. Furthermore, these ridesharing vehicles can make multiple trips within peak travel periods as opposed to private vehicle owners who make single trips to and from work.

A study undertaken by Lane (2005) found that each vehicle in a Philadelphia vehicle-sharing scheme (PhillyVehicleShare) replaced an average of 23 privately-owned vehicles. Whilst costs were cited as a benefit for using this service, the users rated convenience as the biggest advantage of using the service as they no longer had to worry about being stuck in traffic when using the vehicle-sharing scheme.

Shared mobility is certainly not a panacea for traffic congestion on South African roads. However, there is enough evidence that shared mobility could reduce the number of vehicles on the road. The South African experience of shared mobility is still in its infancy and it could take a long time before its benefits are felt during peak travel periods.

In a Nigerian study by Somuyiwa, et al (2015) researchers found that the inconvenience of long travel periods to and from work had a negative effect on the productivity of workers. Lost productivity represents the opportunity cost of productive time that commuters could have spent earning a living. This problem is most prevalent in South Africa's Apartheid spatial planning which located the majority of people far away from economic opportunities. The time these people spend travelling to and from work could be spent being productive in a work environment and robs them of lost earnings.

Another research paper by Sweet (2014) brings a new dimension to the economic impact of congestion through lost productivity. In this study it is argued that over time, higher congestion levels will lead to lower employment growth because employers will have to compensate employees for time lost due to traffic congestion. The study further contends that the cost of the additional travel time is borne by the employers, which in turn inhibits their ability to employ more workers. In most shared mobility services like ride-sharing, commuters are able to do some amount of work whilst travelling, which lessen productivity losses.

According to McDonald (2015), there is a new trend of millennials in global cities with well-established public transport travelling less. In this research paper millennials are said to be "going nowhere" in that not only are they in no rush to buy vehicles, but they are travelling less. They are instead choosing to live in city centres where work opportunities are accessible by alternative transport modes like cycling. Given the fact that millennials enjoy high levels of internet connectivity, they tend be the early adopters of any shared mobility scheme. Flexible workspaces and enterprise mobility might also

explain this reduced travel demand by millennials. These mobility trends are adding to the productivity levels of this new generation of workforce and this is a positive development to local economies. Circella, et al (2017) proved that there is a strong correlation between multimodality and accessibility of economic opportunities. As early adopters, millennials are much more responsive to new mobility options than their older counterparts.

The literature covered above indicate some relationship between shared mobility and vehicle ownership. Whilst shared mobility services like Uber have been welcomed by South Africans, their effects on traffic congestion may be different from other well developed markets.

2.4. Benefits of Private Vehicle Ownership

Notwithstanding the growing options for mobility, there could still be reasons that force South Africans to hold onto their private vehicles. Unlike in other developed nations where there are a number of travel options like the extensive network of rail and bus services, South African have very limited options. In a study by Luke (2018), it was found that South African students have very strong intentions to purchase a vehicle as soon as they can afford it. The main reason for this intention lies in the strong perception of poor public transport services.

In other global cities like Dubai where the city government has established a very efficient rail system, some commuters still prefer to drive their own vehicles (Bajracharya, 2016). The strong affinity and attachment to private vehicle seems to negate the benefits of public transport, which is cheaper and does not expose commuters to unnecessary delays due to traffic congestion. Furthermore, the strong desire to own a vehicle is associated with benefits such as privacy, freedom of movement, and being in full control of one's own schedule.

In a study by Jeske (2016), private vehicles for black South Africans were likened to cows as a store of value or investment. Black South African men who came from rural areas to seek employment in cities would often leave their families behind and their wives would work in the fields. They would save money to buy cows as investments and to advance the well being of families back home. However, given the drive towards

urbanisation and permanent settlement in cities, vehicles became the new store of value, giving them a sense of ownership.

3. RESEARCH METHODOLOGY

In determining the type of research this study would entail, it became necessary to establish what is known about shared mobility and its possible relationship with factors such as traffic congestion, as well as the benefits and costs of vehicle ownership. Shared mobility is a relatively new concept in South Africa and there is not much body of knowledge on how this mobility option has progressed in this country. It is for this reason that this study was designed to be an exploratory one using qualitative data (Sekaran & Bougie, 2016). Although the results of this exploratory study would not be generalisable to the population, it would nonetheless provide some useful data.

3.1. Research Strategy

The primary objective of this study is to explore the existence of a relationship between two shared mobility and private vehicle ownership. Initial literature reviewed indicates a relationship between the two concepts. However, this relationship was not strong enough to make this a causal study. A causal study is justified when there is a strong cause-effect relationship between a set of variables, independent and dependent (Ellis & Levy, 2009). For this study there are other factors that can also affect vehicle ownership other than shared mobility. For instance, vehicle ownership could be affected by the economic conditions, rising fuel costs, etc.

3.2. Sampling Design

3.2.1. The Population

According to the April 2018 report in the Electronic National Administration Traffic Information System (eNaTIS), which is administered by the Road Traffic Management Corporation (RTMC), there were just over 12 million registered vehicles in South Africa. Up to 65% of these are passenger vehicles and another 23% are Light Duty Vehicles (LDV's). Whilst the eNatis does not keep statistics of privately-owned vehicles, these numbers point to a very high proportion to privately owned vehicles. Over 72% (Gauteng: 42%, Western Cape: 17% and KwaZulu-Natal: 14%) of these light passenger vehicles were registered in the 3 provinces of Gauteng, KwaZulu-Natal and Western Cape; with the rest spread over the other 6 provinces.

The elements of this population that are of interest to this study are all the private vehicle owners of light passenger vehicles but eNaTIS does not keep this data. However, the Statistics South Africa National Household Travel Survey (NHTS) (2013) found that 3 552 000 people drove their privately-owned vehicles to work in 2013. Of these trips, 1,5 million were undertaken in Gauteng, 610 000 in the Western Cape, and 461 000 in KwaZulu-Natal. A total of 74% of these trips were undertaken in these three provinces. These percentages compare very well with the proportion of registered light passenger vehicles in the three provinces (72%).

3.2.2. Sampling Process

From a sampling point of view, the subjects that were of interest to this study are South African vehicle owners who drive to work and who have experienced some form of shared mobility like lift clubs and ride sharing. In South Africa the most common shared mobility services are lift clubs and the ride-sharing services of Uber and Taxify. For the purpose of this study, sampling for the interviews and recruitment should satisfy the purpose of this study. Purposive sampling was therefore deemed to be the most ideal method of sampling.

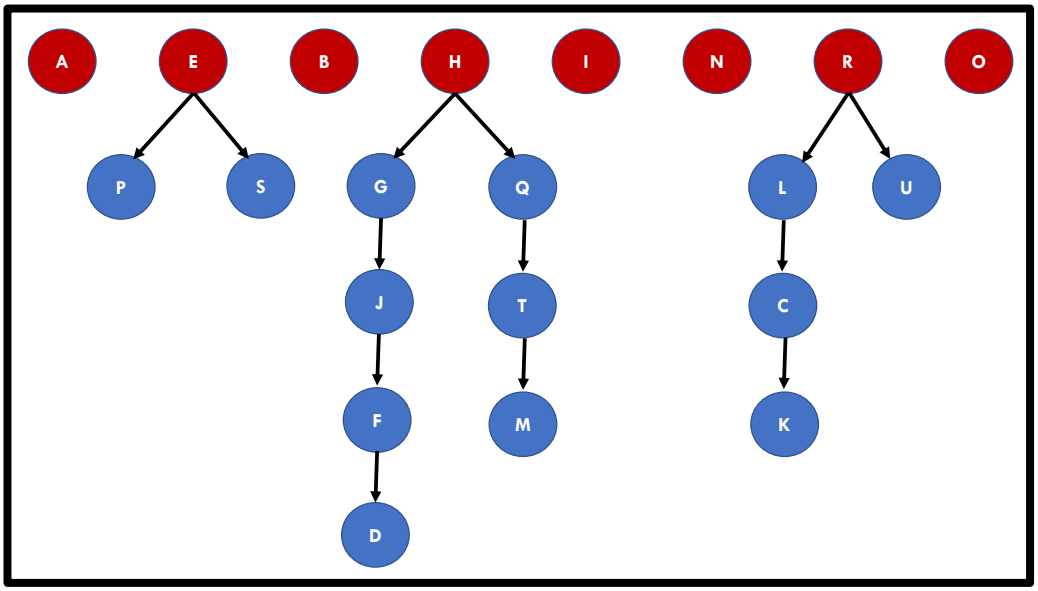
The three metropolitan regions of Durban, Gauteng and Cape Town have established shared mobility services particularly in the field of ride-hailing. Uber and Taxify have high market penetration in these three regions along with vehicle-sharing services like those of Locomute[2] and vehicle-pooling services like those of CarTrip and UgoMyWay[3]. The sample universe for this study includes all private vehicle owners in South Africa who have experienced one of these shared mobility services. Johannesburg was the first to experience the Uber service when it was launched in 2014. For the sake of convenience, it would have been impractical to include in the sample vehicle owners from outside of Johannesburg given the fact that the researcher is based in Johannesburg. Convenience sampling for only those vehicle owners based in Johannesburg was most preferable, although generalisability for the bigger universe would be somewhat compromised (Robinson, 2014). For this reason, it was prudent to limit generalisability to the sample universe of only those private vehicle owners that are based in Johannesburg.

[2] An app-based vehicle-sharing start-up company with presence in Gauteng, Durban and Cape Town.
[3] Cape Town-based Start-up companies that are offering vehicle-pooling services

As for the sample size for this study, the researcher aimed for a sample of 20 subjects who met the criteria set above, that is, *private vehicle owners who drive to work and have experienced some form of shared mobility*. There are a number of potential subjects that are known to the researcher who fit this criteria. However, to avoid selection bias. the snowball sampling strategy was used. Through this method the first respondent who met the selection criteria was selected and through him/her, the next subject was selected and so on, until the targeted sample size was achieved (Harris, et al., 2009). Snowball sampling can either be linear or exponential. In linear sampling the first subject identifies the second, who identifies the third and so forth. In exponential snowball sampling, not all subjects will identify potential subject and those who do can identify more than one subject (Etikan, Alkassim, & Abubakar, 2016). However, to ensure diversity of the sample, subjects were limited to a maximum of two nominations.

The sampling intention was to get all referrals from the first respondent. But it was not until the 8th respondent was interviewed before the first referral became available. The eight respondents that were approached directly are familiar but not close acquaintances and the rest were through referrals. However only respondents E, H and R were able to suggest subjects for interviews.

Figure 1 - Sampling Process



Although the snowball sampling method is generally used for hidden populations, its advantages in this study were meant to reduce researcher bias. Furthermore, this sampling method was preferable because there is no sample frame for qualifying subjects.

3.3. Reliability and Validity

One of the shortcomings of this study that will affect reliability and validity lies in the fact that it was based on non-probability sampling, which would somewhat compromise the generalisability of the results. It is not clear what the size of the targeted population (number of registered private owners of light passenger vehicles) is, owing to the unavailability of this data. This number could only be estimated from the number of registered passenger vehicles in each province. Some of these vehicles could be owned by fleet owners such as vehicle rental companies.

Internal validity for this study was the extent to which the results of this study truly represented the data that was collected. This validity can be affected by the consistency of interpretation and analysis of data. External validity was the extent to which the results could be extrapolated or generalised for the whole population. Some of the factors that might influence external validity included maturation effects, which are

caused by the passage of time (Sekaran & Bougie, 2016). Shared mobility is an evolving concept and no one knows how the adoption of this concept might have evolved by the time this study is concluded in early 2019. The perceptions of respondents on shared mobility might also have changed in the next 6 months due to pace of innovation in this field. Since the data gathering process was started in September 2018, there has been no major change in the perception of shared mobility that could have resulted in maturation effects in this study.

The goodness of measure of the instrument (face-to-face interviews) that was used in this research is critical to establish reliability of the results (Roberts, Priest, & Traynor, 2006). Reliability in the context of this study means that results obtained in Johannesburg should to a large extent be consistent with one another. To test variability of results a pre-test of the interview instrument was undertaken. This was done by conducting 3 high-level face-to-face interviews of subjects selected randomly.

The other issue that would have affected reliability of the results of this study is the generalisability of the results to the broader population of private vehicle owners who have experienced some form of shared mobility. This external generalisability, and by extension reliability, is often not necessary because the data is not quantifiable (Percy, Kostere, & Kostere, 2015). To mitigate this possible weakness in reliability, sampling was selected transparently, and as much as possible, representative of the broader population.

3.4. Data Gathering Methods

3.4.1. Face-to-Face Interviews

The instrument that was used to gather data was in-depth face-to-face interviews. Since this is an exploratory study, interviewing contained a combination of unstructured and structured questions. In the case of unstructured interviews, the participants were given more freedom to respond to a particular question, whilst in a structured interview, participants only respond to the questions asked with little elaboration. The exploratory nature of this study necessitated the use of semi-structured interviews because not much is known about the relationship between shared mobility and private vehicle ownership in the South Africa context. Semi-structured interviews allowed for some flexibility, whilst

keeping the interviews on course to achieve the set objectives of the study (Wilson, 2016). Furthermore, the semi-structured nature of the interview allowed the interviewer to change the direction of the interview or probe certain responses (Doody & Noonan, 2013).

Given the convenience of the location of the subjects and that only 20 were selected, the interviews were conducted face-to-face and lasted for not more than half an hour. The length of each interview varied in accordance with how elaborative the responses were. The settings for each interview were mostly in an office environment except for one that was conducted in a coffee shop.

3.4.2. Interview Protocol

The subjects that were identified directly and through the snowballing sampling process were sent invitation letters as text messages. A sample letter has been annexed as Appendix 8.2. The purpose of this letter was to address any expectations that a subject would have had and covered the following:

- The reason why the subject had been chosen and qualified.
- Expected duration of the interview.
- Research title and broad subject of the interview.
- A warning that the interview would be recorded and assurance of confidentiality.

The interview protocol helped in reducing the likelihood that the subjects would have refused to finish the interview on the grounds of unmet expectations (Knox & Burkard, 2009). This interview protocol was reiterated at the start of each interview wherein subjects were assured of their confidentiality and were also assured of their right to terminate the interview if they felt uncomfortable to continue. None of the 21 subjects that were interviewed had to terminate their interviews.

3.4.3. The Interview Questionnaire

The interview questionnaire (see Appendix 1) contains open-ended, semi-structure questions to encourage conversational dialogue.

3.5. Ethics

The issue of ethics in this study has been considered in the following areas:

3.5.1. Data Gathering

The Protection of Personal Information Act has very strict guidelines on how personal information is collected and used by any entity that collects and disseminates such personal information. The interview protocol will be used to inform participants on what is expected of them before they even agree to participate. This will give them an opportunity to refuse to participate if they are uncomfortable with the process. Furthermore, participants will be assured that they can opt out of the interview process or focus group if they so wish without feeling that they have been subjected to some undue influence.

Some of the ethical principles proposed by Orb, et al. (2001) include the following:

- Autonomy – Full autonomy of participants is characterised by well-informed consent to participate.
- Justice – The rights of participants will be protected at all times and in case of doubt, they will be informed of all their rights.
- Beneficence – This principle ensures that the interest of participants is kept high without being paternalistic.

Other ethics principles that will be observed include the following:

- Informed Consent – All relevant information will be provided to the subjects prior to them agreeing to participate.
- Confidentiality – Assurance of complete confidentiality.
- Withdrawal – The subject will be assured of their full rights to withdraw from the interview process or focus group discussion should they be uncomfortable to continue or for any other reason whatsoever.

Given the researcher's extensive knowledge of the subject, there is a danger that participants might feel pressured to give responses that make them look "intelligent". Participants might also feel that they should offer politically-correct or socially acceptable responses. It is up to the interviewer or facilitator of the focus groups to

ensure that all concepts are explained in greater detail without assuming some level of knowledge on the part of the participants (Grossoehme, 2014).

4. RESULTS

4.1. Ethics

The issue of ethics in this study has been considered in the following areas:

4.1.1. Interview Respondents

The snowball sampling method was applied in recruiting the subjects for this interview. A total of 21 respondents were interviewed, with a gender split of 12 males and 9 females. The majority of respondents are in their 30s and 40s with a few in their 20s and 50s. The overall age split was as follows:

- 20's = 2 respondents;
- 30's = 9 respondents;
- 40's = 6 respondents;
- 50's = 4 respondents.

In terms of driving experience, respondents had been driving for an average of 15 years, the highest being 38 years, and the lowest being 3 years.

Table - Interview Respondents

Respondent	Gender	Age Range	Years Driving	Area of Residence
A	Male	40s	20	Centurion
B	Male	30s	12	Randburg
C	Male	40s	5	Pretoria
D	Male	20s	12	Midrand
E	Male	40s	22	Sunninghill
F	Male	20s	9	Midrand

G	Male	30s	4	Sandton
H	Male	30s	7	Kempton Park
I	Male	50s	38	Randburg
J	Male	30s	11	Kagiso, Krugersdorp
K	Male	50s	30	Randburg
L	Male	50s	30	Pretoria
M	Female	30s	10	Pretoria
N	Female	40s	16	Sandton
O	Female	30s	15	Winchester Hills
P	Female	30s	6	Kempton Park
Q	Female	40s	7	Orange Farm
R	Female	50s	25	Midrand
S	Female	30s	3	Midrand
T	Female	30s	11	Soweto
U	Female	40s	15	Kempton Park

4.2. Responses

Have you used any of the ride-hailing services like those of Uber and Taxify? If so, please share your experiences.

Of the 21 respondents interviewed, only 2 have never used any of the new ride sharing services offered by Uber and Taxify. Their experiences varied but their responses can be grouped as follows:

- **Security:** There was a general feeling that these services are safer than using other means like metered taxis and minibus taxis. This response was more prevalent with female respondents. Even the male respondents felt that the use of ride sharing services are safe, especially at night. There were 2 female respondents who raised some concerns about safety. One had a bad personal experience and she said that the conversation she had with a driver "*went below the belt*" and made her uncomfortable. The other respondent reported about someone else's experience who had been sexually harassed. Other safety concerns were about the rivalry between metered taxi drivers and ride sharing drivers of Uber and Taxify. Whilst none of the respondents were personally affected, they were concerned about their safety every time they ride in an Uber or Taxify vehicle.
- **Professionalism:** In comparison with metered and minibus taxis, Uber and Taxify services were said to be very professional and some respondents noted that they are "*well trained*". Most of the respondents characterised Uber and Taxify as "*friendly*", "*they obey the rules*", "*courteous*" and were said to be "*professional*". One female respondent spoke of an incident where a driver was rude to her, but also said that this was an isolated incident and she had never experienced this with other drivers.
- **Efficiency:** Some of the words used to describe the ride-hailing services were "*reliable*" (6 respondents), "*efficient*" (5 respondents) and "*convenient*" (4 respondents). One respondent said that he likes the idea of "knowing upfront what the trip will cost" and another likes the idea that "the vehicle can be tracked" at all times. One respondent said the ride-hailing services "filled a gap in the market".

Some of the responses were as follows:

- "Uber is safer if you are carrying your laptop…"
- "you are able to identify the driver and the vehicle registration."

Are you or have you been part of a lift club or used similar services? If so, what was your experience?

Fifteen of the twenty-one respondents interviewed have used lift clubs in the past, but none of them are currently using this service. These services differed in that some were for people who did not own vehicles and would pay someone who owns one for a lift to work. Other forms were for people with vehicles who would use their vehicles on a rotational basis with no money transactions involved. Most of the respondents that have used lift clubs have done so before they bought their own vehicles, but had stopped using lift clubs as soon as they bought their own vehicles.

Respondents voiced more disadvantages than advantages of using lift clubs. One of the biggest drawbacks centred on convenience. In the event that a driver was unable to go to work for whatever reason, this would be a huge inconvenience to lift club members. In some instances, one needed to leave work earlier but would be inconvenienced by the lift club obligations, especially if that person was a driver. No less than 10 respondents said they had stopped using lift clubs because they are inconvenient, 6 said they were inflexible and do not fit into their schedules, and other raised issues like lack of punctuality caused by some members.

One of the drawbacks of lift clubs related to payment for services of meeting obligations in rotational system. Some respondents felt that they were "taken advantage of" because they would not be paid in some instances and other members of the club would not fulfil their obligations when their turn comes to drive others. One respondent described lift clubs as "burdensome" and another said they are simply "not nice".

Notwithstanding the challenges faced with lift clubs, there are those that remember some positive elements of this service. Most of the female respondents like the company of lift clubs and enjoyed the conversations that they had in lift clubs. Nine respondents said that the lift clubs were good forms of cost sharing and save money. Other responses were as follows:

- "If you don't want to go to work… what happens?"
- "It was nice because, I mean, you drive with people in your vehicle, so you tend to chat every morning before you get to the office."
- "I enjoyed the company."
- "Friends end up taking advantage of you."
- "When we need payment, people would make excuses."

Cost of Vehicle Ownership

No less than 14 respondents said that in all their household expenses, motor vehicle expenses ranked the second highest behind accommodation expenses such as paying a bond or rental. Five young respondents said that the motor vehicles are the highest with accommodation expenses coming second. Only 2 respondents said motor vehicle expenses are the third highest behind accommodation expenses and school fees for their children.

8 respondents park their vehicles in the garage of their houses, and others use vehicle carports that are paid as part of the accommodation expenses. When asked what they would use the garage for if they did not own a vehicle, most respondents said they would use it for storage, a home gym, home office, or entertainment, while other respondents said they would rent it out.

How do you feel about paying for a vehicle that lies idle most of the time?

Most of the respondents do office work and they do not use their vehicles during working hours. The vehicle use during weekdays ranged from 2 to 4 hours on each week and would lie idle for up to 20 hours daily. When asked how they felt about paying for an asset that lay idle for majority of the time, most respondents said they "never thought about it". Others felt that they have no choice because they need their vehicles to be on standby should they need to travel somewhere at short notice. Other respondents were happy with their vehicles being idle saying that with less travel, their vehicles would not wear out quicker. One said that it's an acceptable price to pay for an idle car. Other responses included the following:

- "The whole cost issue is making me reconsider vehicle ownership."
- "I have not thought about it at that level."

- "One is basically throwing money into the bin."
- "It is a price to pay for convenience and privacy."
- "It serves the purpose as and when needed."
- "The pain of maintaining the vehicle is nothing compared to the inconvenience of not owning a vehicle."
- "Now that we have spoken about it, I am thinking about it."

If someone were to rent your vehicle during its idle time and pay you for the time and mileage, would this appeal to you?

Most of the respondents, particularly younger males, said they would welcome some "extra cash" and that it would help them with the vehicle instalments. However, these respondents also raised issues of wear and tear on their vehicles, saying that too much utilisation would devalue their vehicles. Other older respondents did not believe that this would work. One respondent said that she would *"not be comfortable with a stranger in my vehicle"*, and two other respondents said that they *"never thought about it"* but would welcome it if it can save them money. Other responses included the following:

- "The problem is that the more your vehicle travels, the more it loses value."
- "For me, I'm actually happy if it's not being used….. I am looking at the value of the vehicle."
- "Sharing a vehicle with people sometimes is a liability as people do not respect the property of others."
- "The concept sounds weird and foreign having a stranger driving my vehicle, but business wise making extra cash makes sense."

How do you feel about being stuck in traffic congestion?

All respondents described the time they spend in traffic as "frustrating", "tiring", "stressful", "irritating" and "sheer waste of time". Two female respondents felt that the stress of being stuck in traffic affected their mood when they get to work because they feel helpless. Five of the young respondents said that they work flexible hours as per arrangements with their employers. They come to work early before peak travel times and leave work early before the afternoon rush hour. However, those that have family responsibilities like taking their children to school are unable to avoid rush hour traffic.

For all respondents, traffic congestion adds between 20 minutes to an hour of travel time on any normal weekday without any other occasional causes of congestion like crashes and roadworks. Some of the responses were as follows:

- "I am more tired when I get to work."
- "…. Already your mood is down because you supposed to be here long before that time."
- "I have to wake up early just to beat traffic. It wears you out."

If you were commuting daily to work as a passenger and did not have to drive, how would you spend your time when stuck in traffic congestion?

Fourteen respondents said they would use this time on work-related activities like checking emails and planning their days. The rest of the respondents said they would just relax, read a book, meditate, sleep or watch some YouTube videos. Four of these respondents said they would use the time for their studies. Most respondents felt that not having to deal with the stresses of driving would have a positive effect on their state of mind as this would improve their work stresses. Some of the responses were as follows:

- "I would be fresh coming to work in the morning."
- "It would remove rage from the equation.."

What are your benefits of vehicle ownership?

The majority of respondents (12 in total) mentioned convenience as the main benefit of owning a vehicle. They felt that having their own vehicle at their disposal gives them the "freedom of movement" and one respondent said that "she can do what she wants at the time she wants". Some of the responses included the following:

- "With my own vehicle I can simply get up and go."
- "I can plan my movements."
- "My vehicle helps with emergency trips."
- "Good for long distance trips."
- "As a parent I need a vehicle for my kids."
- "I can travel wherever I need to go."
- "Independence."

- “Reliable”
- “I need flexibility.”
- “My vehicle gives me privacy. I like my space.”
- “I can drive at my own speed without worrying about other people.”
- “But for my safety I had to get a new vehicle. But I always ask myself is it worth it?”
- “My vehicle is a necessity.”
- “You know that if you are leaving at 05h50, you are leaving at 05h50.”
- “Should anything disrupt your day at work, I am able to take my vehicle and actually go home and actually take care of whatever need to be taken care of.”
- “Being at a place where you want to be at the time you want to be.”
- “as a family person, then I think there are more benefits.”
- “I use the opportunity to drive to unwind. My own space and privacy.”

Some of the benefits of vehicle ownership that were cited went beyond meeting the basic needs and i the following responses:

- “Status”
- “Coming from the township, it is a form of status and a sign of adulthood.”
- “My vehicle gives me a sense of ownership.”
- “People think you have their dream vehicle.”
- “They will respect you if you own a vehicle.”
- “I feel like I have arrived.”
- “The vehicle says I am doing well.”
- “The bigger and more expensive the vehicle the higher the status.”
- “Sentimental values”
- “I feel like a little princess in my vehicle.”
- “We are judged by the type of vehicle we drive.”
- “Sense of pride”
- “Sense of worth”
- “My vehicle makes a statement.”
- “Status in the townships.”

- "Peer pressure"

Most of the younger male respondents were the ones that were most vocal on these benefits. However, older and female respondents tended to view their vehicles as necessities and were less concerned about the type of vehicles they own. Female respondents mentioned safety as the major benefit in comparison to using public transport.

If most of these benefits were to be given to you through a combination of vehicle sharing, ride sharing, etc., would you still want to own a vehicle?

Most of the respondents (particularly the female ones) said that they would still want to have their own vehicles because they do not believe that there could be any form of travel that could be a substitute to owning a vehicle. Three of the respondents said that whilst this alternative sounded "interesting" and "tempting", they have never thought about it. Two respondents said that they have been considering "downgrading" by replacing their vehicle with a cheaper model and also "getting rid of the second vehicle". Some responses were as follows:

- "I didn't think about that. Wow, that's interesting."

5. ANALYSIS OF RESULTS

A full transcript of all interviews was produced from the recordings. A step-by-step thematic analysis of data was adopted from Percy, et al. (2015) and followed this process:

a. **Data Review:** All data collected from interviews was reviewed for the purposes of familiarisation with it. Key words, phrases and quotations were highlighted based on their relevance to the research questions.

b. **Highlighted Data:** The highlighted data was then tested against the research aim and research questions for relevance.

c. **Coding:** Initial coding was open and looked for words or phrases that had any bearing to the study. These coded data sets were then categorised or classified in accordance with their similarity and finally emerging patterns were identified. The full coding is illustrated in the tables in Appendix 8.3.

d. **Emerging Themes:** The patterns that supported specific themes were noted. These themes are illustrated in a matrix that will link themes to patterns and finally to data sets of each respondent in the data collection. This thematic analysis can be depicted as follows:

Figure 2 - Coding

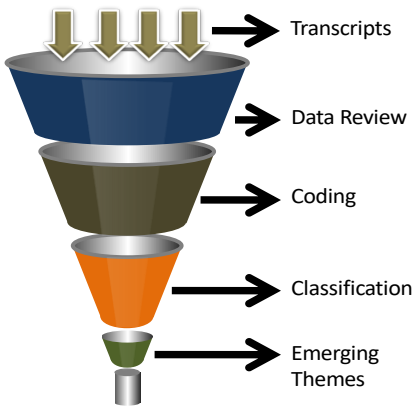


Figure 1

This process was completed for all interviews and then aggregated or integrated for all patterns and themes for all participants in interviews. This thematic analysis is a type of

inductive analysis in that it does not attempt to fit data sets into predetermined categories, as is the case in theoretical analysis (Percy, Kostere, & Kostere, 2015).

5.1. Cost of Private Vehicle Ownership

The basis for this part of the research was to determine if the rising costs of private vehicle ownership provide enough motivation to lead commuters to reconsider ownership of their vehicles in favour other forms of travel. This is how the research question was formulated:

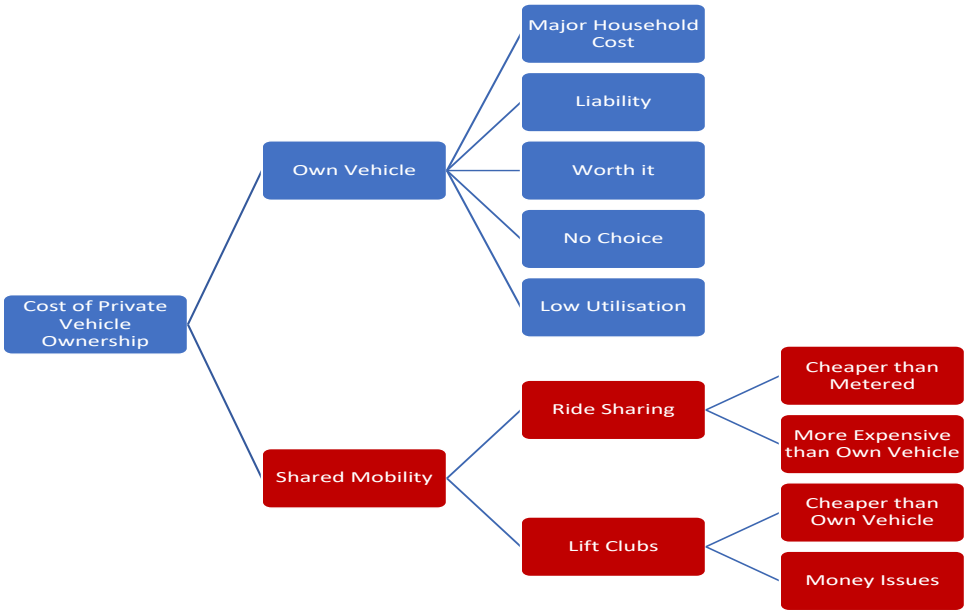
> ***Cost of Vehicle Ownership:*** *How would the rising costs of private vehicle ownership and low utilisation levels lead private vehicle owners to consider shared mobility options like lift clubs and ride-sharing?*

Judging by the responses of most respondents (19 out of 21) the cost of vehicle ownership ranks either first or second highest in their household budgets. Those that are still paying off their houses or renting their accommodation, the vehicle payments for instalments and running costs are the second highest. In ranking these costs, most respondents were not aware of other hidden costs like providing for a garage and parking wherever the vehicle is driven to.

Whilst some respondents were looking at a vehicle as an asset, others classified it as a liability that is draining on household income. When asked about how they felt about paying for the vehicle when it lies idle for most of the time, they responded by saying that it never crossed their minds. Others simply shrugged this off by saying that an idle vehicle is saved from the erosion of its replacement value that comes with higher mileage.

Most respondents were unfazed about the total cost of ownership saying that the benefits far outweigh the costs. Others felt that the vehicle is indispensable and given the poor public transport services, they cannot do without owning vehicles. This points to a general lack of choices on the part of these respondents.

Figure 3 – Coding – Cost of Ownership



5.1.1. Emerging Themes

Whilst other shared mobility options like lift clubs offer cheaper alternatives to using one's own vehicle, they are still not comparable to private vehicle ownership. This has been revealed by the "money issues" that have been raised with lifts clubs when it comes to compensating drivers for rides provided to commuters. Ride sharing has been proven to be more expensive than using one's own vehicle, but only cheaper when compared to metered taxis. The emergent theme can be said to be **"no comparable alternatives"** to private vehicle ownership. Another theme related to this theme is that the cost of private vehicle ownership is **"unavoidable"** to those that can afford it.

Another problem associated with private vehicle ownership is very low utilisation given the fact that private vehicles lay idle for most of the time. This means that private vehicle owners are not getting the full value that is commensurate to the high cost of vehicle ownership. Vehicle owners are thus paying for their vehicles even during the times when they lie idle, which in itself is a cost but is not as explicit as other costs. This emergent theme can be termed: **"hidden costs".**

There is no doubt that shared mobility by its very nature would be a cheaper option given the fact that one pays only for use as opposed to paying for an asset even when not it is not in use. However, ride sharing in its current form is still more expensive as an

alternative to private vehicle ownership, whilst lift clubs are definitely cheaper alternatives. The theme that would suit this analysis for shared mobility in general is that it is **"potentially cheaper"** than private vehicle ownership.

5.2. Traffic Congestion

For this part of the research the objective was to determine how much respondents were willing to live with the inconveniences and the stresses of being stuck in traffic congestion before they consider other modes of travel that do not involve private vehicle ownership. The research was framed as follows:

> ***Traffic Congestion:*** *How do the stresses of traffic congestion negate the benefits of private vehicle ownership to the extent that other forms of travel like shared mobility become attractive to private vehicle owners?*

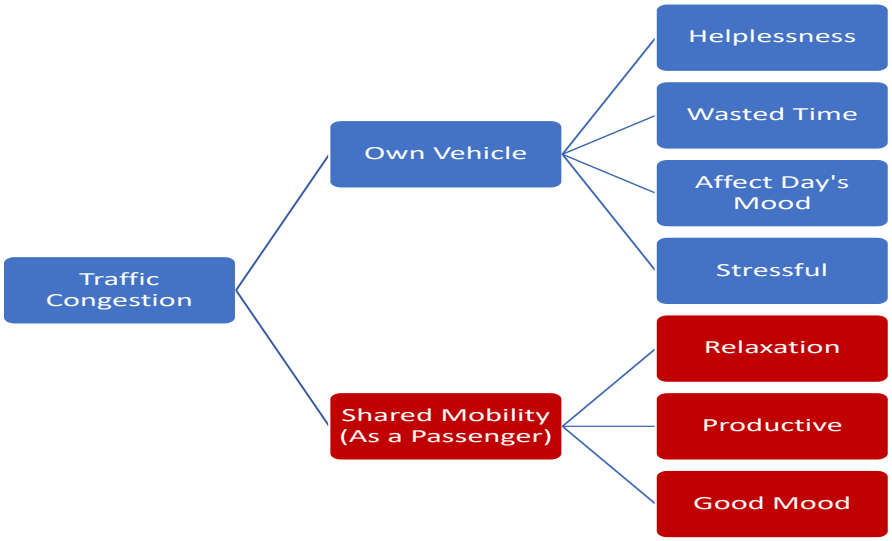
In the previous section, respondents seem to be settled with the fact that there is very little they can do to avoid the high costs of owning a vehicle. As noted above, the majority of respondents expressed frustrations with traffic congestion, which they say is robbing them of valuable time that could be used for work or spending time with their families. Traffic congestion is adding between 30 to 90 minutes to their travel time between places of work and residence - and this is just one way.

Respondents generally feel helpless with traffic congestion and some cannot afford to leave too early to avoid traffic because they have responsibilities like taking their kids to and from school. A few respondents who do not have these responsibilities have had to negotiate flexible working hours with their employers so that they can avoid travelling during peak hours. However, the majority of respondents have accepted the fact that being stuck in traffic congestion is unavoidable in urban travel.

For most respondents the time spent in traffic congestion is one of the major sources of stress. Some say that by the time they finally get to work, they are so stressed to the point that this begins to affect their mood and also adds to the work stresses. They feel helpless because they believe that they have little choices and some cannot afford to live closest to their work due to relatively highly priced accommodation options.

The respondents also indicated that that if they did not have to drive, and were being driven as passengers, they would use the time to catch up on work, sleep, read books, and even study. However, whilst this option would be beneficial, most respondents believe that there are very few cost-effective alternatives like Uber that would help in this regard.

Figure 4 – Coding – Traffic Congestion



5.2.1. Emerging Themes

The feeling of being stuck in traffic congestion when driving one's vehicle during peak travel times has been associated with very strong negative emotions. Drivers feel helpless and emotionally drained, especially those that are unable to avoid travelling during these peak travel times for various reasons such as family responsibilities. This often leads to drivers not starting their days in a good emotional state. Drivers are most affected emotionally by morning traffic because it affects their days by spoiling their moods. The emergent theme for this is that traffic congestion leads to **"bad days"** at work.

The stresses of being stuck in traffic seem to not affect passengers as much as it does drivers. Passengers can simply engage in other activities like reading, "catching up on work", chat with friends on social media, or simply sleep. In contrast to drivers, these passengers would arrive at work in a good mood and some would have already done some work. The emergent theme here is **"peace of mind"**.

5.3. Benefits of Ownership

This part of the research intends to test the desire of respondents to own vehicles in spite of the high costs of ownership, low utilisation and the traffic-induced stresses of being stuck in traffic on a daily basis. The research question was formulated as follows:

> ***Benefits of Vehicle Ownership:*** *What are the benefits of vehicle ownership that make vehicle owners still insist on owning vehicles instead of exploring other options like shared mobility*.

When asked about the benefits of vehicle ownership, most respondents mentioned that they want to be in control of their movements and be able to go wherever they want to go and whenever they want to do so. They compared private vehicle ownership to using public transport, which they said does not give them the convenience they want and that in certain circumstances, only privately-owned vehicles are able to meet their needs. Respondents also mentioned safety as one of the benefits of driving their own vehicles as opposed to using public transport. Comfort and privacy were also listed as some of the benefits, as the respondents "value their space".

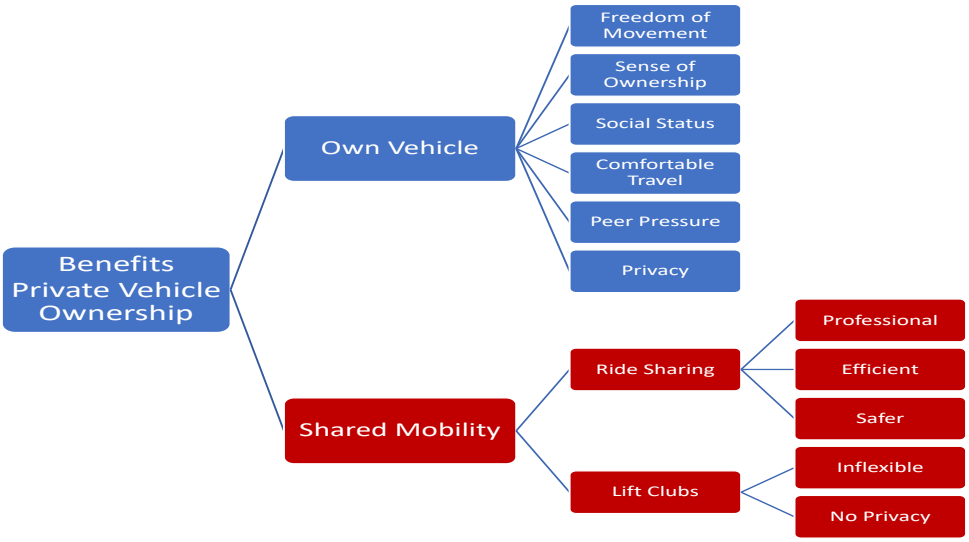
Respondents only mentioned basic needs as benefits for owning vehicles but were reluctant to discuss other needs such as a sense of ownership and other self-actualisation needs. When probed about why they needed to buy bigger and more expensive vehicles when entry level vehicles could meet their basic needs, some respondents started mentioning benefits like vehicle performance, speed, etc. Only a few respondents admitted that they go far beyond just meeting their basic needs when buying a vehicle.

There seem to be far stronger reasons for owning a vehicle other than convenience, flexibility, and freedom of movement. Most respondents mentioned various reasons that have to do with their socialisation and the influence of society. Some respondents indicated that their vehicles give them a sense of ownership and pride. In some social circles they are admired for the vehicles they drive, especially when those vehicles are bigger and/or more expensive.

Some respondents felt pressured by their peers to buy bigger or more expensive vehicles that more than meet their basic needs. In these social circles there is always talk of a "dream car". Those that have more expensive vehicles tend to aspire to even bigger and

better vehicles. Young people entering the job market aspire to purchase their first vehicle as a sign of having achieved something and treat their vehicles as treasured possessions.

Figure 5 – Coding – Benefits of Ownership



5.3.1. Emerging Themes

The strongest theme coming out of the benefits of owning a vehicle is the **"freedom of movement"** that a vehicle brings to their owners. Private vehicle owners are free to do whatever they want, whenever they want, without having to rely on others and/or other public transport and shared mobility options. Having achieved freedom of movement, private vehicle owners do not seem to stop there. Their vehicles seem to give them some social standing in their communities and amongst their peers. Using Maslow's Hierarchy of Needs (Sarma & Hoek, 2004), one could not help but notice that vehicles go beyond meeting merely the physiological needs of movement to earn a living, but they also meet needs such as safety, belonging, and esteem needs. On belonging needs, private vehicle owners get a sense of belonging to certain social circles or communities. For young people, vehicles provide esteem needs that give them a sense of accomplishment that goes with a higher perceived social status. A strong theme coming out of this analysis is the **"social status"** that a vehicle gives some of its owners.

When the benefits of private vehicle ownership are juxtaposed with the benefits of alternatives like ride sharing and lift clubs, there seems to be very little comparison.

Whilst ride sharing is said to be professional, safer, and efficient, it still falls short of matching the very strong traits of freedom of movement and social status. As for lift clubs, this mode of travel is definitely not an option for travellers that can afford to purchase their own private vehicle.

6. CONCLUSION

The final step in this study is to connect the dots to determine how the emerging themes answer the three research questions on cost of ownership, traffic congestion and the benefits of ownership (Vaismoradi, et al; 2016). These themes can be summarised as follows:

⇒ Cost of Ownership:

- **"no comparable alternatives"** – Private vehicle owners do not seem to have any viable and cheaper alternative modes of travel, other than using their own vehicles.
- **"unavoidable"** – Whilst private vehicle owners are aware of the high cost of ownership, they believe these costs are unavoidable for their travel requirements.
- **"hidden costs"** – Private vehicle owners are seemingly not aware of, nor do they take cognisance of, other hidden and implicit costs of ownership such as providing for a garage at home to park their vehicles.
- **"potentially cheaper"** – Shared mobility options have the potential to reduce the cost of travel, but this mode of travel is still not very well developed in South Africa.

⇒ Traffic Congestion:

- **"bad days"** – Traffic congestion is adding to the daily work stresses that motorists face on any given weekday.
- **"peace of mind"** – If private vehicle owners did not have to drive themselves to work every day, they would start their work days in a good state of mind.

⇒ Benefits:

- **"freedom of movement"** – Vehicle owners have the freedom to go wherever they want and whenever they want without relying on anyone else.
- **"social status"** – Vehicle ownership goes far beyond meeting basic needs and it also offers a sense of belonging in some social circles.

On the question of cost of ownership, it can be inferred from the study that in South Africa there are practically no cheaper or viable alternatives for travelling except through privately-owned vehicles. The only form of shared mobility that has been widely used by South Africans and which is cheaper than the use of privately-owned vehicles are lift clubs, but their inherent inconveniences and inflexibility render this option impractical.

There seems to be the issue of hidden or implicit costs of ownership like having to provide for a garage at home to park one's vehicle. Private vehicle owners do not seem to consider implicit costs when making a purchasing decision (Hensher, 2017). Some of these implicit costs include the time spent in traffic during which drivers are unable to do anything else.

On the question of whether the rising costs of ownership could result in a modal shift from privately-owned vehicles to shared mobility, the latter is "potentially" cheaper in South Africa but not well established to become a viable and cheaper option.

In terms of traffic congestion being an ultimate deterrent to private vehicle ownership, there are absolute benefits to not commuting with one's own vehicle. In Li, et al (2016) it was found that Uber led to a 25% reduction in traffic congestion in cities throughout the United States . However, in these cities Uber offers an additional service called UberPool, a pooling service wherein riders going in the same direction can share a ride. This service is not available in South Africa.

One theme associated with traffic congestion is "bad days", in that traffic is adding to stress levels that result in motorists having bad days at work. On the other hand, those who are passengers get to work "fresh" and arrive in a relaxed mood. In essence, this gives them "peace of mind", since they do not have to deal directly with traffic as drivers do. Traffic congestion robs commuters of valuable time that could be used to earn a living. On a macro-economic level, traffic congestion affects the nation's productivity, and represents some form of market failure (Cohen & Kietzmann, 2014). Unlike the cost of ownership, the pain of traffic congestion is much stronger in discouraging personal driving during peak travel periods, but whether it could ultimately reduce private vehicle ownership, has not been established in this study. However, this picture could change with the introduction of more shared mobility options like car-pooling.

In researching the benefits of vehicle ownership, it has been found that South Africans seem to have a very strong affinity to their vehicles. Privately-owned vehicles seem to go beyond satisfying the basic need of being a necessary means of transport to earn a living. The benefits of private vehicle ownership can be summed up with the two themes of "freedom of movement" and "social status". These strong themes, coupled with the lack of viable shared mobility alternatives, make private vehicles indispensable modes of transport for those who can afford them. These benefits also seem to trump the rising costs of ownership.

At this point, it is well worth revisiting the objective of this study. At the initiation of this study, the aim was to explore the existence of a relationship between private vehicle ownership and shared mobility in the South African context. The concept of shared mobility is fairly new in South Africa, and the only experience that respondents could fully relate to were the ride sharing services of Uber and Taxify, as well as lift clubs. As outlined above, shared mobility includes not only public transport services such as trains and buses, but car-sharing and car-pooling. The latter two concepts have not been fully developed in South Africa. It can therefore be concluded that whilst there is some relationship between private vehicle ownership and shared mobility, this relationship is still in its infancy in South Africa.

6.1. Lessons Learnt

The lessons learnt from this study are varied. First, South Africans have a very strong affinity with their vehicles owing to the fact that there are practically very few or no viable and cheaper substitutes to private vehicle ownership. Second, there seems to be general consensus that public transport services are for those who cannot afford the cost of owning a private vehicle. The use of the Gautrain is, however, an exception in that private vehicle owners are prepared to make use of the service as it has not influenced private vehicle ownership. Third, the South African perception of private vehicle ownership and shared mobility are different than those in developed countries that have established and efficient public transport.

6.2. Future Research and Recommendations

As shared mobility evolves globally and as more South Africans realise the benefits of this mode of travel, this may impact private vehicle ownership. Vehicle OEMs are introducing various ownership business models that include subscription-based car-sharing schemes which have the potential to disrupt current ownership models. For instance, if travellers would have vehicles of any kind at their disposal on an as-and-when-required basis, this arrangement could begin to affect private vehicle ownership. The current challenge with private vehicle ownership is that if at any point in time one needs a bigger vehicle, one is unable to swap a vehicle temporarily as one would in a car-sharing scheme.

It is therefore recommended that future research projects be undertaken after new shared mobility services have been introduced in South Africa. The new services that would have an impact on private vehicle ownership include the following:

- ⇒ Car-pooling;
- ⇒ Ridesharing with bigger vehicles;
- ⇒ Car-sharing subscription services.

It is also recommended that future studies include quantitative research that would measure the impact of the introduction of these shared mobility services.

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8. APPENDIX

8.1. Interview Questionnaire

Section A – Introduction

Once more thank you so much for agreeing to take part in this study. Be assured that your responses will be kept strictly confidential. If at any time during this interview you feel uncomfortable to continue, please feel free to stop it. I therefore ask that you be frank by expressing your views freely.

Section B – General and Personal Information

a. Full Name, Email and Contact Number

b. Gender, Age Range (e.g. 20 to 29 years)

c. What is your line of work and your job title?

d. How long have you been a driver?

e. Have you used any ride-hailing services like Uber and Taxify? What is your opinion of these services?

f. Are you or have you ever been part of a lift club before? If so, what has been your experience?

Section C – Cost of Owning a Vehicle

a. What vehicle(s) do you drive? Make, Model, number of household vehicles?

b. Do you have a garage at home or do you use a parking bay? How much do these costs in your area?

c. How much is your average spend per month on your vehicle? Repayments, maintenance, fuel, insurance, etc.?

d. How do your motor vehicle total running costs compare with other major expenses like accommodation, house repayments, etc.?

e. Would you consider a vehicle-sharing or a ride-sharing scheme like lift clubs to reduce your motor vehicle costs?

f. How much time do you use your vehicle on each weekday day and during the weekends?

g. If someone were to rent your vehicle during its idle time and pay you for the time used and kilometres travelled, would this appeal to you? And why?

h. How do you feel about paying for your vehicle when it lies idle?

i. If you did not have to provide for a garage at home to park your vehicle overnight, what would you use with that extra space for?

Section D – Time Lost in Traffic

a. Do you often get stuck in traffic during weekdays?

b. How much time does traffic congestion add to your daily commutes to and from work?

c. How do you feel about the added time you spend travelling to work due to traffic congestion?

d. If this lost time were to be given back to you, what would you use it for?

e. If you were a subscriber to a vehicle or ride-sharing scheme or lift club or use public transport how would you use the time travelling to work?

f. If there was no traffic congestion or if you did not have to drive yourself to work, how would this free time benefit you or your employer?

g. Do you think ride-sharing services like Uber or lift clubs would make you more productive if stuck in traffic congestion?

Section E – Vehicle Ownership

a. For you, what are the benefits of owning a vehicle?

b. If those benefits of owning a vehicle were to be provided for through a combination of travel schemes like lift clubs, ride-hailing (like Uber), public transport, etc.; would you still own a vehicle? Why?

c. Has the total cost of owning a vehicle ever made you reconsider owning a vehicle?

d. Vehicle-Pooling: Do lift club schemes for commuting to work appeal to you and why?

e. Vehicle-Sharing: If you could rent a vehicle of your choice for any period of time, as and when you needed it and within your affordability range, would you still own a vehicle? Why?

f. If all your travel needs were to be arranged through any of the schemes mentioned above (or combination thereof) and at a cost less than that of owning a vehicle, would you still want to own one? Why?

Section E – Closure

May I take this opportunity to thank you for taking part in this interview. I will certainly share with you my findings once this research has been completed. Please be assured that the information you have shared will be treated with the strictest of confidence.

8.2. Letter of Invitation

Dear <Name>

REQUEST FOR INTERVIEW

Would you please help in the research project that I am working on as part of my MBA studies at Wits Business School. The title of my research is "Shared Mobility and Private Vehicle Ownership". I have chosen you because you drive to work and you need not have any further insight into the subject matter.

The interview will last for a maximum of 45 minutes and can be conducted in a quiet place of your choice, preferably in a boardroom. Please note that the interview will be recorded but please be assured that all your responses will be kept confidential.

I hope you will be able to assist and that will be greatly appreciated. I am looking forward to hearing from you.

Your sincerely,

VICTOR RADEBE

8.3. Table of Coding

A. Shared Mobility Services – Uber/Taxify and Lift Clubs

Interview Areas	Open and Categorised/ Grouped Coding	Selective Coding/Emerging Patterns
Experiences and Opinions on Uber and Taxify Services	- Safer than other taxis - Reassuring - Best travel mode at night - Safe for women - - Uber drivers obey rules - Professional - Friendly service - - More Expensive if used every day - More expensive than own vehicle - Known costs upfront - - Safety concerns (rival taxi violence) - Some rude drivers - Sexual harassment - Taxi wars a concern - - Fills a gap in market - Reliable - Efficient - Vehicle can be tracked - Kept updated	- Safe Travel - - - - - Professionalism - - - - More expensive - - - - Taxi Violence - - - - - Efficiency - -
Lift Clubs	- Inconvenience - Inflexible - Often not punctual - Non-payment - Burdensome - Money issues - Family responsibility (kids) - - Save money - Cost sharing - - Enjoy the company	- Inconvenient - - - - - - - - Cost-effective - -

		- Sociable

B. Cost of Ownership

Interview Areas	Open and Categorised/ Grouped Coding	Selective Coding/Emerging Patterns
Ranking of vehicle ownership costs	- 2nd highest to accommodation costs - 3rd highest behind accommodation and school fees	- Too costly
Alternative Uses of Garage	- Rent out - Office - Gym	- Hidden costs
Paying for Idle Vehicle	- Never thought about - - Saves on mileage - - Money down the drain - Vehicle is a liability	- Foreign concept - - Idle vehicle is acceptable - - Wasted
Renting Idle Vehicle	- Love the extra cash - Extra income is good - - Doesn't make sense - Wear and tear - Devalue with more mileage - Replacement value drops - - Sounds weird - No stranger using my vehicle -	- Extra Cash - - - Perceived costly - - - - - Foreign concept

C. Traffic Congestion

Interview Areas	Open and Categorised/ Grouped Coding	Selective Coding/Emerging Patterns
Feelings about getting stuck in traffic	- Frustrating - Tiring - Stressful - Irritating - Road rage - Affect mood for the day -	- Helplessness - - - - - -

	- Waste of time - Too early departure - Robs family time - Time is money	- Lost quality time
Activities if they didn't have to drive to work	- Pray - Meditate - Sleep - Watching YouTube videos - - Study - Reading - - Catch up on work - Emails	- Relaxation - - - - - Personal development - - - Productive

D. Shared Mobility and Vehicle Ownership

Interview Areas	Open and Categorised/ Grouped Coding	Selective Coding/Emerging Patterns
Benefits of vehicle ownership	- Choices for mobility - Get up and go - Independence - Can plan movements - Emergency trips - Long distance trips - Good for a parent - Freedom of movement - Necessity - Flexibility - Consistency - - Sense of ownership - Status - Feel good - Luxury - Respectability - Dream vehicle - Status in townships - Higher status for high value vehicles - Fitting into some circles - Sentimental value	- Convenience - - - Self esteem - Sense of being - Peer pressure - - - - - -

	- Feels like little princess - Sense of satisfaction - Sense of pride - Sense of worth - Judged by what you drive - Comfort - - Security - Bigger vehicles are safer - Privacy - Want my space - Own music - Own speed -	- - - - - - - - - Security - Privacy
Reasons for driving to work and not sharing	- Like my space - Privacy - - Unreliable public transport - - Unsafe public transport - Kids school - - Peer pressure -	- Privacy - - - Convenience - - Safety - - - Self-esteem
Would shared mobility replace ownership	- Never thought about it - - Too few alternatives	- Foreign concept - - Choices
Effects of total cost of ownership	- Not aware of total cost of ownership - - No need for 2nd vehicle - Maintenance too costly - Hassles of ownership – licence, etc. - - Predictability is price worth paying - - Added risk	- Cost conscious - - Control - - - - Less Cost Conscious - - Safety
Openness to shared mobility	- Need to accommodate schedule - - Open but still own vehicle	- Flexibility - - Choices