NON-MOTORISED TRANSPORTATION FOR REVITALISING THE CITY CENTRES OF SOUTH AFRICA

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ABSTRACT

City centres (CBD) of the South African cities are on the wane. It is alleged that the CBDs are losing their attractiveness and vibrancy and gradually becoming redundant. So, arguments have emerged that augmentation of the non-motorised transportation can contribute to the revitalise the CBDs. Therefore, using the case study of Bloemfontein city, the objective of the study is to examine the challenges of non-motorised transportation in the cities of South Africa and explore how the use of non-motorised transportation can revitalise the city centres. The study was conducted by use of a survey research method. Findings revealed that the CBD is accessible by privately driven vehicles only, and is lacking adequate facilities for pedestrians and bicycling facilities are non-existent, which cause accessibility challenges including parking and congestion and social challenges in terms of lack of use of central public spaces and community interaction. The study argued that augmentation of non-motorised transportation by improving pedestrian facilities and creating bicycle movement facilities as well as (re)designing street scrapes that would integrate them with public, social and touristic spaces, will enable higher peoples' movement in the CBDs, usage of the public spaces, and community interaction, which plausibly would revitalise the central areas of the cities of South Africa.

Keywords: Bi-cycling; City centre; ICT; Pedestrian; Public space; Street scape

1. INTRODUCTION

South African city centres, also known as Central Business Districts (CBD) are evidently degenerating and a significant number of activities are being relocating to other areas of the cities. Consequently, the city centres or CBDs are losing their attractiveness and vibrancy and gradually becoming defunct. Evidences from the cities of Johannesburg, Pretoria, Port Elizabeth, Kimberley and Bloemfontein to mention a few, show that new centres of activities have been developed in different parts of these cities or areas close by, which in the process relegated the CBDs. The CBDs which were once nerve centres of the cites and were carrying out significant commercial, civic, political, social interaction and entertainment activities are now becoming more or less prohibited areas for a large segment of the population. The major challenges of such denegation are argued to be poor maintenance of the infrastructure and services, occurrence of crime, fear for safety and lack of local accessibility by not-motorised transportation system such as pedestrianization and bicycling (Das, 2016; Rathete, 2010; Ribbens, 2014). It is argued that, lack of non-motorised accessibility and predominant use of vehicular modes to access the CBDs restrict the access to important public, social, cultural and recreational elements. These challenges consequently limit the use of public places, recreational activities, and community interaction. As a result, the vitality of the CBDs is dwindling.

Therefore, there is a need to examine the status of the non-motorised transportation system in the CBDs of South African cites and how it can enable revitalisation of these city centres. Under these premise, using the case study of Bloemfontein city, the study examines the challenges of non-motorised transportation in the cities of South Africa and how the use of non-motorised transportation can revitalise the city centres. In other words, the scope of the study was limited to assess the status of the non-motorised transportation and its relation with the revitalisation of the central area. Although, land use is an essential component that influences non-motorised transportation, it was kept out of the scope of this particular paper. However, understanding the importance of the linkage between land use and non-motorised transportation, this aspect is considered separately. A survey research method was used to conduct the study. Findings suggest that facilities for pedestrian are undermined and bicycling facilities are non-existent. In the absence of adequate and reliable public transportation system and non-motorised transportation, the CBD is accessible by privately driven vehicles only, which causes accessibility challenges including parking, accidents and congestion as well as social challenges in terms of lack of use of central public spaces and community interaction. Augmentation of non-motorised transportation by designing pedestrian and bicycle friendly street scape, integrating them with public spaces and social and cultural activities and providing adequate non-motorised street amenities and facilities, such as illumination, walking, sitting, bicycle parking areas, Information and Communication Technology (ICT) enabled direction and location finders, signage and markings are expected to plausibly revitalise the centres of the cities of South Africa.

2. NON-MOTORISED TRANSPORTATION: A PERSPECTIVE

It is argued that urban settlements such as CBDs and heritage towns are worst affected because of the increase in population, urban activities and vehicular movements. The environment, in such areas, has degraded to such an extent that people do not wish to visit these areas anymore (Soni & Soni, 2016). In the wake of such rising environmental and social concerns because of the degeneration of these areas, scholars have argued that non- motorised transportation and public transportation should be considered to reduce the social and environmental ills, as they are more efficient than others in addressing mobility needs. Further, it is advocated that they can bring sustainability and vibrancy back to these areas (Litman, 2012; Litman & Burwell, 2006; Soni & Soni, 2016; Vanderschuren, 2012).

Non-motorised transportation includes all forms of travel that do not depend on an engine or motor for movement, which could include walking, bicycle, and animal driven vehicles as well as using small-wheeled transport equipment such as skates, skateboards, push scooters, hand carts and wheelchairs (Draft National Non-Motorised Transport Policy, 2008; Rietveld, 2001). However, non-motorised transportation in cities usually constitutes pedestrian and bicycling (Rietveld, 2001). It plays a dominant role as an affordable, convenient and non-polluting local distribution mode in multi-modal systems, particularly in a number of high income industrialised countries (Giles-Corti, Foster, Shilton, & Falconer, 2010; Walsh, Jakeman, Moles, & O'Regan, 2008; Zunga, 1997). For example, it is evidenced that it plays a significant role for short distance trips and cause a much lower environmental impact and have complete flexibility in terms of timetables and route design (Giles-Corti, et al, 2010; Walsh, et al, 2008). However, on the other hand, it is also argued that it is a low-tech, non- innovative, unpleasant and dangerous but main mode of transport in some of the third world or developing countries (Zunga, 1997).

In recent years, non-motorised transportation particularly in the form of bicycles and pedestalization found to be an integral element of urban transport both in the developed and developing countries world-wide, although its significance and function vary from country to country and city to city. For example, in several countries in Asia, particularly in China, Vietnam, etc., bicycling has been the most or at least the second most important means of urban transport (Tiwari, & Saraf, 1997). Similarly, countries such as India, Australia, Pakistan, Malaysia, etc., are making efforts to augment non-motorised transportation because of the benefits such as less air and noise pollution, less traffic congestion, and fewer public health costs associated with residents' physical inactivity (Soni & Soni, 2016). Besides, it is argued that non-motorised transportation can be very helpful from changing travel behaviour and mode choices in any city. For instance, private vehicle users are expected to realize the benefits of walking, bicycling and using transit, and shift from private modes to sustainable modes (Katzmarzyk & Janssen, 2004; Ming Wen & Rissel, 2008; Ortegon-Sanchez, & Hernandez, 2016). Consequently, the central areas are expected to become free from large scale private vehicles and there shall be a reduced need for parking of the private vehicles in the CBDs leading to change in land use pattern (Soni & Soni, 2016).

However, while developing non-motorised transportation, understanding the relationship between travel mode choice and attributes of the local environment such as topography, spatial, residential density, weather condition, distance, origins and destinations and the presence of non-motorised paths, is of paramount importance (Mat Yazid, Ismail & Atiq, 2011). In this context, evidences from main stream literature suggest that many studies have been conducted on one or more of these aspects over the years. Further, in South Africa a policy on the non- motorised transportation system was developed with an aim at increasing the role of non-motorised transportation as one of the key transport mode. Also, it was aimed at integrating the non-motorised transportation system as an essential element of public transport, and to provide a safe infrastructure and allocate adequate and sustainable funding for the development and promotion of non-motorised transportation (Draft National Non-Motorised Transport Policy, 2008; Draft Road Policy, South Africa, 2017). However, while it dealt with the issues at the macro level, it does not explicitly deal with the challenges concerning to the central areas of the cities. Further, the relationship between the non-motorised transportation and vitality of the city centres has also not been explicitly investigated, specifically in the cities of South Africa. Moreover, as some scholars argues that non-motorised transportation is a necessity in South Africa (Vanderschuren, 2012), there is also a need to examine the strategies to augment the non-motorised transportation and demands for infrastructure in the cities of developing countries such as South Africa and examine how they can bring back the vitality of the CBDs of the cities of South Africa, thus this study.

3. CASE STUDY AREA: CBD OF BLOEMFONTEIN

The Central Business District (CBD) of Bloemfontein city in the Free State Province, South Africa was used as the case study area for data collection and analysis. The CBD of the city was chosen because it resembles to the CBDs of many other cities of South Africa such as Port Elizabeth, Kimberley, etc., with marginal locational and attributional variations. It is quite typical in terms of land use and functions that are usually found in most of the cities of South Africa. Therefore, it is supposed that the investigation will be representative of the typical middle sized cities of South Africa.

Bloemfontein city is the capital city of the Free State Province. It is located almost at the centre of the country (latitude of 29.133 and longitude of 26.214) and has a spatial land

area of 236.17 Square Kilometres. It has a population of more than 460000 (Statistics SA, 2017) and is one of the fast growing cities in the country.

The city has more than 40 suburbs which are essentially residential areas and a CBD. The CBD is composed of mixed land use area which includes, commercial areas, civic areas (such Government offices, offices of professional service providers, banks, police stations, post offices, hospitals, libraries, etc.), educational complexes, tourist attractions, recreational and entertainment areas, parks, paly grounds, religious areas, etc. A large number of Government offices that includes the Provincial Legislature, Premier's office, ministerial departments such as Department of Police, Roads, and Transport, and Department of Water Affairs, important offices such as South African Revenue Services (SARS), etc., are located in the CBD. The commercial activities include large scale retail centres such as shopping malls, market complexes, auto retail and service centres, hotels, informal street side daily markets, etc. Three important transport nodes such as the Inter State Bus Transport terminal, Taxi rank and Railway station are also located in the CBD area. More importantly, the CBD area contains more than 30 touristic sites that include a number of historical and architectural monuments and museums and a central public space called Hoffman Square. The head offices of the Banks, large and specialist hospitals, a number of schools and colleges are also integral part of the CBD. One University of Technology having about 20000 students and a vocational (TVET) college are also located in the CBD area.

The suburbs predominantly constitute residential land uses and associated civic and commercial facilities. The average population density of the city is about 1730 persons per square kilometre. However, the CBD and its adjacent areas such as Westdene, Brandwag Willow, etc., are of high density (ranging between 2000- 3000 persons/ square kilometre). The suburbs at the far North and far South such as Tempe, Groenvlei, Hillsboro, Fauna, Lourier park, Musgrave, etc., are the low density areas (<1000 persons per square kilometre). The rest of the suburbs are of medium density areas (1000-2000 persons per square kilometre). Morphologically the major part of the city constitutes low to medium density areas and low rise buildings. However, the CBD is very compact and significantly dense. The distance of the CBD from the various suburbs range between minimum of 0.5 kilometre to a maximum 15 kilometres. However, the majority of the suburbs are within an average distance of 0.5 to 5 kilometres, which are agued to be accessible by non-motorised transportation.

The CBD is accessible by a paved road network system comprising of arterial roads, local roads and streets, which are predominantly accessible by motorised vehicles. The roads are mostly of one-way system. On road parking facilities are available on most of the roads and streets. Although, paved footpaths are available adjacent to majority of the roads, walking by people is not largely observed. Bicycling facilities are non-existent in the area. The CBD is observed to face large scale parking challenges, congestions, vehicular accidents and air pollution because of the large scale vehicular movement in the area. The vehicular access and non- availability of non-motorised movement facilities such as pedestrian facilities and bicycling hinder the smooth movement of the people inside the CBD area.

Therefore, there is a need to explore the challenges of non-motorised transportation, how the challenges can be addressed and how the use of non-motorised transportation can revitalise the city centres.

4. RESEARCH METHOD

A survey research method was used to conduct the study. Data was collected by conducting two types of survey such as physical survey and perception survey of the people working, and living in- and visiting to the city centre. The physical survey was conducted to collect data on the spatial, and accessibility attributes and availability of non-motorised transportation related facilities in the CBD. The survey was conducted at certain specific areas of the CBD and major roads. The physical survey locations were selected based on the importance, level of activities conducted, availability of the non-motorised transportation facilities and availability of space for creation of potential non-motorised transportation facilities. For this purpose, four important locations such as Hoffman square, area close to the new taxi rank, railway station area, and area close to National museum were selected. These locations were selected because these are some of the focal points in the CBD and major urban functions (activities) and peoples' movement take place in these area. Further, eight important roads, which provide access to the CBD such as President Brand street, Church street, Aliwal street, Henry avenue, Charlotte Maxeke street, East Burger Street, West Burger Street and Saint Andrews Street were chosen. These roads are the major roads in the CBD in which significant vehicular as well as peoples' movement take place. The survey was conducted through direct physical verification and measurements on these locations and roads.

Data on the perception of accessibility of the CBD, status of pedestrianization, bicycling, social and physical- spatial challenges deterring the use of non-motorised transportation system, plausible strategies and demands for infrastructure were collected from the people living, and working in- and visiting the CBD. The data was collected by conducting a perception survey by using a pre-tested questionnaire through a random sampling process. The questionnaires were structured in such a way that a common person or layman without having much technical knowledge can able to respond without much difficulty. In case of difficulty of understanding the question, the interviewers usually explained the question. The respondents were encouraged to provide responses based on their practical or actual experiences. The perception survey was resorted to because of the lack of structured data as well as to gain insights at the grassroots level from the respondents. Initially, the respondents were approached and explained about the survey and their willingness to participate in the survey were sought. Upon their positive response, the purpose and contents of the survey questions were explained followed by interviews on the questions were conducted. Of the total number of 375 people approached 215 people agreed to participate in the survey. This sample size is found to be adequate and acceptable at the confidence level of 95%, worst case percentage of 50% and a confidence interval of 6.68%. The perceptions were collected by using a five point Likert scale ranging between 1 and 5, where the pointer 1 indicates not important, 2 indicates somewhat important, 3 indicates important, 4 is very important and 5 indicates extremely important (Carifio, & Perla, 2008; Gross, 2018; Li, 2013; Peeters, 2015). While developing the scale, the pointers were decided based on the minimum norms or standards required for the level of importance of the variables.

Descriptive statistics that includes Standard Deviation (SD) analysis were conducted to check the consistency of the data and Cronbach α test was conducted to check the reliability of the data set. The perceptions on the various variables and strategies and demands of infrastructure were evaluated based on the mean score of the perceptions on the Likert scale or in other words developing a Perception Index (PI) (Moshin, Beach, & Kwan, 2017; Pakzad, Osmond, & Corkery, 2017; Shan & Yu, 2014; Susan, 2004). However, the evaluations were made on aggregate basis because all the locations and

roads selected for data collection were in the CBD area, and have similar characteristics with marginal variations. Moreover, an initial scrutiny of the results of the analysis of data collected from different locations and roads indicated only marginal variations, so evaluations on aggregate basis was found suitable. A PI more than or equal to 3 (PI≥ 3) was considered as important, for assessing the conditions of accessibility, availability of non- motorised infrastructure, challenges because of lack of non-motorised transportation, strategies and demands for various non-motorised infrastructure. Further, significance tests such as z test was conducted to explore the plausible linkages between non-motorised transportation attributes such as pedestrianization and bicycling facilities with the vitality attributes of the city centres such as use of central pubic space, community interaction, reduction in crimes or fear of crimes. A z probability scores more than 0.5 (z>0.5) is considered that majority of the people agree with the perceptions on the variables and deemed to have statistical significance.

5. RESULTS AND DISCUSSION

The status of the non-motorised transportation and its relation with the revitalisation of the central area of the Bloemfontein city was assessed based on the relevant parameters such as (1) accessibility of the CBD, (2) accessibility modes of transportation (3) non-motorised infrastructure, (4) challenges caused by vehicular access and non-availability of non-motorised transportation facilities, (5) strategies for augmenting non-motorised transportation system and (6) demand for non- motorised transportation related facilities. All the aspects other than the availability of the non-motorised infrastructure were assessed based on the perception survey conducted among the people (respondents) in the absence of structured statistical data. However, the status of the availability of the non-motorised infrastructure was assessed based on the physical survey conducted. However, before the assessment was conducted, SD of the variables were computed to examine the consistency of the responses and Cronbach α test was conducted ascertain the reliability of the data set. The low SD values of the various variables varying between 0.32 to 0.82 indicate the consistency in the responses. Furthermore, Cronbach α values ranging between 0.73 to 0.84 indicate the reliability of the data. Thus, it is construed that the data can be used for further analyses. The analyses of the various aspects are discussed below.

5.1 Accessibility of the CBD

Accessibility implies the quality of travel that takes place at the community and individual level through access management techniques that provide access to various land uses and functions. It focuses on travel time, travel cost, travel options, comfort, and risk while addressing the needs of all within the community. It is indicated by the availability of various infrastructure and facilities to enable people to access the functions or land uses (Handy, 2002). Moreover, it is also construed that accessibility means the ease of reaching desired destinations from a specific location, based on the number of available opportunities and the difficulties or impedance to reach them (Venter & Cross, 2014). In this context the opportunities are measured in terms of employment positions, and the impedance is measured in terms of units of distance or time (Venter & Cross). According to some scholars' accessibility is often specifically linked to notions of equity and social justice. In other words, lack of accessibility or deficits in accessibility may lead to social exclusion and the denial of basic human rights (Jaramillo, Lizárraga & Grindlay, 2012; Martens, 2006; Venter & Cross, 2014). Accessibility is thus determined by elements such as land use, transport, the individual characteristics of the person, as well as availability of opportunities or impedance and linked to equity and social justice. Although, there are

different arguments on the measurements of accessibility, in transportation, the availability of cumulative opportunities such as number of destinations within a certain location, and availability of mode choices for travel, are generally used to measure the level of accessibility (Handy, 2002). Besides, accessibility can be measured through two broad classes of approaches, such as gravity-type measures and threshold-type models. In gravity type measures, it sums all available opportunities in an area, but weighs each according to a function of the travel impedance to reach them. In other words, opportunities located closer to the point of origin amounts to more than opportunities further away (Delmelle & Casas, 2012; Hansen, 1959; Venter & Cross, 2014; Venter & Mohammed, 2013). Although, it has the advantage of not requiring the analyst to specify an arbitrary cut-off distance or travel time, the complexity of gravity indices is more difficult to be interpreted and communicated (Venter & Cross, 2014). On the other hand, threshold-type measures, specify a cut-off value and only count the number of opportunities that are located within that boundary (Venter & Cross, 2014).

Based om the opportunities, impedance and measures of accessibility, Table 1 present the status of the accessibility of the CBD of the Bloemfontein city. From the high perception index and high z probability values it is ascertained that the CBD is largely accessible through roads (PI= 4.15 and z probability is 0.995) which is supplemented by accessible infrastructures such as parking facilities for cars/ buses (PI= 3.42 and z probability is 0.904), bus stops (PI=3.37 and z probability is 0.834) and taxi stops (PI= 3.28 and z probability is 0. 748). However, designated bus or taxi lanes and parking facilities for motor bikes are absent. Similarly, non-motorised transportation facilities such as bicycle lanes and under passes or over passes for pedestrian road crossing are absent although pedestrian walkways on the road sides are available to certain extent, they are perceived to be inadequate (PI= 2.85 and z probability is 0.333). Therefore, the infrastructure for vehicular access such as roads, bus/ taxi stops and parking facilities for cars/ buses/ taxis are available but infrastructure for accessing by non-motorised transportation in the CBD is a challenge.

Table 1: Accessibility of the CBDs

Accessibility infrastructure	Perception index (PI)	SD	z values	z probability
Roads	4.15	0.44	2.61	0.995
Designated Bus/ Taxi Lanes	NA	NA	NA	NA
Parking facilities for Cars/ Buses	3.42	0.32	1.31	0.904
Parking facilities for motor bikes	NA	NA	NA	NA
Pedestrian walkways	2.85	0.35	-0.43	0.333
Bicycle lanes	NA	0		
Bus stops	3.37	0.38	0.97	0.834
Taxi stops	3.28	0.42	0.67	0.748
Elevated (overpass)/ underground Road crossing elements (underpass)	NA			

5.2 Mode of accessibility to the CBD

A significant number of people use private vehicles including taxis for their work or business related trips. According to National Household Travel Survey of South Africa (NHTS) (2013), about 80% people use taxis and 20% use buses for their work related

travel in Free State. However, according to the perception survey conducted in Bloemfontein, more than 67% of the people use private vehicles, 21% use public taxis and 9% use buses. The rest of the people walk although a few use bicycles. In other words, majority of the people use either private vehicles or taxis and the use of non-motorised transportation is almost non-existent.

The status of the modes of accessibility to the CBD is presented in Table 2. It is found that vehicular modes such as privately owned vehicles (PI= 3.87 and z probability is 0.992) is the predominant mode of accessibility in the CBD. Although, public transportation (PI= 2.92 and z probability is 0.432) and privately owned motor bikes (PI= 1.67 and z probability is 0.005) do exist they are not predominantly used to access the CBD by people. Similarly, although some people walk to access the CBD, yet the low perception index and z probability indicate that it is not prevalent (PI= 2.56 and z probability is 0.203). The use of bicycles is similar (PI= 1.18 and z probability is 0.002) to that of walking and is not largely observed.

Table 2: Mode of accessibility to the CBD

Accessibility modes	Perception index (PI)	SD	z values	z probability
Vehicular				
Public transportation	2.92	0.46	-0.174	0.432
Privately owned vehicles (Cars)	3.87	0.36	2.42	0.992
Privately owned vehicles (Motor Bikes)	1.67	0.52	-2.56	0.005
Non-motorised				
Bicycles	1.18	0.64	-2.84	0.002
Pedestrians	2.56	0.53	-0.83	0.203

5.3 Availability of non-motorised transport infrastructure

Availability of non-motorised infrastructure is essentially a pre-requisite to engender non-motorised transportation in the CBDs. The physical survey of the CBD area revealed that pedestrian pathways and road crossings at junctions are available for pedestrian movement (Table 3). The pedestrian pathways are available on both sides of the roads, which are generally found to be paved and have average width ranging between 1.0m to 1.5m. Furthermore, it is found that traffic signal phases for walking are available for the crossing of the roads by the pedestrians. However, underpasses or overpasses for the crossing of the roads are not available in the CBD area. Moreover, medians and islands for pedestrian to wait (or take refuse) during the crossing that assist the pedestrian to cross the roads are only available on important roads and junctions respectively. However, bicycle lanes are not available at all. Thus, it is construed that the CBD has some facilities such as pedestrian walkways, signalling system, medians and islands (for pedestrians to wait or take refuse) available for the pedestrian movement, however it does not facilitate crossing of roads through underpasses or overpasses without conflicting with vehicular movement and bicycling. It is also found that facilities for physically challenges people who use non-motorised transportation are not available except in the form of walking ramps in some places.

Table 3: Availability of non-motorised transport infrastructure (Physical survey)

Infrastructure	Availability	Condition/ attribute
Pedestrian pathways/ footpaths	Yes	Available on both sides of the roads Paved Average Width 1.0m-1.5m
Bicycle ways (lanes)	No	
Road crossings at junctions	Yes	Provided as per the SADC traffic manual, 2012
Overpass or under passes	No	
Traffic signal phases for walking	Available at important junctions	Pedestrians face difficulties to cross the road where pedestrian crossings are not provided.
Medians	Available on some roads	
Islands for pedestrians to wait or take refuse	Available at some junctions	
Facilities available for Physically challenged (disabled) road users	Available sporadically	On some places short distance ramps are available in stead od stairs

5.4 Challenges caused by vehicular access and non-availability of non-motorised transportation facilities

According to the perception survey results (Table 4), the predominant vehicular access and non-availability of non-motorised transportation facilities significantly hamper community interaction among the people (PI= 4.26 and z probability is 0.973) and adequate use of the public places (PI= 4.12 and z probability is 0.966). Similarly, the other challenges which were observed are congestion (PI= 3.72 and z probability is 0.916), non-availability of parking spaces (PI= 3.86 and z probability is 0.937), occurrence of accidents (PI= 3.1 and z probability is 0.591) and lack of accessibility to public places (parks, and central places) (PI= 3.64 and z probability is 0.848). However, commercial activities (PI= 2.14 and z probability is 0.0037) are not generally influenced by the lack of non-motorised transportation facilities and vehicular access.

Table 4: Challenges caused by vehicular access and non-availability of non-motorised transportation facilities

Challenges	Perception index (PI)	SD	z values	Z probability
Congestion	3.72	0.52	1.38	0.916
Parking	3.86	0.56	1.53	0.937
Accidents	3.1	0.43	0.23	0.591
Lack of accessibility of public places (parks, central places)	3.64	0.62	1.03	0.848
Lack of use of public places	4.12	0.61	1.83	0.966
Poor Community interaction	4.26	0.65	1.93	0.973
Commercial activities	2.14	0.32	-2.68	0.0037

5.5 Strategies for augmenting non-motorised transportation system

Augmentation of non-motorised transportation particularly pedestrianization and bicycling needs appropriate strategies and appropriate infrastructures. An evaluation of the various strategies (Table 5) that need to be considered on priority revealed that augmentation of public transportation system (PI= 4.03 and z probability is 0.923), augmentation of bicycling system (PI= 3.92 and z probability is 0.896) and ICT enabled public navigation system on the streets and crime vigilance system (PI= 3.82 and z probability is 0.906) are the three most important strategies which should be prioritised. Similarly, there is a need for the linking of bicycling system with the public transportation system (PI= 3.12 and z probability is 0.598), which would provide seamless integration of public transportation with the non-motorised transportation facilities. Similarly, the linking of the pedestrian walkways and bicycling lanes with the important public areas and places of interest such as parks, play grounds, civic services, business services such as banks, post offices, etc., and places of tourist interest will enable them to integrate with the transportation facilities and provide higher accessibility as well as improve community interaction (PI=3.34 and z probability is 0.729), thus, in other words revitalising the central areas of the cities. However, according to the perceptions of the people, restriction of the vehicular movement (PI=2.76 and z probability is 0.291) in the CBD area including on the internal streets is not a favoured option.

Table 5: Strategies for augmenting non-motorised transportation system

Strategies	Perception index (PI)	SD	z values	z probability
Restrictions of Vehicular movement in the internal streets	2.76	0.44	-0.54	0.291
Off road parking system	3.72	0.62	1.16	0.877
Augmentation of public transportation system	4.03	0.72	1.43	0.923
Augmentation of Bicycling system	3.92	0.73	1.26	0.896
Linking public bicycling system with public transportation system	3.12	0.48	0.25	0.598
Linking pedestrian pathways and bicycling lanes with important public areas and places of interest	3.34	0.56	0.61	0.729
ICT enabled public navigation system on the streets and crime vigilance system	3.82	0.62	1.32	0.906

5.6 Demand for non-motorised transportation related facilities

Based on the strategies, the various infrastructures that are demanded by the people on priority are strengthening of the pedestrian walkways where available and creation of pedestrian walkways if not available (PI= 4.15 and z probability is 0.956), Illuminating the roads (PI=3.53 and z probability is 0.802), and installation of crime vigilance system (PI= 3.42 and z probability is 0.719), which are expected to augment the walking and bicycling without fear of crime or accidents. Besides, creation of street side beautiful street scape

and arboriculture (plants and gardens) (PI= 3.45 and z probability is 0.708) in addition to provision of sitting places on the street sides and central places (PI= 3.18 and z probability is 0.666) are the next preferred infrastructure demands. Further, there are demands for the on demand availability of bicycles (PI= 3.12 and z probability is 0.594), and bicycle parking areas (PI= 3.02 and z probability is 0.662) that will allow people using public transportation for seamless accessibility to different elements in the CBD area. However, construction of overpasses and underpasses for pedestrians (PI= 2.16 and z probability is 0.006) was not favoured by the respondents.

Table 6: Demand for non- motorised transportation related facilities

Facilities	Perception index	SD	z values	z probability
Pedestrian walk ways (strengthening and creation as relevant)	4.15	0.67	1.71	0.956
Bicycle lanes	3.23	0.56	0.41	0.659
On demand bicycles availability	3.12	0.49	0.24	0.594
Bicycle parking areas	3.02	0.48	0.042	0.662
Sitting facilities on the streets and public places	3.18	0.42	0.43	0.666
Illumination	3.53	0.62	0.85	0.802
Overpass and underpasses for pedestrians	2.16	0.56	-1.5	0.006
Installation of crime vigilance system	3.42	0.72	0.58	0.719
Street scape design and arboriculture (gardens and plants)	3.45	0.82	0.55	0.708

5.7 Discussion

The findings of the investigation manifested that the CBD of the Bloemfontein city is accessible mostly by vehicular modes of transportation particularly by the predominant use of privately driven cars followed by public transportation facilities. Although, pedestrian movement facilities are available to certain extent, non-motorised transportation in terms of walking and bicycling is not largely evident. Consequently, it is found that the predominant vehicular access and lack of non-motorised transportation facilities or lack of pedestrian or bicycling not only causes accessibility related challenges such as congestion, parking problems and accidents but also hamper the vivacity and liveliness of the central area. However, the vivacity of the central area would be augmented by the higher use of central public places and parks and higher social and community interaction because of the accessibility by non-motorised transportation. Therefore, there is a necessity for strategies for augmenting non-motorised transportation particularly pedestrianization and bicycling. Specifically, strategies such as strengthening of public transportation system, introduction of bicycling system and provision of ICT enabled navigation system on the streets and crime vigilance system are perceived to enhance accessibility of the CBD. Further, the linking of bicycling system with the public transportation system, would provide seamless integration of public transportation with the non-motorised transportation facilities (Zimmerman & Fang, 2015), which are expected to facilitate pedestrian and bicycling movements in the CBD of the city without much challenge (Soni & Soni, 2016). Similarly, the linking of the pedestrian pathways and bicycling lanes with the important public areas and places of interest such as parks, play grounds, civic services, business services such

as banks, post offices, etc., and places of tourist interest will enable them to integrate with the transportation facilities and provide higher accessibility as well as improve community interaction. In other words, community interaction and movement of people by walking and bicycling can be argued to contribute to revitalise the central areas of the cities (Silberberg, Lorah, Disbrow, & Muessig, 2013). Consequently, there is a demand for the creation of a number of infrastructure and service facilities in the CBD. According to the findings of this study, the infrastructure that are to be considered on priority include strengthening of the pedestrian walkways where available and creation of pedestrian walkways if not available, illuminating the roads, and installation of crime vigilance system. These infrastructures are envisaged to augment the walking and bicycling without fear of crime or accidents. Besides, the creation of beautiful street scape with street side amenities and arboriculture (gardens, plants and trees) in addition to provision of sitting places on the street sides and central public areas will help creation of a beautiful image of the city and bring feel good factors among the people (Das, 2016) and encourage non-motorised transportation. Furthermore, it is perceived that the on-demand availability of bicycles will allow people using public transportation for accessing different elements in the CBD area seamlessly. The enhanced pedestrian movement and bicycling and consequent increased access to important elements of the CBD such a parks, public places, tourist elements, etc., without the fear of crime, accidents and getting stuck in the traffic because of congestion would enable higher usage of these elements and also likely to engender higher community interaction (Silberberg, et al, 2013). Consequently, it is argued that the combined effect of non-motorised transportation, increased accessibility and use of important elements in the CBD, enabling the area free from the fear of accidents and crime and higher community interaction will make the area lively and vivacious, thus revitalising the CBD.

6. CONCLUSION

In the wake of the degeneration and decline of the importance of the CBDs of the cities of South Africa as well as challenges of accessibility and environmental pollution, an argument has emerged to augment non-motorised transportation to revitalise these areas. Therefore, this study explored the various challenges of non-motorised transportation in the CBDs and examined how it can contribute to bring back the vitality and vivacity of the CBDs. For this purpose, a case study of Bloemfontein city was considered. The study was conducted by using a survey research method. In the absence of structured statistical data, data collected from physical survey and perception survey was used. Findings suggest that the CBD of Bloemfontein has accessibility challenges with regards to non-motorised transportation although they are largely accessible by vehicular modes of transportation. Some facilities for non-motorised transportation particularly for pedestrians are available, however, facilities for bicycling are totally non-existent. The lack of non-motorised transportation has engendered several challenges that include poor community interaction among the people, inadequate use of the public places, occurrence of traffic congestion, non-availability of parking spaces, occurrence of accidents, and lack of accessibility to public places, although commercial activities are not significantly affected. Consequently, it is argued that the lack of access to- and use of public spaces, and lack of community interaction in addition to the accessibility challenges and fears of crime contribute to lessen the liveliness and vivacity of the CBDs. Therefore, augmentation of non-motorised transportation system by improving pedestrian facilities, creating bicycle movement infrastructures, installing ICT enabled public navigation system on the streets and crime vigilance system, and designing beautiful street scape and integrating them with public spaces, social activities and tourist attractions that would enhance peoples' movement in the CBD as well as enable higher community interaction is envisaged to contribute to revitalise the city centres (CBDs) of South Africa. However, the study has

certain limitation such as it is based on limited perception survey and in one city only. Also, although land use influences the non-motorised transportation system, it is considered separately and kept out of the scope of the paper. So, to generalise the findings, further research by considering other cities of the country as well as land use aspects are necessary.

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