STRATEGIC OVERVIEW AND ANALYSIS OF VEHICLE OWNERSHIP TRENDS IN SOUTH AFRICA WITH AN EMPHASIS ON LIGHT PASSENGER VEHICLES

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ABSTRACT

The paper summarises the research work undertaken by CSIR Transportek, to evaluate the vehicle ownership trends and use in South Africa, within the context of transportation planning. The paper further highlights attempts made in the study to forecast the car ownership trends in South Africa and some selected urban areas using the logistic curve theory.

The analysis of current and projected vehicle ownership and usage is primarily based on the information accessed from the National Traffic Information System (NaTIS) database of the National Department of Transport. Further data was sourced from the National Department of Minerals and Energy Affairs, Statistics South Africa and some metropolitan vehicle registering authorities.

The study findings are interpreted in such a way as to provide useful insight into vehicle ownership in South Africa.

1. INTRODUCTION

Worldwide experiences have shown that high levels of vehicle ownership can be associated with increased congestion, air pollution and other externalities. Therefore, the challenge is to manage more efficiently the current road space and the surrounding environment in a sustainable way. Vehicle ownership studies on a countrywide scale have been used across the world to provide necessary input into strategic transportation planning and policy formulation.

This paper presents the results of the work undertaken to analyse the current trends in vehicle ownership and use in South Africa. Furthermore, an attempt is made to forecast the car ownership trends, in terms of cars/1000 population, based on the logistic curve theory.

2. THE STUDY APPROACH

The analysis of current and projected vehicle ownership and usage was primarily based on the information accessed from the National Traffic Information (NaTIS) database of the National Department of Transport, with additional data sourced from the National Department of Minerals and Energy, Statistics South Africa and some urban and district vehicle registering authorities. Prior to using the data from the NaTIS database, an effort was made to ensure its integrity as far as possible by removing the erroneous entries and the inconsistencies observed.

The vehicle ownership profiles were based on attributes of the vehicles registered at the end of the year 2000. These following attributes were considered:

- Vehicle Park by vehicle type.
- Vehicle Park by geographical area.
- Average ages of the vehicles at the end of 2000, per vehicle type and province, assuming the age distribution follows the gamma distribution
- Scenario based forecasting

With regard to the forecasting of car ownership, the logistic curve theory was employed. The theory is based on the assumption that the ownership of a commodity, cars in this case, follows an S-shaped curve over time. The curve asymptotes to some saturation value representing the equilibrium point in the market where the replacement rate of the commodity equals the disposal rate. The quality of the forecasts using this approach depends primarily on the quality of the time series data. However, the time series data of car ownership in South Africa has been marked by inconsistencies due to the changes in the administration of data storage, changing of land demarcations affecting demographics data and more remarkably by the manipulation of market growth by the economic policies of the past government. All these factors have influenced the quality of the time series data of vehicle ownership in South Africa and hence the quality of the forecasted car ownership results in this paper. In an attempt to lessen the effects of these distorting factors, the forecasts in this paper have been presented in terms of various car ownership saturation values, from which interpolations of future car ownership can be made.

A number of stakeholders were also consulted during the course of the study as far as their area of expertise interface with the study. These stakeholders are the Department of Minerals and Energy, South African Revenue Services, Department of Trade and Industry and the National Association of Automobile Manufacturers of South Africa (NAAMSA).

3.   THE STUDY FINDINGS

The findings provided in this paper are a summary of the extensive work undertaken on the number of vehicles, geographical distribution of the vehicle population, the age distributions of the vehicle types and the forecasting of the car ownership. The term vehicle refers to all the motorised vehicles and cars refer to the light passenger vehicles.

3.1 Vehicle park by vehicle
The types of vehicles in the NaTIS database are defined in terms of the number of passengers that can be carried and Gross Vehicle Mass (GVM).

- Light passenger vehicles: carrying capacity < 12 persons
- Minibuses: Minibus/Kombi
- Buses: heavy passenger vehicle with carrying capacity > 12 persons
- Light load vehicles: GVM < 3500 kg
- Heavy load vehicles (GVM > 3500 kg)
- Other: combination of motorcycles, special and unknown vehicles

Figures 1 and 2 show the absolute number of all the vehicles and the proportions of the vehicle types in South Africa respectively. The total number of vehicles in the country is by year 2000 was 6 739 318. Light passenger vehicles account for about 58% of the total vehicles in the country, followed by light load vehicles at 26%. Minibuses account for about 4%. Buses account for under 0,5 %. It can also be noted that buses combined with minibuses still account for less than 5% of the total vehicles.
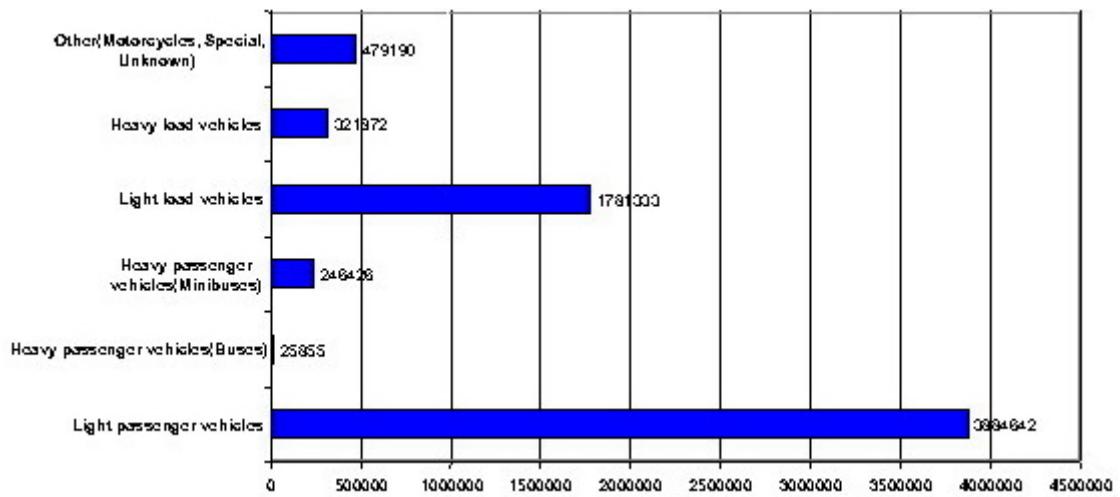
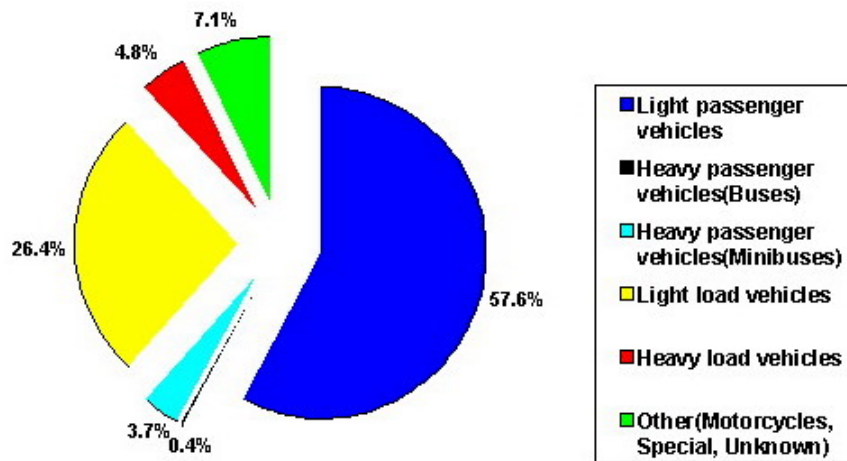Figure 1.Total South African Live Park by Vehicle Type – 2000.

Figure 2. 2000 - National Proportions of Vehicle.

3.2 Vehicle park by geographical area

Figures 3 and 4 show the geographic distribution of vehicle population with reference to the respective provinces at the end of the year 2000.
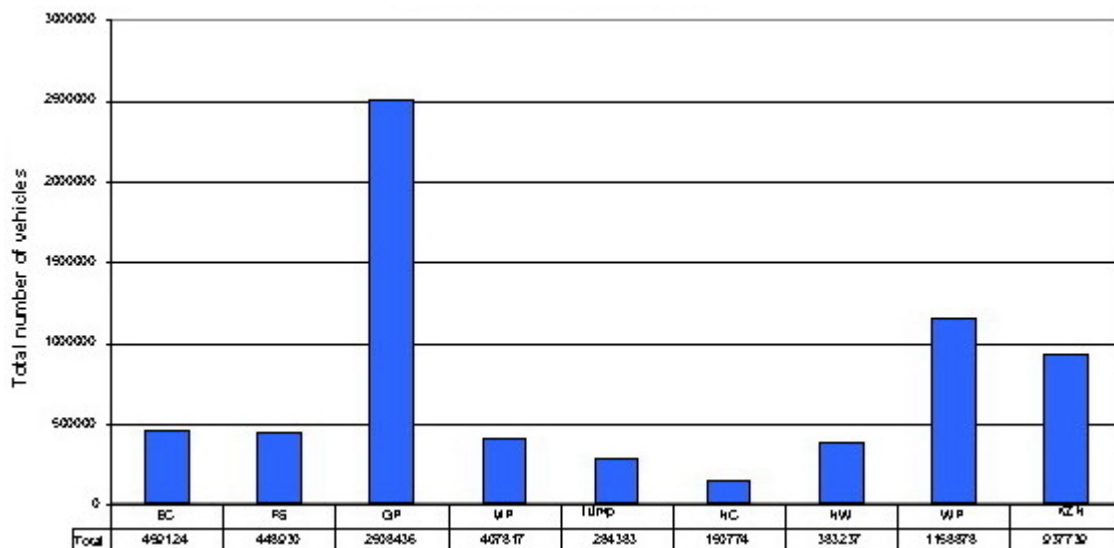

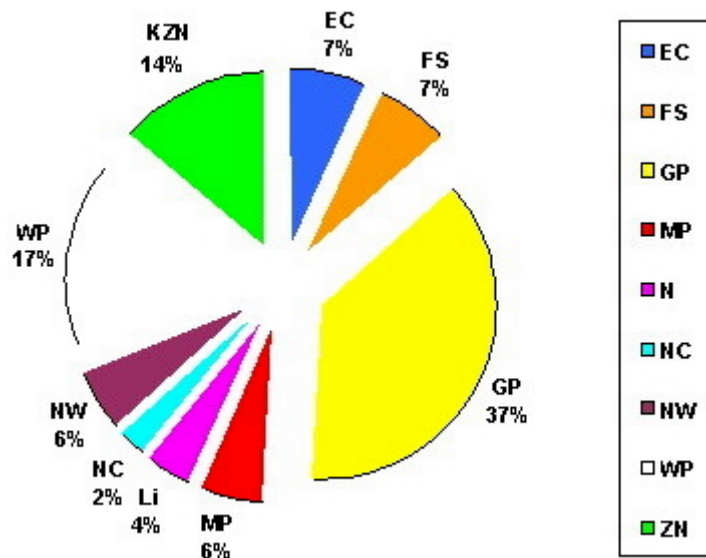Figure 3. Total Vehicle Park by province at the end of 2000 (6 739 318)

Figure 4. 2000 National live vehicle park provincial split.

Gauteng has the highest number of vehicles at 37%.It is followed by the Western Cape at 17 %. Gauteng province with the smallest area coverage, has fifteen times the number of vehicles that the Northern Cape Province with the largest area coverage. Eastern Cape, Free State, Western Cape and Mpumalanga provinces each account for about 7% of the total vehicles.

Figure 5 shows the graphical comparison of the vehicle ownership in the six metropolitan municipalities of South Africa. Johannesburg has about 1 200 000 vehicles. This is the highest number of vehicles compared to the other metros. The other three metros, Ekurhuleni, Tshwane and Cape Town, each account for around 600 000 vehicles. The Nelson Mandela Metro accounts for the least vehicles around 200 000 vehicles.
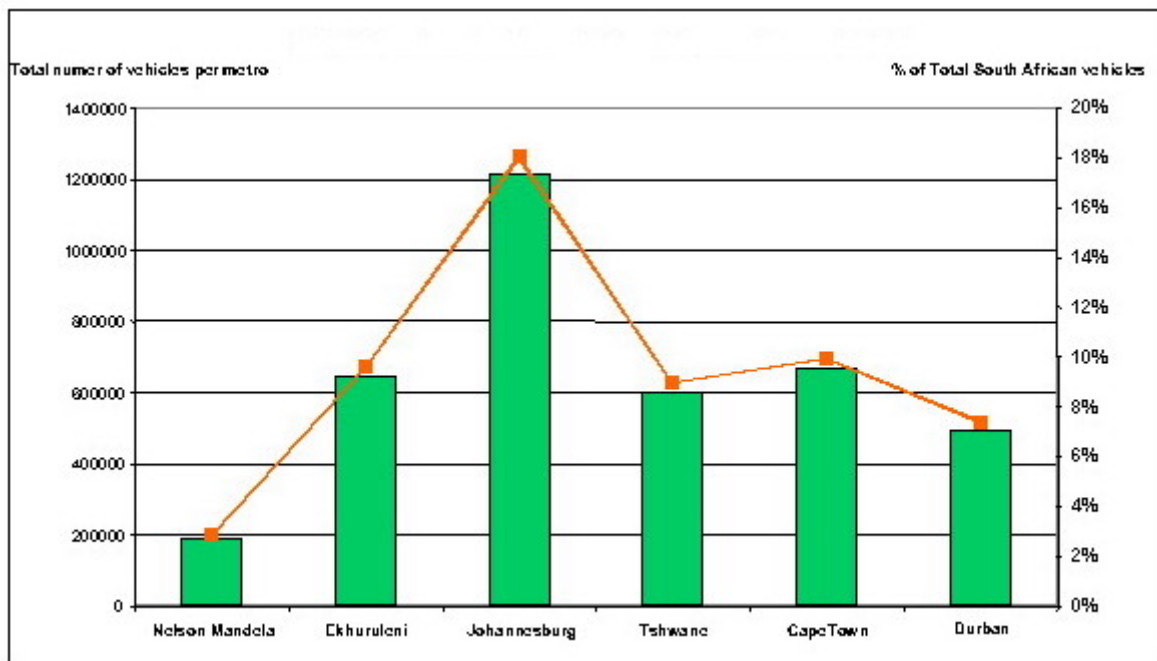

Figure 5. Total number of vehicles per Metropolital area at the end of 2000.

3.3 Average Ages of the vehicles
Table 1 shows the average ages of vehicle types in South Africa at the end of the year 2000. The average ages were obtained by fitting a gamma distribution to the age distribution of respective vehicle types.

The vehicle fleet in South Africa is relatively old. The ages of minibuses and buses are a cause for concern, considering the high annual kilometres travelled by these types of vehicles as public transport vehicles. The ages have a direct implication on the operating costs and safety of the vehicles.

Further analysis has revealed that the average ages of the vehicles per vehicle type is almost the same across all the provinces. The ages of vehicles in KwaZulu-Natal, however, are relatively lower that the ages of vehicles in the other provinces. The average age of light passenger cars in Gauteng is the lowest at 10.5 years. The Free State province has in overall, the oldest population of vehicles in the country.

Table 1.

Vehicle type	Average Age (Years)
Light Passenger vehicles	11.9
Light Load Vehicle	11.6
Minibuses	12.2
Buses	14.3
Heavy Load vehicles	14.1
"Other" vehicles	17.2

4. SCENARIO–BASED PROJECTIONS OF CAR OWNERSHIP

The logistic curve used in scenario-based projections is represented by the following equation:

$$C_t = \frac{S}{1 + b\exp(-aSt)}$$

where C_t = car ownership at any given time t (cars/1000 population)
    b = constant from the derivation of the equation
    a = constant from the derivation of the equation
    S = saturation level (cars/1000 population)
    t = time

The saturation value (S) is obtained by assuming a linear relationship between the percentage changes in car ownership on the one hand and cars ownership on the other. The value of saturation corresponds with the car ownership level where the percentage change in car ownership is zero. The constants a and b can be determined using boundary conditions at time t = 0 or by using multiple regression. In this study multiple regression was performed to obtain the values of a and b.

Figures 1 to 5 represent the projected car ownership trends in South Africa and selected urban areas, using 1940 as the base year. It should be noted that the urban areas referred to in the paper do not coincide with the current demarcations. The increase in the coverage of these urban areas to include areas with lower car ownership profiles will tend to decrease the projected values. The cars referred to in these figures include all the cars owned by private individuals and companies.

Figure 1 illustrates the projected car ownership in the whole of South Africa. The current car ownership is marginally overestimated estimated at about 110cars/1000 population. The Moving South Africa report of the National Department of Transport estimated that the car ownership saturation value for South Africa would be in the region of 120 cars/1000 population. Figure 1 estimates that saturation value would be reached at around the year 2070. The other curves in Figure 6 illustrate scenarios for different assumed saturation values.
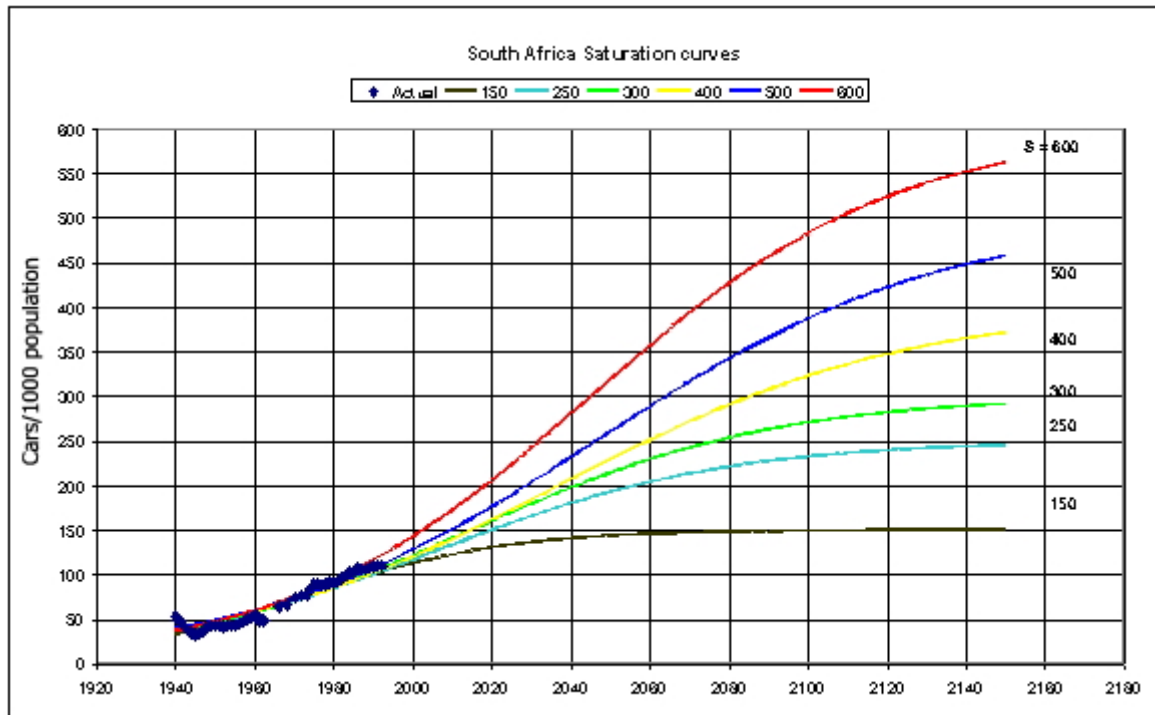

Figure 6. South African saturation curves

Figures 7 to 10 illustrate the logistic curves for Buffalo City, Tshwane, Cape Town and Johannesburg. These areas have been selected in terms of availability of historic data of car ownership, and therefore represent the more affluent areas in these urban areas.

The following can be noted from these figures:
- The car ownership levels on a country scale are significantly different from the metropolitan areas
- In the short to medium term, the car ownership levels are insensitive to the different saturation values.
- Tshwane is more likely to reach a definite saturation level sooner than all the other urban areas.
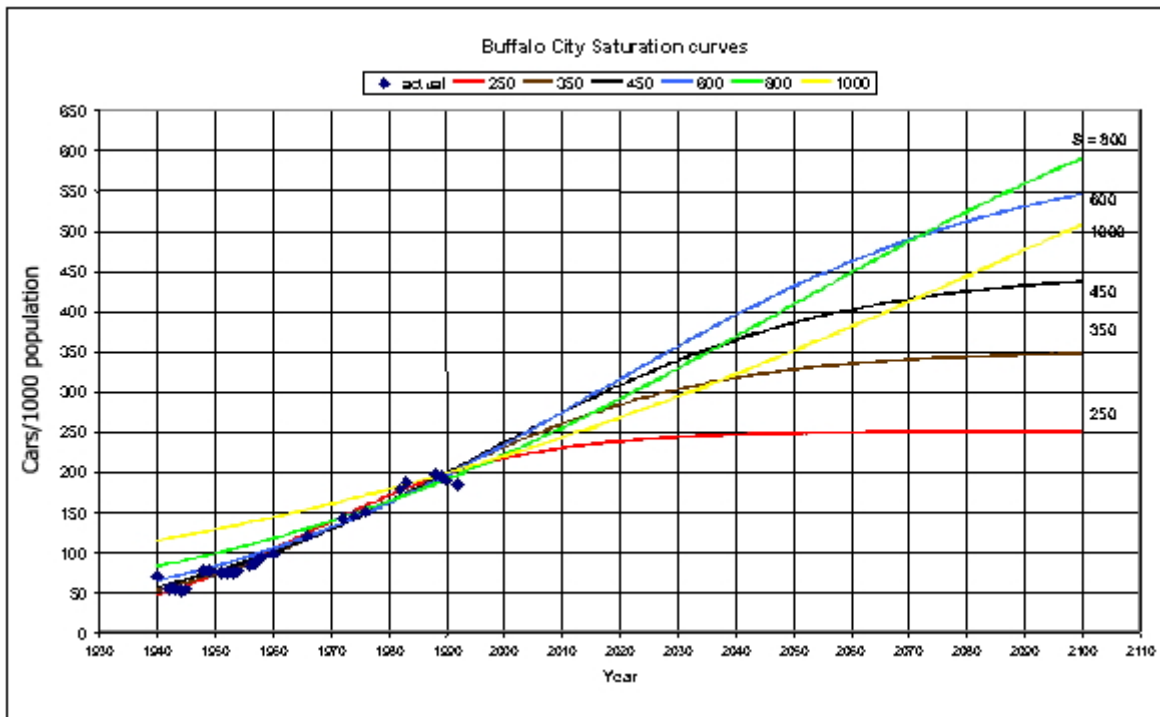- Johannesburg and Cape Town logistic curves have similar patterns
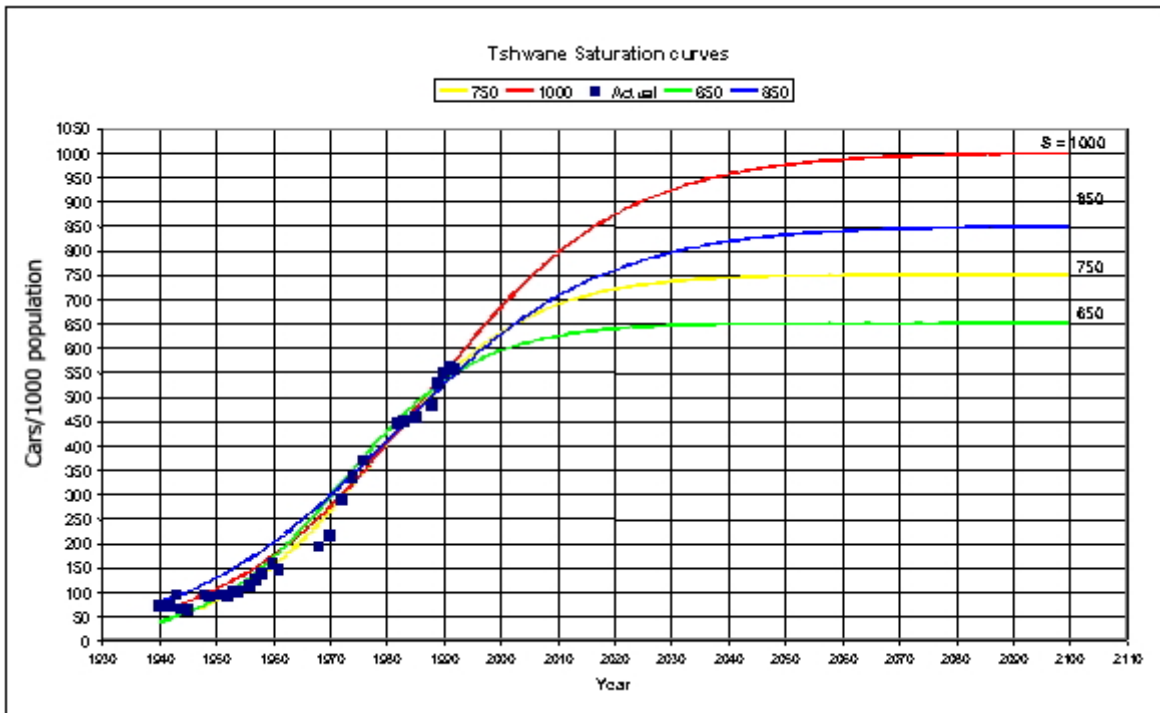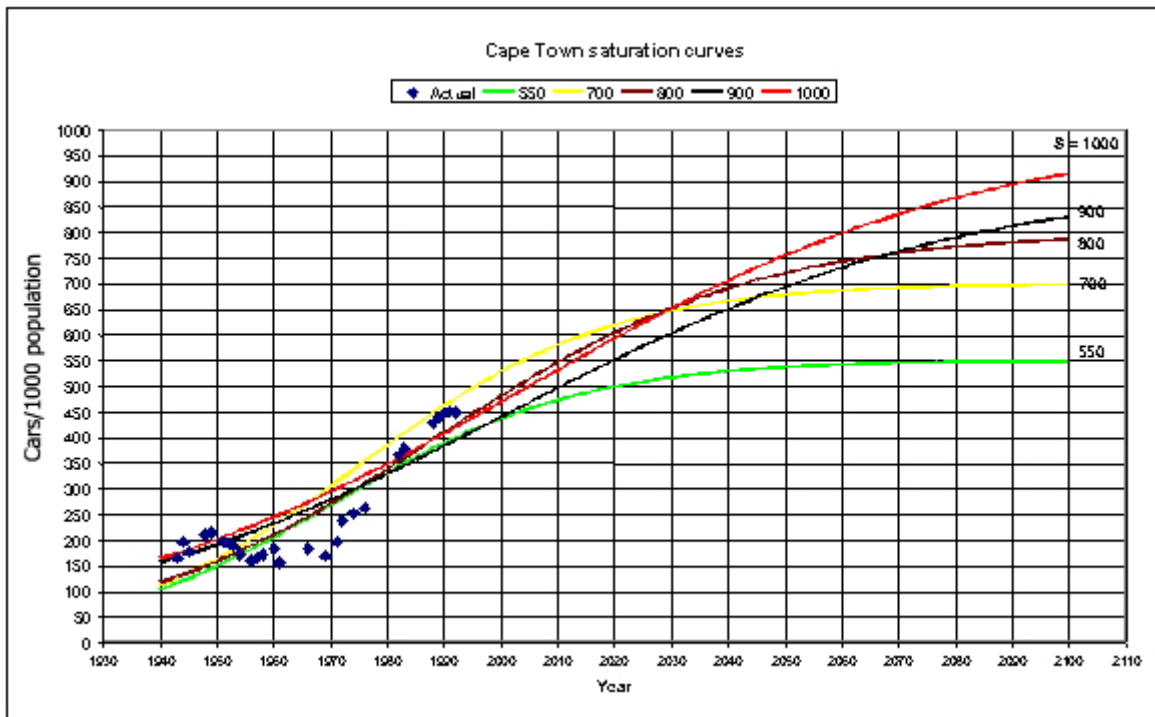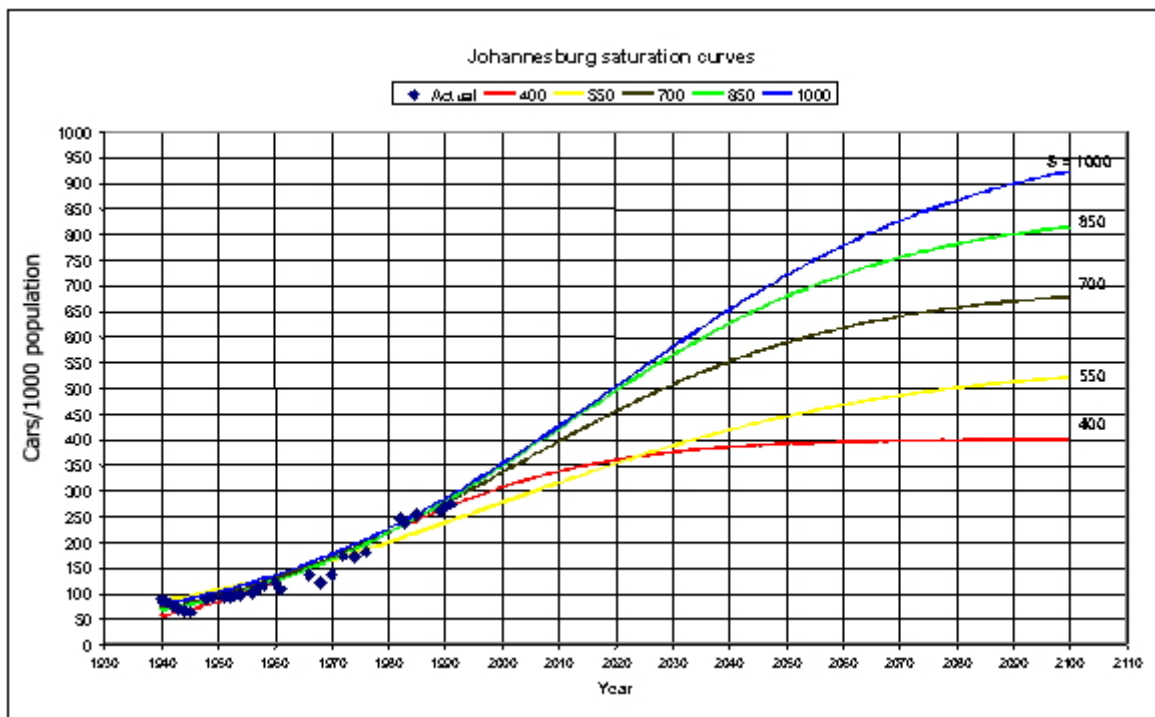
Figure 7.

Figure 8.

Figure 9.

Figure 10.

5.   CONCLUSIONS

The paper presented a summary of the research work conducted into the vehicle ownership profiles and use in South Africa. Furthermore, an attempt was made to project the car ownership trends based on the time series data of car ownership in South Africa and some selected urban areas. The analysis was based on data obtained from the cleaned NaTIS database, Statistics South Africa, the Department of Minerals and Energy and some vehicle registration authorities.

The following can be concluded from the findings of the study:
- The total number of vehicles in the country is 6 739 318
- At 58% of the total vehicles, Light passenger vehicles account for the largest proportions of vehicle population in South Africa.
- The combined proportion of buses and minibuses make up less than 5% of the total vehicle population in South Africa.
- At 37 % of the total vehicles, Gauteng province is the province with the highest number of vehicles
- Eastern Cape, Free State, Western Cape and Mpumalanga each account for about 7% of the total vehicles.
- Johannesburg had 1 200 000 vehicles by year 2000 which is the highest of all the metros.
- Cape Town, Ekurhuleni and Tshwane each account for 600 000 vehicles.
- All the vehicle categories have an average age above 11 years.
- The car ownership levels on a country scale are significantly different from the metropolitan areas. The urban areas have on average significantly higher levels of car ownership than the average car ownership at the country level. The saturation levels of car ownership in urban areas were estimated to be much higher than at the country level.

The study was approached from a transportation planning point of view. It would
also, be worthwhile conducting a study that incorporates behavioural analysis of vehicle ownership trends. Such studies are usually conducted by the vehicle manufacturing industry for marketing purposes. Extending these behavioural studies to transportation planning, including elasticity of car ownership and use, would give a valuable input in the design of public transport operations. In particular, the cost of providing the equivalent level of service required by the public on a sustainable level can be estimated. This approach however requires much more data than currently available. The importance of comprehensive collection and systematic storage of data cannot therefore be overemphasised.