PERCEPTIONS OF THE FACTORS CAUSING TRAFFIC CONGESTION AND PLAUSIBLE MEASURES TO ALLEVIATE THE CHALLENGE IN BLOEMFONTEIN, SOUTH AFRICA

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ABSTRACT

Sustainable road transportation and sustainable development are interlinked and influence the success of each other. In this context road, traffic congestion on the roads of cities of South Africa remains a challenge for their sustainable development. Despite various attempts to mitigate congestion, some of the cities are still facing the challenge enormously, which keeps on increasing. Therefore, this study examined the parameters, which engender traffic congestion and whether use of ICT can alleviate the challenge in the cities of South Africa. The study was conducted by using a survey research method and using Bloemfontein city of South Africa as a case study and case analyses from different cities of South Africa. It is revealed that traffic congestion and delay are the major road transportation challenges in the Bloemfontein city that are engendered by the use of large-scale private vehicles. Availability of accessible and cost effective public transportation system may not able to solve the problem alone. People perceive that use of ICT in travel and socio-economic activity needs can be a major factor, which can reduce traffic congestion and engender sustainable road transportation in the city.

Keywords: Information and Communication Technology (ICT); Public transport; Road;

Sustainable road transportation; Travel time

1. INTRODUCTION

In South Africa, the population keeps on increasing and so is the need to provide infrastructure. In conjunction, there is a demand for appropriate solutions that will better the lives of human beings, along with conserving resources for the future generation. According to census 2011, the population of South Africa grew by 7 million between 2001 and 2011. This increase in the population calls for the solutions to accommodate the growth without compromising the quality and efficiency of the services. Among these is the need for efficient transportation systems and solutions that will alleviate the transport challenges that South African cities are facing.

Sustainable road transportation is found to be an integral part of sustainable development as large scale transportation and vehicular activities are increasingly contributing to the economic, mobility, living conditions and environmental challenges of regions or cities (Haghshenas, Vaziri, Gholamialam 2015; Schipper, Deakin, & McAndrews, 2010). Therefore, it is argued that urban areas/ regions require safe, fast, energy-efficient and low

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Proceedings ISBN Number: 978-1-920017-89-7
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carbon emission transportation system in order to contribute to sustainability of cities or regions (Rockwood, Garmire 2015). For this reason, it is imperative to prioritise sustainable transportation at different scales of habitation such as city, region or at national level (Haghshenas, Vaziri, Gholamialam 2015; Rodrigue 2007; Dobranskyte-Niskota, Perujo and Pregl, 2007). According to scholars there is no single indicator that would define sustainable road transportation. Many international organizations such as (EU, Eurostat, EEA, UN and WHO) argue that indicators should be the representatives of selected geographical or political area (Dobranskyte-Niskota, Perujo and Pregl, 2007; Litman, Burwell, 2006). Accordingly, a set of indicators have been proposed and developed based on economic, social, and environmental attributes (Emberger, Pfaffenbichler, Jaensirisak, & Timms, 2008; Haghshenas, Vaziri, Gholamialam 2015; Li, Liu, Hu, Wang, & Yang, 2009; Litman, 2007; Zhao, 2009). Consequently, the various important indicators to measure sustainable road transportation envisaged include fossil fuel consumption and CO2 emissions, vehicle pollution emissions, per capita motor vehicle mileage, traffic crash injuries and deaths, transport land consumption, roadway aesthetic conditions (EC, 2005; Litman, Burwell, 2006; Sietchiping, Permezel, Ngomsi, 2012; Thynell, Mohan, Tiwari 2010). However, it is also implicit that in a city urban activities, land use and road transportation system are complementary to each other. So, the concept of sustainable road transportation in an urban area is governed by different indicators which include among others accessibility to- and quality of public transportation, level of congestion, level of carbon emissions and polluting matters, road utilization, facilities for pedestrian movement, traffic crashes, etc. (Haghshenas, Vaziri, Gholamialam 2015; Zhao, 2009). Thus, based on these indicators some scholars have advocated that the sustainable road transport policy should tackle rising levels of congestion, noise and pollution, encourage use of more environmentally-friendly modes of transport, use of higher public transportation, reduction of traffic crashes and use of Information Communication Technologies (ICT) to reduce travel needs (Dobranskyte-Niskota, Perujo and Pregl, 2007; Emuze and Das, 2015; Haghshenas, Vaziri, Gholamialam 2015; Zhao, 2009).

 According to the United Nations, South Africa is experiencing continuing urbanisation that might leave 71.3% of South African population living in urban areas by 2030, which is expected to reach nearly 80% by 2050. Consequently, there is a demand for travel needs in the cities of the country. In the wake of an inadequate public transportation system in a number of major cities, people resort to self-driven private cars, which has resulted to various road transportation challenges including that of congestion and traffic collisions (Bhattacharya, 2010). Further, Emuze and, Das (2015) suggested that a continuous increase in traffic demand on account of higher levels of urbanization, population growth, changes in population density are some of the factors that cause challenges for the road transportation system as against the needs for efficient mobility of people and goods as well to create a sustained transportation system in cities of South Africa. Not only do these factors delay the progress of the cities, but they also result in traffic collisions, traffic congestion and consequent increase in travel times, fuel consumption and carbon emissions. However, traffic congestion is observed to be a major issue that hinder sustainable road transportation in cities of South Africa. Although, several measures are taken that include the introduction of public transportation such as Gautrain and Bus Rapid Transit System (BRT), in Johannesburg and Pretoria, and MyCiTi bus system in Cape Town, etc., some of the cities are still facing the challenge enormously, which keeps on increasing. Further, the cities, which do not have any public transportation system, also face severe traffic congestion, at least during the peak hours of the day. Thus, it is argued that there is a need to explore alternative avenues that could alleviate traffic congestion in the cities of South Africa. Therefore, the objective of the study was to explore what are the parameters which

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engender traffic congestion, and whether use of ICT can alleviate the challenge in the cities of South Africa. The study was conducted by using a survey research method and using Bloemfontein city of South Africa as a case study and case analyses of other cities of the country. It is found that traffic congestion and delay are the major road transportation challenges in the Bloemfontein city, which are caused by the use of large-scale private vehicles on account of efficiency, flexibility, psychological feelings and safety despite the availability of public transportation system in the city. In addition, as per perception of people, use of ICT in travel and socio-economic activity needs can be a major factor, which can to reduce traffic congestion and engender sustainable road transportation in the city.

2. APPROACH OF STUDY

The study presented in this paper is based on qualitative and quantitative research. It was done through literature review of different journals and book publications. The literature coinciding with sustainable road transportation in South Africa and other developed cities were studied and critically analysed. Cities and regions in South Africa, which have adopted the concept of sustainable road transportation such as Gauteng region, Durban, and Cape Town were specifically analysed to reflect on their successes and challenges.

Further, Bloemfontein city was considered as the case study for this study in the attempt to try to understand the behaviour of the transportation users, to investigate their views of the existing transportation system, and to understand how best they will welcome change if new systems were to be introduced regarding the transportation system. Bloemfontein was considered as the case study city because it is one of the growing cities of the country, which offers higher order socio-economic and infrastructural facilities to the people of the central region of the country. People from the surrounding towns and rural areas commute daily to the city for their socio-economic and business needs such as, attending schools and colleges, accessing health facilities, for shopping, entertainment, and performing jobs. Because of the growing needs of movement of the people of the city and its surrounding areas and higher dependence on vehicular transportation, the city faces mounting road transportation challenges in and around the city. As observed in the Integrated Development Plan (IDP), Mangaung Metro Municipality (2012), the current road transportation system is found to be inadequate, overcrowded during peak periods, unsafe, inconvenient and often unreliable (IDP 2011/2012) leading to sustainable challenges. However, traffic congestion in the city particularly during peak hours is a leading challenge in the city, which is expected to become acute in future. In the wake of an inadequate public transportation system, and prevalence of predominantly privately car driven mobility system, there is a need to explore any other alternative means, which can alleviate traffic congestion system. In this, a preliminary investigation was conducted to explore if ICT has the potential to contribute to the reduction of traffic congestion in the city.

For this purpose, a survey was conducted to collect primary data from the residents and road users of the city by using a pre-tested questionnaire. The survey was conducted among 305 respondents through a random sampling process. The demography of the respondents includes 60% males and 40% females. The respondents constitute 67% African, 15% white, 12% coloured, 3% Asian and 3% Indian people. In addition, about 75 % of the respondents had already acquired their university qualification and some were continuing with their studies. About 20% has secondary school education only and 5% had primary education or less.

The sample questions that were included in the questionnaire focused mainly on the sustainable road transportation related challenges in the city. A part of the questionnaire

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focused on the following factors which included challenges faced during the trip, vehicles used for travel, reasons of use of public transportation, types of public transportation use, types of private transportation used, reasons for use of private transportation, and perception on how sustainable road transportation can be achieved.

3. RESULTS AND DISCUSSION

3.1 Lessons learnt from South Africa cities/ regions

Traffic congestion is one of the transportation challenges planners are trying to alleviate. It has undesirable consequences which includes negative economic impacts and environmental pollution (Rao and Rao, 2012; Sorensen, 2008; Wang, Gao, Xu, Sun, 2014). According to census statistics, Gauteng, Western Cape and KwaZulu-Natal Provinces show increase of the population by 15%, 10.3% and 0.1% from the year 2007 to 2011 respectively. These are three provinces in South Africa, which have showed massive progress in the development of efficient transportation systems that prioritises public transportation through various initiatives. The transportation systems in the cities of these Provinces offer a fast, convenient, safe and efficient public transport service. The characteristics of these systems are discussed as below.

Gauteng: Johannesburg and Pretoria

Gauteng's public transport system is undergoing something of a revolution. It has an ongoing Gautrain project that started operating in 2010, which is the first rapid rail network in Africa. It connects two of the most important cities of the country Johannesburg and Pretoria passing through important locations such as Sandon city, Rosebank, Centurion to a name a few. The Johannesburg city also has the Rea Vaya BRT and park and ride facilities. Similarly, The BRT system A Re Yeng has been operational in the city of Pretoria. Though Johannesburg and Pretoria are multi-modal cities, they still face the challenge of congestion. Most of the commuters use taxis to get around the city because they are more flexible and save time compared to other modes of public transport. This is according to data released by Statistics SA in its National Household Travel Survey, which investigated travel patterns, and transport problems in the country. According to the survey, taxis are the main source of transport for most households at 41.6 percent as compared to private cars (13.7 percent), buses (10.2 percent), car passengers (13.7 percent) and trains (4.4 percent) (Stats, S.A., 2014).

According to an annual global traffic index produced by satnav specialist TomTom in 2016 in a News 24 article, Johannesburg ranked number 44 worldwide, with 46.8 hours spent in traffic per year leading to severe traffic congestion in the city. Therefore, despite the augmentation of public transportation system, traffic congestion and sustainable road transportation remained as a serious challenge.

Kwazulu Natal: Durban

Kwazulu Natal has a GO! Durban plan, which is the city's integrated rapid public transport network (IRPTN) plan that is believed to mobilise the citizens of the growing metropolis. The plan is to make Durban as the Africa's most caring and liveable city by 2030. The key objective is to put Durban on par with the world's most successful cities. According to Her Worship the mayor, Councillor Zandile Gumede the GO! Durban will have nine routes by

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various modes of transport- bus, rail, taxis, cycling and walking. It is planned that seven stations will begin functioning once the GO! Durban system begins in mid-2018. In addition, there will be an Advanced Public Management Transport System that will provide passengers with information on bus arrival times. Information will be available on electronic displays at stations, on buses and via Mobile Applications (Petterson, 2017).

Currently the city's transportation system consists of bus, rail, taxis, cycling and walking, but the road transport is not integrated with technology (e.g. Apps, real time information), Further, there are solutions such as Uber and Taxify, which are not entirely effective as their prices are forever fluctuating, as they are dependent on availability of drivers and distance (Petterson, 2017).

According to an annual global traffic index produced by satnav specialist TomTom in 2016 in a News 24 article, Durban ranked number 158 worldwide, with 30.2 hours spent in traffic per year indicating significant traffic congestion challenges in the city.

Western Cape: Cape Town

Public transport is considered the more affordable option when it comes to travelling. Many use it for their daily commute to and from work because it is cheaper and can reduce the amount of time spent in traffic. Golden Arrow Bus Services operates in the Cape Town metropolitan and transports 48.5 million passengers annually. Metrorail Western Cape is the train service transporting citizens to and from its 122 train stations in the province. Further, MyCiTi is the Cape Town's Bus Rapid Transit (BRT) system, which transports citizens in and around the Cape Metropole. It uses dedicated lanes to reduce travel times and operating costs. Besides, people in the city use mini bus taxis and metered taxis for their local travel needs (Strydom, 2010). According to an annual global traffic index produced by satnav specialist TomTom in 2016 in a News 24 article, Cape Town ranked number 33 worldwide, with 49.1 hours spent in traffic per year. This signifies that Cape Town is the most congested city in South Africa, and despite the various public road transportation systems available and in operation in the city; the city still faces high levels of traffic congestion

Free State: Bloemfontein

The Mangaung Metropolitan Municipality has a five-year Integrated Development Plan in place, and transport is a key component. The N8 is a central part of the plan, providing the main link on the East-West axis. A commuter rail option is being explored with the Passenger Rail Association of South Africa (PRASA), to enable residents of Botshabelo and Thaba Nchu to better connect with Bloemfontein. Linking this to a bus rapid transport (BRT) system and taxis will also form part of the solution. Currently the city's transportation is only based on subsidised Interstate Bus Line (IBL) buses, minibus taxis, metered taxis, and private cars that have been changed to operate as taxis (BEPP, 2017/18). According to an annual global traffic index produced by satnav specialist TomTom in 2016 in a news 24 article, Bloemfontein ranked number 470 worldwide, with 16.1 hours spent in traffic per year. Although, the traffic congestion in Bloemfontein is relatively less than other cities of the country, it is still significant.

The study of the above four cities revealed that the cities have multimodal system for local and regional transportation. Further, public transportation system in terms of BRT system, local and metro rail system are operational. However, the roads of the cities are congested

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leading to loss of valuable time. So, measures such as public transportation system including BRT system and metro rail cannot able to alleviate traffic congestion in a city. Therefore, there is a need for alternative options such as use of ICT during travel and socio-economic activities of the people.

3.2 People's perception on traffic congestion related parameters in Bloemfontein city

The results of the preliminary investigation on various parameters related to traffic congestion in Bloemfontein city are reported as follows.

Figure 1 indicates the various sustainable road transportation challenges in Bloemfontein city. According to the perception of people, traffic congestion (13%), and delay (13%) are the major challenges followed by fuel consumption (10%), cost of travel (10%), distance travelled (10%) and road safety (9%). Therefore, traffic congestion and associated delay are found to be the major sustainable road transportation challenges the city facing.
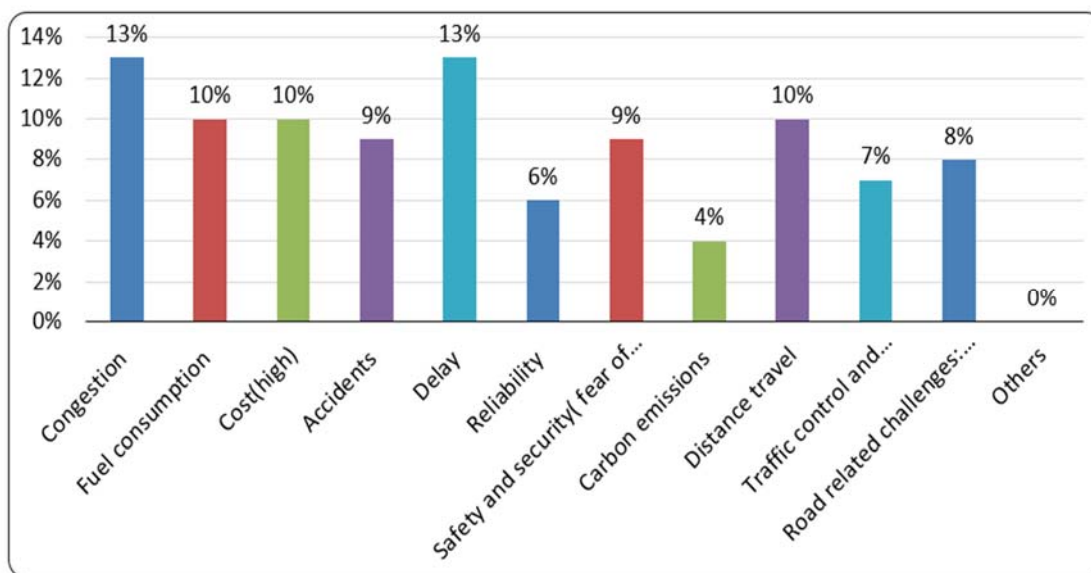

Fig 1. Sustainable road transportation challenges in Bloemfontein city

Figure 2 presents the challenges faced by people during the trip. It is revealed that congestion (28%) and delay (29%) are the two most important challenges people face during a trip. However, road accidents (16%) and diversion of roads (13%) are the two other most significant challenges during a trip in the city. Thus, it is construed that traffic congestion and delay are the major challenges that hinder sustainable road transportation in the city.
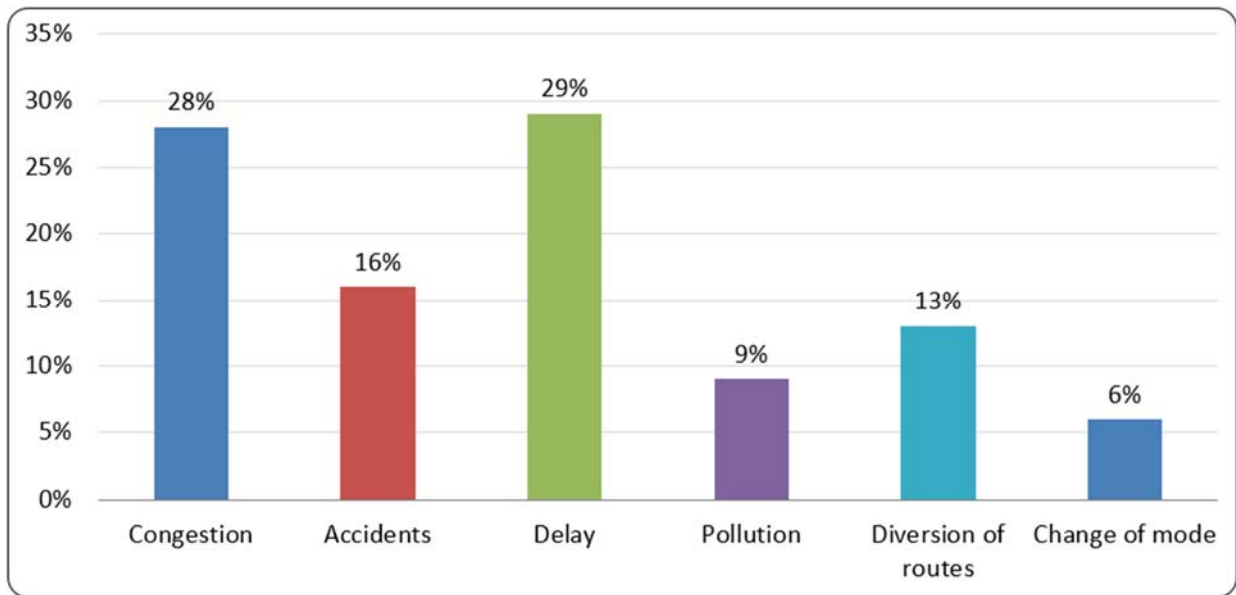
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Fig 2. Road transportation challenges during the trip in Bloemfontein city

The use of different types of road transportation modes plays a significant role in attaining sustainable road transportation or specifically in reducing congestion. The survey revealed that only about 29% of people use public transportation while about 35% people use private transportation and about 36% of people use both. This indicates that a large number of private vehicles (driven by individuals) are operated on the roads of the city, leading to high traffic volume and consequent congestion.
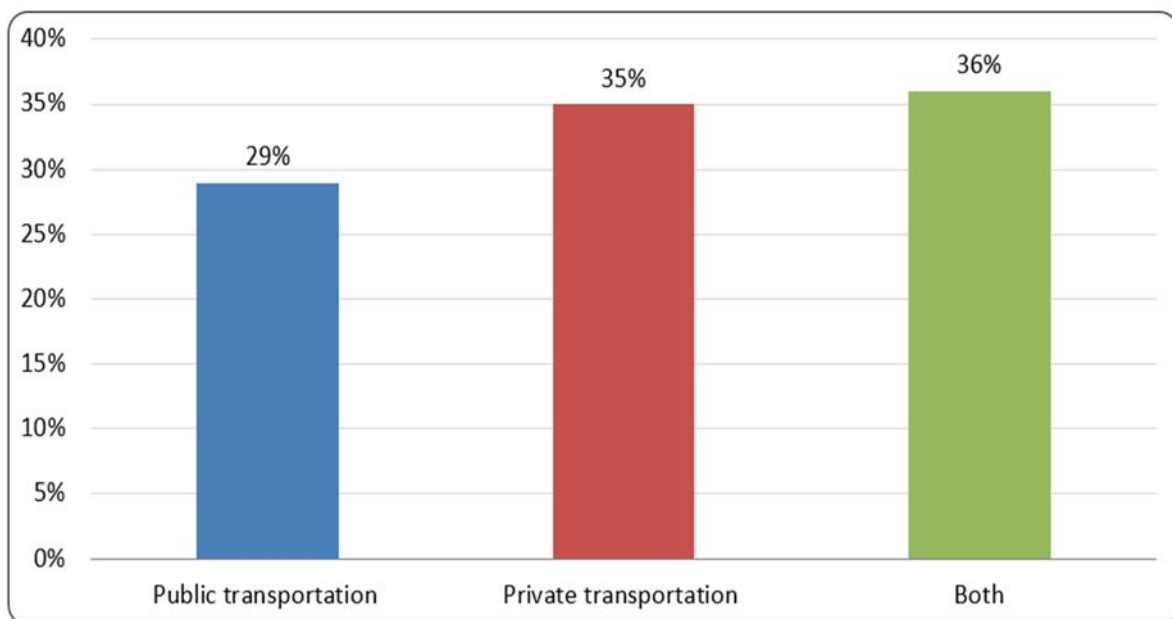

Fig. 3 Modes of transportation in the Bloemfontein city
An investigation on the types of public transportation used revealed that pubic taxis (47%) followed by metered taxis (32%) which also include passenger cars that are used as taxis, are the major types of public transportation people use in the city (Fig 4). However, only about 21% people use public buses. This indicates although public transportation in forms of buses is available only about one- fifth of the people use it. In contrast, it is found that about 69% of the people use individually driven cars and about 12% use private cars owned by companies. That indicates that more than three fourth of people who use private

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transportation use cars. This implies that the use of large number of individually driven cars contribute to the traffic volume, which consequently lead to traffic congestion.
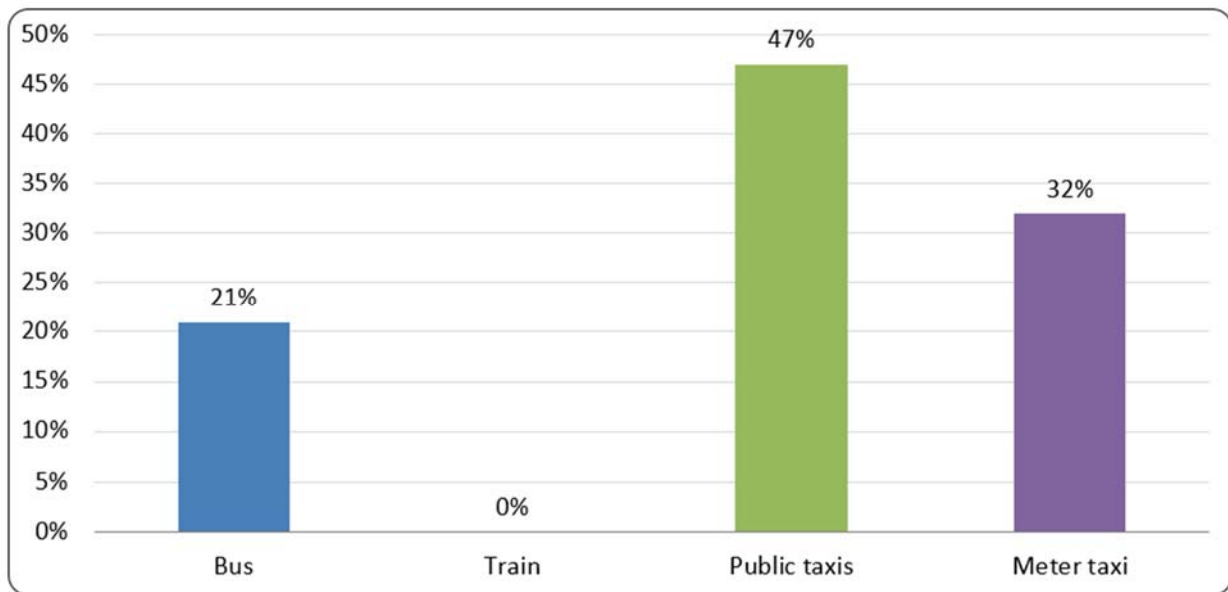

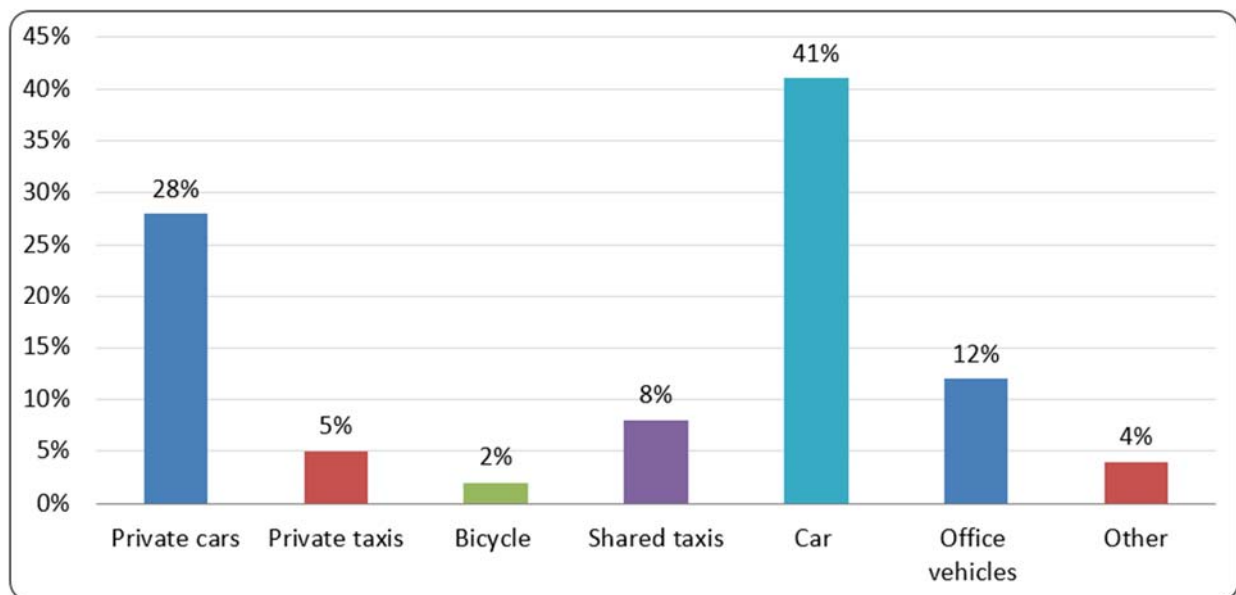**Fig. 4 Type of public transportation in use in Bloemfontein city**

Fig. 5 Type of private transportation in use in Bloemfontein city

Further, the survey also revealed that challenges of efficiency, reliability and security are the major reasons, which deter the use of public transportation. According to more than one-fourth of the people, Public transportation is available in the city and about 30% people feel that it is cost effective (Figure 6). Also, about 21% of people perceive it as accessible (Figure 6). Thus, it is found that despite the availability, accessibility and cost effectiveness of public transportation system, the challenges of reliability, efficiency and safety hinder the use of public transportation in the city. On the other hand, the survey revealed that psychological feeling (24%), safety (24%), efficiency (23%) and flexibility of the schedule (19%) are the

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prime reasons of use of private transportation although it may not be cost effective (Figure 7).
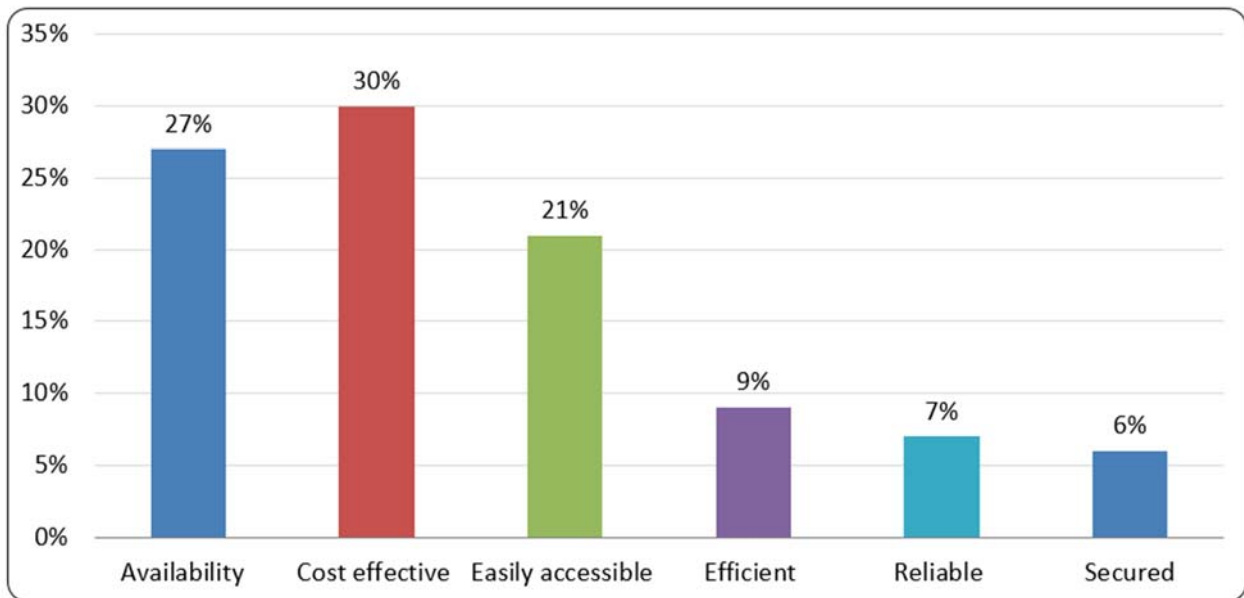

Fig. 6 Reasons of use of Public transportation in Bloemfontein city
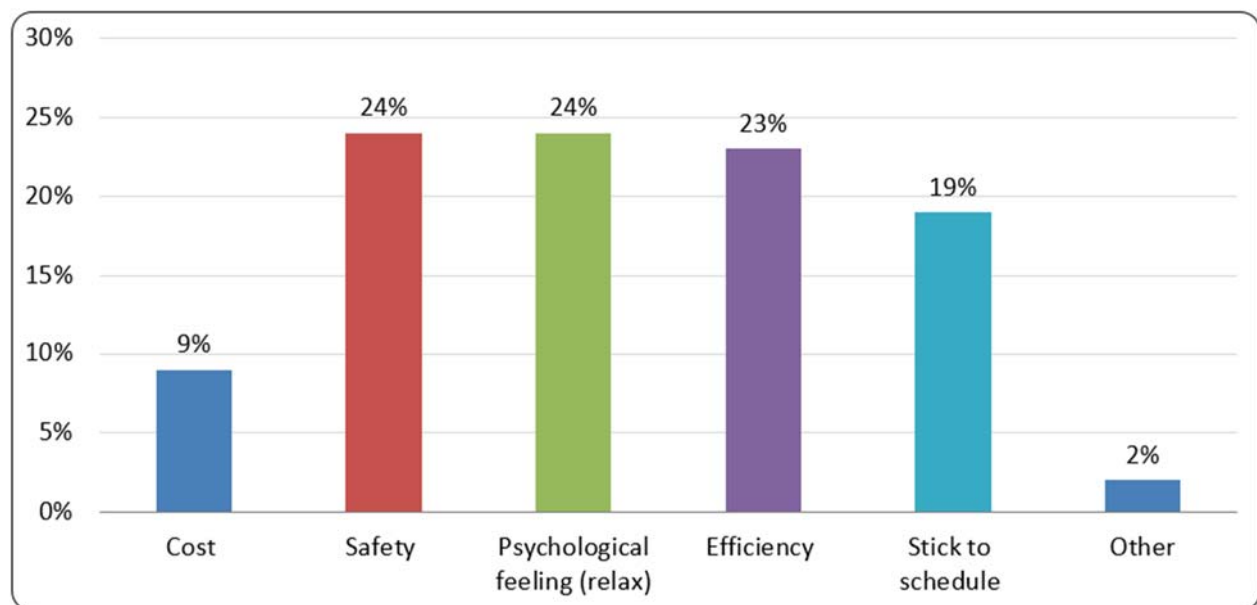

Fig. 7 Reasons of use of private transportation in Bloemfontein city

Thus, it is found that traffic congestion and delay are the major road transportation challenges in the Bloemfontein city. These challenges are engendered by use of large-scale private vehicles on the account of efficiency, flexibility, psychological feelings and safety despite the availability of accessible and cost effective public transportation system in the city. Therefore, there is a need for reduction of traffic volume- particularly individually driven private cars on the roads in order to reduce traffic congestion and it can be argued that availability of cost effective and accessible public transportation system may not alone able to provide the solution to the challenge.

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Further, an investigation regarding the possible avenues and solutions to improve the scenario in the city revealed that improved roads (16%), traffic control and management (16%), improvement in public transportation system (14%) and use of ICT (12%) could able to reduce traffic congestion and engender sustainable road transportation in the city.
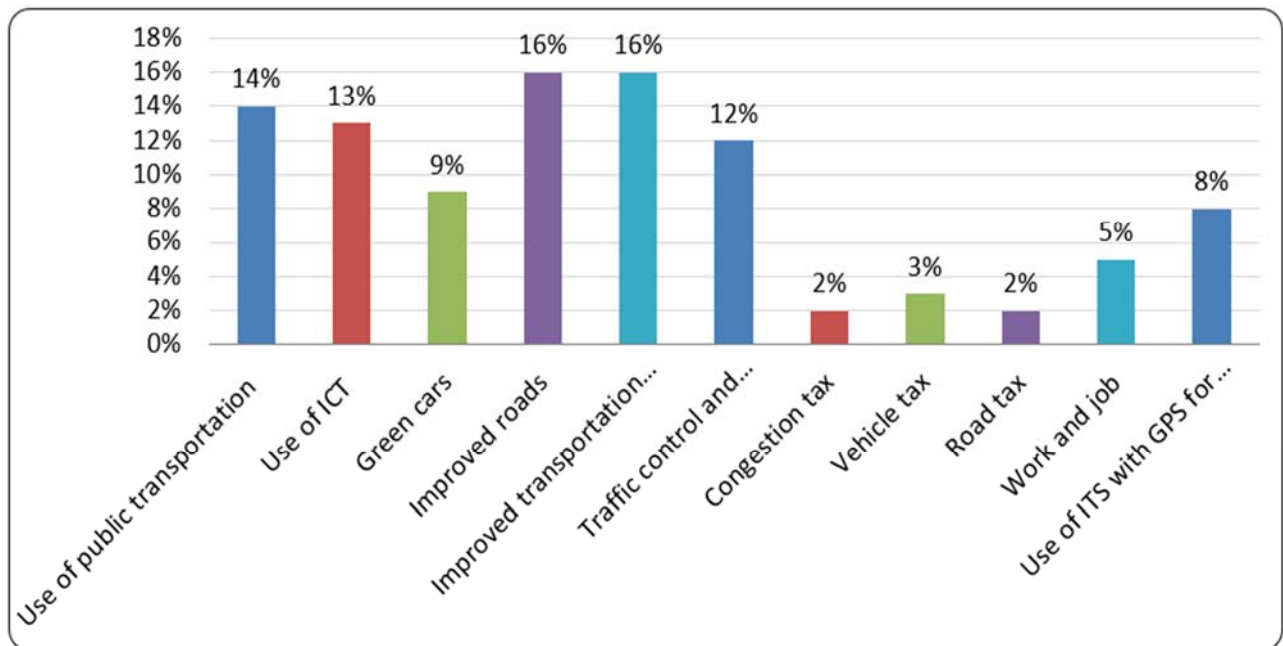

Fig. 8 Possible solutions to reduce congestion and improve sustainable road transportation

3.3 Discussion

South African cities are moving towards sustainable cities, and some of the challenges that need to be addressed include alleviating congestion to make sure that the transportation systems in our cities are safe, cost effective, reliable, and efficient and stick to the schedule. Experiences from Gauteng region has shown that despite having the Rea Vaya bus rapid transit in Johannesburg and A Re Yeng in Pretoria, and Gautrain in the region, they are the two most congested cities in South Africa. Similarly, Cape Town managed to have different kinds of modes of transport, but still struggle with congestion around the city. They have dedicated lanes for their BRT buses but that has not entirely been their solution to alleviating congestion around the city. However, concurrently, these cities- Cape Town, Durban Johannesburg and Pretoria apparently have managed to reduce some of their transportation challenges by introducing different modes of transport, and BRT and use of ICT enabled solutions, yet still this shows that there is a gap that needs to be addressed in the city to make sure that congestion levels are dropped. The gap may be bridged by enabling people to use of ICT in their socio-economic activity and transportation needs. For example, people's response to solutions like Uber and Taxify in these cities have been a good example of how people would react to a transportation system that is integrated with ICT. If Bloemfontein wants to be a more sustainable city, it can adopt some of the solutions these cities have adopted in trying to provide a transportation system that is more effective and reliable. The only challenge the city would have to solve is to plan to integrate the ICT to their integrated public transportation, in order to try to reduce the number of vehicles on the roads, thus leading to more sustainable cities that offer different modes of transport, at reasonable costs. The increased ownership of smart phones, and internet availability in

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households is an encouraging step in this regard as people would respond more to a transportation system solution that would be integrated to their cell phones e.g. internet, App, real time information since that is where people prefer to get their information from and make their travel decisions. An informed travel decision by use of ICT and use of appropriate modes of vehicle can reduce traffic volume and consequently traffic congestion on the roads of South African cities including Bloemfontein.

4. CONCLUSION

Traffic congestion is a challenge in South African cities and it hampers sustainable road transportation. It is also found that conventional measures such as availability of public transportation does not alleviate the traffic congestion challenges. Therefore, the objective of the study was to explore the various parameters, which engender traffic congestion and whether use of ICT can alleviate the challenge in the cities of South Africa. For this purpose, case study analyses of different cities of South Africa and use of a survey research methodology were followed. Data was collected by Bloemfontein city as case study. Findings suggest that traffic congestion and delay are the major road transportation challenges in the Bloemfontein city. These challenges are caused by the use of large-scale private vehicles on the account of efficiency, flexibility, psychological feelings and safety despite the availability of accessible and cost effective public transportation system in the city. This warrants or reduction of traffic volume- particularly individually driven private cars on the roads in order to reduce traffic congestion. However, it is also found that availability of cost effective and accessible public transportation system may not alone able to provide the solution to the challenge. Also, it found that according to people, use of ICT in travel and socio-economic activity needs can be a major factor, which can to reduce traffic congestion and engender sustainable road transportation in the city. However, the conclusion is partial as this is based on preliminary investigations of causes of traffic congestion and people's perception. A further detailed investigation will offer higher insights as how ICT can enable reduction of traffic congestion and engender sustainable road transportation in the cities of South Africa, which is the focus of the continuing research.

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37th Annual Southern African Transport Conference (SATC 2018)
Proceedings ISBN Number: 978-1-920017-89-7
Produced by: Jukwaa Media : www.jukwaa.net

9 - 12 July 2018
Pretoria, South Africa

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