



CENTRE FOR TRANSPORT STUDIES MASTER OF PHILOSOPHY
SPECIALISING IN TRANSPORT STUDIES

Challenges and Opportunities for Sustainable Urban Mobility (Non-Motorised Transport): A Case Study of Eveline Street in the Windhoek Municipality, Namibia

MINOR DISSERTATION (END5037Z)



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Cover Picture: Eveline Street in Windhoek Municipality, Namibia
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ABSTRACT

Windhoek has several inherited structural challenges that include a trend of decreasing densities of urban settlements, along with social inequalities and highly skewed levels of access and mobility. The most vulnerable members of the society in Windhoek currently carry the majority of the transportation costs and inconveniences. Non-Motorised Transport (NMT) in Eveline Street forms a significant part of the daily activity of people as they commute to and from public transport stops and stations, places of work, places of education and walking to water collection points and means of creating a living. The implementation of Non-Motorised Transport (NMT) facilities as a manner of supporting NMT trips has been largely neglected in Eveline Street thus, exposing NMT users to road accidents.

Non-Motorised Transport (NMT) is a core aspect in the development of a sustainable transport system for the City of Windhoek. Its importance derives from the high percentage of persons in Windhoek who depends on NMT, as well as its economic and ecological efficiency compared to Motorised Transport (MT) on distances up to approximately 5 km. Approximately 20% of Windhoek's households can afford to own a car, therefore roads alone are not enough to secure social sustainability and only worsens already existing income inequality (Araes, 2007). Non-Motorised Transport (NMT) supplements public transport, contributes to lively urban quarters and is an integral part of the transport system of Windhoek. Low income households in Windhoek spend up to one quarter (25%) of their income on transport (Zwicky et al., 2013). Non-Motorised Transport (NMT) users are the most vulnerable traffic-group, often involved in severe accidents and there is a need for special attention and provision to enable, strengthen and develop NMT as a proper and feasible mode of transport in Windhoek. Non-Motorised Transport (NMT) has an important role to play in greening the economy in the context of providing and promoting more sustainable transport options, forming part of more cost-effective solutions in establishing a sustainable transport system to improve economic progression for the residents of Windhoek.

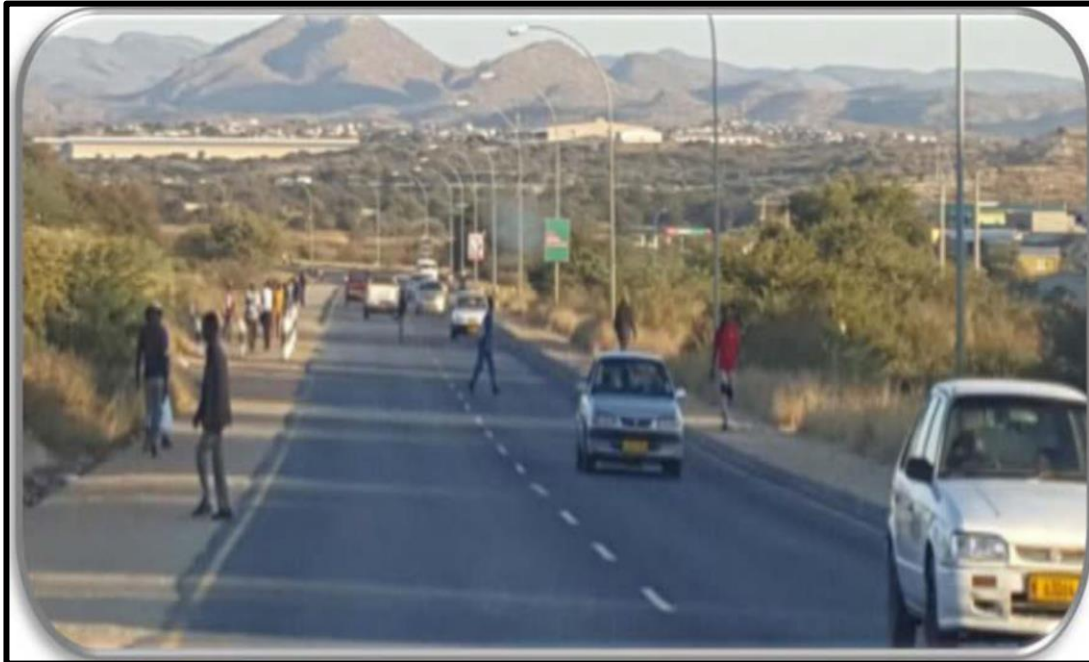


FIGURE 1: TRAFFIC SITUATION INCLUDING PEDESTRIANS IN OTJOMUISE ROAD IN WINDHOEK

The main motivating reason for this research was to investigate the current opportunities and challenges being experienced that affects the promotion of the Non-Motorised Transport (NMT) in providing a sustainable urban mobility within Eveline Street in the Windhoek Municipal area, Namibia. This study further seeks to examine the potential and sustainability for effective transportation planning for Non-Motorised Transport (NMT) and its effects in the reduction of Motorised Transport (MT) congestion in the area. In Windhoek, the main types of Non-Motorised Transport (NMT) users are pedestrians (majority type) and cyclists (minority type). The research paper aims to come up with the conclusive proposals and possible intervention measures that will help in the provision and management of Non-Motorised Transport (NMT) infrastructure to ensure a sustainable urban transport system. Thus, helping Windhoek municipality, Namibian government, stakeholders and practitioners to make better informed decisions when addressing the transport challenges of NMT users in urban areas. The scope of the research was limited to Non-Motorised Transport (NMT), more specifically, walking and cycling as a mode of transport in the infamous Eveline Street in the high density suburb of Greenwell Matongo in the area of Katutura in the greater Windhoek municipality. Eveline Street being used as a case study to understand what potential value NMT trips could be for Windhoek. There are various benefits to Non-Motorised Transport (NMT) as a mode

of transport. Safety benefits of successful NMT facilities include lower risk of road collisions, injuries and fatalities, while there are also several health benefits of NMT trips, which include lowered levels of stress, obesity and other Non-Communicable Diseases (NCDs). Non-Motorised Transport (NMT), as a mode of transport, is one of the most sustainable modes of transport, as it does not rely on fuel and, is one of the cleanest modes of transportation. Furthermore, Non-Motorised Transport (NMT) trips have various socio-economic benefits that help to address equality concerns, which are highly relevant for pedestrians in Windhoek. An example, of how improved NMT trips could address equality issues, would be increasing the mobility and accessibility of vulnerable members of society. This can be for socio-economic reasons or physical and mental abilities that influence the individual's ability to commute.

The research methodology involved the review of literature, primary and secondary data collection, validation and analysis, interpretation and subsequent recommendations to address urban mobility challenges and policy recommendations to promote NMT for Windhoek Municipality. The methodology comprises surveys, traffic counts; direct observation and behavioral studies. The tools used included questionnaires, tally sheets, walkability audit tool, maps and photographs. The secondary data was obtained mainly through the literature review of the existing work by academic and researchers on NMT, land use and transport planning, institutional setup and policy administration. Other sources of secondary data included universities, libraries, internet, GIZ Studies, MVA Namibia, SUTMP, Local authorities records, Namibia Statistics Agency, and Government documents on transport and environment. The data was collected by administering roadside questionnaire, direct observations of behavior and the walkability of the area, interviewing key informants, photographs and Global Positioning Systems (GPS) locations.

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1. INTRODUCTION

1.1. PROBLEM TO BE INVESTIGATED

There are various challenges facing Non-Motorised Transport (NMT) as a mode of transport in urban areas of Namibia, which include issues related to policy, strategies and budgeting for NMT facilities and programs, as well as poor education and training for both NMT and other road users. External challenges that affect NMT trips include poor enforcement of road regulations, security concerns (crime), the lack of integration between NMT facilities and other modes of transport facilities, as well as land use planning that does not support NMT as a mode of transport. Approximately 20% of Windhoek's households can afford to own a car. Roads alone are therefore not enough to secure social sustainability and only worsens already existing income inequality. Low income households in Windhoek spend up to one quarter (25%) of their income on transport. Hence there is a need for a new planning approach, which provides sustainable transport options for all citizens, especially the poor, children, elderly and disabled. The importance of NMT as an integral part of the transport system in providing more sustainable transport options is acknowledged. NMT forms a significant part of the daily activity of people as they commute to and from public transport stops and stations, places of work, places of education and walking to water collection points and means of creating a living. NMT has an important role to play in greening the economy in the context of providing and promoting more sustainable transport options, forming part of more cost-effective solutions in establishing a sustainable transport system to improve economic progression for the residents of Windhoek. According to the World Bank (2006) on a sustainable urban transport, the reason why it has been so difficult to achieve a balance between Motorised Traffic (MT) and Non-Motorised Transport (NMT) is because many people automatically think of traffic as MT only and often do not realise that NMT traffic is also present in most African cities. Furthermore, NMT trips often outnumber by MT trips. With little consideration for NMT traffic in Windhoek, sustainable urban mobility will be a far-to-reach goal in urban planning and strategies. The previous city planners had little or no regard for human traffic, as was evident along Eveline Street in one of the high-density suburbs of Katutura in Windhoek. Many formal and informal businesses along Eveline Street have contributed to traffic congestion, especially during peak hours and to a large extent on weekends. Because of the ubiquity of type of streets such as Eveline Street, it is fair to conclude that the city streets favour MT.

Non-Motorised Transport (NMT) users pay the price of the disorganisation that characterise Eveline Street. Eveline Street contributes its fair share to the region's pedestrian crash statistics, Khomas region is the highest among all the regions in Namibia in terms of pedestrian crashes per region, as show in Table 1, making Eveline Street unsafe for NMT users.

TABLE 1: PEDESTRIAN CRASHES PER REGION (SOURCE: MVA, 2016)

Region	Total Crashes	Pedestrian Crashes	Percentage
Khomas	1614	594	37
Erongo	478	108	23
Otjozondjupa	393	49	12
Oshana	364	119	33
Oshikoto	240	39	16
Hardap	176	19	11
Omusati	176	30	17
Kavango (East&West)	165	55	33
Ohangwena	156	34	22
//Kharas	119	24	20
Kunene	87	7	8
Omaheke	85	15	18
Zambezi	81	37	46
Total	4134	1130	

Road safety in Namibia is a challenge. Some of the main reasons given for motorised road collisions include excessive speeding and alcohol (and drug) abuse whilst driving (MVA, 2016). However, while these are the stated reasons for the collisions, this does not necessarily mean that they are the only possible causes. Alternative reasons, which are underlying or are currently unidentified contributing factors may not be evident from the reports received from the collisions. An indication that this may be the case in Namibia is that, while significant efforts to address speeding and drunk driving have been ongoing for several decades, they have not resulted in substantial reductions in the rates of road collision fatalities and injuries, especially for pedestrian and other NMT users. Various campaigns, such as the Decade of Action for Road Safety, which had aimed at reducing the number of road fatalities and injuries

by half (WHO, 2011) have failed to reach targets or demonstrate a noticeable impact. Therefore, contributing reasons for poor road safety that are fundamental to the design and implementation of the transportation network would be appropriate to investigate.

The next challenge identified is the inadequate provision of NMT facilities for NMT users, resulting in sub-par levels of service for NMT users. Providing adequate levels of service for NMT users is seen as an important aspect in the literature for other countries (Pucher and Buehler, 2008; Verma *et al.*, 2015), as well as locally in South Africa (Vanderschuren and Galaria, 2003; NDoT, 2015). In South Africa, the lack of adequate NMT facilities could be seen as hindering the acceptance and support of NMT trips in South Africa (City of Cape Town, 2009). The current prioritization of NMT facilities seems to be much lower than what is necessary to make substantial progress in terms of providing adequate implementation of facilities, to ensure safe, convenient and comfortable NMT trips in South Africa (Vanderschuren and Galaria, 2003; Behrens, 2004; NDoT, 2015). There are various potential reasons why there are inadequate facilities. Reasons range from insufficiently trained stakeholders and practitioners, to more basic issues, such as insufficient funding frameworks, that allow for the appropriate NMT facilities to be built and maintained (City of Cape Town, 2009). Local government and municipalities are trying to address the inadequate level of NMT facilities through measures including master plans and guideline (Visser, *et al.*, 2003; City of Cape Town, 2005; Cape Winelands District Municipality, 2009; City of Johannesburg, 2009). However, an integrated NMT approach which takes into account the various stakeholders in both the public and private environments is still lacking (Vanderschuren and Galaria, 2003; Pretorius, 2015). The lack of an integrated approach can be seen in many new developments, upgrades of current road facilities and new public transport (PT) facilities and services not taking into account the needs of NMT users. The NDoT hopes that the newly drafted NMT Facility Guidelines will help address this issue, by encouraging practitioners and stakeholders to include NMT facilities through providing comprehensive and practical guidelines (NDoT, 2015). However, as the guidelines are not legally binding, the effectiveness of this approach is questionable and relies heavily on how the guidelines are distributed and presented, to the relevant stakeholders and general public. Additionally, the relevant stakeholders and practitioners that are responsible for designing and implementing NMT facilities will need to be motivated to adopt the new NMT Facility Guidelines into their work. The consequences of inadequate provision of NMT facilities include illegal and dangerous travel behaviour (both by

NMT users and motorists), as well as increased dependency on motorised transport trips (Baufeldt, 2016). By not providing adequate facilities for NMT trips, individuals switch to motorised forms of transport as soon these modes are available or affordable for them. Increasing levels of motorised transport is problematic, as it results in increased levels of congestion and the various negative externalities associated with private motorised transportation, as well as resulting in public transport becoming less viable due to declining number of passengers. Additionally, the usage of motorized transport reduces the amount of physical activity of individuals on a daily basis, which further worsens the levels of health of South Africans, which in turn increases the cost of health-care for South Africa (City of Cape Town, 2014). An additional consequence of inadequate NMT facilities is the high level of inequity which is reflected in the space allocation to the different road users (Litman, 2002). Individuals with higher incomes are dominating public road spaces in South Africa with private cars (Behrens, 2004) and vulnerable road users, such as pedestrians and cyclists, are being poorly provided for (City of Cape Town, 2005; City of Cape Town, 2009). Addressing inequality throughout South Africa, especially in the public spaces, is an important aspect of transformation in South Africa (Özler, 2007). In the Constitution of South Africa, as well as the Bill of Rights, improving levels of equality regardless of income, race, age, or gender is a central theme. Therefore, addressing the needs of NMT users is an important aspect of upholding these rights in a practical manner, which could have significant positive impacts for society as a whole (City of Cape Town, 2009; NDoT, 2008). Alternative solutions to improving NMT trips in South Africa, which are often encouraged over and above implementing NMT facilities, include bike supply, education or events (Baufeldt, 2016). While the above mentioned alternatives do have a role in improving NMT trips, they may be ineffective and limited in their success if the physical implementations (NMT facilities) are not in place. An example of where a lack of adequate NMT facilities had a direct impact on the success of one of these alternative measures was a national bicycle supply program of Shova Kula, where a key lesson learnt from that program was the importance of implementation of cycling infrastructure (NDoT, 2008).

1.2. BACKGROUND TO THE RESEARCH PROBLEM

Public Transport (PT) and Non-Motorised Transport (NMT) service provision in Namibia has been and still remains a hindrance in achieving economic and social development. Windhoek,

from a political and social standpoint, is littered with past transgressions (apartheid being the prime example) that have more often than not shaped the spatial layout of the city in a negative way, leaving large groups of the Windhoek residents far distances away from essential public amenities (schools, health facilities, places of employment etc.). Due to the influence of apartheid on the spatial layout of Windhoek, and low-income housing developments generally constructed on the outer fringes of cities based on low acquisition costs of land, there is now immense strain on public transport and Non-Motorised Transport (NMT) systems in Windhoek which serves to bridge the distance gaps created. Windhoek population is rapidly growing at 3.1 % per annum above the national growth rate of 1.4 % (2011 Household Census). The population currently stands at around 325.000 (Zwicky et al., (2013). Transport affects the lives of Windhoek residents daily and in different ways such as getting to and from work or being able to access essential services in the areas of the City. Windhoek has several inherited structural challenges that include a trend of decreasing densities of urban settlements, along with social inequalities and highly skewed levels of access and mobility. Windhoek has different features that require a highly individual transport system that is characterised by high density in poor areas, a CBD area, growth during apartheid, high peak demand for traffic between 17H00 and 18H00 when shops are close (SUTMP, 2015). The most vulnerable members of the Windhoek population currently carry the majority of the transportation costs and inconveniences. Windhoek, like many developing cities, faces a rapid population growth attributed to rural-urban migration and this trend has led to a spatial extension of the city with limited infrastructural development. Particularly, the transportation system bias towards motorised transport poses many challenges to sustainable urban mobility, such as congestion and high rates of accidents, as well as limited transport facilities, which all have a negative impact on the economic welfare of the Windhoek population.

At present, the transport infrastructure of the City is very much geared towards vehicles, which dominate the motorised transport with taxis amounting to about 57% of motorised trips and private cars which cater for around 37%. In the total picture, municipal buses are almost negligible with 6%, even though they are very important for specific population groups. In total motorised transport caters for about 70% of all trips. The remaining percentage of Windhoek population relies on non-motorized transport (NMT) for distances under 5 km (SUTMP, 2015), although this mode makes its users vulnerable to conflicts with motorised transport (MT). Non-Motorised Transport (NMT) consists above all by walking more than 97%, while cycling is almost negligible. According to the Motor Vehicle Accident Fund, the Khomas region, where

Windhoek is located, recorded the highest number of pedestrian crashes of 37% as compared to other regions of Namibia. In terms of public transport, the dominating mode is the taxi with a share of 90% as opposed to municipal buses with 10%. Public transport systems exist only in very limited extent (Zwicky et al., (2013). Provisions for non-motorised transport (NMT) the second most important means of transportation in the northern and central parts of Windhoek are inadequate, disconnected and almost non-existent for bicycles. It is therefore evident that private taxis, private cars and mini buses are commonly used by the majority of the population in preference to the City of Windhoek bus service. Vehicle ownership is increasing rapidly in line with per capita economic growth (CoW, 2018). All through the twentieth century, transportation planning and the implementation of transportation facilities in the developing world have been heavily weighted towards private motorised transportation, despite the fact that Non-Motorised transport (NMT) and public transportation constitute a significant proportion of all trips in urban areas (Khisty, 2003), and that they can provide viable alternatives to most motorised trips. It was only during the last two decades that many researchers and practitioners worldwide recognized the importance and advantages of Non-Motorised Transport (NMT) and public transport. Their investigations and findings have contributed much towards identifying, if not mitigating, some of the more glaring problems of urban transport. However, most of these investigatory studies have been performed in a piecemeal and in disjointed fashion and have focused mostly on a developed world context.

Non-Motorised Transport (NMT), generally, refers to any mode of transport that relies on energy, which is not generated by an engine (NDoT, 2015). A common example of this type of energy would be walking or cycling using human effort as an energy source. There are many documents on the definitions for Non-Motorised Transport (NMT). Although there are varieties in these definitions, there seems to be general agreement that Non-Motorised Transport (NMT) refers to all means of facilitating movement of people and goods on roads, which do not involve the use of an engine, such as walking, cycling, wheelchair, scooter, handcart, bicycles/tricycles, human portage, wheelbarrows, animal drawn carts and other human powered vehicles (Litman, 2014). The difference between Non-Motorised Transport (NMT) and Motorised Transport (MT) is that Non-Motorised Transport (NMT) uses human/animal power to facilitate movement of people and goods, as opposed to an engine. Walking and cycling provide affordable and basic transport. People who are physically, economically and socially disadvantaged often rely on walking and cycling as means of mobility. Improving Non-

Motorised Transport (NMT) can, therefore, help achieve social equity and economic opportunity objectives (Litman, 2014).

1.3. PURPOSE OF THE STUDY

Currently, there is limited research that demonstrates the balance between MT and NMT facilities in Windhoek, or whether NMT implementations have been successful or not, in terms of addressing the major challenges facing NMT users. The gap of knowledge regarding NMT facilities in Windhoek could be contributing to the slow or complete lack of implementation that is currently seen in the different parts of the country. One of the goals of this research is to establish the balance between Motorised Transport (MT) and Non-Motorised Transport (NMT) infrastructure achievable with the existing traffic conditions along Eveline Street, as well as to determine the current conditions of Non-Motorised Transport (NMT) and Motorised Transport (MT) facilities in Eveline Street. A balanced provision of infrastructure starts with a balanced perception of what urban traffic is and should aim to achieve.

While data regarding NMT trips and NMT fatalities and injuries in Windhoek is scarce, it is hoped that through this study more insight into the current situation using the available data will be uncovered. Combined with the extensive literature review and best practices, it is hoped that new links of understanding regarding the challenges that surround NMT trips, and more specifically balancing infrastructure needs between MT and NMT, will be established.

An important aspect of demonstrating the value of NMT trips in Windhoek is taking the local factors, influences and perspectives into account. Therefore, demonstrating that the value of NMT facilities that have been documented in other parts of the world applies to Windhoek can increase the support and justification of investing in future NMT facilities implementations. However, if the benefit of NMT infrastructure cannot be demonstrated or if the implementations of NMT facilities do not have the same type of effects as MT, then it will indicate that the context of Windhoek has a significant impact on NMT trips. The related implications may mean that implementing NMT facilities in Windhoek would remain a secondary measure, rather than a primary measure, to addressing the challenges facing NMT users.

Therefore, the following research questions are proposed for the aims and objectives.

1.4. AIMS AND OBJECTIVES

The purpose of this study is to highlight the characteristics, challenges, opportunities, role, and benefits for NMT and to suggest a framework to include Non-Motorised Transport (NMT) in all street designs in the city to enhance sustainable urban mobility in the Windhoek Municipal area, Namibia. The analysis will be based on Eveline Street.

Specific Objectives are:

1. To determine the current conditions of Non-Motorised Transport (NMT) and Motorised Transport (MT) in Eveline Street.
2. To determine the challenges and opportunities of Non-Motorised Transport (NMT) in the study area.

1.5. RESEARCH QUESTIONS

The research questions that the study seeks to address include:

1. Is the balance between Motorised Transport (MT) and Non-Motorised Transport (NMT) infrastructure achievable with the existing traffic conditions along Eveline Street?
2. What is the extent of other Non-Motorised Transport (NMT) modes besides walking along Eveline Street?
3. What will the economic impact be, of Non-Motorised Transport (NMT) facility implementation along the busiest street in Windhoek, i.e. Eveline Street?

1.6. THE STUDY AREA

The study will cover the popular Eveline Street in the high-density suburb of Greenwell Matongo in Katutura in the greater Windhoek Municipality, Namibia. In this case, Eveline Street is hereby treated as a Non-Motorised Transport (NMT) analysis zone. The case study area was chosen because it is compact, ever congested both with Non-Motorised Transport (NMT) and Motorised Transport (MT), has high numbers of public transport, especially taxis and municipal buses, and a high concentration of small and medium business activities. The street was also conveniently selected because it experiences high levels of traffic congestion, both during peak and off-peak periods, during weekdays and on weekends.

The street is a 2.11 km long ring road of which both ends link with Otjomuise Road. The volume of Non-Motorised Transport (NMT) is very high, due to many businesses operating along the sides of this street. The most informal noticeable businesses are bars, car wash facilities and hair salons. The majority of Non-Motorised Transport (NMT) users along Eveline Street walk to access businesses sustained by the street, and public services such as the satellite police station, schools, community library, fuel stations and churches, among other visited destinations. Eveline Street connects other high-density suburbs of Goreangab Dam and Havana, which accommodate mostly low-income groups who can hardly afford transport. Large volumes of Non-Motorised Transport (NMT) users frequent the street during weekends, until late, consuming alcohol, which sometimes has grievous consequences on their mobility, especially during the night. The water from mostly informal car wash businesses flows onto the motorway, causing potholes and the condition of the street is deplorable, most of the time, negatively affecting both Motorised Transport (MT) and Non-Motorised Transport (NMT). The absence of effective Non-Motorised Transport (NMT) infrastructure has increased the vulnerability of NMT users and, thus, this case study provides an opportunity to investigate and implement the various NMT strategies to achieve sustainable urban mobility for many similar streets in the municipal area of Windhoek. Figure 2 shows the location of Eveline Street in Windhoek.

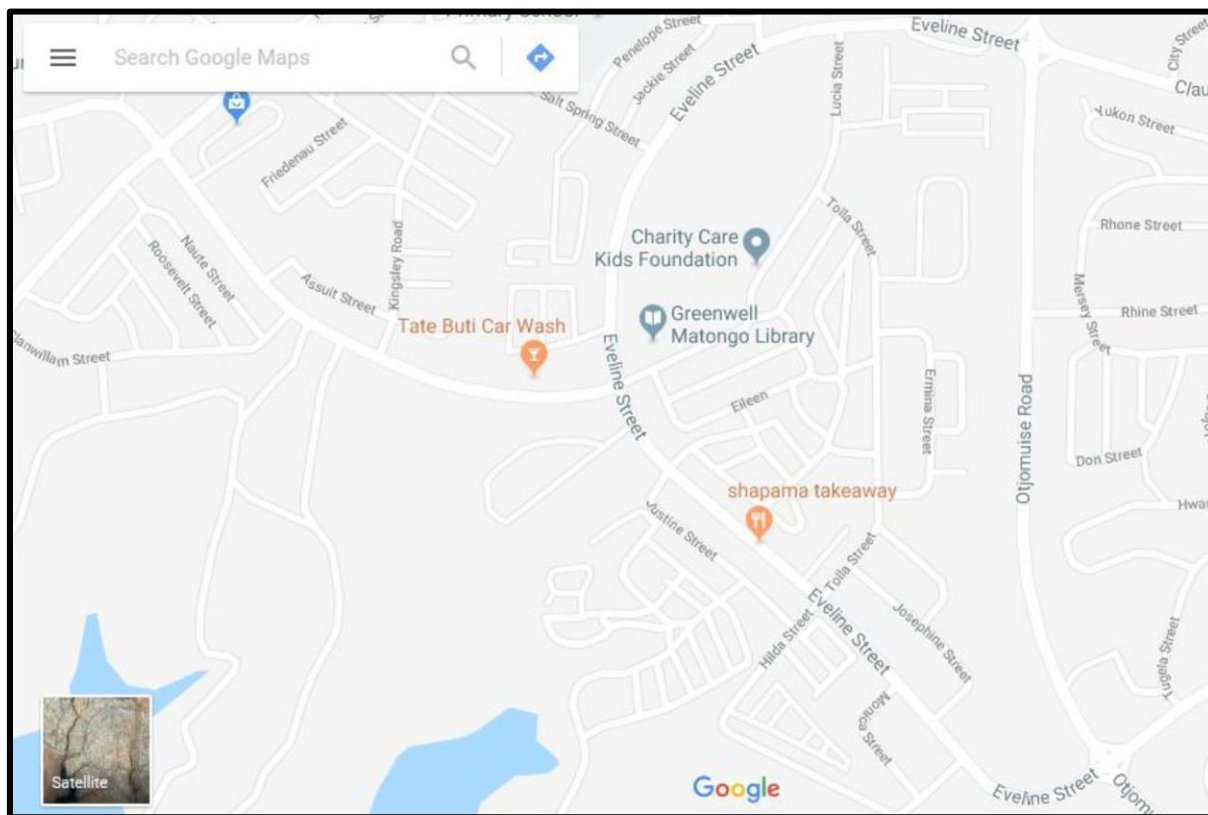


FIGURE 2: MAP SHOWING EVELINE STREET (SOURCE: GOOGLE MAPS, 2019)

1.7. THE SCOPE AND LIMITATION OF THE STUDY

The scope of this research is balancing infrastructure needs between MT and NMT in Eveline Street in Windhoek, Municipal area, Namibia. Eveline Street is used as a case study for Windhoek. While Eveline Street does not express all possible urban street characteristics, it is one of the main Street in Windhoek and has been affected by policies and frameworks that have influenced the other major Streets in the City. It was, therefore, considered a suitable area to conduct the research in. Due to resource constraints, the investigations could not be extended to other Streets of Windhoek.

Even though literature on international examples namely, NMT in Europe, NMT in Asia and NMT in Africa were reviewed, primary data for this study focused on Eveline Street. Policies and other non-infrastructure strategies that aimed to improve NMT trips and NMT safety in Windhoek were excluded from the scope of this research. The focus of the research is to determine the balance between Motorised Transport (MT) and Non-Motorised Transport (NMT) infrastructure. Considering that there have also not been any significant changes

regarding NMT, as a mode of transport, in national policies in the recent years (Walters, 2008; NDoT, 2008; City of Cape Town, 2014), it was assumed that this can be considered to have been a stable element in the development of NMT, as a mode of transport. The guidelines regarding NMT facilities were included, as they provide the direct basis for NMT facilities in Windhoek. The guidelines that were reviewed include the Pedestrian Facility Guidelines (NDoT, 2003), the Final Draft of the National NMT Facility Guidelines (NDoT, 2015), the Final Draft of the City of Windhoek NMT Infrastructure Design Guidelines (CoW,2018) as well as the Final Draft of the City of Windhoek NMT Infrastructure Design Guideline Annexure A – Urban Design Guideline (CoW,2018)

The main limitations of the qualitative data collection method were the type of available data of Windhoek, as well as the time frame that was predetermined. Some of the setbacks that were encountered in this project were:

- I. **TIME:** The study was limited to the early morning hours (between 06h00 and 08h00) due to pedestrians being very much in a hurry outside the perimeters of those two hours, as congestion along the street would delay them further, if they must stand and answer questionnaires and which they perceived to be lengthy and time consuming. The after-hours was the same situation, as most of the respondents would rather concern themselves with how they are going to get back home than worry about the questionnaires. Another time limitation of the study was the vastness of the street, it took time to interview all the respondents on time from one end of the street to the other.
- II. **FINANCE:** The high cost to print, distribute and access all points along Eveline Street on time, during data collection, affected the research work.
- III. **DATA COLLECTION:** The researcher had a problem with collecting data from respondents, due to the literacy level to understand the questions properly, the nature of their work, because they are either in a hurry to get to work or tired from work, and the distance they travel to get to work and back home is long.

1.8. STRUCTURE OF THE THESIS

Chapter 1 introduces the research topic and gives the background to the research problems that are investigated. Chapter 2 presents a review of literature on the benefits of NMT, as a mode of transport, to present the various benefits that could be generated by encouraging NMT trips. International examples namely, NMT in Europe, NMT in Asia and NMT in Africa are presented. In addition, NMT as a mode of transport is discussed and the two modes of NMT, namely walking and cycling are discussed. To conclude Chapter 2, the policy framework of NMT from the South African perspective is discussed. This is because the Namibian government has an agreement with the South African government to adopt South African NMT standards and apply them in Namibia, where relevant. Chapter 3 covers the Research Method used and its relevance to the study. In Chapter 4, analysis various results of data collected and interpretation of the results and the findings are then discussed. Additionally, a SWOT analysis of the case study will be performed. Chapter 5 presents the final conclusions along with some recommendations based on the research that was done in this research paper.

2. CHALLENGES AND BENEFITS OF NMT

The traditional engineering practices are primarily concerned with ensuring the efficient and optimal flow of motorised vehicles, especially the flow of privately owned motor vehicles. Modelling efforts typically aim at ensuring that the flow of vehicles occurs with as little resistance as possible and at the highest speed possible (Litman, 2007). Improving the efficiency of Non-Motorised Transport (NMT) is economically vital. Almost every trip begins and ends with walking, therefore, NMT provides significant benefits, as explained below.

2.1. WHAT BENEFITS DOES NMT HAVE AS A MODE OF TRANSPORT

In this section the focus is on the benefits of Non-Motorised Transport (NMT) as a mode of transportation with the main focus on walking and cycling. Non-Motorised Transport (NMT) trips have many benefits for the individuals who make the trips, as well as for society at large (Heinen et al., 2010). This mode of transport is environmentally sustainable, as it does not rely on fossil fuels and can also be a highly efficient mode of transport (Litman, 2002; Heinen et al., 2010). These characteristics make NMT an attractive mode to encourage and develop, especially as the world looks to move towards less polluting forms of transport. The benefits of NMT trips extend from transportation having reduced harmful environment effects, to improving the health of people. NMT as a mode of transport helps generate a wide range of benefits for both the individual and the society. The main benefit is increased levels of road safety for Non-Motorised Transport (NMT) users as well as Motorised Transport (MT) users. Non-Motorised Transport (NMT) trips also help to improve health, as well as the environment. As a sustainable mode of transport, it also has equality benefits for communities that increase the levels of NMT trips through improving the efficiency, safety and convenience of NMT trips. By improving the quality of a NMT trip the transportation system becomes more equitable as NMT users trip experiences that are on with par with MT trips (Baufeldt, 2016). It is important to note that improving the quality of NMT trips is especially important in addressing the needs of the more socio-economically vulnerable members of society that rely on NMT trips to meet their travel demand. A simple example would be providing well maintained sidewalks for school children walking to school, that improves their experience compared to walking to school along an uneven, unattractive road where there is no separation from motorised traffic (Baufeldt, 2016). The various benefits of Non-Motorised Transport (NMT), as a mode of transport, will be explained in the following sections below.

2.2. HEALTH BENEFITS OF NMT

Active transport, such as walking and cycling, promotes healthy lifestyles and regular exercise. Ensuring that a significant proportion of all trips are Non-Motorised Transport (NMT) trips, has several health benefits (Søelensminde, 2004; Oja et al., 2011; Massink et al., 2011). Health benefits include reducing the risk of premature mortality, certain cancers, high blood pressure, type-2 diabetes and musculoskeletal ailments (Søelensminde, 2004), among other Non-Communicable Diseases (NCD) (Mayosi, et al., 2009). The majority of these benefits are, due to increased physical activity associated with NMT trips (Reynolds, 2009; Mayosi, et al., 2009). In a major study of 263 450 commuters by Celis-Morales et al. (2017), it was found that people who cycle or walk had lower cardiovascular disease risk and cyclists had lower risk of cancer and lower all-cause mortality rates, as cited by Litman (2017). Evidence also suggests that active transport provides psychological benefits. Martin et al. (2014) evaluated data from British Household Panel Survey and concluded that the overall psychological well-being was significantly higher for active mode commuters compared to car travel or public transport and that negative associations were noticed between time spent driving and well-being, as cited by Litman (2017). Recently, the severity of South Africa's obesity has been in the focus of the media. It was recently found that more individuals in South Africa are likely to die from obesity related illnesses than poverty related illness (Health Systems Trust, 2015). The government is now taking significant steps towards in order to addresses this specific health burden of South Africa (South Africa Government, 2015). In many developing countries, such as Colombia, they value NMT trips due to the associated health benefits which is a driving motivation behind many of the recent policy and urban environment changes that have occurred in recent years (Parra et al., 2007). In Bogota, Colombia, several changes have been made to increase the amount of NMT trips that are made and in so doing, increases the level of physical activity of the people of the city. Several projects, facilities and events have been implemented to encourage people to include walking and cycling trips in their daily lives. One of measures includes "The Cicoloruta Transportation System" which is a network of 300 km of dedicated bicycle paths (Parra et al., 2007). The initial motivation for implementing the Cicoloruta was to help reduce the congestion in the city (Parra et al., 2007; Massink et al., 2011) but it is now seen as an important component of encouraging a healthy life-style for the inhabitants of the city. Increasing NMT trips (commuting or recreational) will help to address this specific and growing health challenge. Furthermore, with the increasing focus on environmental concerns, NMT trips are also seen as a possible way of improving the quality of the environment by

reducing carbon emissions (Massink et al., 2011), air pollution and other negative impacts (Jacobsen, 2003) associated with urban settlements.

2.3. ROAD SAFETY BENEFITS OF NMT

Road safety can be viewed in terms of the actual road fatality and injury levels, as well as in terms of the perceived levels of road safety felt by the users (Baufeldt, 2016). Perceived road safety can often have a more significant effect on travel behaviour than actual road traffic safety improvements (Søelensminde, 2004). There is a strong relationship between higher NMT usage and an improvement in road traffic safety (Litman, 2007). Søelensminde (2004) notes that traffic accidents are likely to be reduced with increased levels of NMT infrastructure. This may be due to motorists becoming more sensitive to the needs of NMT users, or the NMT users becoming more visible and accepted as a viable mode of transportation (Pucher and Buehler, 2010). Availability of NMT infrastructure promotes safe mobility for all, including vulnerable groups, such as school going children, the physically challenged and the elderly. Road safety is a major issue. One of the negative externalities of motorised transportation is the high number of road fatalities and injuries. This is particularly true for developing countries and Namibia is a prime example thereof, as it has one of the worst levels of road safety in the world (CoW, 2018). Fatalities and injuries have massive impacts on both those involved in the road collisions, and those who are left behind (Mohan, 2002). While high road fatalities and injuries are typical of developing countries, they are not inevitable and should be addressed with appropriate and adequate actions. This has been done in several developing countries already. One such country is Colombia, which has managed to improve the levels of safety through various strategies, including the implementation of NMT events (most notably the Bogota's Ciclovía), education initiatives, as well as creating awareness regarding NMT, as a mode of transport (Montes et al., 2012; Bogota Como Vamos, 2014; Gomez et al., 2015). While Colombia still has significantly more to do to improve the level of road safety to more acceptable levels, the progress so far is encouraging and indicates that prioritising and emphasising NMT, as a mode of transport, has positive impacts on improving road safety numbers (Baufeldt, 2016).

Several studies (Jacobsen, 2003; Pucher and Buehler, 2008; Elvik, 2009; Verma et al., 2015) indicate that implementing bicycle infrastructure leads to a significant decrease in fatalities and injuries of vulnerable road users, and to increased rates of walking and cycling. Both developed

and developing countries have demonstrated this impact of improving NMT facilities on fatalities and injuries (Jacobsen, 2003; Elvik, 2009; Verma et al., 2015). As mentioned by Pucher and Bucher (2008) and Jacobsen (2003), the more people who walk or cycle, the less likely a motorist is to collide with them. The relationship between the number of people walking and cycling and the chance that they will be involved in a collision with a motorised vehicle, for developed countries, is predictable and has been modelled by Jacobsen (2003). This is somewhat different to the situation in Namibia where a majority of people already walk. Cyclists in Namibia are however still a minority road user group, who is especially vulnerable. The philosophy of safety in numbers seems to have more of a critical aspect for these road users, which may explain why officially and unofficially organised cycle tours and races are well supported and relatively common but commuting rides by these same individual riders' remains comparatively low. These middle and higher income cyclists are more likely to use motorised transportation as their selected mode of transportation (Behrens, 2004). South Africans generally see cycling as a form of commuting as an unattractive mode of transportation (Bechstein, 2010). However, cycling and walking, have several attractive benefits, with one of the largest incentive benefits being the associated health benefits.

2.4. SOCIETAL AND ENVIRONMENTAL BENEFIT OF NMT

One of the most important benefits of increasing NMT trips are the positive effect it has on improving the urban environment by reducing levels of pollution and congestion. This is especially true and applicable for the developing world (Whitelegg and Williams, 2000; Massink et al., 2010). The rapidly increasing transport demands, especially of developing countries, would not be as problematic if it were not for the various negative externalities that appear in various costs and damages. However, as the trend in developing countries is to shift towards higher dependency on motorised transportation, the transport demand and trends needs to be consciously managed, if these negative externalities are to be avoided (Baufeldt, 2016). In developing countries such as Colombia and Mexico, this benefit of NMT trips has become an important way for ensuring the liveability in urban spaces. Liveability, as a concept, is often considered to be defined as taking into account a wide range of factors that affect the quality of life for people in an area (Baufeldt, 2016). Howley et al. (2009) defined liveability to include factors which may include levels of health, sense of safety, access to services, cost of living, mobility and accessibility and social interactions. Improving liveability, ultimately, results in spaces that are sustainable, productive, cost efficient, as well as attractive to live and work in.

It has become an essential concept due to rapid urbanisation and increasing population growth in urban spaces. As the demand for resources and services grows in urban areas, including escalating transport demands (Massink et al., 2010; Verma et al., 2015), managing the sustainability and liveability of settlements becomes increasingly important. For example, transport demands are often met by motorised transport modes, which generates more negative externalities for the environment, as well as the health of people (Jacobsen, 2003; Wright and Montezuma 2004; Massink et al., 2010). NMT trips help to reduce the demand for Motorised Transportation by providing an alternative that is cheaper than motorised trips and, generally, more efficient in terms of resources used and energy required. Thus, by prioritising NMT, as a mode of transport, the liveability of an area can be improved upon, by reducing and mitigating the various negative externalities of Motorised Transportation (Baufeldt, 2016). For example, in Bogota, where recent prioritisation of increasing the number of NMT trips and improving public spaces has occurred, a reduction in emission from Motorised Transport (MT) has been recorded by the air quality monitoring systems of the city. The reduction of emissions was attributed to the increase in the proportion of walking and cycling trips, which has been estimated to be responsible for as much as 40% of the reduction of some of the pollutants (Wright and Montezuma 2004). NMT trips have made a significant contribution to addressing the severe air pollution challenge and are of great value for the city of Bogota. Massink et al. (2010), do indicate that Bogota's bicycle modal share is still relatively small compared to other developed countries, such as the Netherlands, the benefits are still substantial (Massink et al., 2010; Montes et al., 2012; Gomez et al., 2015). Massink et al. (2010) were also able to show that these benefits of CO₂ saved would be valued at between \$1 million and \$7 million, depending on various influencing factors, while Montes et al., (2012) showed the high benefit-to-cost ratios of pro-NMT programs. NMT trips, therefore, help to decrease the negative externalities of motorised transport trips. These negative externalities of motorised transportation include high levels of emissions (most notably Green House Gasses), noise pollution, reduced road safety, increased levels of congestion, and the associated loss of productivity thereof (Massink et al., 2010). Furthermore, NMT trips have been noted to address the equality challenges that surround transportation.

2.5. SOCIO-ECONOMIC AND EQUALITY BENEFITS OF NMT

The role that transportation has in addressing equality challenges, such as social exclusion, has been well established and noted in various studies and policies (Litman, 2002; Behrens, 2004;

City of Cape Town, 2005; Gray, et al., 2006; Garrard, et al., 2008; UNEP, 2010; Van Wee, 2011). This section presents a brief summary of transportation equality concepts and socio-economic challenges.

The fairness equity, deals with the distribution of impacts between individuals and groups (Litman, 2002). The resources and costs should be equally and fairly distributed, without one group of individuals experiencing more favour than another. Fair allocation of resources and costs would help to reduce the chance of social exclusion (Baufeldt, 2016). Van Wee (2011), defines social exclusion as 'the fact that some people or population groups are excluded from a certain minimum level of participation in location based activities, whereas they wish to participate, and need to do so in order to maintain a reasonable quality of life within the society in which they live'. An example to explain this type of equity can be seen clearly between the different types of transport modes. In most African countries, MT has been prioritised over NMT, as a mode of transport, in terms of infrastructure, priority of road space and safety (Baufeldt, 2016). Therefore, NMT users are often viewed as being second class road users, where an increase in horizontal equity would result in them having the same level of experience and same level of service as a Motorised Transport user. Transportation within a city has significant roles in either reducing the levels of inequality by providing affordable and accessible modes of transportation for all socioeconomic groups, or by reinforcing inequality by investing more resources in modes of transportation that promote social division (Van Wee, 2011). This is an important consideration as higher income earners often have more resources to effectively dominate road space, whether intentionally or unintentionally (Baufeldt, 2016). Prioritising private Motorised Transportation (MT) over public transportation (PT) and Non-Motorised Transport (NMT) is a classic example of an inequitable decision. Litman (2002) highlights a few of the consequences of inequitable transport decisions. One of these consequences are the additional direct and indirect costs for socio-economically vulnerable individuals, including increased amount of time spent commuting, increased exposure to pollution, increased risk of involvement in road collisions or attack on personal safety (Baufeldt, 2016). Inequitable transport decisions have a large impact on the type of employment opportunities and the manner that economic developments occur, which can have a significant impact on the opportunities and quality of life for lower-income groups (Baufeldt, 2016). Non-Motorised Transport (NMT) facilities improve the mobility and access of individuals, especially in lower and middle income areas, the road infrastructure will meet the needs of

more road users than only those that have access to MT. Transport policies, strategies and implementations should be adjusted to compensate for economically and socially disadvantaged groups (Baufeldt, 2016). One clear way that this could be achieved, would to increase the priority of NMT as a mode of transport in its own right, as well as a feeder mode to other forms of public transportation. Improving the quality and efficiency of NMT as a mode of transport, not only addresses the transport needs of vulnerable groups of society, but also helps to improve the status and culture acceptance of NMT trips. In turn, the investments in the NMT facilities help to reduce the social and economic stigma attached to walking and cycling (Baufeldt, 2016). Addressing the needs of all types of user links directly to improving social exclusion and has strong connections to both levels of access and accessibility.

Access is defined from an individual's perspective and accessibility is defined from a location's perspective (Van Wee, 2011). The level of accessibility that a socially excluded individual may experience can also be described as the mutual interactions between the transport system, the land-use system, the individual component and the time component (Baufeldt, 2016). Ensuring that all individuals with any type of mobility impairment are taken into account is necessary to create a transportation system, and therefore a society, that is equitable and inclusive. NMT trips can directly help address some of the consequences of an inequitable transportation system. The transportation system of South Africa is particularly inequitable (Vanderschuren and Galaria, 2003; Behrens, 2004) and therefore this impact of NMT, as a mode of transport, would be especially valuable. By providing NMT facilities and allocating sufficient road space to NMT users, the transportation network becomes more equitable between the different road users. Consequentially, NMT trips aid in increasing the accessibility and mobility of socio-economically sensitive individuals to employment opportunities and economic developments (Baufeldt, 2016).

2.6. NMT IMPROVE QUALITY OF LIFE

Reducing the number and lengths of motorised trips has several benefits for the environment in both the local and global context. Globally, a reduction in motorised trips and the related dependence on fossil fuels means a more sustainable use of resources. When comparing NMT to MT, it has significantly lower uses of non-renewable resources (Litman, 2007). Due to the fundamental nature of NMT, it does not depend on non-renewable fuels for trips, but rather energy from the individual. Communities that have higher levels of NMT have better levels of

cohesion, equity and liveability (Shumi et al., 2014). This hypothesis was found to be true by Appleyard et al. (1981), who measured the differences in liveability along three residential streets in San Francisco that vary in levels of traffic volume and are physically similar. Cervero (2002) shows how the built environment influences traffic, mobility choices, accessibility, liveability and quality-of-life. He, amongst others, presents evidence that a compact, mixed-use, and walking friendly environment influences mode choice in favour of non-motorised and public transport. NMT is often the only means by which the most vulnerable members in society can gain access to opportunities and social services, limiting their high levels of social exclusion (Teunissen et al., 2015). It gives independence and mobility to those that have little else, decreasing income inequality and social exclusion (Bogota Declaration, 2011). NMT trips help reduce congestion, while efficient NMT infrastructure also improves the attractiveness of public transport modes. Hence, NMT helps to further reduce the burden of traffic on the motorised transportation network (Sinnott et al., 2011; Pucher and Buehler, 2010; Sølensminde, 2004; Litman, 2007). Reducing the need for MT facilities has several co-benefits, including lower public expenditure on maintaining the Motorised Transport (MT) facilities (Litman, 2007). Additionally, cities that are fully dependent on motorised transport are beneficial to urban businesses and communities (Buehler and Pucher, 2012).

2.7. THE CHALLENGE OF LACK OF ADEQUATE NMT FACILITIES

Providing adequate levels of service for Non-Motorised Transport (NMT) users is seen as an important aspect in the literature for other countries (Pucher and Buehler, 2008; Verma et al., 2015), as well as in South Africa (Vanderschuren and Galaria, 2003; NDoT, 2015). In South Africa, the lack of adequate NMT facilities could be seen as hindering the acceptance and support of NMT trips in South Africa (City of Cape Town, 2009). The current prioritization of NMT facilities in South Africa seems to be much lower than what is necessary to make substantial progress in terms of providing adequate implementation of facilities, to ensure safe, convenient and comfortable NMT trips in South Africa (Vanderschuren and Galaria, 2003; Behrens, 2004; NDoT, 2015). The consequences of inadequate provision of NMT facilities include illegal and dangerous travel behaviour (both by NMT users and MT users), as well as increased dependency on Motorised Transport trips (Baufeldt, 2016). By not providing adequate facilities for NMT trips, individuals switch to motorised forms of transport as soon as these modes are available or affordable for them. Increasing levels of Motorised Transport is problematic, as it results in increased levels of congestion and the various negative externalities

associated with private Motorised Transportation, as well as resulting in public transport becoming less viable due to declining number of passengers (Baufeldt, 2016). In addition, Motorised Transport use reduces the amount of physical activity of individuals on a daily basis, which further worsens the levels of health of South Africans, which, in turn, increases the cost of health-care for South Africa (City of Cape Town, 2014).

An additional consequence of inadequate NMT facilities is the high level of inequity which is reflected in the space allocation to the different road users (Litman, 2002). Individuals with higher incomes are dominating public road spaces in South Africa with private cars (Behrens, 2004) and vulnerable road users, such as pedestrians and cyclists, are being poorly provided for (City of Cape Town, 2005; City of Cape Town, 2009).

In the following section Non-Motorised Transport (NMT) as a mode of transport based on international examples namely, NMT in Europe, NMT in Asia and NMT in Africa, will be briefly reviewed.

2.8. NMT IN EUROPE

Europe has since realised the need to incorporate Non-Motorised Transport (NMT) as a mode in its urban transport planning policies and initiatives because of the devastating negative externalities associated with Motorised Transport especially the advent of climate change. Around 80% of European citizens live in an urban environment. They share in their daily life the same space and, for their mobility, the same infrastructure. Urban mobility accounts for 40% of all carbon emissions of road transport and up to 70% of other pollutants from transport. European cities increasingly face problems caused by transport and traffic. The question of how to enhance mobility while at the same time reducing congestion, accidents and pollution is a common challenge to all major cities in Europe. Cities themselves are usually in the best position to find the right answer to this question that considers their specific circumstances. However, some European countries have more NMT users than others due to different land use measures, NMT facilities and importantly cultural differences. In The Netherlands, Denmark and Germany, there has been a co-ordinated set of initiatives to promote cycling and walking to work, adapting the urban transport infrastructure to support NMT through specific and extensive facilities on a network basis, coupled with aggressive traffic calming and regulation, and with various different approaches to separate cycle paths versus accommodation on

multiuse streets (James et. al., 2006). A host of programs advocating NMT use have been rolled out across Europe. Among the programs is the Short Trip Contracts in Flanders, Belgium in 2004 and whose objectives were to stimulate walking and cycling for short distances of a maximum of 5 km. The program targeted all local authorities, councils and all stakeholders who would sign a short-trip contract to commit 20% of their travel to NMT modes during a month campaign and record their saved car kilometers which would then be compiled and receive prizes. The program resulted in the saving of 362 899 km in total and saving 59 515 kg of CO₂ emissions. The other notable program was CIVITAS initiative by the European Commission in Ploiesti, Romania which saw the creation of the first real cycling and walking space with facilities designed and improved. A total of 4, 3 km of walking streets was created, and 14, 85 km of cycling lanes were created which improved accessibility of the CBD, lower pollution and traffic congestion (Canters et. al., 2007). NMT trips (mainly cycling and walking), were prioritised in The Netherlands as a way of addressing the increasing number of fatalities and injuries on roads, as well as easing the rising levels of congestion and the other negative externalities of Motorised Transport (Pucher and Buehler, 2008; Heinen et al., 2010). Negative externalities refer to the costs that are incurred on individuals or groups that did not choose/agree to the cost that has now occurred for them. This has resulted in NMT trips, more specifically cycling, becoming a significant part of their culture and way of life. While there is still Private Motorised Transport (PMT) (which refers to privately owned cars), many shorter trips are completed on a bicycle, or a combination of NMT trip (walking or cycling) and a public transport (PT) trip (mainly bus or train) (Rietveld, 2001). Through consistently prioritising road safety and developing its NMT infrastructure, The Netherlands has become one of the safest countries in the world, with regards to transport (Wegman et al., 2007; Pucher and Buehler, 2008). In The Netherlands the main NMT modes are cycling and walking. Compared to other countries, including the United Kingdom and the United States of America, The Netherlands maintains high levels of NMT trips, which have been estimated to be 46% of all trips (Jacobsen, 2003). The significant proportion of all trips being NMT trips indicates that NMT, as a mode of transport, can play a significant role in meeting the transport demand and, therefore, managing traffic effectively. This generates significant benefits both on the individual level, as well as the society as a whole (Søelensminde, 2004; Wegman et al., 2007; Pucher and Buehler, 2008).

The Netherlands is a good example of how a country can turn the trend of decreasing NMT trips and increasing MT trips around (Pucher and Buehler, 2008). Due to the mass production of motor vehicles from 1950's onwards, NMT trips became unattractive, as car ownership rapidly increased in The Netherlands, Germany and the United Kingdom (Pucher and Buehler, 2008). However, The Netherlands soon realised that the trend of declining NMT trips (especially cycling) and increasing MT trips was highly detrimental to urban spaces and inhabitants. This was accentuated in cities that have limited space, and could not afford to accommodate the increasing requirements for PMT (Pucher and Buehler, 2008), thereby forcing them to change the way they travelled sooner than other countries.

2.9. NMT IN ASIA

The rapid increase in Motorised Transport (MT) in Asia combined with limited attention to pedestrian, cycling and public transport facilities have resulted in a decrease in the overall NMT trip mode share. In Asia, MT congestion has facilitated the shrinking of space allocated to pedestrians and cyclists leaving these NMT users without a choice but to resort to Motorised Transport (MT). Asia has the highest record of 73% of the global outdoor air pollution premature deaths resulting from this rapid MT and NMT users are the most vulnerable especially pedestrians who are always travelling on the sides of Motorised Transport. In Asia NMT accidents and fatalities are rising and even severely among the most vulnerable groups such as children and the elderly. In 2010, Japan topped the Asian list with a share of 51% followed by Bangladesh with a share of 44% (WHO, 2010). These negative consequences of rapid MT have sensitised Asian countries and are now realising the urgency with which they should embrace NMT as a sustainable alternative. Among programs that have been successfully implemented in Asian cities is the Bike-Share scheme which was successfully implemented in Hangzhou, China. In Manila, Philippines Carless Day has been one of the programs implemented successfully to sensitise the public on issues pertaining to NMT. Technically, a host of custom-made tools on assessing and implementing NMT in the Asian context have been designed e.g. the Asian Cyclebility Assessment Tool (Clean Air Asia, 2013).

2.10. NMT IN AFRICA

Anybody familiar with cities in the developing world will notice that an increasing number of them are becoming unliveable. These urban areas have horrendous problems of traffic congestion, safety, and environmental damage. Governments in these countries are facing serious challenges to keep people and goods moving with no relief in sight (Nkurunziza, 2013).

In addition, most cities of the developing world and in particular those of African countries are experiencing rapid urbanisation characterised by uncontrolled urban sprawl and high population growth rates. For example, in the City of Dar-es-Salaam, the population in 2002 was approximately 2.5 million (Tanzania Population and Housing Census, 2002), but presently the population size of the city is estimated to be more than 3 million with an estimated population growth rate of more than 4 % per annum (Dar es Salaam City Council, 2004, JICA, 2008). This rapid growth in most African cities has resulted into many multifaceted and intertwined problems among which transport is intense. The rapidly growing Motorised Transport combined with population growth, triggered by both migration and natural growth has led to severe congestion in most cities in recent years and thus threatening their economic growth prospects (World Bank, 2005).

Mobility in the African cities is characterised by travel demand that far exceeds travel supply (World Bank, 2002, Gakenheimer, 1999). The demand for public transport and NMT has grown steadily for the past decades due to urban population increase whereas the supply has been declining thus creating severe transportation problems (Amer, 2007, Khisty, 2003). Moreover, a large portion of the cities populations still depends on either the poor public transport or walking because they do not have an alternative to make another choice (Amer, 2007, Gakenheimer, 1999). This has compelled urban residents in particular those in informal unplanned settlements to walk long distances to their work places every day (World Business Council for Sustainable Development, 2007) and pay higher cost on transport.

NMT modes such as cycling have due recognition in some African cities, however, they have been neglected as an important mode of transport because of careless urban transport planning and unplanned city developments. This has significantly affected accessibility of city residents in particular those that are living in urban rural fringes but make their livelihood by working in the city centres. In this process, initiatives of improving the urban mobility of the low income people in cities such as Dar-es-Salaam have been tried mainly to integrate the low cost modes (primarily cycling) into the urban transport system (Nkurunziza, 2013). In Africa, walking is the predominant mode of transport and pedestrians account for 50% of all daily trips in Sub-Saharan Africa but surprisingly even very basic NMT infrastructure does not exist. Cycling is less popular in most African cities but becomes noticeable in medium-sized cities (SSATP, 2005). NMT continue to receive little attention in terms of policy development and

implementation despite its immense benefits. Majority of the urban poor resides in the peripheries of most cities and they make up the majority of NMT users but the distances they travel are not always appropriate for walking and cycling as they pose personal and traffic safety risks. They must travel long distances at high cost to work, hospitals, recreation facilities and school, and are dependent on public transport and walking or cycling (NMT) for their travel needs. The consequences of poor NMT planning have resulted in high rates of pedestrian fatalities, poor quality environments and an increasing dependency on MT (Vanderschuren et. al., 2017). Although NMT experience challenges in Africa, there is still enough room to improve it as a sustainable mode, since the rates of urbanisation and motorisation are still relatively low. Non-Motorised Transport (NMT), also known as active transport and human powered transport, refers to walking, cycling and variants such as wheelchair, scooter and handcart use. NMT offers a lot of benefits such as user gains, infrastructure improvements and the reduction of negative environmental impacts (Vanderschuren, 2012). In Africa, NMT is a necessity and not really driven by the benefits mentioned. The majority of urban residents in Africa are from low-income households. The urban poor are dependent on NMT and their urban transport expenditures account a large lump sum of their household incomes as indicated in Figure 3 (Vanderschuren, 2012). Improving mobility is seen as key to facilitating the economic upliftment of the urban poor.

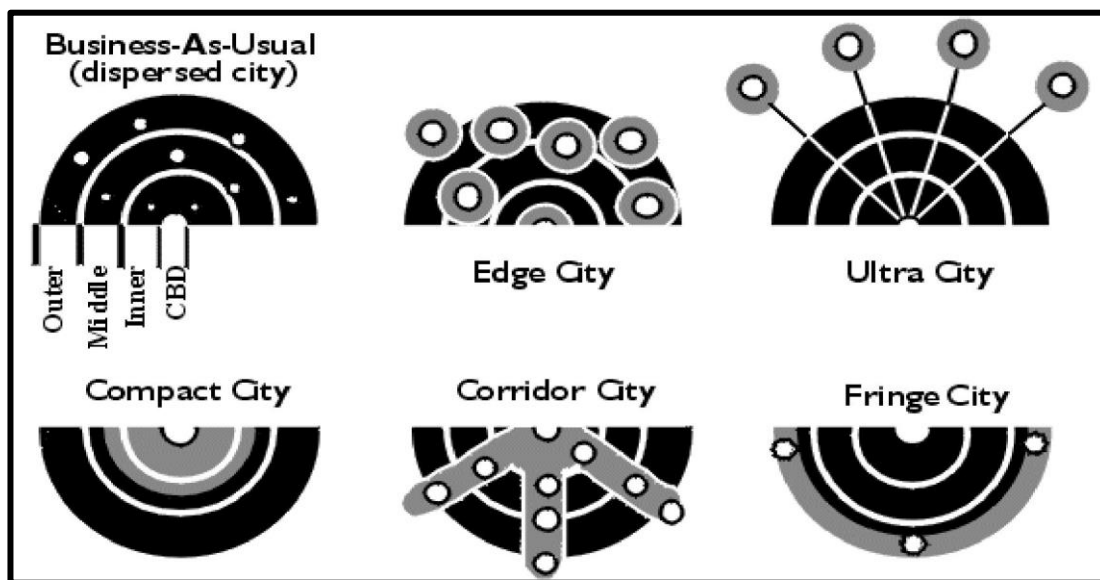


FIGURE 3: BUSINESS-AS-USUAL (DISPERSED CITY) (SOURCE: VANDERSCHUREN, 2012)

A brief insight into the structural challenges and existing frameworks that have shaped Non-Motorised Transport (NMT), as a mode of transport, in South Africa is now presented.

Historically, in South Africa the needs of Non-Motorised Transport (NMT) users were not acknowledged in national policies or strategies and consequently, not included in the planning and development of South Africa (Vanderschuren and Galaria, 2003; Behrens, 2005). The historical transport policies and legislation focused heavily on the motorised forms of transport (Walters, 2008), with little consideration of NMT as a mode of transport from a national perspective. As a consequence, developments in South Africa have, traditionally, been designed to rely heavily on Motorised Transport (Vanderschuren and Galaria, 2003; Behrens, 2005) and this trend has continued in more recent developments (City of Cape Town, 2014). This is despite an acknowledged awareness that better spatial and land use planning is important in addressing many of the present challenges (City of Cape Town, 2006; NDoT, 2008; City of Cape Town, 2014; NDoT, 2015). South African settlements have two distinct characteristics, which have a significant impact on NMT trips (Behrens, 2005; City of Cape Town, 2009; Lombard et al., 2007; NDoT, 2014b; Vanderschuren, et al., 2015):

1. Settlements are isolated from each other and have a low mix of different uses (Lombard et al., 2007; NDoT, 2014b; Vanderschuren, et al., 2015);
2. Settlements have low densities, and densities of developments continue to drop. This has resulted in greater distances being travelled and more time and money being spent on commuting (Behrens, 2005; Lombard et al., 2007, STATSSA, 2014). When taking into consideration that the majority of South Africans do not have access to private Motorised Transport and are restricted to public transport and NMT trips (Behrens, 2013; STATSSA, 2014), it is clear that transport in South Africa has inherited high levels of inequality (Vanderschuren and Galaria, 2003; Behrens, 2004; Özler, 2007; City of Cape Town, 2014). Recent developments have not incorporated the various characteristics that make NMT trips viable (Vanderschuren and Galaria, 2003; Behrens, 2004; City of Cape Town, 2009). An example of this is the continuation of low density residential developments located on the outskirts of developments (Vanderschuren and Galaria, 2003; City of Cape Town, 2009), a practice which is connected to the spatial and land use planning. The implications of the low density developments, with regards to transport, is that not only is transport expensive, due to increased distances but it also makes more sustainable modes of transport, such as NMT trips and public transport

trips, difficult to sustainably implement and maintain (Lombard et al., 2007; Dawood and Mokonyama, 2015).

In the following section the international comparison of the modal split in various countries will be briefly reviewed.

2.11. INTERNATIONAL COMPARISONS

In most developed countries, cycling has been growing in popularity as many cities work to create a more balanced system and have reclaimed streets from auto dominance. Cycling has surpassed recreational niches to become an extraordinary viable mode of transportation in northern European cities (World Health Organisation, 2000). Currently the highest bicycle mode share in the world is 27% in The Netherlands, 18% in Denmark, 10% in Germany and 10% in Sweden (Pucher and Buehler, 2007). All these countries have a very high standard of living, a growing auto ownership and rising income. Yet cycling has been thriving, primarily due to long term commitment of enhancing safety, speed and convenience of the green mode while making MT use difficult (Pucher and Buehler, 2007). The greater awareness of growing environmental and social problems has also added momentum to the popularity of cycling in many cities. (Maddox, 2001, Ascroft, 1997, Osberg and Stiles, 1998).

Indented statistics show wide variation within the United States at the low end of the spectrum. As shown in Table 2, some European countries display much higher use of NMT (Pucher, 1996). The European context seems to display substantial contrasts with some countries following the U.S.A pattern of increased auto mobility and related reductions in transit use and NMT, while others exhibit substantially greater reliance on NMT. In The Netherlands, Denmark, and Germany, there has been a coordinated set of initiatives to promote cycling and walking to work, adapting the urban transport infrastructure to support NMT through specific and extensive facilities on a network basis, coupled with aggressive traffic calming and regulation, and with various different approaches to separate bike paths versus accommodation on multiuse streets.

TABLE 2: MODES SPLIT IN URBAN AREAS (PUCHER ET. AL., 1996)

Country	Car	Transit	Cycling	Walking	Other
Austria	39%	13%	9%	31%	8%
Canada	74%	14%	1%	10%	1%

Denmark	42%	14%	20%	21%	3%
France	54%	12%	4%	30%	0%
Germany	52%	11%	10%	27%	0%
Netherlands	44%	8%	27%	19%	1%
Sweden	36%	11%	10%	39%	4%
Switzerland	38%	20%	10%	29%	3%
UK	62%	14%	8%	12%	4%
USA	84%	3%	1%	9%	2%

2.12. NMT AS A MODE OF TRANSPORT

This section aims to explain the definition of Non-Motorised Transport (NMT) and to discuss the two modes of transport namely walking and cycling.

Non-Motorised Transport (NMT) refer to types of transport that are not powered by engines or motorised vehicles, whilst the term 'NMT user' is accepted as an inclusive term that covers road users from pedestrians, cyclists and skaters to individuals that use animal-drawn carts, rickshaws and so forth, to assist their movement (NDoT, 2015). Due to the varied nature of users, there are a number of different types of facilities that are potentially appropriate to or beneficial for the different NMT users. However, for the purposes of this research, the focus will mainly be on challenges and opportunities for pedestrians and cyclists in Eveline Street in the Windhoek Municipality, Namibia. These two NMT users (pedestrians and cyclists) are the more standard and most common types of NMT users in Eveline Street. Pedestrians are, generally, the more dominant NMT user type, the cyclists have important advantages in terms of time and energy efficiencies.

The different components of a Non-Motorised Transport (NMT) network are now discussed in the following sections, starting with walking.

2.13. WALKING

For very short trips, walking is the main mode of transport in most societies, rich or poor, since everyone must walk one way or another. Langen (2001) indicated that most trips in all countries involve some walking as access and egress to the main mode. The modal share of walking can be very high compared to other modes of transport. Past studies show that between 25 and 50

percent of trips in the major Indian cities, and around 50 percent of all trips in major African cities, are entirely on foot and that trips undertaken primarily by public transport also involve significant walking distances (Langen, 2001). The political, engineering and planning attitude towards pedestrians is often neglectful though, as the pedestrian space is continually being neglected and ignored as facilities are not provided.

2.13.1. PEDESTRIAN FACILITIES

Pedestrian facilities can vary considerably, from simple cost-effective sidewalks to multi-purpose recreational parks. Often the quality of the journey is as important as the destination for pedestrians, as they interact closely with the surrounding environment. Pedestrian facilities often serve several functions. Parks, for example, can either be the destination of a recreational trip or can form an attractive link as part of a NMT route (Baufeldt, 2016). In the example of a park, both suggested functions rely on the pedestrian facilities linking the origin of the individual with the park and also to the surrounding areas of the park, especially if the pedestrian is using the park as part of their trip. Therefore, the concept of creating an integrated pedestrian network is important (DTTS, 2013). The pedestrian networks can be broken down into components of crossing facilities, link facilities and amenities.

2.13.2. PEDESTRIAN AMENITIES

Pedestrian amenities should be implemented to both assist pedestrians during their trip as well as part of creating a sense of place and belonging (Baufeldt, 2016). Amenities can range from simple street furniture, such as benches and shelters (especially at public transport stops, such as bus stops), to more innovative concepts such as involving the community in street art projects, and recreational or open spaces where people can interact or relax along their journey. Including elements such as water-fountains, benches, resting areas, along with appropriate information and signage, all contribute to an environment in which the individuals feels at ease and comfortable in their surroundings (NDoT, 2015).

2.14. CYCLING

Bicycles are a desirable mode of transport in many cities, but it is important to analyse who uses them, what the prevailing social and political attitudes are to the use of the mode, and whether there are particular obstacles to their use by women. Besides the gender issue, which is identified to be one of the major challenges to promote future cycling, accessibility and affordability are additional barriers to cycling. There are a number of people who cycle, but

this is limited to recreational cycling more outside of the City and a small share of commuter cycling. The overall cycling share of all NMT movements surveyed was 2% (CoW, 2018). The complexity of the identified barriers requires multiple mitigation strategies, e.g. actions that will address the provision of NMT specific facilities, bicycle accessibility, better road safety education and enforcement, and improved land-use mix of future developments. There is a perception that Windhoek is too hilly for cycling. However, from a quantitative analysis point of view, the actual road gradients of many roads in the City do not confirm this. The bicycle represents a trade-up from walking (Wilmink, 2001). Riehl (2015) states that, the number of people cycling is still low so far, although an opportunity for an increase in cycling exists, due to the short distances, the overall road structure can integrate cycling infrastructure. When planning for cycling infrastructure Riehl (2015) recommends distinguishing cyclists into:

Work day cyclists - who use cycling on a daily basis for commuting to work.

Leisure cyclists - who cycle for recreation and favour biking in open spaces like parks and boulevards separated from motorised transport.

Scholar Cyclists - who are young and less adept on their bicycles and, therefore, safety should be of essence in implementing policies.

This differentiation can be applied to the City of Windhoek, although the primary focus should be the establishment of a network to cater for education and work trips, due to the existing challenges of safety along Eveline Street.

2.14.1. CYCLING FACILITIES

The facilities designed and implemented for cyclists often have to balance the need for a smooth comfortable route against providing sufficient separation from either or both motorised traffic and pedestrian traffic (Baufeldt, 2016). Essentially, in order for a cycling facility to be effective the speed differential between the cyclists and other road users should not be significant if conflicts and dangerous situations are to be avoided. Well-designed and implemented cycling facilities should create complete routes and networks, which enable cyclists to travel without excessive barriers or hindering elements to their destinations. This not only improves the quality of the journey for the cyclists but also reduces the energy that is needed, as well as the time that is taken on a bicycle. These are key aspects of making cycling as a mode of transport attractive and viable for individuals (Baufeldt, 2016).

2.15. NMT FACILITIES ON THE SIDEWALK

Sometimes there is insufficient space available along sidewalks to retro-fit NMT facilities. When the space available is insufficient, the accepted and recommended minimum widths reflected in Figure 4 can be applied. As absolute minimum widths (not desired), the following can also be applied:

- A sidewalk with 1.2m for pedestrians;
- 1.5m for cyclists, separated by a painted line;
- 2m sidewalk for pedestrians and cyclists with no separation between the modes;
- And a 1.5m sidewalk only for pedestrians (CoW, 2018).

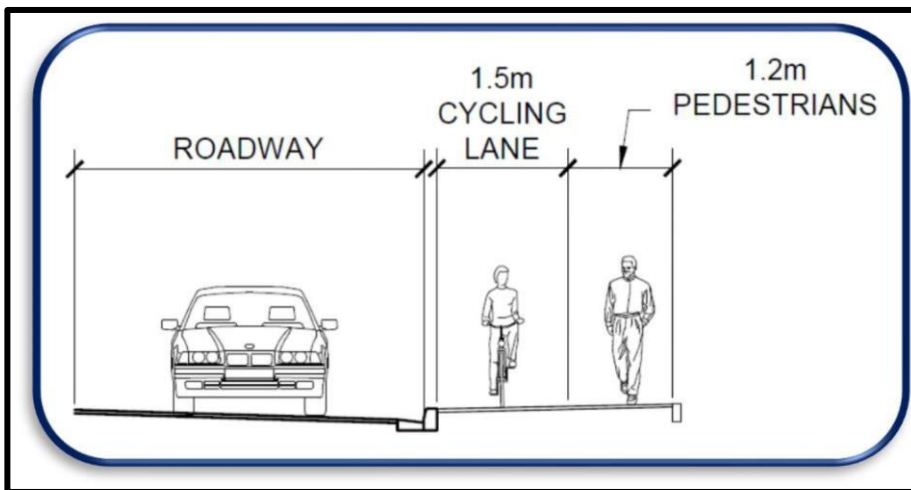


FIGURE 4: ABSOLUTE MINIMUM DIMENSIONS FOR NMT FACILITIES ON THE SIDEWALK- NMT FACILITY GUIDELINES (COW, 2018).

This section aims to review the various Non-Motorised Transport (NMT) Policy, Strategy and guidelines, specifically, of South Africa. The reason for this is because the Namibian government has an agreement with the South African government to adopt South African NMT standards and apply them in Namibia, where relevant. The focus will be on walking and cycling. In addition, Namibia has also adopted the Southern African Development Community (SADC) Road Traffic Signs Manual (RTSM) which provides the regulatory framework to harmonize road traffic signs and their supporting regulation throughout the member states of SADC.

2.16. THE POLICY FRAMEWORK OF NMT

The Road Traffic and Transport Act of 1999 was endorsed to provide for the establishment of the Transportation Commission of Namibia, for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, the control and regulation of road

transport across Namibia's borders and for matters incidental thereto. The Road Traffic and Transport Act provide some reference to NMT infrastructure and NMT users but regulation is mainly limited to road signage- NMT Facility Guidelines (CoW, 2018).

Awareness and support for NMT, as a transport mode, throughout South Africa continued to grow over the years, with more NMT events, bike supply and educational programs being implemented. Similarly to this, the related frameworks in terms of policy, strategies, and guidelines have also received attention (Baufeldt, 2016).

The White Paper on National Transport Policy (NDoT, 1996). This policy formed the strategic objectives for the government's approach to transport planning and development. It was, however, limited in the details of the practical implications of supporting NMT users and NMT trips. Some of the details that were included relate to addressing fundamental principles that influence the viability of NMT trips. These have been emphasised in *The Red Book: Guidelines for Human Settlement Planning and Design* (CSIR, 2000). Some of the key points regarding NMT trips include:

- Movement networks should permit direct pedestrian access to places of interest and public transport facilities. Prioritises the movement of NMT users, helping to make NMT trips direct and efficient.
- Work trips should be limited to 40km or one hour travel time in each direction. Encourages settlements to be as close to places of work and other urban centres as possible, which would allow for an increased number of NMT trips being made.
- Walking distances to public transport facilities should be less than one kilometre. The desired goal is to have a public transport boarding point around every 400 - 500m. South Africans currently walk much further than 1km to gain access to transportation and other services (Behrens, 2005; Vanderschuren et al., 2015).
- Public transport has been set to a goal of 4:5 to private transport.
- Settlement plans should be designed so that residential areas have access to public transport. This may mean implementing an increased number of NMT facilities and Public Transportation stops and stations.
- Settlements should be planned in order to provide a variety of activities close to dwellings. This type of planning would support and encourage NMT as a mode of transportation while reducing the dependency on fossil fuels.

These key points highlight that NMT trips are considered to be an important mode of transport. It also highlights the relationship between land use and planning and how these elements both have an important role in improving the viability of NMT trips in urban areas of South Africa (Baufeldt, 2016).

The Draft Non-Motorised Transport Policy for South Africa (NDoT, 2008). The document highlights the importance of NMT trips for South Africans, as well as the various challenges that face NMT users. It also suggests solutions to the problems facing NMT users and NMT trips within the Draft Non-Motorised Transport Policy (NDoT, 2008), the key objectives include:

- Increase the role of NMT as a mode of transport in South Africa,
- Integrate NMT trips into public transport trips,
- Provide safe, adequate NMT infrastructure, and
- Sustainably fund NMT development in South Africa.

While the document is still in draft form, it has provided a basis on which local governmental authorities and municipalities can draft and compile their own local NMT policies and strategies with regards to prioritising and implementing NMT facilities and NMT programs. However, the long delay in finalising the document into a published draft is problematic and suggests a lack of consistent prioritisation regarding the formalisation of NMT as a mode of transport in South Africa (Baufeldt, 2016).

The White Paper (NDoT, 1996) also focuses on addressing the transportation challenges as perceived in the early 1990's (Behrens and Wilkinson, 2001) and introduces the concept of user-centred transport systems. Rather than viewing the individual as a commuter, the term customer is introduced.

The Moving South Africa Strategy (MSA) which formed an important project, following the legislation of the White Paper (NDoT, 1996). The aim of MSA (NDoT, 1998) was to provide a long term strategy in order to realise the goals of the White Paper (Behrens and Wilkinson, 2001). It was also created with the intention of guiding the various role-players in forming the essential and necessary relationships in order for the transport services to be upgraded successfully. MSA introduced several new themes into South African transportation, including NMT, as a transport mode (Behrens and Wilkinson, 2001).

Some of the features within MSA (NDoT, 1998) that are related to NMT trips, included:

- Urban employment activities should be encouraged to locate within mass transport corridors, thereby increasing density and mixed land uses.
- Public infrastructure will be appropriate to each transport corridor and this will be determined by the transport authorities responsible for each corridor.

The Pedestrian and Bicycle Facility Guidelines (2003) provided a well-researched and comprehensive foundation, which was used as a starting point for the recently revised and expanded NMT Facility Guidelines (NDoT, 2015). The revision and expansion of the guidelines include new concepts and best practices, such as Universal Access, as well as addressing other identified gaps (NDoT, 2015). The updating of the guidelines also aimed to make the facility guidelines more user-friendly and more applicable to the challenges that face South Africans today (NDoT, 2015).

2.17. CONCLUSION

There is a need to strike a balance between MT and NMT infrastructure implementation. In most African countries, MT has been prioritised over NMT, as a mode of transport, in terms of infrastructure, priority of road space and safety (Baufeldt, 2016). Therefore, NMT users are often viewed as being second class road users, where an increase in horizontal equity would result in them having the same level of experience and same level of service as a Motorised Transport user. This has significantly affected accessibility of African cities residents in particular those that are living in urban rural fringes but make their livelihood by working in the city centres.

One way of deciding whether there is a balance between MT and NMT infrastructure is to look at some of the cost benefit analyses that have been done. Generally, cost-benefit analyses of walking and cycling infrastructure indicate that investments in cycling are cost-effective and beneficial (Elvik, 2000; Sælensminde, 2004; Cavill *et al.*, 2008). The potential value of NMT trips (namely, walking and cycling) is not only applicable to developed countries but also for developing countries (Massink *et al.*, 2010; Whitelegg and Williams, 2000), where it is currently often undervalued as a mode of transportation (Massink *et al.*, 2010). While implementing MT infrastructure, such as highways, may be costly for developing countries, the positive cost-benefit ratios demonstrated by Sælensminde (2004) and other mentioned researchers indicate that these types of investments would generate a high sustainable return

(in terms of investments) for the countries that choose to develop their NMT facilities. One of the fundamental principles that these high returns on NMT facilities are based on is the reduction of NMT collisions, while increasing NMT trips.

NMT as a mode of transport helps generate a wide range of benefits for both the individual and the society. The main benefit is increased levels of road safety for NMT users as well as motorised transport users. NMT trips also helps to improve health, as well as the environment. As a sustainable mode of transport, it also has equality benefits for communities that increase the levels of NMT trips through improving the efficiency, safety and convenience of NMT trips (Baufeldt, 2016).South Africa, as well as the Bill of Rights, improving levels of equality regardless of income, race, age, or gender is a central theme therefore, addressing the needs of NMT users is an important aspect of upholding these rights in a practical manner, which could have significant positive impacts for society as a whole (City of Cape Town, 2009; NDoT, 2008).

In conclusion. every trip starts with walking and ends with walking. NMT forms a significant part of the daily activity of people as they commute to and from public transport stops and stations, places of work, places of education and walking to water collection points and means of creating a living. NMT also has an important role to play in greening the economy in the context of providing and promoting more sustainable transport options, forming part of more cost-effective solutions in establishing a sustainable transport system.

3. RESEARCH METHODOLOGY

The chapter outlines the research design and method. The focus of the research is to determine the balance between MT and NMT in Eveline Street in the Windhoek Municipal area, Namibia. Due to the nature of the research questions in Chapter 1, a mixed method approach was used to investigate the balance between MT and NMT. This approach allowed a comprehensive and multi-perspective investigation to determine a balance between MT and NMT.

3.1. THE STUDY AREA SELECTION

The particular selection of case study areas also helped to prevent a macro-context of Windhoek being used as the research case area. The selection of Eveline Street sole case study area therefore provided a better indication of all the possible challenges and opportunity of the Street. This is the motivating reason behind having several case studies of one particular street than to have a range of characteristics and locations in the whole Windhoek Municipal area. The case study areas were selected to represent all socio-economic groups, as well as to determine the balance between MT and NMT in Eveline Street.

The research is based on a case study of Eveline Street in the Windhoek municipal area in Namibia as shown in Figure 6. Windhoek is the capital and the largest city in Namibia with an area of about 342 km. The population density of Windhoek is estimated at 325 858 inhabitants (Namibia Statistics Agency [NSA], 2011). Windhoek is the most developed city in the country. However, in Windhoek as in many other towns in Namibia, NMT facilities are almost non-existent. This is despite 29% of inhabitants in and around Windhoek using walking as their main mode of transport (Araes, 2007). In Figure 5, the points on the study area along Eveline Street indicate the zones for traffic counts. Point A is the street shoulder at Kwasa-Kwasa Enterprises where traffic density is high due to a fuel station that been recently constructed, with its access facing Eveline Street. Point B, is few hundred metres away at the junction of Eveline with Lucia Street. Point C is the busiest 4-way stop at the intersection of Greenwell Matongo suburb with Goreangab suburb where Eveline Street is located. Point D, is at the 3-way stop at the intersection of Lobito, which connects Greenwell Matongo, Goreangab and Havana. Point E, is further down at the intersection of Lucia Street with Eveline Street

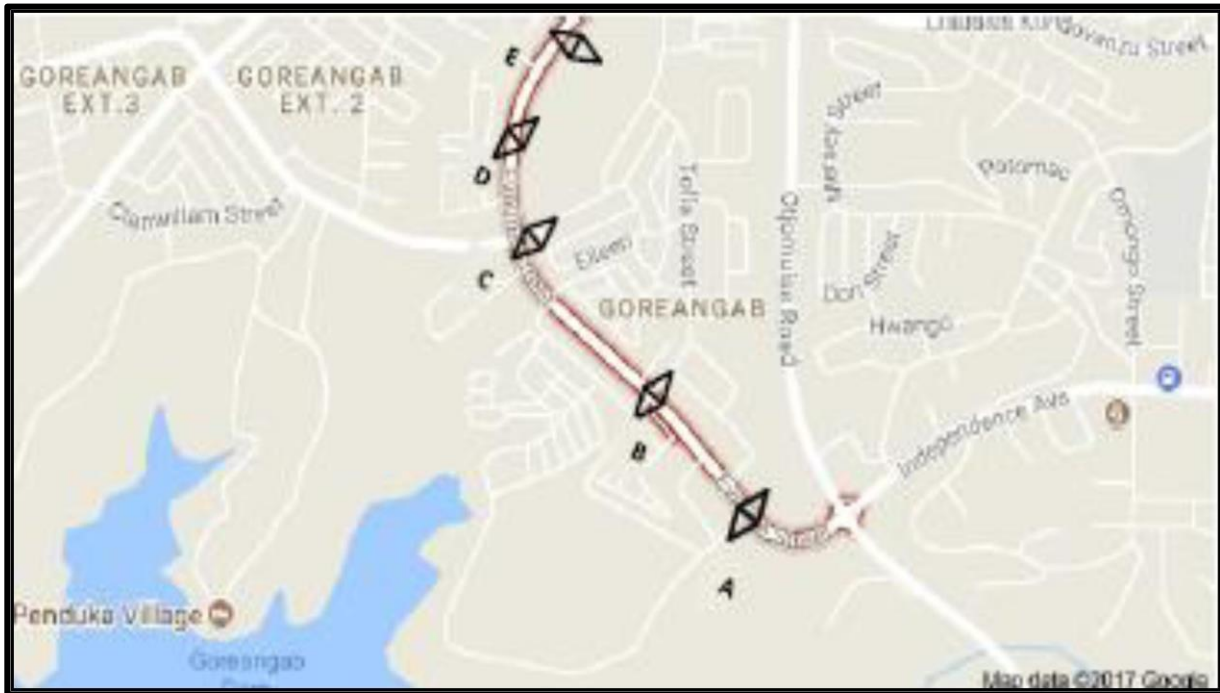


FIGURE 5: MAP OF EVELINE STREET SHOWING POINTS OF STUDY (SOURCE: GOOGLE MAPS 2017)

3.2. METHOD OUTLINE

One of the main motivating factors behind this research was to determine the balance between MT and NMT in Eveline Street taking into account the Challenges and Opportunities for Sustainable urban mobility as the research was focused on several benefits of NMT as a mode of transport (Health benefits, Road safety benefits, Societal and Environmental benefits and Socio-Economic and Equality benefits) the method used would have to be able to combine the findings of these various investigations.

As the research aimed to discuss the both qualitative data collection method and the Eveline Street NMT infrastructure assessments to determine the balance between MT and NMT infrastructure in Eveline Street.

The adopted design approach provides the main framework for the research. This was done, because the Eveline Street NMT infrastructure assessments was used to determine the balance between MT and NMT infrastructure and highlighted most of the fundamental factors:

- Provision of safe crossing opportunities across the Eveline Street;
- Provision of safe routes to schools is a priority;
- Increases road safety by reducing the number of fatalities and injuries;

Ensure well-designed NMT campaigns in parallel with the implementation of NMT infrastructure; and

Provision of support NMT infrastructure such as bicycle storage, lockers, and safe interchange with Public Transport.

The qualitative data collection method was done to provides insights into the problem or helps to develop ideas or hypotheses and to investigate deeper into the study of NMT.

Therefore, NMT plays a fundamental role in the future transport system of Windhoek and requires a well-considered approach to ensure successful implementation and undertaken in a practical manner. Implementation of NMT infrastructure should be balanced with the implementation of MT infrastructure. The research aimed to investigate whether the balance between MT and NMT infrastructure is achievable with the existing traffic conditions along Eveline Street. By using both, qualitative methods and Eveline Street NMT infrastructure assessments, the different aspects could be investigated in the most efficient and rigorous manner.

3.3. FLOW DIAGRAM OF RESEARCH METHOD

The research was conducted in various steps, which are outlined in Figure 6. In the flow diagram, the key research steps are indicated as well as where in the process of this research each step was completed. The arrows indicate where the products of each step provided inputs into the next research step. The methodology comprises surveys, traffic counts; direct observation and behavioral studies. The tools used included questionnaires, tally sheets, walkability audit tool, maps and photographs.

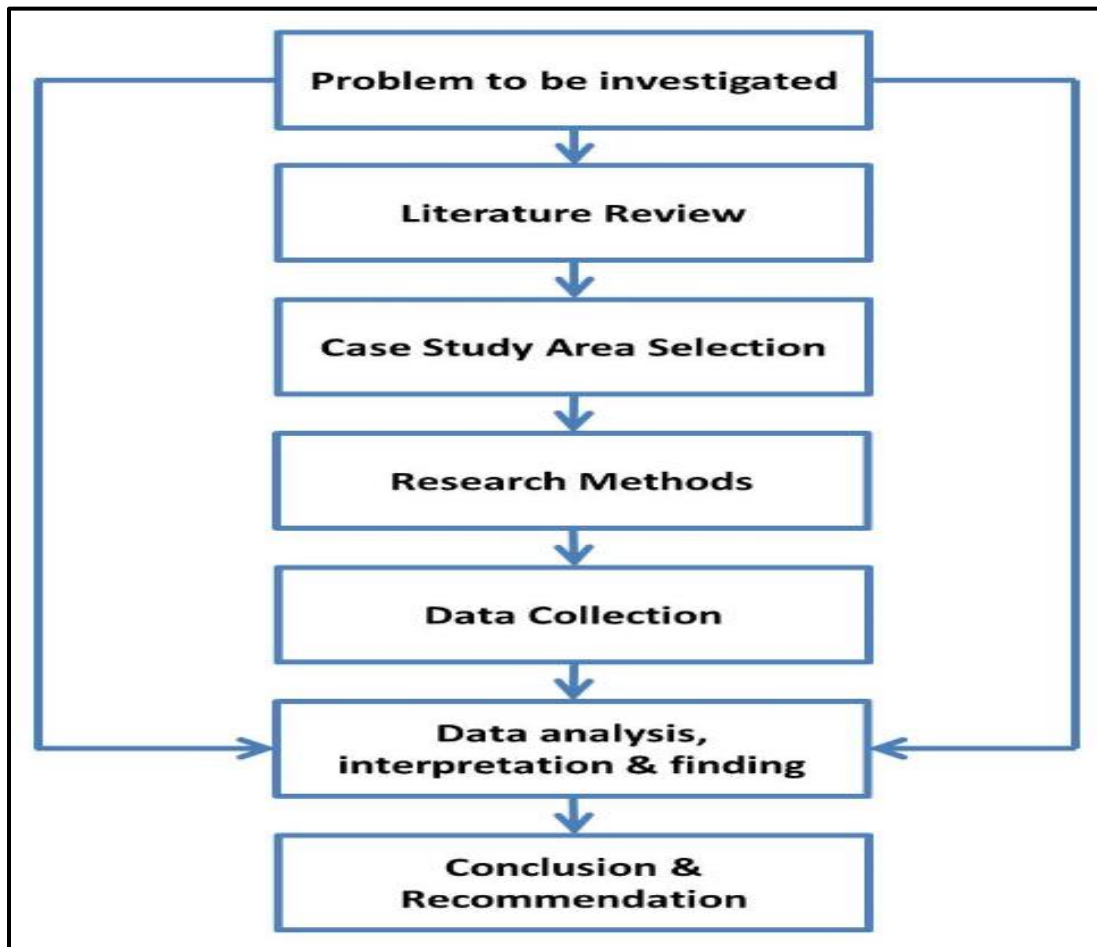


FIGURE 6: FLOW DIAGRAM OF RESEARCH METHOD

3.4. TYPES OF DATA

More than two different sources of data were central to the investigations in this research design and method. This was done so that all research questions could be adequately answered. Triangulation is defined as a way to mix various sources of types of data or even research methods (Olsen, 2004; Johnson *et al.*, 2007). The triangulation of the different data sources

helped to increase the validity of the evaluation and research findings (Johnson *et al.*, 2007; Yeasmin and Rahman, 2012). Within the case study design framework, triangulation of data sources was included as a way to increase the level of objectivity and robustness of the research findings (Olsen, 2004). In the research, the triangulation of the data included both infrastructure assessments and quantitative data. The use of various data sources helped to explore the effects of the NMT implementations from multiple perspectives. This increased the depth of the understanding of the investigation (Olsen, 2004). One advantage of this is not only to answer the proposed research questions and to help validate them, but also to ensure consistency in the results of the research conducted (Olsen, 2004; Yeasmin and Rahman, 2012).

The questions that were proposed at the beginning of this research would be answered by various sources of data. The investigations were therefore divided into two streams of research. Firstly, using the qualitative data that had been identified and sourced, the qualitative investigations were conducted. This helped to determine a balance between MT and NMT infrastructure in Eveline Street. Whenever possible, a combination of various data was used in order to verify the proposed findings. This was done for two main reasons. Firstly, it helped develop a more comprehensive understanding of the Challenges and Opportunities for Sustainable Urban Mobility (NMT) in Eveline Street in the Windhoek Municipality, Namibia. Secondly, in areas where there were data gaps, of one source of data, a secondary data source could be used to supplement the research.

3.5. PRIMARY DATA

Different types and sources of data that were required to support this study were used. The primary data fell short in addressing the interaction between NMT types and the challenges and opportunities of NMT as a mode, and how they can be modelled to assist in forecasting NMT use and integration of NMT in the mainstream transportation planning and implementation. The data was collected by administering roadside questionnaire, direct observations of behaviour and the walkability of the area, interviewing key informants, photographs and Global Positioning Systems (GPS) locations.

3.5.1. TRAFFIC COUNTS

Traffic flow data is important in the planning of a particular section of the road network and for its subsequent maintenance. Traffic data collection and analysis follows varying trends and plays an important role in the evaluation and management of road network schemes, (Botswana Ministry of Works and Transport, Roads Department, 2004). The traffic flow data was collected to determine an NMT programme of road widening needs and general improvement to accommodate NMT users and to establish the relationship between traffic volume, number of NMT user accidents and causes thereof. Traffic tallies were done at the 5 points along Eveline Street at intersections and junctions. The counts were done manually during peak hours between 06:00am and 09:00am, between 12:00pm and 14:00pm and also between 17:00pm and 19:00pm for two consecutive days, Sunday and Monday, representing traffic conditions along Eveline Street during the weekend (Sunday) and during a normal business day (Monday).

3.5.2. PARTICIPATORY TRANSECT WALK AND PHOTOGRAPHY

Participatory transect walks for two (2) hours were undertaken to document challenges and opportunity for the sustainable urban transport that incorporates NMT as a sustainable mode. The photographs were taken to document the existing challenges on the mobility of NMT along Eveline Street.

3.6. SECONDARY DATA

Secondary data highlighted most of the fundamental factors. Therefore, these gaps in the modelling of NMT necessitated the ensuing primary methods of NMT data modelling to investigate deeper into the study of NMT. The secondary data was obtained mainly through the literature review of the existing work by academic and researchers on NMT, land use and transport planning, institutional setup and policy administration. Other sources of secondary data included universities, libraries, internet, GIZ studies, MVA Namibia, SUTMP, local authorities records, Namibia Statistics Agency, and Government documents on transport and environment.

3.6.1. SURVEY

A general need for NMT planning requires data on trip and personal characteristics of travellers. NMT travel surveys performed for modelling purposes are a potentially effective means of collecting this data. Data on non-motorised trips is increasingly being collected in NMT surveys. Surveys must be designed carefully to ensure that all non-motorised trips are reported. Also, since there are, generally, few reported bicycle trips, additional means of collecting data on bicycle trips, such as supplemental stated preference surveys, may be required. The potential for non-motorised data collection, using emerging ITS information technologies, should also be investigated (FHWA, 1999). A questionnaire (see Appendix 1) was administered to 100 respondents. Due to the population size in the area, time constraint and the busy schedule of activities along this busy street, data collection was done at five different points along Eveline Street. At each point, 20 randomly selected respondents were drawn from pedestrians, cyclists, traders, private cars and public transport, among others and were sampled. The survey was done with the help of research assistants stationed at each point along Eveline Street and the survey was a roadside questionnaire, since many respondents were passers-by. The data collected through the questionnaire was essential in addressing issues of NMT sustainability, current levels of NMT use as a mode, as well as an assortment of challenges impacting NMT and demand for NMT infrastructure improvement along the study area. The survey was conducted during two consecutive days of which one day was a weekend day (Sunday) and the other on a Monday. The survey was conducted at different times of the day.

Sources and method of data collection and the type of data are shown in Table 3.

TABLE 3: DATA, TYPE OF DATA, SOURCES AND METHOD OF COLLECTIONS

Data Type	Data Collected	Source	Collection Method
Primary	Socio-economic characteristics of sample	Field	Questionnaire administered
	Modal used	Field	Direct observation and Photography
	Trip Purpose	Field	Direct observation
	Journey Duration	Field	Questionnaire administered
	Preferred Modal	Field	Questionnaire administered
	Footpaths and Cycle track conditions	Field	Questionnaire administered, Direct observation and Photography
	NMT Potential	Field	Questionnaire administered and Direct observation
	Key players	Field	Questionnaire administered and Direct observation
	Traffic Tally	Field	Direct observation
	Walkability of Street	Field	Direct observation and Photography
Secondary	NMT Types	Library, Internet and Journals	Reading and Internet visits
	Challenges and Opportunities of NMT	Library, Internet and Journals	Reading and Internet visits
	Maps	Google Maps	Internet visits

The data collected from Eveline Street targeted the different NMT users. The following issues were addressed:

- The sustainability for NMT (cycling and walking) in Eveline Street and its effects in the creation of traffic congestion,
- The existing challenges affecting the NMT within the study area,

- The current levels of NMT in Eveline Street compared to other modes of transport, and
- The desired physical infrastructural intervention that can be implemented to promote the NMT in Eveline Street.

3.6 DATA VALIDATION

The methods used for data validation were face validation and content validation whilst quantitative data was prepared in MS Excel before analysis. The questionnaire was evaluated from the design perspective whereby no respondents registered any difficulties. Content validation method allowed the study to verify that the question items targeted the objectives of the study.

3.7 DATA ANALYSIS AND INTERPRETATION

The data that was collected from the field was edited to ascertain its suitability and accuracy. The quantitative data was analysed using descriptive statistics and presented in the form of tables, percentages, graphs and charts. The qualitative data was analysed through the use of content analysis of the questions administered, with reference to the study objectives. Results of the data analysis provided information that formed the basis for discussion, conclusion, and interpretation of the findings and recommendations of the study. Microsoft Excel was used to record and analyse the data, as well as to represent the data and findings, using graphs, pie charts and tables, where applicable. Bar charts/histograms, pie charts and percentages were applied in assessing variables related to use of different modes of transport along Eveline Street. Content analysis was extensively used to access, organise and analyse unstructured information in the questionnaires. It allowed for classification and sorting and enabled the researcher to arrange information and examine the relationships in the data; along with the analysis with linking, shaping, searching and modelling of the data. The analysed data was later exported to Microsoft Word where the researcher was able to come up with the SWOT analysis, recommendations and conclusions of the analysis.

To conclude, the research methodology involved the review of literature, primary and secondary data collection, validation and analysis, interpretation and subsequent recommendations to address urban mobility challenges and policy recommendations to

promote NMT for Windhoek municipal area. The methodology comprises surveys, traffic counts; direct observation and behavioural studies. The tools used included questionnaires, tally sheets, walkability audit tool, maps and photographs. The secondary data was obtained mainly through the literature review of the existing work by academic and researchers on NMT, land use and transport planning, institutional setup and policy administration. Although the questionnaire addressed most questions to do with NMT, there were a couple of no responders from whom we could not get a comment possibly due to time constraints, however the study recommends brief questions that will attract effective response and to test the questionnaire before use in the study. To reduce bias, the questionnaire ought to guarantee privacy to respondents that value their anonymity when it comes to studies of this nature. As for traffic counts, new technologically advanced and efficient methods should be used to enhance the results of any study of this nature.

4. DATA ANALYSIS, INTERPRETATION AND FINDINGS

The demographics of the participants, such as age, gender, marital status etc., were investigated to determine the socio-economic status of the users of NMT. The results of the data collected through survey questionnaires, description of statistics, observation and photographs are presented and discussed in this chapter.

4.1. THE SURVEY

The rate of response by participants in the study was 100% with more than 75% of the questions being answered. This was due to the fact that the questions were administered directly to participants by the researcher and the assistants, on the spot at the roadside, rather than handing out the questionnaires to participants for completion at their own pace.

4.1.1. GENDER OF PARTICIPANTS

Males constituted the majority of the participants with 62% and female participants were 38%, according to Table 4. There appears to be more male pedestrians on Eveline Street. This is, most probably, due to security issues whereby women prefer taking self-imposed precautionary measures to avert sexual assaults common in these transit points (Law, 1999). Furthermore, males make up the majority of the workforce. Most females are not prepared to walk or cycle and hence, most women favour motorised transport to work as they consider their safety more than their more macho male counterparts.

TABLE 4: PARTICIPANTS GENDER

Gender	Frequency	% Percent
Male	62	62
Female	38	38
Total	100	100

4.1.2. AGE GROUPS OF PARTICIPANTS

Most of the NMT users are young people, as shown in Figure 7. Participants below 18 years, make up 47% of the sample. Young adults of 18-36 years age group make up the bulk of NMT users. These two age groups are the most active groups, comprising the bulk of the general workforce. The 37-55 years age group had 6% of the participants, which can be attributed to this age group's preference of Motorised transport, as they are established and, therefore, able

to own a car. The age groups above 55 years had no participants, probably due to the fact that most of them are vulnerable, due to aging and, therefore, are inactive. That is why they are not part of the pie chart.

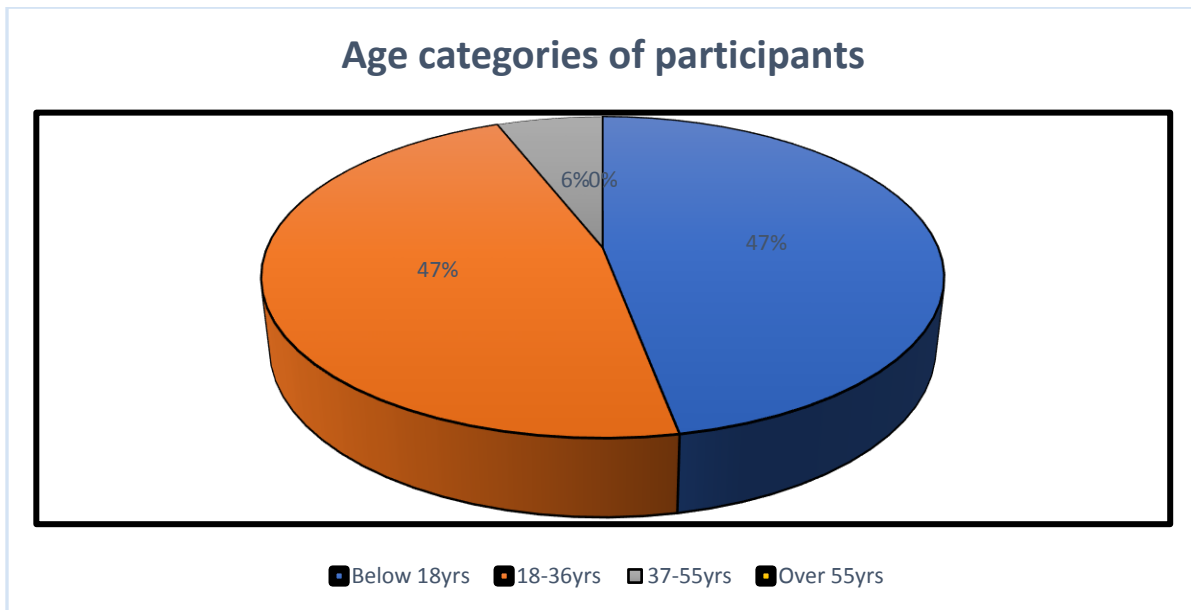


FIGURE 7: AGE CATEGORIES OF PARTICIPANTS

4.1.3. MARITAL STATUS

As can be seen in Table 5, the majority of the people (85 %) that frequent Eveline Street are singles, while an insignificant 6% are married and others, including the widowers making up the remaining 9%. The majority of respondents are single because most of them are below 18 years and classified themselves as single.

TABLE 5: MARITAL STATUS OF PARTICIPANTS

Marital Status	%Percentage
Single	85
Married	6
Others	9
Total	100

4.1.4. PURPOSE OF TRIP

In Figure 8, it can be seen that 44% of the participants are employed, hence, they will be going to and from work via Eveline Street. Fifteen percent of business trips are minimal, because street vendors frequent the street for business. A low percentage of 3% of participants come to Eveline Street for shopping. This is explained by lack of shopping facilities in this area, as shebeens are the only visible facilities.

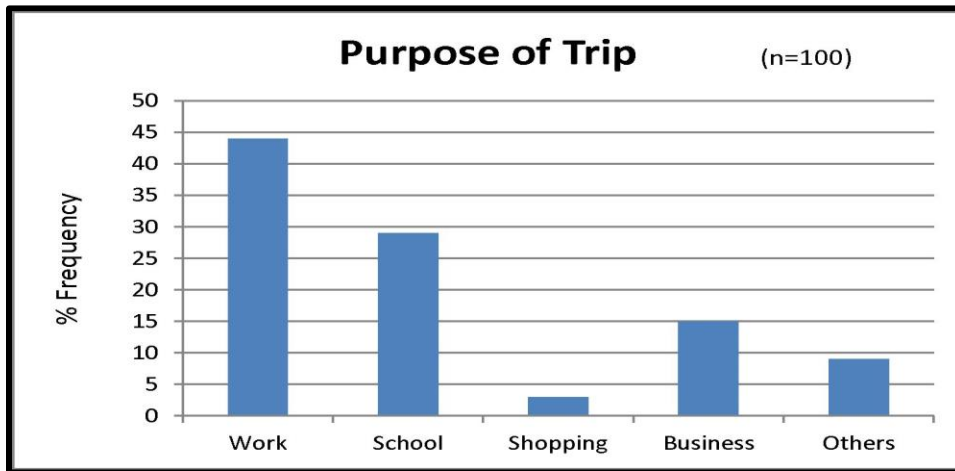


FIGURE 8: PURPOSE OF TRIP

4.1.5. OCCUPATION

In Figure 9, the majority (44.0% of the participants) are manual labourers, especially in the construction industry. Due to income, they cannot afford public transport; hence, they resort to walking or cycling. Self-employment takes a fair share of 26%, comprising of various traders dotted alongside the street, and makes up the bulk of NMT users.

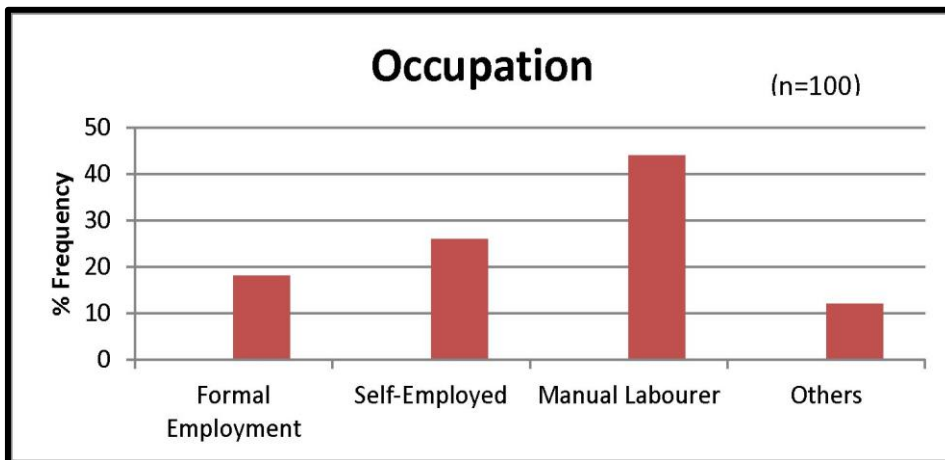


FIGURE 9 : OCCUPATION OF PARTICIPANTS

4.1.6. PREFERRED MODE OF TRANSPORT ALONG EVELINE STREET

In Figure 10, the majority of people living in the study area prefer walking and this is followed by public transport users. The cycling mode along with the personal car, were equally preferred both constituting 12%. However, an insignificant 3% preferred a motorbike as a mode.

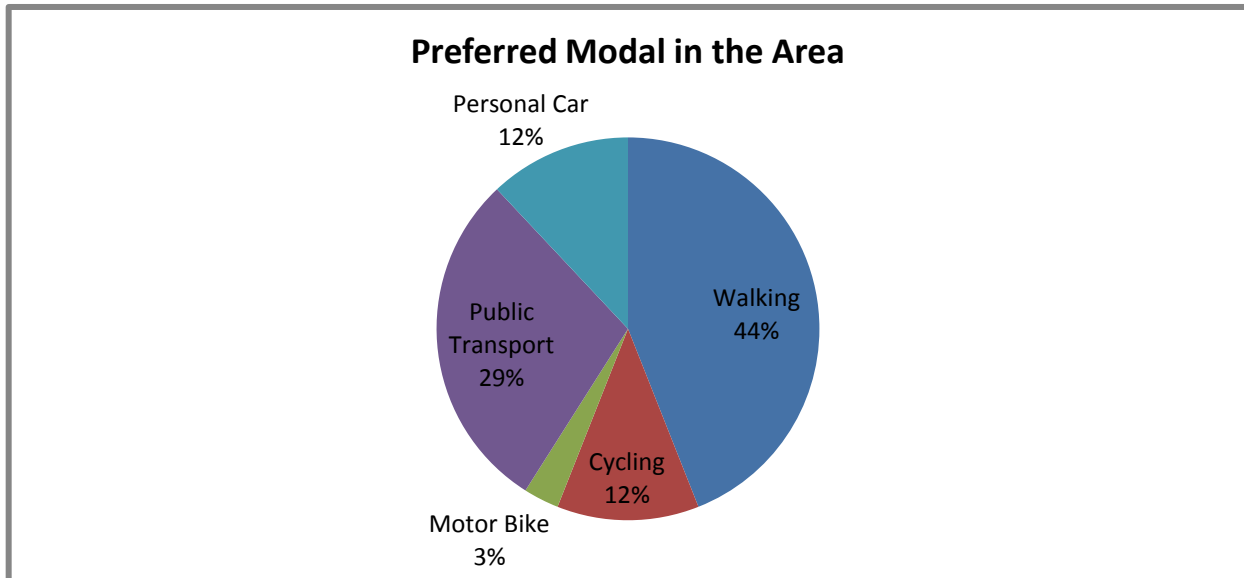


FIGURE 10: PREFERRED MODE OF TRANSPORT IN THE STUDY AREA

4.1.7. SATISFACTION WITH TIME TAKEN

Most participants are not satisfied with the time it takes to reach their destinations, because of congestion during peak hours and the absence of NMT facilities like pedestrian walkways. During weekends Eveline Street is busy with informal carwash businesses and people drinking on sidewalks, intruding the street and causing congestion for NMT leading to increased travel times, hence, dissatisfaction by 65% of respondents, whilst 35% were satisfied with the time they took to reach their destination.

4.2. WALKABILITY AUDIT

Figure 11 shows the walkability of the Eveline Street. Walkability in this instance is not solely about distance, but includes safety, surface, topography, obstruction, urban design and the flow of the walk among other factors. It is however vital to the movement of pedestrians and cyclist in the area and influences the vehicle trips, the design of the public spaces and the liveability of the area. Particular hazardous locations in Windhoek include the Western Bypass, Monte Christo Road and Eveline Street in the north western communities. A lack of law enforcement and partially ignorant travel behaviour of motorists and pedestrians leave NMT users even more vulnerable. Conflicts between motorists and pedestrians are a challenge, especially at some signalised intersections with left-turn slip lanes (CoW, 2018).



FIGURE 11: LEARNERS WALKING TO AND FROM SCHOOL ALONG UNSURFACED SIDEWALKS (COW, 2018)

Road safety situation is of specific concern for children. The learners have to travel a long way and pedestrian crossings are not provided adequately along Eveline Street. From the study, it became evident that physical separation from motorised traffic is preferred and required. A total of 265 NMT-related incidents were recorded between January to July 2017 in the Khomas region (CoW, 2018). It is evident that the majority of NMT incidents happened in the north-western sector of Windhoek, especially along Independence Avenue, Eveline Street and Monte Christo Road. Another higher concentration of NMT crashes is found in the wider CBD area. The high prevalence of NMT related incidents could potentially be linked to the high NMT share in these neighborhoods, lack of adequate NMT infrastructure and high level of informal crossing activity. During the survey some of the participants shared the opinion that they do not feel safe going to school, as they have to walk far and cross the main road from Goreangab (Eveline Street), which is not safe as motorised do not drive carefully. Eveline Street fared poorly on walkability rating, with an overall score of 30% owing to the absence of suitable NMT facilities, such as walking paths and pavements, which force pedestrians to walk on the road or dirt paths. The NMT conditions along the study area encourage potential conflict between pedestrians and motor vehicle traffic, due to obstruction by car-washing businesses and vendors, especially during weekends, when the shebeens are fully patronised.

During peak hours, the traffic volume increases, making it difficult for pedestrians to cross the street. Motor vehicles normally over-speed between the robots at Otjomuise Road and Kwasa-

Kwasa compound, increasing the vulnerability of NMT users, especially school learners wanting to cross the street in the absence of crossing facilities or traffic signals. Two speed humps and two raised pedestrian crossings are present but not on the most dangerous segments of the street. During weekends and nights walkability is made difficult by violent muggings by some elements frequenting the many shebeens of the infamous street. Eveline Street does not have existing NMT facilities to accommodate the high volume of pedestrians in that area. Pedestrian walkway is not available in Eveline Street therefore, pedestrians are forced to walk on unpaved sand walkways that are fully parked with cars. The photograph in Figure 12 , shows illegal dumping material burnt, mechanical work and a clothing vendor trading by the sideway, supposed to be used as pedestrian walkway, along Eveline street. The way cars are parked is dangerous and this increases the chance of pedestrian crashes in the area, as pedestrians are forced to walk on the road surface.



FIGURE 12: ENCROACHMENT ALONG THE ROAD RESERVE

There are limited facilities for pedestrians with only 6% of the total road network having paved sidewalks in Windhoek, while the majority of the roads do have some form of gravel sidewalk or shoulder that are not always properly maintained or continuous (CoW, 2018). The lack of continuity is further expressed by barriers experienced at intersections where there are no dropped kerbs or lack of pedestrian crossing lines at left turn slip lanes. Gravel sidewalks can be found throughout the City as indicate in Figure 13, especially in the north western suburb where Eveline Street is located, which far outweighs the number of the paved sidewalk sections.

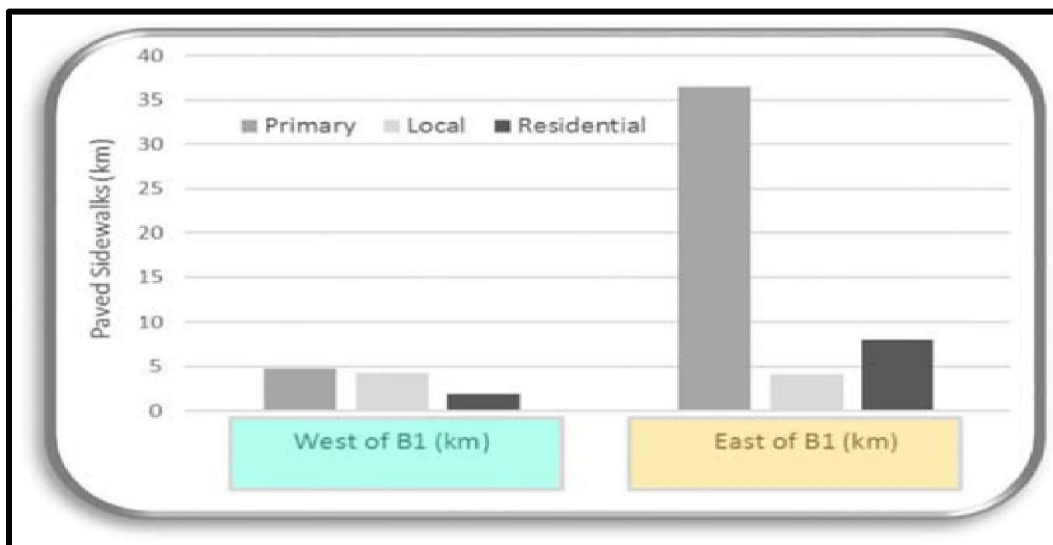


FIGURE 13: EXTENT OF PAVED SIDEWALKS COMPARED BETWEEN THE AREAS WEST VERSUS EAST OF THE WESTERN BY-PASS (SOURCE: COW, 2018)

Many challenges exist for pedestrians and cyclists in the way that the road is currently functioning (CoW, 2018).

An audit of existing road signage should be undertaken to determine to what extent it can be rationalised. In this manner the effective width of sidewalks can be increased in a relatively cost-effective manner. Formal and informal trading or related activities within the road reserve as indicated in Figure 14, which impact the effective width of sidewalks, should be moved.



FIGURE 14: HAWKERS AND INFORMAL TRADERS WITH ROAD RESERVES

The following possible measures should be implemented to increase the effective width or available space needed to implement NMT facilities:

- The hawkers and traders should be relocated from the sidewalk to designated areas.

- The need to improved management of hawkers and traders within or adjacent to the road reserve.
- The installation of fences along Eveline Street to prevent the encroachment of shacks, bars etc., into the road reserve.
- The provision of barrier kerbs with or without bollards to prevent vehicles from parking on the sidewalks.

Eveline Street has small business established adjacent to the road reserve, albeit illegally, therefore, options must be explored to provide dedicated areas for such activities, or to rezone adjacent properties where possible, to improve road safety, appropriately define attraction points and planning and development of NMT facilities.



FIGURE 15: UNSAFE PEDESTRIAN CROSSING FROM THE BUS STOP

Eveline Street is a major barrier to NMT movement and requires well-considered strategies to improve crossing safety by reducing informal pedestrian crossing behaviour as shown in Figure 15.

Figure 16, show a pedestrian walking past a car parked along Eveline Street. The car is parked on the pedestrian walkways impeding the movement of NMT modes, which is a common sight, especially over weekends along Eveline Street.



FIGURE 16: MOTORISED TRANSPORT PARKED ON THE WALKWAYS

In Figure 17, this photograph was taken in Eveline Street of a pedestrian walking on a sandy unpaved pedestrian walkway, revealing the absence of a paved pedestrian walkway that would improve the walkability of the area.



FIGURE 17: BARS AND CAR WASH ON THE PEDESTRIAN WALKWAYS

4.3. TRAFFIC TALLY

Point A, B, C, D and E, in Figure 18 of the study area along Eveline Street, indicate the zones for traffic counts. Point A is the street shoulder at Kwasa-Kwasa Enterprises where traffic density is high, due to the Fuel Station recently erected, and it is the entrance to Eveline Street. A few hundred metres away along the street, Point B is a junction of Eveline and Lucia Street. Point C is the busiest 4-way junction connecting the suburb of Greenwell Matongo and

Goreangab suburb, and Point D is a 3-way junction at Lobito which, again, connects Greenwell Matongo, Goreangab and Havana, used mainly by modes coming from the western direction of the street. Point E is further down and again Lucia Street makes a junction with Eveline Street, whose traffic flow is significant to the analysis. Appendix 3 and 4 shows the traffic tally matrix for the 5 points of travel analysis along Eveline Street on two different days, one working day (Monday) and one weekend day (Sunday). The traffic volumes for all modes are high in the morning and evening when most people are travelling to and from work or school. The data shows that walking is the main mode of travelling whilst cycling and motorbikes have the least takers.

4.3.1. MOTORISED TRAFFIC FLOW

In Figure 18, Point C recorded the highest volume of traffic in the morning and evening on the Monday, when people are travelling to work in the morning and returning home in the evening. This point is a 4-way stop intersection providing the main link to the other suburbs like Goreangab, Havana and Hakahana. During weekends, the flow of traffic is relatively uniform at all the points, with point A being an exception, recording somewhat high volumes, especially during the afternoons when people are refueling at the Fuel Station in that vicinity and when most people take detours to the popular Goreangab Dam for recreational purposes.

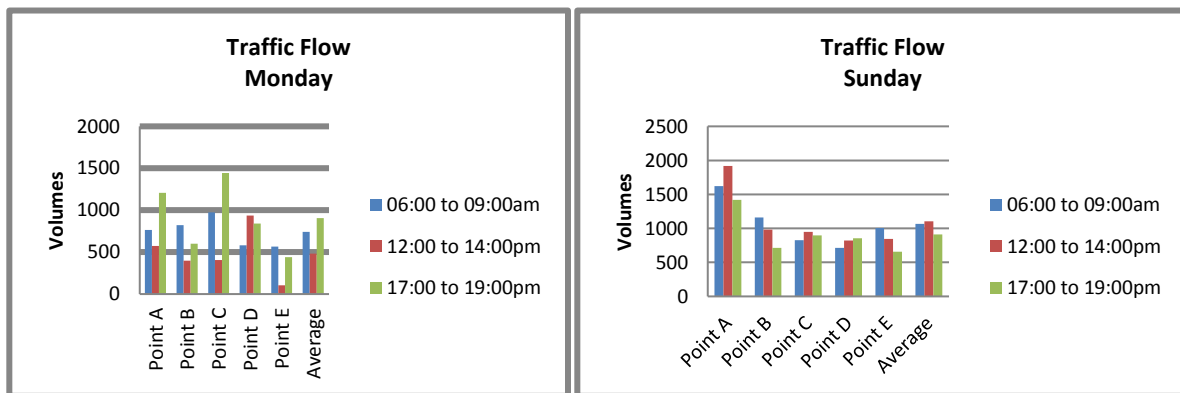


FIGURE 18: TRAFFIC FLOW AT POINT A-D IN THE MORNING, AFTERNOON AND EVENING ON DAY 1 & 2

4.3.2. CYCLIST FLOW

In Figure 19, the volume of cyclist flow is high during morning and evening when cyclists travel to and from work, respectively. The cyclist flow becomes low during weekends, indicating that this mode is mainly used for work and school purposes, rather than recreation. The difference between Monday and Sunday serve as an indication. The cyclists were asked to

stop voluntarily and asked for their time to participate in the survey, and a few cyclists were willing to take part, which also points to the low volumes of cyclist flow.

There is a clear statistically significant positive correlation between the reduction of NMT fatalities and the increase in NMT trips (Pucher and Bucher, 2008). The people are less likely to cycle if it is unsafe, and that if the conditions are safer then they will cycle more. It should be noted that the decreased trend of cyclist fatalities, as shown in Figure 19, are linked by Pucher and Bucher (2008) to the prioritised implementation of cycling facilities if cycling, walking or other forms of NMT modes are to be encouraged (Rietveld and Daniel, 2004; Pucher and Bucher, 2008), increasing the levels of safety, both actual and perceived, is important. The impact that NMT facilities have on improving safety should, therefore, not be neglected nor should the positive effects that NMT facilities have on increasing the use of NMT forms of transport (Baufeldt, 2016).

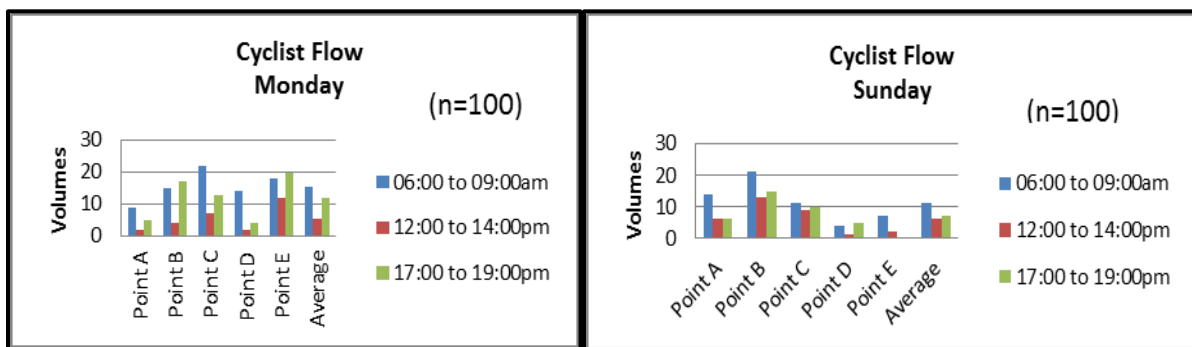


FIGURE 19: CYCLIST FLOW AT POINT A-D IN THE MORNING, AFTERNOON AND EVENING, DAY 1 & 2

4.3.3. PEDESTRIAN FLOW

In Figure 20, the highest volumes of pedestrians are recorded during the mornings and evenings when most people are travelling for work and school. Point C has the highest pedestrian record, as it is central, and in the proximity of trip generators, such as the satellite Police Station, community library and the Universal Church. Point A recorded the second highest pedestrian volume owing to school children attending a nearby secondary school, such as Highline Secondary School and Goreangab High School. During weekends the volume of pedestrians' increases in the afternoons, as most people frequent the street for its alcohol shops, carwash businesses and other trip generators of informal businesses along the street. The flow of pedestrians decreases in the evenings, because of safety concerns.

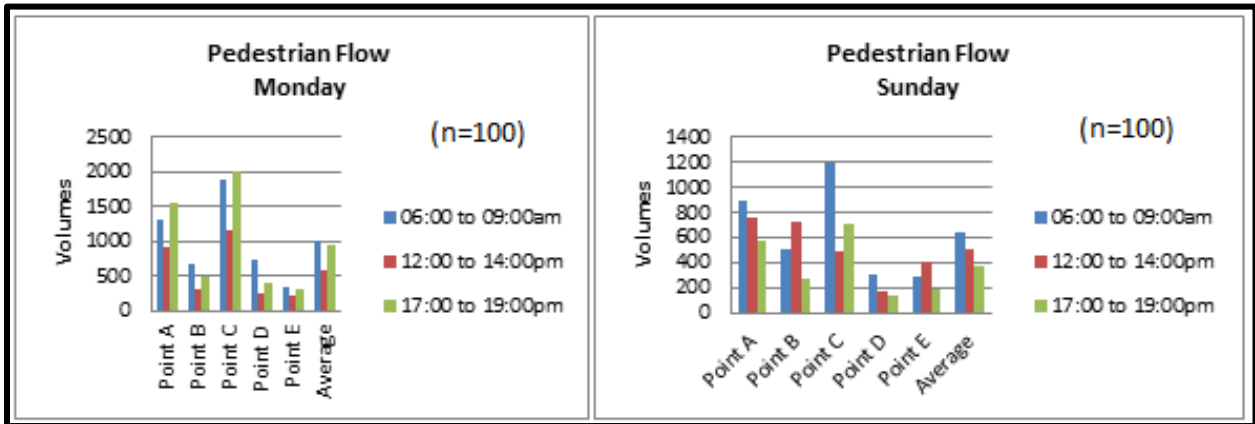


FIGURE 20: TRAFFIC FLOW AT POINT A-D IN THE MORNING, AFTERNOON AND EVENING, DAY 1&2

4.3.4. DESCRIPTION OF STATISTICS

The majority of pedestrian crashes for 2016 occurred during late afternoon hours with a total of 48% occurring between 16:00 hrs and 23:59 hrs (MVA, 2016) as shown in Figure 21.

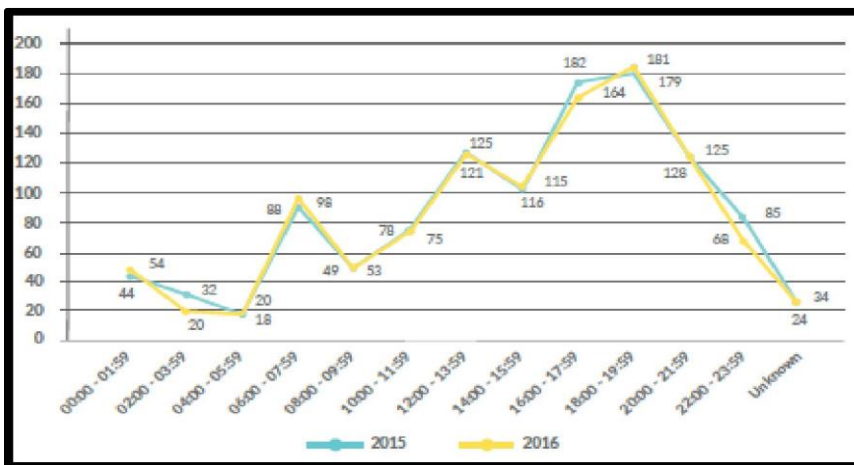


FIGURE 21: PEDESTRIAN CRASHES BY TIME OF DAY (SOURCE: MVA, 2016)

Eveline Street, similar to many other streets in Windhoek, has pedestrian crashes occurring mainly during weekends with Fridays recording 16%, while Saturdays record 21%. The lowest number of pedestrian crashes occurs on Wednesday with 12%, as shown in Figure 22.

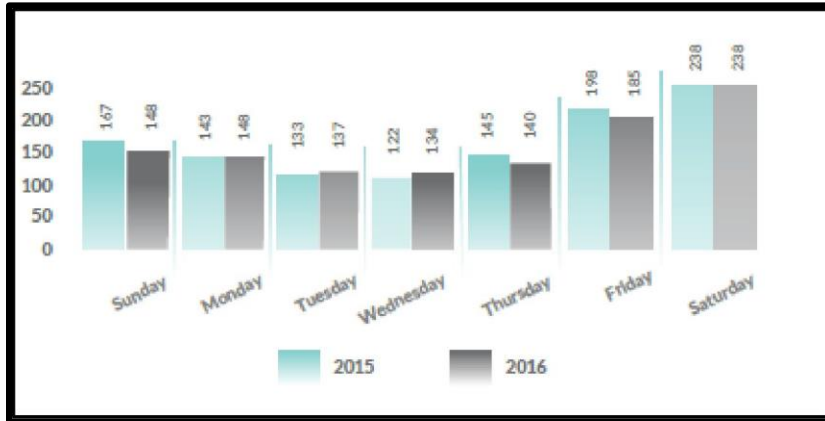


FIGURE 22: PEDESTRIAN CRASHES BY DAY OF THE WEEK (SOURCE: MVA, 2016)

An average of 1 006 pedestrian injuries were recorded in 2016 with 38% of the victims aged between 16 and 35 years and 26% being children under 15 years old in the Khomas region. Among these injuries 61% were males with fatality of 72% claiming males, which is a cause for concern economically and socially. Khomas Region also topped the cyclist crashes list recording 37% with 43 crashes, and this is concerning as low income groups resort to cycling as a mode of transport to workplaces and schools, due to an ever-increasing cost of living. The cost of the absence of a sustainable urban mobility strategy to have an all-inclusive transport infrastructure was reflected by a total of N\$169 million payment for medical services in 2016 and of the claims from MVA. Windhoek leads the pack with lodged claims of 44% (MVA, 2016). Where NMT is the main transport mode for the work journeys of the poor, it is also critical for the economic functioning of Eveline Street and the country as a whole. Despite these obvious merits, NMT have tended to be ignored by economic and spatial planners, road engineers and policymakers in the formulation of infrastructure policy, and positively discouraged as a service provider (Angira, 2008).

4.4. FINDINGS

The majority of people living in the study area prefer walking and this is followed by public transport users. The cycling mode along with the personal car, were equally preferred both constituting 12%. However, an insignificant 3% preferred a motorbike as a mode. The highest

volumes of pedestrians are recorded during the mornings and evenings when most people are travelling for work and school. The flow of pedestrians decreases in the evenings, because of safety concerns. The volume of cyclist flow is high during morning and evening when cyclists travel to and from work, respectively. The cyclist flow becomes low during weekends, indicating that this mode is mainly used for work and school purposes, rather than recreation.

From the study, the following are some of the findings, after the analysis of the primary and secondary data.

4.4.1. LACK OF NMT FACILITIES

The lack of integrated of Non-Motorised Transport (NMT) facilities was one of the main concerns that were raised by the experts in the interviews regarding NMT facility implementations in Cape Town (Baufeldt, 2016). To address this concern, the NMT facility implementations should focus on achieving a well-connected NMT network that would serve the needs of maybe fewer identified communities before attempting to meet the needs of those living in another area. In this manner NMT trips would be better supported as the NMT facilities would meet the needs of the NMT users for the entire NMT trip instead of only for selected links. Therefore, reducing the number of missing links or barriers that face NMT users, which deter them from making a NMT trip in the first place would have a significantly positive impact on the number of NMT trips. NMT facilities consisted of dedicated walkways, measures to prevent motor vehicles from driving and parking on road shoulders and walkways, construction of missing links, short cuts, and of bicycle lanes and dedicated cycle tracks. Traffic calming measures included intersection re-design of some intersections to increase their safety and efficiency for NMT, speed humps, raised zebra crossings, pedestrian crossing islands, medians, road narrowing with bicycle slips, and bus bays (Litman, 2014). Eveline Street is a very busy street in terms of traffic and pedestrian flows, but it has no visible infrastructure, such as pedestrian walkways and cycle tracks for NMT, which can improve the walkability and cyclebility of the study area. The street does not have facilities to accommodate the high volume of pedestrians in that area. Pedestrians walk along dirt informal paths, which are clogged by parked automotive or operating car wash facilities most of the times, which forces some pedestrians on the motorway, thereby increasing the potential of MT-NMT conflict. Eveline Street lacks signage and crossings, which exacerbate the potential conflict with MT, especially the curve in the entrance to the street until Kwasa-Kwasa (Point A) which is a high risk area

with MT's that will be speeding from Independence Avenue. At Point C, which is the 4-way intersection leading to Goreangab, there are no pedestrian crossings or signals to help the mobility of NMT users. Two speed humps and two raised pedestrian crossings are present but not on the most dangerous segments of the street. The low volume of cyclists, according to the analysed data, may be attributed to the lack of related facilities. The cyclist has to risk sharing the road with MT that disregards NMT. Overall, Eveline Street, like many other streets of the Windhoek Municipal area, was built without due consideration of NMT as a mode, hence the absence of pedestrian paths and cycle tracks among other NMT facilities. The current state of NMT infrastructure development in Windhoek is not at the same level between the north-western areas and south-eastern areas, which is of concern. By taking the Western By-pass as a spatial divider, it is evident in Figure 23 that 82% of all paved sidewalks are located in areas east of the Western by-pass and these are mostly in the CBD areas. Generally, there is a lack of adequate NMT infrastructure, specifically a lack of safe crossing points across the Western by-pass, Eveline Street and across Monte Christo Road.

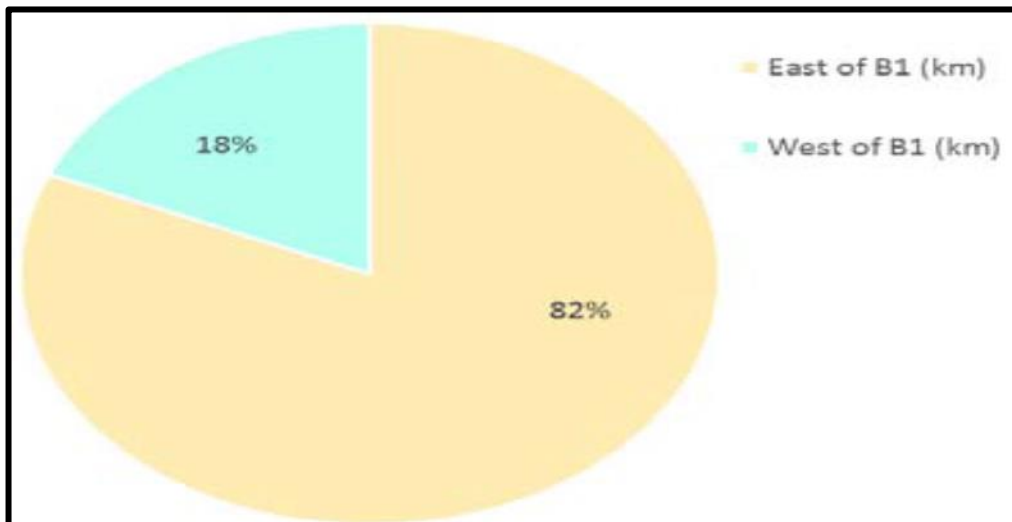


FIGURE 23: PERCENTAGE OF PAVED SIDEWALK PROVISION IN THE AREAS WEST VERSUS THE AREAS EAST OF THE WESTERN BY-PASS (SOURCE: COW, 2018)

Gravel sidewalks can be found throughout the City especially in the north western suburb where Eveline Street is located, which far outweighs the number of the paved sidewalk sections. Many challenges exist for pedestrians and cyclists in the way that the road is currently functioning (CoW, 2018).

4.4.2. TRAFFIC CONGESTION

There is no single definition of traffic congestion and the problem can be interpreted in different ways, although, in general, it is a situation in which demand for road space exceeds the supply (Talukdar, 2013). Traffic congestion occurs when traffic is delayed, due to the presence of an excess number of vehicles on the same portion of the roadway at a particular time, resulting in slower than normal or "free flow" speeds (Link et al., 1999). There are long queues of vehicles, which move in a constant start and stop basis, because the number of vehicles trying to use the road exceeds the design capacity of the road. Consequently, it results in delay in traffic movement and the traveller cannot move in a desirable manner (Taylor, 2003). Traffic congestion can be described in two ways:

- The high vehicle concentration moving at low flow speed, and
- The number of vehicles on the road is close to, or exceeds, the maximum capacity of the road causing an imbalance between travel demand and transport system supply (Talukdar, 2013).

Eveline Street is heavily congested by human and motor traffic during peak hours. The 95% of participants in this study indicated that they were not satisfied with the time they take to reach their destinations, which is caused by this congestion. The high traffic during peak hours is a result of the high volumes of personal cars, which normally carry single passengers and, to a considerable extent, by public transport in the form of sedan taxis. Pedestrian congestion is relatively increased during weekends when the roadsides are blocked by cars and the patrons of the bars along the street. By design, Eveline Street is narrow and has been compounded by bar verandas encroaching the roadway, which has a significant impact on pedestrian mobility. Traffic congestion is worse at intersections and inadequate signage and traffic control measures make pedestrians become victims to such road conditions. Lack of taxi ranks along Eveline Street adds to the traffic congestion as taxis are stopping everywhere, disregarding the municipal traffic by-laws. Eveline Street has poor connectivity with roadways and pathways, because better connected streets allow direct travel between destinations.

4.4.3. LACK OF NMT AWARENESS

A major challenge of which NMT is facing is that it is not recognised as a mode of transport. This lack of recognition is owed to the general lack of consideration for pedestrians and cyclists by motorists and the lawless and reckless behaviour of NMT users. The lack of consideration for NMT users is also inherent from transport infrastructural planning and design. The

conscious introduction of the culture of walking and cycling in the mobility environment, and the respect and consideration for NMT users in the streetscape environment, are required. The lack of awareness and recognition has also caused a stigma against NMT. It has resulted in culture/social behaviour that NMT use is negative, not desired and only for the poor.

NMT planning should have greater priority in Windhoek, but it is largely neglected, due to the lack of awareness of the role of NMT modes of transport, minimal funding and other basic transport infrastructural needs taking preference over NMT. Non prioritisation of NMT, among other reasons, results in high rates of pedestrian accidents, with approximately 37% of pedestrian fatalities recorded in Khomas (MVA, 2016). The majority of the respondents was not formally educated but constitutes a large group of NMT users and they would find it difficult to understand the objectives of this study. They are a mode of transport in their own right, hence, they deserve the same privilege as MT users when using the road, and the street should have infrastructure to improve their mobility.

4.4.4. PROVISION OF NMT INFRASTRUCTURE IN URBAN ROAD DESIGNS

Lack of NMT infrastructure and NMT safety programs is a setback for NMT in Windhoek, particularly Eveline Street, where pedestrian flow is impeded by lack of sidewalks and cycle tracks for these significant modes. Improvements to NMT environments, mainly used by the poor, could be a way to increase urban productivity and thus reduce poverty. If the primary objective is to provide a safe and efficient travel environment, then a very high priority must be given to large-scale traffic calming measures throughout road networks, and provision of safe NMT road space along the major arterial road network. Road signs and markings for pedestrian and public transport facilities must be provided to guide and warn all road users about the presence of pedestrians and public transport activity and to regulate public transport and pedestrian behaviour. Typically, road markings and signage are provided at pedestrian crossings, along footpaths, along cycle paths / lanes as warning signs to motorists and to guide pedestrians and cyclists as shown in figure 24 & 25.



FIGURE 24: RAISED PEDESTRIAN CROSSING WITH BOLLARDS (SOURCE: COW, 2018)



FIGURE 25: BICYCLE LANE DEVELOPED IN EXISTING ROAD SHOULDER (SOURCE: COW, 2018)

As a way to summarise and simplify the results of the research various investigations, a SWOT analysis of the results was then drafted. This aimed to highlight the current opportunities and challenges experienced that affects the promotion of the Non-Motorised Transport (NMT) in Eveline Street in the Windhoek Municipal area, in an accessible way, which could then be used in the decision making regarding NMT implementations in the future.

4.5. SWOT ANALYSIS

4.5.1. SWOT ANALYSIS OF CASE STUDY: STRENGTHS

The strengths of the NMT in Eveline Street are highlighted and summarised in the following bullet points.

- The Windhoek Non-Motorised Transport (NMT) Strategy is completed and if adopted by CoW it will be used as the key the guideline policy framework within which the development will be addressed in terms of NMT in all new and upgraded development.
- In areas that NMT has been improved such as around the Eveline fuel station, the safety of NMT users has improved significantly (based on quantitative investigations).
- Unpaved sidewalk is already in existence, NMT facility provision is generally improving the facilities that are available to NMT users. This is helping to create better urban spaces for NMT users to move within.
- The basic ways to address concerns of NMT users are incorporated into the Windhoek NMT Strategy. These practices need to be adopted by the Windhoek Municipality, as newer, better designs and practices have been developed and are available and can be readily implemented.
- Sidewalks must be provided along the frontage of the development. Implementation of NMT strategy is going to improve the livelihood of pedestrians as there is a big number of pedestrians in the area.

4.5.2. SWOT ANALYSIS OF CASE STUDY: WEAKNESSES

The weaknesses of NMT in Eveline Street are highlighted and summarised in the following bullet points.

- The internal NMT movement must be assessed and internal pedestrian desire lines identified. The NMT facility in Eveline Street should address the needs of NMT users by providing routes that are shorter and more direct than motorised transport routes.
- All sidewalks in Eveline Street are not paved.
- The street lighting in Eveline Street is important to improve personal security as well as to improve sight lines for pedestrians and cyclists. Street lighting does not always light up pedestrian sidewalks because the lighting is mounted on the side of the road and can create a dark spot behind the streetlight as trees, bars, carwashes, houses also interfere with the lighting and create dark spots.
- Left turn slip lanes do not incorporate pedestrian crossing lines or dropped kerbs for pedestrians and cyclists to cross the slip lane. To ensure NMT continuity and address NMT safety, the NMT movement should be made more comfortable and safe and a form of pedestrian crossing should be incorporated across all the left-turn slip lanes.

- All impacted intersections in Eveline Street warranting upgrading should be universally accessible; pedestrian crossings provided where required and signalised intersections should have pedestrian push-buttons.
- In many of the images for the case study Challenges and Opportunities for Sustainable Urban Mobility (NMT), Eveline Street in the Windhoek, there were indications of poor considerations for NMT users. These include complete lack of safe, paved pedestrian walkways and cycling lines, which would create movement barriers. Additionally, other barriers such as street furniture (dustbins, lampposts, signs, dumpsite, parked cars, and vendors) were poorly regulated and motorised traffic will continue to dominate public transport spaces, leaving NMT users as second-class commuters.
- In some of the areas in Eveline Street, there was clear evidence of inadequate maintenance with vegetation and waste dominating the sidewalks. If this is not addressed and properly managed then it is unlikely that the pedestrians will use the sidewalks optimally without hindrance.

4.5.3. SWOT ANALYSIS OF CASE STUDY: OPPORTUNITIES

The opportunities of the NMT in Eveline Street are highlighted and summarised in the following bullet points.

- Better integration with public transport and places of education and work could greatly improve NMT trips in Eveline Street.
- Interventions at school accesses and safer routes to schools. Appropriate road signs and markings, including a speed limit zone of 40km/h surrounding the school should be adopted.
- NMT safety elements should also be considered at appropriate locations. These include surfaced sidewalks or paths, handrails or guardrails where appropriate, pedestrian bridges (where warranted), staircases along steep gradients, pedestrian crossings and refuge islands for pedestrians along Eveline Street.
- Road signs and markings for pedestrian should be provided to guide and warn all road users about the presence of pedestrians and cyclist and to regulate their behaviour. The road markings and signage should be provided at pedestrian crossings, along footpaths, along cycle paths / lanes as warning signs to motorists and other road users.

- Using the Windhoek NMT strategy would improve the prioritisation and quality of the designs of NMT facilities in Eveline Street. The guidelines provide a clear approach to develop much improved designs and implementations of NMT facilities.

4.5.4. SWOT ANALYSIS OF CASE STUDY: THREATS

The threats of the NMT in Eveline Street are highlighted and summarised in the following bullet points.

- NMT paths or sideways along Eveline Street is obstructed by the clutter of urban street furniture such street lighting poles, road signs, traffic light poles, cars, carwash, bars and vendors. These are typically located in such a manner that it obstructs the flow of NMT users.
- Building awareness around the implementation of NMT infrastructure design guideline, and encouraging practitioners and stakeholders to use the guidelines in their projects and design for new and existing development, would need sufficient training, education and perhaps incentives. It will take dedicated resources to achieve this and if this does not happen it is unlikely that the quality of the NMT facilities that are being rolled out will improve.
- Improved management of hawkers and traders within or adjacent to the road reserve. The formal or informal trading or related activities within the road reserve impact the effective width of sidewalks and such activities compete for available space with pedestrians and available space for pedestrians is sacrificed to an extent that at times pedestrians are forced into the road, therefore relocating hawkers and traders to designated areas is necessary.
- The provision of barrier kerbs with or without bollards to prevent vehicles from parking on the sidewalks.
- Universally Accessibility- Eveline Street should be upgraded to the universally accessible standards especially at the intersections to accommodate everybody including persons with disability. Tactile paving at pedestrian crossings should be aligned at 90-degree to the direction of travel to avoid blind pedestrians being guided towards the centre of the intersection.
- Separation between cyclists and pedestrians. Improvement of NMT facilities will have a smaller positive impact on the cyclist than the impact with regards to the pedestrians. Therefore, steps should be taken to ensure that future cycling facilities are better

designed, implemented and maintained to ensure the maximum benefit to the NMT users and that resource and efforts are not wasted.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSION

NMT as a mode of transport has benefits that could greatly contribute to the transportation network and urban environment in Windhoek and more specifically to Eveline Street. However, there are still challenges of providing for NMT users in Eveline Street, so that they are able to make NMT trips in a safe and comfortable manner. The aim of this research was to investigate those challenges and opportunities for Sustainable Urban Mobility, NMT, in Eveline Street in the Windhoek Municipality, Namibia. Several research questions were drafted and through various methods of data collection adopted in the research and an analysis that were used in this study, these research questions were addressed. The conclusions to all the research questions are now briefly concluded.

The development and implementation of the NMT strategy for the sustainable urban transport systems requires radical departures from normal planning and decision-making processes, as cities around the world are establishing visions for sustainable development and how they can realise their dreams. All decision making must be sustainability-based by integrating social, economic, environmental and cultural considerations, as well as compact, transit-oriented urban form principles, to shorten the walking distance. The nature of what NMT facilities must be implemented depends slightly on the local context. However, the NMT facility implementations generally aimed to improve pedestrian and cycling paths. Furthermore, the urban environments were improved through landscaping features, improved intersections and applying principles of Universal Access to the designs (Baufeldt, 2016).

1. Is the balance between motorised transport and NMT infrastructure achievable with the existing traffic conditions along Eveline Street?

From the study it can be concluded that the balance or logical integration of NMT and motorised transport can be achievable despite the existing traffic conditions. The lack of integrated planning is a significant contributor to the poor NMT environment in Windhoek and on Eveline Street. The lack of NMT integration is also evident in development planning where NMT is not given sufficient attention in the design of roads, traffic impact assessments and other planning tools. In practice, the road can be widened along Eveline Street to accommodate the NMT facilities for pedestrians and cyclists and to add traffic calming measures to reduce car speeds and safe pedestrian crossings across Eveline Street for those engaged in economic

activities and for school children as shown in Figure 26. The implementation of these measures will ensure sustainable mobility in Eveline Street and will create a safe environment for NMT and MT to coexistence.



FIGURE 26: COMPLEX PEDESTRIAN CROSSING ENVIRONMENT AT ROUNDABOUTS ALONG INDEPENDENCE AVENUE (SOURCE: COW, 2018)

In Windhoek dual carriageway roads are very wide with at least two lanes per direction. The wide roads is challenging for NMT users to cross. Shoulder widths are mainly narrow if existent at all and some gravel shoulders are also to be found. Left-turn slip lanes are a common feature at most signalised intersections, which make NMT crossings risky due to the conflict with left-turning vehicles. Pedestrian signal phasing and the width of pedestrian refuge island make for relatively long NMT crossing distances at intersections. Left turn slip lanes do not incorporate pedestrian crossing lines or dropped kerbs for pedestrians and cyclists to cross the slip lane. To ensure NMT continuity and address NMT safety, the NMT movement should be made more comfortable and safe and a form of pedestrian crossing should be incorporated across all the left-turn slip lanes (CoW, 2018).



FIGURE 27: OBSTRUCTION FROM VEHICLES PARKING ON SIDEWALKS

As indicated in Figure 27, one of the big concerns is also the general practice of using sidewalks as parking spaces. Overall, the road network suggests that the needs of pedestrians are not prioritised in the design and planning of roads, resulting in a non-friendly pedestrian environment. Therefore, a lack of connectivity and cohesion in the quality of NMT routes leaves the NMT Network with significant gaps all over Windhoek.

2. What is the extent of other NMT modes besides walking along Eveline Street?

NMT mode in Eveline Street, besides walking is cycling, other NMT carts are uncommon. Wheelbarrows are used to transport wares for people who set up their informal markets along Eveline Street during the day, and discard in the evening, when the dark comes. Other NMT modes like skateboarders, animal-drawn carts etc., are very limited in the study area. The majority of people living in the study area prefer walking as pedestrians constitute 44% of the preferred modal share as opposed to 12% of cyclist.

There is no provision for cyclists made in Windhoek except for at the Grove Mall, which means current NMT facilities are limited to the walking mode. There are also limited facilities for pedestrians with only 6% of the total road network having paved sidewalks in Windhoek, while the majority of the roads do have some form of gravel sidewalk or shoulder that are not always properly maintained or continuous. The lack of continuity is further expressed by barriers experienced at intersections where there are no dropped kerbs or lack of pedestrian crossing lines at left turn slip lanes (CoW, 2018).

3. What will the economic impact be of NMT facility implementation along the busiest street in Windhoek, (i.e.) Eveline Street?

The implementation of NMT facilities along Eveline Street has the potential to contribute to economic transformation by providing opportunities for small businesses along Eveline Street linked to NMT support services, as well as safe pedestrian movement along the Street. The development of NMT infrastructure can also provide quality economic environments in support of social transformation. Improving the NMT facilities along the busy Eveline Street will increase business opportunities for locals due to business reductions in traffic conflict between NMT and MT, reduce traffic congestion and improved security (which means that those members of the community who were previously not comfortable visiting the business units dotted along Eveline Street will now be able to do so), which will have positive impact on the economy. The study further concludes that the successful implementation of NMT projects depends on the provision of appropriate NMT infrastructure, public awareness and formal education of the potential NMT users and financing of NMT-related projects. Overcoming these challenges will require changes in transport investment patterns, infrastructure design standards, street space allocation in all suburbs, financing systems and regulatory policy.

5.2. STUDY RECOMMENDATIONS

Recommendations are now made based on the conclusions, and secondly, a few recommendations are made regarding improvements and suggestions for further research within this area of NMT in Windhoek.

Recommendations for implementation and further research in this area of non-motorised transport

Investigating other streets in Windhoek, in the manner as described in this research, could be the next step in verifying whether the research methods used in this research are transferable to other major streets in Windhoek. This would help to establish if NMT facility improvement and upgrades will have an impact on safety of pedestrians along the busiest streets in Windhoek and to make sure that provision of proper pedestrian infrastructure must have the highest priority in urban transport investments to achieve major urban productivity gains and contribute directly to poverty alleviation.

Furthermore, several research questions could be further investigated. These include the following:

- Which specific NMT links, if upgraded, would greatly improve the connectivity of the existing NMT network, thereby improving the safety of the NMT users along the entire

length of their trips, as well as improving the efficiency of NMT trips by establishing seamless and direct routes?

- Investigate the relationship between public transport facilities and NMT facilities in Windhoek.
 - How to integrate NMT facilities into an existing public transport network
 - How would improvements to NMT facilities improve mobility in Windhoek and alleviate poverty?
- What NMT facilities would make the biggest contribution to improving the lives and level of service experienced by NMT users?

From the findings of these research questions, the importance of NMT, to improve mobility, could be better understood and prioritised in the Windhoek.

In the longer term:

The improvement and integration of public transport and NMT facilities should be effected before new development rights outside the initial development phase are considered.

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7. APPENDICES

7.1. APPENDIX 1: QUESTIONNAIRE



Questionnaire No —

Date —

STRUCTURED QUESTIONNAIRE FOR ROAD USERS

The purpose of this questionnaire is to determine the challenges faced by NMT users and to identify possible opportunities associated with this mode of transport along Eveline Street in the high density suburb of Greenwell Matongo.

Declaration

*The information given will be treated with confidentiality and used for academic purposes only.
Please answer the Questions as instructed*

Study Area

Respondents Details

1. **Name (Optional)**.....

2. **Age (Years)**

- a) Below 18 b) 18-36 c) 37-55 d) Over 55

3. **Sex:** 1. Male 2. Female

4. **Marital status**

- 1. Single 2. Married 3. Divorced 4. Separated 5. Others

Specify.....

5. Educational Level

1. No formal education 2.Primary 3.Secondary 4.College 5.University

6. Occupation

1. Formal employment 2. Self-employed 3. Farmer 4. Manual labourer 5. Others
Specify

.....

7. Journey mode to Eveline Street

1. Walking 2. Cycling 3. Motor Bike 4. Personal Car 5. Public Transport

8. Where is your place of origin?

- 1 Greenwell 2. Goreangab 3. Havana 4.Hakahana 5. Wanaheda 6. Others
Specify

9. Where is your destination?

- 1 Greenwell 2. Goreangab 3. Havana 4.Hakahana 5. Wanaheda 6. Others
Specify

10. How long do you take (Minutes) to reach your destination?

- 1 (1-20minutes) 2. (21-40 minutes) 3. (41-60) minutes 5. Other

11. Are you satisfied with the time you take?

1. Yes 2. No.

12. If No what can be done to reduce your journey time?

.....
.....

13. What is the purpose of your journey?

1. Work 2.School 3.Shopping 4.Business 5.Others
Specify.....

14. What time of the day do you take long to reach your trip?

1. 5:00 - 7.00am 2. 7:00 – 9:00am 3. 9.00 – 11:00am 4. 11:00-1:00pm
5. 1:00 - 3.00pm 6. 3:00 – 5:00pm 7. 5:00 -7:00pm

15. What is your preferred mode of transport within the area?

1. Walking 2.Cycling 3. Motor Bike 4.Public Transport 5. Personal Car 6. Others

16. How would you describe the condition of each of the NMT infrastructure (Foot paths

Personal Car											
Public Transport (Taxi)	No. of Vehicles										
Public Transport (Buses)	No. of Vehicles										
Motorbike	No. of Vehicles										
Cycling	No. of Vehicles										
	No. of Vehicles										

Pedestrian										

C. Walkability Audit Tool

CDC (2004) provides a Walkability Audit Tool which consists of an evaluation form, shown below, for rating a particular travel segment or area in terms of eight factors. A total rating of 70-100 is considered good, ratings of 40-69 are considered medium and a rating under 40 is considered poor.

In this exercise we ask you to fill in the Walkability Audit Tool for your city.

Figure 7 Walkability Audit Tool

A. Pedestrian Facilities (High Importance): Presence of a suitable facility, such as a walking path or pavement.				
1 No facility – pedestrians walk on road or dirt path.	2	3 Paved walkway on one side of road, minor discontinuities that present modest barrier to walking.	4	5 Continuous paved walkway on both sides of road or completely separated from roadway.
B. Pedestrian Conflicts (High Importance): potential for conflict with motor vehicle traffic due to driveways, high speed and volume traffic, large intersections, poor pedestrian visibility, etc.				
1 High conflict potential	2	3	4	5 Low conflict potential.
C. Crossings (High Importance) presence and visibility of crossings at intersecting roads. Traffic signals have functional ‘walk’ lights that provide sufficient crossing time.				

1 Crossings not present despite large intersections.	2	3	4	5 No intersections, or crossings clearly marked
D. Maintenance (Medium Importance): buckling pavement, overgrown vegetation, standing water, etc.				
1 Major or frequent problems.	2	3	4	5 No problems.
E. Path Size (Medium Importance): adequate functional width, taking into account factors such as utility poles and signs within pathway.				
1 No permanent facilities.	2 Narrow path (<3' width).	3	4	5 Wide path (>5' functional width).
F. Buffer (Medium Importance): space separating path from adjacent roadway				
1 No buffer from roadway or pedestrians walks in roadway.	2	3 Moderate buffer (3' from traffic)	4	5 Not adjacent to roadway.
G. Universal Access (Medium Importance): ease of access for mobility impaired people. Includes ramps for wheelchairs, handrails along steps, etc.				
1 Completely impassable to people with impairments.	2 Difficult or dangerous (e.g., no wheelchair ramps).	3	4 Accessible, but inconvenient (e.g., greater travel distance)	5 Fully accessible and convenient.
H. Aesthetics (Medium Importance): attractive facilities and conditions create a place that				

people enjoy.				
1 Uninviting	2	3	4	5 Very attractive.
I. Shade/Covering (Low Importance): amount of shade and rain cover.				
1 No cover	2	3 Moderate cover	4	5 Full cover

This form can be used to evaluate the walkability of a particular travel segment or area. Values for “High Importance” factors (A-C) are multiple by 3, and “Medium Importance” factors (D-H) are multiplied by 2. The results are summed for a total score.

Calculations

	Basic Sums	Weight Factor	Totals
Sum of “High Importance” Factors (A-C)		x 3	
Sum of “Medium Importance” Factors (D-H)		x 2	
Sum of “Low Importance” Factor (I)		x 1	
<i>Total Score</i>			<i>/100</i>

Observations

In addition to the quantitative analysis, also provide the following information.

1. What is the most dangerous location along this segment or area?
2. What is the most unpleasant element of this segment or area?
3. What improvements would make this segment or area better for walking?
4. Would it be possible to design a more direct route to connect destinations along this segment or area?
5. Are conditions of this segment or area appropriate and attractive for exercise and recreational use?

7.2. APPENDIX 2: ETHICS FORM

Ethics clearance was completed through the online systems. Copy of the hardcopy form is shown below.

Application for Approval of Ethics in Research (EiR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form before collecting or analysing data. The objective of submitting this application prior to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the EBE Ethics in Research Handbook (available from the UCT EBE, Research Ethics website) prior to completing this application form: <http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf>

APPLICANT'S DETAILS	
Name of principal researcher, student or external applicant	Erwin Kamundu
Department	Civil Engineering
Preferred email address of applicant:	Erwin.Kamundu@windhoekcc.org.na
If a Student	Your Degree: e.g., MSc, PhD, etc.,
	Name of Supervisor (if supervised):
If this is a research contract, indicate the source of funding/sponsorship	
Project Title	

CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE URBAN MOBILITY (NON-MOTORISED TRANSPORT): A CASE STUDY OF EVELINE STREET IN THE WINDHOEK MUNICIPAL AREA, NAMIBIA

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY			
	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Erwin Kamundu	signature removed	03 Jul 2017

APPLICATION APPROVED BY			
	Full name	Signature	Date
Supervisor (where applicable)	Click here to enter text M Vanderschur	signature removed	Click here to enter a date 12 Aug 17
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduate research (Including	Click here to enter text Roger Behrens	signature removed to avoid exposure online	Click here to enter a date 17 Oct 17

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7.3. APPENDIX 3: TRAFFIC TALLY FOR MORNING, AFTERNOON AND EVENING HOURS, SUNDAY

Mode	Time	Points					Average
		A	B	C	D	E	
Personal Car	06:00 to 09:00am	764	822	974	581	566	741.4
	12:00 to 14:00pm	572	399	406	936	104	483.4
	17:00 to 19:00pm	1208	601	1445	840	440	906.8
Public Transport (Taxi)	06:00 to 09:00am	1001	418	1102	502	442	693
	12:00 to 14:00pm	865	311	1124	318	316	586.8
	17:00 to 19:00pm	1225	647	1485	850	580	957.4
Public Transport (Bus)	06:00 to 09:00am	63	42	56	54	120	67
	12:00 to 14:00pm	58	36	64	39	101	59.6
	17:00 to 19:00pm	89	51	92	71	139	88.4
Motorbike	06:00 to 09:00am	1	6	11	2	0	4
	12:00 to 14:00pm	0	2	9	3	7	4.2
	17:00 to 19:00pm	5	8	7	1	5	5.2
Bicycle	06:00 to 09:00am	9	15	22	14	18	15.6
	12:00 to 14:00pm	2	4	7	2	12	5.4
	17:00 to 19:00pm	5	17	13	4	20	11.8
Pedestrian	06:00 to 09:00am	1320	675	1890	736	344	993
	12:00 to 14:00pm	925	310	1151	254	211	570.2
	17:00 to 19:00pm	1540	482	2004	412	305	948.6

7.4. APPENDIX 4: TRAFFIC TALLY FOR MORNING, AFTERNOON AND EVENING HOURS, MONDAY

Mode	Time	Points					Average
		A	B	C	D	E	
Personal Car	06:00 to 09:00am	1622	1160	826	715	1005	1065.6
	12:00 to 14:00pm	1920	980	951	821	847	1103.8
	17:00 to 19:00pm	1418	715	898	856	658	909
Public Transport (Taxi)	06:00 to 09:00am	601	520	1031	428	521	620.2
	12:00 to 14:00pm	468	412	1506	544	253	636.6
	17:00 to 19:00pm	679	259	1112	509	317	575.2
Public Transport (Bus)	06:00 to 09:00am	48	78	56	15	66	52.6
	12:00 to 14:00pm	36	53	60	18	41	41.6
	17:00 to 19:00pm	28	34	51	7	44	32.8
Motorbike	06:00 to 09:00am	3	8	13	1	2	5.4
	12:00 to 14:00pm	1	7	10	0	3	4.2
	17:00 to 19:00pm	4	8	2	1	7	4.4
Bicycle	06:00 to 09:00am	14	21	11	4	7	11.4
	12:00 to 14:00pm	6	13	9	1	2	6.2
	17:00 to 19:00pm	6	15	10	5	0	7.2
Pedestrian	06:00 to 09:00am	899	507	1204	301	290	640.2
	12:00 to 14:00pm	765	734	498	167	406	514
	17:00 to 19:00pm	570	269	703	140	188	374