Effects of Land Use on Non-Motorized Transport Patterns in Eldoret Central Business District

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Abstract

Non-motorized transport is a primary means of transportation for people in developing countries. Developing countries, including Kenya have prioritized vehicular mobility to the disadvantage of non-motorized transport which is more affordable. Motorized transport though popular does not provide a door-to-door access as does NMT. This thesis sought to evaluate the influence of land uses on non-motorized patterns within Eldoret Central Business District. The land use – transport nexus is dynamic process with land uses determining the location of activities accessed by people through the transport networks. Eldoret's transport system is characterized by high population and stiff competition for limited road space among motorists, pedestrians and cyclists. Its high travel demand is occasioned by administrative, industrial, institutional, regional and local economic roles. Findings of this study are to inform urban governance in promotion on NMT and guide prioritization of provision of infrastructure along NMT hotspot zones and corridors.

The municipality has been growing since its inception in 1958 from an area of 25km² to the gazetted municipal area of 148km². in 1969 its population stood at 18192 growing to 475716 in 2019. Traffic volume was surveyed along three key transport corridors with an aim of getting insights on NMT travel patterns for the CBD. From the survey, modal share, trip frequency, cross-tabulation of traffic volume versus time as well as trip purposes were analysed. Land uses influences travel patterns. As a consequence of growing municipality, land uses have transformed from expanding CBD to sprawling residential neighbourhoods. Uganda, Kisumu, Iten and Nandi roads are the key access routes and are characterized by inadequate NMT infrastructure. Where NMT facilities exist, its development is faced with non-aligned building lines, non-universality, lack of provision for different modes of NMT, utilization of pedestrian zones for vehicle parking and informal traders. Public transport is disorderly with over 15 terminals. Modal share findings places pedestrians at 95% while handcarts and cyclists constitute 1% and 4% respectively. MTRH, Paul's bakery and Barngetuny plaza enumerating highest daily NMT traffic volumes. From the study, routine trips constitute 86% while irregular and production trips contribute 4% and 10% respectively. Shared road space, inadequate crossings and poor traffic separation is a challenge and results in traffic conflicts. Traffic calming facilities at crossings and separation of NMT modes is inadequate.

In order to overcome the challenges, regional, municipal and CBD level recommendations are put forward. Regional proposals aim at decongesting the CBD through downgrading of Uganda road, promoting transit-oriented developments and long-term relocation of the industrial park. Municipal proposals aim at opening up roads for better traffic circulation through upgrading of ring roads, completion of missing links, developing public transport and parking strategy to release CBD space for NMT infrastructure development and use. This study further recommends development of safe, cohesive and comfortable multi-modal NMT infrastructure networked in on all pedestrian zones. It is further proposed that bi-cycle parking silos are developed at the termini to incentivize cycling given the gentle terrain across the municipality. Motorized traffic circulation has been altered through conversion of narrow streets from two-way to one-way streets and limiting of allowable turns at road intersections. Channelling of NMT traffic using a barrier along Uganda road to designated crossing points where traffic separation and calming facilities are proposed.

Key words: land use, Non-Motorized Transport, mobility, policy

Declaration

This thesis is my original work and has not been presented in any other University or College for examination purpose or any other award.

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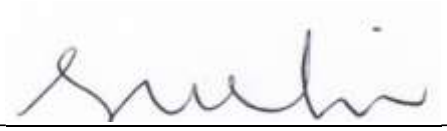
Declaration by Supervisors

This thesis has been submitted for examination with our approval as the University supervisors.

Sign:  Date: 20th May 2021

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Dedication

To my family;

Kipkalya, Chelangat, Kibet and Agnes

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Acronyms

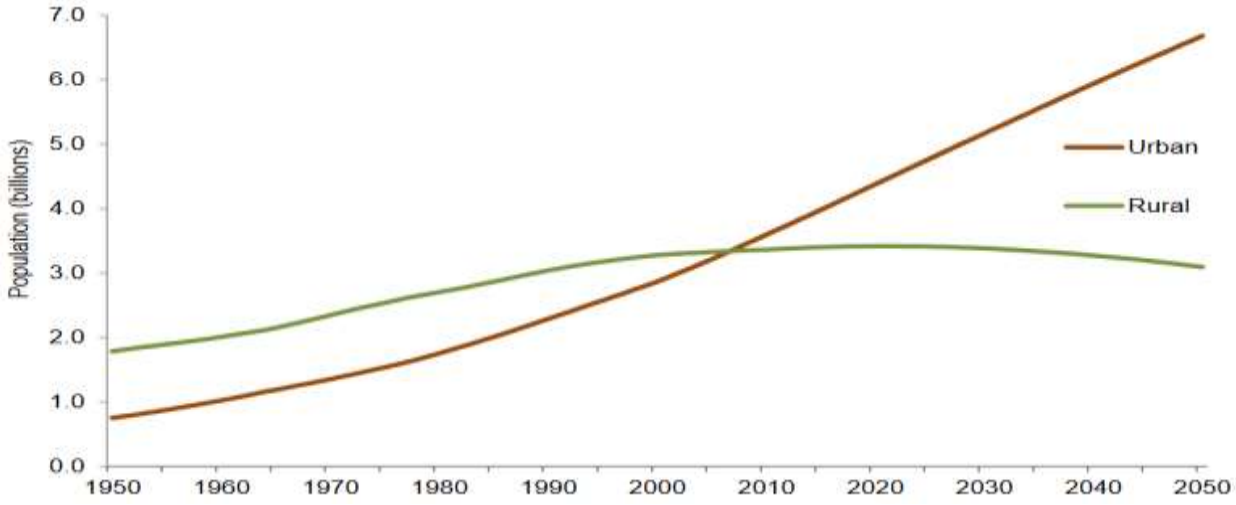
CBD	Central Business District
IRF	International Road Federation
KCC	Kenya Cooperative Creameries
KMP	Kenya Municipal Programme
NCPB	National Cereals and Produce Board
NMT	Non-Motorized Transport
MTRH	Moi Teaching and Referral Hospital
UNEP	United Nations Environmental Programme
KMTC	Kenya Medical Training Institute
KISIP	Kenya Informal Settlements Improvement Project
MT	Motorized Transport
CGUG	County Government of Uasin Gishu
MoL&PP	Ministry of Lands and Physical Planning
MoTIHUD	Ministry of Transport Infrastructure Housing and Urban Development
KERRA	Kenya Rural Roads Authority
KURA	Kenya Urban Roads Authority
KAA	Kenya Airports Authority
UACA	Urban Areas and Cities Act
SDMUAK	Street Design Manual for Urban areas in Kenya

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

The importance of transport in urban areas cannot be overemphasized. Transport plays a key role as an economic growth stimulant through enhancing the efficiency of services. Further to this, it provides mobility to urban dwellers so that social, cultural, and economic activities available in an urban settlement can be accessed. Transportation therefore is a critical enabler of urban development. Consequently, urban development is the main influence in land use through its transformative effects on the built environment *(Lambin, 2001)*. The land uses have a close relation with the human population. This is because the land use activities depend on the level of concentration of the human population and their demographic characteristics. Globally, the urban population has been rapidly urbanizing and so are urban land use characteristics. According to United Nations (2019), 55% of the current world's population lives in urban areas and is projected to be at 68% by 2050 as shown in *Figure 1* below. The urban population is becoming the majority though the rural population continues to grow especially in developing countries (Salas, 1986), with rural land use dynamics tends to explicit urban characteristics. In sub-Saharan Africa, the majority of urban residents are low-income earners and are dependent on non-motorized transport. Kenya being among the developing countries has a growing and urbanizing population.

Figure 1: Urban and rural populations of the world, 1950-2050



Source: United Nations, 2019

With a high urban population, demand for urban infrastructure continues to rise. Kenya's population has been rising steadily and consequently, urban areas have expanded to cater for growth in population and Eldoret municipality is no exception *(Figure 12)*. NMT infrastructure has got several advantages including; reduced congestion, less health issues, accident and social cost, and reduced infrastructure. Despite these advantages, policymakers have not prioritized its provision in most urban areas *(Rahula et al, 2013)*. In majority of urban areas, motorized transport has been favoured in policy direction resulting in high numbers of cars constituting a majority of traffic *(Salleh et. al, 2014)*.

The land use – transport nexus is a complex two-way dynamic process. The distribution of land uses determines the location of activities and people access these activity points through the transport networks. Motorized transport - though popular - does not provide door-to-door access. NMT therefore is used to increase the coverage of motorized transport to inaccessible areas. For improved NMT travel, *Salleh et. al (2014)* identified improved infrastructure and land-use efficiency. In this study it is aimed at understanding the influence of land uses on NMT travel patterns through an examination of land uses and existing NMT infrastructure.

1.2 Development Problem

According to the World Bank (2019), urban areas in developing countries often devote 15 to 25 percent, or more of their annual expenditures to transport systems. On the other hand, urban households spend between 8% and 12% of their income on transport needs but this rises up to 25% for poor households in large cities. To complement this there is a need to incorporate Non-motorised transport (NMT) in urban systems. NMT plays a dominant role as an affordable mode with significant benefits, though in most cases with mixed results.

Historically, settlement patterns have a relationship with transportation networks. Siting of settlements were made in areas where transportation modes were easily accessible (Srinivasan, 2000). Transport facilities improved with time as settlements grew. Since then, urbanization has continued to be a strong and positive force in development throughout the world and so are transportation systems. Transportation helps shape an area’s economic health, settlement patterns, and quality of life. The system provides for the mobility of people, goods, and services. Its performance affects public policy concerns like air quality, environmental resource consumption, social equity, land use, urban growth, economic development, safety, and security. This, therefore,

calls for an efficient, safe, and sustainable transport system that can be developed through transport planning. Planning recognizes the critical links between transportation and other societal goals. This is aimed at reducing challenges and eliminate bottlenecks. A plan, therefore, outlines strategies for operation, management, maintenance, and financing of a transportation system in such a way as to advance long-term goals.

Transportation challenges are dominant in developing countries and Kenya is no exception. These challenges range from poor planning, resource allocation to poor infrastructural implementation mechanisms as well as maintenance. Meager investment in land use planning has led to the haphazard sprawling of settlements across the country. The rapid land-use changes are majorly driven by the private sector and not the public sector (Oanda & Jowi, 2013). Transport infrastructural development is one of the sectors that is hard-hit as transportation needs from rapidly changing land use has not been catered for. Transport provision is affected because it is spearheaded by the government whose actions are not fast or immediate like those of the private sector. In most cases, setting aside land for major transportation corridors requires reserving land before other land uses have been developed. Nonetheless, land acquisition to expand or create adequate transport routes is a common strategy. Land acquisition has been documented as part of development impediments due to existing land tenure systems and legal challenges (Kiggundu & Mukiibi, 2012). As this does not always happen, our urban areas continue to expand spatially with little compliance to development control initiatives. This has led to a disruption of urban economies and a low quality of life (Suliman, 2019).

There is an accelerated rate of urbanization in Kenya arising from the coming into force of the constitution of Kenya (2010). From the 2019 Population and Housing Census, Kenya's urban population for Kenya stood at 27.5 % rising from 23.2% in 2009 (KNBS, 2019). This constitutional dispensation has counties crafted to deliver essential services and governance closer to the people. As devolved governance takes shape, sprawling of county urban areas are taking place as they act as new centers of power and investment destination. This is taking place as meager land-use planning initiatives take a very slow pace. This has led to unsustainable urban growth and deterioration of the urban environment. The transportation sector continues to be one of the affected land-use sectors.

According to *Mutua et. al* (2017), transport sector development is considered the weakest link in the urban area development performance index. As an enabler of economic growth, transportation requires authorities to put in place measures for an effective and efficient system. In most urban areas, the sector is characterized by traffic congestion. Commuters spend many man-hours to and from work. Subsequently, *Srinivasan* (2000) argues that the economic and environmental implications of traffic congestion are linked to a lack of coordination between land use and transportation planning. The Municipality of Eldoret is one of the towns that experiences gridlock at peak hours. This traffic challenge is compounded by the long-standing attention to the provision of motorized traffic infrastructure. Though commendable, users of non-motorized modes are at greater risk of accidents as they share a common right of way with motorized transport (MT). Furthermore, NMT users become an inconvenience to the MT users escalating the traffic snarl-ups.

1.3 Research Problem

According to Suliman (2019), poor transportation leads to disruption of urban economies and low quality of life. Transportation plays key role as an economic growth stimulant as it enhances efficiency of service delivery but poor transportation can lead to disruption of urban economies and leads to a low quality of life (Suliman, 2019). In urban areas, different forms of travel are used depending on the urban area though both Motorized and non-motorized transport modes are popular. Over time motorized transport has been favored in policy direction resulting in high numbers of cars contributing to majority of traffic (Salleh et al, 2014). Though, motorized transport is popular, it does not provide a door-to-door access. For improved NMT travel, Salleh et. al (2014), identified improved infrastructure and land-use efficiency as some of the key factors.

According toMutua et. al, (2017), Transport sector development is considered the weakest link in Kenya's urban area development performance index. The use of private cars, traffic conflicts and inadequate NMT infrastructure results in this low development index. In Eldoret, transportation is are characterized by an inadequate supply of public transport and stiff competition for limited road space among motorists, pedestrians and cyclists (Ministry of Transport, 2009). According to *KNBS* (2019), Eldoret - the home of Kenya's elite athletes - is the fifth most populous urban area with a population of 475,716. This accounts for 41% of Uasin Gishu county population. This population resides within 5% of county's landmass. It is worth noting that during working hours, the

population within Eldoret is much higher due to the concentration of activities that people seek across the region. It not only serves as a county headquarters of Uasin Gishu County but a regional economic hub to the North-Western part of Kenya. It also serves neighbouring countries through the Trans-African highway, the meter-gauge railway, and through the Eldoret International Airport.

The municipality has no organized public transport system that takes people close to activity points. Public transport operates haphazardly with intention of bringing people to the termini. Travelers at these terminals seek to access activity points using NMT facilities. The CBD is a critical area where working NMT facilities are most needed. According to Kenya's Street Design Manual, commercial zones require seamless development of frontage, pedestrian, and furniture zones between the built environment and motorized carriageways.

Eldoret's role as a regional hub for the provision of goods and services attracts many people from the hinterland. Regional government agency offices located here include Kerio-Valley Development Authority, Kenya Highway Authority, and Moi Teaching & Referral Hospital among others. The town is home to several industries e.g., Raiply, Kenya Pipeline Company, Unga Limited, and National Cereals and Produce Board, and hence a huge portion of the workforce is located in the town. Besides, the municipality is home to several tertiary educational institutions hence a high number of persons depending on NMT, road, and air transport. Other services include banking and retail. As earlier mentioned, Eldoret it is a transport hub for both national and international transport. Road, air, and rail transport modes are functioning at different levels with the municipality acting as a transit town for all the modes. Locally, residents are concentrated along the arterial roads with the preference of using private cars with inadequate walkways compounding the traffic mess. The rapid sprawling of settlements has considerably decreased transportation efficiency. Because transport planning affects land use development, and land use conditions affect transport activity *(Litman et al., 2019)* this research, therefore, aims at analyzing the influence of land-use dynamics in the NMT system in Eldoret CBD.

The key access and transit routes in Eldoret are sampled. Uganda road is part of the Trans-African highway though it plays lower urban roles due to myriad of land use activities along this corridor. Kisumu-Iten Road corridor is the immediate lower-level arterial road within the municipality. It provides access to the southern and Northern peri-urban estates and hinterland. Nandi road and

Oloo street are circulation roads within the CBD. Around this study corridors are commercial, administrative, industrial, and social amenities which are key traffic generators. Key challenges are inadequate NMT infrastructure. The inadequacy is characterized by limited development of pedestrian zones, limited crossing points and traffic calming facilities, irregular building lines, and existing parking strategy.

1.4 Research Questions

Research questions are as follows;

a) What are the land use characteristics in Eldoret CBD?
b) What are the characteristics of the transport system in particular NMT at Eldoret CBD?
c) How does land use transformation affect NMT travel patterns at Eldoret CBD?
d) What proposals need to be integrated to the existing transport system to cater for NMT users?

1.5 Research Objectives

1.5.1 General Objective

The general objective is to evaluate the influence of land uses in the mobility patterns of NMT users within the CBD of Eldoret. It is aimed that through this study findings, travel characteristics of NMT users based on their trip purposes highlights hotspot transport corridors and types of trips generated by specific land uses. Travel patterns throughout the day creating traffic hotspots highlighting travel patterns and provide important information for prioritization of management of traffic as well as data for urban governance.

1.5.2 Specific Objective

Towards attainment of the general objective, specific objectives were formulated as follows:

i. To examine the land use characteristics in Eldoret CBD
ii. To examine the characteristics of the transport system in particular NMT at Eldoret CBD
iii. To evaluate the influence of land use transformations on NMT travel patterns in Eldoret CBD
iv. To make proposals that integrate the NMT needs in Eldoret CBD

1.6 Research Hypotheses

The null hypothesis is: There is no relationship between land use and mobility of non-motorized users. Consequently, the alternative hypothesis is: Land use has a relationship with non-motorized transport user's mobility and patterns.

1.7 Scope of the Study

The study focused on the land use characteristics and its influence to travel patterns of NMT users. A look at the infrastructure provision as well as motorized traffic movement while looking at key conflict areas and observations from traffic governance personnel.

The geographical extent of the study is limited to the Central Business District (CBD) of Eldoret Municipality measuring $1km^2$ and its neighbourhood. The spatial scope of the study area was informed by the walking city concept and the popularity of NMT modes in this location. The study focused on non-motorized transport dynamics along three main corridors: Uganda, Kisumu-Iten and Oloo-Nandi Road corridors.

Uganda Road Corridor is the main municipal arterial that serves local and transiting traffic. It also links commercial district and residential areas from Annex to the East to Huruma to the West. The road has all categories of traffic and is usually heavily congested especially during peak hours. Access to the road is mainly through the collector roads at designated intersections. County headquarters, industrial area, malls e.g., Zion and Rupa are located along this corridor

The other corridor is Kisumu and Iten Roads Corridor. The two roads link to Uganda road at the CBD from Northern and Southern directions. It serves the densely populated peri-CBD settlements of Langas, Jerusalem, and Kimumu. County headquarters, Eldoret Polytechnic, two bus termini, and several university campuses are located along this corridor. Nandi road and Oloo Street is a key circulation corridor for CBD traffic. Oloo street extends from Nandi Road from Nandi Park roundabout through the commercial centre and crosses Uganda road but for this study it terminates at intersection with Uganda road. On the other hand, Nandi Road has a matatu terminus, Moi Teaching & Referral Hospital (MTRH) and Moi University's medical school. Other facilities along this corridor are St. Luke and Mediheal hospitals, AIC church, Shree Swaminarayan Temple, commercial and residential neighbourhoods. Though Nandi Road is the main access to MTRH, matatus are prohibited rendering NMT modes, taxis and private vehicles the only options for access.

1.8 Justification

The importance of transport for Eldoret cannot be overemphasized. It is a stimulus to the municipal's economic growth. But why would one want to study the effects of urban land-use dynamics on Non-Motorized Transport patterns? Well, Sustainable Development Goals recognize the importance of transport in sustainable development. According to *Koinange* (2016) investments in motorized transport have been the primary focus for a long time to the disadvantage of NMT particularly walking and cycling. Fortunately, the new SDGs call for "safe, affordable, accessible and sustainable transport systems for all". Sustainability, therefore, means addressing Motorized and Non-Motorized transport needs fairly.

In Kenya, transport is looked at as a key pillar and a critical enabler in the achievement of economic Recovery Strategy for Wealth and Employment Creation strategy (Ministry of Transport, 2009). NMT is key in the actualization of the objectives of the transport plan. Statistics show that 40% to 60% and 15% to 20% of Nairobi and Mombasa cities residents respectively meet their daily travel needs by walking (Ministry of Transport, 2009; NCC, 2015). Equally, NMT users in Eldoret are a considerable percentage of road users.

Non-motorized Transportation in this research is limited to pedestrians, cyclists, and hand cart movers. These are the common NMT modes in Kenya's urban areas. Non-Motorized Transport modes are used for short travel distances. It is therefore essential to know the spatial extent of such modes and their variation across land uses. Travel patterns of NMT users are dynamic, based on land use patterns and individual mobility characteristics. Road infrastructure development has largely been limited to motorized transport infrastructure. With meagre NMT infrastructure developments, NMT users share space with other traffic users leading to frequent conflicts.

Due to the ever-increasing population, the municipality has been growing gradually over the years. Trends of Eldoret's growth can be related to changes in the extent of the municipal boundary as provided by the Ministry of Lands & Physical Planning (2019). In 1959 the town was elevated to Municipal Council with an area of 25km^2, under legal Notice No. 515 of 1958 after which it was extended to 50km^2 in 1974. In 1988, the municipal boundary was extended to 148km^2 and has further changed to 724 km^2 in 2019 through the development of integrated land use plan for this spatial scope. Nonetheless, transportation demands within the study area have not only been due to the growth of the urban area but because of services sought by people in the municipality. The

study areas play not only local and regional roles but also international. Some of the international roles is mainly transportation through air, road, and rail transport. Within the North Rift region, Eldoret serves as headquarters of the Kerio Valley Development Authority, the Moi Teaching & Referral Hospital and the North Rift Economic Bloc. Key parastatals are serving the region including KeNHA, NCPB, and High Court among others. Locally, it is the county headquarters and there are key national services provided here. These include the Huduma centre, roads and security agencies. From these, the study area attracts considerable local and transit traffic. The geometry of roads was designed that traffic either terminates at the study area or can only transit through it through there is ongoing construction of a bypass that is expected to alter traffic dynamics. The study area therefore, provides a favourable site to analyse transport and land use interactions due to high level of service.

1.9 Definition of Terms

Non-Motorized Transport (NMT) is a means of transport that include walking, the use of wheelbarrows and hand-carts, bicycles and tricycles for passenger and freight transport.

Transportation is the movement of people and goods from one location to another and with a purpose. In this study it is used to refer to motorized and non-motorized traffic movement to, from and across the study area. Focus is given the movement characteristics of NMT users (pedestrians, bicycles and hand-carts) and their interactions with Motorized traffic and other land uses.

Central Business District (CBD) is the focal point of the municipality with a high concentration of commercial offices, retail shops, banking and transportation. In the study area, it refers to the conventional old town of Eldoret. This area is characterized by markets, bus terminals, shops and banking. This area has so far transitioned to neighbouring areas to include MTRH, county headquarters, high court, part of industrial area and Uasin Gishu secondary school area.

Land use is the type of activity on which land whether built or unbuilt is subjected to and from which users derive economic and socio-cultural benefits. In the context of this study, land use is used in reference to purpose that necessitate movement of persons or vehicular traffic towards access to certain points attainment of intended purpose. Some of reasons that necessitate travel from one land use to another include work, education, health, shopping and business among others.

Land use transformations is used to refer to land use activities that have kept changing over time resulting in the high level of service in the study area that necessitate people seeking services to travel to or through the study area.

Transit Oriented Development is used to mean urban land use development that is anchored on public transport and avoids over-reliance on use of motorized transport.

Universal is a term used to refer to NMT transport infrastructure, facilities and services designed for the widest range of potential users, including people with mobility and visual impairments (disabilities), the elderly, those on wheelchairs and people walking with small children or with pushchairs. While aiming to address the needs of people with disabilities, it is a comprehensive concept with provisions that can benefit all users.

Matatu is a public transport vehicle for hire with a driver used by one or more passengers for a specific journey along pre-determined routes and it operates based on demand and supply.

Walkway refers to a pedestrian way not associated with a road usually located at the side of a road

Integrated Transport This refers to the planning for the needs of NMT users are incorporated as an integral part of all land transport schemes including transport terminals, corridors and land use planning.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview

This chapter covers transportation planning, NMT movement patterns, land use, and urban growth theories significant in the provision of urban transport. It explores the spatial structure of land uses and how they affect the mobility patterns of NMT users. It further explores the impact of urban land use transformations on NMT travel patterns. The chapter ends with an information gap and research conceptual framework.

2.2 Transport Planning

Transport planning is scale-specific and multi-dimensional. Since the 1970s, traffic challenges have increased significantly due to increase in car ownership, complicated settlement patterns, environmental awareness and economy. More often traffic is equated with water in a piped reticulation network or gas that expands to fill available space. Transport strategies and policies have changed over time towards providing sustainable solutions to these complicated transport challenges. Urban areas have become engines of economic development and policymakers are faced with the daunting task of developing and managing efficient transport systems. Key urban transportation challenges include affordability, managing deteriorating pollution, reduction of congestion, use of sustainable energy and management of accidents.

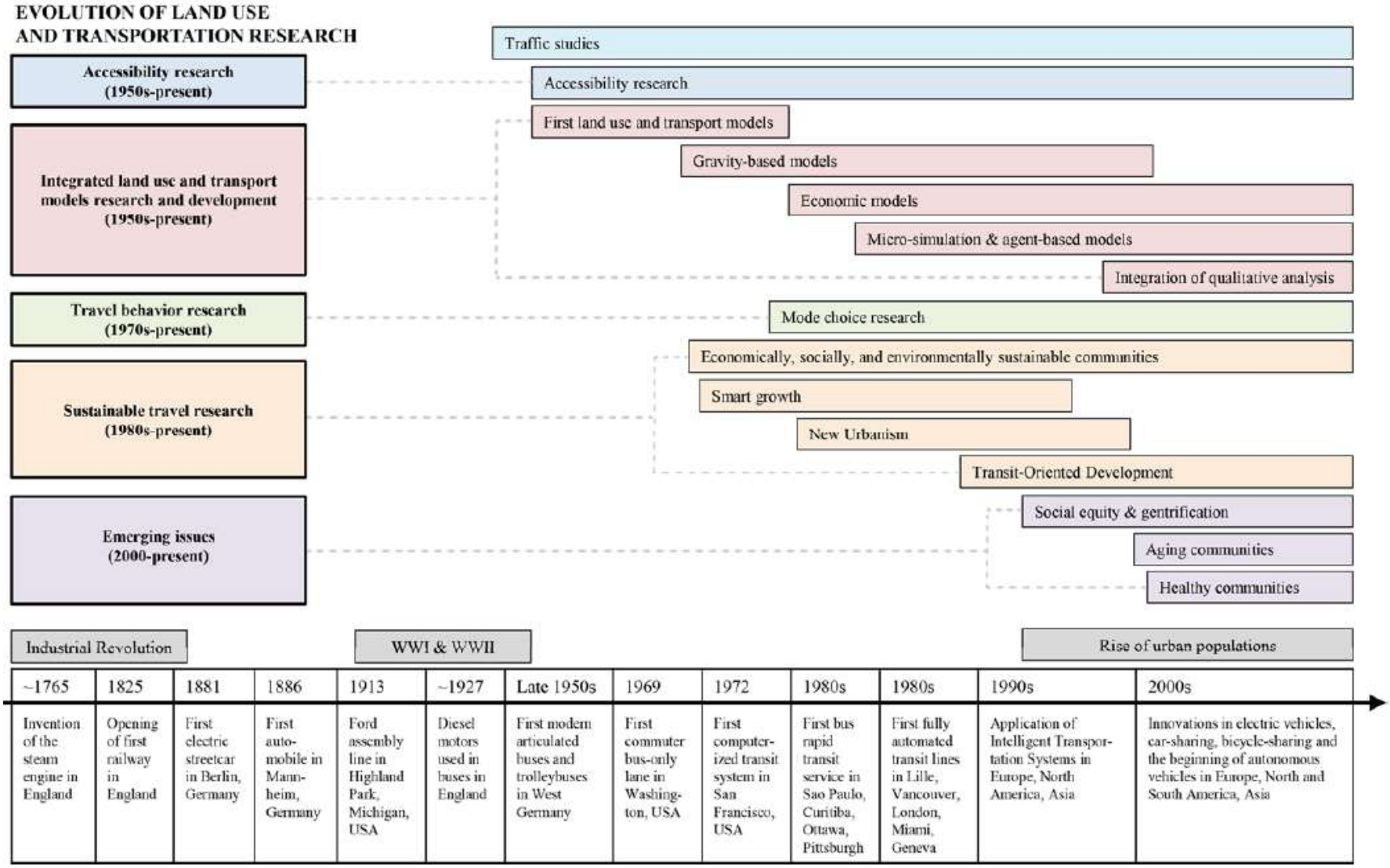
According to *Suliman* (2019), transport is key in urban development. He argues that with poor transportation there is a risk in disruption of urban economies and low quality of life. Access to transport is assumed to be one of the key drivers for urban development. Choosing the right urban transport strategy must therefore be comprehensive and multi-modal while taking cognisance of the supply and demand requirements *(Kasraian et al., 2019).*

Transport planning is known to be a development stimulant whose decisions influence land use. This is directly seen through the amount of land used for transport infrastructure and indirectly through location and design of development. When new roads are developed or existing ones upgraded, there is an increase in attractiveness of the land the roads provide access to and subsequently promote new urban activities. When development is to be made, traffic assessment is necessary to assess the effects of implementing a traffic policy with a view of harmonizing transportation and land use. Traffic assessment is used to implement transport master plans and to regulate land use patterns and densities.

2.3 Concept of Land Use and Transportation

There is a close link in the relationship between land use and transport. Areas with adequate transport networks, attract more people and activities. Socio-cultural and economic activities coupled with spatio-temporal character form an activity system that characterizes urban areas. These activities are either routine, irregular or production. Routine activities are those whose travel patterns are predictable and occur regularly e.g., shopping and commuting to school. Irregular activities are those shaped by lifestyle or that which depend on need basis e.g., seeking of medical services, leisure or sports. These largely depend on the mobility of the person involved. Finally, production activities are those related to production and manufacturing with global, regional, and local linkages. Transportation is therefore a derived demand by the need of urban residents to access activity locations (Srinivasan, 2000). *Van Lierop et al* (2017) provide a chronology of land use and transportation research as shown in *Figure 2*.

Figure 2: Evolution of land use and transportation Research



Source: Adopted from Van Lierop et al , 2017

2.4 CBDs and Transport Development

2.4.1 History of CBDs

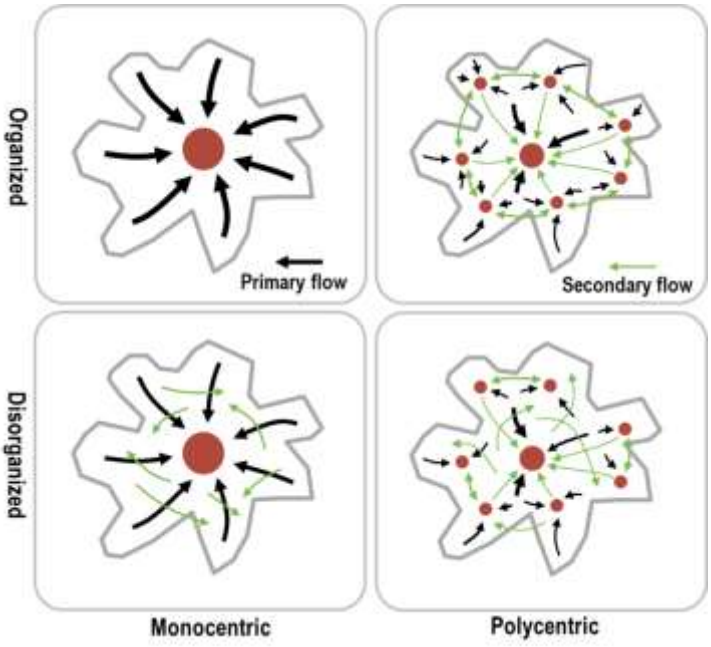
The Central Business District is the focal point of urban areas and transportation networks. Its history is traced to ancient times when it developed as market centres where farmers, merchants, and consumers meet to exchange goods. Within CBDs, there is high competition and limited space and property values tend to be at a premium. Historically, urban areas were designed in a "hub and spoke" pattern which focussed on travel patterns between peripheral residential areas and the employment node (CBD) at the centre *(Belzer et al., 2011)*. The urban form is determined by people's activities where common activities are centrally placed whereas residential areas are located in the surrounding. Using the analogy of a steel magnet, the common activities are the magnetic centre while iron filings surrounding it act as the residential neighbourhood. Within proximity of the magnet, the fillings are densely clustered while with increasing distance from the magnet the density decreases. At some point, clustering of the filings no longer exists. These are areas where magnetism doesn't exist and can be inferred as rural.

The Spatial extent of CBDs varies based on human activities within it. *Newman et. al.* (2016), outlines in the walking city concept that the larger the CBD coverage the higher the land use densities around it and leads to extended transit zones. In the walking city concept, this pattern was created as walking was the only and preferred mode of movement. Similar patterns with little variation are evident in urban areas with the advent of modern transport modes.

2.4.2 Spatial Structure of Urban Areas

According to Bertaud (2004), an urban area's spatial structure is a result of market forces interacting with regulations and infrastructure investments. Urban forms are path-dependent and usually develop through unintended and unforeseen consequences of policies and regulations (Bertaud, 2004). The urban form is defined by the urban area's geolocation and the inter-relationships of urban elements as shown in *Figure 3*. The figure shows schematic trip patterns in monocentric and polycentric urban areas.

Figure 3:Schematic representation of Urban area trip patterns



Source: Adopted from Bertaud, 2004

Further, monocentric models have been widely used to analyse the spatial organization of urban areas. Over the years, the structure of urban areas has deviated from the monocentric model arising from traffic generation zones clustered outside the traditional CBD. Urban areas therefore have mutated into polycentric centers with CBD acting as the transition zone. Municipality of Eldoret depicts a polycentric character with developing radially with key nodes developing along Nairobi, Kisumu, Malaba, and Iten roads which radiate from the CBD.

Mobility in monocentric and polycentric urban settlements tend to be similar. Patterns of trips depend on the character of land uses within these urban areas. Areas where residents work or attend school attract people across the urban area while settlement areas are dispersed as the origin of trips.

2.5 Theoretical Foundations

As urban areas develop, they exhibit a functional structure with organized land uses performing specific roles. At the core of an urban area is central business district. Hoover *et. al.* (1984) describes the CBD as a point of maximum accessibility where people of the area could easily assemble. The CBD is determined by the least total distance for all the population to converge and is determined by the cost of travel and available transport infrastructure. Further, the spatial

arrangement of road networks has a bearing of urban land uses and this is explained by urban structure theories. The following theoretical approaches in urban land use and transport interactions have been considered relevant to this study.

2.5.1 Economic Theory

Transport economic theory deals with the allocation of resources within the transport sector and it was founded by John R. Meyer in 1959 (Kanemoto, 2006). This theory advocates that the movement of people, goods, and services happens over networks at certain speeds and peaks at certain times due to demand. Within these transportation networks are constraints that influence resource allocation. NMT patterns take the shortest path within existing networks and are influenced by land uses along these networks.

It is often alleged that traveling is demand derived and therefore there would be no travel if it were not for activities being undertaken where the trip terminates. Traveling is not consumed solely for its own sake except occasionally as a weekend road trip or nature walk. On the other hand, there is always the need for people to leave home for work, school or to the market. With transport being demand-oriented, the shape and elasticity of choices are considered. Between these places is time separation for return journey and directness between origin and destination points. The separation may be quantified by the time of travel per day and the amount spent. From an economic perspective, the more costly the return trip is, the lesser the quantity consumed. As an example, if fuel prices are doubled, there would be less travel. Similarly, the longer it takes to travel from origin to destination, the less likely it is that people travels between these two points.

2.5.2 Theory of Urban Fabrics

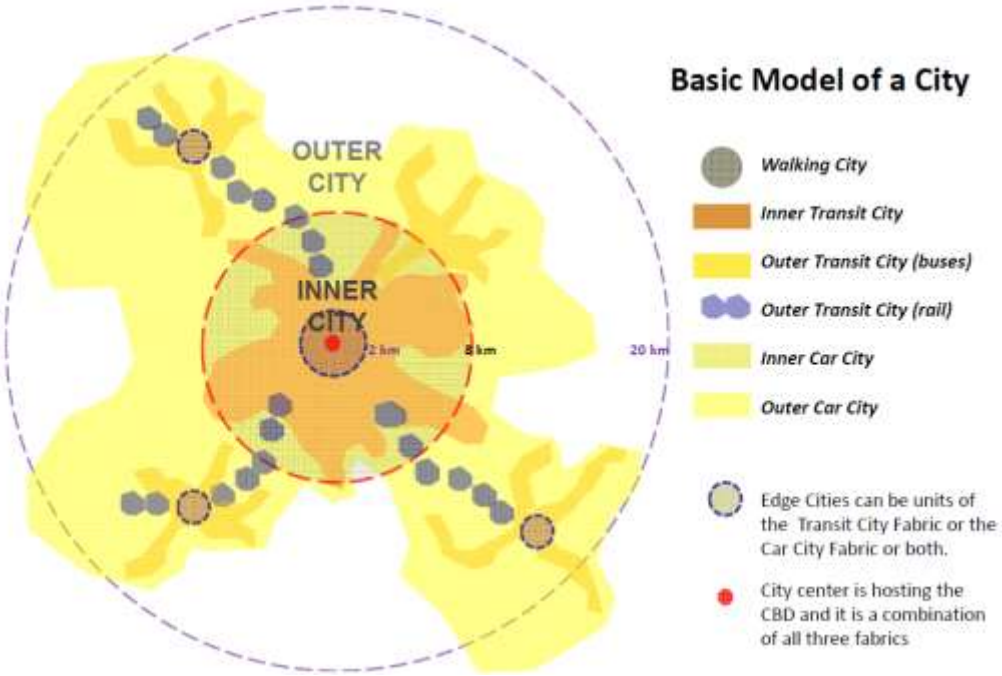
Urban areas are shaped by historical and geographical features but alteration of transportation priorities can greatly alter the patterns of land uses. According to Newman *et al.* (2016), urban fabrics of cities grow to be *'one-hour-wide'* based on the rate at which people move. Newman *et al.* argue that the urban fabrics start to be dysfunctional and people start to change infrastructure and land uses in order to align to this principle. From this principle, there are three urban systems as shaped by transportation needs: walking city, transit/public transport city, and automobile city.

The walking city concept is derived from settlement history where walking was the only form of transport available to enable people to get across their cities. It is estimated that pedestrians historically travel at an average speed of 3-4km/hr (Kosonen, 2020). Walking cities were therefore

dense with narrow streets with intense developments within a one-kilometre radius. Modern cities, according to Kosonen (2020), are trying to reclaim intense urban activity and fine-grained streets associated with walkability through pedestrianisation and traffic calming. Transit urban fabric is based on the availability of trains or public transport linking the core urban areas with its suburbs because they travel faster than walking. The automobile city was a takeover from walking and transit city models following provision of roads and parking spaces for automobiles. Automobile cities created continuous less dense cities in all directions due to improved travel speeds of automobiles.

Recent trends indicate a preference for walking and public transport urban fabric over car-based urban fabric (Newman *et al.,* 2015). Walking in urban areas has existed for a considerable time of settlement history. This is because walking was a major form of urban cities for 8,000 years before trolley lines and subways in the 19th century and internal combustion engines in the 20th century (Kanemoto, 2006; Newman *et al.,* 2016).

Figure 4: Urban Fabrics



Source: Kosonen, 2020

Figure 4 shows an overlap of all the transport-related urban fabrics. Transit urban fabric overlaps with walking fabric. The overlap is a transition zone where those who reside in the transit region

are brought to access services at the central business district and the walking fabric. In this study, this theory is relevant in the identification of the urban fabrics of Eldoret i.e., the origin and destination traffic zones. NMT users do not necessarily originate from peri-CBD traffic zones but from peripheral areas of the municipality who then walk to access their target areas once in the walking urban fabric zone.

2.5.3 The New Urbanism Theory

The New Urbanism Theory is one of the planning movements initiated in late 20th Century in the United States. It is a contemporary urban planning and design concept that aims to change the way in which urban development is shaped (Wirth, 1938). It originates as a critique of suburban sprawl in the United States during the 1980s which advocated for development of mixed use, mixed income and NMT-oriented neighbourhoods (Liu, 2012). The theory has been argued as an important phenomenon to emerge in American urban development planning in the post-cold-war era. The theory advocates for modelling urban developments on a compact scale of urban neighbourhoods, densification of residential areas and placing urban amenities within walking urban fabric neighbouring residential houses and transport corridors.

In this theory, Eldoret would benefit in its application through creation of safe and cohesive network of NMT tracks, green areas, and other support amenities. This is defined as the construction of universal-multimodal walkways, compact and mixed-use neighbourhoods, planned in a manner that its components are still based on conventional urban form, but assembled in a more integrated fashion. It is aimed that through new urbanism theory, community values, cultural, equity and sustainability are promoted. New urbanism is therefore progressive, as it advocates an approach to making urban nodes and neighbourhoods and redeveloping urban areas by also placing strong emphasis on its residents' well-being.

2.5.4 Complex Network Theory

Complex Network Theory offers an insight into the network of urban systems. According to Ding (2019), this theory shows that nodes of an urban system are critical. The nodes have an inter-relationship with other sub-systems including land use, transportation and population. Chang (2016) argues that there is a two-way relationship between transport and land-uses i.e., travel demands and patterns are influenced by land uses. The land uses are impacted by transportation

evidenced by accessibility levels which in turn affects the geographical distribution of activities (Chang, 2016).

A networked urban area is one in which various attractive features are aggregated in multiple areas that are interconnected by transport corridors. A network of land uses connected by transport routes are interdependent on each other. If one node is affected, all the other parts of the urban area are affected in some way.

2.5.5 The Urban Design Theories

Urban area design is looked at in its widest sense supported by theories in architectural design for urban development. In these theories, urban design process considers the natural landscapes and human considerations. An urban design is a subjective matter that uses ideas and communication to attain an intended dream. According to Trancik (1986), in his '*Finding Lost Space'* book, he differentiated the following three urban design theories: The figure-ground, linkage and place theories.

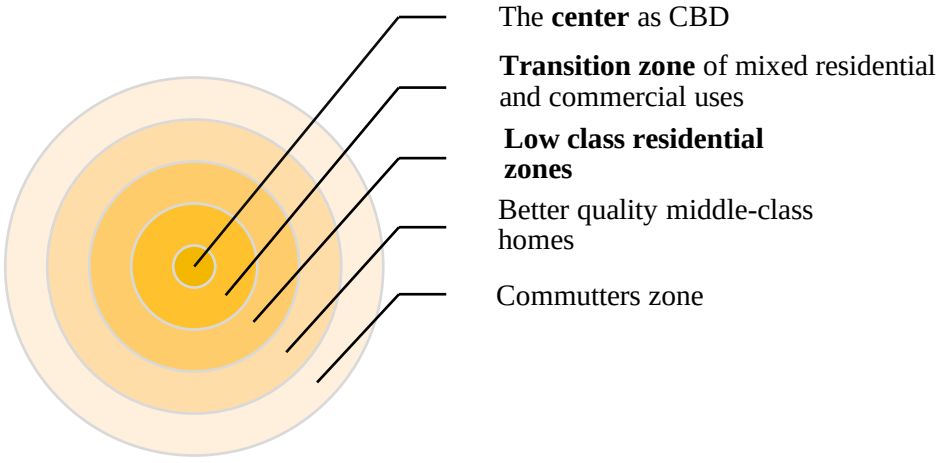
The figure-ground theory is concerned with the relation between the coverage of urban structures as solid mass ("figure") and open voids ("ground"). The pattern of the urban areas as a plan is seen as a fabric which can be modified. The linkage theory focuses on the inter-connectivity of urban elements. The inter-connectivity is expressed through road corridors, lanes, walkways, cycle lanes and open spaces. The idea behind this is a linear network of urban elements structuring spatial order. The place theory puts consideration to socio-cultural aspects to urban design. This leads to giving preference to internal context of an urban setup above abstract external designs.

According to Trancik (1986), all these theories have its own value but drawing ideas from all the three optimizes an urban design structure. Eldoret CBD have a network of street though narrow. A consideration of giving structure to the solids and voids, organizing network of NMT that responds to residents' needs are considered in the recommendations

2.5.6 Concentric Zone Theory

Urban areas grow with increasing complexities. These complexities are partly explained through the Concentric Zone Theory that was put forward by Ernest Burgess in the 1920s. This theory describes the distribution of zones within the urban area where the zones (in form of land uses) are depicted in concentric rings. The centre of these rings is the CBD. Outside CBD are land uses that keep changing away from the centre (Krishna, 2020). The zones are identified in *Figure 5*.

Figure 5: Concentric Zone Model



Source: Author's Construct

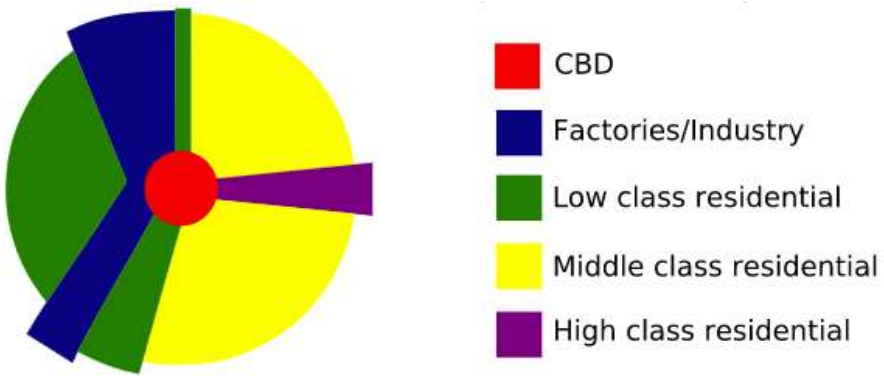
According to Krishna (2020), Burgess observed that there exists a correlation between distance from CBD and the economic status of residents. The theory notes that wealthy residents live further from the CBD. These characteristics are visible in Eldoret. The CBD is centrally placed with key regional roads passing through the CBD. Wealthy residents live in Elgon View, Annex, and Kenmosa estates which are fairly far from the CBD. And as the CBD grows, it exerts pressure on zones that surround it. Its outward expansion causes the conversion of residential neighbourhoods within its proximity which subsequently causes them to expand outwards in form of concentric rings. These CBD expansion characteristics are evident where the old town (CBD) was limited to areas between Uganda road and Nandi Road. The current developments including MTRH, Judiciary, Moi Girls high school, industrial area, Government square, and neighbouring areas depicting a high concentration of commercial, social, and civic life. These areas and their neighbourhood make up the transition zones. The low economic residential areas include Huruma, Pioneer, Langas, Action, and Munyaka. Commuter's zone includes areas like Moi University, University of Eldoret, Airport, and rural settlements beyond the municipality.

2.5.7 Sector Model

This model was proposed by Homer Hoyt in 1939. Hoyt's proposition of urban structure was aimed at overcoming weaknesses of the concentric model. This model was mainly based on patterns of residential rent and impacts of transport in urban development. Based on his study, sectors with uniform rent were identified to be located in one or more sectors of a city. Maps were

then generated with housing features and land-use patterns then he analysed transportation impact on urban land use characteristics. From these studies, Hoyt was able to conclude that rent in American cities where his study was based tend to conform to sector patterns rather than concentric circles. The sector model further highlights that land use types tend to cluster together and tend to extend outward in a radial manner to produce sectors without encircling the city at its outside limits.

Figure 6: Sector Model



Source: Adopted from Burdett, 2021

The key sectors identified by Hoyt as provided in *Figure 6* are;

1. CBD
2. Industries and manufacturing
3. Low-class residential
4. Middle-class residential
5. High-class residential

The model demonstrates a commercial area (CBD) where all other sectors belonging to different economic levels radiate from. The proximity of sectors is determined by the attractiveness of land uses at each other. As an example, from *Figure 6*, industrial and low-residential areas tend to attract each other. Poor residential areas lie immediately adjacent to the industrial and manufacturing area. Some land uses repel each other e.g., industrial areas and high-class residential areas. The wealthy occupies the most favoured residential locations stretching outwards from the CBD while industries and warehouses are likely to be aligned along transport corridors, repelling the high-class residential areas. From these, Hoyt introduced a directional aspect to the sector model.

2.6 Characteristics of NMT

Transport is an act of moving goods, services, and people from one point to another as occasioned by market forces of demand and supply. Movement is necessitated by the need to move from home to school, from work to shopping malls, from home to health facility, and to an array of other locations based on need. Within urban areas, motorized transport (MT) and non-motorized transport (NMT) are the major modes used. According to Litman (2020), automobiles hardly existed before 1900 but have become dominant modes of traveling in the 21st century. Motorization coupled with a growing urban population leads to perennial traffic congestion in urban areas. The number of man-hours, fuel, and money wasted from traffic congestion is enormous. Additionally, cars idling in traffic jams emit carbon dioxide and other emissions, contributing to local air pollution and global climate change (Harvey, 2020).

To overcome this Harvey (2020), argues that urban areas should be designed for people and not motorized transport. Through planning, alternative transport modes, e.g., NMT require critical consideration. Despite motorized transport's popularity, it does not access all areas and is complemented by NMT to increase its reach.

2.6.1 Types of NMT

Non-Motorised Transport (NMT) is also called active or human-powered transport. It includes walking, cycling, and variants such as wheelchair travel, skating, and handcarts. Further animal transport e.g., animal-drawn carts form part NMT. Cycling, which is part on NMT, entails the use of a manual bicycle or tricycle. It is used for short trips to work, shops and for leisure purposes. It is also used to travel to work and is faster than walking. Carts, both human and animal-drawn, are common for delivery of goods.

These modes form an important part of urban mobility. Among the urban poor, it is the preferred mode of movement though it is often not prioritized in planning transport systems. It is a key element of encouraging clean urban transport. It is an attractive mode for short travel distances and makes up the largest share of trips in urban cities. According to NCC (2015), up to 40%-60% of daily Nairobi trips are NMT based.

2.6.2 Benefits

There is a rising need for NMT infrastructure in urban areas. Walking, pushing hand-carts and the growing demand for cycling demand is attributable to its benefits and opportunities. Some of these

benefits according to NCC (2015) are; friendliness to the environment, public health improvements, employment generation opportunities, lowers household transport costs, increased savings and utilises less space.

The negative effects of motorized transport e.g., pollution is reduced through high use of NMT modes. Additionally, travellers benefit due to regular physical activity leading to low risk of lifestyle diseases and hence lower public health care costs. Reduced accidents among pedestrians due to commonly uniform and lower vehicle speeds is a major incentive to addressing NMT requirements. Lower travel times through provision of smooth and comfortable walkways (or through shift to cycling), and reducing trip distances by removing diversions can substantially reduce household and city transport costs. Savings of transportation costs contribute to poverty alleviation amongst the urban poor.

Additionally, traffic congestion can substantially be reduced when NMT is integrated with public transport as it encourages shift from private car to public transit and lowers transport investment and costs of maintenance. Other benefits include employment opportunities in construction and maintenance of NMT facilities which are largely labour-intensive construction, business opportunities in bicycle spare parts, repair shops, and the creation of opportunities for hawkers to sell their wares alongside dedicated NMT facilities.

2.6.3 Challenges

Despite the benefits attributed to the use of NMT there are real and imagined challenges associated with this mode of transport. It is recognized that integration of NMT infrastructure within the existing transport system has not been a priority among policymakers. Kenya's transport policy (2009) recognizes that, although NMT is commonly used in several parts of the country, little has been done to incorporate them into the national transport system for it to effectively play a complementary role in cargo and passenger transportation. This has led to lack of NMT infrastructure leading to existing road space being shared amongst all modes of transport. Resulting from shared space are conflicts leading to accidents and due to NMT users' susceptibility, they become key victims. These accidents happen when pedestrians cross a road while others occur when they walk in the road or alongside it.

Other challenges include insecurity, inefficiency, low comfort, limited walking distance, and terrain ruggedness, convenience, and support infrastructure. Unlike MT, NMT requires street

environments that are well lit and free from criminals. Secure storage facilities for bicycles are important in promotion for this mode. Availability of shortest path between origin and destination is preferred but may not be an option due to insecurity or lack of infrastructure and hence renders it inefficient and uncomfortable. Terrain ruggedness influences modal choice with sharp gradients limiting NMT usage.

Finally, preference of NMT is influenced by support infrastructure provided. Traffic separation of NMT modes promotes its usage. According to Mitullah *et. al* (2012), there is need to mainstream NMT within the transport system through provision of support infrastructure. The complementary infrastructure includes bicycle parking silos, lockers, roadside restrooms, urban furniture, and shower facilities. Angira (2008), acknowledges that despite the challenges, safety, comfort, and efficiency cover-up for NMT deficiencies.

2.6.4 NMT in Eldoret

Non-Motorized Transport is a topical issue among stakeholders in Eldoret Municipality. According to the County Government of Uasin Gishu (2017), the provision of NMT infrastructure within the CBD is one of its priority programs. In partnership with World Bank, the county government has constructed 32 kilometres of non-motorized transport foot and cycle paths across the municipality (*Table 1*; MoL&PP, 2019). According to UNEP (2019), it is estimated that more than 80 kilometres of pedestrian walkways and bicycle paths have been constructed in Eldoret under Kenya Municipal Programme (KMP) and Kenya Informal Settlements Improvement Project (KISIP). Additionally, in Sosiani a non-motorized bridge connecting the CBD and Pioneer/Kipkaren estate has been constructed.

Table 1: Extent of NMT Facilities along Major Roads NMT

Facility	**Length**
Kisumu Road	10 km
Iten Road	12 km
Uganda Road (A8)	8 km
Nandi Road	2 km

Source: MoL&PP, 2019

2.7 Planning Considerations for NMT infrastructure

The Netherlands is one of the high-ranking countries that promotes high level of NMT use while restraining the use of cars. In provision of NMT infrastructure, traffic calming considerations are

incorporated into multi-modal conflict areas. These include lowering of vehicular speeds, low motor vehicle volumes, and use of intelligent traffic management system to separate traffic. In Netherlands, universal urban infrastructure is developed in an open manner without hard borders between public and private properties e.g., minimal use of concrete walls, fences, dead-end streets so that continuous and direct NMT routes are provided.

Land use plans should be designed to integrate green space with walking and cycling facilities. Additionally, local authorities have to finance annual maintenance of these facilities while developers are obliged to contribute to area-wide services including cycle-friendly streets and parking facilities which are sometimes obligatory with building permits.

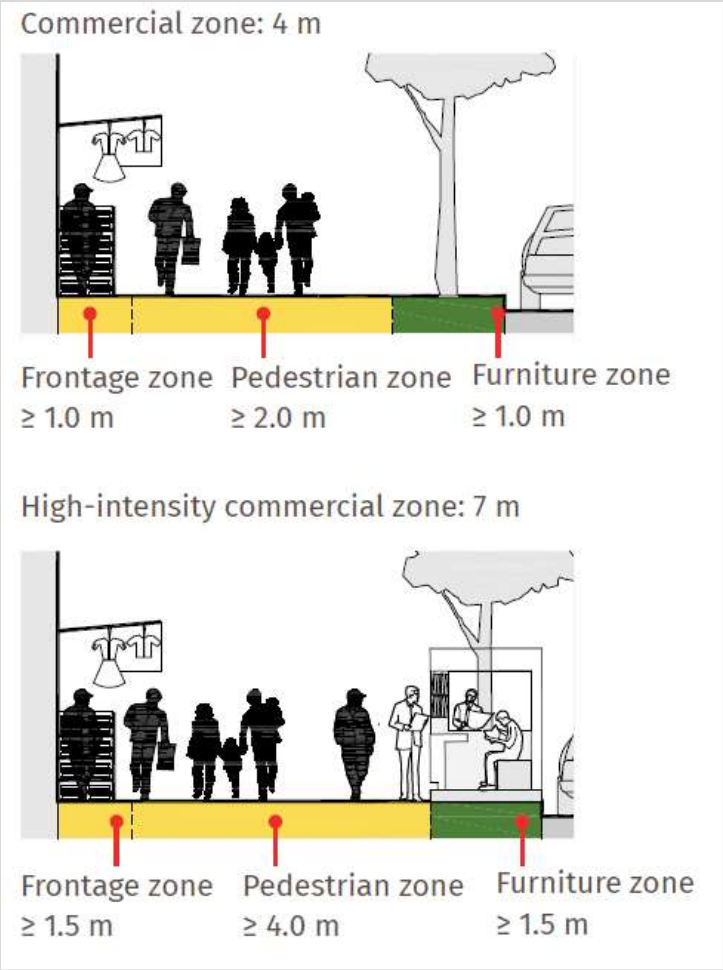
In Kenya, the streets design manual for urban areas provides for the shared space in the streets. The manual provides for speed moderation based on street function. Within local streets, a maximum speed of 15km/h is allowed so that the traffic can safely mix. Within local and collector streets a maximum speed of 30km/h is permissible with separated footpaths. Within this class of roads, the cyclists and vehicles can share the carriageway with calming facilities provided. Arterial streets are recommended to have speed limit of 40-50 km/h and physically separated cycle tracks and footpaths. Traffic calming or signalization are required at pedestrian crossings.

While providing these facilities there is need for adoption of universal access design. Article 54 of the Constitution of Kenya recognizes the needs of persons with disabilities, stating that persons with disabilities are entitled to reasonable access to places and transport services. The Persons with Disabilities Act of 2003 further entitles persons with disabilities "*to a barrier-free and disability-friendly environment to enable them to have access to buildings, roads and other social amenities*."

To promote safe, efficient designs, street design manual uses modal hierarchies to inform design and operation decisions. The provided default hierarchy is *pedestrian > bicycle > public transport > freight > personal vehicles > personal vehicle parking*. Good crossings are to be provided allow pedestrians and cyclists to cross busy streets safely and conveniently. A formal pedestrian crossing should be located wherever there is a concentrated need for people to cross the street (e.g., at a bus stop, at an entrance to a shopping mall, or where a path intersects the street). In bus commercial areas, crossings should be spaced at more frequent intervals. It is considered that at-grade crossings are superior to pedestrian foot bridges or tunnels. Pedestrian's dislike having to climb a stairway

in order to cross the street, so they are likely to avoid it and crosses at-grade as they please. This preference makes costly foot bridges and tunnels an unwise use of limited resources.

Figure 7: NMT provision within commercial zones

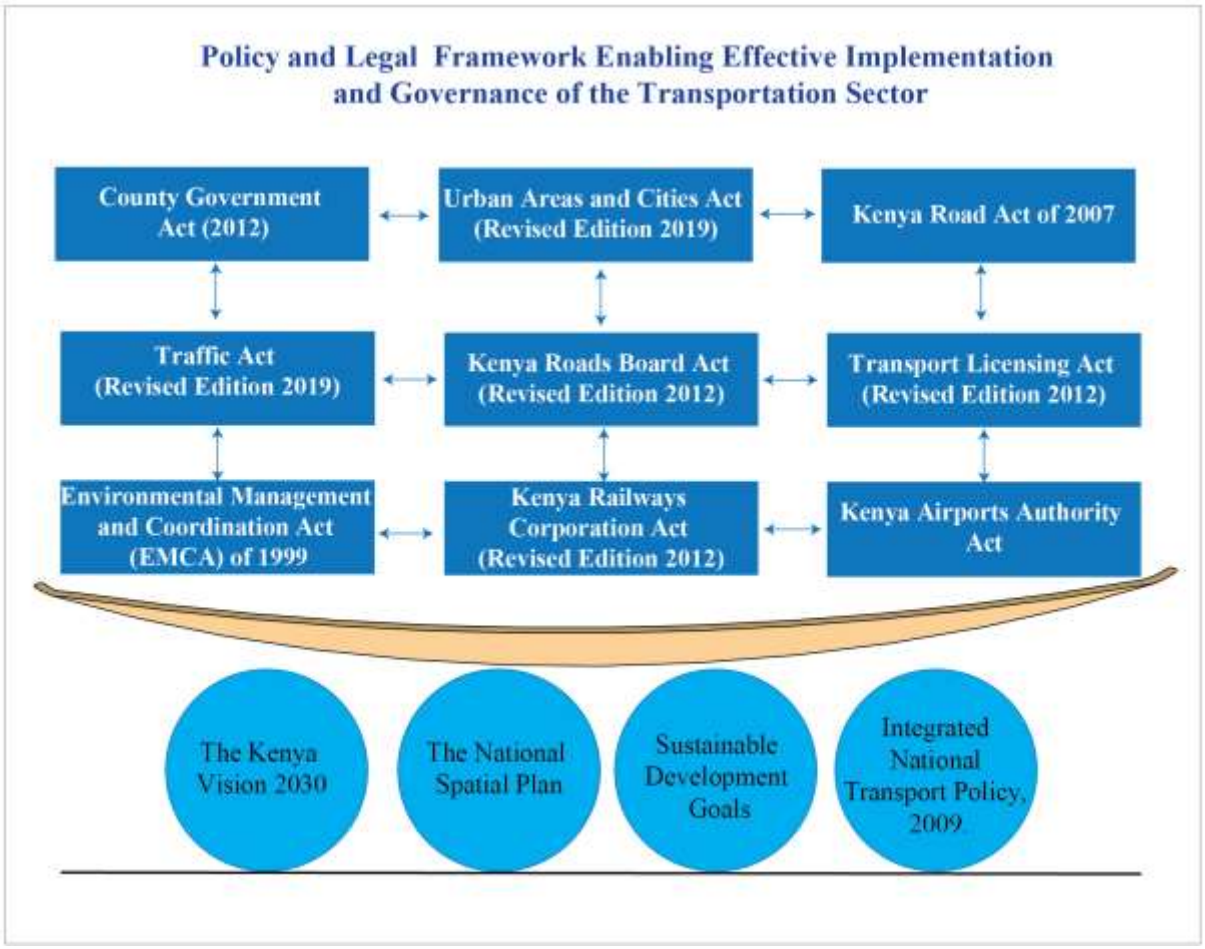


Source: SDMUAK, 2019

2.8 Institutional, Policy and Legislative Provisions

The concepts of policy and governance are intertwined (Mitullah & Opiyo, 2012). Policy and appropriate legislation enable effective implementation and governance of the transportation sector. In this respect therefore, the policy and legal provision in promoting the development of NMT in Kenya are as follows:

Figure 8: Policy, Legal and Institutional Frameworks



2.8.1 Policy Framework

I. Sustainable Development Goals

Managing the transport sector can make a direct and indirect contribution towards the achievements of the SDGs if the three pillars of sustainable development – economic, social and environmental – are integrated into transport policies, planning and operation. Transport policies, initiatives and projects can contribute towards achievement of goals 1, 2, 3, 7, 9, 11, 13 and 17 of the SDGs. To be specific sustainable transport can contribute towards attainment of following aspects of the SDGs:

a) Goal 1 and 2 which aims at ending poverty, hunger and attaining food security;

b) Goal 3 whose objective is improving road safety;

c) Goal 7 that targets improvement of efficient energy in the transport sector;

d) Goal 9 whose aim is development of quality, reliable, sustainable and resilient transport infrastructure;

e) Goal 11 whose goal is improvement of urban public transportation system;

f) Goal 13 that targets impact of climate on transport as well as mitigation and adaptation measures;

g) Goal 17 on collaboration and partnership to develop sustainable transport system.

II. New Urban Agenda, Africa 2063

The New urban agenda (2063) is part of Africa's strategic framework aimed at attainment of an "integrated, prosperous and peaceful Africa, driven by its own citizens, representing a dynamic force in the international arena". One of the aspirations of this vision is a prosperous Africa with inclusive growth and sustainable development. Sustainable transport is key to the aspiration and vision. According to Kajange (2017), key issues in the transport policy as identified by African ministers responsible for transport include an approach that integrates road, rail, air, maritime and urban transport. NMT is key component of urban transport.

III. The Kenya Vision 2030

Kenya's Vision 2030 aspires to setting up a strong institutional framework for infrastructure development, increased connectivity, reduced transport and related costs. The vision targets the development and maintenance of an integrated, safe and efficient transportation network. It further provides for a 50-year Integrated National Transport Master Plan linked to the National Spatial Plan. The master plan intends to ensure that investment and location of transport infrastructure and services are consistent with other public policies. The vision further notes that 1700km of NMT infrastructure including paths and walkways are to be built by 2030.

IV. Integrated National Transport Policy, 2009.

The National Transport Policy (2009) augments Vision 2030. It provides for the need to incorporate NMT infrastructure into the existing road network. The policy delegates development of NMT infrastructure to county governments. It outlines provision and maintenance of adequate sidewalks and pavements for pedestrians, separate lanes, parking bays, bridges, footpaths, and other facilities for NMT users including ramps for the physically challenged. Finally, the policy encourages road construction agencies to incorporate universal NMT infrastructure into their planning and design programmes.

V. The National Spatial Plan

The plan addresses land use, socio-economic and environmental issues to achieve balanced and sustainable spatial development and optimal land use across the country. The plan provides comprehensive strategies and policy guidelines to deal with issues development issues including transportation. It identifies transportation as key element in the economic growth of any nation. It improves the access into different regions through connectivity and thus easing the movement of goods and people.

VI. Nairobi City County's Non-Motorized Transport Policy.

Nairobi is the only county with an NMT policy. Its motto is "Towards Non-Motorized Transport as the Mode of Choice". This NMT policy recognizes that the current system of transportation in the city devoid of NMT poses a number of challenges to the comfort of pedestrians. These challenges include traffic congestion, radial network system, neglected infrastructure and inefficient traffic management, encroachment and weak enforcement. NMT challenges have similarity across Kenya's urban areas. Towards overcoming these challenges, the policy aims to attain the following:

(i) Developing and maintaining a transport system that fully integrates NMT as part of the Nairobi transport system,

(ii) Creating a safe, cohesive and comfortable network of footpaths, cycling lanes and tracks, green areas, and other support amenities, and

(iii) Put in place laws and regulations to ensure that NMT facilities and areas are not encroached by the motorized modes and other street users.

2.8.2 Legal Framework

a) County Government Act (2012)

Provides for county governments' powers, functions and responsibilities to deliver services and for connected purposes. The Act places responsibilities of county planning to the county governments including various types of county planning. Transportation planning is one of the types of plans the Acts mandates the county to prepare.

b) Urban Areas and Cities Act (2019)

Provides for the classification, governance, and management of urban areas and cities; the criteria of establishing urban areas and the principle of governance and participation of residents. Parking,

traffic control, public transport, and street lighting are listed as requirements for classification of an area

c) Traffic Act (2019)

The Traffic Act provides the framework for the enforcement of traffic laws, including those relevant to NMT users. Part V provides penalties for driving vehicles at speeds greater than 50km/h on any road within the boundaries of any urban area. Highway authorities are directed to erect and maintain traffic signs and speed limiting road design features. The highway authority is also tasked with ensuring that traffic routes in the vicinity of educational institutions are equipped with safe NMT features. This Act also prohibits driving on pedestrian walkway and cycling lanes. This Act principally provides for traffic management within and without urban areas.

d) Kenya Road Act of 2007

Provides for classification, management, construction and maintenance of public roads in Kenya and establishes KeNHA, KURA, and KeRRA and stipulates their functions. Most of the roads within Eldoret municipalities are under the management of KURA and KeNHA.

e) Environmental Management and Coordination Act (EMCA) of 1999

Establishes the National Environment Management Authority (NEMA) and legal framework for the management of the environment and lists all major roads among projects to undergo environmental impact assessment before construction.

f) Kenya Roads Board Act (2012)

Provides for the establishment of the Kenya Roads Board, an agency tasked with distributing revenues from fuel levies for use in road maintenance.

g) Transport Licensing Act (2012)

This Act of parliament provides for the co-ordination and control of means of and facilities for transport. It provides for licensing of movement of all vehicles including transportation of goods and person in the public interest and safety.

h) Kenya Railways Corporation Act (2012)

An Act of Parliament to provide for the establishment of a corporation to be known as Kenya Railways, for functions of railway infrastructure and transport management.

i) Kenya Airports Authority Act (2012)

The Act provides for the mandate to ensure efficient and effective airport facilities and services in a sustainable environment.

2.8.3 Institutional Framework

a) National level

The Ministry of Transport, Infrastructure, Housing, Urban Development, and Public Works (MoTIHUD) is responsible for overall transport policy. The three road authorities, namely the Kenya National Highways Authority (KeNHA), Kenya Urban Roads Authority (KURA), and Kenya Rural Roads Authority (KeRRA), are responsible for the management, development, rehabilitation and maintenance of roads in the country, as stipulated by Kenya Roads Act, 2007. The Kenya Roads Board (KRB) oversees the road network and coordinates its development, rehabilitation, and maintenance by administering the Fuel Levy. Licensing of movement of goods and persons is placed under the transport and licensing board still under the MoTIHUD. Kenya railways and Kenya airport authority manages both infrastructure and transport of railway and air respectively. The two agencies are under the ministry – MoTIHUD. All these agencies develop infrastructure including NMT provisions.

b) County level

At the county level, transportation is managed by the county government in liaison with National Police Service, KeNHA, KURA, Kenya railways, KAA and Ministry of MoTIHUD. For the transport infrastructure under the county government, the departments of Roads, Transport & Public Works and Lands, Physical planning & Urban development are responsible for the development, rehabilitation and maintenance of road network in the County and within the municipality. There is also the Municipal Board established according to UACA (2019) overseeing municipal transport infrastructure and services among other duties. The transport section is responsible for transport policy formulation and development of the regulatory framework, transport infrastructure, management of the vehicle fleet and public transport through the allocation of working spaces and bus terminals. The illustration below shows the transportation institutional arrangements.

2.9 Overall Information Gap

Transportation and land use have a long history of influencing each other (Van Lierop et al , 2017), and this relationship has been studied over the last century. According to Van Lierop et al (2017), research in this sector has been and still aimed at developing precisely measured, relevant and

reflective findings for effective strategies and policy formulation. A chronology of transport-land use research is provided in *Figure 4*.

In Eldoret, existing studies show a bias to vehicular mobility over NMT. Komollo (2010), developed a framework aimed at sustainable decongestion of Eldoret CBD. His study focused on vehicular mobility and the provision of parking within Eldoret CBD. Studies related to NMT within Eldoret are largely project-based aimed at sourcing for funding. As it stands, NMT infrastructure is limited to a few roads and largely not integrated into the CBD (MoL&PP, 2019; Cheserek et al, 2012). Nonetheless, NMT use has become popular as urban economies coupled with a general awareness of its benefits continue to improve (Cheserek et al, 2012).

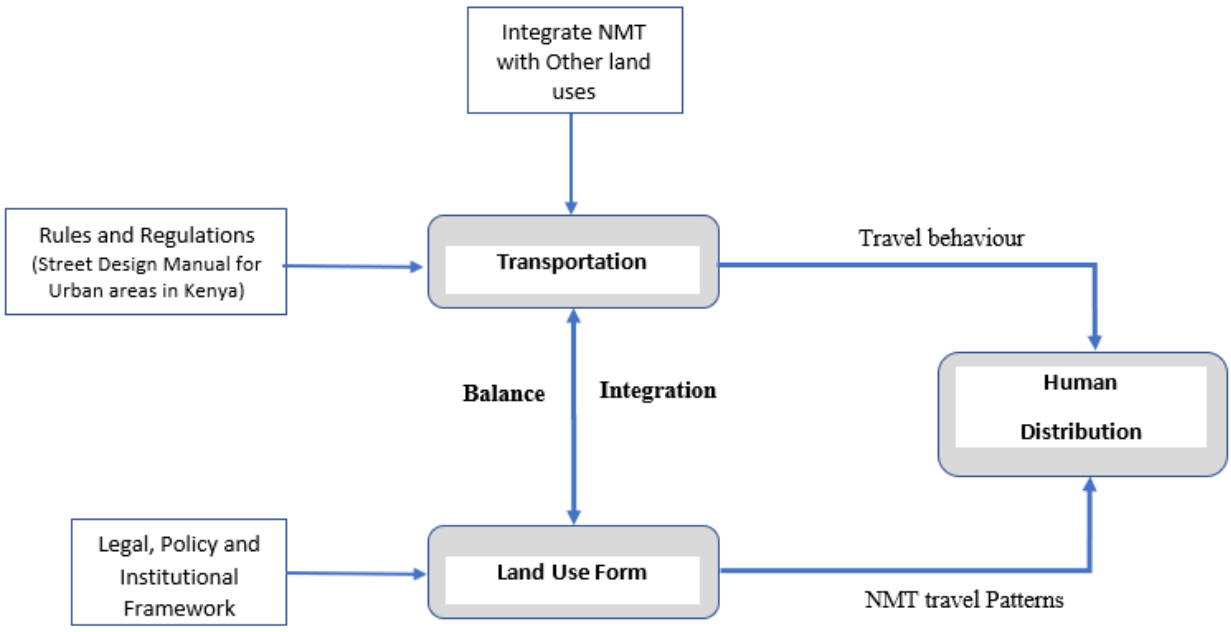
This research, therefore, aims to deduce mobility patterns of users along key road corridors as influenced by the land-use dynamics. The support infrastructure is evaluated to assess its adequacy against existing standards, legal and policy framework.

2.10 Conceptual Framework

The impact of walking, hand-carting, and cycling on urban mobility must be precisely evaluated. The relationship between urban performance and NMT remains unclear. According to Rudolph *et al.* (2016), the socio-economic impacts of walking and cycling are difficult to fully assess due to the extensive data requirements and complexity of standard evaluation processes such as cost-benefit analysis. Nonetheless, NMT is recognized as a valuable component of the transportation system, human well-being and the environment (IRF, 2019). Its benefits include environmental friendliness, increased liveability, improved health, economic gains, and transportation benefits.

In Eldoret, the growth and changing land-use dynamics in its CBD defines the transport character of the municipality. Its growth is best understood through a chronology of its recent history through a synthesis of imagery and development control data. The use of a time series of satellite imageries is aimed to generate land use/cover analysis coupled with a synthesis of municipal's information is expected to give indicators of growth. Transport provides linkage between land uses and NMT is not any different. Understanding mobility of NMT users and the challenges they face is expected to provide an in-depth understanding of NMT user characteristics within Eldoret CBD.

Figure 10: Conceptual framework



CHAPTER THREE - RESEARCH METHODOLOGY

3.1 Introduction

This chapter covers the research design, target population, sampling, data collection and analysis methods to be adopted in the research. The sampling frame, data analysis and interpretation techniques employed are also covered in this chapter.

3.2 Research Design

Descriptive research design was adopted. The data collection incorporated observation, case studies, instrument administration and road users' experience. Traffic and NMT infrastructure studies were undertaken to provide an understanding of the operation of the existing transport network within the planning area.

The research adopted a three-tier approach as follows; to employ the following data collection methods:

1. Non-Motorized Transport travel demands,
2. Non-Motorized Transport user's questionnaire, and
3. Road infrastructure survey and assessment.

Preparation of this plan was divided into three major activities.

- Data Collection - which entailed review of existing data, mapping, household surveys, Key informant interviews, focused group discussions and traffic surveys/counts
- Data Analysis - which entailed detailed interpretation of collected data.
- Drawing conclusions and recommendations based on study findings, stakeholder concerns and gaps for further research and decision making based on the analysed data, transport development models and stakeholder concerns.

All the data were be subsequently processed and analysed to provide an in-depth understanding of the challenges, needs and performance of the non-motorized transportation system in the Eldoret CBD.

3.3 Selection of Study Area

Eldoret Municipality is one of the fast-growing urban areas. It is located 320 km to the North-West of Nairobi, the capital city of Kenya. According to KNBS (2019), it is currently the fifth most populous urban area in the country. Its growth is attributed to population growth and immigration,

improved standards of living, continued improvement of commerce and industrial development. For these reasons, demand for transport services has significantly increased especially within the CBD where commercial, social and recreational services are concentrated. However, the support infrastructure and services do not meet the demand thereby creating transportation challenges within the municipality such as traffic congestion.

Transportation influences urban growth patterns and economic activity by providing access to land uses. Eldoret is a transport hub with air, rail, and road transport services available. It acts as the administrative capital of the North Rift Economic Bloc, county headquarters as well as key regional institutions like KVDA, roads authorities, NCPB, educational and health institutions among others. It is further a home to industries sourcing raw materials from hinterland and employs critical mass of municipal's residents. All these urban roles and the status of the municipality have placed it as a key transport hub with varying needs. Further, Mutua, *et. al.* (2017), in their study on Kenya's Transport sector development found out that transport is the weakest link in urban areas development performance index. NMT was selected as a sub-sector based on Eldoret's CBD's form and the over-emphasis on motorized transport development that has been favoured in policy direction resulting in high numbers of cars contributing to traffic congestion (Salleh *et al*, 2014). The selection of the study area, therefore, was presumed to provide an ideal site to analyse NMT travel patterns as influenced by land uses.

3.4 Literature Review

A comprehensive review of literature relevant to the technical and spatial research scope was done. This includes transportation infrastructure projects, proposals and policy documents. Additionally, a review of documents that have been studied and relate to the persistent transport issues that plague the urban areas just like Eldoret were looked at.

3.5 Target Population

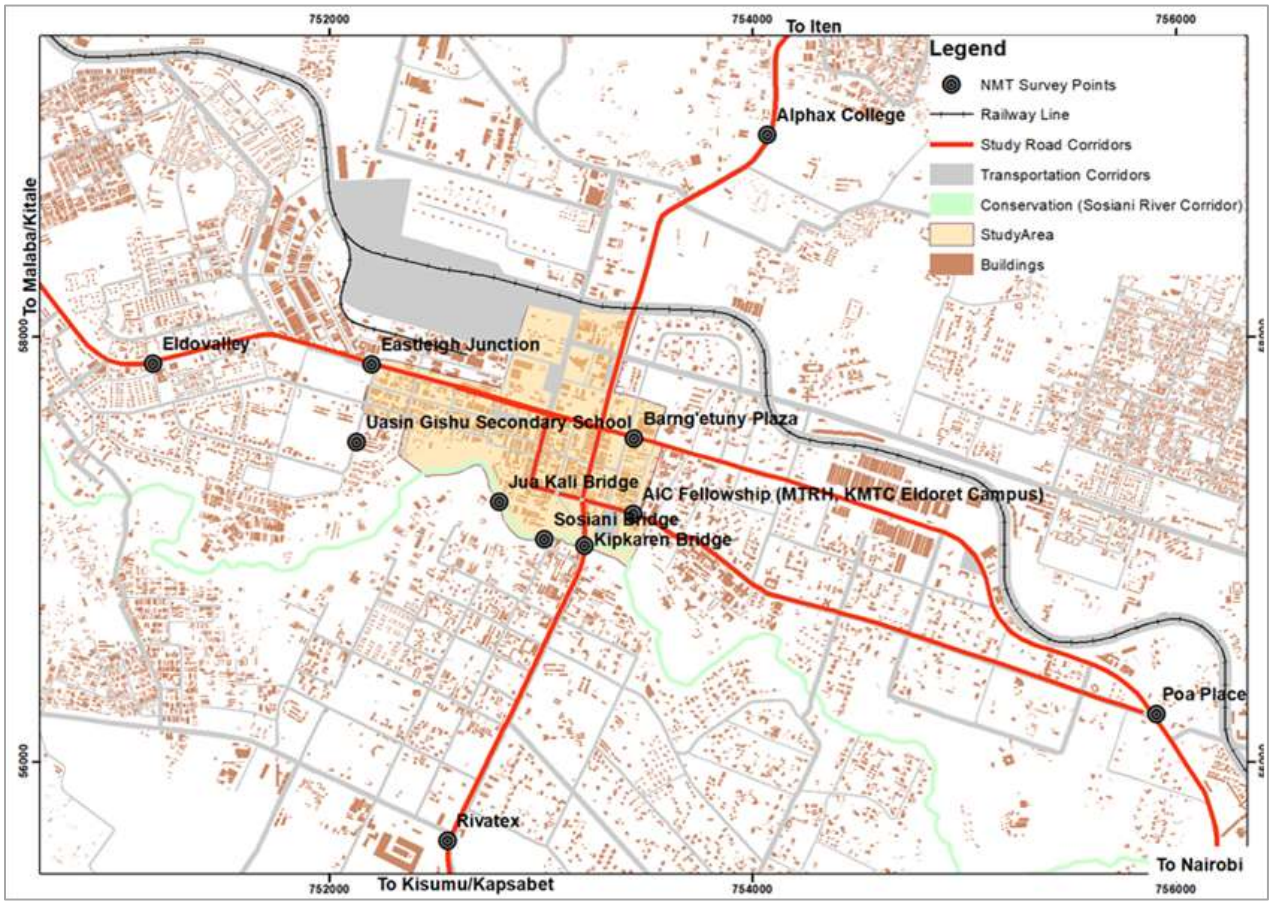
The study's target population included the study road corridors, NMT users (pedestrians, cyclists, and hand carts), and institutional representatives (the police and the county urban planning unit). From the NMT users, all the pedestrians, cyclists, and hand carts were all counted from 7:00am to 7:00pm while sampling for interviews were done among the users and institutional representatives. Since the population of the NMT users are largely active during the day, users were counted from 7:00am to 7:00pm. It is thereby assumed needs and deduction of this research were to be concluded

based on infrastructure used during the day. Interviews of sampled NMT users were conducted during peak hours i.e., morning, lunch hour, and evening.

3.6 Sample Size and Sampling Design

According to KNBS (2019), Eldoret municipality is the fifth most populous urban area with a population of 475,716 inhabitants. The municipality has grown from a regional agricultural town to a regional transport and economic hub. Though motorized transport is a popular means of transport, not all places are accessible by public or private transport due to prevailing by-laws and infrastructura provisions. As an example, there is no existing framework for travellers transiting from one terminal facility to another or a CBD circulation plan. NMT, therefore, is important means of travel within urban areas for door-to-door access.

Map 1: NMT Traffic Cordon Points



In this study, 1km^2 of the CBD was the focus of this study while taking cognisance of traffic generation areas beyond the CBD area. A land-use map was generated for the study area. The target

population in the delineated study area were the roads and the NMT users. The proposed road condition survey and NMT traffic survey and sampling points are shown in *Map 2*. Along these corridors, purposive sampling of the major land use transformation facilities was done. This was aimed at identifying NMT traffic hotspots as influenced by land use transformations in the study area. The sampled road corridor are the main urban highways into and out of the CBD. From the NMT Strategy Policy for Nairobi City County (Nairobi City County, 2015), 40% of the residents use NMT. Eldoret is assumed to have this high percentage of NMT users due to similar characteristics of Kenyan urban areas. A stratified sampling procedure was be used to distribute samples among the pedestrians, cyclists, and hand carts.

3.7 Data Collection Methods

3.7.1 Desktop Reviews

Desktop review is a process of scoping literature of the project area in order to have factual information on mobility, land use and state of transport infrastructure among others. The scope of desktop review entailed the following:

- Population and municipal boundary trends
- A review of land use characteristics
- Infrastructure assessment
- Mobility needs and characteristics of NMT users
- Case studies
- Research methodologies

3.7.2 Road Corridor Mapping

An inventory and condition of the major roads and existing NMT facilities was be undertaken within the study area. The information to be collected includes road lengths, width, and availability of on-street parking spaces. The data obtained was important in the evaluation of the capacity and adequacy of the road segment. In addition, the information assisted in assessing the level of service the road segment set for NMT is used for.

3.7.3 Road Condition Assessment

From the road infrastructure inventory, an assessment was made on road reserve, NMT facilities and road side infrastructure. The data obtained was important in the evaluation of the capacity for

NMT infrastructure provision. In addition, the information also assisted in assessing the level of service the road segment set for NMT is used for. Building line alignment was mapped out as they were considered to affect the provision of NMT facilities along the corridors. Finally, universality and the state of the pedestrian zones were documented to inform user needs along the study corridors.

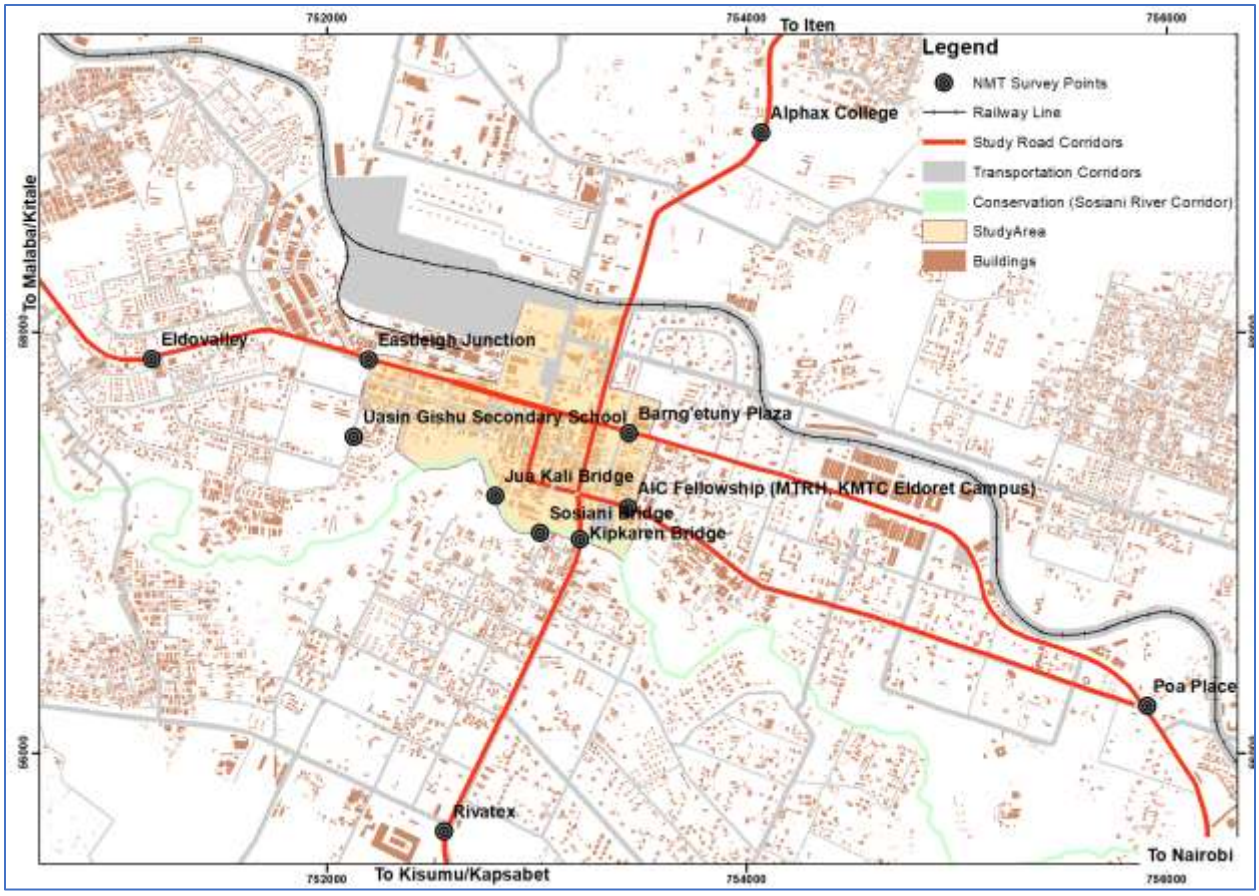
3.7.4 NMT Interviews

Roadside interviews shall be carried out at locations of link counts over a period of 2 days for 12 hours. Information was be collected such as origins and destinations, proportion of external trips, and trip purposes. This data is crucial in establishing residents' trips and challenges. The information collected was used to amplify the household data on study area crossings. It is aimed that the survey provides travel characteristics of the residents. The questionnaire was tailored to capture essential NMT topical issues. From this survey the following characteristics were deduced:

- Trip Frequency and Purpose
- Travel time
- Modal share

3.7.5 NMT Traffic Survey

This traffic survey entailed NMT traffic link count at the cordon points. Traffic count involved a two-directional enumeration of NMT users at the selected points. The classified non-motorized traffic volume counts were carried at link locations, and at major NMT entries to the CBD over a period of two (2) days. The most critical locations were identified during the initial site visit and desk reviews.



Map 2: NMT Link count points

3.7.6 Land Use Dynamics Analysis

The degree of human development and land utilization is reflected directly by land use. This is because land use intuitively records physical features which are changed by human activities. With the change in land use, dynamics on mobility are affected as transport is the link between the land uses. In this study land use transformations were be analysed. Land use characteristics in an urban area is not usually physical changes but it may relate to the intensity of human activities. It may also be a wholesome or partial land use change of existing infrastructure. The evolution of land use within Eldoret relates to its changing role from a local agricultural urban node to its current role as a regional and international economic and transport hub. Using traffic data and trip purpose by the NMT users as generated by land uses along study corridors, an inference was made on how the land uses are influenced by the land-uses.

3.8 Data Analysis Methods

Collected data were first be documented in a structured way using a filing or data management system. The data was then digitized using a pre-prepared codebook or software formats. Digitized data were examined for logical consistency and accuracy as collected. They were then sorted to check for errors of omission and commission. The data collected were classified, measured, analysed, and interpreted for each of the research objectives.

3.8.1 Land Use Transformation

Land use analysis is aimed at developing an inventory and assessment of road conditions for NMT usage. The inventory is aimed at creating a basis for possible interventions based on the findings of the study. Further, the destinations and/or origins of trips are located along the study corridors. Their change in service provision affects traffic in their surroundings. These land-use transformations provided valuable historical background and feasible interventions going forward.

3.8.2 NMT Interviews

Qualitative and quantitative data from road side interviews were analysed. From the interview, origin and destination of NMT users were deduced including the amount of travel time, modal share, trip purpose, income levels, and challenges faced.

3.8.3 Traffic Counts

The performance of the existing NMT facilities depends on the traffic that uses them. From this traffic survey, the number of users towards and away from the CBD were to indicate the level of service. Users that cross the roads at the link count points were enumerated aimed at possible intervention at those points. Where possible accident data from the traffic police were sought for these link count points. Traffic counts provided modal share at every link county point as well as volume.

3.9 Data Presentation Plan

Data presentation were deduced from the questionnaires, observation guides and maps. Qualitative data were organized in a way that provided answers to the research objectives. Graphics were used quantitative data presentation. An interpretation of proposals has been enumerated and visualized in using maps.

3.10 Ethical Considerations

Ethics refers to the *'ethos'* of conducting a research. The University of Nairobi requires researchers to comply with 15% or less plagiarized material. This is part of research's objective to contribute to knowledge through shedding light to what is already know. Further to this, this research adhered to the following among other standard research considerations;

i. Adhere to university code of ethics
ii. Respect to privacy
iii. Respect for confidentiality
iv. No falsification of data

3.11 Data Needs Matrix

Table 2 outline the data requirements, methods of acquisition, instruments, data analysis methods and possible sources of the data.

Table 2: Data needs matrix

Obj.	**Data required**	**Data source**	**Methods of data collection**	**Data instruments**
To examine the land use characteristics in Eldoret CBD	CBD Land use	• County Government of Uasin Gishu • Field observation • Interviews	i. Land use transformation ii. Interview iii. Field observation	i. Map/Checklists ii. Key Informant Guide
	Infrastructure characteristics			
To examine the characteristics of the transport system in particular NMT at Eldoret CBD	NMT infrastructure Condition	• Field survey • Interviews	• Field observation • Key informant guide	• Map/Checklist • Interview guide
	Origin-Destination Surveys	• NMT Users	• Interviews	• Questionnaire
To evaluate the influence of land use transformations on NMT travel patterns in Eldoret CBD	Land uses	• Secondary sources	• Secondary sources	• Digitization
	NMT Traffic Volumes	• Field Survey	• Traffic Survey	• Checklist
	Origin-Destination Surveys	• Field Survey	• Interviews	• Questionnaire
	Junction Assessment	• Fieldwork • NPS/Traffic Marshals	• Junction survey • Interview	• Checklist • Key informant guide
To make proposals that integrate the NMT needs in Eldoret CBD	Challenges/ Opportunities	• Findings of Objective 1, 2 and 3 • Literature review on best practices		

CHAPTER FOUR – STUDY AREA

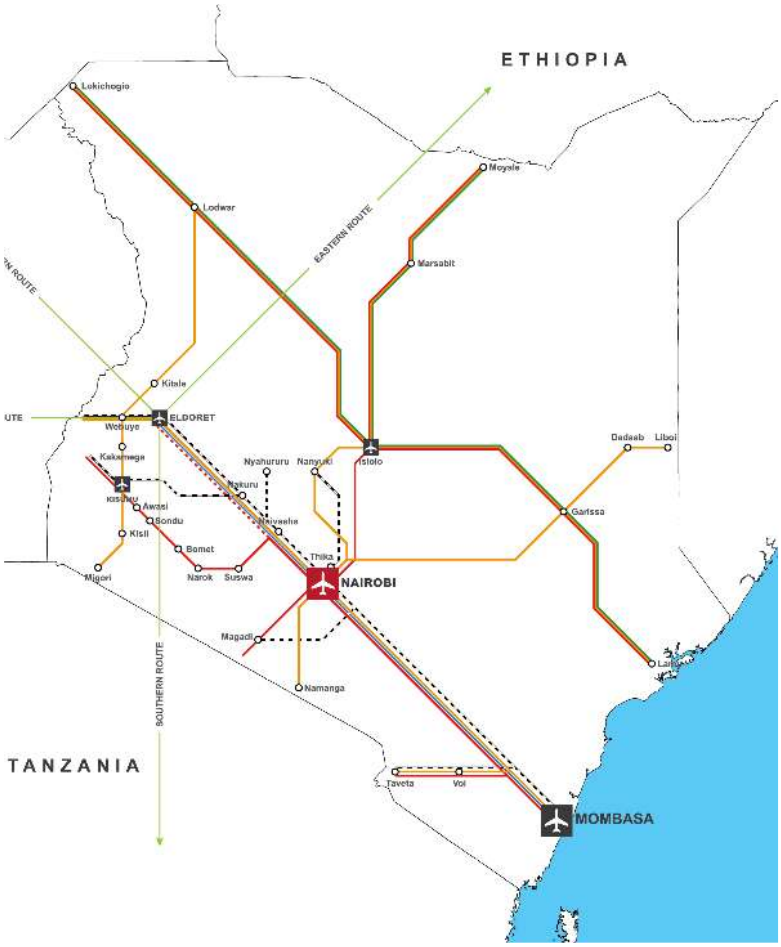
4.1 Introduction

This chapter gives a description of the locational and historical context of Eldoret CBD and its neighbourhood. It also highlights the geographical extent of the planning area as well as a brief on planning and development elements. This provides an understanding of the study area by laying historical perspective, physiographic character as well as Eldoret's population and demographic characteristics.

4.2 Geographical location

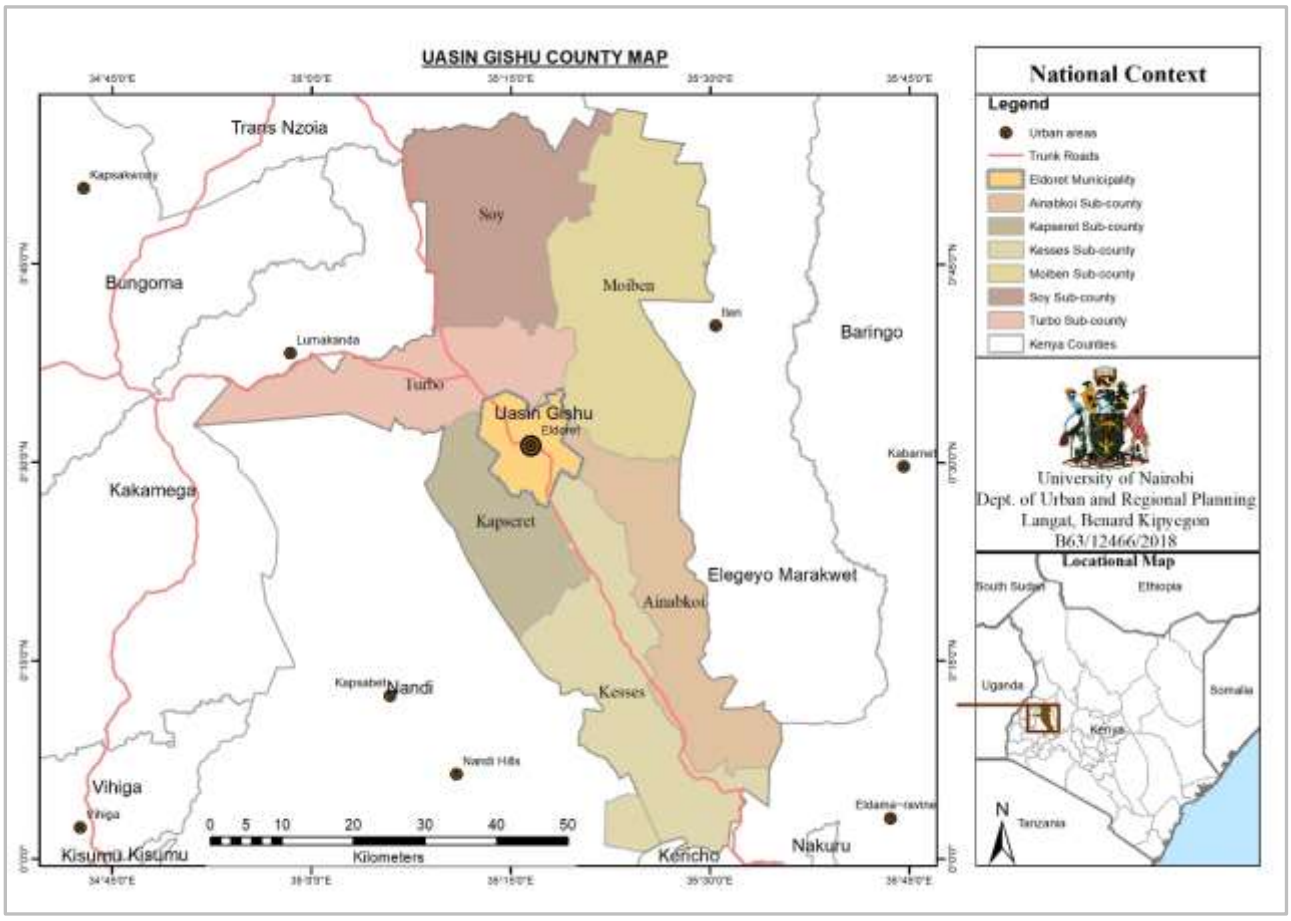
Eldoret Municipality is sited approximately 320km to the North-West of Nairobi, the capital city of Kenya (*Figure 11*). It is one of the fast-growing municipalities and economic hub in the North Rift region. The municipality is considered the fifth-largest urban area after Nairobi, Mombasa, Nakuru, and Ruiru. It is a key transport hub in the country.

Figure 11: National Locational Context



The municipality is connected to the rest of the country, the Eastern African region, and the world at large via Eldoret International Airport, the Metre-Gauge Railway and the national trunk roads. It is connected by the Trans-African Highway (A8) and other arterial roads e.g., Eldoret-Iten (B8), Eldoret-Kisumu (B16), and Eldoret-Ziwa (C621) road among others. *Map 3* shows the locational context of the municipality.

Map 3: National Locational Context

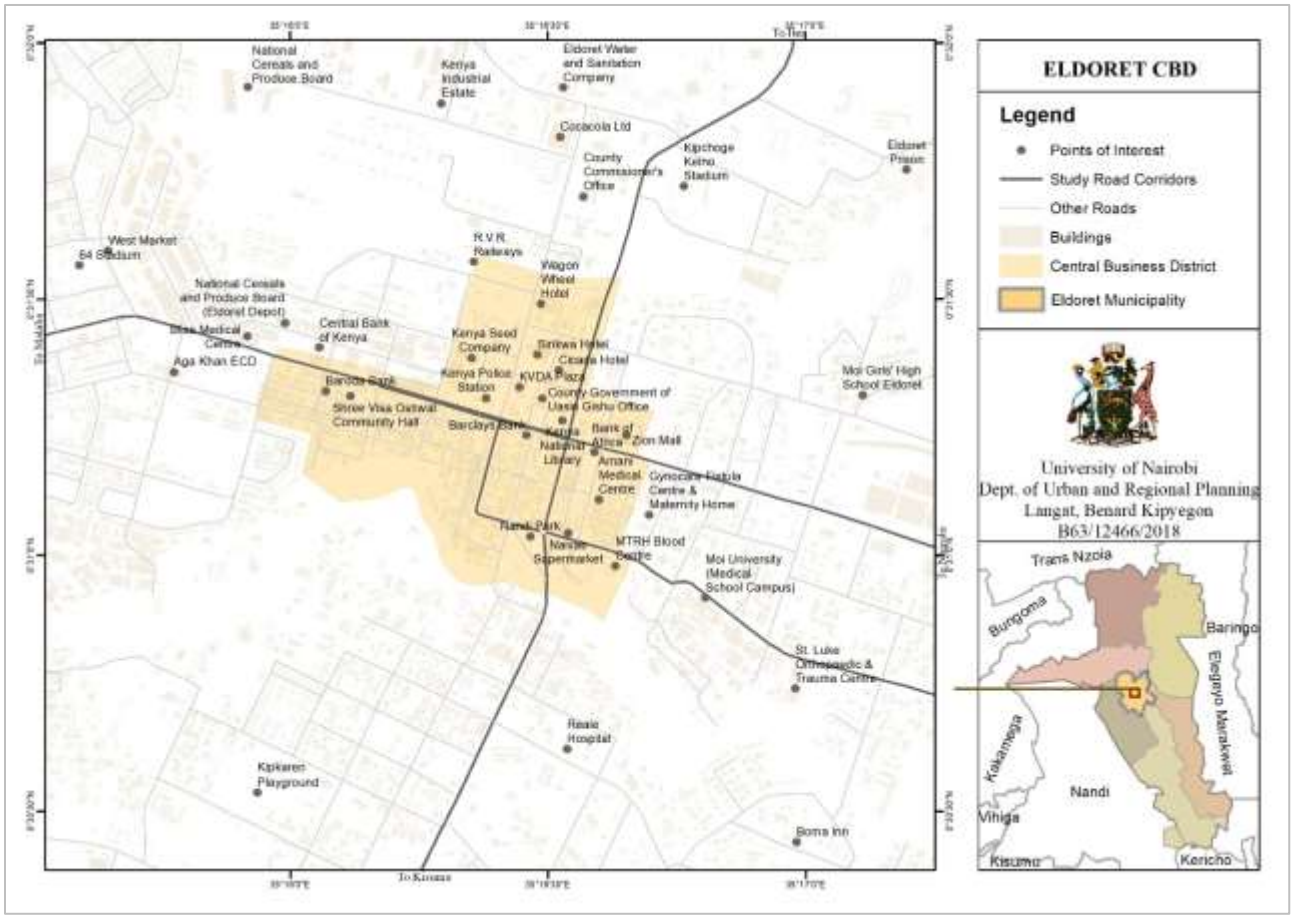


Source: IEBC,2012 and MoL&PP, 2019

Eldoret is strategically positioned within the North Rift Economic Bloc and acts as its headquarters. There are eight member counties. It is widely known as the home of champions and was planned as a regional industrial town (Ministry of Lands & Settlement, 1973). It is currently home to several industries for example National Cereals and Produce Board (NCPB), Raiply, KCC, Unga limited, and Kenya Pipeline Corporation depot. Major educational institutions, health, and service industries serving the region are also located here. The trans-African highway traverses the CBD and connects

to the hinterland by radial roads. An airstrip is located close to CBD as shown in *Map 5*. These facilities and services places Eldoret as a strategic regional economic and transport hub.

Map 4: Local Locational Context



Source: IEBC,2012 and MoL&PP, 2019

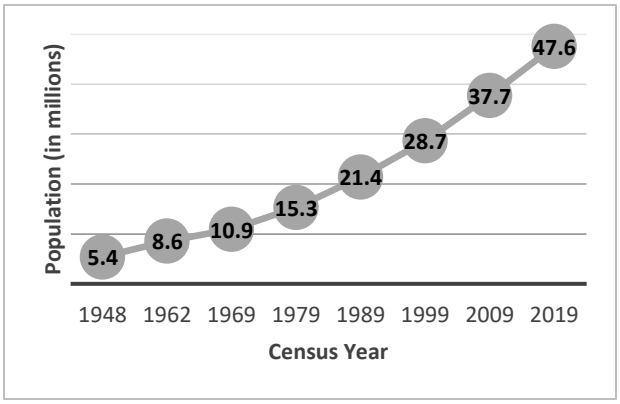
The CBD traverses three sublocations, namely: Huruma, Sigot, and Kamukunji located within Kipkenyo, Kimumu, and Kuinet/Kapsuswa wards. It borders Elgon View estate, Pioneer, Kidiwa, Kokwas, Jerusalem, Kapsoya and Kamukunji estates. The delineated CBD area as shown in *Map 4* is approximately 107 hectares. The area is located North of Equator within latitudes 0°30'30"N and 0°31'45"N and within longitudes 35°15'45"E and 35°17'45"E.

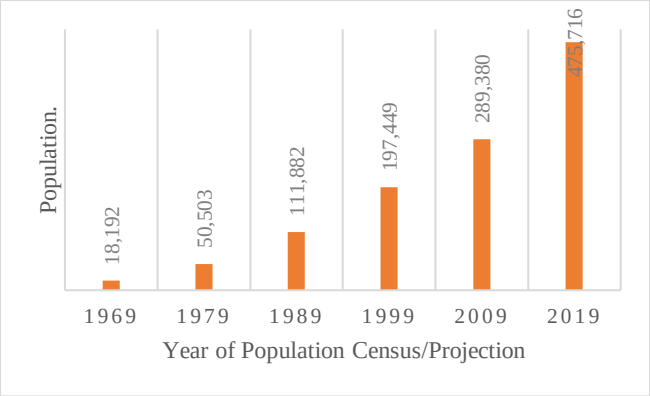
4.3 Demographic Characteristics

Over the years, Eldoret has exhibited continuous expansion in terms of population. Its urban population growth is high as shown in *Figure 12* and over spilling to its peri-urban areas. The

population growth relates to the boundary changes provided in *Figure 13* and not limited to a constant spatial scope

Figure 12: Population trends of Kenya's (L) and municipality (R)





Source: KNBS 2019

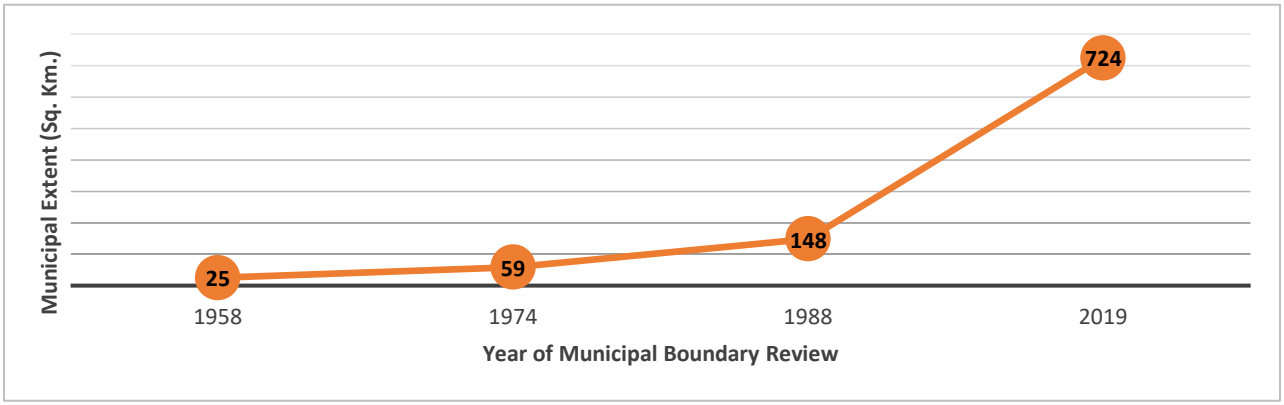
4.4 Historical Context

The history of Eldoret can be traced back to the beginning of the 20th century. It was started along the Kenya-Uganda railway shortly after white settlers established themselves for farming activities in the North Rift region (Badoux *et. al.*, 2018). According to Badoux *et. al.*, (2018), the municipality consisted of four distinct settlement areas during Kenya's independence. The settlements were the British settlers, Boers, Asians, and Kenyans. Boers had immigrated to practice farming while Asians were the unskilled laborers on the construction of the railway. In the pre-colonial period, the vast land was used by the Maasai to graze cattle who used to water their animals on the shores of River Sosiani (Badoux *et. al.*, 2018). This changed after independence when the White Highlands were re-Africanized through the settlement schemes, whereby Kenyans from various regions of the country moved to the North Rift, particularly to Eldoret. With increased population, the Eldoret's economic status became more vibrant as an agricultural centre. Tremendous growth was witnessed following ascension of President Moi to power in 1978 as he initiated infrastructural developments and establishment of institutions.

Its growth can be demonstrated from the municipal boundary extensions. According to Korir (2015), the municipal boundary has extended over the years due to population pressure. In 1958, under legal Notice No. 515, the municipality had an area of 25 km^2. It was reviewed to 50 km^2 in 1974 and further extended in 1988 to 148 km^2 - a situation which remains to date. The current municipal extent is

documented in the municipal Gazette Notice No. 460 dated 18th January 2019 as it appears on Kenyan Gazette Vol. CXXI-No. 9. Recent developments (MoL&PP, 2019) show municipality is being extended to 724 km^2. This recently developed and approved a plan by the national government has been advertised for review to align it with the Physical and Land use planning (2019) law and development partners' requirements. *Figure 13* below visualizes the trends in boundary changes of the municipality.

Figure 13: Municipal boundary trends



Source: MoL&PP, 2019

With the historical understanding of Eldoret, its social fabric is key for this study. It is home to many with most residents having no intentions to emigrate (Badoux, M. *et al*, 2018). This is attributed to the perception that the municipality offers a good quality of life. These opportunities include: thriving business prospects, cheaper operation costs, less congestion and it being safer than the capital city, Nairobi (Badoux, et al., 2018). Hence, the thriving municipal economy and the potential it offers for further growth.

The urban growth could not have happened without modernisation of complementary transport infrastructure. Kenya's modern transport system is associated with construction of Mackinnon-Slater roads from Mombasa through Nairobi to Busia through Eldoret preceding the railway (Alila *et. al.*, 2005). In Eldoret, Uganda road – which was built in 1950s – forms part of the Trans-African highway and divides the study area into two. Other key regional linkages and urban circulation roads have since been developed, key among them being Kisumu and Iten roads. Local circulation roads have been improved by government agencies and the county government of Uasin Gishu, with the ongoing bypass from Cheplaskei through Kapseret to Maili Tisa one of the key roads aimed at managing through traffic. The Kenya-Uganda railway was built from Mombasa Port during 1890s and first

years of the 20th century. This metre-gauge railway linked Nairobi to Eldoret and extends to Kampala, Uganda. There are other lines connecting key economic area in Kenya e.g., Taveta, Nanyuki and Kisumu lines. The line to Eldoret (also hosting a container terminal depot) was completed in 1924 and in 1928 it was extended to Kampala, Uganda (Alila *et. al.*, 2005). This line is part of the 2050 km metre gauge railway and the recently constructed 592 km of standard gauge railway.

Other transportation modes within Eldoret are air and pipeline. There are two operational airfields i.e., Eldoret Airstrip and Eldoret International Airport. Eldoret Airstrip is used for domestic purpose and is located within 500 m from the CBD along Iten road. Eldoret International Airport was established in 1995 and is a key cargo and passenger transit terminal. The urban area has an oil pipeline and a depot

4.5 Climatic and Physiographic Characteristics

The municipality is located at the base of the Uasin Gishu plateau. The plateau is surrounded by the undulating hills of Cherangani and Mount Elgon to the North, Nandi escarpment to the South and Elgeyo Marakwet Escarpment to the East. The plateau is at the centre of These geographical features greatly influencing the region's climatic conditions. The municipality lies between 2100m on the southern part to 2700m above the sea level. The topographic character has influenced its settlement patterns. The steep ridge to the north part is one of the natural structuring elements which separates the municipality and its rural hinterland of Soy.

River Sosiani and its tributaries traverse the municipality from the East to the West. Its geological composition comprises tertiary volcanic Uasin Gishu phonolites lavas. There is significant rainfall throughout the year ranging between 900 mm to 1200 mm (MoL&PP, 2019). The municipality is largely built-up and artificial surfaces with pockets of vegetation are present along environmentally sensitive areas.

4.6 Socio-Economic and Cultural Profile

Eldoret is a cosmopolitan municipality - a place where Kenyans and foreigners of all shades interact and live. The Kalenjin, the Kikuyu, the Luhya, the Luo and the Kisii are the most represented ethnic communities (Badoux, et al., 2018). The diversity forms the social fabric of the municipality. As the locals continue to immigrate to the municipality to seek for employment and better living conditions,

Eldoret has also become a home to people from neighbouring countries especially refugees seeking a more peaceful environment to live in.

Eldoret's being home to regional industries and its image as a vibrant urban centre have played a role in attracting migrants (Badoux *et. al.*, 2018). The fertile hinterland forms the food basket of Kenya where its stable foods - wheat and maize - are produced. Agricultural industries are located here, ranging from flour milling, food processing as well as farm input factories e.g., fertilizer factory by Toyota Tsusho East Africa. The economic diversity of the municipality improved with the government's funding of infrastructure, establishment of industries and institutions e.g., the Moi Teaching and Referral hospital as well as the military training school among others.

Finally, the urban area is an investment destination for many people, firms and development partners. It is seen as a municipality with enormous growth potential.

4.7 Social Infrastructure

The growth of the municipality can be attributed to availability of social infrastructure. These social facilities range from health, education, sports facilities and socio-cultural activities among others. Moi and Eldoret universities are located here along with campuses of majority of Kenya's universities. This is complimented by Eldoret Polytechnic, several technical colleges, prominent national secondary and primary schools.

The municipality boasts of the Moi Teaching and Referral Hospital, a county and several sub-county hospitals. These are supplemented by private health facilities and lower-level government facilities. Kenya is regarded as the home of athletics and Eldoret hosts the International Association of Athletics Federations (IAAF)'s High Altitude Training Center for Kenyan and international athletes. Prominent athletes train and live here.

4.8 Physical Infrastructure

The Trans-African highway (A8) is one of the structuring elements of the town. It traverses the CBD with other roads radiating from it to the hinterland and neighbouring counties and countries. Eldoret International Airport is located to the South receiving an average of 13 passenger flights per day. Eldoret Airstrip located to the North of the CBD is operational largely receiving private charters and emergency operation air services. The Kenya-Uganda railway passes through the CBD and plays a major role in the transportation of raw materials to factories and finished goods to their respective markets especially cargo to Uganda.

The municipality is served with piped water by ELDOWAS which sources water from Kapsoya, Sosiani and Chebara treatment plants. There exists a liquid waste treatment plant along Sosiani River near Huruma settlement. Solid waste disposal site is located near the liquid waste treatment with several collection points across the municipality.

4.9 Governance

Eldoret is a gazetted municipality vide Gazette Notice No. 460 of 2019. The municipality operates under Uasin Gishu County Government. Though the municipal board is fully constituted, its roles as outlined in UACA, 2019 have not been fully transferred. The municipality therefore operates in liaison with county department. Additionally, the board lacks a proper financing framework that is aimed at improving its development mandate as outlined in UACA, 2019.

CHAPTER FIVE – STUDY FINDINGS

5.1 Introduction

This chapter outlines the study findings sourced from traffic survey, infrastructure assessment and literature review. It enumerates and evaluates the socio-economic, demographic, land use dynamics, traffic survey and transport infrastructure within Eldoret Central Business District. The data collected for this study was derived from interviews, traffic survey and infrastructure assessment that was conducted between September 2019 and May 2020.

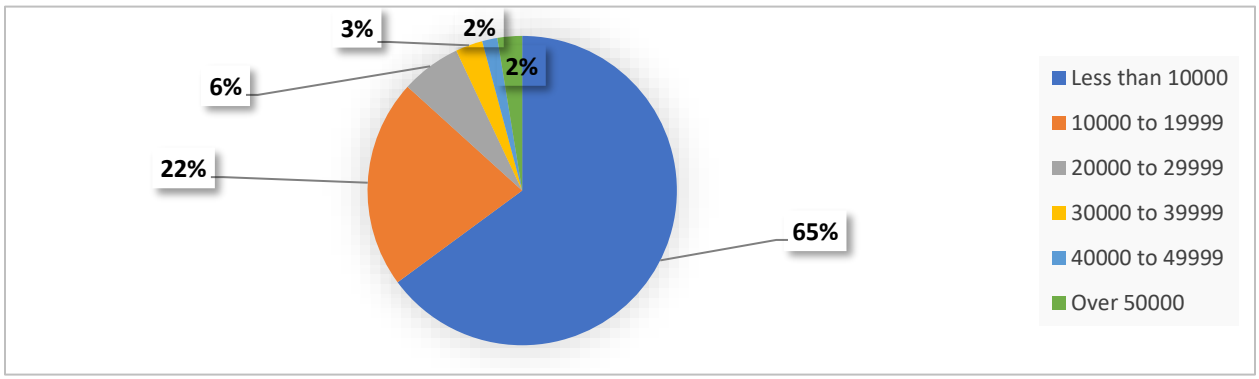
In the analysis, travel characteristics including volume, origin-destination surveys, NMT modes, challenges and opportunities have been analysed. Factors that influence travel characteristics were documented including the state of walkways and land uses. Existing state of infrastructure, challenges and opportunities were used to inform possible proposals as per preferences of stakeholders, professional judgement, policy and legal framework.

5.2 Socio-Economic Characteristics

Land uses determine where people live and visit. The study area constitutes 13.45% land mass of Kamukunji, Sigot and Huruma sublocations that make up the CBD. Assuming the population distribution is uniform, it is estimated that 5806 persons are located within the study area as per the 2019 population and housing census (KNBS, 2019). The study contextualized the land uses neighbouring the CBD which are slowly changing into commercial character of the CBD due to increasing demand for CBD services. The people access services and goods from these areas through NMT modes directly from residential neighbourhoods or transiting through the terminals.

Income levels influence trip choices across households as it represents ability of household members to pay for a journey and/or access of a service at destination points. Income levels further affect the number of trips one makes. Generally, the higher the income the higher trip generation rate. *Figure 14* presents the monthly income levels of NMT users. From the field survey, 65% of the respondents have income earnings ranging from KES 40,000 to KES 49,999 with only 2% earning more than KES 50,000. Up to 65% of the NMT users earn less than KES 10,000 per month.

Figure 14: Respondent's Income Levels



Source: Fieldwork, 2020

From the study area, car ownership stands at 24%. Though one may use a private car or a public transport vehicle, access to destination points within the study area would still require completion of journeys using NMT modes. Generally, car-owning households tend to generate more trips than those without, hence the more the cars in a household, the more the number of trips generated. Logically, number of cars owned is itself related to the income of the family.

5.3 Land use Dynamics

As the urban population increase, the land-use dynamics continue to change consequently influencing mobility characteristics of the people. Land-use changes in Eldoret can be related to the trends in the municipality's extents since 1958. According to the Ministry of Lands & Physical Planning (2019) and Korir (2015) growth of Eldoret is depicted by the changes of the municipal boundary where in 1958 the boundary was 25 km² while in 1974 it was revised to 59 km². The boundary subsequently changed in 1989 to 148 km² which was adopted in the gazetted Eldoret municipal charter of 2020. Nonetheless, as per Land Use Plan of 2019, the spatial scope of the plan covered 724 km^2, depicting the expanding urban environment. The temporal changes in municipal extents were affected to accommodate the sprawling urban character.

The 1973 Rift Valley Physical Development Plan envisaged that Eldoret could grow towards North-West of River Sosiani with limiting factors being the escarpment to the North and formerly forested Southern part. With this projection, its current radial growth pattern along the regional linkage roads connecting the Town to Kitale, Kisumu and Nakuru is what was envisaged. Eldoret was planned as an industrial town having four zones. The three out of the four industrial zones were located along the railway line while the fourth was adjacent to a proposed by-pass. Since the 1973 plan, other land

use planning programs have been initiated with the latest being Eldoret Local Physical Development Plan (2015-2040) of 2019.

The study area is 10% of the gazetted municipal boundary and is centrally placed. It forms the nerve centre of the Eldoret Municipality and is largely occupied by commercial uses. Other land uses include four main-bus and seven complementary terminals, government administrative offices, education, health and recreational facilities. Places where NMT users visit or originate from depend on activities at these points. The growth is radial growing towards the periphery along the study road corridors. The key local traffic generators around the study area are residential, commercial, educational, health and industrial activities.

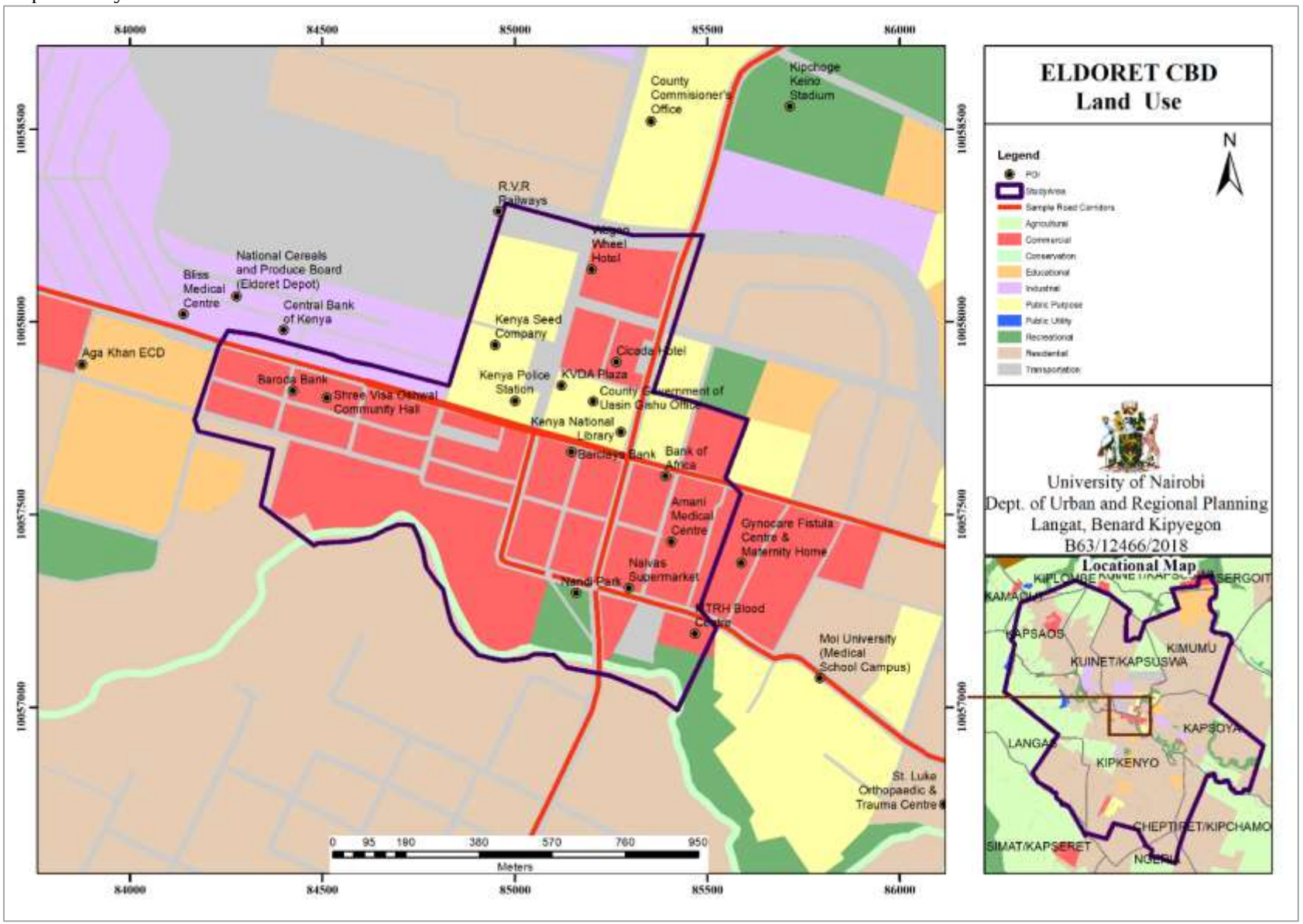
Uganda road corridor is the main urban highway in Eldoret and it forms part of international trunk road. It traverses the municipality in east to west direction and forms the backbone of the internal road network and is what divides the municipality into the south and North distinct areas. It connects high/medium class residential areas and the administration offices in the East to the low/medium class residential areas in the West through the CBD. The Road also serves one of the Kenyan Pipeline Corporation oil depots, located to the western side. The road is classified as an International Trunk Road despite serving local collection and distribution functions. It is this clash of use within the CBD which has led to numerous mobility issues both for motorized and non-motorized traffic. Key landmarks are accessed from this road including terminal, industrial, government agencies, health, commercial and recreational uses. The terminals include Tagore, Main stage, complementary county stages and private operator terminals. The county headquarters, the police headquarters, Huduma centre, Central Bank and County Hospital are located along this corridor. Other key landmarks are Zion mall, industrial area, fuel stations and banking institutions.

Kisumu road and Iten road corridor links to Uganda road at the CBD from Northern and Southern directions respectively. Iten road serves areas to the north of CBD including Eldoret Airstrip, residential areas of Action and Kimumu, University of Eldoret and Marura trading centre at the edge of the municipality. Kisumu road serves the areas surrounding the southern side including Pioneer Estate, Rivatex, Eldoret Sports Club, Catholic University of Eastern Africa, Eldoret Polytechnic, Chinese, Langas, Kapseret urban node upto the Eldoret International Airport. Land uses along these corridors comprise of commercial establishments (retail shops, food joints, automobile dealerships, clubs & hotels, etc.), health facilities, educational facilities, hardware, light to heavy industrial

establishments e.g., Rivatex, petrol stations, wood processing, Juakali etc. Key land marks along this corridor include county headquarters, county hospital, Iten and Sosiani terminals, banks and commercial outlets.

Nandi road and Oloo street Corridor are circulation roads connecting Uganda and Kisumu roads. The main land uses along this corridor are commercial, transport, educational and health facilities. The main landmarks include Moi Teaching and Referral Hospital, a number of private hospitals and Shree Shwaminarayan Temple. The transport land use in the form of terminus is another focal point along the corridor. This is where Sosiani stage is situated among other roadside complementary terminals. Naivas and Khetias supermarkets are located here. Education institutions along this corridor include Kenya Medical Training College and Moi University's School of Medicine. This corridor runs parallel to Uganda road and there are many connecting roads between the two roads including Waiganjo street, Lumumba Avenue, Makasembo road, Kisumu Road and Kenyatta Avenue. Land use characteristics in the study area are depicted by purpose by NMT travellers' activities at origin and destination.

Map 5: Study area Land uses

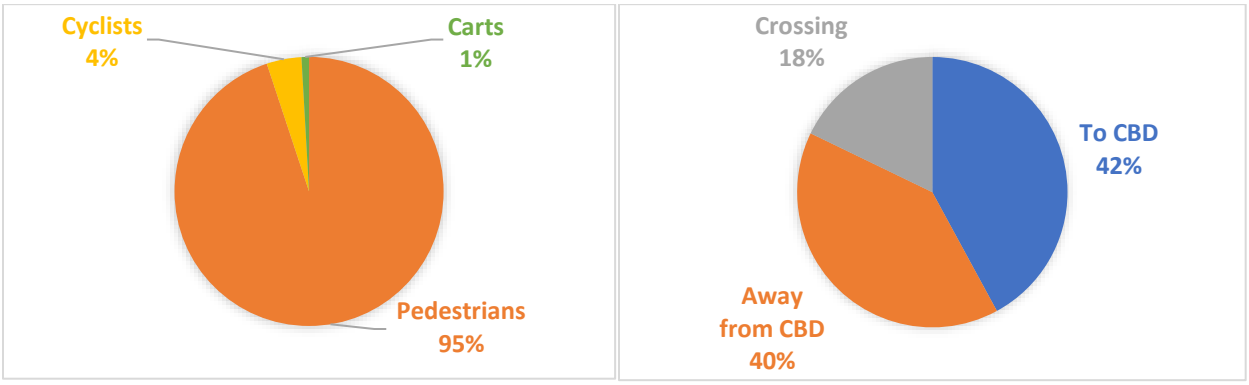


Source: Fieldwork, 2020

5.4 NMT Mobility characteristics

From the traffic survey, 95% of NMT users constitute pedestrians while 4% and 1% are cyclists and human pushed hand-carts respectively. Out of these as depicted by *Figure 15*, up to 18% were enumerated while crossing the roads at the cordon points while between 40% and 42% constitute outbound and inbound traffic respectively.

Figure 15: NMT categories (L) and direction of movement (R)

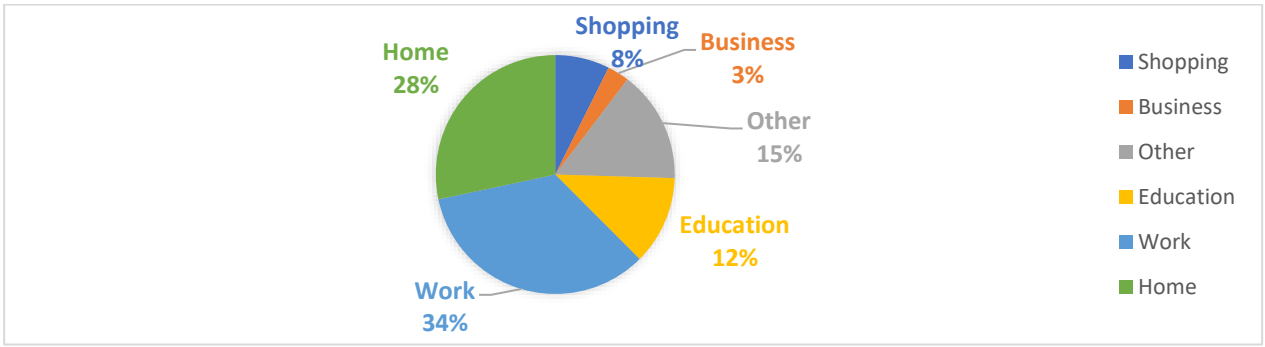


Source: Fieldwork, 2020

5.4.1 Inbound NMT Traffic Characteristics

Mobility patterns NMT traffic give an indication of how the CBD land uses are organized. It further provides an indicator of land uses within proximity of the CBD where the NMT users originate from or are attracted to. Mobility patterns exist within key land uses including the market, terminals, commercial area, health, education, and government departments. Travel is undertaken to engage in an activity at some other locations since the activity cannot be completed in the place of origin. The activities are varied due to the individual needs and intentions. Figure 16 outlines the variety of activities at origin and destinations. Approximately 74% of trips are home-to-work-to-education trips, which is the dominant routine trips.

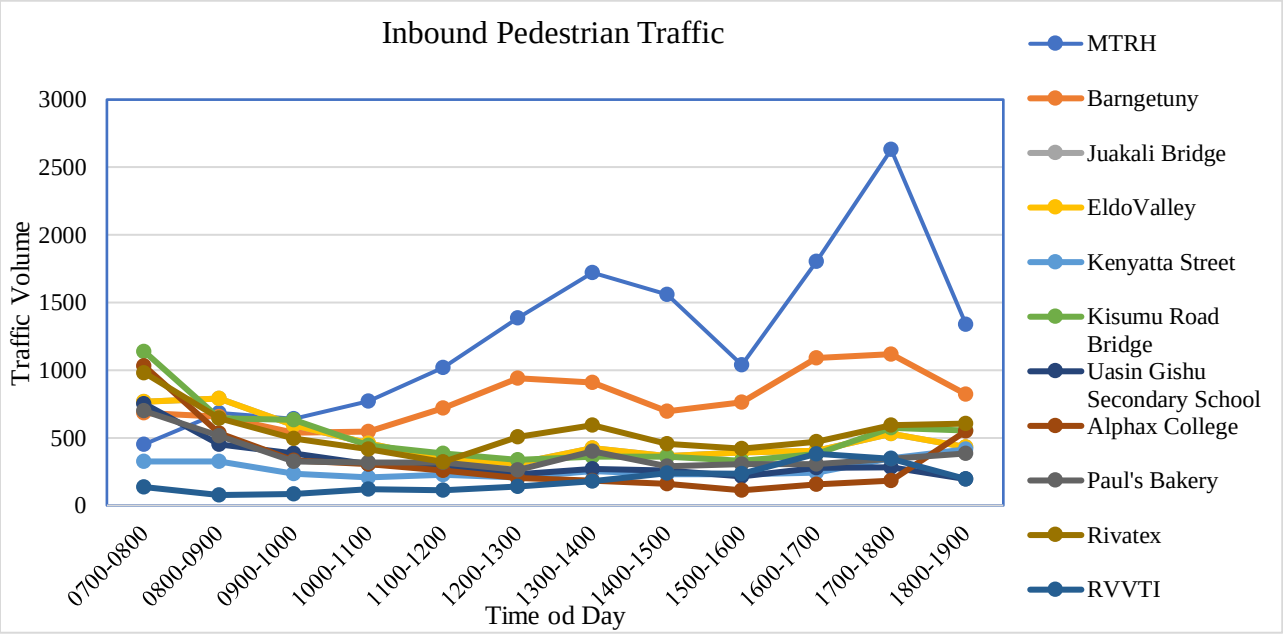
Figure 16: Purposes of Inbound Traffic



Source, Fieldwork, 2020

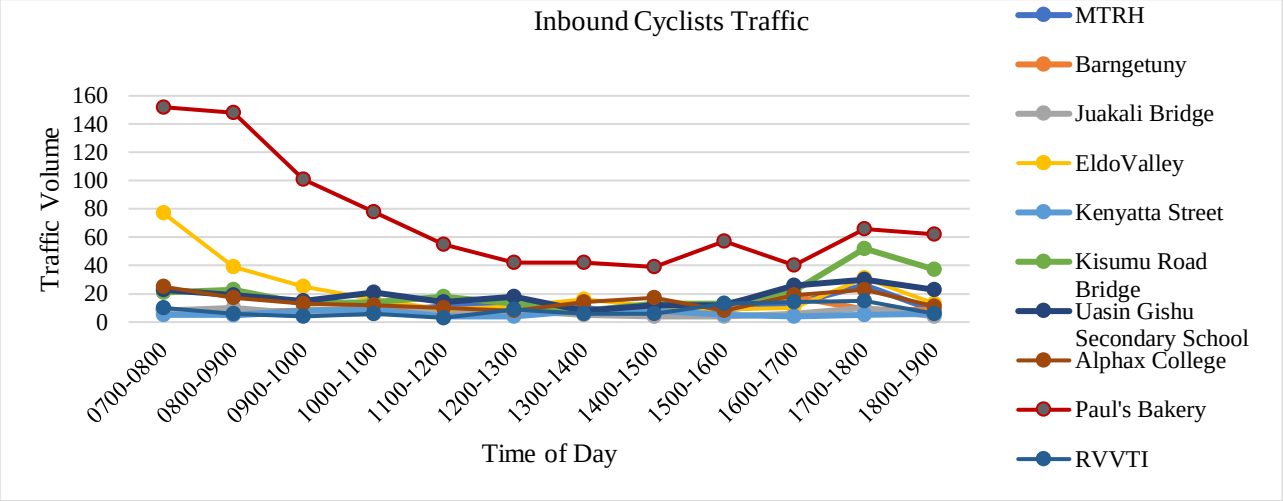
Pedestrians make a vital segment of the NMT within the study area. *Figure 17* shows MTRH and Barngetuny cordon points provide the highest volume of inbound traffic. This high pedestrian traffic is attributed to land uses neighbouring these areas and the direction from which the pedestrians originate from. At the MTRH cordon point, the traffic originates from health institutions especially the referral hospital. At this point, the spike of pedestrians between 1700Hrs to 1800Hrs is attributed to hospital visiting hours and its workforce leaving work or change of shift. Students and workers of the Eldoret KMTC and medical school contribute significantly to this high traffic volume at this cordon point. Barngetuny cordon point is located at the intersection point of Uganda, Kisumu and Iten road. At this point, traffic originates from the Eastern and Northern parts of the CBD destined for work, business, seeking government services, or transiting through the CBD. High traffic of Cyclists and Handcarts was experienced at Paul's bakery cordon point (*Figure 18* and *Figure 19*). From *Figure 18*, high cyclists' traffic is experienced between 7:00 am and 9:00 am while handcarts are relatively normal throughout the day except at Paul's bakery between 5:00 pm and 7:00 pm.

Figure 17: CBD Inbound Pedestrian Traffic across day:



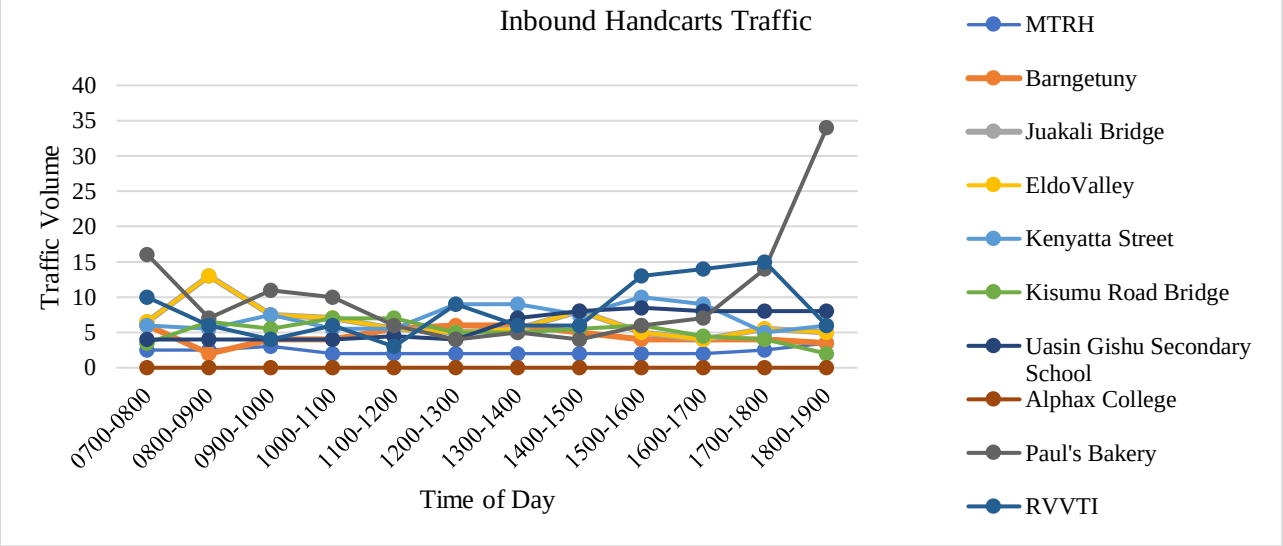
Source: Fieldwork; 2020

Figure 18: Daily Trends of Inbound Cyclists



Source: Fieldwork; 2020

Figure 19: Daily Trends of outbound Handcarts



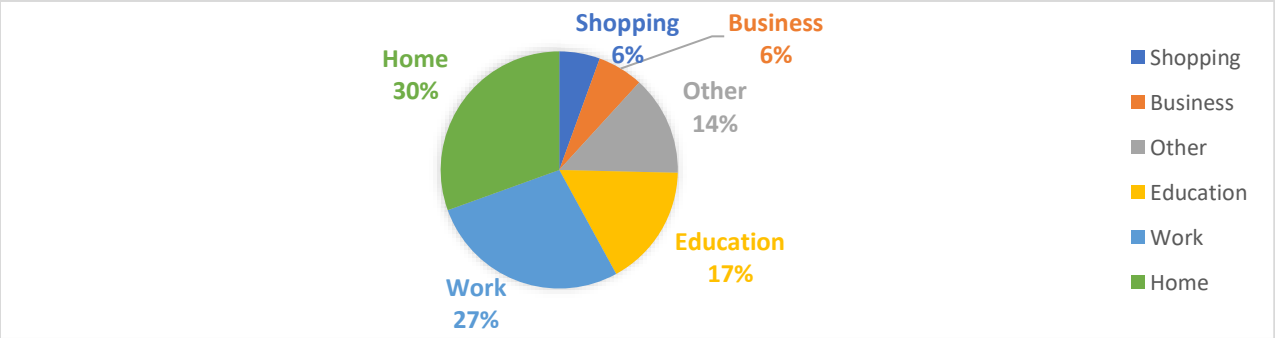
Source: Fieldwork; 2020

5.4.2 Outbound NMT Traffic Characteristics

From the land-use patterns, commercial and social services especially education and health are concentrated within the CBD. These land uses are key traffic generators within the CBD but due to the form of the municipality, areas neighbouring CBD are influential in NMT mobility patterns. This is depicted in the intended activities by outbound NMT users as shown in *Figure 20*. The majority of outbound traffic are heading home while 27% and 17% are going to work and school respectively.

These three categories make approximately two-thirds of the outbound NMT users. Eldoret has grown with suburbs developing into neighbourhoods with commercial, social, and residential needs. Along the study corridors, there are fast-growing developments. Key land uses on these corridors that attract NMT traffic are Eldoret Polytechnic, Rivatex, Langas residential area, and commercial activities along Kisumu Road. Along Uganda road corridor are Raiply, Rupa mall, Huruma, and annex settlement areas. MTRH, Medical school, KMTC, and St. Luke hospital are located along Nandi Road corridor while Iten Road has Kimumu, Eldoret Airstrip, and the University of Eldoret.

Figure 20: Outbound (R) Traffic

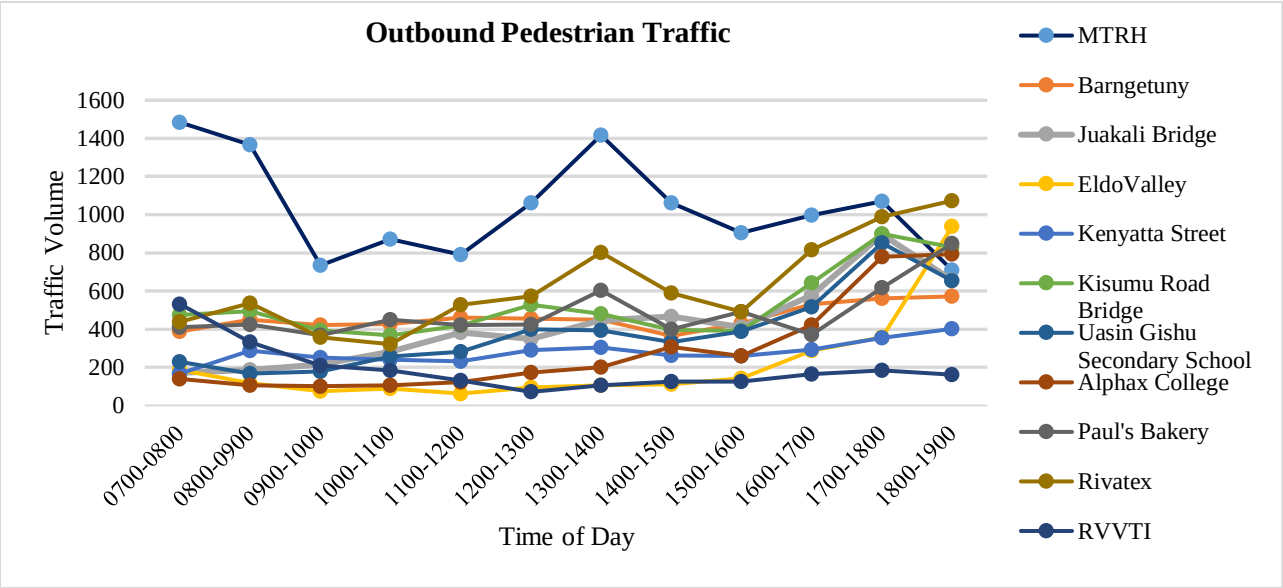


Source, Fieldwork, 2020

The CBD act as either originator or transition point of NMT traffic to peri-CBD areas. From *Figure 21* the highest outbound pedestrian traffic was surveyed at MTRH. It is inferred that the land uses along Nandi corridor are key attraction points. These land uses include the MTRH where traffic peaks in the morning between 7:00 am to 9:00 am and from 1:00 pm to 2:00 pm. These times are associated with work reporting times as well as hospital's visiting hours.

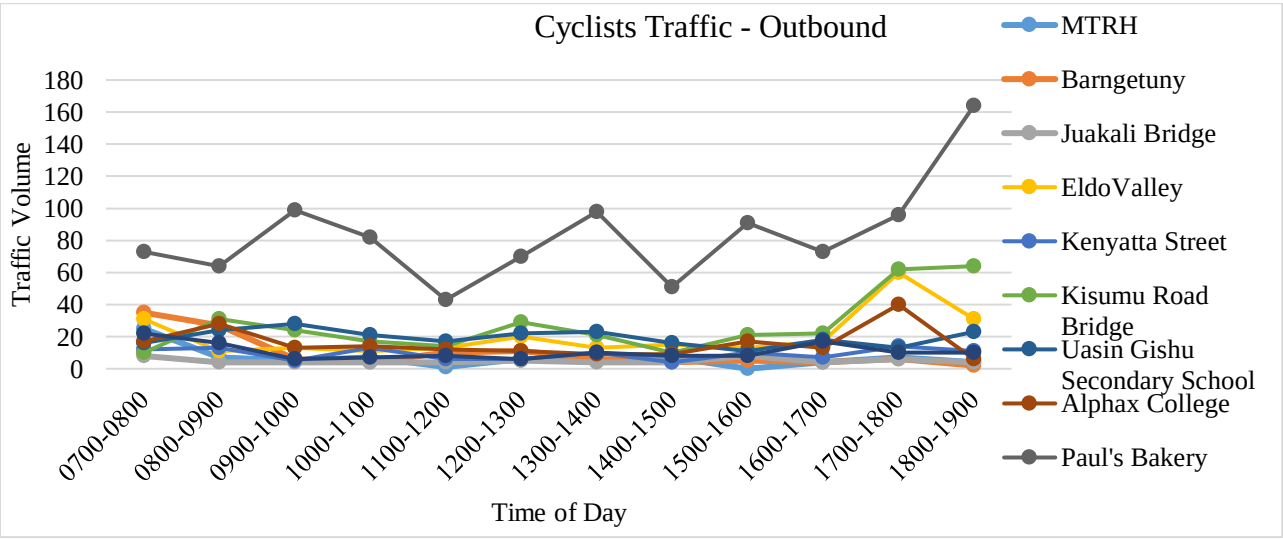
Outbound pedestrian traffic at all cordon points peaks in the evening as from 5pm to 7pm. For outbound cyclists, the low-density residential neighbourhood of Kipkaren and Pioneer estates are key residential areas for bicycle users. These estates are connected by an NMT bridge and highest cyclist traffic passes here as shown in *Figure 22*. In the same note, handcart traffic is a common NMT mode for light cargo transport along study corridors. It was observed that there were no handcarts near Uasin Gishu High School (*Figure 23*).

Figure 21: Outbound Pedestrian Traffic



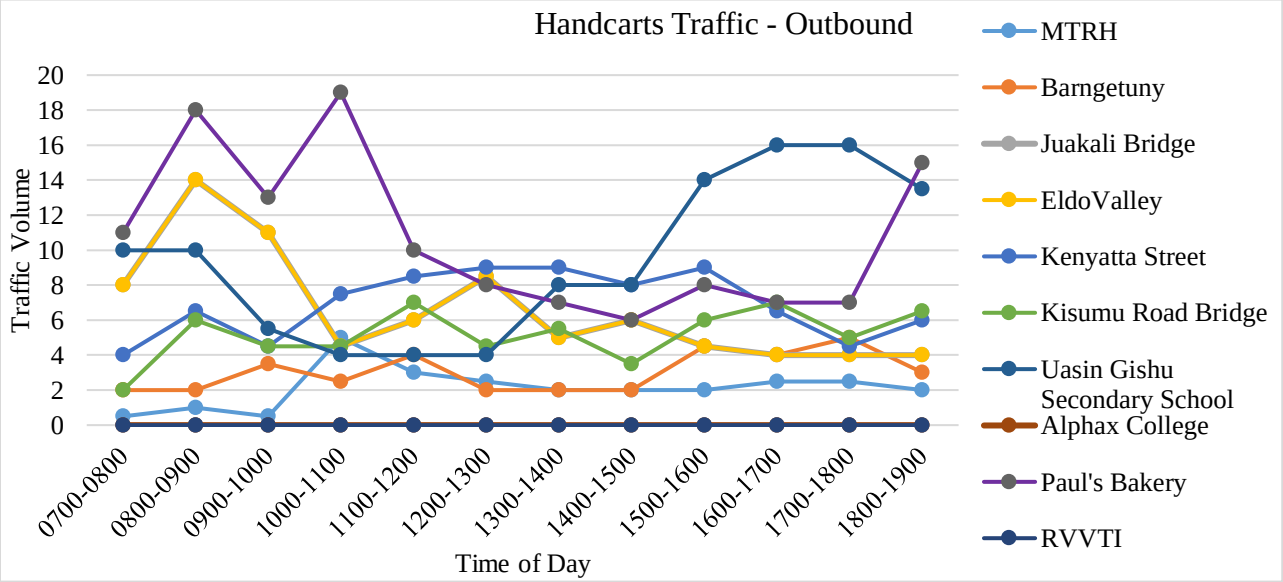
Source: Fieldwork; 2020

Figure 22: Outbound Cyclists Traffic



Source: Fieldwork; 2020

Figure 23: Outbound Handcarts Traffic

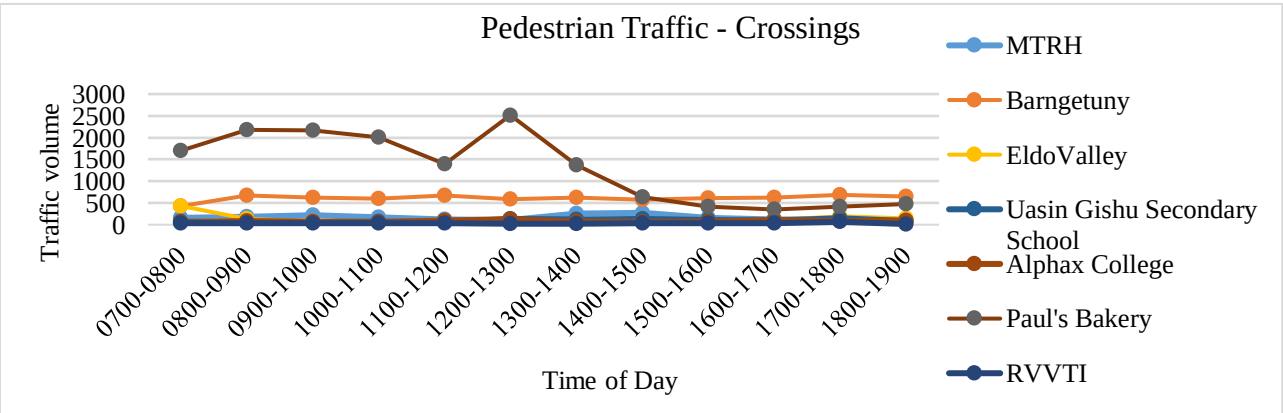


Source: Fieldwork; 2020

5.4.3 NMT Crossings

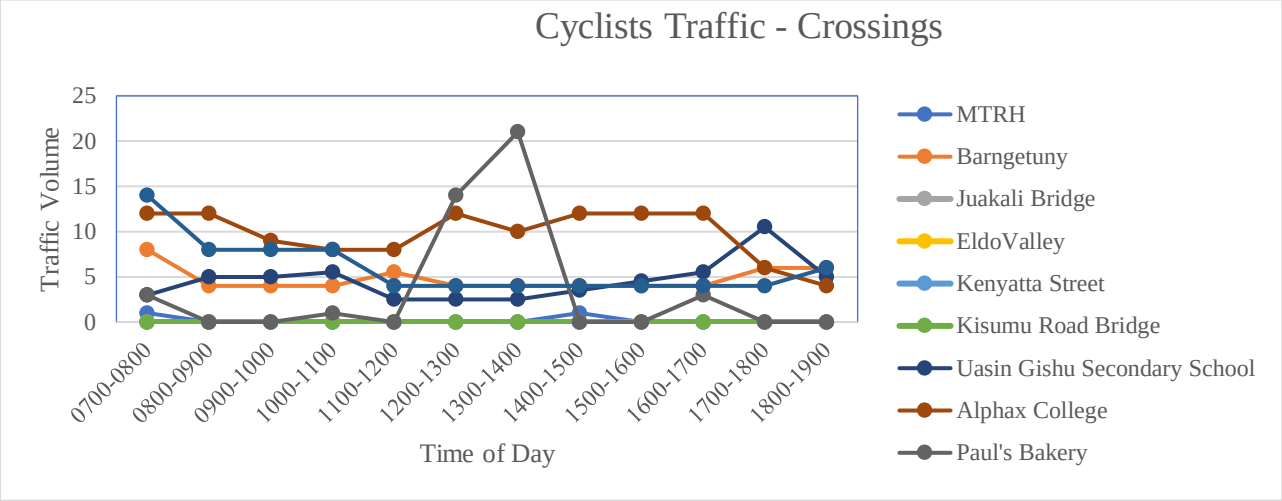
Within the study area, designated road crossings are limited though where available signages are faded and observed with a little caution. NMT users take the shortest path from origin to destination resulting in the crossing of road sections of the study corridors including undesignated areas. This results in traffic conflict with motorized traffic. High road crossings were observed at Paul's bakery for pedestrians while for cyclists and handcarts, Alphax and Juakali bridge were surveyed as the crossing points respectively (Figure 24, Figure 25, and Figure 26).

Figure 24: Pedestrian Traffic crossing roads



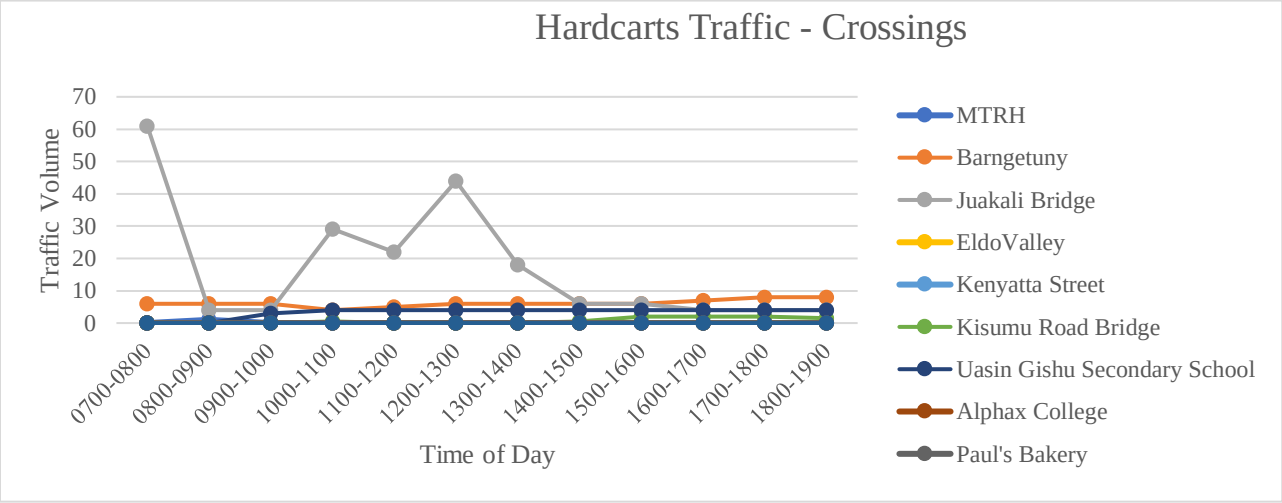
Source: Fieldwork; 2020

Figure 25: Cyclists Traffic crossing roads



Source: Fieldwork; 2020

Figure 26: Handcarts Traffic crossing roads



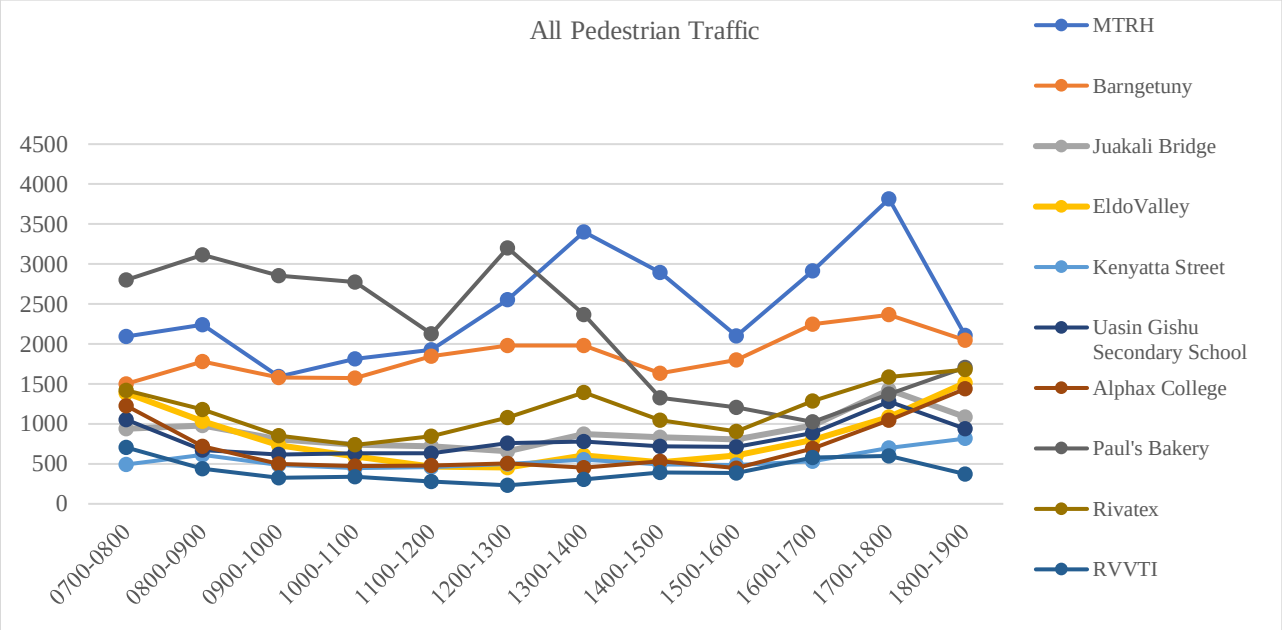
Source: Fieldwork; 2020

5.4.4 Summary of NMT Mobility Patterns

Pedestrians are the preferred mode of NMT use constituting 95%. From

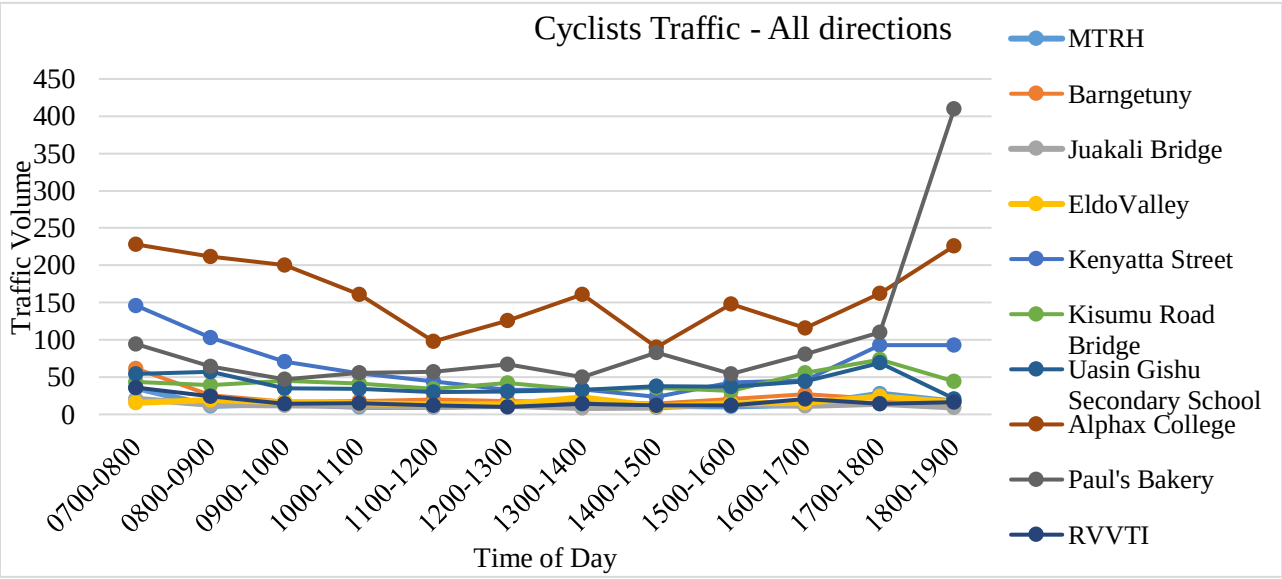
Figure *27*, Paul's bakery, Barngetuny and MTRH cordon points experience the highest pedestrian traffic. The Paul's bakery cordon point was adjacent to Tagore bus terminal, the industrial area, and an entry point from the Western part of the municipality to the CBD. Residents of areas like Kidiwa, Mwanzo, and Shauri due to their proximity either walk or cycle to the CBD through Paul's Bakery. From Figure 28, the highest volume of cyclists was enumerated at Alphax. From Figure *29*, the highest volume of handcarts were mapped at the bridge at Eldovalley. All the modes peak between 7:00 am to 8:00 am, 1:00 am to 2:00 pm and 6:00 am to 7:00 pm.

Figure 27: Pedestrian Traffic



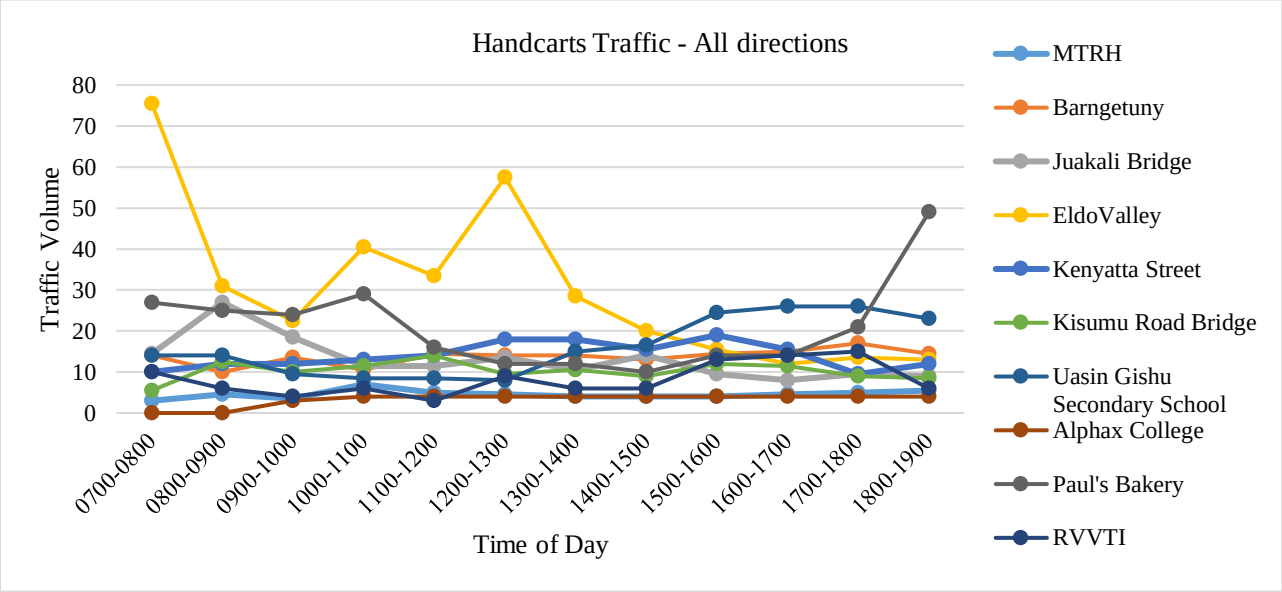
Source: Fieldwork; 2020

Figure 28: Cyclists Traffic



Source: Fieldwork; 2020

Figure 29: Handcart's traffic

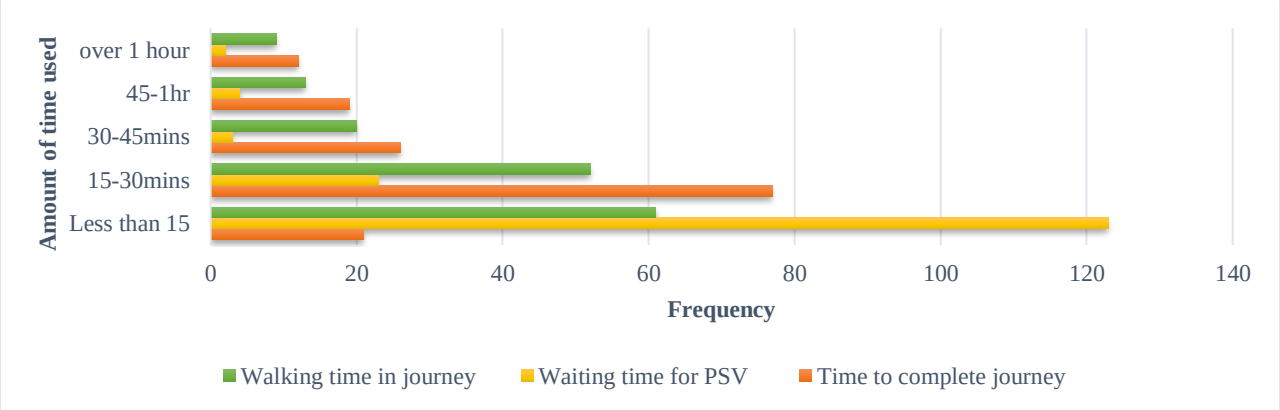


Source: Fieldwork; 2020

5.5 Journey Completion Characteristics

Interestingly, travellers complete their journeys using multi-modal means i.e., using a combination of matatu, *boda boda* and NMT mode. Completion of a journey takes an average of 15 to 30 minutes with a waiting time averaging 15 minutes for most travellers. From the survey, the use of NMT is common for journey completion. This shows the value of developing NMT infrastructure within the study area as part of road corridor development.

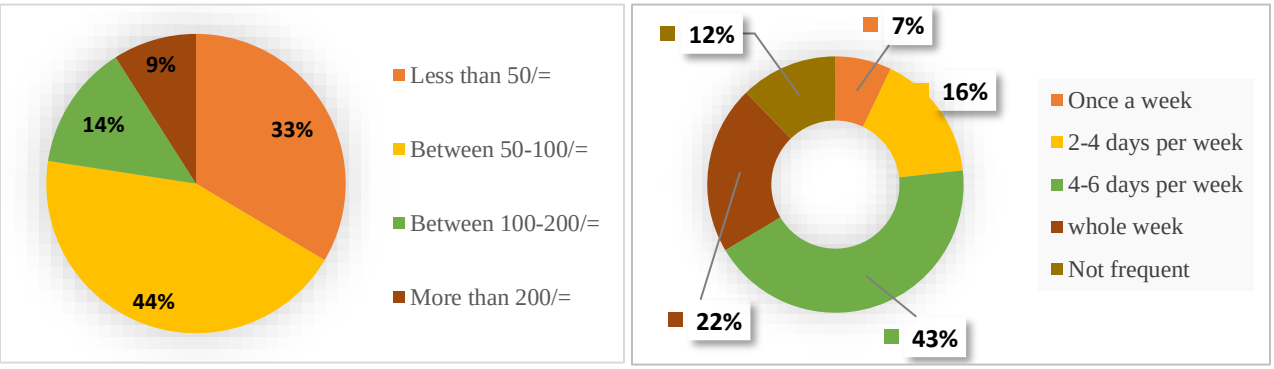
Figure 30: Travel time characteristics



Source: Fieldwork, 2020

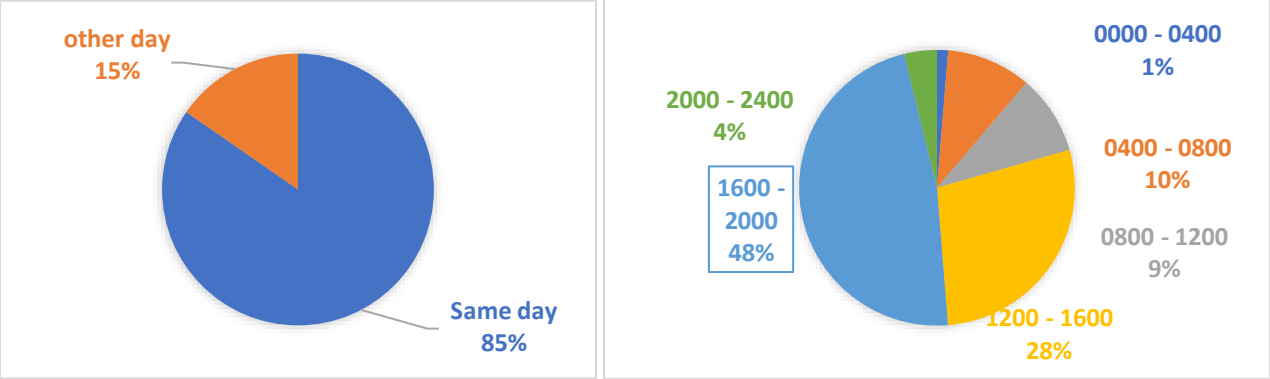
From the study, 44% of travellers spend between KES 50/- and KES 100/- per trip per day while 33% spend less than KES 50/-. The frequency of these trips ranges from 43% for 4 to 6 days per week, 22% for the whole week while the others are either less than 4 days per week or not as frequent *(Figure 31*). Additionally, 85% make daily trips with 48% making return trips between 1600Hrs and 2000Hrs similar to official working or study hours in Kenya.

Figure 31: Average cost of travel (L) and Frequency of travel (R)



Source: Fieldwork, 2020

Figure 32: Day of return trip (L) and Time of return (R)



Source: Fieldwork, 2020

5.6 Characteristics of NMT in Study Corridors

The study corridors' findings are discussed from the lens of functionality and shape. The CBD is a unique transport analysis zone (TAZ) because it acts as the originator, destination, or distributor of

traffic. The footpaths across the study area are shared among pedestrians, hand carts, and cyclists including non-intended conflicting uses.

Plate 1: Pedestrian Zone along Kisumu Road (L) and Iten Road (R)

Source: Fieldwork, 2020

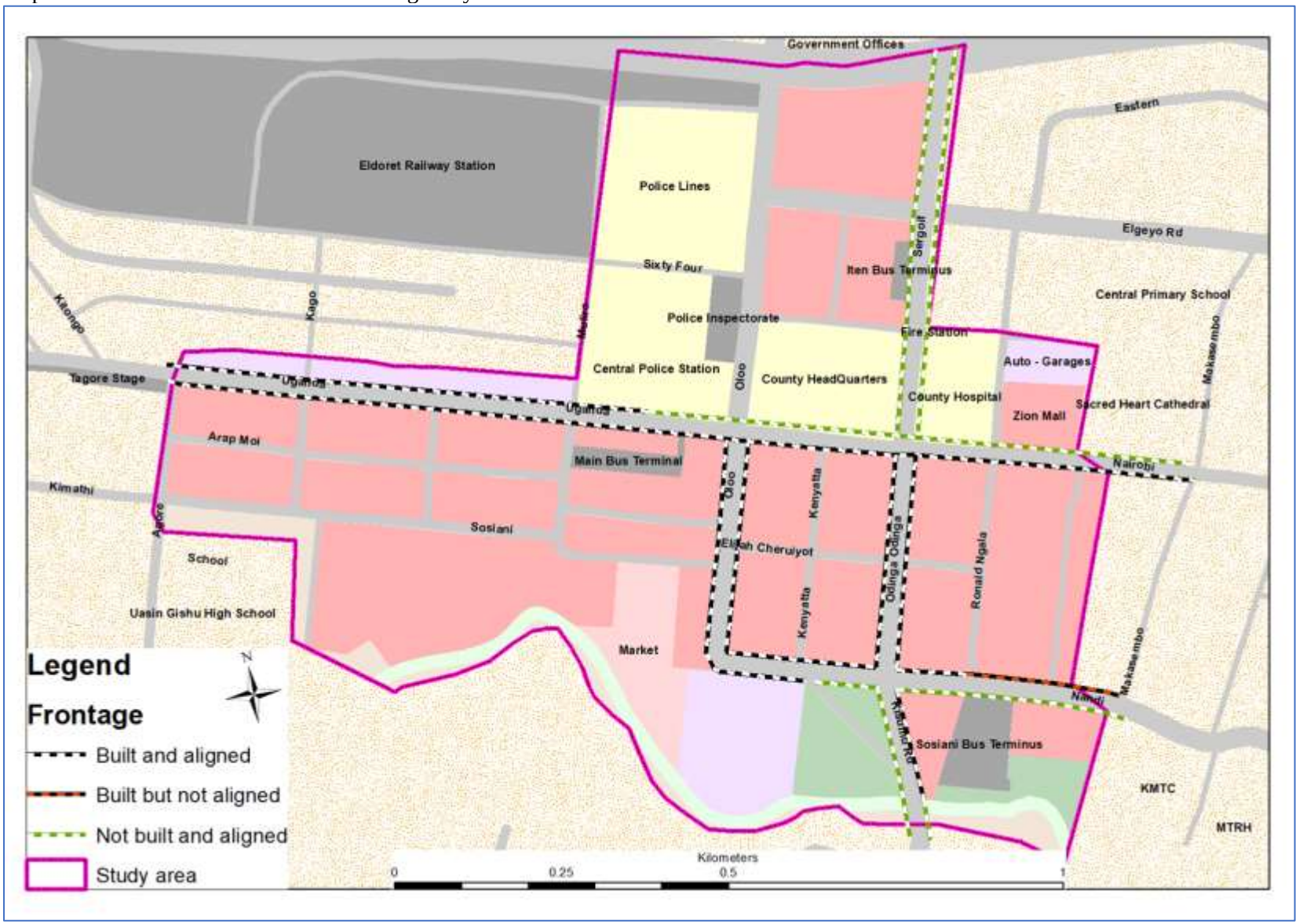
Plate 2: Matatus Parking on road shoulders along Oloo Street;

Source: Fieldwork, 2020

Alignment of building lines affects NMT infrastructure along the pedestrian zone of the road reserve. There is an irregular alignment of the building line in some of the sections of the study corridors as shown in *Map 6*. A section of Nandi road has an irregular building line. The non-alignment affects the provision of universal walkways in the pedestrian zone as well as urban furniture. The characteristics are assessed here based on provisions of the Kenya Road Classification Manual (MoR,

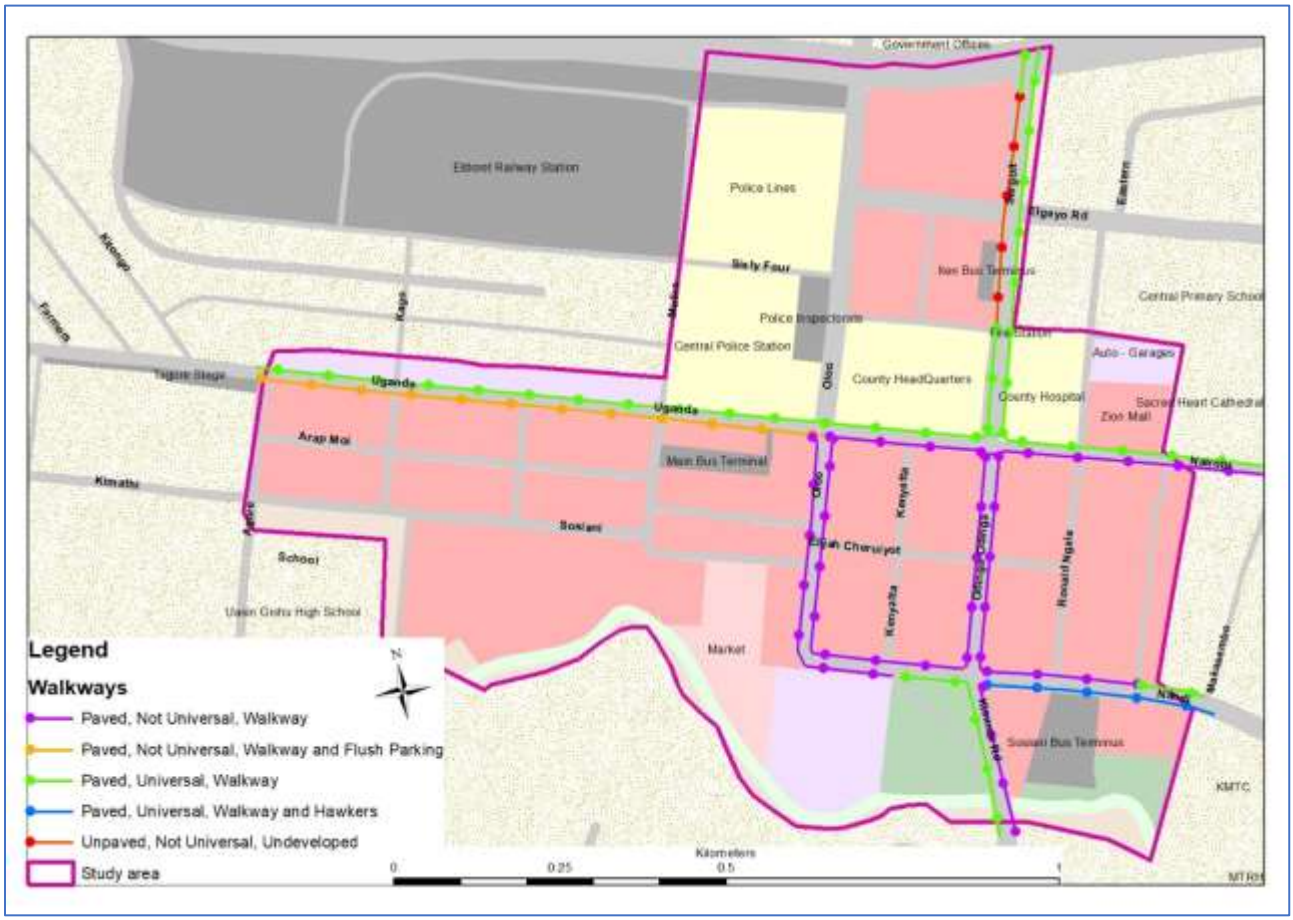
2009) and the Highway Capacity Manual. Nonetheless, walkways have been developed as part of the frontages of the built and unbuilt sections of the study corridors (*Map 7*). Walkways along Iten road are 2.5 metres wide though the section is unpaved. Within the other corridors there are paved walkways though there is a challenge of non-universality and obstruction by parking as depicted by *Plate 1*. Beyond the CBD, adequate walkways are developed along Iten, Kisumu, and Uganda road. It was noted that this was largely because of sufficient and protected road reserve. Another motivation for this was municipal's residential estates are located along these corridors hence a higher demand for this infrastructure along these routes.

Map 6: NMT infrastructure assessment along study corridors



Source: fieldwork, 2020

Map 7: NMT infrastructure assessment



Source: Fieldwork, 2020

5.6.1 Uganda Road (A8) Corridor

Uganda Road corridor traverses the study area from east to west and forms the backbone of the internal road network within CBD. Both motorized and non-motorized traffic are found in this section. It connects key NMT traffic generation areas including bus termini, residential, commercial, and administrative offices. Shops, major hotels, petrol stations and light industries that include county headquarters have direct access to the road.

Intense commercial activities draw access from this road. All categories of traffic are attracted/generated by shops, major hotels, petrol stations, learning institutions, etc. The main Bus terminal, called *"Main stage"* and western terminus called *"Tagore"* are located along this corridor. The combination of local and through traffic has brought about serious mobility issues, characteristic of adverse delays and longer journey times.

The road reserve at this section is 30 metres wide, with 27 metres of free space and another 3 metres occupied by canopies of buildings along the street. The section to the west of Kisumu-Iten Road is a dual carriageway with 2 (two) lanes, 2 (two) direction arrangement and a median raised island of 0.5 metres for motorized traffic separation. There is an additional lane towards the Kitale direction mainly utilized for on-street parking as shown in *Plate 3*. The drainage is lined and partly underground. Besides it on the northern side is a 2-m wide walkway and is not adequate for pedestrians who walk on the verandas below the canopies of buildings.

There are designated crossing points for pedestrians e.g., at the Kisumu-Iten Road intersection and the thin raised median separation does not give a safe landing to prepare for second crossing in this dual road section.

Plate 3: Section of Uganda Road

Source: Google Earth

Plate 4: Utilization of Road shoulders by NMT in sections of Uganda Road:

Source: Fieldwork, 2020

5.6.2 Kisumu Road (B8) and Iten Road (B16) Corridor

The corridor commences from Iten road intersection with railway line, it crosses the Uganda road and traverses the commercial nerve of study area up to River Sosiani. The corridor serves both the southern and northern parts of the study area which are key in traffic generation. The southern traffic generators include Pioneer Estate, Rivatex, Eldoret Sports Club, Catholic University of Eastern Africa, Eldoret Polytechnic, Chinese, Langas, Kapseret urban node to the Eldoret International Airport whereas the northern estates include Eldoret Airstrip, Action Centre, Kimumu and University of Eldoret. Kisumu road section is 0.5 km from Uganda road intersection to River Sosiani. It is a single carriage way with parking on either side from the intersection to the round-about on Nandi Road. It is 30 metres road reserve. The road condition is smooth bitumen surface with lined drainage.

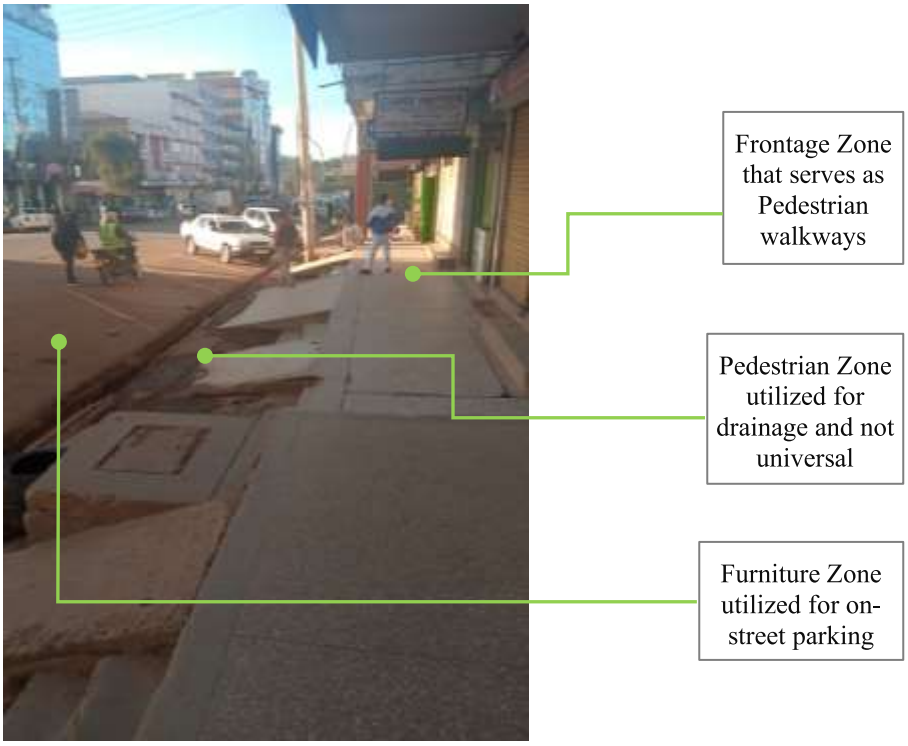
Iten road corridor starts at Uganda road intersection up to railway line. This section of the corridor serves the national and county administrative zone. It also serves major industries such as maize millers and Cocacola among others. Other important facilities include the library, Kipchoge Keino stadium, major hotels and key distributor of traffic to neighbouring estates and through traffic.

This section is 0.5km from the intersection of Uganda road. The road surface is smooth with a road reserve of 25m. It has been provided with drainage in its entirety and a 2.5m walkways on either side though some sections are incomplete.

Plate 5: Shoe shiners occupy walkways along Iten road adjacent to KNLS

Source: Fieldwork, 2020

Plate 6: Section of Kisumu Road in the CBD



Source; Fieldwork, 2020

5.6.3 Nandi Road and Oloo Street Corridor

The road corridor is 1.0 km from KMTC through Nandi Park round-about to the junction with Uganda road. The main land uses along this corridor are commercial, recreational and Sosiani Bus terminus. This corridor is the main access to KMTC – Eldoret campus, the Moi university medical school,

MTRH and a number of private hospitals along Nandi Road. *Plate 7* shows a footbridge and footpaths and Nandi Park adjacent to this corridor.

Plate 7: River Sosiani footbridge (L) and footpath at Nandi Park (R)

Source: Fieldwork, 2020

Plate 8: Section of Nandi Road

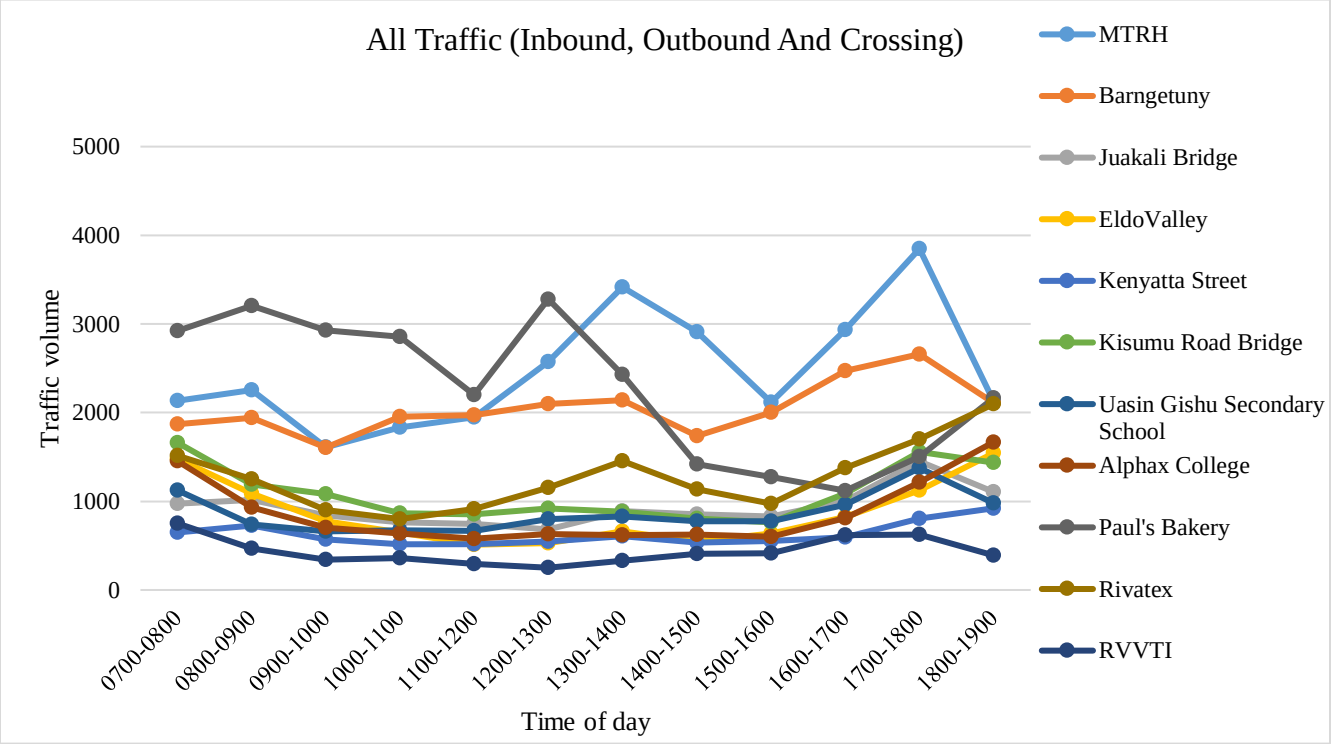
Source: Fieldwork, 2020

5.7 Influence of land uses dynamics on NMT

5.7.1 Key traffic generators

The most common mode of NMT is walking which constitutes approximately 94% of the NMT traffic that was counted. The figure below shows the average daily NMT traffic by location and direction.

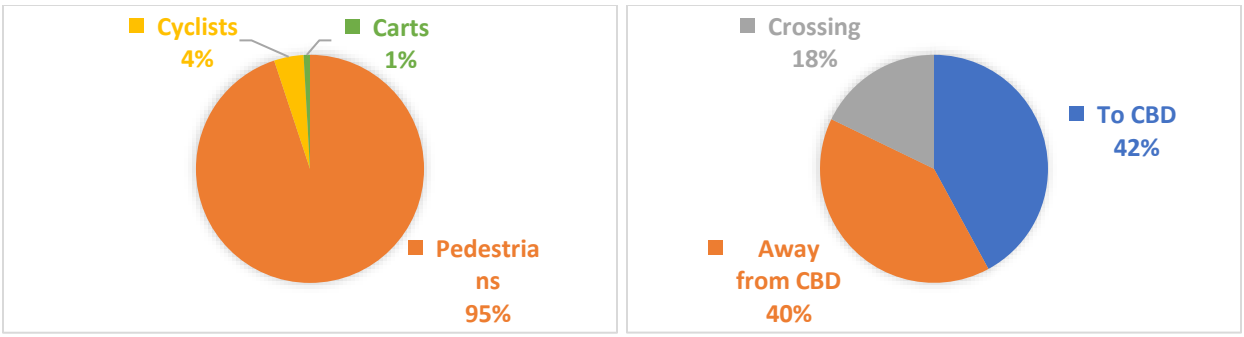
Figure 33: NMT traffic volumes



Source: Fieldwork, 2020

The highest NMT traffic volumes were observed along routes Nandi Road and Uganda road. This is from traffic counts witnessed at survey points at MTRH, Paul's bakery and at Barngetuny plaza. In the neighbourhood of these survey points are land uses that generate high human traffic which include government offices, medical facilities and terminal facilities. Paul's bakery is adjacent to Tagore bus terminal, Bargentuny plaza is located at intersection of Iten-Kisumu and Uganda roads while MTRH being a referral hospital generates high traffic volume due to people seeking health services. Walking also provides fast and direct connectivity. **Error! Reference source not found.** shows that NMT users average between 40% to 42% for travellers moving towards or away from CBD. A significant number of NMT users averaging 18% crosses roads with most of these crossing points not designated. This creates conflict with other road users and the high number of accidents especially along A8 which was designed as a highway but plays lower urban functions.

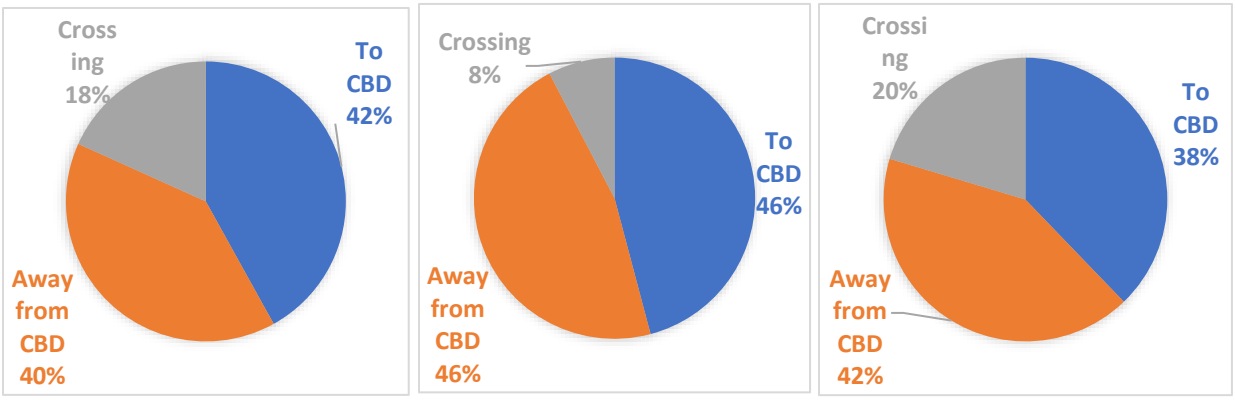
Figure 34: NMT traffic split (R) and Direction of Movement (L)



Source: Fieldwork, 2020

The characteristics of these NMT modes depict that there is a high number of users crossing roads (*Figure 35*). Pedestrians make up 18% while cyclists and carts constitute 8% and 20% respectively. It is therefore indicative that inadequacy of traffic calming facilities to enable safe crossings poses risks to road users. A considerable volume of users exiting and entering the CBD by walking, cycling or pushing hand carts indicates preference to this mode.

Figure 35: Movement characteristics of Pedestrians (L), Cyclists (C) and Carts (R)



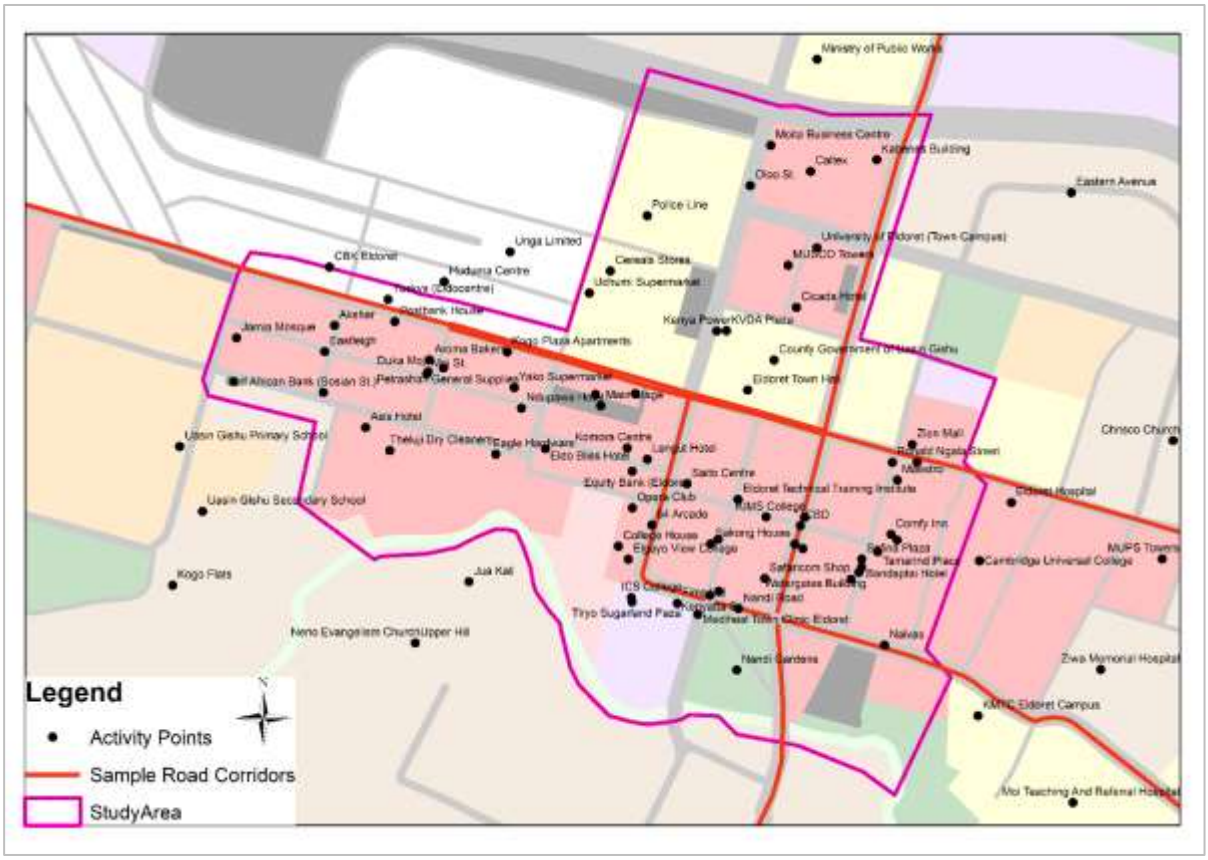
Source: Fieldwork, 2020

Traffic generation points are predictable and occur regularly. These include home, work, education and business-based trips accounting to 77% and 80% of origin and destination activities respectively. Shopping in both cases is an irregular activity as it depends on need basis whereas other activities may fall in routine, irregular or production activity. These activity points are concentrated within the central business district (*Map 8*).

5.7.2 MT Movements and Intersection Capacity Assessment

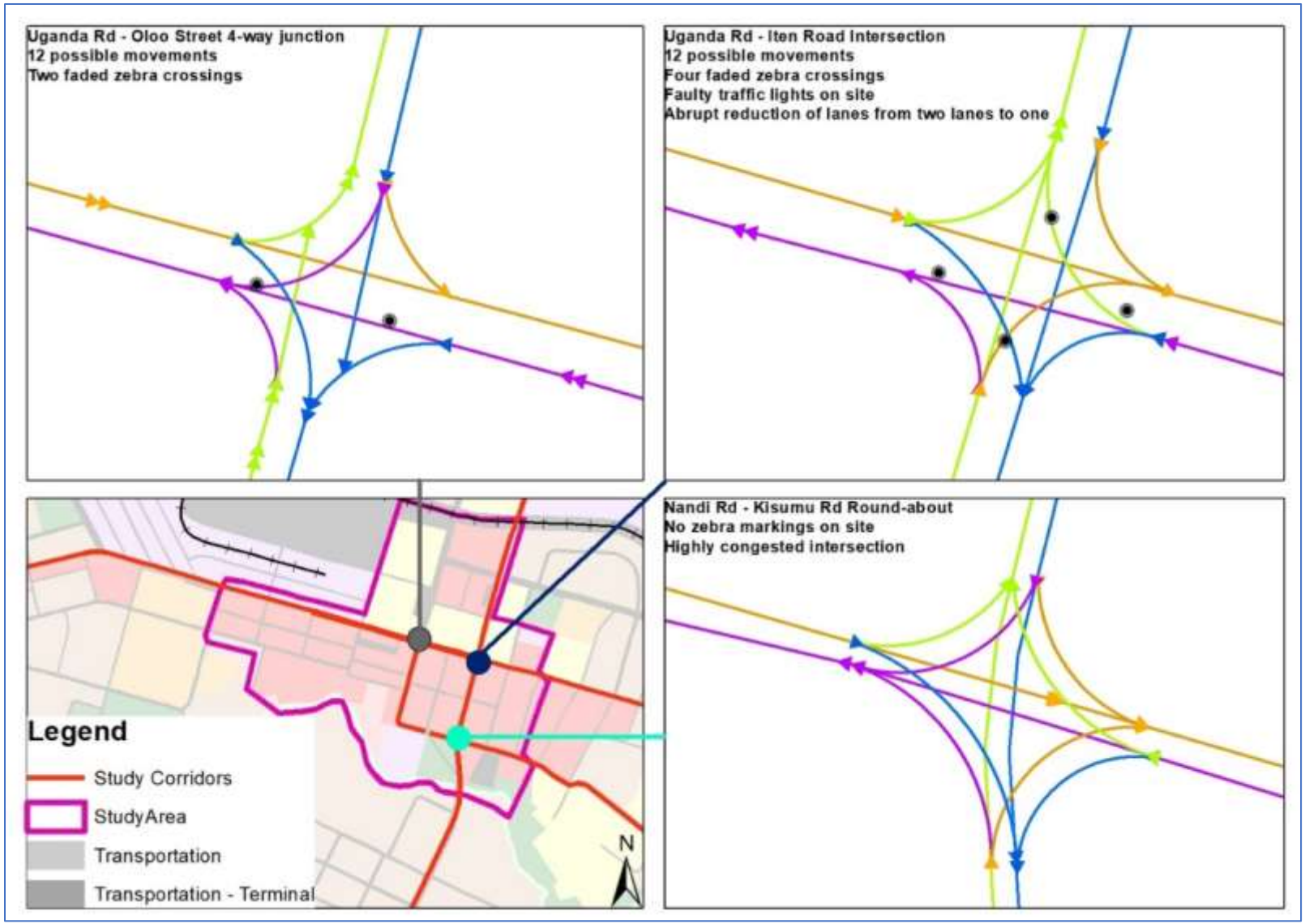
Map 9. At this junction, there are twelve possible movements where from each approaching motorized traffic, it has up to three turns to make.

Map 8: Activity Points



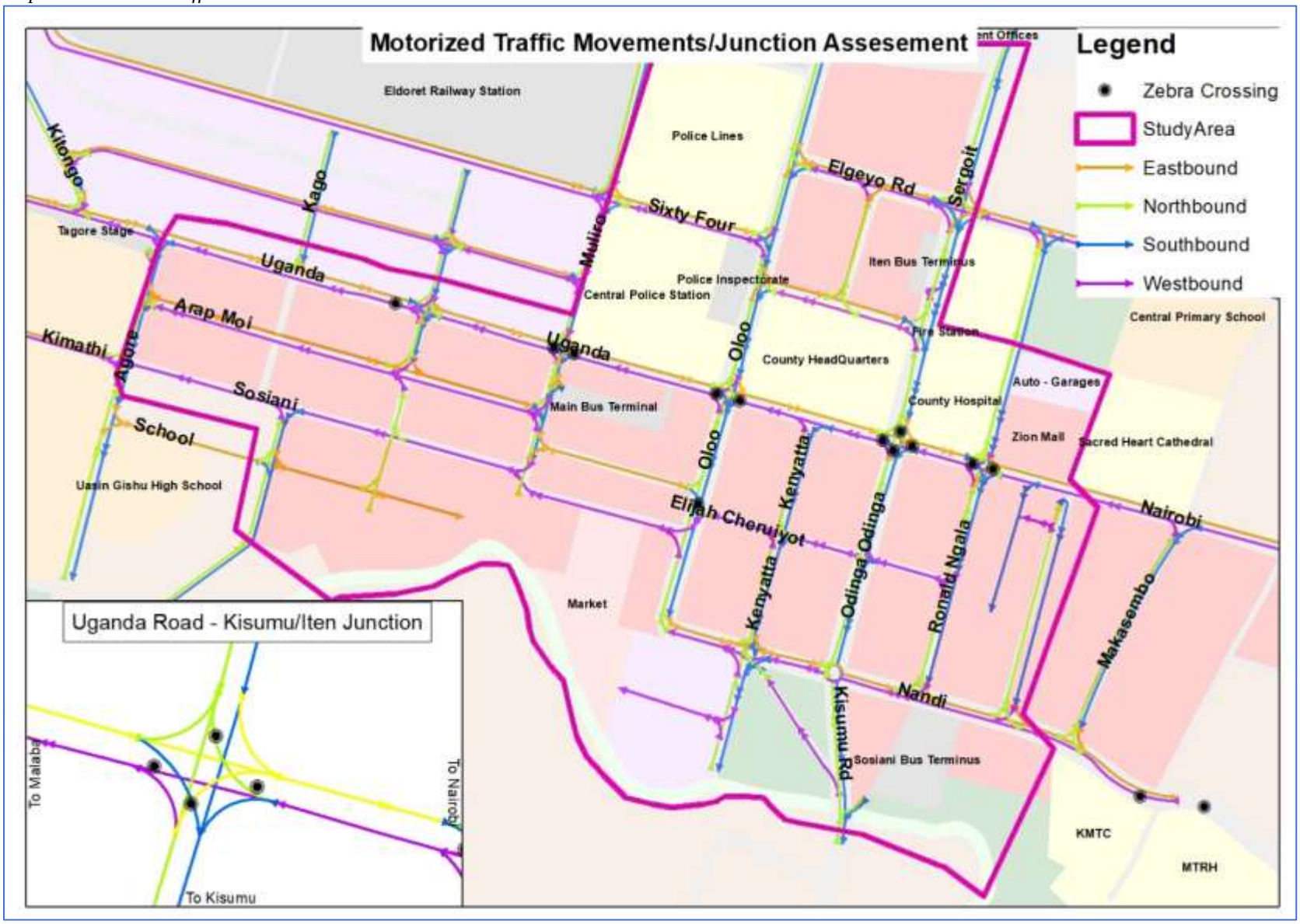
Source: Fieldwork, 2020

Map 9: Study Corridors Intersection Assessment



Source: Fieldwork, 2020

Map 10: Motorized traffic Movements



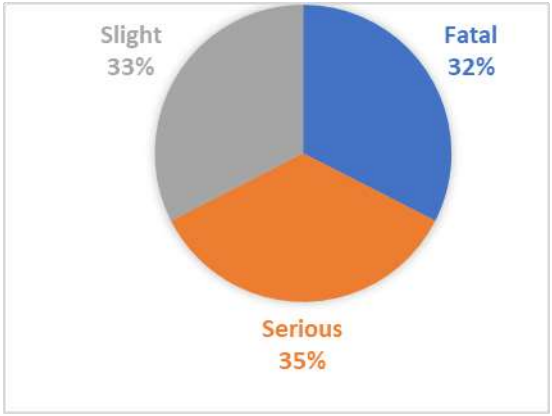
Source: Fieldwork, 2020

5.7.3 Accident Profile

Disaggregated accident data was collected from Central Police stations in Eldoret. According to traffic officers, description of accidents varies from station to station and from officer to officer, making analysis difficult and more than 50% of accidents are not reported, especially accidents considered slight. Additionally, accident causes are not detailed enough to give comprehensive and data for technical analysis. However, the data is good enough to make an inference of the accident trends.

Reported accident cases from the National Police Services indicated that 33% are slight, 35% serious while 32% are fatal (*Figure 36*). Accidents considered slight are those with minor injury and damage to property occur while those classified as serious are those that lead to hospitalization but without fatality. Fatal accidents are characterized by death within 30 days from occurrence.

Figure 36: Severity of accidents



Source: Eldoret Police, 2020

The three accident severity types used are defined below:

i. Fatal – If death occurs within a fixed period (e.g. 30 days) following the accident;
ii. Serious Injury – No fatalities occur, only major injuries that lead to hospitalization; and,
iii. Slight Injury or damage only – Minor injury and damage to property occur.

Table 3: Black spot points

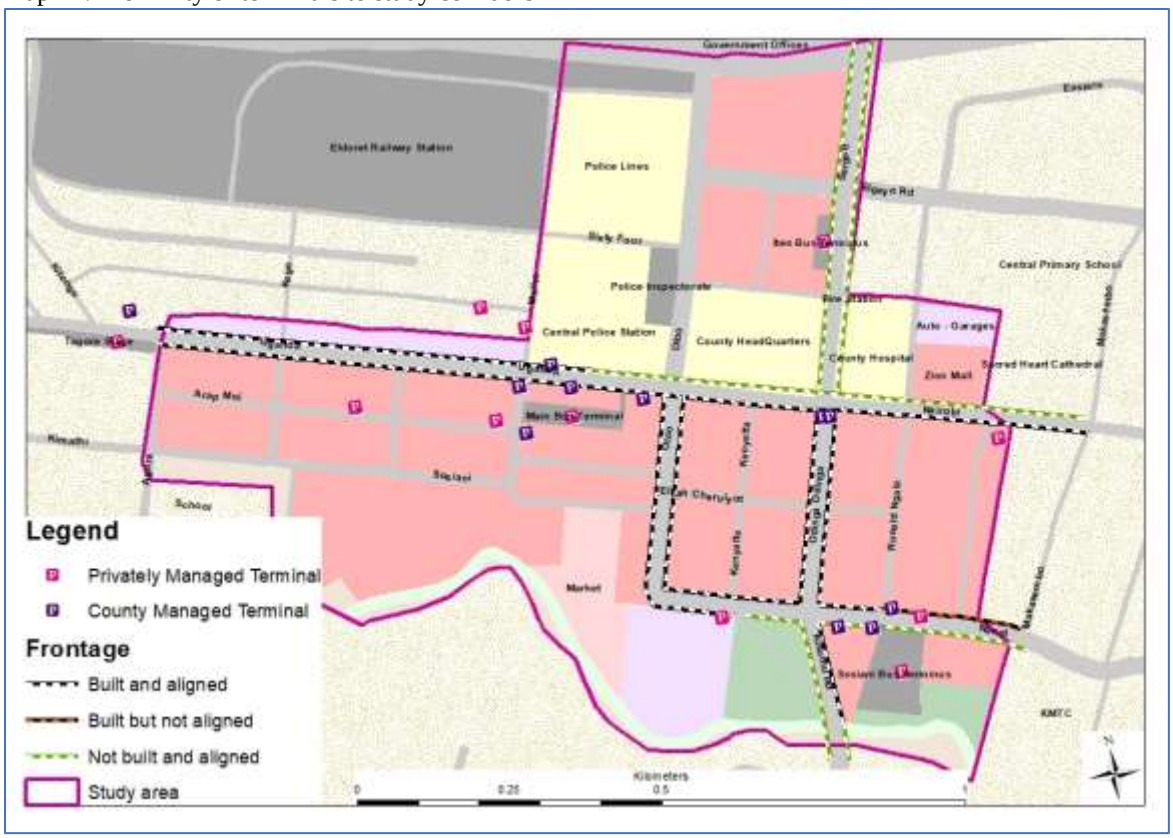
Corridor	Location	Weakness
Iten Road	Kipchogei Keino stadium	1. Inadequate bumps 2. Defaced signage
Eldoret-iten	Chepkanga stretch	1. Over speeding by motorist

Uganda Road	National Bank White castle/ Central Police North Rift stage Huduma centre Iten-Uganda-Kimsusmu road junction Uganda-Oloo street junction	1. Lack of zebra crossing 2. Lack of traffic separation 3. Negligence by the Boda boda riders 4. Transit vehicles passing through CBD 5. Inadequate walkways
Kisumu Road	Sosiani Bridge Nandi road roundabout	1. Faded zebra crossing 2. Notorious drivers, taking dangerous U-turns. 3. Traffic conflict with motorized traffic 4. Competition by matatus

Source: Fieldwork, 2020

Uganda road is the most accident-prone roads section especially near North-Rift shuttle and Iten-Kisumu Road junction. The figure below shows proximity of terminals to the study corridors. One of the key challenges is the lack of traffic separator leading to NMT users crossing the road at random locations.

Map 11: Proximity of terminals to study corridors

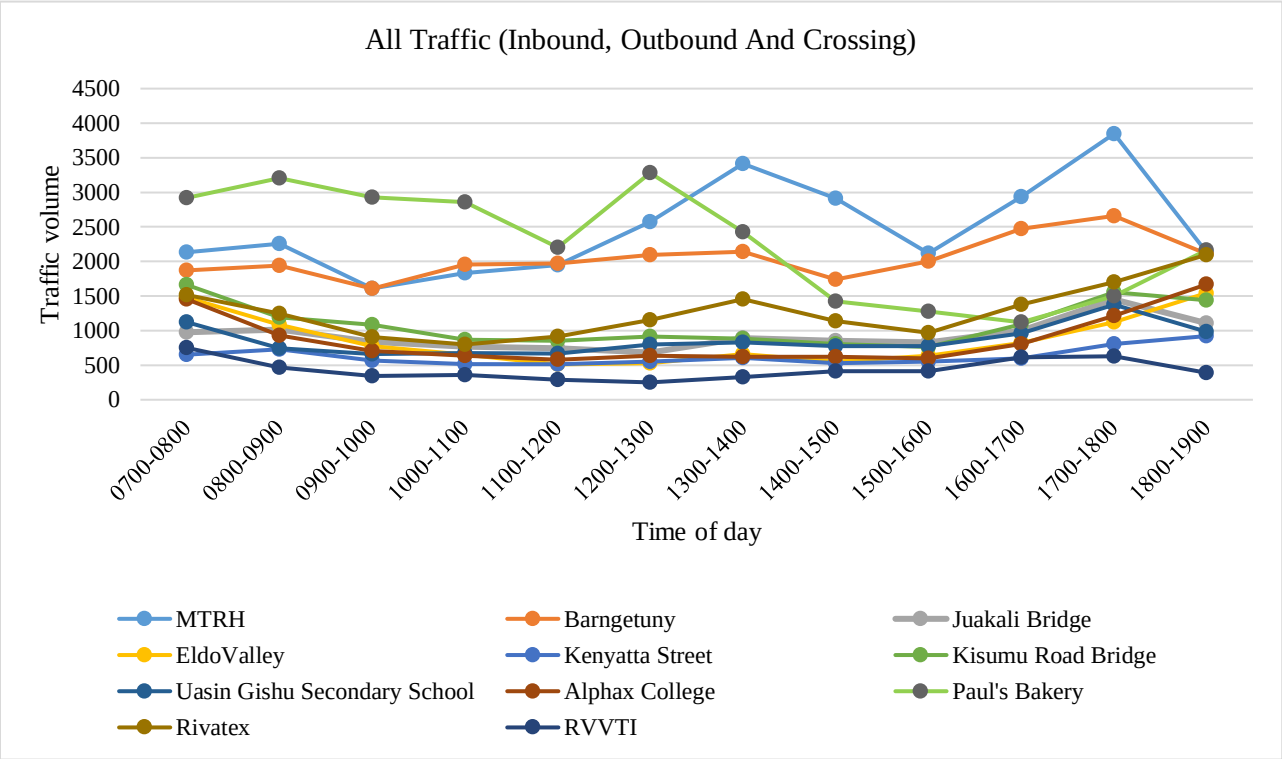


Source: Fieldwork, 2020

5.8 Discussion of findings

The CBD is a unique transport analysis zone (TAZ) because it acts as the originator, destination, or distributor of traffic. NMT mobility patterns are attracted to certain areas of the CBD depicting its form based on the organization of land uses. From *Figure 37*, the cumulative traffic volume across the day was surveyed at Paul's bakery, MTRH, and Barngetuny plaza. At Paul's bakery, the key land uses are low class residential estates e.g., Kokwas, Kidiwa, Mwanzo, and Huruma which are within walking distance from the CBD.

Figure 37: Cumulative Traffic volume

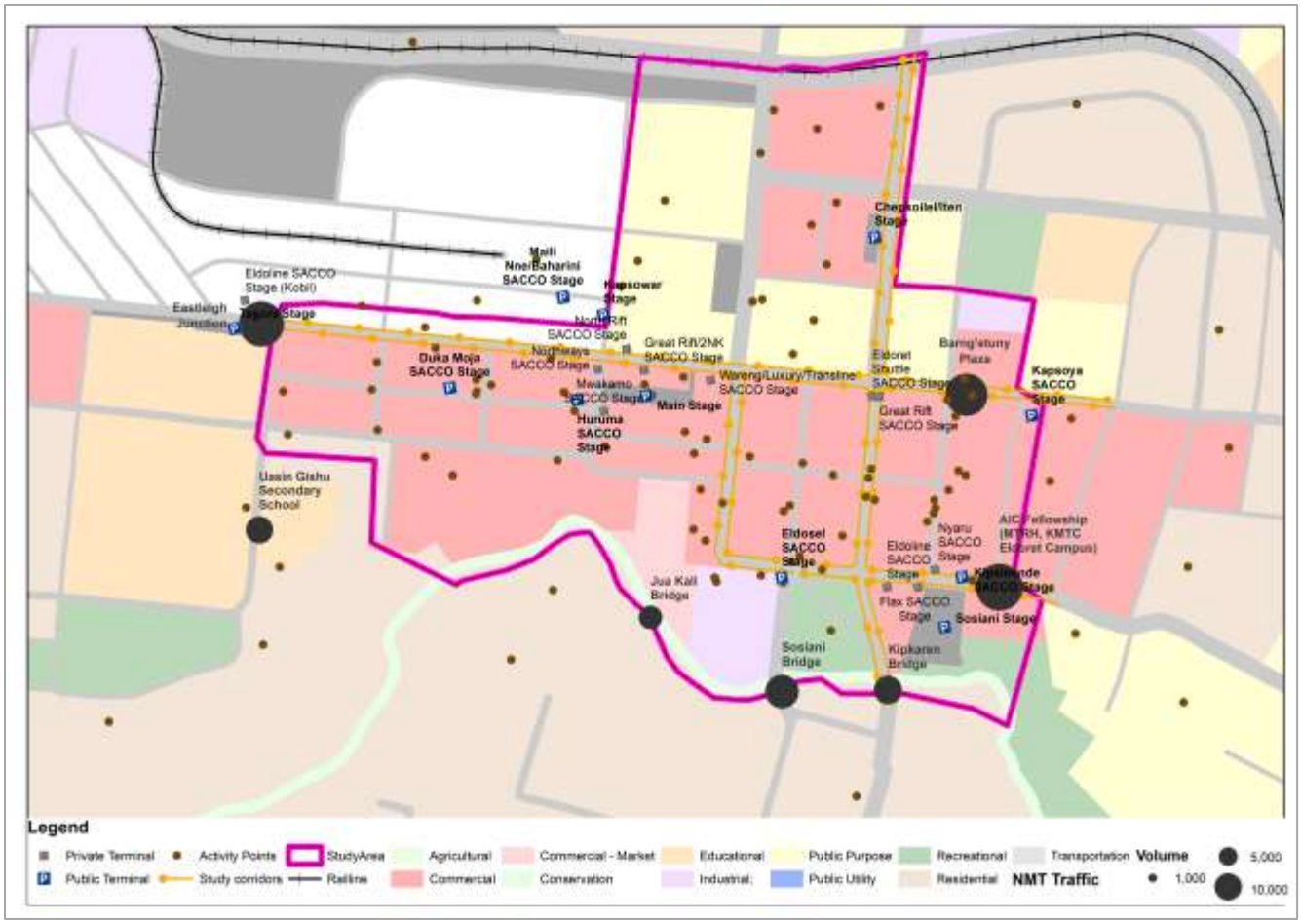


Source: Fieldwork, 2020

Other land uses are the Tagore bus terminal, the industrial area, and the CBD. All these land uses place Paul's bakery as an entry or exit point of NMT users long the Uganda road corridor on the western side of the CBD. At this cordon point, the highest NMT traffic was surveyed from 7:00 am to 1:00 pm. As from 1:00 pm to 7:00 pm, MTRH enumerated the highest NMT traffic. MTRH is located along Nandi Road corridor to the South-East of the CBD. Key land uses neighbouring these survey points are the Moi Teaching & Referral, St. Luke and hospitals. Other land uses are Moi University medical school and KMTC whose students and staff generates traffic along Nandi Road.

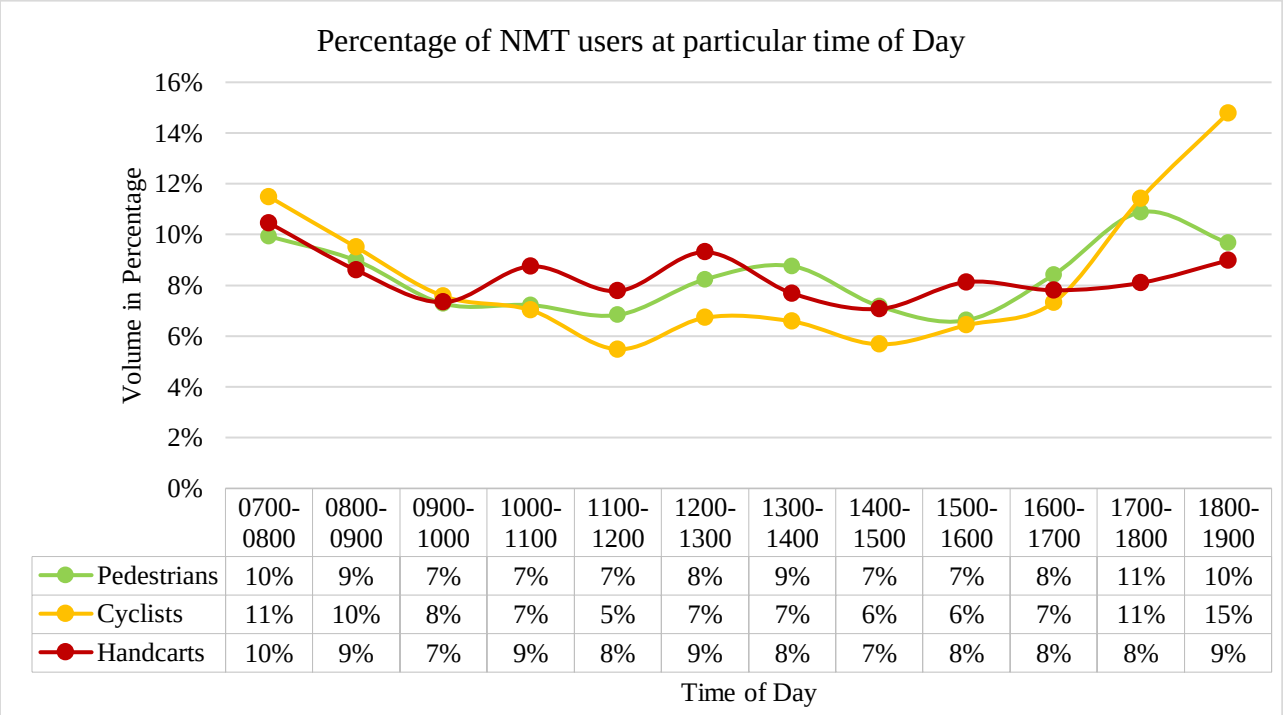
Sosiani bus terminal and the downtown commercial areas of Eldoret are in close proximity to the MTRH cordon point. Barngetuny cordon point is located along the Uganda road corridor to the East of the CBD. It is in close proximity to the government square, Zion mall, religious centres, secondary bus terminals, and the core-commercial centre especially banking institutions. Map 12 visualizes the activity points where NMT users are destined or originate from. Travel patterns further peaks in the morning and evening between 7:00 am to 8:00 am and 5:00 am and 7:00 pm respectively. Map 12illustrates the percentages of NMT categories at particular time of day.

Map 12: Traffic volume and activity points



Source: Fieldwork, 2020

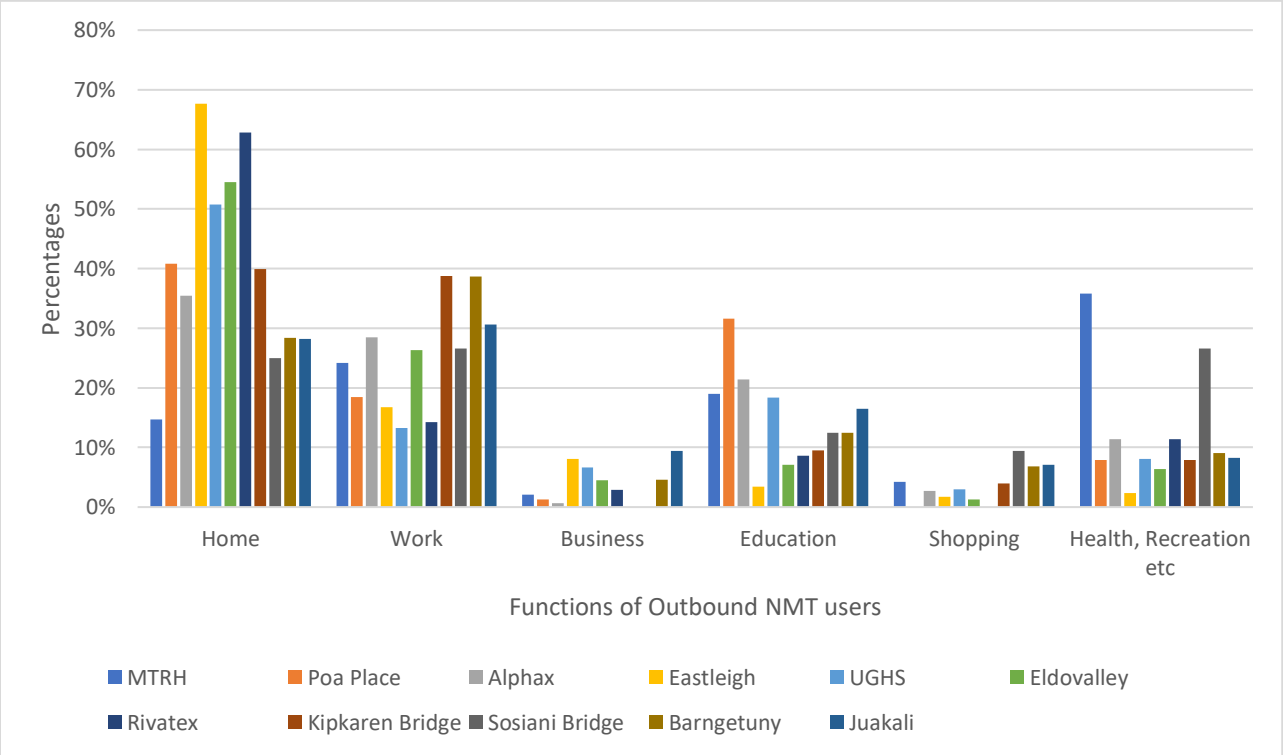
Figure 38: Percentage of NMT users



	0700-0800	0800-0900	0900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	1700-1800	1800-1900
Pedestrians	10%	9%	7%	7%	7%	8%	9%	7%	7%	8%	11%	10%
Cyclists	11%	10%	8%	7%	5%	7%	7%	6%	6%	7%	11%	15%
Handcarts	10%	9%	7%	9%	8%	9%	8%	7%	8%	8%	8%	9%

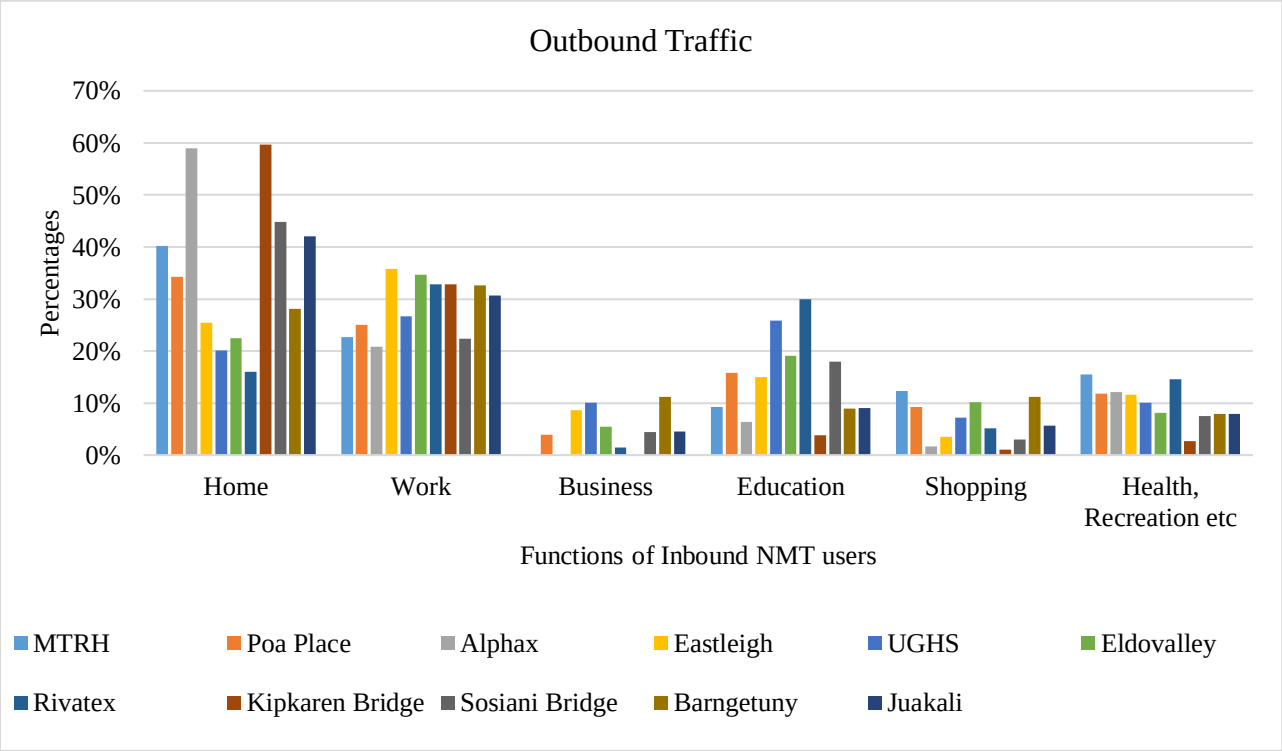
Source: Fieldwork, 2020

Figure 39: Destination purpose of Inbound Traffic



Source: Fieldwork, 2020

Figure 40: NMT Users' functions at origin outside CBD



Source: Fieldwork, 2020

Figure 39 and Figure 40 visualizes the trip types of inbound and outbound traffic. Majority of daily trips entail home-work trips with educational trips common within the CBD. Routine trips constitute 86% of the daily trips while irregular and production trips make up 4% and 10% respectively. The CBD therefore is characterized by land uses that requires the residents to access throughout the week. And with the public transport being unreliable, the use of NMT as a preferred form of travel or complementary in trip completion is on high demand.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter outlines the summary of findings on land use - transport interactions especially NMT modes with land uses within the core-urban area of Eldoret municipality. Further it outlines the planning implications that these findings have.

6.2 Summary of Findings

From the study, NMT users engaging in routine activities makes the bulk of the users. The frequent predictable activities include going to work or home, schooling and running of businesses. These activities further imply the kind of land uses located within the study area as users' travel demand is influenced by this. From the survey, areas with health and terminals are NMT hotspots. This is because they contribute to high volume of NMT traffic as people seek services, attend work or as transit from the public transport system complete their journeys using NMT. Within the core of the study area, streets are narrow and the commercial zones are utilized by pedestrians while cyclists and hand cart movers share space with motorized traffic. The pedestrian zone is largely undeveloped though where infrastructure exists lack universality and conflicted by car parks, un-aligned buildings, informal traders, and street furniture. Nonetheless, beyond the core commercial area, adequate walkways have been installed along the study corridors. This was motivated by adequate road reserve and location of municipal's residential areas along these routes.

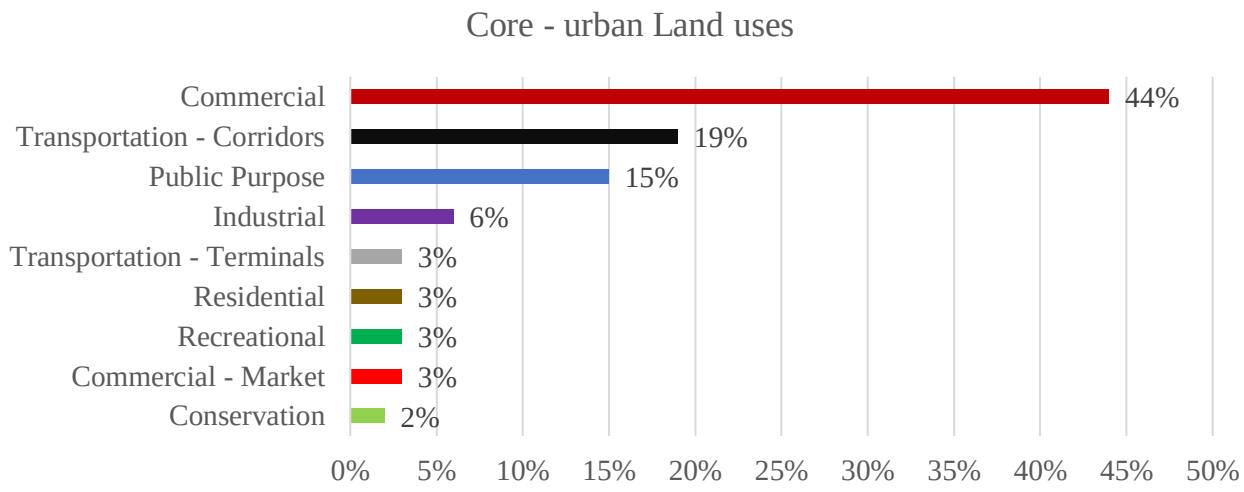
Land uses influence mobility characteristics. This is seen through traffic volumes at key cordon points. At the MTRH, the highest traffic volume was enumerated. It can then be inferred that work and seeking of medical services are key. Further, around the terminal facilities, traffic volume is high as travellers complement their journey by completing their journeys using NMT modes within the CBD. Inadequately designed transport network and services further contribute to NMT travel patterns. NMT traffic peaks in the morning, midday, and in the evening. These peak hours are associated with working hours and midday breaks. These peak hours are influenced by the availability of commercial, transport, health, education and government services during the day and within the study area.

6.2.1 Eldoret Core-Urban are Land Use Characteristics

Transportation and land use within the study area are intertwined. The municipality has been growing steadily since its inception to date. As the urban population increase, the land-use dynamics continue to change consequently influencing mobility characteristics of the people. Land-use changes in Eldoret, can be related to the trends in the municipality's extent since 1958. According to the Ministry of Lands & Physical Planning (2019) and Korir (2015) growth of Eldoret is depicted by the changes of the municipal boundary. In 1959 the town boundary was 25 km² while in 1974 and 1989 they were 59 km² and 148 km² respectively. The gazette municipal extent is coincident with the 1989 boundary. In 2019 Ministry of Land and Physical planning developed a land-use plan for 724 km^2 which was informed by development trends that have surpassed the municipal extent.

The Central Business district is a continuous area with no crisp boundary. It is made up of the old-town boundary with a transition zone in its neighbourhood created by land-use transformations in the recent past. Within this core-CBD, which is approximately 1 km^2, has majority commercial and transport of 47% and 22% as shown in *Figure 41* below.

Figure 41: CBD Land Use Characteristics



Source: Fieldwork, 2020

The commercial zone comprises of retail shops, supermarkets, financial institutions, and restaurants whereas transportation entail the bus termini, partly rail and road corridors. Key county, national and regional facilities are domiciled here making public purpose. Industrial activities within CBD include juakali workshops, service stations, and a section of go-downs.

These facilities have positively influenced the growth of the municipality. It is worth noting the municipality plays a key role as a north rift economic hub with key transport, administrative and industrial functions. International cargo passes through here from Eldoret International Airport and Uganda road being an international truck road. The study area is a distributor of traffic to neighbouring counties and hinterland of the county as well as within the municipality. This is evidenced by 22 (twenty-two) public and privately managed termini. Administratively, it acts as headquarters of the Uasin Gishu County, Kerio Valley Development Authority, has a high court, NOREB, NCPB, MTRH, and several parastatals. A number of education institutions have their colleges or campuses here. There is a high student and resident population which influences residential land use activities around these institutions. Within the neighbourhood of old-town commercial area, mixed-used is common development.

6.2.2 Characteristics of Eldoret Transport System

Transport infrastructure is a critical component in the functioning of an urban area. It is considered an economic growth stimulant because it enhances efficiency in the delivery of services. There are three categories of transport infrastructure in Eldoret i.e., roads, rail, and air. Within the core-urban which makes up the study area, the main infrastructure is roads with both motorized and non-motorized modes being used. Rail transport traverses the northern part of CBD though it is currently being used for cargo goods only. It is called the Uganda railway because it was originally built by the British to provide land-locked Uganda with access to international waters. Its line is 1,000 mm gauge and is a single track with sidings to the Eldoret go downs. Eldoret International Airport and Eldoret airstrip are the terminal air transport facilities in the area. They handle passengers and cargo from both local and international and are also available for chartered planes.

The trunk roads i.e., Uganda, Iten, and Kisumu roads traverses the study area while Nandi Road and Oloo street are circulation roads. Uganda road (A8) is part of the trans-African highway. Within the study area, its road reserve is 27 metres with a dual carriageway and a 2 metre side walk that is intermittently developed on either side. Nonetheless, the 1.5 km dual carriageway abruptly changes to a single carriageway at intersection with Iten/ Kisumu roads a well-known black spot and ends at Kago road junction next to Tagore bus terminal.

This road section serves commercial and administrative parts of Eldoret. All categories of traffic are found in this section. Both local and transit vehicles ply this route. From the traffic survey, a high

volume of NMT users uses this road. It was also noted that where there are intersections are conflict zones between the different modes. There is a lack of traffic separation interventions resulting in accidents. Along the study corridors, walkways were developed due to sufficient road reserve which was available for development. Additionally, these roads lead to residential neighbourhoods whose residents were intended to benefit from the infrastructure development.

6.2.3 Influence of Land Uses on Non-Motorized Transport

From literature and the study findings, the influence of land uses on NMT mobility patterns is significant. Key in NMT user's mobility patterns is the further influence by the organization of land uses. Land uses patterns lead to new patterns in transport due to demand for services at each neighbourhood or transport analysis zones. When land-use characteristics transform over time, urban developments in the neighbourhood change, and travel time is affected. As a consequence of land-use transformations, urban residents settle away from the CBD where land is cheap and bigger plots are available. This is a common settlement pattern in Kenyan towns with the Eldoret's study corridors being focal in expanding Eldoret urban area and depicts radial character. With an increase in population, the newly settled areas become congested and the cyclic pattern on moving to the new area especially where new roads have been constructed continues to happen.

Traffic patterns within Eldoret are attributed to the spatial structure of land uses. First, the urban area has grown in a radial form along Uganda, Iten, and Kisumu road which radiates from the CBD. This radial form has resulted in local traffic converging at the CBD where they either terminate or transit. Traffic generation points are centrally located e.g., government's administrative offices, banking institutions, recreation, and commercial zone. All these activities are traffic generators especially NMT because while using public transport their termination points are the termini then travellers have to access various points by NMT options. Within the municipality, the major traffic generation points include Eldoret International Airport, Moi University, and the agriculturally productive hinterland.

Table 4: NMT user's activities within CBD

	MTRH	Poa Place	Alphax	Eastleigh	UGHS	Eldovalley	Rivatex	Kipkaren B	Sosiani B	Barngetuny	uakali
Home	40%	34%	59%	25%	20%	22%	16%	60%	45%	28%	42%
Work	23%	25%	21%	36%	27%	35%	33%	33%	22%	33%	31%
Business	0%	4%	0%	9%	10%	5%	1%	0%	4%	11%	5%

Education	9%	16%	6%	15%	26%	19%	30%	4%	18%	9%	9%
Shopping	12%	9%	2%	3%	7%	10%	5%	1%	3%	11%	6%
Health, Recreation, Etc	15%	12%	12%	12%	10%	8%	15%	3%	7%	8%	8%
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100 %

Source: Fieldwork, 2020

Table 5: NMT user's activities out of CBD

	MTRH	**Poa Place**	**Alphax**	**Eastleigh**	**UGHS**	**Eldovalley**	**Rivatex**	**Kipkaren B**	**Sosiani B**	**Barngetuny**	**Juakali**
Home	15%	41%	35%	68%	51%	54%	63%	40%	25%	28%	28%
Work	24%	18%	28%	17%	13%	26%	14%	39%	**27%**	**39%**	**31%**
business	2%	1%	1%	8%	7%	4%	3%	0%	0%	5%	9%
education	19%	32%	21%	3%	18%	7%	9%	10%	13%	13%	16%
shopping	4%	0%	3%	2%	3%	1%	0%	4%	9%	7%	7%
others	36%	8%	11%	2%	8%	6%	11%	8%	27%	9%	8%
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Fieldwork, 2020

The study corridors radiate from the CBD and places the study area as a local, regional and international transport node. Travel demand is influenced by land uses because of the services or activities located within these land uses. The growth of the municipality has largely been along the three urban highways. To the west along Uganda road are the sprawling Huruma, Mwanzo, and Juakali estates. The Moi University West Campus and Kenya Pipeline Corporation (KPC) depot provide human and motorized traffic demand points. From the traffic generated, land uses transform towards providing basic services e.g., residential, hotels, retail, and eatery facilities for this high population. Along the northern corridor of Iten road, the University of Eldoret formerly Chepkoilel campus is the main attraction point. The university has a high student population and staff. The university population requires key services. This has led to schools, health, markets, and recreation facilities being developed in the neighbourhood. These include Chebisaas boys' high school, Chepkoilel Secondary, Equator flower farms and Ainabtich market. Estates that have developed along this corridor include Sogomo, Kimumu, and Munyaka. The southern corridor has the Eldoret International Airport, Showground, Rivatex, and the Eldoret polytechnic. Hill school, Pioneer schools, and Reale hospital are some of the facilities to its south. Key estates are Langas, Pioneer and

Kapseret. Along the Nairobi corridor are industries, Moi University annex Campus and neighbouring Elgon view estate.

From the study, the key local traffic generation and destination zones is the CBD and neighbouring estates e.g., Langas, Kamukunji, Huruma, Eastleigh, Kidiwa, Mail Nne, MTRH, Eldoret International Airport, Kimumu areas, Pioneer Estate, bus stations, and educational institutions. Others include the administration zone; the cereal board go downs and the neighbouring industrial area. From the traffic survey a high number of NMT uses were mapped at Barngetuny Plaza, MTRH and Tagore bus terminus. At Barngetuny plaza, is the intersection of Kisumu/Iten road and Uganda roads. This junction is key for travellers from the north and eastern part of the municipality. Adjacent to this junction are county headquarters, the county hospital, Zion mall, and Iten bus terminal which indicates their influence as traffic generators or attraction points.

At the MTRH cordon point, the cumulative total of NMT users was the highest with Tagore and Barngetuny plaza coming second and third respectively. This is an indicator that land use activities influence NMT users. NMT users at this point were largely those seeking services at the hospital and/or students at medical school or KMTC. Others were travellers accessing the CBD through Nandi Road or from the Sosiani bus terminal among other users. Additionally, the highest number of NMT users crossing the corridors were mapped at Tagore bus terminus. This can be attributed to the terminus itself, residential neighbourhoods within walking distance from the CBD and the industries. NMT users' travel patterns, therefore, are largely influenced by the location of land uses.

6.3 Recommendations

Transportation and land use within any urban area are intertwined. With changing land uses there is an expected new movement pattern due to transport demand occasioned by land use. Roads are the arteries through which the economy thrives. This is quite evident in Eldoret where developments are largely aligned to Uganda (A8), Kisumu (B8) and Iten (B16) road corridors. Eldoret is characterized by transit route-oriented developments, where high density residential areas e.g., Kimumu, Langas and Huruma are located along the highways. The commercial, service and industrial areas are centralized and together with other urban development depict a radial form of urban development.

From the findings of the study, radical land-use proposals within and around CBD have been recommended. The recommendations have been categorised as follows;

6.3.1 Regional Level Recommendations

Transportation planning decisions influence land use directly, by affecting the amount of land used for transport facilities, and indirectly, by affecting the location and design of development. As an example, expanding urban highways increases pavement area, and encourages dispersed urban development, while walking, cycling and public transit improvements encourage compact, infill development of urban areas.

The following are some of the recommendations envisioned to promote compact development, infill development, and redevelopment;

i. Downgrading of Uganda road from arterial to an urban collector road. This will lead to removal of all cargo trucks to the bypass that is under construction once completed. Once the bypass is complete it will become mandatory for cargo and through traffic to use it.
ii. Transform the Eldoret industrial park to commercial to create space for CBD regeneration. A new industrial park to be proposed at Leseru and Plateau rail stations. The current central railway station to only serve as a passenger station.
iii. Develop a logistic hub at Leseru as a short-term measure so as to use to manage cargo traffic that accesses facilities within CBD or in its neighbourhood e.g., NCPB and KPC trucks. The recommended logistics hubs will serve as transport organization, separation, coordination and distribution of goods so as to manage congestion that is regularly experienced at NCPB, KPC, Unga limited and Raiply among others. All trucks must enter the Logistical hub apart from those on permitted transit. A queuing number will be allocated to trucks within the logistic hubs and trucks will only proceed to destination when it's their turn, e.g., when it's time for refiling or when onsite parking space is available for loading or offloading.

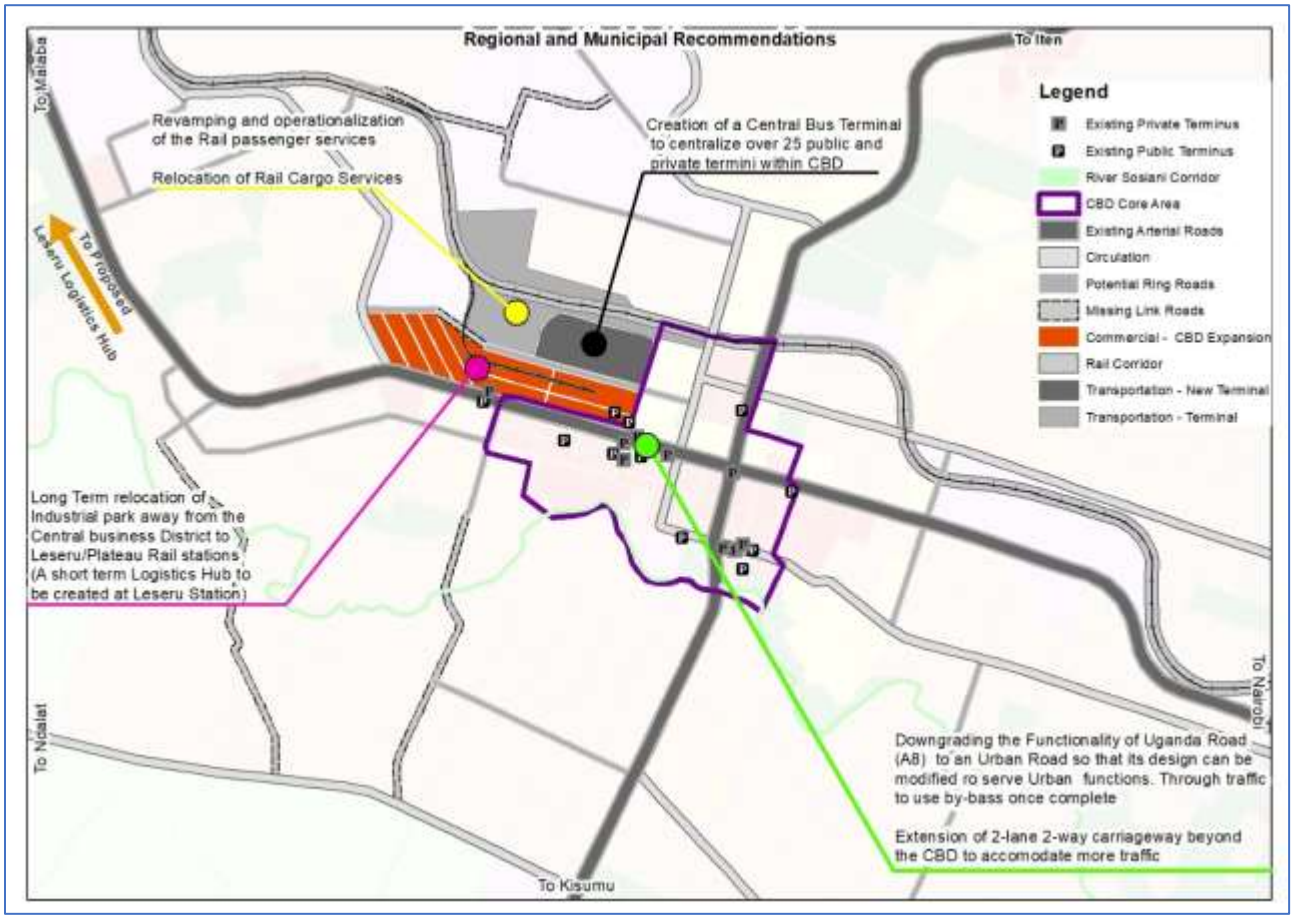
The planning implications of these recommendations is reduction of congestion within the CBD due to diversion of through traffic to the soon to be completed bypass. Degradation of the Uganda road to an urban collector road will allow design modification to cater for both motorized and NMT traffic needs. The core-urban CBD has limited space for expansion, the proposal of existing industrial area redevelopment will necessitate relocation of the industrial neighbourhood towards Leseru and Plateau rail stations where other industrial parks are upcoming. This is proposed as a long-term measure but in the short term is development of logistics hubs at the two rail stations so as to manage cargo traffic in accessing the depots within CBD and its neighbourhood.

6.3.2 Municipal Level Proposals

In order to promote compact developments, the limited space for development in the CBD is proposed to be expanded. The current industrial area needs to be redeveloped to align it to the current transportation demands (Map 13). Residential neighbourhoods adjacent to the CBD are proposed to be rejuvenated through redevelopment of action plans to promote key services including but not limited to shopping, banking, basic education, religious centres, social centres, sports and light industries. These estates include Kidiwa, Macharia, Pioneer, Langas and Kokwas. Apart from this, the following are municipal level recommendations aimed at complementing provision of NMT infrastructure and service proposals;

i. Eldoret municipality is generally characterized by gentle terrain which is favourable for NMT infrastructure development and usage. It is recommended that the county create a safe, cohesive and comfortable network of footpaths, cycling lanes and tracks, green areas, and other support amenities
ii. Reorganization of land uses in and around CBD through long term relocation of industrial zone to create space for CBD improvement/regeneration
iii. Enhance connectivity through construction of rings roads around CBD and completion of roads with missing links. This will encourage better linkages to land uses and encourage more rational mobility patterns
iv. There are 4 (four) key bus termini with 7 (seven) more complementary termini managed from the main terminals. Additionally, there are at least 11 (eleven) privately managed termini created due to congestion in the public termini. All these termini are poorly managed and located along study corridors which are notably black spots. From this relocation of these termini to a central terminus is proposed to be complimented with assigning routes for PSVs.
v. Introduce one-way roads within the study area so that extra lane is pedestrianized to cater for NMT traffic
vi. Reconfiguration of parking. This includes removal of all parking spaces along A8 and conversion of angular to flush parking to create space for NMT corridor along the study roads.

Map 13: Regional and Municipal Recommendations



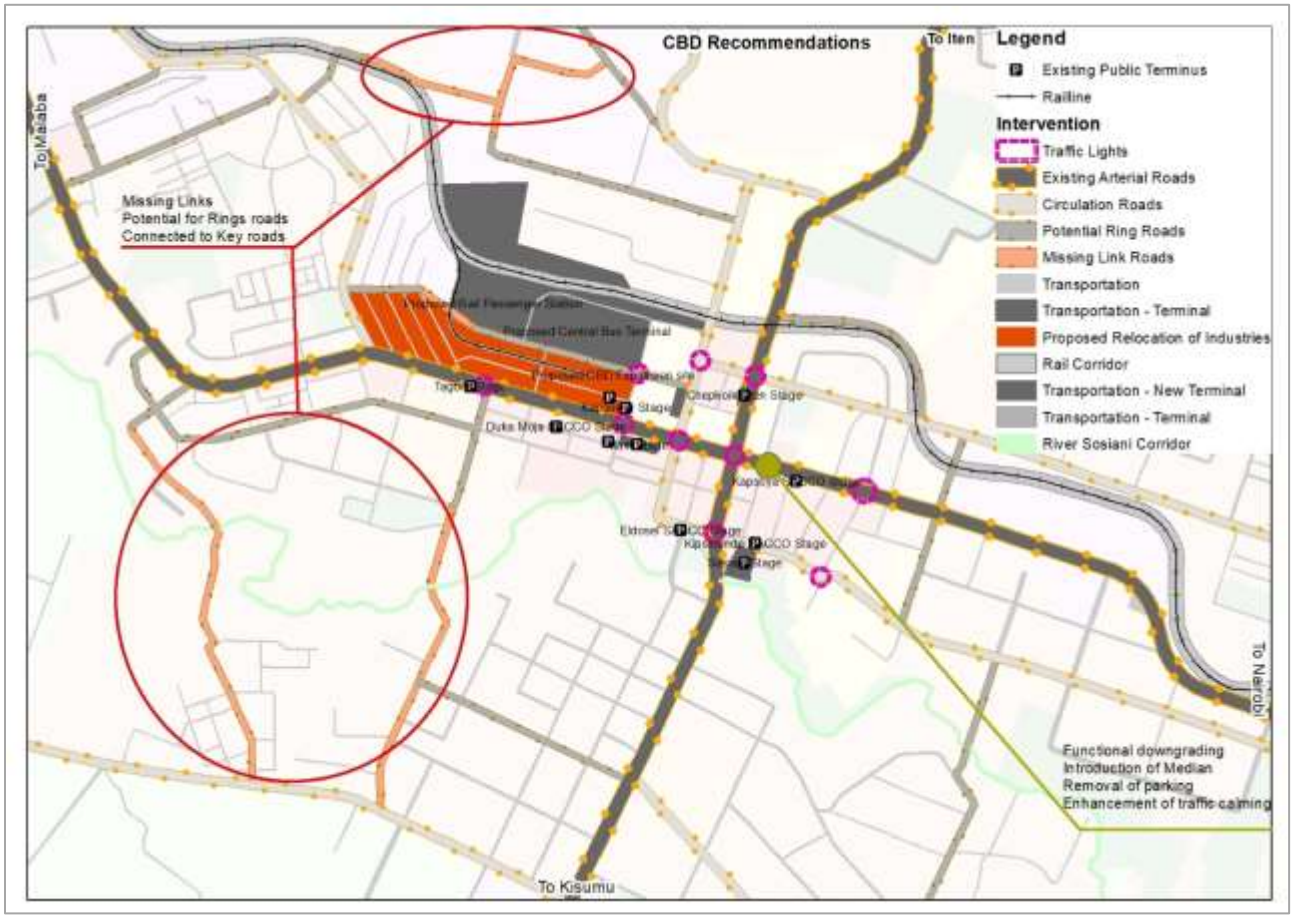
These recommendations are meant to promote walkability and reduce the demand for motorised transport. This will limit the travel demand hence reducing congestion on transport system. Travel to and outside these re-planned zones should only be in search of high order services for example tertiary education, High end supermarkets and medical services among others. Space for higher order services will get space from the long-term relocation of the industrial park.

6.3.3 CBD Level Proposals

Inadequate transport infrastructure and traffic conflicts is a major setback for a safe, cohesive and comfortable network of NMT infrastructure in Eldoret. With limited walkway infrastructure, there is need to incorporate multi-modal NMT infrastructure e.g., cycling paths. *Map 14* provides some of the proposed interventions. Along the A8, it is proposed that a median is introduced to deter indiscriminate crossing of the corridor leading to preventable accidents. The designated crossing points are proposed to be installed with traffic separation interventions e.g., traffic lights, deceleration

lanes, median islands for pedestrians and limiting direction of movement by motorized traffic at selected intersections. Road reserves are generally narrow in the CBD, and to overcome this, angular parking ares are to be converted to flush parking areas and developing covered surface water drainage to supplement NMT infrastructure.

Map 14: CBD Proposals



Additionally, there is need to pedestrianize some roads so as to channel NMT traffic to these streets. Some of these pedestrianized streets would be designed to accommodate informal traders who currently occupy walkways selling their wares. Informal businesses lining the walkways to be improved in terms of layout, construction fabric and site management interventions. The resultant outcome will be organized business activities in an aesthetic and clean environment. Eldoret municipality is generally characterized by gentle terrain which is favourable for NMT infrastructure development and usage. To promote the use of bicycles, there is need for development of parking silo within the existing bus termini. Hand carts though not popular are common for movement of goods from the market but because of their slow movement the use of *tuk-tuk* is preferred as it can

move faster and due to licensing can be a source of revenue to the county. It is therefore recommended that handcarts be banned from the CBD. Finally, motorized traffic management is proposed through closure of some roads and junctions.

6.4 Conclusions

The study aim was to asses and present the land use, assessment of transport infrastructure and NMT users characteristics in order deduce NMT travel patterns as influenced by land uses within the Eldoret CBD. The form of urban areas and uncoordinated land use transformations has compromised the existing transport system and increased the challenge of NMT infrastructure provision and mobility of its users. Policy makers have over a long time been faced with conflicting demands; on one hand revenue generation provision of motorized parking while on the other restricting motorized traffic through development of pedestrian zones currently utilized as parking. These conflicting issues including un-aligned building lines and inadequate traffic calming infrastructure is compounded by land use transformation that have led to specific zones experiencing high NMT traffic volumes and have not been prioritized in infrastructure and traffic management interventions.

From the study, NMT users engaging in routine activities makes the bulk of the users. The frequent predictable activities include going to work or home, schooling and running of businesses constitute 86% of the daily trips. These activities further imply the kind of land uses located within the study area as users' travel demand is influenced by this. From the survey, areas with health and terminals are NMT traffic hotspots depicted by traffic volume and trip types. The Road corridors within the CBD are narrow and the commercial frontage zones utilized by pedestrians while cyclists and hand cart movers share space with motorized traffic. The pedestrian zone is mainly utilized as parking or temporary terminals though where infrastructure exists lack universality and conflicted by car parks, un-aligned buildings, informal traders, and inadequate street furniture. Nonetheless, beyond the core commercial area, adequate walkways have been installed along the study corridors. This was motivated by adequate road reserve and location of municipal's residential areas along these routes.

Land uses influence mobility characteristics. Inadequately designed transport network and services further contribute to NMT travel patterns. NMT traffic peaks in the morning, midday, and in the evening. These peak hours are associated with working hours and midday breaks. These peak hours are influenced by the availability of commercial, transport, health, education and government services during the day and within the study area. To overcome these challenges recommendations have been

put forth looking at the municipality as a whole to part. To start with is decongestion of the CBD through removal of motorized traffic. To do this, completion of by-pass aimed at diverting transit traffic and a long-term relocation of the industrial park. Relocation of the industrial park would create space for expansion of congestion CBD. Additionally, upgrading of ring roads and completion of missing road links will improve motorized traffic circulation. Finally, implementation of universal and networked along pedestrian zones across the CBD is recommended. Along the network of paths are traffic calming and separation infrastructure to channel traffic to designated crossings and reduce accident incidences.

6.5 Suggestions for Further Research

This study has been done through data analysis of traffic survey limited to NMT. Further studies have been proposed as follows:

1. Eldoret's terrain is gentle and favourable for NMT use. Nonetheless, it was observed that cycling – which is a faster mode than the popular walking – is not popular among residents. A detailed study on adoption of cycling as a key mode of travel towards its promotion in Eldoret is advisable.
2. Public transport is an issue of concern and it goes well with NMT. A further study on challenges of integrating NMT and public transport in order to promote high volume public and non-motorized transport
3. NMT use has significant benefits but Africans have a negative view of low-cost transport modes/forms. Further research is recommended towards identifying what can be done to enhance NMT usage in African urban areas
4. Within this study only NMT survey was studied, a further research on motorized traffic movements especially utilization of intersections because it was observed that MT enjoy maximum direction of movement (12 movement in a 4-way junction)

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APPENDICES

Appendix A: Questionnaire

Interviewer Name: …… Phone No……..

Interview Location:……..…… Date:……Time:……..

Mode of Transport: **Pedestrian** ☐ **Cyclist** ☐ **Cart** ☐

1) Name of Interviewee: _____

2) Education Qualifications (Tick where necessary)

No formal education	☐	KCSE certificate	☐	Diploma	☐		
KCPE certificate	☐	Certificate	☐	Degree +	☐		

3) Occupation/Professional status

Civil servant	☐	Formal employment	☐	Student	☐		
Self employed	☐	Artisan/Juakali	☐	Not employed	☐		

4) Where have you started your trip (*walking, cycling or cart*)? _____

5) What was the purpose being at the origin? *(Choose one, if other write actual reason)*

Home	☐	Education	☐	Shopping	☐		
Work	☐	Hospital	☐	Other	☐		

Comment: _____

6) How much time in **minutes** have you taken from origin? ……...

7) Where is your intended **Destination** of this trip (*walking, cycling or cart*)? _____

8) What is the **purpose** of going to destination? *(Choose one, if other write actual reason)*

Home	☐	Education	☐	Shopping	☐		
Work	☐	Hospital	☐	Other	☐		

Comment: _____

9) How much time **in minutes** will it take you to the destination from here? ……..

10) Question on return trip

a. Will you make a return trip today? YES …….. NO……..

b. If YES what time of day? …….

c. If NO, after how many days? ……

11) How often do you Walk, Cycle or Cart? *Choose one*

Many times, daily		1 – 2 days a week		5 – 6 days a week			
Twice Daily		3 – 4 days a week		Other			

12) Questions on NMT user preference

a. Do you prefer walking, cycling or Carting? YES ……. NO ……..

b. If YES, what would be your preferred walking, cycling or Carting **distance**? …….m

c. If YES, how many **minutes** would you prefer to walk, cycle or cart? ……. Minutes

d. Is walking, cycling or Carting a good alternative to using car/bodaboda? YES….. No…..

13) What are the reasons for using NMT modes *(walking, cycling or Carting)*?

To save money		No transport means to the area		Lack of fare			
To exercise my body		I enjoy the company of friend(s)		Other			

14) What are the main challenges you face while using this mode of transport? *In order of severity (1 = less severe and 5 = very severe)*

Harassment from Motorized transport (boda boda or cars)

Expose to harsh weather condition

Harassment from other pedestrians/cyclists/cart operators

Conflict from hawkers, shops etc

NMT infrastructure is not provided or in poor condition

Other:

15) What proposals would you make to improve NMT infrastructure and use?

a.

b.

c.

16) What is your income range per month?

Less than 10000		20000 - 29999		40000 - 49999			
10000 - 19999		30000 - 39999		Over 50000			

Appendix B: Key informant guide

No	Question	Target Audience
1	What is the state of Non-motorized transport in Eldoret CBD	All
2.	Are there statistical data on modal splits on road users	Municipal planner
3.	Is there an existing transport policy for the municipality (more so for non-motorized transport)	Public works Municipal planner
4.	Could you identify critical NMT infrastructure in the CBD?	All
5.	Could you identify the infrastructure including the funding agency?	Public works Municipal planner
6.	Where are the conflict areas between NMT and motorized traffic?	Traffic police and marshals
7.	How do enforcement officers/agencies overcome the above conflict? List further recommendation if any	
8.	Are there existing interventions for NMT within the study area?	All
9	Could you identify NMT corridors with most NMT traffic challenges	
10	In relation to question above, what would you recommend to be done to overcome the challenge	

Appendix C: Traffic Count checklist

ELDORET NMT SURVEY FORM			
NON-MOTORISED TRAFFIC COUNTS			
Location Name: _____		**Date: _____**	
Direction: From_____		**To _____**	
Name of the Enumerator:		ID number of Enumerator:	
Signature of the Enumerator:		Phone number of Enumerator:	
Time	**PEDESTRIANS**	**CYCLISTS**	**CARTS**
7:00 - 0730			
7:30 – 8:00			

Appendix D: NMT Infrastructure Survey

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 walk 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

Appendix E: Research Permit

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