INTEGRATION OF NON-MOTORISED TRANSPORT SYSTEMS IN THE PLANNING AND DEVELOPMENT OF MEDIUM SIZED TOWNS IN KENYA. A CASE OF ELDORET MUNICIPALITY

By

Mulongo Leonard Simiyu
SES/D.Phil. 19/2000

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of philosophy in environmental studies (Division of environmental planning and management), Moi University.

DIVISION OF PLANNING AND ENVIROMENTAL MANAGEMENT SCHOOL OF ENVIRONMENTAL STUDIES
MOI UNIVERSITY

NOVEMBER 2005

DECLARATION

DECLARATION BY CANDIDATE

This thesis is my original work and has not been presented for examination in any study programme of and or any Institute or University. No part of this work may be reproduced without permission of the author and or Moi University.

MULONGO LEONARD SIMIYU

SES/D.Phil. 19/2000

19/11/05
DATE

DECLARATION BY THE SUPERVISORS

This thesis has been submitted for examination on our approval as University Supervisors

Dr. VAO ODENYO
Division of Environmental Planning and Management

19/11/2005
DATE

DR. M.S. RAO
Division of Physical Sciences

19/11/2005
DATE

DR. S OBIERO
Department of Urban and Regional Planning
University of Nairobi
P.O. Box 30197,
Nairobi.

19/11/2005
DATE

DEDICATION

To my late father Patrick Mulongo, my mother Julian, wife Jacqueline, daughter Helen and son Hillary and to those of you who have endeavored to realize an environmentally friendly mobility system for our towns. May God bless you abundantly and fulfill all your desires.

ABSTRACT

Transport is a basic pre-condition of sustainable society, a livable world and a localized economy. Today, however, virtually all cities in the world are faced with transport problems of one kind or another, and efforts towards ensuring a satisfactory level of mobility in these cities especially in third world countries has not achieved much success and the situation remains elusive to urban and transport planners. The failure to articulate the needs of all transport components and users and the lack of proper conceptualization of the prevailing urban land use patterns, structure and transport planning policies seems to have been the major cause to the current urban mobility conflicts facing our medium sized towns today.

The study was undertaken in Eldoret town and sought to examine how urban transport using Non Motorised transport system can be integrated in the planning and development of medium sized towns in Kenya. It laid emphasis on Non Motorised Transport (NMT) component, a system which inspite of being environmentally friendly and economically consistent, has not been fully integrated as a transport system in our towns as explained by the little attention in terms of space and financial allocation accorded to it.

The main issues covered included examining the current land use and transport system in Eldoret and the relationship between the two, assessing NMT role and the extent to which it has been catered for in the town and proposing development strategies of integrating urban transport system in the overall urban structure. The findings derived revealed, a great potential for NMT as a mode of transport in Eldoret arising from the number of trips either made on foot or cycling. It emerged also that needs of NMT cannot be articulated in isolation from those of Motorised Transport (MT) for most conflicts arise when each is articulated in isolation and finally the structure of the town, land use pattern and its historical growth were identified as some of the essential attributes significant in determining the nature and viability of a given mode of transport. For instance, a town located on a steep gradient like Kisii is not favourable to NMT use while a rather gentle sloping town like Busia or Bungoma tend to attract large volumes of NMT.

From the research findings, the study recommends the need to decentralize major employment and socio-economic infrastructures away from the central business district (CBD) for they make NMT users covering along distance which makes it less viable and unfriendly. Decentralization could also reduce congestion within the CBD and the resultant conflicts. As part of enhancement of NMT integration, the study recommends that some routes currently used by both NMT and MT could be closed especially in the evening and weekends for either pedal or pedestrian users. Examples involving Nandi- Elijah Cheruiyot and Sosiani road that links Moi Referral and Teaching Hospital to the Bus Terminus and the western direction of the town. Finally, since the current planning has left no space for NMT provision, the study recommends traffic calming along the existing facilities in order to create room and coexistence for both NMT and MT.

TABLE OF CONTENTS

CONTENTS **PAGE**

CHAPTER THREE: RESEARCH METHODOLOGY AND STUDY AREA

CHAPTER FOUR: FINDINGS, ANALYSIS AND RESULTS

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES,

LIST OF PLATES

ACRONYMS AND ABBREVIATIONS

ADT—Average Daily Traffic
AMREF---African Medical Research Foundation
CBD--- Central Business District
CPC- Corn Producing Company
EATEC--- East Africa Tanning Extracting Company
EMC—Eldoret Municipal Council
GM--- Gravity Model
GOK--- Government of Kenya
KCC--- Kenya Creameries Co-operative
KIE- Kenya Industrial Estates
KUTIP--- Kenya Urban Transport Infrastructure Programme
MT---Motorised Transport
NMT--- Non Motorised Transport (cycling, walking & handcart pushers)
O-D--- Origin Destination
PPD--- Physical Planning Department
PT—Public Transport (buses, and Matatus)
UN--- United Nations
RVTI- Rift Valley Technical Institute
SSATP—Sub Saharan Africa Transport Program
UTP—Urban Transport Process
UPT--- Urban transport Planning

ACKNOWLEDGEMENT

This study owes thanks to many people and institutions for their support, encouragement and contributions. In the first place Moi University for enabling me to undertake my studies by settling part of my tuition fees, the Germany government through DAAD for granting me an in-country scholarship towards my research and the entire staff of School of Environmental Studies, Division of environmental Planning and Management in particular for their support and contribution.

I am highly indebted to my three supervisors Dr.Victor Odenyo, Dr. Rao and Dr. Samuel Obiero for their guidance; advice, sacrifice and constructive criticism that was instrumental towards the completion of this study. Not forgetting the residents of Eldoret town, the Municipal Council workers and the Kenya police Eldoret Station for their direct and indirect support.

Special thanks go to my lord and my family members for their indispensable force. Not withstanding the advice and criticisms I received, I am solely responsible for any errors, opinions and views articulated in this study.

CHAPTER ONE: INTRODUCTION

1.1. Overview

The significance of this chapter lies in the fact that it articulates key attributes, which are the cornerstone of the study. The chapter gives an account of the background to the study, general analysis of the transport system at the international, regional and local level as a way of conceptualizing the magnitude of the problem. Other issues of great significance addressed in this chapter include the study's statement of problem, research questions, objectives and hypothesis as based on the background to the study.

1.2. Background to the study

Integrated land use and transport modeling is an area of research that reached a high peak in Britain in the early seventies, mainly with an academic interest. Real world applications in industrialized nations, however, have been limited mainly because of the slow rate of growth of cities of Europe. Considering the location of activities and other socio-economic variables, most cities in Europe and the USA regularly use stand-alone transport models for their everyday planning practice (De La Barra, 1989).

The above situation however, is quite different from third world countries since cities grow so rapidly that the interaction between the location of activities and transport system becomes a dominant issue. This situation, to a large extent has not been actualized due to lack of a clear conceptual framework on how transport systems can be integrated in the overall land use and urban structure. This therefore presents an opportunity for integration since the situation is dynamic.

Transport like any other component of development, is an important sector in all-economic activities and its cost is a significant variable in the market pricing of goods (Gleave, 1989). It is an epitome of the complex relationships that exist between the physical environment and patterns of social and political activity and levels of economic development (Hoyle et al, 1983). In advanced and developing countries, investment in transport is a matter for political negotiation, economic calculation and environmental consideration (Adams, 1981). Modern economies require, and assume, relatively sophisticated transport systems; yet changes are frequently contentious.

In spite of the role played by transport in development, a majority of the world's peoples, however, inhabit areas underprovided with even rudimentary forms of transport making accessibility to the majority of people impossible.

The present day rapid urbanization and population increase, however, has become one of the main international challenges confronting very many developing countries. It has placed tremendous pressure on all urban services, such as education, housing, health and infrastructure services to an extent that nations can no longer decide on whether to improve or provide new transport systems especially Non Motorised Transport at the expense of other land use activities.

Today, urban planners, engineers together with other policy makers are continually confronted with the dichotomy of the needs or aspirations of communities versus their ability to pay for the respective services (Austin, 1996). For more than fifty years for instance, the planning and design of settlements in most of our cities in Africa, has been dominated by the political ideology of separate development and the planning ideology of modernism.

These ideologies have led to the development of mono-functional settlements, often fragmented and environmentally sterile with the challenges facing many urban centres being of how to create a framework for settlement-making which will enrich life in settlements and serve as an instrument of urban reconstruction and development so as to accomplish the following: -

- Promote integrated land development in urban areas;
- Promote the integration of the social Approaches, economic, institutional and physical aspects of land development;
- Promote the availability of residential and employment opportunities in close proximity to or integrated with each other; and
- Encourage environmentally sustainable land development practices and processes.

As cities continue to urbanize and people continue to settle in the urban areas, the above pressure, shall only but continue. In India, for instance, rapid urbanization trends since the beginning of the last century have resulted in almost one fifth of its total population, i.e. of 547 million living in urban areas. This widely varying socio-economic characteristics and development profiles of the different sized cities that have resulted as typified by their different roles of industrialization, modernization and urbanization have exerted a strong influence upon the use and choice of urban transport modes within the respective cities (Rao et al, 1990).

Even though deficiencies in public transport service are identified in almost all the world's towns and cities, the problems are particularly severe in urban areas of the less developed countries. Major cities in these nations provide an arena in which the various principal transport modes exist in a competitive environment and create what

can often be seen as intractable problems. In this situation, devising and implementing solutions to ensure a more efficient and acceptable use of the urban transport infrastructure still remains the principal concern of the planners and policy makers (Brian et al, 1992).

Recent studies conducted in the metropolitan and medium sized cities (those with a population of 100,000 and more) in third world countries show that urban transport problems are both extensive and varied, revealing the widespread use of different, transport modes. A particular feature that has been noticed in these medium sized urban areas has been the notable inadequacy of their bus public transport facilities and in situations where efforts have been made to provide improved public transport, the trend still remains quite below the expected demand.

In Africa, however, alleviation of the current transport situation calls for proper re-examination by transport and other developmental planners of the existing land use and urban structures so as to formulate stronger policies, strategies and programmes that emphasize integration of transport systems in the overall socio-economic and urban land use structure.

1.3. Urban Transport Situation in Africa

The transportation situation in Africa has evolved overtime based on the transport scenario occurring across the world. Its development therefore can be traced right from prior to industrial revolution taking place in Europe, introduction of mechanical progress and as per the present situation (Creighton 1970).

Most African countries inherited a pattern of transportation systems specifically designed by colonial powers to assist in exploitation of natural resources. Thus in the

wake of independence, the various countries found themselves looking more towards Europe than neighbouring African countries (Oni, 2001).

Prior to the industrial revolution, the prime difficulties faced by men in transporting themselves and their goods over the surface of the earth were physical ones. During this period, transport planning was mainly geared towards overcoming the frictions of land travel, the shifting winds and dangers of the seas. Although these frictions may not appear real to most people today, many people who traveled in eastern countries can remember seeing carts being dragged through rutted roads with both men and horses in the traces: a harsh reminder of the difficulty of movement (Oni, 2001).

While the above scenario applied to those parts of the world where industrial revolution is still going on, for Africa in the absence of horses, the situation was not only the same but also rather cumbersome given the nature of terrain to be covered.

The introduction of mechanical progress, however, provided an opportunity for the introduction of engines for propulsion, better materials for vehicles and ships, and better surfaces (both rail and road) for vehicles to use in traveling on land.

The investments in smoother, all-weather road surfaces and in rails actually reduced the physical frictions of travel thus abating the physical difficulties of travel.

In relative scale of difficulties facing men, the physical problem therefore greatly diminished and partly as a result of the success, the more serious transportation difficulties became the conflicts between and among people taking a variety of forms.

In the tighter urban world of today, however, most of the mechanical techniques are no longer assured of their earlier high rate of profitability. Although transportation facilities are already everywhere; land is increasingly scarce; people are living at

higher densities; people traveling more; and standards of what people want in the way of living conditions are going up as fast as modern communications can convey the idea of what the rich are doing (Mulongo, 2001).

The rapid urbanization occurring across the globe has even changed the scenario with the difficulty of transportation in Africa becoming no longer how to overcome distance but how to thread through masses of people and vehicles. It has also meant not only more people than ever before living and working in cities but also more people and goods making more trips in areas, often over longer distances (World Resources, 1996 and World Resources, 1997).

How urban areas, especially the rapidly growing cities of the developing world, have met the burgeoning demand for urban travel, is what has today let to the present implications for the environment, the economic efficiency, and the livability of these areas. Cities have traditionally responded to travel demand by expanding the transportation supply. In much of the developed world, that has meant building more roads to accommodate an ever-growing number of vehicles, thereby creating a new urban form: the sprawling metropolis.

The cost of increasing dependence on cars in the world's cities however, are becoming too apparent and include expensive road building and maintenance; clogged, congested streets that undermine economic productivity; high levels of energy consumption, with its attendant economic and environmental costs; worsening air (air pollution through increase in carbon monoxide) and noise pollution; traffic

accidents; and social inequalities that arise when the poor find transportation services increasingly unaffordable (World Resources 1996 and World Resources, 1997). One major issue threatening urban sustainability in Africa therefore is the deteriorating mobility conditions, which has accompanied the urbanization of poverty. The African population will be 50 per cent urban in this century, with high urban population growth rates projected into the next century (Materu, 2001). While urbanization has been accompanied with high economic growth rates almost everywhere in the world, in Africa especially sub Sahara Africa; the picture has been different and dismal. Poor urban mobility conditions in the form of inadequate and efficient transport and communications facilities as a result of increased social and economic costs of urban life in Africa is what characterizes the transport situation in Africa today.

With an overview of the transport evolution worldwide, the technical task therefore is of how to manage transportations flow so as to reduce the present and future conflicts between people. It also focuses on how to make sure that the resources, which are being allocated for transportation capital improvement, will earn a high profit for society. The technical task from transportation point of view therefore calls for plans for entire networks (as opposed to single facilities) of all types of transportation facilities.

Although rapid motorisation growth rates have been most commonly associated with the deteriorating conditions of urban transport systems in the third world, high rates of urbanization and related changes to the economic base of settlements in this part of the globe are in fact the more influential contributing factors. One significant attribute

with these trends is that they have taken place in settlements, which are foci in their respective countries of forces of modernisation, industrialisation and technology-transfer, and thus constitute very important centres of local, national and regional development.

As a result of the above scenario, transport problems of third world cities inevitably have taken on a variety of forms, depending upon their location, associated wealth and levels of motorisation. Urban transport manifestation and root problems in third world urban cities, especially for African towns can be summarized as per (Dimitriou's, 1990) perspective, as shown in Figure 1.1 and WB SSATP (2001). Dimitriou (1990) in his approach of urban problem analysis outlines two categories, which consist of manifestation of problem on the one hand and root cause of the problem on the other. Under problem manifestation, the key aspects seem to revolve around air and noise pollution, traffic congestion, environmental degradation, higher road accidents, increased inaccessibility of underprivileged. For the sake of this study, the list could be expanded to include lack of harmony in transport articulation in relation to people's demands.

From the list of root problem as pinpointed in Figure 1.1, higher population growth, increased urban expansion, inadequate land use control, poor traffic management and enforcement and incompatible traffic mix form consist of the key urban transport problems facing cities and urban centres in third world countries. The list also includes incompatible urban form & density configuration, inadequate transport facilities, poor infrastructure maintenance & management and inefficiently operated public transport services.

Figure 1.1 however, is not complete in relation to this study because it does not emphasize the fact that inadequate land use control is what has let to the non-provision of Non Motorised Transport system in our major urban centers in Africa. Faced with the various problems as outlined in figure 1.1, the main question that remains is the way forward.

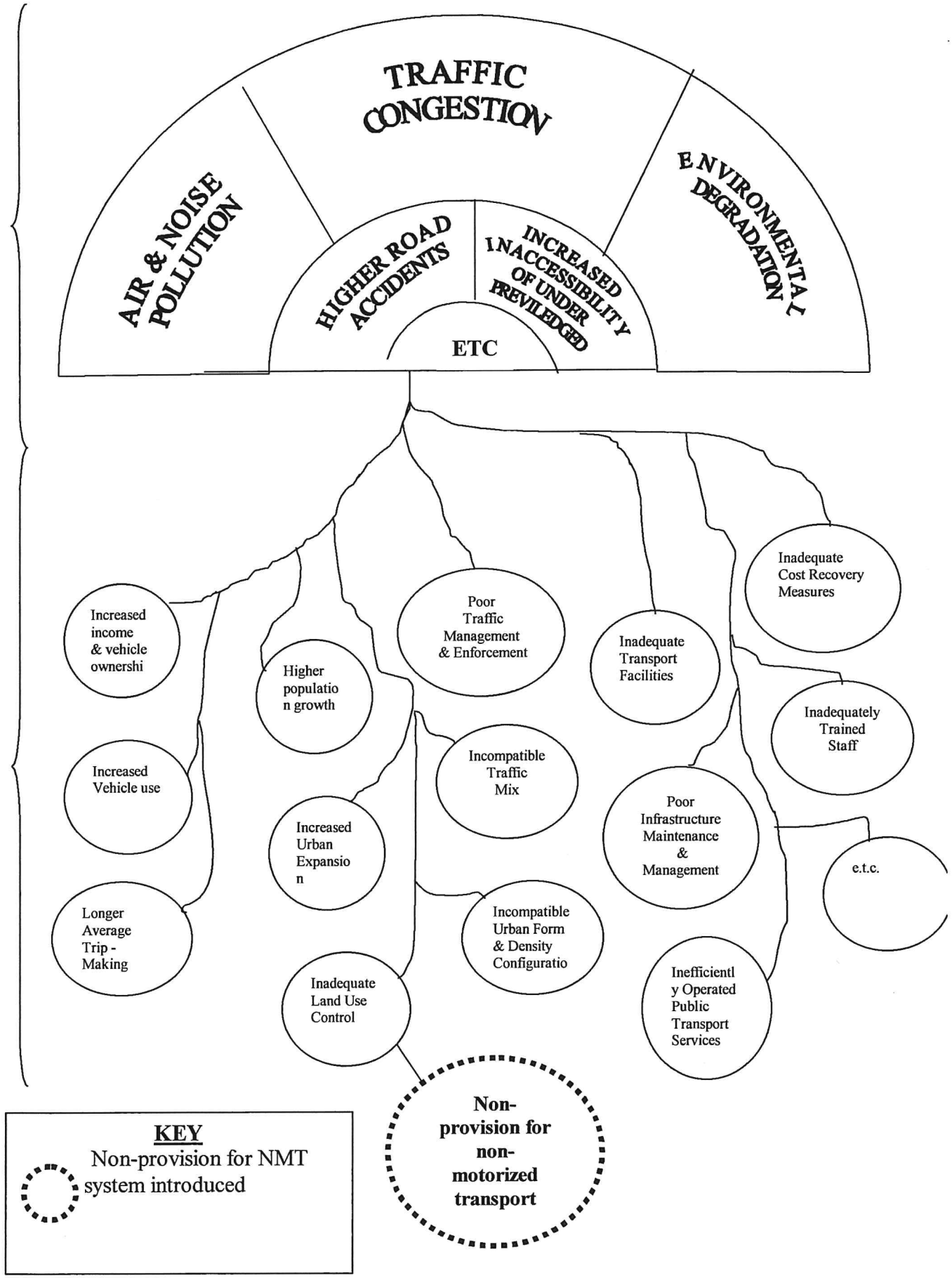


Figure 1.1. "Transport root cause Problems illustrated by the modified Dimitriou's (1992) Transport root problem model."

As much as the root course revolves around the mentioned issues, problems of planning response geared towards goal setting and formulation looks the only way out in addressing the manifested problems for African cities. The need for integration of NMT in the overall land use problem therefore could be a way forward towards a multi dimensional approach in addressing urban transport problems.

Together with (Dimitiriou's, 1990) analysis, (WB SSATP, 2001) established the following to be urban mobility conditions and problems facing major urban areas in Africa. The study however is based on Kenyan and Tanzanian cities. The conditions include: -

- Pedestrians dominating the use of the road reserves for trips on foot, for outdoor trading or social contacts, for just passing time, or in the case of children, playing;
- A large proportion of all urban trips is entirely on foot where in the biggest cities it goes up to 50% while in medium sized towns (Eldoret) to 60-70%;
- Most other trips use public transport for much of the distance, but also involve considerable walking. A modal share of the car above 10% was found to be an exception; although in most cities it is even lower. The modal share of cycling in the biggest cities happened to be lower while in the medium sized cities it was found to be higher;
- The number of old motor vehicles with technical faults, such as bad brakes, was found to be substantial and they also emit a lot of pollution;
- Drivers often show minimal respect for other road users, and the proportion of "tired" commercial vehicle drivers that make too many working hours per day, is high;

- Enforcement of traffic rules and regulations is minimal, and legal penalties and financial compensation obligations in case of an accident are sometimes easy to escape; and
- The average passenger throughout per meter of road cross-section per day is up to ten times higher than it is in Europe or north America, for example an Average Daily Traffic (ADT) of 120,000 persons on 2 X 1 lane collector road. The capacity utilization and the cost effectiveness of the urban road infrastructure for both NMT and MT was found to be high, the reasons being due to the high number of pedestrians, high proportion of high occupancy public transport vehicles, small road network length per head of population and a less pronounced rush hour due to a high proportion of jobs in the informal sector and a public transport supply that is not based on maximum peak demand which forces passengers to spread their travel over a longer period.

Concerning Africa's urban transport problems, the WB SSATP study established the following to be the most typical problems that affect the inhabitants of large cities in Africa. They include:-

- High and often unaffordable costs of urban travel; and as a result:
- Severely suppressed mobility and low economic and social participation of the urban poor;
- Expenditure of a far too high proportion of household income and available time on daily travel;
- Long travel distance. Due to fast city growth and insufficient economic development and services in the new, often unplanned parts of the city, trip distances have increased strongly during the last decades;

- Poor route infrastructure network, in particular of walking and cycling routes, and poor access in general, peripheral and low-income parts of the urban area;
- High number of traffic accidents; most of the victims are non-Motorised road users;
- Poor pavement quality. On pedestrian walkways there is often no pavement provision at all; and
- Outdoor insecurity, in particular, after dark.

Arising from the above analysis by Dimitiriou (1990), and WB SSATP (2001), urban transport mobility conditions and problems are typically the same across the entire African continent. More so, most of the above issues arise due to the question of integrating the various mobility needs in the overall land use patterns within the urban areas. The existence of the above problems however is not at all negative for policy makers. It creates big challenges and chances to do important problem solving things through careful comparison and assessment of mobility needs in relation to other land use activities in the urban areas.

1.4. Transportation in society

In spite of the numerous problems facing urban transport in third world cities, the role of transport in the society is still crucial in that it is the cornerstone of all present and anticipated developments not only for the productive and livable cities but for the sustainability of a society as well as depicted in the role of transportation in society. Transportation is such an integral part of almost all human activities that it is in principle impossible to differentiate completely between cause and effect. Rather,

advances in transportation have made possible changes in the way in which we live and how the societies are organized.

In the process of settlement making, transportation has been essential in providing the basic spatial framework within which a number of urban processes that involve the physical movement or reticulation of people, goods and services find spatial form. In the daily operation of a settlement system, it has been essential in enabling the convenient, efficient, affordable and safe movement of people, goods, and services so as to satisfy the needs of a variety of users and facilitate the effective operation of local space economies.

A further measure of the performance has been the degree to which the transportation network minimizes the demand for movement, and hence the degree to which ease of access is increased. A clear understanding of the benefits as well as negative attributes of transportation in the society could however be understood by considering the roles played by transportation in the society by examining its economic, social, political and environmental roles.

1.4.1. Economic Role of Transport

Economics is concerned with the production, distribution, and consumption of goods and services, which are of value to humans. The economic role of transport therefore arises when considering the place of production, time and quality of goods required by people. The desire to use the natural resources of the earth available to satisfy the necessities of life such as food, clothing, and shelter is what creates the need for transport.

The surface of the earth on which man lives is not uniformly endowed with natural resources and no location is sufficiently well endowed locally, to provide the standard of living found in most societies, by drawing only from local resources. Transport usually comes in to facilitate the extension of the range of sources of supply of goods to be consumed in an area and, to make it possible to use cheaper sources or sources of higher quality. For instance, the reduction in the transportation cost between two points, A and B, gives a place utility to the goods being produced at A.

Another element from the economic perspective of transport is the concept of time utility of goods. The demand for a good may occur during only a particular period of time and perhaps cease thereafter. A good example is the demand for Christmas trees. If the trees can be cut and transported to potential buyers before Christmas, then they can be sold. However, if they arrive after Christmas, their value becomes little or nothing. Transport as such helps in transporting goods so that their essential qualities are not diminished or lost. The economic role of transport can therefore be seen as making it possible to move goods from one place to another, the latter presumably being a place where the good is more useful or valuable. Place utility, time utility and quality utility are the key concepts (Edward, 1978). The role played by the respective modes of transport therefore is usually assessed economically based on the place value, time utility and quality.

1.4.2. Social Role of Transportation

It is often difficult to differentiate precisely between the economic and the social roles of transportation. However, much of the role of transportation and its effect on the manner in which we live is what creates the distinction between the economic and

social roles of transport. The social role therefore refers to the general organization of society, the style of life in the sense of the range of activities, both economic and non-economic that people engage in.

The increased speed of transport and the reduction in the costs of transport results in a much wider variety of spatial patterns. With the cheapness of transport, any desirable dispersion or concentration of population or of economic activities is facilitated.
The ease of travel within an urban area brings with it a number of social changes, one being the wide range of options given to the family in the choice of place of residence relative to the place(s) of work. The range given is extremely great and to a large extent has enabled many people to move from places fairly close to their places of employment to more distant places, which are desirable for other reasons.
The increase in accessibility, or ease of travel, due to mechanized transport however has had other, perhaps less obvious, negative effects. As much as it enables other patterns of activities to occur, it creates disparities in travel opportunities in that a certain level of income is able to use the new forms of transport while others are forced to rely on the traditional modes of transport due to their inability. For instance, automobile has become a symbol of wealth and status in society rivaling homes and other major possessions (Edward, 1978).

1.4.3. Political role of transportation

The world is divided into numerous political units, within which the manner of government and laws are more or less uniform. Such political units are formed for mutual protection from enemies, for economic advantages, for enhancement of a common culture. Politically therefore, transportation ensures proper functioning of

political units. For instance in urban areas, the wards, boroughs, CBD, regulative suburbs, can easily be linked to one another efficiently.

It therefore facilitates the governing of a larger area by a single government and tends to promote uniformity in the application of laws and justice.

It should be noted however that the broad array of transport systems presents a problem of choice for all societies; a choice which is likely to have a fundamental influence downstream on the economic and social structure of that society.

1.4.4. Environmental role of transportation

The environmental role of transport tends to be a negative one, especially as compared to the social, economic and political role. It is however this negative attribute of the environmental role of transport that makes this study significant in that NMT appears friendlier to the environment. There are numerous categories into which the environmental effects may be placed; a convenient categorization for purposes of this study consists of the following: pollution, consumption of energy, consumption of land and aesthetics, and safety.

In the pollution category, one of the unwanted by-products of most technologies of transportation is the pollution of the natural environment. The most serious form of this pollution, and the one most difficult to deal with, is the contamination of the air by various particles and gases. All forms of transport apart from NMT undoubtedly do pollute the environment to some extent but those forms, which employ internal combustion engines on the vehicles, seem to emit the greatest amount of pollutants, especially in areas of population concentration where the pollutants are actually injurious to health in some cases.

Another form of pollution, which is definitely annoying and may be harmful physically and psychologically, is noise. This is an unwanted product of almost all movement. The various negative attributes associated to transport however have engendered the desire to evolve a more transport friendly mode of transport in that not all modes of transport are injurious to the environment i.e. Non Motorised Transport.

1.4.5. Summary

In summary therefore, transport has quite a number of roles to play, which revolve around the social, political, environmental, and economical although each role is a function of the various modes of transport deployed. Effective performance of each role however is a function of how each has been integrated in the overall development structure of the respective urban system (Mulongo, 2001).

The nature and scale of transport problems facing African cities vary with the size of urban area, reflecting the balance between the use of private and public transport infrastructure available. Past experience also reveal that the major challenges facing the transport sector are those attributed to the application of inappropriate transport policy, planning and design measures that originally evolved from industrialized countries that are contextless in third world countries, particularly African countries (Asfaw, 2001).

One major contributory factor is the tendency for increasing distances to be established between homes and the principal destination of daily trips, resulting in a higher level of personal trip-making and lengthier journeys which has in turn imposed greater demands upon road and public transport systems that are already nearing or surpassing their capacity (Hanson, 1986).

Arising from the above analysis, the present state of transport system in our urban centres in Africa can be summarized as Unattractive, Unsafe, Uncomfortable, Incoherent, Not direct and; Long travel distance. Given the current haphazard mixed land use patterns of development, the situation can accelerate if proper attention is not paid to planning of transportation.

1.5. Statement of the problem

Transportation is an integral part of the functioning of any society. It exhibits a very close relationship to the style of life, the range and location of productive and leisure activities, and the goods and services, which will be available for consumption. The benefits and many of the negative effects of increased transport in whichever form however, can only be understood by considering how its needs can be addressed in the overall urban growth.

The rapid urbanization occurring across much of the globe has meant not only more people than ever before will be living and working in cities but that more people and goods will be making more trips in urban areas, often over longer distances. While many urban centres all over the world, have responded to the ever-increasing travel demands by expanding the transportation supply through building of more roads to accommodate an ever-growing number of vehicles, the problems facing urban transportation especially in developing countries are more than the piecemeal provision of infrastructures due to ineffective planning and engineering that was based on the western paradigm.

For instance, in most of the African cities, there has been a tendency by the planning departments to concentrate on land use planning, housing and plot allocation while paying little attention to transport problems and more so the Non Motorised Transport system. Similarly, engineering departments have also tended to concentrate on road construction and maintenance with attention for road network planning and the effects of mobility on land use and city growth with little attention on how to integrate the various transport systems in the overall planning of the upcoming cities. Due to lack of effective planning and engineering, the situation on the ground has only but remained unmanageable with problems handled in a crisis manner (Opiyo, 2001). Although the relationship between the location of activities and transport system has been extensively discussed in the literature for many years, due to perhaps the historical development of theories related to the use of space and those of transport and given the fact that both evolved in relative isolation, integration of the various transport systems in relation to the overall urban structure still remains an elusive area to many transport researchers, especially as it concerns cities in third world areas (Human Settlement Planning and Design, 1997) .

Today, there is little attention paid in current land use planning to Perry's (1929) and Stein's (1942) concepts of neighbourhood developments with shops, library, doctor among others in easy walking and cycle distance. Perry (1929) advocated that developments should be based on a neighbourhood unit where facilities would be located within a quarter of a mile of the furthest dwelling (Perry, 1929). Stein on the other hand, built his assumption on the works of Perry and advocated for a situation where amenities were placed in easy walking or cycling distance of homes with a degree of NMT vehicular segregation.

Failure to conceptualize the fact that transport needs cannot be articulated in isolation of the other land use activities and urban morphology is therefore what has prompted the current disparities facing the integration of the various transport systems in the land use patterns in most of our medium sized towns today. The current congestion being experienced in major CBD and other appendages in urban areas; have been to a large extent due to improper articulation of transport systems in the overall land use development. The greatest transportation challenges therefore facing cities today revolve around the harmonization of the needs of transport on the one hand and those of the entire overall urban structure. Through this, an effective and efficient system that is environmentally friendly, economically viable and socially acceptable to its users can be evolved.

This study therefore has examined how the urban transport sector using Non Motorised transport (NMT) component can be integrated in the overall urban land use patterns and structure in the development and planning of medium sized urban centres. Centres with a population of about 200.000 people. Integration helps in striking a balance between the available spaces in relation to the various land uses. As much as NMT plays a key role in the overall transport sector in our urban areas, its needs are still far from being articulated by urban transport planners. This has led to the current problems, majority of which revolve around lack of institutional framework, space, long detours, insecure routes, congestion, impassable routes and encroachment on the routes by the informal sector, thus hindering mobility.

1.6. Research questions

The study has addressed the following key questions: -

1. To what extent has the town's land use and structure contributed to the prevailing transport system in the urban areas?
2. Are there any conflicts between MT and NMT modes of transport in the urban areas?
3. What are the environmental implications of the present transport system as determined by the existing land use and structure of the town?
4. Does NMT have a role in urban areas?
5. What is the overall transport system for medium sized towns in developing countries.

1.7. Objectives of study

The main objective of the study therefore was to evolve an integrated model in the planning and development of Non Motorised Transport system in medium sized towns while specific objectives were as follows:-

1. To examine the current land use and transport system in Eldoret.
2. To establish the significance of NMT and the extent to which it has been catered for in the town.
3. To assess the existing conflicts between NMT and MT modes in medium sized towns.
4. To develop an integrated urban system that incorporates urban mobility, (that facilitates pedestrialization and pedelization), land use and environment.

1.8. Study Hypothesis

1. There is no linkage between the current land use pattern and transport system in Eldoret.
2. There exist no conflicts between NMT and MT modes of transport in Eldoret.
3. NMT has no role to play in the overall development in the development of urban areas.

1.9. Study Area

The study was conducted in Eldoret town. The town is an administrative capital of Uasin Gishu District in the Rift Valley Province of Kenya. It is located about 300 Km north west of Nairobi and along the International Highway (A104) to Uganda, Burundi, Rwanda and the Democratic Republic of Congo and Sudan. It is about 65 km to the north of the equator.

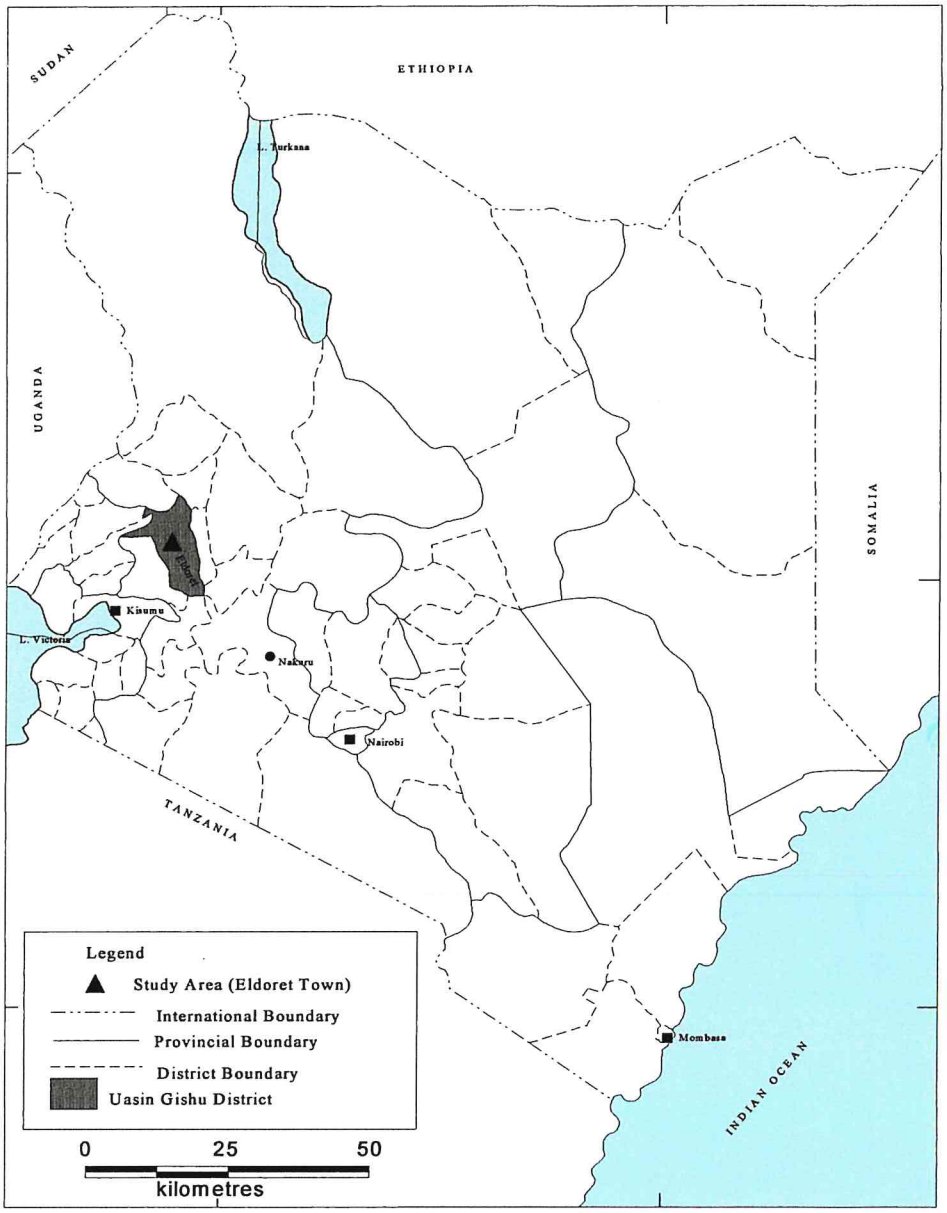


Fig: 1.2. Study area

1.10. Justification of the study

Investment in infrastructure is crucial to the efficiency and habitability of our urban areas. World Bank research conducted in South Africa in 1995 indicates that investment in infrastructure has a significant impact on GDP growth, as infrastructure raises general levels of welfare and health. For sustainable progress, as well as for the general health and well being of the population, urban settlements should be coherently planned, with ample space provided for incremental approaches to provide sustainable and affordable levels while ensuring acceptable and adequate functionality.

This study therefore is justified in that the findings shall not merely assist professionals in producing efficiently serviced "townships'', but rather create sustainable and vibrant human settlements where people are able to work, live and play using alternative modes of transport that are environmentally friendly.

Planning is two fold in that it can be human centred or nature centred. Human centred planning tends to ensure that the developmental needs and activities of people living in settlements be urban or rural are catered for and, in particular, that opportunities for people to achieve their full potential through their own efforts are maximised. The approach therefore is people driven and democratic. The nature centred approach to planning recognizes that natural systems interact in highly synergistic ways, which must be respected if breakdowns in them are to be prevented. The approach emphasises design with nature, thereby creating synergy between man-made and ecological systems (Baynham, et al, 1986, Mc Harg, 1975).

The fulfillment of both human centred and nature centred approaches can only be realised through a well-integrated approach where all systems of land use are brought on board to facilitate co existence. A well-integrated framework makes it possible to identify performance qualities, which can guide planning and against which plans and settlements can be monitored and measured. The focus on NMT mode is well conceived in that its integration in the overall urban development facilitates access to the economic, social, cultural and recreational benefits, which result from the agglomeration of people.

Most of the studies have often been based on the implicit preconception that they could "solve" urban movement problems: the aim of politician, technocrat and laymen alike, being to rid their city of traffic congestion. NMT users (Cyclists and pedestrians) have a hard time in most urban areas. This has been partly because of so little is done for them. It is also because so much is done against them. The land use and traffic planning which is concerned with provision for vehicles and access for car owners for instance, is not just ignoring pedestrians and cyclists in a neutral way; but also creates barriers of distance and physical layout which make it much more difficult for any form of NMT mobility in the urban setup.

To a large extent, all this has come as a result of planning policies, which have failed to take account of their impact on pedestrians and cyclists as well as with policies, which are designed to make specific provision for them. Transferring of urban transport planning technology from the industrialized countries to the third world is suspect on three counts: in terms of relevance, conceptual validity and empirical evidence.

The much-needed focus on non-motorized movement in third world was initially brought about by the global energy crisis of 1973, and the subsequent interest shown in energy saving transport modes by the World Bank. The subsequent researches that followed confirmed further the need for transport planners to identify and plan for alternative modes of public transport, which are more consistent with prevailing economic, and development constraints.

Early studies apart from recognizing the role and intensity of non motorized travel, have failed to evolve any meaningful planning guidance for the promotion of the interests of non motorized travel, a failure which has been attributed to an incomplete understanding of the relationship between movement (and its various transport technologies) and its social, economic, and cultural context.

This study was tailored towards the fulfillment of minimization of transport conflicts, reduction of air pollution and noise pollution emanating from MT and improvement of circulation of both MT and NMT users in our cities, which is in harmony with the present situation requirement. In this era of sustainable development, we cannot talk of an environmentally friendly urban transport without emphasizing NMT. The significance of the study therefore lies in the fact that its outcome could assist in addressing challenges facing urban transport professionals in developing a more reliable (efficient) and affordable (cost effective) urban transport under satisfactory conditions of safety.

The question of how to reduce the total cost of urban transport and at the same time increase the number of trips that an average person can make is what remains to be

fulfilled in African urban centres. The study also helps in generating policies that enhance both pedestrialization and pedalization of mobility in our urban areas. Finally, the study has focused on a mode of transport which is not only consistent with the current prevailing economic and development situation but is also environmentally friendly to most of our medium sized towns which are already polluted from the various agro-based industries and motor transport.

1.11. Scope of the study

Studies focusing on the Non Motorised Transport system in most of our major cities and towns in Africa have not been fully comprehensive especially in evolving possible means for integrating the system in the overall planning and development of the towns. Where attempts have been made, the confinement has always been on the negative attributes associated with the NMT system as such giving the impression that NMT is not viable in the overall planning and development of our urban areas. The scope of this study was therefore guided by those attributes that could facilitate the process of NMT integration.

As a component of transport system, NMT consists of a number of modes ranging from, handcart pullers/pushers, ox/donkey driven carts, walking and cycling but depending on the physical and structure together with the economic set up of a given region. Due to limited resources and complexity of the system, the study confined itself mainly to the cycling and walking component. This to a large extent was attributed to the magnitude of conflicts generated between the two modes and the MT component especially while sharing the available space.

1.12. Contribution of the study

The contribution of this study lies in the fact that it provides an insight into urban and transport planners on how to create a balance between transport systems and land use activities on the one hand, and NMT traffic and MT traffic on the other. It has often been difficult to realize a balanced provision of traffic infrastructure for both MT traffic and NMT traffic since many people automatically think of traffic as MT traffic and never realize that NMT traffic is there just as well, and that in most African cities NMT trips outnumber MT trips. The study therefore emphasizes the fact that a balanced provision of infrastructure starts with a balanced perception of what urban traffic is something that has remained elusive to most transport planners.

The study also articulates the best way possible on how transportation needs can be conceptualized in the large scope of land use planning and development as such generating ample literature/knowledge on how the various modes of transport can be catered for in a medium sized town.

The study findings comes at a time when Kenya is revitalizing the transport sector and some of the measures already undertaken are conducive for Non Motorised transport system in our towns and cities. The articulation of the suggested findings and recommendations therefore could make NMT to compete effectively not only with other modes of transport but other land use activities in general. For instance, the introduction of speed governors in the Public transport sector shall go along side in promoting the growth of NMT for most of the conflicts that arise due to over speeding of Matatus and Buses can is easily contained.

CHAPTER 2: LITERATURE REVIEW

2.1. Overview

Theory refers to a system of thought, which through logical constructs supplies an explanation of a process, behaviour, or other phenomenon of interest as it exists in reality. It could also mean verbal formulation while model refers to a mathematical representation. Theories also provide the descriptive and the explanatory basis for taking a normative view the "what ought to be'', which is the focus of decision-makers in utilizing land use planning and management processes (Creighton, 1970).

The strategic role that theory plays in man's quest for knowledge and understanding is so basic and its fundamental importance so well demonstrated in other disciplines that it seems unnecessary to stress its importance for the planning field. Given the importance of theory, to the development of a discipline and the dramatic breakthroughs in several fields achieved in recent times, it is curious to find theoretical research being neglected, yet this is a reality of the present situation.

Successful attempts to develop theories and models that are in harmony with our infrastructural demands especially in third world countries is far from reality. In the absence of a clear framework, most surveys, which have been made as part of urban transportation studies for instance, have only but portrayed the city with a much finer level of detail than has been possible. This scenario has meant viewing certain urban phenomena in as a continua made up of many small particles a conception which suggests the need to adopt planning methods which are different from those based either on emotional statements or on conventional reasoning (Creighton, 1970).

This chapter therefore gives a theoretical review of the key factors instrumental in the transportation planning in our medium sized towns. The review seeks to develop a successful process that can help in the integration of the various forms or systems of transport in the overall development and planning of medium towns. Contrary to the previous process where long range transportation plans for cities have been merely a reflection of travel and transportation facilities, the theoretical assessment developed for this study emphasise integration as based on the towns structure or morphology, land use system and pattern and the general growth of the cities.

This study therefore strongly assumes that an analysis of the above aspects is what will determine the nature of travel patterns, transport facilities and the general trend of the town's growth. All the three components are interrelated and the articulation or the total absence of conceptualization of any of them is what has led to the prevailing problems being faced ranging from increased accidents; pollution; congestion; inaccessibility; ugliness; strain and discomfort; noise and nuisance.

Guided by the fundamental aspects in successful integration process, the study as pinpointed in this chapter, has reviewed theories both from descriptive and explanatory perspective in order to ascertain how land use planning can be integrated to accommodate all the essential activities so as to increase the levels of accessibility at an affordable cost. The descriptive theory emphasizes "what is'' while explanatory extends "what is'' to "why''. Both the descriptive and explanatory provides a basis for taking a normative view the "what ought to be''.

Integration of transport systems into spatial organization of land use planning and development takes various forms and the degree to which some of the measures are achieved could be essential to people. Full integration however, implies first and foremost that the key modes of transport are provided so as to enable the users to gain access to their relevant mode with affordable or no cost at all (Urban Edge, 1990).

For the case of public transport for instance, there may be need to provide feeder bus lines to enable riders who do not live within walking distance to gain access to the other modes of transport. It could also imply developing single fares that allow passengers to transfer from one mode of transport to another without having to incur some extra cost. Finally, it could lead to developing routes parallel to one another so as to minimize conflicts and congestion by the use of the available systems.

Despite the advantages gained through integration of transport systems, full integration is rarely attained due to either poor conceptualization of land use parameters or clear picture on the actual urban structure that exist for each town. Lack of knowledge of the historical development of how urban centres have evolved over time has been another limitation. Since most of our urban centres have been based either descriptive or explanatory approach of spatial land use planning, it becomes therefore significant to review the various theories that exist either on land use or transport planning in order to enhance a smooth process of integration.

The review of the respective theories also gives an overview of how transport relate, to other economic activities, given the fact that demand for a given land use pattern will always be a function of the cost of transport to be incurred. The current stalemate

facing the transport system is therefore an attribute of the early theories and models of land use, which only considered land value in terms of rent values.

Accessibility or transport was considered in an ambiguous way and basically as exogenous. Even in the work of Wingo (1961), which could be considered to have pioneered the field because it developed both transport and land use to considerable extent, the two remained in separate compartments, and the transport variables that go into the land use model are therefore restricted to the concept of distance to the centre.

Majority of these models revolved around micro economic, spatial interaction, transport planning models and urban travel theory. This section therefore will analyse critically what each entails with a view of evolving appropriate strategies that can assist in integrating NMT in the overall urban land use structure.

2.2. Non Motorized Transport System in Africa

The concept Non-Motorised Transport (NMT) as a mode of transport seems to have emerged spontaneously in the past decade in response to a multiplicity of concerns- environmental, poverty, energy, economic and the axiomatic failure of car- dominated transport. Its first use appears to have been at a UN Economic and Social Commission for Asia and the Pacific Workshop in Bangkok in 1983 on the " Improvement potential of Non-Motorised Transport''. The next use was in 1984 at the UK Cranfield Institute of Technology by H.Gowen in his paper titled " Non-Motorised Transport in Developing Countries''. In 1988, it was used by Setty Pendakur at a special group meeting of TRB, "Non-Motorised transport in India.''

Subsequently, the World Conference on Transport Research took it up at the 1989 meeting in Yokohama.

In Africa however, due to the prevailing economic situation, the concept of NMT is well entrenched to an extent that it is regarded simply as a label to be stuck with. Walking and cycling for instance, have become major ingredient of the urban transport in most cities as well as rural areas owing to the fact that large majority of cities have low per capita income (Chacha, 1996).

Non Motorised Transport (NMT) system encompasses the use of cycling, walking, handcart pushers and all other modes of transport that are non-motor propelled. With the absence of horse chariots, electric trams and motorbuses, walking and cycling are the dominant mode of transport in towns and cities of Africa. Like in other third world countries, they account for 35% of all journeys in African cities. In general, Non Motorised transport assumes the greatest importance as a means of personal mobility and a large proportion of all journeys rely on NMT. Like the case of India, the lower income group depends upon walking for almost 60% of all journeys and in most cases covering a distance of 10 km (Rao et al, 1990).

In the context of today's increasingly global and westernized urban landscapes, we need to be realistic however that there are obvious limitations; that make NMT an in effective alternative to cars and public transport. For instance, the use of NMT is only convenient within a range of 2 to 3km, there after its usage decreases as soon as motorbikes or cars become economically feasible as evidenced in China, India and Indonesia (World Resources, 1995 and World resources 1996).

The second difficulty with NMT is that it tends to focus on the supply, or transport system, side of the means of improvement rather than fundamental travel demands per se. It thereby perpetuates one of the worst aspects of 'road-motor car domination', which to a great degree has characterized past transport developments and present problems. At this point therefore, emphasizing the means of transport detracts attention from the real objective. As such, the central issue is what degree of mobility and access do people really need to fulfill their lives.

Other studies have indicated that walking, which is a component of NMT, accounts for around 75 per cent of all journeys of less than one mile despite the obstacles and deterrents (Hillman & Whalley, 1979). It has also been established that the range of facilities and important destinations that are within a specified radius is clearly an important determinant of the proportion of journeys that have to be made on foot as opposed to car or public transport for those who have a choice.

The above analysis therefore implies that planning land use in such away that more facilities are either in a walking or cycling distance of where people live has a double pay-off, and trends which reduce the number of places people can conveniently walk or cycle to, carry a double penalty.

Non Motorised Transport system, inspite of the role it plays as a mode of transport, has continued to receive minimum attention either in the allocation of financial resources or space as compared to Motorised Transport. This is true in countries like Kenya but not in industrialized ones. It is less glamorous and less prestigious than building roads or bridges even though it is relatively cheap and does not account for

much in a world where men are often judged by the size of their budgets (Sylvia et al, 1990).

Problems facing Non Motorised transport in the world have to a large extent been attributed to the fact that little is done for them or so much is done against them. The land use and traffic planning which is concerned with provision for vehicles and access for car owners does not just ignore the system in a neutral way; but it often creates barriers of distance and physical layout that make it much more difficult to either cycle or walk about (Sylvia Trench, 1990). In Brazil's Sao Paulo, when plans to construct 300Km of bike paths and lanes were announced, even though it was to run concurrently with the massive road construction, the engineers admitted that if it were possible, they would have taken part of the sidewalk space for Motorised traffic as well (Ricardo Neves, 1995).

In situations where all modes of transport systems are well integrated in the overall urban development, the above perception can be minimized thus paving way for balanced development for all systems. A sustainable city therefore could be conceptualized as one that embraces both pedal power and pedestrialisation. This therefore raises an important question for this study as to how cities can move from the present situation to an urban transportation vision that includes Non-Motorised vehicles without developing programs that can curtail car use and promote an integrated and environmentally viable urban transportation system with a clearly defined place for non-Motorised vehicles.

Although in the automobile age, non Motorised transportation is often given short shrift, if properly promoted and encouraged, NMT vehicles can provide access to shopping, schools, and workplace. For cities plagued by serious traffic congestion and air pollution, Non Motorised transport can be an important alternative to relying on private vehicles and could serve as a link in an integrated public transportation system.

2.3. Descriptive concepts of spatial organization

Among the earliest descriptive frameworks, there are three classic concepts: one known as the concentric-zone concept, a second referred to as the sector concept while the third being the Multi-nuclei concept. Among the three, the first and last deals with the entire pattern of use areas, whereas sector system was developed primarily to explain the structure of residential areas. Sector and zonal theories are used to describe changes in the basic arrangements of land use patterns.

2.3.1. Concentric-Zone Concept

Early land economists frequently used the Burgess (1925) conventionalized diagram to explain the composite effect of market forces upon land use arrangements as shown in Fig **2.1.** Burgess's concept was developed in the early 1920s to explain ecological processes in the city; which he visualised as a series of five concentric zones. At the core is the "loop'' or Central Business District (CBD) with its shopping areas, its theater districts, its hotels, its office buildings, its banking houses and the other businesses which seek a central location. In small communities these business functions intermingle; in large cities they form more or less distinct sub districts (Burgess 1925 and Burgess, 1929).

Adjoining the "loop" and fanning out into the next zone although still in the first zone are the city's commercial areas. Here the market districts and the older wholesale districts and warehouse areas are located.

As shown in **Fig 2.1**, the second zone, which he referred to as the zone of transition, comes after the Loop. It is a zone identified by the variety and changing character of its uses. The residential areas begin here. In one portion of the zone, an island-like cluster of first citizen homes persisting behind brick walls and iron fences may exist, clinging tenaciously to the respectability that once marked the entire area.

In some sections of large cities, such structures may have been supplanted by high-rise apartment houses while in others the old structures may still be standing, but with antique signs signifying new uses. In most cases, other sections of the zone particularly those adjoining the industrial wedges, contain the residential slum areas. This zone blends into a third zone consisting largely of blue-collar homes-homes of factory workers, labourers and so on. The fourth zone contains the large residential areas of the city. This is the area where the white-collar workers and middle-class families are found.

The fifth zone, of which he referred to as the commuter's zone, consists of the suburban communities found along the arteries of transportation. This zone also houses the middle-class and upper-income groups. As a theoretical description of the relative positions of the major functional areas of land use in the city and how they change over the years, the elemental simplicity of this approach has had considerable appeal. In his theory, Burgess observes that as growth occurs, each inner zone of the generalized diagram tends to invade the next outer zone, following what the human ecologists refer to as a sequence of invasion-succession.

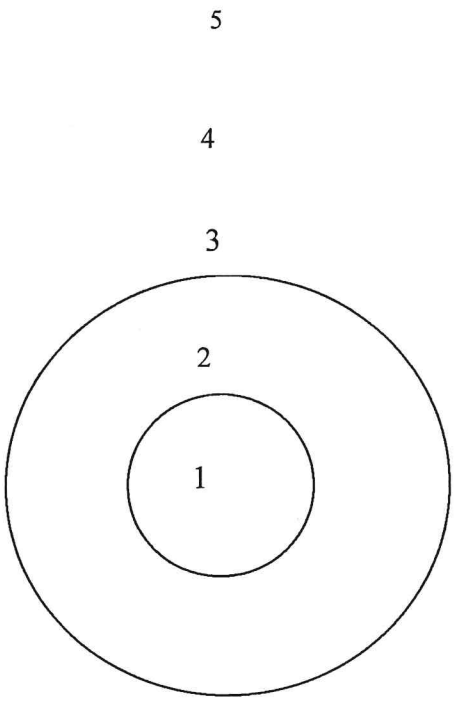


Figure 2.1: Concentric Zone Concept as sourced from Chapin and Kaiser (1979)

KEY

1. Central Business District
2. Zone Of Transition
3. Zone Of Workingmen's Homes
4. Zone Of Better Residences
5. Commuters Zone

When the concentric theory was advanced, the rate of progression of the rippling tendency depended on economic expansion in the city and the rate of population growth; but in more recent times, it may well depend on the rate of decentralization of middle income group in response to neighbourhood deterioration and in the USA the inflow of blacks in the city centre and the existence of new housing and employment alternatives in the suburbs.

The works of Burgess are quite instrumental to this study in a number of ways. For instance, when urban areas decrease in population, the outer zones tend to remain stationary while the inner fringe of the transitional zone tends to recede into the commercial district. When these changes happen, the levels of mobility together with the respective modes change accordingly. It is at this level that many trips are concentrated within the CBD and either through cycling or pedestrialization thereby creating the need for a well-planned and integrated system.

Another aspect with the theory is that the moment activities tend to be located depending on the level of magnitude and affordability, there will be a tendency for the low income earners to be located closer to their work places so as to avoid the transportation cost. Since many people tend to rely on NMT to make the short distances, this therefore calls for a well-integrated NMT that enhances appropriateness of the facilities.

Most of our Urban areas have been planned based on the concentric theory where concentration of activities has tended to be confined at one particular point, i.e. CBD or industrial area. In terms of mobility, these areas have ended up as the major points

of confusion if not black spots. This therefore calls for proper planning so as to minimize conflicts between the various land uses.

Finally the work of Burgess can assist policy makers in formulating concentric transport systems that are in harmony with the needs of the people and other landuse activities.

2.3.2. Sector Concept

Work relating to the sector approach provides theoretical descriptions of land use patterns, which take into account the irregularities that tend to develop in use patterns. Hoyt (1939) propagated this theory ten years after Burgess's work in connection with a study of residential areas in the United States. The theory provides some new insights into the patterning of landuses that leads to a theoretical explanation of residential land uses in terms of wedge-shaped sectors radial to the city's centre and along established lines of transportation as shown in **Fig. 2.2**.

Viewed in the context of change, the theory holds that similar types of uses originating near the centre of the city tend to migrate within the same sector and away from the centre. This concept holds that different income classes of a city tend to be found in distinct describable in terms of sectors of a circle centred on the central business district. The high rent or high price residential areas can be identified in particular sectors, and there is a gradation of rentals downwards from the high rental areas in all directions. High rent areas are conceived as having a dominant influence on the direction of residential area growth and as exhibiting various growth characteristics.

The sector theory provides a more detailed explanation of residential patterns of land use than that set forth in the concentric-zone formulation, particularly in the more discriminating way in which it deals with the dynamics of growth processes. Criticisms of Hoyt's work and reformulations growing out of it clearly indicate the profound effect the sector theory has had in stimulating awareness of the need for a theory of urban landuse. With the many social and economic changes in central cities that have occurred since publication of Hoyt's study this need is stronger than ever today.

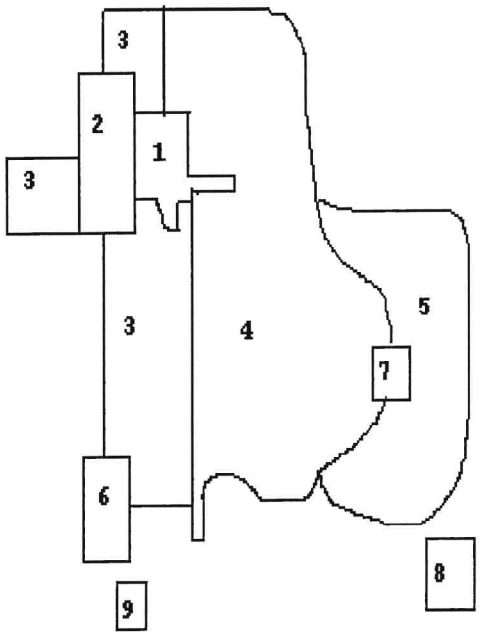


Fig. 2.2: Sector Concept sourced from Hoyt, H (1939)

Key

1. Central Business District
2. Wholesale And Light Manufacturing
3. Low Class Residential
4. Middle- Class Residential
5. High-Class Residential
6. Heavy Manufacturing
7. Outlying Business District
8. Residential Suburb
9. Industrial Suburb

2.3.3. Multiple Nuclei Concept

The Multiple Nuclei Concept (Fig 2.3) was first suggested by Mckenzie (1933), and the hypothesis is built around the observation that frequently there are series of nuclei in the patterning of the urban land uses rather than the single central core postulated by the other two theories. In expanding on this concept in their essays on the nature of cities, Harris and Ullman (1945) and Ullman (1962) observed that cities are sometimes distinct centres in the original metropolitan area that persists as centres as growth fills in the areas between them and sometimes emerge as new centres as urbanization proceeds.

As noted by Harris and Ullman, the number of nuclei and the function of each vary from one metropolitan area to another with the CBD serving as one nucleus. The others may appear in the form of industrial or wholesaling centres where specialized economic activities of similar or complementing character have gravitated. Others emerge in the guise of major outlying retail centres or university centres. Finally, the suburban centre and the more distant satellite community for commuters are mentioned as nuclei to be recognized in the conception of the urban land use configuration.

There are four factors observed from the works of Ullman and Harris that tend to account for the emergence of separate nuclei in urban land use patterns. One is the interdependence of certain types of activities and their need for close physical proximity. A second is a natural clustering tendency among certain types of activities that find it mutually profitable to locate together, as evidenced in retail centres, medical centres, and outlying office building centres.

A third is the converse of the last- the appearance of centres to accommodate activities that may have no particular affinity for one another, but are inimical to other uses by virtue of the traffic they generate, the extensive railroad or truck-loading facilities they require.

Finally, there is the related factor of high rents or high land costs, which have the effect of attracting, or repelling users in the process of nucleation.

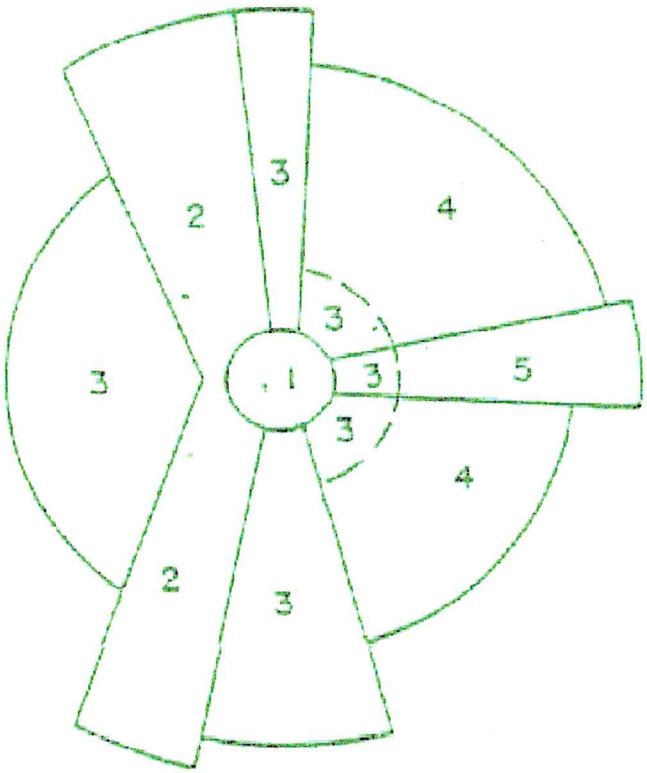


Fig. 2.3. MULTIPLE-NUCLEI CONCEPT
Source: Chapin & Kaizer (1979

Key:

1. Central Business District
2. Wholesale And Light Manufacturing
3. Low Class Residential
4. Middle- Class Residential
5. High-Class Residential

2.3.4. Applicable theory for the study

For this study, as a hypothesis, the multiple-nuclei concept appears to recognize many of the realities of contemporary metropolitan area land use patterns. However, it needs study, elaboration, and probably modification based on empirical investigations of the kind undertaken by Hoyt before it can become an operationally useful framework for describing urban land use.

There is also need for clear differentiation between factors explaining the structure and dynamics of change. For instance, some nuclei recognized in the concept are explained primarily in terms of natural market forces, others in terms of overcoming the friction of space made possible by the automobile, the development of electric power, and other technological advances; and still others in terms of community values and legalistic controls such as zoning.

All in all and for the sake of this study, the theoretical explanations that provide the patterning of landuses serve as a useful purpose in helping describe the effects of the economic forces, which are fundamental in shaping the respective patterns. In contrast to descriptive frameworks which lay more emphases on taxonomy and classification, explanatory theories, a part from being concerned with defining particular process, behaviour or other phenomenon as it exists in reality, also answers questions as to why such phenomenon come to evolve over time, space and structure.

In terms of spatial land use organization, knowledge of the structure and functioning of the urban economy is fundamental to all land use planning analyses for the destiny

of an urban centre is controlled by the extent and character of its productive and income producing activity and its general vitality.

The just concluded review on the respective theories creates an understanding on how cities have developed. For instance, most urban areas flourish because they serve as centres for the production and distribution of goods and services, production and distribution functions create jobs, and employment opportunities that attract people. An expanding urban economy with the implications it has for new business and industries and population growth means more land going into use thus the relevance of NMT integration as part of enhancing accessibility to the various land use systems.

2.4. The integrated land use and transport model

The relationship between the location of activities and the transportation system has been discussed extensively in the literature for many years, but it is only recently that it has been established more formally. This has been due perhaps to the historical development of theories related to the use of space and those related to the use of transport, and to the fact that both have evolved in relative isolation (Barra, 1989).

There are a number of theories, which have been advanced, that can assist in integrating Non Motorised transport systems in the overall urban transport especially in the urban land use structure. It should be noted, however, that depending on how they were evolved, they tend to focus on the general transport planning but not at the specific component forming the overall transport network. Their usefulness however lies on how each can be simulated with one another to provide a well-integrated

transport system that is in harmony with the prevailing urban structure and land use pattern.

2.4.1. Micro-economic theories of land use theories

In explaining the spatial distribution of activities, these theories take as their central concern two related questions: the rationale that regulates the location of activities and how land rent or land values emerge from the process. The respective theories developed under micro-economic approach start by adopting the conceptual framework of classical and neo-classical economics.

They regard the location of activities as an outcome of a combined market mechanism involving three basic elements: commodities, land and transport, with each playing a significant role. For instance land is required to perform productive operations or for the satisfaction of residential needs. Transport on the other hand is required in order to move surplus production or labour. A good example is that a farmer may want to sell his surplus in the market place while a resident of a city may want to sell his labour where there is a demand for it. Transportation here is crucial for it facilitates the process of exchange either of commodities to market or of residents to their place of work.

The theories considered land to be a large featureless plain and infinitely available so that in principle, there would be no need to pay for it. What gives land a differential quality is the cost of travel or accessibility, which is the main factor in the generation of land values.

Another attribute to the theories is that they look at the process of activity, location and rent from the point of view of the individual resident or firm. Activities will compete for the consumption of land and once equilibrium has been reached, they will have chosen a site of a particular size such that the cost of land and transport they have to pay optimizes their utility. Competition will always determine the price of land in each location and the price of commodities at the market place.

The element of equilibrium, satisfaction and value of land and rent can only be achieved based on a more sustainable mode of transport. In addressing the question of equity (equilibrium), there is need to model a transport system that is in harmony with all the required attributes in the urban land use system. Transport again can only be meaningful if it looks at the various land use patterns and structure. Elimination of distance and cost is a factor of the type of transport, even though space could play a role.

The proponents of the micro economic theories of land use were Von Thunen (1826), Christaller (1933), Losch (1940), Wingo (1961) and Alonso (1964). Most of their attributes however had many features in common and revolved around land use as the result of a market mechanism in which individual household and firms competed for space thus generating an equilibrium pattern of land rent. Each of the above theorists emphasizes the role of transport in spatial land use distribution.

The model of Von Thunen, in spite of the fact that it was developed so many years ago, remains the most general proposition, because it equilibrates not only a land market, but a market of commodities as well. It extends to include demand elasticities

of land and commodities, which results in a model which is more general, and that contains all the variables required to give a broad and simplified explanation of how a spatial and economic system works. His works explained the way in which transport costs affect agricultural producers and consumers, the consequences for the process of land allocation and rent and the price of agricultural commodities. He made the first attempt of explaining the effect of transport costs on the location of activities and the functioning of the land market using an idealised agricultural region at the centre with a single market place where a large number of producers prefer to sell their products. His application of the model to the urban case followed a natural path.

Wingo (1961) and Alonso (1964) in their models updated Von Thunen's proposition by incorporating many elements from modern micro economic analysis with the only element added to the extended version being the budget constraint. Wingo (1961) proposed the principle of complementarity's between the cost of transport and land rent implying that whatever the location of a household, a fixed amount of money will be spent on land and transport. In the urban case, the introduction of a land consumption function becomes obligatory, because residential activities have elasticity too high to be ignored.

Wingo's (1961) work provides a systematic and rigorous statement of urban spatial structure in the framework of equilibrium theory. Focusing his attention to residential development, he first developed a concept of transportation demand, considering the spatial relationship between home and work and with the journey to work viewed as the technological link between the labour force and the production processes.

He conceptualised demand for movement, as being a function of the total employment of an urban area multiplied by the frequencies of work trips, the number of trips required to support the production process. He recognized the tendency of urban society to substitute communication for transportation and stressed the necessity of taking technological development into account for this reason.

Just like the case of Von Thunen, Wingo presents a number of simplifying assumptions where he talks of an idealised urban area having only one centre of employment where all residents' work and all of them have the same income and preferences.

The framework Wingo proposes functions under the usual behavioral axiom at those who control residential space and households who seek space each behave to maximize their returns. He specifies these factors as given: the creations of employment centres, a particular transportation technology, a set of urban households, and the marginal value households place on residential space. Wingo uses his model to determine the spatial distribution, value, and extent of land required for residential use. By introducing transportation into his formulation as an explicit part of the explanatory framework, Wingo provides a ready means of operationalizing classical land rent theory.

In Alonso's model, an individual's household equilibrium is achieved by selecting a combination of quantity of land, distance from the city centre and quantity of composite good which as a combination, will maximize its satisfaction but stay within its income constraint. His model stimulates a process by which potential users bid for land (based on their individual bid price curves) and the landlords sell or rent the land to the highest bidder. At this juncture, the pattern of land values and land uses,

become mutually determining and transport integral could step in when it comes to a situation where equilibrium has to be fulfilled.

The Alonso's formulation explains how preferences on the demand side and land and location opportunities on the supply side are mediated through the market mechanisms to establish land use. The structural features of the resulting pattern- the grouping of users similar function and the density characteristics- are a joint result of market and political processes. An analysis of both Alonso and Wingo's work reveals the extent to which transportation cost could be substituted with space costs.

The works of Christaller (1933) and Losch (1940) is based on Von Thunen's original model although their work provides an explanation of how more complex regions are formed, with multiple market centres, and of how the regions relate to each other. They were in other words the architects of what became known as the central place theory. A region based on Christaller's perspective, shall grow in complexity as more and more commodities are introduced resulting into a larger number of regular hexagonal patterns of different hierarchical orders, laid on top of each other.

2.4.2. A synthesis of the Micro-economic models Vs land use/transport system integration

As much as most of the theories are based on idealised situations and time framework, they can be relied upon in the formulation of appropriate strategies and policies ideal for the integration of NMT in the overall development structure of our medium sized towns. The works of Wingo for instance focus on the relationship between transport cost, the location of activities and land values as one way of enhancing the principle

of complementarity's between the cost of transport and land rent. In relation to this study, there is a need to introduce an element on the type or mode of transport in that transport cost alone is not enough when it comes to the integration of transport in the overall development of urban centres. Through the use of an appropriate mode of transport, the cost of transport could be contained thus strengthening mobility between two different localities i.e. residential and industrial points. Another attribute for this study is their emphasis on equilibrium, distance minimization and profit maximization, which can act as a pointer in relation to the type of transport mode relevant for the development of a given urban structure.

It should be observed also that, however important these theoretical developments are, their achievements cannot be matched by practical applications. One possible reason for this is that most economists in the field, having established theoretical frameworks, resorted to essentially linear or log-linear econometric models for the empirical work. Alonso's (1964) model for instance, does present a very simple linear model as empirical evidence of an otherwise highly elaborate theory.

Another restriction revolves at the way space and activities are represented. Since micro economic models treat space as continuous variable, it is all but impossible to represent the variety and richness of the urban and regional geography. Finally, the micro theories are basically disaggregated in their approach because their analysis centres on the behaviour of individual units.

2.5. Spatial interaction models

The spatial interaction models unlike the micro economic theories focus mainly on aggregate since both space and activities are grouped into discrete categories unlike the case with micro-economic models where analysis centres on the behavior of individual units. Spatial models define zones containing a large number of activities instead of analysing particular points in space. Their rapid growth has been attributed to their simplicity in application and reality to actual cases (Barra, 1989). They are also relevant to transportation analysis, for instance, during the 1960s and 1970s as a result of rapid urban growth, and increase in car availability, many transport related projects were implemented such as motorways and mass transit system.

The first spatial models were mainly based on gravitational analogy something which derived from the aggregate approach. Instead of looking at individual molecules of an urban area, spatial interaction is more interested in the behaviour of whole masses, and the relationship among them. Proper regional or urban theory was as a result of the regional gravitational analogy, through more empirical testing carried out.

One of the first steps in this direction was the work of (Hansen, 1959), who still using the gravitational analogy, elaborated on the location of residents as a function of accessibility to employment. Huff (1962) & Huff (1963) made an important contribution by interpreting the basic gravity model in economic terms and probabilities. Lowry (1964) however, achieved a landmark by using economic base principles and introducing a multiplier to provide a more comprehensive explanation of the urban structure. The possibility of applying spatial interaction models to real cases has been further improved by the development of calibration techniques to estimate the various parameters involved.

2.5.1. Basic Concepts in Spatial Interaction models

In spatial interaction models, land used by activities is defined as aggregate units of space or zone, containing a certain number of activities within them. The aggregates interact, generating flows of different kinds, which can be of a concrete nature such as trips, migrations, and movement of commodities or of a more abstract nature such as dependencies, diffusions and opportunity. Each zone is described in terms of a number of attributes and the zones are linked to each other by means of infrastructures or networks, depending on the nature of the flows.

In spatial interaction model, the gravity form states that interaction between any two zones is proportional to the number of activities in each zone (masses), and inversely proportional to the friction imposed by the particular infrastructure that connects them. If the system is composed of more than two zones, flows between any particular pair of zones has to be restricted by combined effect of all other zones present in the system.

The number of trips based on the spatial modes is a result of the points of attraction and production variables and trip generation factor. Spatial models can be alternatively used to measure the potential of a particular zone with respect to all others. This kind of analysis can be useful for diagnosis to determine the development potential of a zone or for design purposes, to determine the optimal location of an industry with respect to a particular market.

2.5.2. Specific forms of spatial models

Applications of spatial interaction models are numerous, and they range from those related to simulation of flows and location of activities. One of the best-known models of flows is Wilson's (1970)-trip distribution and modal-split model. The purpose of the model is to simulate the number of trips between origin zones to destination zones j by transport mode k and population type n, T^{kn}_{ij}. In this model, population type represents, generally, car-ownership (n=1 car-owners, n=2 non-car-owners). Inputs to the model are the number of trip origins by population type, O^n_i and the number of destinations in each zone, D_j, as well as travel cost matrices by mode, c^k_{ij}.

From the above analysis, if two modes are being considered- public and private- non-car-owners are forced to choose only from the former, while car-owners are allowed to choose from both. This model is viable as far as this study is concerned in that if transport system is integrated in the overall landuse development, a variety of modes of transport shall emerge so that the use of the car does not become the only option. It is therefore a good starting point in the harmonization of various activities within an urban centre.

Models of the location of activities as advocated by Hansen (1959) on the other hand, seek to simulate the location of residents in an urban area. The model assumes that there had been an increment in population, which must be allocated to zones as a function of accessibility. Accessibility is measured based on the number of attracting activities in a given zone such as the number of jobs, services among others. The size of zones depends on the other hand on the increase in population and the vacant land available.

The most popular of all spatial interaction models is that of Lowry (1964), which defines the urban system as composed of a basic employment sector, a service employment sector and residential sector. Basic employment in each zone is exogenous and the purpose of the model is to estimate the location of residents and of service jobs that is derived from the location of basic job. Other exogenous variables are the land available in each zone and an accessibility matrix or matrix of transport costs. Lowry's perception is that several sub models are linked to each other within an iterative system thus allowing for a more complex structure.

2.6. The Urban Transport Planning (UTP) Process

The conventional wisdom of transport planning practice in urban area is closely identified with the application of the urban transport planning process and its derivatives (Dimitrio, 1982). This process is a formalized planning methodology designed to provide guidelines and priorities for future investment and construction of urban transport infrastructure and facilities.

The method presents a scenario whereby urban traffic and transport problems worldwide come to be seen as an internationally common set of phenomena with merely local differences considered in themselves insufficient to invalidate employing a universal analysis and related set of proposals. Its applicability has been widely spread in that for Brazil, the UK and USA, the respective countries have gone to an extent of institutionalizing and supporting the legislation obliging the planning agencies to adopting particular procedures of the process in order to qualify for central government funding.

This process operates in such away that transport planning recommendations derived from the UTP process are arrived at through the simulation of land use and transport relationships on a city-wide and zonal basis, employing data from household and road-side surveys, as well as planning studies. In theory, the process and its derivatives are not supportive of any one-transport mode but are concerned with the provision and distribution of all types of urban transport facilities. It is at this stage that the significance of the process in relation to this study is visualized. Through the general framework, it is possible to harmonise the various features given in relation to the demands of NMT in the overall planning and development of medium sized cities in third world countries.

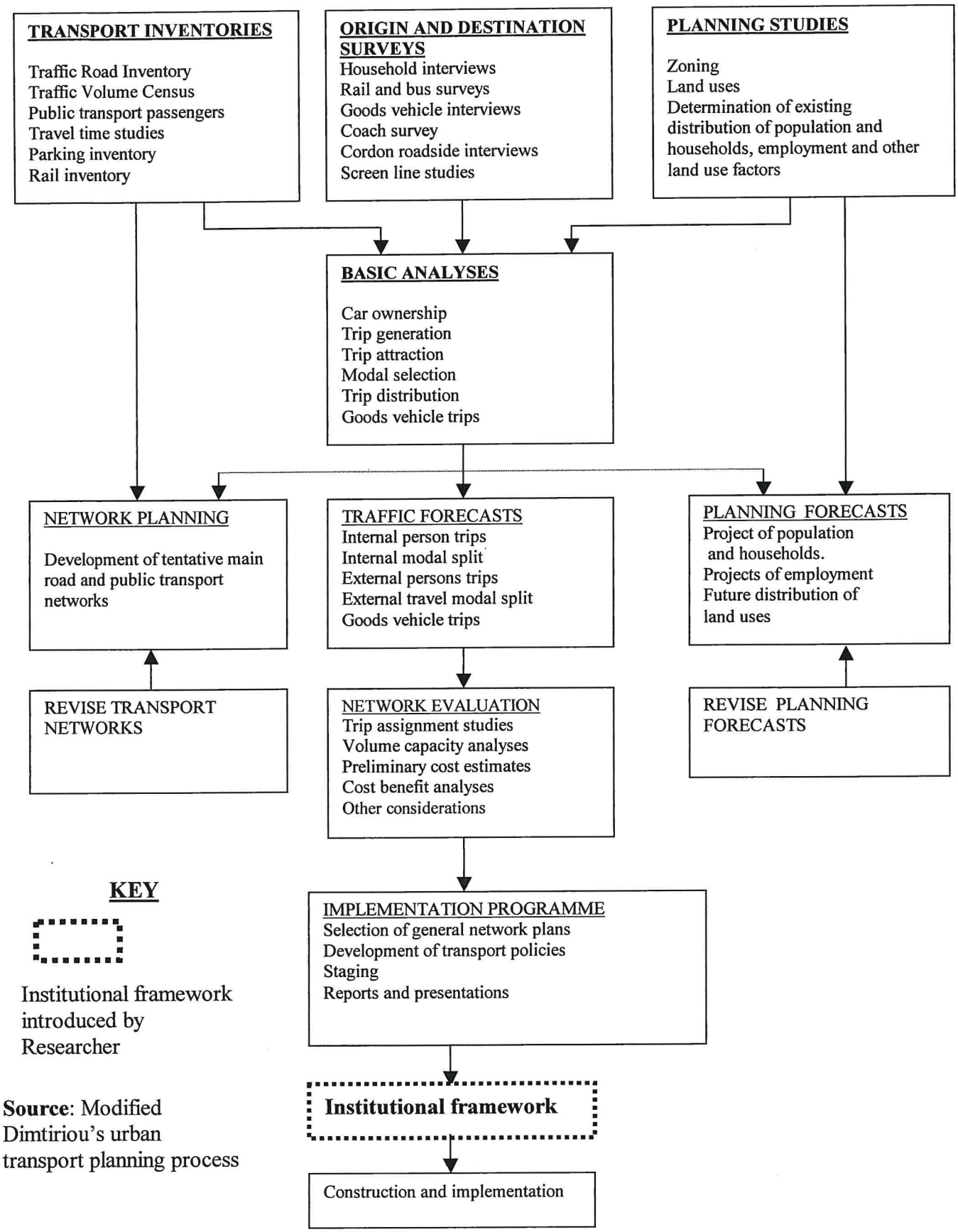
In character, the UTP process represents a scientific effort at planning urban transport demand particularly motorized road traffic by: -

- observing current travel behavior
- advancing certain hypotheses concerning the relationship between urban land use and movement
- testing the hypotheses as a basis for making demand, and
- ultimately recommending additional transport capacity

The general framework and features of the process as shown in Fig **2.4** has its origin in urban transport studies of Detroit (Detroit City, 1953-56) and Chicago (Chicago City, 1959-62) as well as Mitchell and Rapkin (1954) in their research at Columbia University, that presented numerous key hypotheses regarding the relationship of traffic and land use. From the figure, the basic stages of the classical format of the process include:

- the preparation of land use, transport and travel inventories of the study areas;
- the analysis of present land use and travel characteristics;
- the forecast of landuse and travel characteristics;
- the setting of goals and the formulation of transport alternatives designed to accommodate the project travel demands and landuse changes; and
- the testing and evolution of alternative transport plans

Irrespective of the modal split applied, the above stages have remained as the major cornerstone of conventional urban transport planning practice since the inception of the process during the 1950s in the USA.



Source: Modified Dimtiriou's urban transport planning process

Figure: 2. 4. THE URBAN TRANSPORT PLANNING PROCESS

The framework has been applied worldwide in one form or other, to cities as diverse as Nairobi (Wilbur Smith and Associates, 1978), London (Freeman Fox et al, 1964-66) and to Athens, Calcutta and Lagos by Wilbur Smith and Associates in 1963, 1967, and 1974 respectively.

The major features of the concept underlying this universally adopted planning process include:-

- an extensive dependence upon simulation and quantification;
- a semblance of comprehensiveness;
- a formality of approach based on principles of systems thinking; and
- a set of procedures akin to a scientific approach to problem solving.

The reliance of the process and many of its constituent parts on simulation and quantification is most evident in the modeling of travel demand. This simulates the adjustment of transport demand and supply by modeling various factors believed to affect travel. The simulation exercise is represented by a set of inter-related sub models, which estimate trip generation, trip distribution, modal split and traffic assignment.

The extensive dependence upon quantification arises from the ability of the transport analyst to measure NMT flows and their speed. This process is ideal to this study in that it is able to give a comprehensive concern by providing a citywide coverage of all types of urban transport modes. The semblance of comprehensiveness arises from its incorporation of land use/transport interactions as a basis for estimating future travel demand.

2.6.1. Evolution

The first major technical breakthrough in terms of the application of the most rudimentary basics of the UTP process came in 1955 with the Washington (D.C) Metropolitan area transport study, which applied the first of the trip generation and trip distribution models. An earlier landmark however was the Detroit area metropolitan transportation study (1955 – 56) directed by Carrol (1956). It was the Detroit study that publicized and documented application of the ideas commonly associated with the UTP process. The study contributed not only to the development of travel analysis but also to attempts to rationalize parts of the transport system configuration.

The achievements with the utilization of UTP were: -

1. The concern for transport interaction with land use, particularly in the early 1960s, incorporates the periods of operational development and conceptual stability.
2. Current developments in the field of public participation where (Comez-Ibanez, 1982) claims soon became clear that one could not do any major urban transport planning without involving citizens. This was vividly illustrated by the experience in Boston in the 1970s when the city had a transportation planning review that cost between US dollars 3 – 4 million with very little on technical modeling.
3. Development related to the collapse in the credibility of large-scale planning efforts which were replaced by more small-scale planning or limited short term projects after using techniques closely related to or derived from those of the Chicago study but of a 'back of an envelope' sketch plan character.
4. The breakthrough of UTP early achievement as per (Carrol, 1982) was the breakaway from simple traffic engineering to focus at the urban transport system

as a whole. In so doing, it became evident that many current and recent developments are, in urban transport planning regressive.

5. To give more attention to public transport systems. The Chicago study for instance offered an explanation of the potential feedback of transport system changes on land usage patterns.

2.6.2. Traffic and Transport System Analysis

Within the general framework of the UTP Process, a number of more specific concepts and assumptions are employed. These are usually tied to a set of sub-models used to analyse, simulate and forecast traffic movements i.e., movements that are seen to be a function of land use and socio economic changes of an urban area.
This set of sub-models is commonly referred to as the 'Four Stage Process' or the transport planning Modeling. It is considered by many to be the most well developed part of the UTP process and in most cases it is usually confused with the overall UTP process itself shown in figure 2.4. From the views of Wilson et al (1969), the four-stage process is usually intended to correspond to decision-making stages of trip-maker namely:

- Whether to make a trip (trip generation);
- Where to go (trip distribution);
- Which mode of transport to use (modal split); and
- Which route to use (traffic assignment)?

The above sub models are however, exclusively concerned with the trip-maker and with trip-making characteristics, and do not include wider considerations of planning for urban movement. On the basis of observed and measured current travel patterns,

future trip movement in the UTP process are forecast by the 'Four Stage Process', by assuming a not very different future for:

- Travel behaviour;
- Transport technology;
- Land use; and
- Land use/traffic interaction

The four-stage process is comparable to the Newtonian Laws of Gravitational Attraction, in which trip attraction and distribution patterns can be explained by some measure of 'push and pull' forces on trip origins and destinations.

2.6.3. Application of UTP process and its derivatives in developing countries

The process of UTP together with its features can easily help in addressing most of the urban transport problems facing the planning and development of medium sized centres. There are however many deficiencies that can be observed while applying the process to developing countries. Most of these limitations revolve around the respective assumptions associated with the process for instance: -

- the belief that the urban transport problem is essentially on how to overcome motorised traffic congestion- whereas the overwhelming majority of households in third World cities are not vehicle owning;
- the premise that increasing vehicle-ownership levels are inevitable- because saturation levels of these projections are likened to those of the industrialised countries, they become self-fulfilling;

- the idea that informal public transport does not warrant detailed study- transport studies thus exclude important means of mobility and employment for the urban poor;
- the belief that benefits are best derived by improving the operational efficiency of transport systems- for third world cities, where transport systems are often planned and managed in favour of selective sections of the community, this aggravates equity issues in transport;
- the premise that variables affecting travel demand do not experience unexpected changes-the questionable even in medium term planning where unexpected changes and robust circumstances in the third world can jeopardise forecasts for ten years hence; and
- the idea that urban problems are essentially the same world-wide- examples of the very different evolutionary developments of transport problems are essentially the same world-wide- examples of the very different evolutionary developments of transport problems in third world cities however contradict this.

Other deficiencies of the UTP Process have been ascribed to its pseudo scientific features which portray a false sense of accuracy and comprehensive coverage Dimitriou (1977) the respective features have been said to have 'wall-papered' over many aspects the process cannot cope with, as well as provide the urban transport planner with a false sense of technical competence.

Additional limitations of conventional urban transport planning when applied in third world contexts have to do with (after Khan and Willumsen, 1986):

- the high cost of its modeling efforts-traditional techniques are very demanding in terms of data, technical skills, computer resources and time;
- limitations of data; good and reliable data in Third World countries are a scarce resource;
- perceptions of the problem addressed; these are often so different from those of the industrialised countries that new models are required;
- scarcity of technical resources; appropriately qualified and skilled personnel are a rare commodity in the Third World; and
- problems of communication the complex and heavy modeling emphasis often alienate decision-makers

As much as it might not be applicable to the present situation, there is need to consider the above factors while articulating transportation needs.

Inspite of the limitations, the same process with slight modification is suitable in pinpointing key features vital for bringing various land use activities closer to one another thus enhancing the process of integration. It can be relied upon to realize a balanced mix in that different versions and derivatives of this process can be widely used overtime by policy makers and technocrats when confronted with major traffic congestion problems that require a city wide planning process.

The components of the UTP process may together be likened to a generalized travel demand model based upon certain broad assumptions incorporating a number of sub-models, each with their own related assumptions.

The principal components are: -

- Traffic and transport systems analysis and forecasting
- Land use based urban development analysis and fore costing

- Transport goal, policy plan formulation and evaluation

Before examining the above, it is beneficial to dwell a bit on the general assumptions that underlie the process as expressed by Bruton (1970): -

- Decisive relationships exist between all modes of transport and therefore, the role of a particular mode cannot be determined separately
- Transport systems both influence and serve the development of an area
- The transport situation in areas of continuous urbanization requires regional treatment
- An urban transport study is integral to the overall planning process and cannot be considered in isolation, and
- The transport planning process is on going and thus requires constant updating

If however, one looks back at more that 30 years at the application of UTP process and its derivatives, it is apparent that these generalized assumptions are more reflective of normative thinking and hypothesis setting rather than well understood empirical evidence and practice. This and other criticisms, especially as they relate to third world circumstances, were voiced by a number of academics and practitioners in the 1970s (Viola, 1976; McNeill, 1978).

Unfortunately, many of the criticisms are still valid today with regard to several newer developments, particularly in the transport-modeling field.

The analysis of the evolution of the UTP process shows that the hypotheses and techniques it employs are primarily taken from experience of industrialized countries. This is especially evident if one examines assumptions concerning the relationship of transport to urban development. Assumptions about desired paths of urban

development however, cannot have universal application, since the notion of what is desirable varies from place to place as Banjo (1982) emphasized, the use of assumption about travel behavior based on traditional market economics of industrialized nations can only be applied with caution to the third world given the different cultural dimensions and economic priorities.

2.6.4. UTP Process in Relation to NMT Systems

A synthesis of the UTP process in relation to planning of NMT transport systems reveals quite a number of issues. Foremost, it provides the relevant methodology of understanding the general trend of transport system irrespective of the type of transport. It can be relied upon when addressing the needs of NMT especially when utilizing its Sub-models such as trip-generation, trip-distribution, modal split and traffic assignment within an urban centre.

The four-stage process which is part of UTP process is crucial in planning for NMT needs for it helps in articulating among others:- the travel behaviour, transport technology, landuse and landuse/traffic interaction which are vital elements in transport planning. Like other transport models, there is need however to base the various models and theories on the needs of third world Urban centres.

2.7. Urban travel theories

A part from the above theories related to land use and urban structure, for the sake of this study, a review of urban travel theories is significant. Travel theories strive to uncover and explain, in a seasoned fashion, those regularities in travel which would be likely to persist over a long time period and which would thereby make traffic

forecasting sufficiently reliable to be used in long range planning. Majority of the travel theories were conceptualised in the 1950's based on the prevailing problems facing transportation planners (Creighton, 1970).

One of the critical problems facing transportation planners in the 1950's was how to find some means of explaining the behaviour of people's trip patterns. In the absence of a well-developed theory, planners were forced to rely too much upon data obtained from massive origin- destination surveys of whose data tended to be stale. In the study of urban travel patterns, gravity model and the opportunity theory are quite instrumental. Each of which helps us to determine travel patterns by addressing questions ranging from why trips are made, where the trips go, which origins would be linked to which destinations, why the trip length frequency distribution curve take its peculiar and regular shape. The articulation of the above questions helps in laying a solid basis for planning future transportation improvements.

2.7.1. Gravity model

Gravity model provides a theory of travel, which can deal with travel generated in new parts of cities. It was based on the well-known observation that many kinds of human interactions behave in a fashion, which is strikingly similar to Newton's law of gravity. This implied that trips (or messages) between groups of people occur, in a number, proportionately to the products of the sizes of the two population groups and in inverse proportion to some power of distance between.

The mathematical statement of the gravity model is as follows:

$$T_{ij} = P_i \frac{\frac{A_{ij}}{d_{ij}^{\ b}}}{\frac{A_1}{d_{i1}^{\ b}} + \frac{A_2}{d_{i2}^{\ b}} + \ldots \frac{A_n}{d_{in}^{\ b}}},$$

Where T_{ij} = trips produced in zone i and attracted to zone j;

P_i = trips produced by zone i;

A_j = trips attracted by zone j (from all zones);

d_{ij} = spatial separation between zones i and j. This is generally expressed as total travel time (tij) between zones i and j.

b = an empirically determined exponent which expresses the average area wide effect of spatial separation between zones on trip interchange.

As much as gravity formula is probably the most widely used formula for estimating travel, it was and remains a theory of analogy, not explaining travel but merely saying "it appears that travel does behave in this fashion" (Creighton, 1970). Its theoretical nature in explaining travel patterns in the urban centres therefore prompted earlier transport planners based in Chicago to develop a new theory of travel known as opportunity theory that was viewed as integral part of the testing mechanism that was adopted for use in a model to estimate urban growth.

2.7.2. The Opportunity theory of travel

The opportunity theory was developed by Morton Schneider as a synthesis of ideas. In briefest terms, the theory states that a traveler, searching out from a zone of origin and looking for a sustainable destination, has a definable probability of accepting each destination opportunity that he encounters although the probability is in effect

modified so that it becomes lowered by each opportunity passed by the outwards search.

There are four basic ideas that underlie the theory. The first idea is that people want to minimize the cost, time, danger, unpleasantness, and other adverse factors connected with travel. This assumption as stated by Creighton (1970) runs counter to many prevailing notions about travel which suggest that people tend to keep traveling more and more, without limit although travel has real costs in time and money which increase with distance as shown fig 2.5.

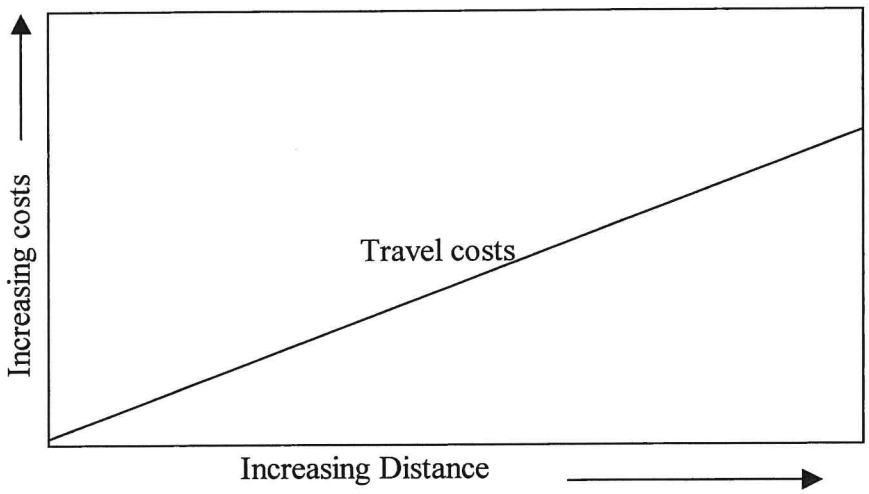


Fig 2.5: The Opportunity Theory of travel

Based one the above idea, it is quite reasonable to assume that people will consider travel costs and seek to keep their trips as short as possible.

The second idea is that every person who starts out to make a trip is surrounded by a field of opportunities that are not identical from which he can select one which will meet the need which impelled him to make the trip in the first place. The traveler is selective and selectivity of individuals could be expressed as a probability of accepting one of the opportunities available.

The third idea is that while the probability of finding greater rewards or satisfaction increases by traveling farther, the rate of increase declines with distance. A person starts out from his home to satisfy some desire, the opportunities available to him increase very rapidly, because the land area containing the opportunities increases as the square of the radius outward where he is searching. The fourth idea is that there is usually an adjustment of the locations of people's activities or land uses to meet the

realities of the costs of travel and their different needs. For instance, chain storeowners will always put their establishments at places, which are carefully considered to maximize profits by getting close to the customer.

In relation to this study, the urban travel theories have a significant role in our understanding of why various land use activities tend to be located in their respective areas. The respective factors are the same, which can help us in predicting future travel patterns as determined by the different travel patterns.

2.8. Conceptual Framework

The micro-economic, spatial interaction, travel and urban transport planning models reviewed above can generate a basic theoretical framework crucial for the integration of Non Motorised transport system in the development of our medium sized towns.

The theoretical framework as conceptualised in **Fig 2.6** gives an understanding that there is no transport integration that can take place without first and foremost assessing three key components namely land use, transport system and the urban morphology or structure. The assessment of the prevailing land use, for instance helps in ascertaining the different land use patterns prevailing within a locality and how their existence influence the various mobility needs to be expected over time and space.

The second instrument, which is transport system as, indicated in the framework helps in the identification of the network type, modal split, traffic assessment, terminals and generation.

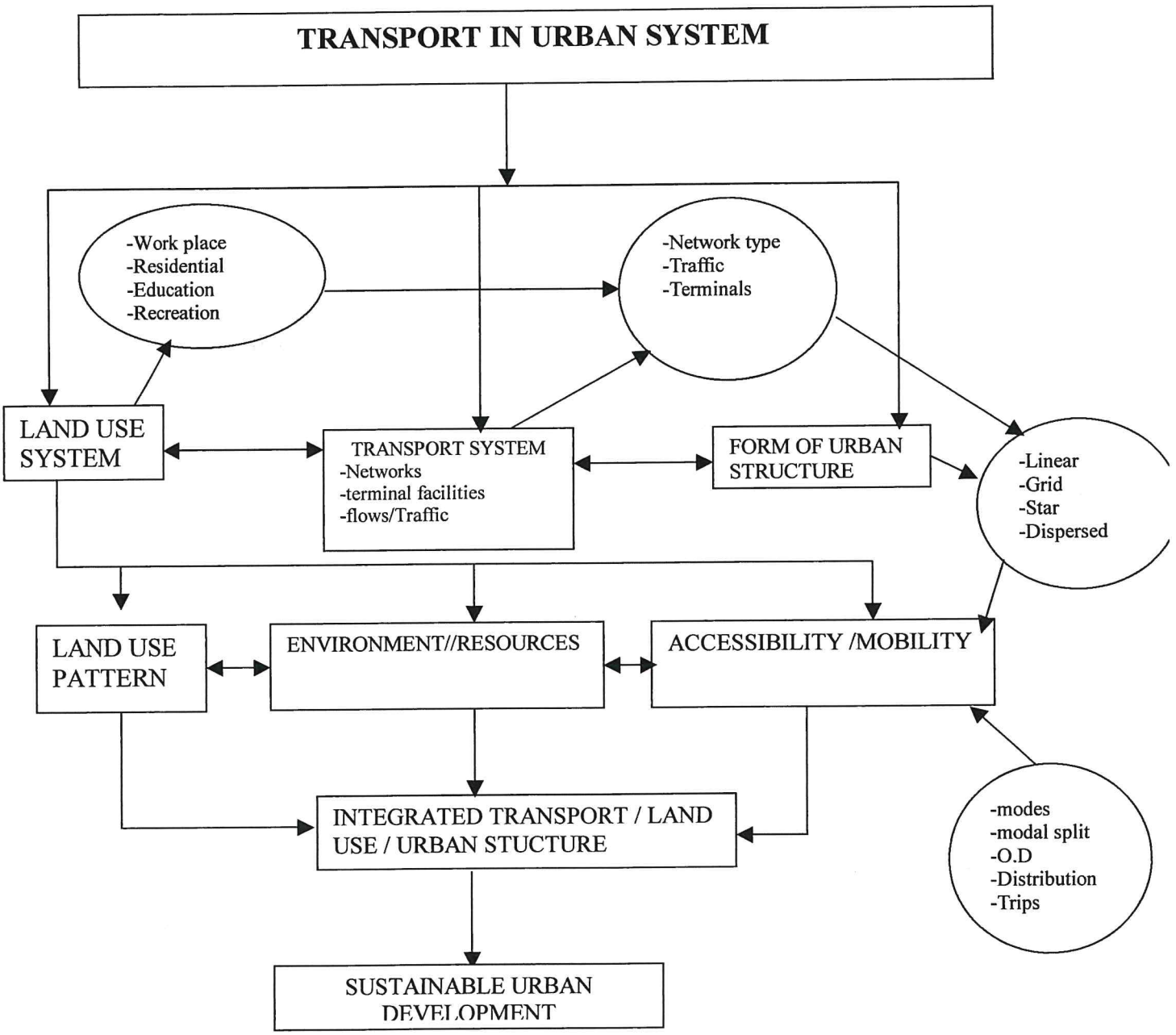


Fig 2.6. CONCEPTUAL FRAMEWORK

Source: ***Researcher's Perception***

The significance of this type lies in the fact that irrespective of the nature of network, we are able to examine the ability and viability of each mode of transport as based on its popularity thus the level of integration.

A town's urban structure is also crucial in the integration process. This is basically the morphology of the town as based on the physical or geological setup. There is always a significant relation between the nature of transport network as determined by the scope of morphology. An analysis of the town's urban structure helps in presenting the types of setups, which exist and how they contribute to the respective mobility patterns in an urban setup. Certain structures ranging from linear, grid, star, radial and dispersed exist and each has an influence on the nature and type of transport structure to be expected in a locality.

As pinpointed in the framework, irrespective of the above three attributes, the integration process shall only be complete the moment it is sustainable or environmentally friendly to all land use activities. Proper integration of the three components is what therefore helps in the realization of a balanced Mobility system, which articulates all the basic necessities.

CHAPTER THREE: RESEARCH METHODOLOGY AND STUDY AREA

3.0. Overview

This study based on the above undertakings required a large variety of information; both qualitative and quantitative, depending on the nature of questions, objectives and hypothesis being addressed at various stages. **Table 3.1** gives a summary of the nature of information collected. The table is arranged in six columns, each column representing vital information which included; factors relevant to the study; type of data specific for each factor; source of information; method of collection; analysis and presentation.

As indicated in the table, the information collected in relation to this study included; review of literature transport development models; urban land use planning and management, Non Motorized Transport (NMT) both at national and international level; information on Eldoret's land use pattern and structure; socio-economic status; transport situation and historical development. It is out of the above issues that relevant information was obtained to address the study questions, objectives and provide way forward for the integration of Non Motorised Transport system in the planning and development of medium sized towns in Kenya. The subsequent analysis gives a detailed analysis on the information contained in **table 3.1.**

Literature on transport development and urban land use planning and management was vital in assisting in the building of the theoretical understanding of this study. It consisted mainly of descriptive or qualitative secondary data. Most of this information was obtained through review of journals and publications either available in the

libraries or downloaded from the Internet. Since most of the information was descriptive; the nature of analysis remained explanatory and presented both in report form and flow diagram. Chapters 1 and 2, forms the bulk of literature collected through the above review.

Table 3.1: Data Matrix Table

Factor	**Data**	**Source**	**Method of collection**	**Method of analysis**	**Method of presentation**
-Transport development -Transport models	Secondary	-Library -Journals	-Review -Internet	Theoretical Descriptive Explanatory	-Report form -Flow diagram
Town's Land use/structure on urban transport	Form, Patterns, location & distribution	DPPD EMC GOK -Field	-Mapping -Transect -Actual site visit	Theoretical -Mapping	-Report -Maps Charts
Town's Socio-economic status	-Population -Historical development -Type of activities -Impetus of growth	Pop. Census reports - DDP - EMC - Library	-Review -Interview Questionnaire	-Statistical -Tabulation -Mapping	- Report -Maps -Graphic -Tabulation
Transport in Eldoret	-Modes -Distribution -O-D pattern -Infrastruct. factors	-EMC -Traffic Police -MOPW&H	-Traffic count -Observation -Measurement	Cross tabulation.	-Tables -Maps -Graphic -Desire lines
NMT in Eldoret	-Types -Distribution -O-D -Modal split Modal choice -Trip genera. -Travel destination. -Facilities -Black spots	- EMC - Field - Traffic Police	-Traffic count -Route inspection -Accident data from police -Road side interviews Questionnaire -Focused discussions -Household survey (SSATP)	-Statistical (SPSS) -Tabulations -	-Graphic -Tables -Maps

The information on Eldoret's socio-economic status; historical development; land use pattern and structure and transport system was significant in collecting information on types of activities; their location and distribution; social and economic infrastructures; population growth and factors behind the present land use pattern and structure of the town. This information was sourced from literature available at Government of Kenya offices (District Physical Planning, Eldoret Municipal Council and department of statistics); fieldwork and library. The methods of collection included; mapping, transecting, site visit, review of journals and publication, focused group discussion and use of questionnaire.

The third type of information focused on transport situation in the study area. This type of information is what formed a background of this study for integration of NMT in the overall urban planning and development in urban areas starts with an analysis of the prevailing transport situation. This type of information was significant in the understanding of the mobility patterns, modal split, origin destination patterns, nature and conditions of the infrastructure, street management, desire lines, major conflicts and missing links and distribution. The major sources of information were government institutions (Eldoret Municipal Council, Eldoret Division Traffic Police, Ministry of public works and housing) and the fieldwork.

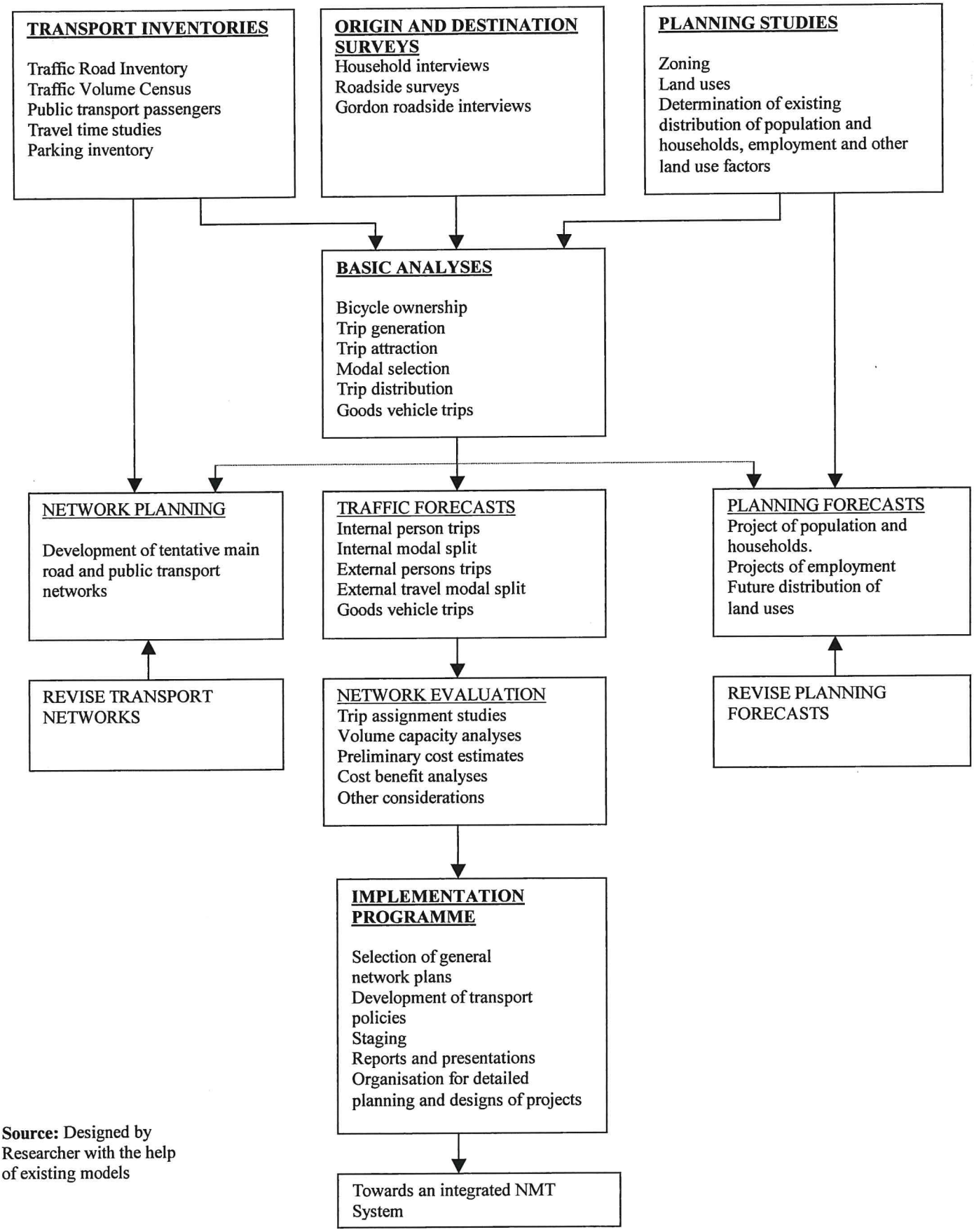
Methods of data collection for the above information included; traffic count, route analysis, observation, measurement, route site interviews, mapping while analysis was through cross tabulation and tabulation. This information is presented inform of tables, maps, graphs, desire lines and report.

The other information observed in the study was on the Non Motorised Transport component of urban mobility in Eldoret. The collection of this data is meant to assess NMT potential, determine the various types, distribution, modal split and choice, O-D patterns, Desire lines rout determination and inspection, traffic flow, NMT intensities, route quality and major bottlenecks. The source of these data was Eldoret Municipal Council, fieldwork and traffic police. The process involved traffic counts; roadside interviews; use of questionnaire; photographs; mapping and household survey undertaken by SSATP (1999). Methods of analysis included; cross tabulation; measures of central tendency; dispersion and relationship and Statistical Package for Social Science (SPSS). The respective data has been presented in form of tables, charts, graphs, report form and maps.

In summary, the above analysis illustrates what is contained in table 3. It is emphasized, however, that a part from the above methodology of data collection, the study also made use of face-to-face discussions with the relevant stakeholders and users to obtaining vital information required. In order to facilitate the actual process of obtaining both qualitative and quantitative data, this study with some slight modification in relation to Non Motorised Transport system relied heavily on the famous Urban Transport Planning Process developed in the United States of America. How this approach functions is clearly explained in chapter two of this text.
Given the prevailing land use situation and scattered activities in the town, the use of both non-probability and probability sampling techniques were applied. Both cluster and random sampling methods were used while administering both household and roadside questionnaire for instance, classification of the town's residential development zones was based on both cluster and random sampling.

The raw data underwent the process of editing and coding as a way of determining the validity of the information in relation to the study questions and objectives.

From the above process of analysis, it became easy to make cross tabulation of the statistical data as focused on the set objectives and research questions. The use of slides, flow charts, cross sections formed major ways of data presentation of analyzed data. Most of the information revolved however on major land use, black spots, transports situation in study area, O-D patterns and desire lines.



Source: Designed by Researcher with the help of existing models

Figure 3.1. Modified utp process in nmt data collection

3.1. Study area

The choice of Eldoret as a case study was motivated, among other reasons, by the following: -

- Its function as an agro-based town serving both its residents and the hinterland;
- Its rapid growth as Kenya's secondary town at about 8% per annum; its strategic position as a regional centre serving the entire of east and central Africa;
- Availability of room for implementation of the resultant effects of transport integration in the overall land use pattern;
- The prevailing land structure and;
- Previous baseline surveys by the World Bank that found it ideal for NMT systems provision.

3.1.1. Physical features

Eldoret is located in the high-agricultural-potential highlands of Uasin Gishu District in Rift Valley Province. It is located at approximately latitude 0^0 31' North and longitude 35^0 16' East. It lies at an average altitude of 2085 metres above sea level. The land rises from the River Sosiani valley both northwards and southwards from about 1800 metres in the extreme northwest and from below 2120 metres in the extreme southeast towards and beyond the 2200 metres contour line. A steep slope known as Uasin Gishu Escarpment (DDP 1996) marks the northern part of the town. Geologically, volcanic deposits and phonolite dominate the town, and this has contributed towards the formation of red clay soils in the region.

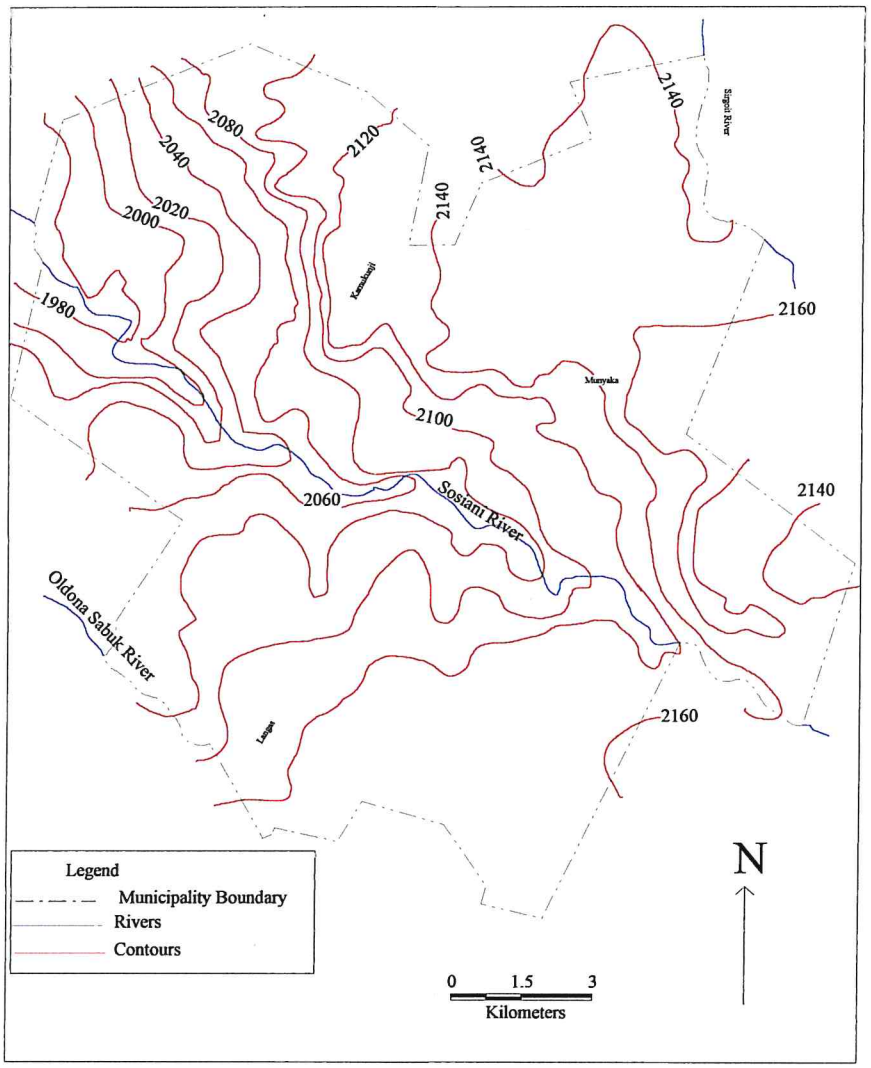


Figure 3.2: A topographic contour map of Eldoret Municipality

3.1.2. Regional set up

Eldoret is strategically located at the centre of a large high potential agricultural area, which has contributed to its growth as an important storage, processing and distribution centre for agricultural produce from its hinterland. Its position has also made it an ideal centre for wholesale and retail, servicing of farm tools and machinery, provision of administrative services and entertainment.
The most significant feature of Eldoret's growth is the increase in industrial enterprise, which has taken place for the last 33 years since independence. Its favourable location with respect to markets in Western Kenya, Uganda and Sudan, its position as a railway town, its rich agricultural hinterland as well as the availability of the necessary infrastructural services and facilities are some of the key factors that have contributed to its present growth **(Why Eldoret 1986).**

It is one urban centre whose origin, evolution and practical significance have been closely knit to the history of the nation. It enjoys the evergreen Savannah lands of the legendary Sirikwa civilisation, the traditional pasturelands of nilohamitic Kalenjins.

One of the town's greatest resources is however its physical setting and climate. Set on a high plateau of about 1800m above mean sea level, it has a healthy, cool and brazing climate, with fresh winds and moderate humidity throughout the year thus making it a more habitable zone.

3.1.3. Historical Development

The town's historical development indicate that Eldoret developed from an isolated post office serving mostly a European farming community in the early 1900s into a major dynamic regional administrative, commercial, educative and into a hub of industrial development. The first settlers are believed to have arrived in the Uasin Gishu District soon after the year 1900. Of its earliest history, little is known, except that in the lore of the Kalenjin and Maasai it was occupied by a pastoral people, the Sirikwa-described by both tribes as " the people who were here before us". Eldoret, as it is known today, is a creation of European adventurism into the interior of Kenya at the turn of the last century. It owes its modern origin to the settlement of Boers from South Africa who were encouraged to settle in Uasin Gishu by the then East African Protectorate authorities. The British considered the Uasin plateau as a "murram pit'' unsuitable for agriculture. The town's development however owes a lot to farm 64 that was selected as the site for the new township because it was a poor, stony piece of ground, which no farmer wanted and it was a compromise among the number of conflicting suggestions.

The change of name from "64" it is noted was decided when the Governor, Sir Percy Giround, announced his decision to establish an administrative centre there to serve both the Uasin Gishu and Trans Nzoia Districts. Farmers gathered at "64" from miles around to meet him and many slept under their wagons, on what was then described as a "wind-swept, treeless plain". The origin of the name Eldoret is the Maasai word "eldore" meaning "stony river"- the river-bed of the nearby Sosiani is very stony; "t" was added to make it sound like a Nandi word.

It was declared a British administrative centre of Uasin Gishu and Trans Nzoia Districts in 1912 thereafter proclaimed a township with an area of 11.2 square kilometers. It was during this time that the name "Eldoret" was officially gazetted. Its commerce during this time consisted of a row of offices and shops constructed of stones laid in mud, and the bank was built of mud and wattle around the spot where a heavy safe had been dropped off an ox-wagon.

The change of name from "64" to Eldoret and its Township status gave a spur to development. Two Asians, Noor Mohamed and Dhanji Madhavji, had already started trading. A police station, administrative offices and official houses were built during this time. A large hangar-type mud and wattle shack was erected next door to the post office and this served as hotel, bar and general store. Other business started; the pioneer hotel was built and in 1920 Barclays Bank D.C.O. opened a branch in the town.

The development of the town however was slow for a period of 12 years due to lack of communication and by then the railhead was 64 miles away at Kibigori, entailing a hazardous journey over wild terrain and through rivers by ox-wagon, horse or on foot. It was not until 1924 when a section of the Kenya-Uganda Railway line passing through Eldoret was completed and when the Governor of Kenya, Sir Robert Coryndon, arrived in Eldoret on the first train that a new era began for the town and Western Kenya. Goods could then be imported cheaply and farm produce transported out at competitive prices thus giving the town new impetus to its growth.

The 1924 developments together with permanent settlement in Uasin Gishu District were responsible for the growth of Eldoret as a railway yard with a junction to Kitale. Most urban development in form of built up areas started in 1925 after the completion of the railway. As the seat of district administrative and a service centre for the surrounding farming hinterland, Eldoret benefited from the population related to local government, the railway and the farmers from the adjoining areas. By 1929, the town was elevated to a Municipal Board so as to be able to collect rate to meet the difficulties that were being experienced of providing township services to keep pace with the rapid commercial development. It is understood that the first rate was levied to help meet the cost of the first budget, assisted by a government grant of £3,000.

The year 1928 saw the installation of a piped water supply from Sosiani River and in 1933, the east Africa power and lighting Co. Ltd., installed an electricity plant, which also enabled the Municipal Board to light up the main streets. In 1930, the first loan of £5,314 was obtained to help in the building of low- rental housing and a market in the town's African location. The aerodrome was taken over and licensed for all types of aircraft-exactly four years after the first aircraft piloted by Lord Cadberry, landed on the polo ground. As the township grew, churches, schools, clubs and even a cinemahall were established.

The Second World War however hit the town hard and even after the hostilities ceased, development remained slow due to shortage of materials. It was not until when the supplies improved that the town experienced a boom that lasted through the next decade. New buildings sprang up overnight and more intensive development of farms took place with the government rehabilitation and development of loans. The

increase in wheat production and livestock by the farmers enabled the exploration of the Uganda market for milk, meat and poultry.

The town Hall was built in 1956 and in January 1958, the town was elevated to Municipal Council status and the first mayor elected in November 1959; a time when the Governor of Kenya presented the town with its charter and mace. Its boundary was extended to 59 km^2 in 1974 and to 147.9 km^2 in 1988. The above extension appears to be well beyond the existing and future requirement for urban land engulfing large tracts of agricultural land some of which have been illegally or legally subdivided with no proper guidelines in relation to zoning requirements and regulations. The rapid development of the suburban areas into slum and/or squatter settlement is as a result of the engulfing of unplanned former agricultural land.

Eldoret's prosperity in the beginning could be said depended on the successful development of the surrounding farmlands; as hitching posts gave way to parking bays. The establishment of factory chimneys altered the skyline of "stony River" at a rapid pace for the last 40 years since independence. Today, agriculture, commerce, tourism and a little manufacturing jointly spell prosperity for an ever-increasing population; to raise their standard of living all round. The current land use pattern depicts a ribbon type of development with an overall development structure controlled by the ridge to the North, Nairobi–Uganda road and Sosiani River in the South.

Its population Catchment for economic activities has also increased tremendously to include districts of Uasin Gishu, Elgeyo, Marakwet, Nandi, Trans Nzoia and Kericho all with a combined population of 2.5 million people as per 1989 census. The urban influence of the town is also felt as far as Lodwar, Bungoma, Nakuru and Kisumu.

This is evidenced by the number of *Matatus* operating to and from the above towns. From the historical perspective of the town, it comes out clearly that the town evolved as a nucleus with concentration of several activities surrounding it. Another aspect, which tends to reflect the sector theory, is the fact that development emerged guided by key features such as railway line and river Sosian.

The early layout of the town therefore is what has contributed to the present ribbon type of development taking into consideration the works of Hoyt in his sector theory. With the emergence of other major activities such as industries, the scenario has since changed to embrace the multiple nuclei concept with development being concentrated around the several nuclei points i.e., industries, residential centres, health and education institutions.

This therefore points to a scenario where integration of NMT to the overall land use system has to focus to a large extent on how the town has evolved putting also into consideration the current desire lines as determined by the various impetus of development.

The subsequent analysis undertaken below therefore are meant to assist in analysing the present organization set up of the town to be able to conceptualize the way forward for the anticipated integration. Since the town has inclined both to the historical and present situation, the point of integration shall revolve on how the present situation could be harmonized in the future and historical growth of the town.

3.1.4. Socio-Economic Characteristics

This section gives a synthesis of the relevance of socio-economic indicators behind the town's mobility growth. The key parameters discussed have included the population growth and distribution, household economic characteristics and how they have influenced adaptability to various mobility patterns. The actual analysis of each item is as discussed below.

3.1.4.1. Rate of population growth

The town has been growing fast. For instance, in 1962, the town population stood at 19,605 inhabitants while in 1965, the figure rose to 24,900. It further increased to 50,503 as per 1979 population census and by 1989 it had grown to 104,900 people thus making it the fifth most populated town after Nairobi, Mombasa, Kisumu and Nakuru. The 1999 population and housing census placed the town's population at 197,449 people while the population distribution in its major estates was as highlighted in Table 3.2.

Table 3.2: Population distribution in seven major estates in Eldoret as sourced from 1999 population census (GOK 1999)

MAJOR AREAS	POPULATION
Kilimani	24,777
Kamukunji	15,376
Kimumu	11,142
Kapsoya	21,545
Huruma	35,298
Kapsaos	14,254
Langas	60,973
TOTAL	**183,365**

Source: 1999 Population and Housing Census (GOK).

Out of the 197,449 total population recorded in 1999, the above estates account for over 92%. With the town's population growth placed at 8% per annum and the current influx from the rural areas and other urban areas, the current population of the town could well be estimated at 300,000 people by the end of 2003. The changes that have taken place between 1999 to the present, i.e. subdivision and subsequent disposal of EATEC land to private developers could as well put the above estimates slightly higher or lower due to the collapse of major industries as source of employment.
The tremendous growth being witnessed in the town has been in one way or the other attributed to natural growth; net in migration; boundary extensions which basically transforms rural population into urban population and, finally, the rapid increase until recently in industrial growth.

3.1.4.2. Household size

The occupancy varies from one (1) person to nine (9) persons per household. The highest occupancy frequency was recorded at three (3) and four (4) persons while the average was calculated as 4.4. persons. The number of persons per household seems to be lower than expected. The number of persons per household within Eldoret seems to have remained at between 3&4 persons just like was the case during the 1989 and 1999 population and housing census.

3.1.4.3. Household age distribution

Persons in the 15-34 age group form 50% of the population and this was found to be due to the migration of young adults after primary and secondary education in search of employment opportunities in the town.

Table 3.3. Household age distribution

Age group (years)	Proportion (%)
0-14	28
15-24	29
25-34	21
35-44	14
45-59	7
60 and above	1

Source: Field survey 2002

3.2. Occupation

As shown in table 3.4, 000male form the highest number of persons 56.3% in full time employment, daily labourers and students. Female spouses on the other hand are involved in own household work, self-employment and house servants which may be giving them some sort of small income. A large number of females are in full time employment in industries within the town, which have preferences for female employees in some sections of their production.

Table 3.4. : A summary of occupation of persons as per household

Occupation	**Male heads**	**Female Spouses**	**Others**
	%	%	%
Full time (skilled)	56.3	30.6	6.0
Full-time Unskilled	7.9	2.3	3.4
Daily labourer	6.8	2.3	7.0
House servant	0.0	1.7	16.8
Self employed	28.2	30.6	8.6
Own household work	0.0	23.8	3.1
Student	0.2	2.7	41.0
Unemployed	0.6	6.0	13.7
Disabled or too old	0.0	---	0.4
Total (%)	100	100	100

Source: Fieldwork survey 2001

3.3. Household Incomes

The income distribution for all households interviewed show that there is a uniform monthly income from Kshs. 2,400 to over Kshs.20, 000. From the field study also, no residential zone can be categorized as a very low-income zone. This can be related to the fact that presently there are no well-established and isolated slum areas within the town boundaries. Also most areas around the town boundaries are under agricultural use, which provides some of the residents with a little income.

3.3.1. Household Income and Occupation

Most unskilled workers and labourers have incomes less than Kshs. 10,000 per month (over 90%). Incomes for most skilled household heads are more than Kshs. 5,000, and self-employed have incomes almost uniformly distributed in all income groups.

Table 3.5: Household income and occupation

Income (Kshs/Month)	Occupation			
	Full time Skilled	Full time unskilled	Daily labourer	Self employed
	(%)	(%)	(%)	(%)
0 - 5,000	14	45	69	24
5001 - 10,000	30	47	28	35
10001-20,000	36	6	3	22
Over 20,000	20	2	0	19
	100	100	100	100

Source: field survey

Table 3.6: Household Income distribution

Income (Kshs/month)	Households	Proportion (%)
0 - 2,400	22	4
2,401 - 5,000	120	19
5,001 - 7,500	106	17
7,501 - 10,000	100	16
10,001- 15,000	102	16
15,001- 20,000	77	12
Over 20,000	106	16
Total	**633**	**100**

From the table, there seems to be a uniform distribution of household incomes in each of the income brackets, except for the 0-2,400-income group.

3.4. Analysis of Urban land uses: types and spatial development

The general land use pattern especially the location and distribution of activities in the town as observed from the field has been to a large extent a function of the town's structure especially the geological setup, prevailing land tenure system and the existing networks and railway line. As shown on **Fig 3.2**, the town's physical set up as determined by River Sosiani and the northern escarpment has created a corridor of development between the two features thus embracing the existing linear/ribbon development that has further been enhanced by the prevailing road networks.

Due to the geological influence, there has been high concentration of commercial activities developing along the two features (river Sosian and escarpment). It was only with the expansion of the Municipal boundary in 1988 that the influence changed a bit taking into consideration the element of other factors such road network and land tenure system.

The prevailing land tenure system has also contributed greatly towards the prevailing land use patterns in Eldoret. For instance, most of the land in Eldoret is owned on freehold basis as such is dominated by agricultural activities and therefore the presence of the agricultural zone. Most of the commercial and public utility land falls on leasehold or trust land and is confined within the CBD.

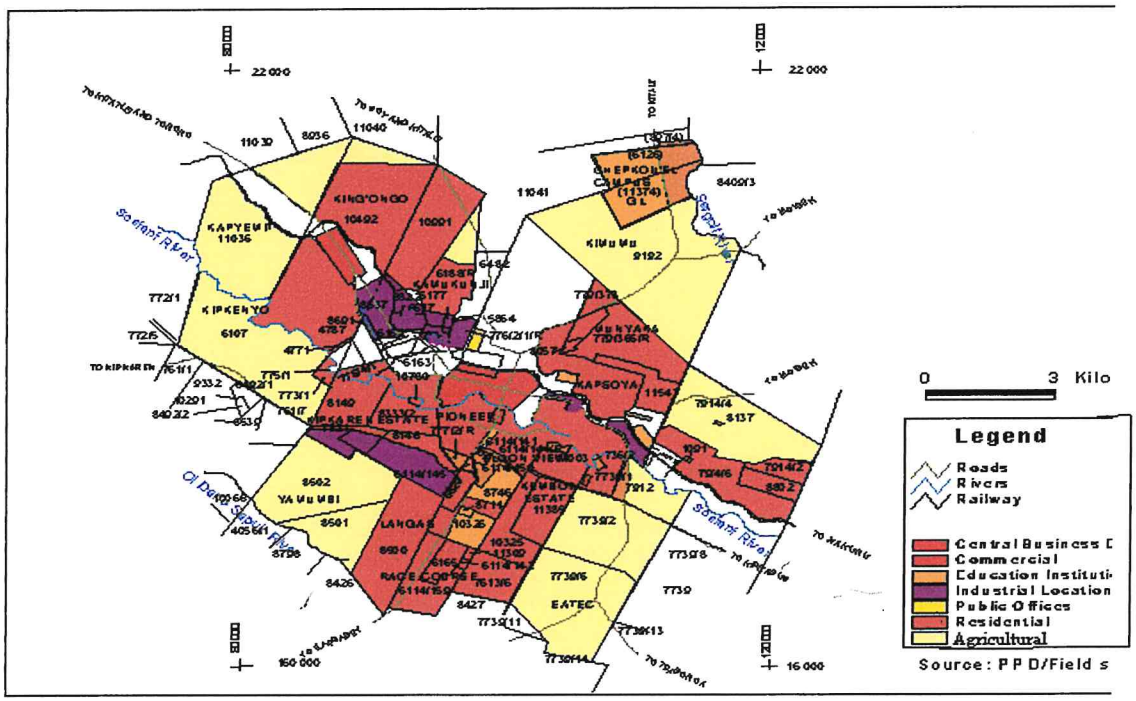


Figure 3.4: Existing Land use pattern

The influence of the prevailing road network and railway line in the understanding of the land use pattern in Eldoret is well understood from the high concentration of different activities along the networks. For instance, although many industrial as well as commercial zones have tended to locate within the CBD, majority however have been specific and either front the main highway or railway line. Based on the above factors, the prevailing land use pattern for Eldoret is as discussed below.

3.4.1. CBD

From the field survey, Lumumba Street could define the CBD to the east, Tagore road to the West, Sosiani River to the South and the northern ridge to the North. As already highlighted, high volumes of human traffic characterize the CBD. The most notable streets within the CBD with high volumes include Elijah Cheruiyot that links Moi Referral hospital to the main Bus park, Oloo Nandi street and Uganda road stretch cutting across the centre of the town.

The presence of high traffic volumes within the CBD however has only but been a blessing in disguise. Many of the manifested problems ranging from congestion thus poor circulation, pickpockets, long detours, accidents thus black spots are only but some of the transport problems facing the CBD.

3.4.2. Industrial development

The town has been providing one of the largest and fastest growing industrial sectors outside Nairobi, Thika and Mombasa due to its unique position in a vast, agriculturally rich area whose economic catchment area includes the Districts of Uasin Gishu, Trans Nzoia, Nandi, Keiyo and Marakwet.

Some of the established industrial undertakings include:-

- Wool spinning and garment manufacture
- Manufacture of plywood
- Manufacture of starch and glucose-processing of dairy products
- Flour milling
- Manufacture of edible oils

There are also a number of skilled light engineering workshops, which provide technical services to the transport industry and mechanized farming. The commerce and industrial sector in the town is significant for several reasons. The production and distribution of essential goods and services is both useful in satisfying basic needs of the population and for provision of inputs in this and other sectors. Eldoret is production and distribution centre for most of the consumer goods and services in the district.

Favoured by a good communication network with the rest of the country and situated in the midst of rich agricultural farmland, the town hosts several other activities i.e., commercial banks, an agricultural finance institution, National Cereals and Produce Board stores, Kenya Pipeline Companies, textile industries among others. The existence of the above enterprises and services has greatly stimulated the level of commercial activity in the district. Since the surrounding area is basically an agricultural area, the industrial development relies mainly on raw materials from the agricultural sector.

The town's industrial development however has been attributed to a number of functions:-

- The growth of the Town as a regional economic centre;
- The strategic location of Eldoret with regard to the export markets of Uganda, Sudan and Central African countries;
- The high agricultural income enjoyed by the residents of the district and the neighbouring districts thereby creating demand for various products and services;
- The strategic location of Eldoret town with regard to the domestic market in north Rift Valley, Western Kenya and Nyanza;
- The readily available supply from the district and neighbouring districts; and
- The well-established infrastructure serving the town.

Land planned for industrial development can be classified into two broad categories:-

- Railway served industrial land; and
- Industrial land not served with railway siding

The railway served industrial land is approximately 27.51Ha and falls adjacent to the railway station and is fully developed. This land however is not completely exhausted since there is still 7.28 Hectares, which can be used for infilling while another 20.23 Ha. is available in an area, which could easily be served with a railway siding from the Eldoret railway station.

The railway served industries comprise the present Unga maize millers, Coca-Cola, Kenya Industrial Estates, MOPW depot and Municipal yard, slaughterhouse and Steel

mill together with maize millers, Corn Producing Company (CPC), former EATEC factory and present KCC milk processing factory. This area is well planned courtesy of the colonial era. The Industrial land not served with railway siding comprises 37.3ha. which is developed while an area approximately 169.88ha conveniently located in a site which is partly serviced with the necessary infrastructure conducive to industrial development is planned and has great potential for future expansion of these services.

Most of the town's industrial zones therefore are located to the East and West of the CBD and front either the railway or Uganda/Nairobi road. A part from the agro-based industries, the town has attracted other key industries and institutions. The modern industrial development is however characterized by the location of industries almost in every direction of the town. Their location a part from the town's structure is a function of the existing rail and road network. Major industries falling within the modern type include Kenknit, Corn Processing Company, Rai Plywood and the former Raymond, KCC and Rivatex industries that have subsequently closed down.

By the time of this study, out of a total number of twelve industries operating towards the end of 1999 in the town, only five were still operating. These include; Kenknit, Corn Processing Company (CPC), Rai Plywood, Unga Millers limited and Rift valley bottlers. The collapse of the others has been attributed to the poor remuneration affecting the farmers' countrywide and the general economic problems facing the country. Since most of the industries are Agro-based, it therefore becomes difficult to sustain them. Improved economic situation and management however could revitalize the lost glory.

3.4.3. Major Industries considered for the study

As established from the field, majority of the industries that could have been vital to this study have either closed down or are at their lowest in production as compared to 1980s and early 90s. Since majority of the industries are agro based, the present hardships facing the agricultural sector has not been favourable. Among the industries that closed down are Rivatex, Raymond, EATEC and KCC. A part from EATEC and Rivatex, the other two have reopened and are picking up slowly. For the sake of this study however, I will dwell a little bit on all the industries even those that have closed down since the present land use pattern characterizing Eldoret town is attributed a lot to their present location.

Rivatex

This industry however is not in operational. It closed down towards the end of 1999 and plans to resurrect it have never yielded any meaningful fruits. All in all, it is one of the oldest industries that started as a joint venture between the Kenya Government through ICDC and four foreign partners, on the outskirts of Eldoret in 1975. From the time of its inception in June 1975, textile mill, lying on an area of 22048 square metres and a total initial investment of Kshs. 283 million, had emerged as one of the high quality fabric's producer for uniforms, suiting and furnishing.

By 1978, its investment stood at Kshs. 400 million with a labourforce of 1162 technical, 249 administrative and 10 expatriates with a total production of 12 million metres of high quality fabrics per year ranging from dyed and printed cotton and polyester blends to locally designed and created original patterns. By the time of its closure, the labourforce was estimated at 2,500 consisting of both skilled and

unskilled. It is this labourforce that is contributing to the present day origin destination pattern to and from Langas and the CBD in search of employment opportunities. Distinct NMT routes although not developed are visible on the ground illustrating NMT movements from one end to the other.

Raymond Woolen Mills

Raymond was one of the biggest factories in terms of size and the number of employees with a labourforce of 2,300, working non-stop on three shifts basis. It was also one of the oldest factories, established in 1968 as a joint venture of the J.K.Organization of India, the ICDC and Chadha Bothers Ltd.

By the time of its closure, the mill had encompassed a comprehensive range of products from sewing thread to fabric; from blankets to ready made suits, employment creation to a training institute manned by its qualified staff with a responsibility to train operators, maintenance personnel, technician apprentices, and supervisors. Its closure came early 2000, which led to loss of employment opportunities.

Unlike Rivatex, by the beginning of the year 2003, Raymond factory, which was under receivership since 2000, had been sold to Rupa investors, the same group managing KenKnit. It has so far employed 1,500 people to start with. The heavy traffic volume of NMT that was associated with Raymond in the early 1980s shall soon peak with the current revival of the factory.

KCC

KCC on the other hand had about 2,000 people employed and sustained by the factory. With the emergence of other milk processing companies and due to poor management, the factory collapsed towards the end of 2000 and can no longer sustain itself. Unlike Rivatex, this factory has re-opened under New KCC and is slowly picking up despite the competitions from other privately owned milk processing plants for instance brokeside.

Rai Plywood

It is the only surviving major industry in Eldoret town with a labourforce of about 3,500 employees. Rai Plywood depends mainly on the natural resources available inform of indigenous trees growing luxuriantly all over the country.

This factory however is on the road to collapse if reforestation measures are not put in place. It is also faced by a number of internal family problems that almost let to the collapse of the industry some time back in the year 2001.

Like Rivatex and Langas, Rai Plywood has also led to the emergence of Huruma Estate together with an agglomeration of activities. In relation to this study, Rai Plywood is well known for the short trips that emanate from Huruma and its environment either on foot or by bicycling.

Ken-Knit

This is the only knitwear factory operating. From a steady start, with a labourforce of 30, the company today employs over 1,500 semi-skilled and skilled workers and technicians. The factory was established in 1966. It is located towards the eastern side of the town about 2km away and along the main Nairobi-Uganda road.

The current production specialises in the production of yarn for the blanket industry and the manufacture of high-value woven blankets. Dralon fibre from Germany is the only raw material imported at present. Its creation is not linked to any residential evolvement, as was the case with Rivatex or Rai plywood.

National Cereals Board

Majestically rising up towards the sky, on the western outskirts of Eldoret CBD, are 12 towering grain silos, silently standing side by side like a well-designed monument. NCPB is a parastal body whose role is to handle cereals from all over the region for storage and distribution. It is also a major source of employment especially, for majority of people living in Kamukunji and parts of Low income Municipal residential zone.

Plate 3.3: NMT route from Kidiwa estate via tunnel towards National Cereals Board

Kenya Industrial Estates

KIE as is popularly known, is a government institution under the ministry of industries, engaged in the promotion of small and medium scale industries. In Eldoret, it was started in mid 1975 and lies on a 15 acres plot of land provided by the Municipal Council. Inspite of the steady start witnessed during its establishment countrywide, the progress however is not that promising since major activities have closed down for instance Mareba roofing tiles. This has also affected employment opportunities within the area.

Apart from the above-mentioned industries, other major points of attraction include Pipeline deport and Kenya Ports Authority inland container depot currently under lease for educational activities by Moi University Evening Classes. Unlike the case for major industries, many of the light industries are located to the western direction of the town. This in a way has boosted the region thus increasing the current levels of trip generation being observed especially from Huruma and the surrounding residential areas of Kahoya and Maili Nne.

The general distribution of industries in relation to this study is quite significant in that the way they are located could easily attract an agglomeration of other activities such as commercial on informal basis and even settlements. For instance, the location of Rai Plywood in the western direction, has contributed to the growth of Huruma as a satellite centre with basic amenities that include shopping facilities, health and educational institutions thus attracting quite a number of NMT trips within the locality as observed elsewhere in this text.

With adequate planning and proper integration of the various land use activities especially in satellite centres closer to industrial areas such as Rivatex, Raymond and the old industrial areas, many trips could be made through NMT mode of transport. This would therefore leave only those trips made for higher order needs to be undertaken to the CBD. The current industrial location has contributed a lot to the various desire lines being witnessed in the town.

3.4.4. Residential Zone

There is great demand for housing in Eldoret particularly low cost houses for the low-income groups. Inspite of this demand, the Municipal council a part from the few structures that were constructed back in 1986, there are no plans for future development and even some of the houses are already earmarked for sale to private individuals. Most of the residential places are emerging due to the private sector initiative, which to a large extent are not well planned. They lack essential infrastructures such as water, electricity, sanitary facilities and road network together with drainage patterns.

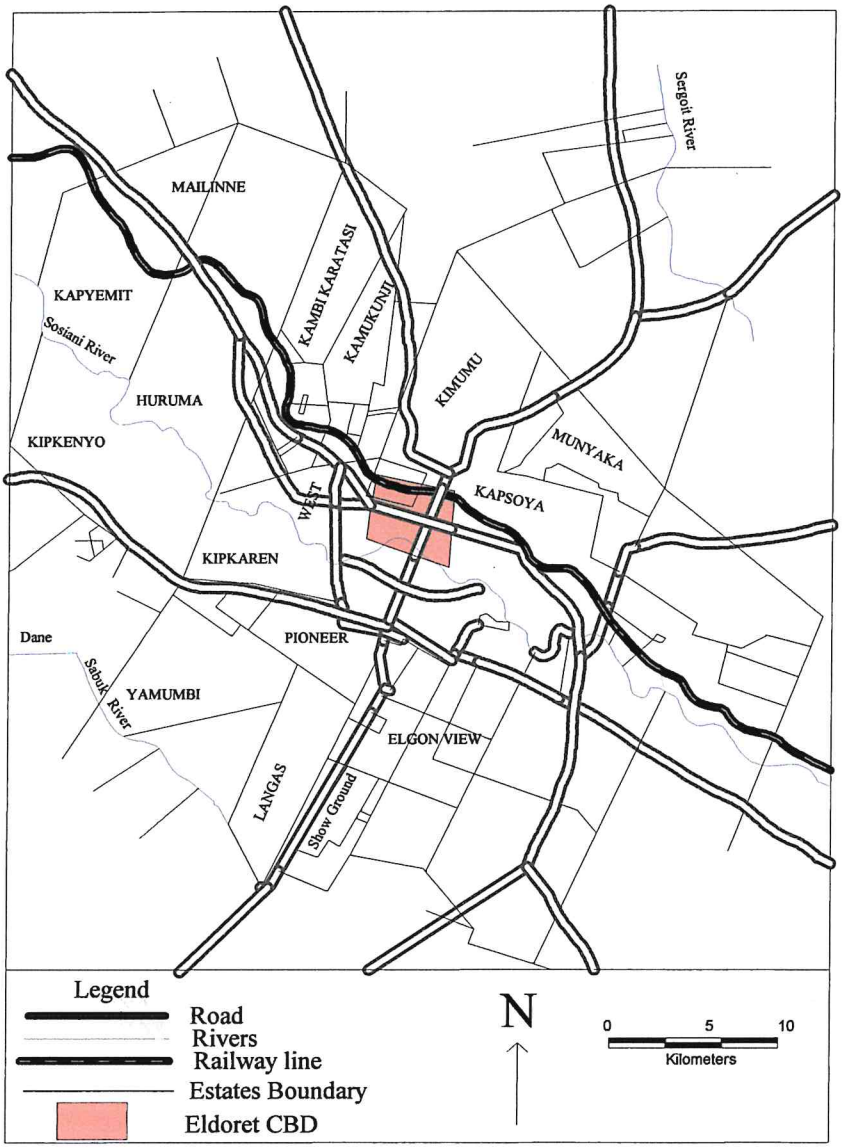


Figure 3.5: Major residential zones within Eldoret Municipal Council

The prevailing structure of the town as already highlighted elsewhere in this study has contributed a lot towards the distribution and siting of residential activities in Eldoret. The study observed a tendency of locating residential areas closer to areas of employment or the CBD. The prevailing land tenure system, where most of the land is under freehold, also explains why most estates are located in the outskirts still dominated by agro-based activities.

The town's residential development can be characterized in the following zones:-

- Langas and Kipkarren
- Huruma, Kahoya, Roadblock, Rural
- Munyaka, Kimumu, Kapsoya site and service
- Elgon View, Racecourse, Pioneer
- EMC houses, Kamukunji, Old Uganda Road
- Kodhek, Bondeni, West Indies
- CBD, Railway, Eastern Avenue, Kapsoya, Hospital.

The above classification is a function of socio-economic aspects, uniformity of landuse, population distribution/density as determined by the 1999 population and housing census. This was the classification adopted for effective administration of this study.

3.4.4.1. Langas and Kipkaren

The zone is located in the southern part of the town and covers an area of 24km$^{2.}$ The population of this area was found to be 27,982 people in 8.986 households in 1989 with male/female ratio being 1:29 at that time (Central Bureau of Statistics, CBS, and National Census). This zone is a home for low-income earners with majority of income falling between Kshs.5, 000 (34%) to Kshs. 10,000 (33%).

The 1999 Population and Housing Census put the population at about 60,973 people and with the current growth of 8% per annum for the entire Eldoret; the current population could be estimated at 75,607 people by the end of 2003. This therefore makes the Langas-Kipkaren zone the most densely populated. The development of this zone however has been attributed to the establishment of Rivatex Industry together with a string of factories located along Kipkaren.

Unlike Langas, Kipkaren benefited from the World Bank site and service scheme although not fully developed. Only 65% of the area is settled. The area however is well planned with proper infrastructure like roads, water, sewer line and electricity thanks, to the World Bank site and service scheme.

Plate .3.4: A section of lower CBD and parts of Pioneer and Kipkarren. Note the numerous routes towards Kipkarren. Photo was taken in 2002.

On the other hand, land in Langas is informally owned with no title deeds as such making it difficult to tell whether it is freehold or leasehold. The current setup being experienced is as a result of the upgrading that was undertaken by **AMREF** which mainly involved the demolition of developed buildings to pave way for the provision of basic infrastructure facilities such as water, roads, and drainage. In relation to this study, Langas consists of heavy volumes of traffic using NMT as explained by the various footpaths stretching all the way from Sosiani River WB SSATP footbridge via 1st street all the way to Langas from the CBD. Trips through MT are also many especially at night since it is insecure to use NMT at night. It is therefore a major contributor of traffic generation in Eldoret as highlighted in the O-D patterns.

3.4.4.2. Huruma, Kahoya Road-block and Rural

This residential zone is located in the western side of the CBD, and on the Southern side of Uganda road. It is densely populated estate in Eldoret and houses a mixture of high and middle residential settlements. Kahoya and Rural Estates are medium density settlements.

The development of Huruma has been attributed to the existence of Rai Plywood factory and of late Kenya Pipeline Depot and Kenya Ports Authority inland container, which is currently being used for teaching services for Moi Universities parallel programmes.

It is also the home of majority of Rai Plywood workers and a few of those who work in the CBD. It also houses the District Hospital thanks to the elevation of the former

district hospital into a teaching and referral facility. Unlike Langas, Huruma has well designed road reserves, which can easily be relied upon in the development of NMT facilities in the estate. Its current population is estimated at 43,768 by the end of 2003. The 1999 population and housing census revealed a population of 35,298 people in an area of 5.6 km^2.

3.4.4.3. Munyaka, Kimumu and Kapsoya site and service scheme

Apart from Munyaka, the other two estates are well planned. However, Kimumu is not fully developed and some of the area is still under agricultural use. It is a zone that mainly houses medium to high-income earners. With a population of more than 11,142 people, Kimumu has developed as one of those settlement areas that had initially been set a side for agricultural settlement scheme. It lies to the Northeast direction of Eldoret town about 5 km from the CBD. It neighbours Munyaka to the south and Illula to the east. It also stretches towards Moi University's Chepkoilel Campus towards the northeast.

Another unique characteristic with Kimumu is that land tenure system is purely freehold due to its historical development as a settlement scheme for the squatters who however have subdivided the land in sizes of 0.1ha and sold them to the respective private developers. Located about 5 kms away, Kimumu is the home for Moi University Chepkoilel campus, attracting residents mainly from the institution and those working from the CBD and other industrial areas and even beyond the town as well as the district. In terms of road network, this estate is well provided with ample space of road reserve with the hierarchy of roads here ranging from 9m to 15m. The ample space is quite ideal for future implementation of NMT facilities.

The impetus of development and growth emerging from the south and east could easily lead to the matching of Kimumu with its neighbouring centres; therefore there is need for a well-developed transport system catering for all demands.
Kapsoya on the other hand is one of those residential areas that have developed as a site and service scheme thanks to the World Bank project. It is also surrounded by such areas as Munyaka, Mwitiritia, border farm majority of which are informally developed with no basic amenities. With the current population being 21,545 people, it is set to increase especially with the current developments taking place.

It houses middle-income earners working in town and as far as Moi University Main Campus. Its proximity to Raymond, KenKnit, KCC, CPC and RVTI makes it ideal for the workers employed in some of the industries. Most of the trips are made on foot. Of the three estates forming up this zone, it is only Munyaka that is informally developed. Lying between Kapsoya and Kimumu, this estate is poorly planned due to the informal settlement that characterised its growth.

3.4.4.4. Elgon view, Racecourse, Pioneer

This zone consists mainly of a low-density medium/high income settlement and is located to the southern part of the CBD along Kisumu road. Some parts of this zone although residential are still dominated by agricultural activities, educational institutions and some commercial activities. The subdivision of former EATEC land and further disposal of the same, has also contributed to further expansion of this zone towards Nairobi road to the East. With adequate elaborate planning, this zone would be ideal for low-density settlement. Majority of full employed skilled and self-employed workers are from this zone. For instance 40.5 % and 23.4% of the

employees are on full time and self employed respectively. This is justified by the high levels of income of over 20,000/= witnessed in the zone.

3.4.4.5. EMC houses, Kamukunji, Old Uganda, Bacon and Shauri Moyo

It is one of the major residential zones in Eldoret located in the western direction of the town about 2Km from the CBD and one of the oldest estates with a population of about 24,777 people as per the 1999-population and housing census. It has the largest number of low/middle incomes majority either working at Rai plywood or within the CBD.

This zone also houses the famous West Open-air market known for second hand clothes especially in western Kenya. It is well sewered with streetlights found almost everywhere within the estate. In relation to this study, the location of this estate closer to the CBD and other strategic points of employment have contributed significantly to the high volumes of pedestrians and cyclists being generated from this area to the CBD. Major streets such as Muyodi, Sixty-four, and Stadium have ended up as major collector streets of Mitaa road thus the high volume being witnessed.

In terms of convenience to the CBD Kamukunji estate located in the northern direction and with a population of about 15,376 people as per the 1999 population is quite ideal. It is among those estates that have developed informally over time due to its closeness to the old industrial area and the CBD.

It also owes its development to the location of the famous Gituro Quarry located within the vicinity.

The present improvement as witnessed in the provision of water, improvement of sanitary facilities and road network was however attributed to the upgrading that was undertaken by AMREF by 1995 and 1998 and through KUTIP undertaken through the World Bank assistance. The area under this estate could also increase especially with the subsequent subdivision of the land adjacent to it in the northern direction. Almost about 400 families are expected to reside within the vicinity. The estate generates high volumes of traffic towards the CBD and the old industrial area either on foot, cycling or through public transport even though most of the streets are not well developed.

Plate 3.5: An overview of Kamukunji estate located to the north west of Eldoret town. The photo was taken in the 2002. Kamukunji is one of the high density zone and its closeness to town makes it ideal for NMT users.

3.4.4.6. Kodhek, Bondeni, West Indies

Is located about two kilometers to the Western side of the CBD and houses mainly middle/high income earners. The income levels for this zone range from 10,000 to over 20,000/=. Out of the total number of people residing in this zone, 35% earn more than 20,000/= with 6% earning below 5,000/=. Majority of the labourforce is also skilled and on both full time (41.5%) and on self-employment (19.2%).

3.4.4.7. CBD, Railway, Police lines, Eastern, Kapsoya, Hospital

This zone comprises those who work and reside within the vicinity of their working place. It is composed of low, middle and high-income earners. It is also dominated by high skilled labourforce who are either on full time employment or self employed. The income levels range from 5,001/= to 10,000/= (42%) while 25% of the households have a monthly income of between 10,001/= to 15,000/= with only 12% earning above 20,000/= per month.

Infrastructure wise, the zone is well endowed with a number of basic amenities such as sewer trunk lines, paved roads, electricity and is accessible to major institutions such as Moi Referral and Teaching Hospital among others. Majority of the trips made in this zone is either on foot or by private vehicles due to the high levels of income and its proximity to the source of employment. Apart from the unplanned residential settlements, private residential developments also exist especially in areas that were initially under agricultural development. This includes parts of Kimumu to the northeast, Yamumbi to the south, Kapsaos to the west, which are still dominated by agricultural activities. Most of these areas have ended up as satellite towns for Eldoret town.

The town is also a home to other unique landuse activities, which play significant roles. They include: - Eldoret International Airport located to the south, Moi Referral and teaching Hospital, Moi University town and Chepkoilel campuses and church institutions all of which are instrumental for this study.

CHAPTER 4: FINDINGS, ANALYSIS AND RESULTS

4.0. OVERVIEW

This chapter gives an account of the overall transport situation in the study area with a view of determining the Non-Motorised transport system in the study area. It looks at the key issues, which forms the baseline of this study. The analysis derived is what has formed the basis for formulation of guidelines in relation to the integration of NMT in the overall planning and development of medium sized towns in the country.

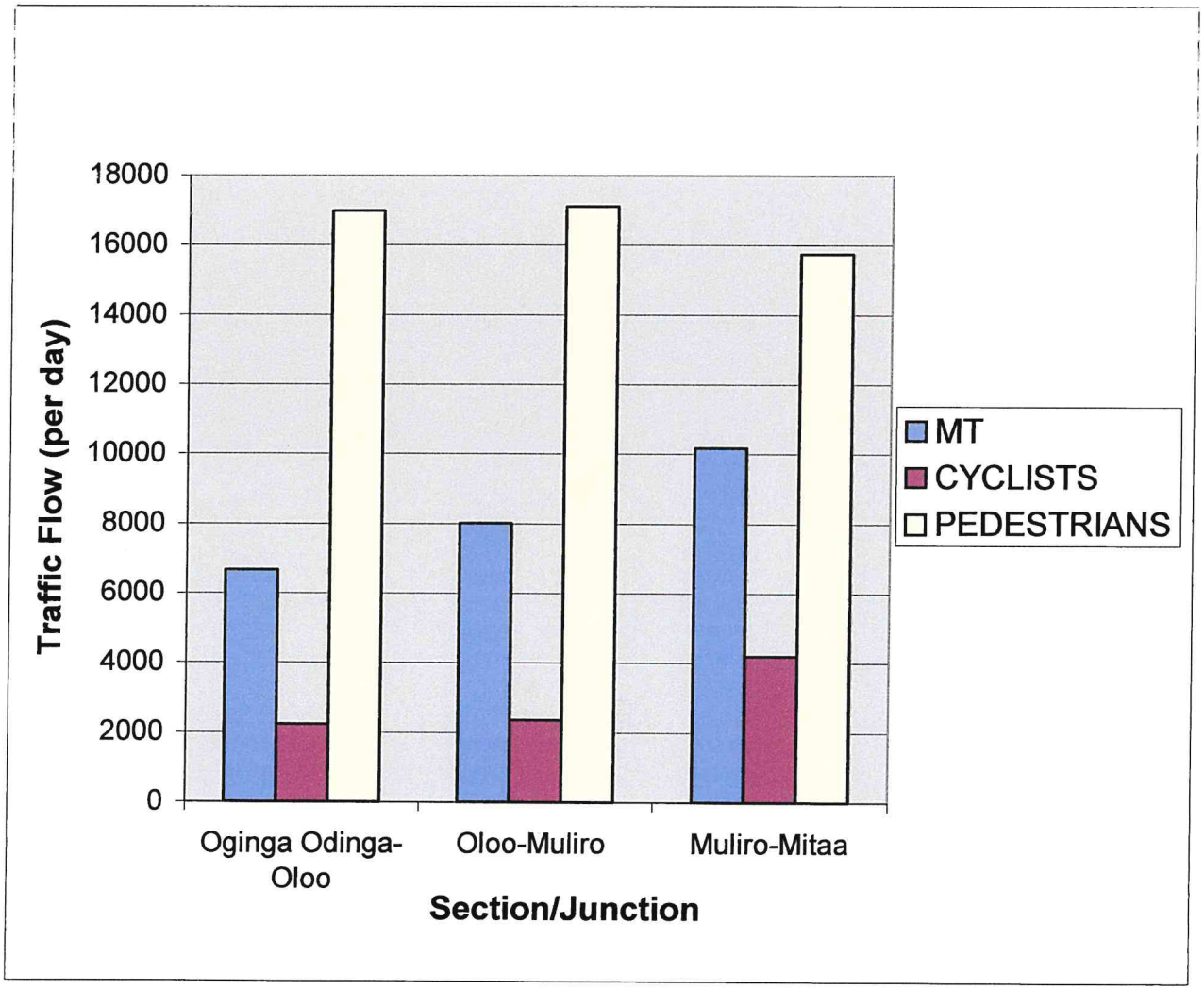
4.1. Existing Transport Situation

The town's transport system is based on the existing road and railway network, which form part of the regional transportation system both locally and internationally as illustrated in Fig **4.1**. The railway line for instance has been instrumental in linking the town with the port of Mombasa, Nairobi and Nakuru in Kenya and Tororo, Jinja, Kampala and Kasese in Uganda. On the road network Uganda Road consisting of both through and local traffic and characterized by high volumes of traffic flow of both MT and NMT is quite pivotal to the study.

Table 4.1: Traffic flows along Uganda Road per day (12 hours) in both directions

Section	MT	Cyclists	Pedestrians
Oginga Odinga-Oloo Junctions	6,671	2,214	16,972
Oloo-Muliro Junctions	8,016	2,344	17,102
Muliro-Mitaa Junctions	10,167	4,195	15,749

Source: Field Traffic Count 2002.



As illustrated in fig. 4.1 and table 4.1, high volume of both MT and NMT traffic flow is recorded at the major intersections along Uganda road, a fact that was found attributable to the numerous land use activities located on either side of the road thus influencing the various mobility systems. For instance, many pedestrians cross Uganda road at Oloo intersection to the northern direction since the District Headquarter together with other facilities like slaughterhouse and water offices are located in the Northern direction.

4.1.1. Road categories and hierarchy system

All roads in Eldoret form the road network and not all of them have the same significance or function for the movement of traffic. From planning point, Eldoret's road network can be classified into a number of types, according to their main function. Although the functional classification used in different countries are quite similar, there are some differences in the vocabulary used. The Eldoret classification was found to consist of (i) access roads, (ii) collector (local and major) and (iii) the urban corridor as based on the UK tradition being applied in the whole country.

4.1.2. Access roads

In this case, access roads are those streets that provide access to houses, shops, offices and plots and form a large part of the public open space in a city. They also provide a play area for children. Irrespective of the mode of transport for an earlier part of the trip, studies have shown that final access to buildings is always on foot. Urban access streets are first and foremost pedestrian territory.

In Eldoret, access roads were found to comprise such streets as Muyodi, Stadium, sixty-four, Elijah Cheruiyot, Oloo, Muliro and Tagore with each playing a major role of linking either traffic flow from the residential area to the CBD or to work place. For the sake of this study, these streets form the backbone of the non-Motorised transport in Eldoret as established from the heavy human traffic flow along them. High volumes of pedestrians and cyclists were recorded during peak hours in the morning or evening with majority of people either heading to employment areas or to residential.

Due to the general structure and land use patterns characterizing Eldoret, the study noted a scenario where most access routes are only significant to a certain component of the non Motorised transport. For instance, while Muyodi, Stadium and Sixty-four streets were found to play a vital role in linking pedestrians from the major residential zones to the CBD and other employment areas located beyond the CBD, market and Sosiani streets located within the CBD were found instrumental for both handcart pullers and pedestrians heading to the Municipal whole and retail markets. Majority of the access routes however are narrow, inaccessible, congested, insecure with no streetlights, poorly drained and too long, especially those passing through private land. Long detours end up being formed.

As a result of the above conditions, most of the routes are hardly used throughout the season for instance during rainy seasons or at night for fear of being mugged.

4.1.3. Collector Road

Two categories of collector roads were observed and these were minor (local) collectors and major collectors. The differentiation was brought about by the function of each system. These routes are popular to pedestrians an attribute that has attracted quite a number of economic activities such as shops, hotels, small business, workshops and financial institutions locating along them with a hopes of getting clients. They also provide the link between access streets and collectors and corridors although this is only applicable for traffic with its origin or destination found within the concerned neighbourhood.

The following were found to be the local collector roads within Eldoret.

They include: -

- Ramongi drive
- First Avenue located to the south
- Third avenue
- Sirikwa road
- Sixty four street
- Arap Kitongo
- Kimathi road

As noted from the field, most of the above local collector roads have an MT traffic volume that leaves plenty of space for cyclists of which with simple traffic calming measures, they can be made safe and attractive to NMT users especially the cyclists.

One common characteristic with most of the local collector roads in Eldoret as applied to most cities in Africa, is that they are the lowest class of roads expected to

have bitumen carriageway pavement thus making walking along the local collectors in general absent.

4.1.4. Major Collector

The major collector roads were found to include: -

- Mitaa road
- Oloo Street
- Nandi
- Muliro
- Oginga Odinga
- Tagore
- Uganda
- Kisumu
- Elijah Cheruiyot

Majority of the major collector roads it was established connect local collectors and access streets to corridors as well as other local collectors and streets. For many trips within Eldoret, whether entirely pedestrian or by bicycle or including a "matatu: or by car, a collector road it was found is the highest class of road used. The desirable distance between collector roads depended on the land use density and the MT volume. It was also established that majority of the collector roads have an important access function for the activities along the road. Within the CBD and in district centres, they are concentrations of economic activity with many shops and offices located along them.

As shown elsewhere, high NMT traffic flow is usually recorded along these routes making them quite significant in the planning and integration of NMT in the overall transport system.

From the traffic counts undertaken, local and major collector routes play quite a significant role in the overall urban situation in the town. Their functions were found to range from accessing different modes of transport to various land uses in the CBD as already mentioned above. The counts also revealed high volumes of traffic flow consisting of various users ranging from pedestrians, cyclists, handcart pullers or a combination of any of the modes. The respective function of each route however was found to revolve around the origin and destination pattern prevailing.

A significant element observed in relation to these routes is that their variant usages also make them appear unfriendly to its users. The heavy traffic flow witnessed it was discovered is the source of the high insecurity problems on the routes involving NMT and MT. Other cases of traffic congestion, accidents, improper traffic chanelisation and high levels of black spots were observed as major problems making the routes not only unusable but also unfriendly.

4.1.5. Urban Corridor

The most important function of an urban corridor road in a town is to provide for efficient transit traffic from one part of the city to another. The second and almost as important, function of urban corridor roads is that, because of the optimal accessibility that they give, they are a prime location for important urban activities, such as office buildings, shopping centres, large markets and large businesses Marius De langen (2001).

Traditionally, the corridor network is radial towards the central business district (CBD), but increasingly the demand for efficient traffic movement between other parts of the expanding city, the outside CBD, have occasionally necessitated corridors that have no relation to the CBD. Urban corridor sections outside the CBD also have significant potential to develop as important activity concentrations thus reducing the need for longer trips to the CBD.

Studies on urban corridors also reveal that the preferred distance between parallel corridors is usually quite high, in a square road grid, it varies between around 3km in the central parts and 6-10km towards the urban periphery (SSATP 2001)

Based on the above characteristics, Uganda-Nairobi highway was found to be the major urban corridor in Eldoret with the minor ones including Kisumu Road, Elgeyo Road, Nandi Road and Sergoit Road together with the railway, mainly for transit goods either to or from Uganda. The respective corridors however approach the town in a radial manner, and form the main MT traffic inlets.

In the subsequent chapters, more details have been covered about the above road hierarchies in relation to the study. The backbone of the transport system in Eldoret however, was found to consist of the motor network that adds to a total of about 240 Km long thus making the town one of the well-connected regions to surrounding settlements. Both pedestrian walkways and bicycle tracks appear longer and dense although no records exist on their actual size for most of them are located beside the MT.

4.2. Road Maintenance and Traffic Management

Out of the 240km of road network in Eldoret the study established only 55km classified as trunk roads whose maintenance responsibility is the Ministry of Public works and Housing (MOPW&H). These trunk roads include Nairobi/Uganda Highway, Kisumu road, Elgeyo, Sergoit, Oloo Street, Oginga Odinga Road, Plateau and Kipkaren road.

Eldoret Municipal Council on the other hand is responsible for the design, construction and maintenance of a large section of the urban roads, storm water drains, street lighting and bridges including pedestrian and cycle tracks.
On road management, the transport system is further divided among several agencies whose operations are not clearly synchronized. For instance, it was observed from the field that both the MOPW&H and Eldoret Municipal Council irregularly maintain most of the above roads. This has led to the increase in accident levels within the CBD and traffic congestion due to the mixing of the local and transit traffic in the CBD. A number of accidents have also occurred as illustrated in table 4.2 due to the nature of roads majority being either poor or very poor as seen in table 4.3.

Table 4.2: ACCIDENT DATA FOR THE YEAR 2000-2003

YEAR	DIED	SERIOUSLY INJURED	LIGHTLY INJURED	TOTAL NO. OF VICTIMS
2000	56	203	206	465
2001	101	261	412	774
2002	78	229	242	549
2003	68	148	192	408

Source: Traffic police –Eldoret 2004

Table 4.3: Conditions of road network

Condition	*Paved (Km)*	*Unpaved*	*Total*
Good	36.53	0 .00	36.53
Adequate	17.75	4.04	21.79
Poor	36.27	79.00	115.26
Very Poor	16.98	49.51	66.49
Total	*107.53*	*132.54*	*240.07*

Source: Ministry of Local Government (UDD) 1999.

From Table 4.3, out of the 240km forming the road network, only 44.7% or 107.53km is paved and of the paved surface, 15% is classified to be in good condition, 7.4% adequate 15.1% poor and 7.1% as very poor. The unpaved road network totals to 132.54 Km or 55.2% majority of which is either in poor or very poor condition.

The road network within the CBD is well maintained thanks to the World Bank project undertaken either under KUTIP. A few of the residential roads especially the collectors roads are paved although majority of the streets are not only unpaved but are poorly lit with no streetlights at all. Most of these streets fall mainly in the low and densely populated residential zones such as Langas, Huruma, and Ngomongo.

A part from the few roads that form corridors from various directions, there exists no outer ring. This has led to the high level of congestion witnessed in the CBD along the only International Trunk Road (A104)- the Nairobi Uganda Highway that passes through the CBD.

4.3. Modes of Transport

Various modes of transport were identified and they included walking, cycling, handcart pushers, public and private transport, private and cycling. The usage of each mode of transport however was found to be a function of the users ability economically, distance to be covered as determined by the origin-destination and the purpose of the trip being made. Walking for instance, tended to confine within the

CBD, residential areas and to place of work with an average distance covered ranging from between 1km to 5km.

The use of public and private mode of transport it was established is determined by distance, time, function of the trip and users ability. For instance, the study noted that majority of trips involving public transport involved people who stay at the periphery of the town and work in town. The influence of economic ability was found to affect mainly those in the middle class group who own good residential houses.

Of the highlighted modes however, the study through a household survey established that walking is the most predominant mode of transport in Eldoret with many residents walking to places of work- CBD, Industrial area and back to their homes. About 45% of trips are made on foot, while public transport accounts for 25%, private car 15%, cycling 10% and other modes accounting for 5%. The bulk of the walk trips are from the relatively low-income areas like Huruma, Maili Nne, Bondeni, Kamukunji, Langas, Kipkaren, Jerusalem and Ngomongo.

Public Transport is provided by "Matatus", mainly between the CBD/Industrial area and the distant low-income areas highlighted above. Cycling on the other hand is relatively developed as compared to other larger cities like Nairobi. Although there is a downward trend in the development of cycling, its modal share is significant and potential for further development if adequate infrastructure is provided. Inspite of the popularity bestowed on each mode by its users, the study established a number of problems affecting each mode, which hinders their effectiveness. Majority of these problems are discussed in the text.

4.3.1. Major Public transport corridors

Apart from the transit buses that converge at the town's bus park either to up-country or major urban cities such as Nairobi, Kisumu, Nakuru and the boarder towns like Malaba, Eldoret as a town has no public bus services. As much as public transport accounted for 24% of the trips made either to work or CBD, the commonly used mode of public transport was mainly by use Matatus spread all over the town. They either link the CBD and the residential areas or major industrial and educational areas. Majority however operates between the CBD and the residential areas especially in the low-income areas.

One major observation was that the composition of traffic flow both in the morning and evening was found to be more less the same as characterised by the pull and push factors determining mobility situation from one point to the other.

The major prominent routes used for public transport served by Matatus originating from the CBD in the town were found to include: -

- Langas route
- Huruma/Mwenderi route
- Kapsoya-route
- KCC/EATEC/Sukunanga corridor
- Chepkoilel, Kimumu/ Munyaka route
- Maili Nne route
- Kamukunji/ Kidiwa/Mwanzo route

The significance of the above routes to NMT lies in the fact that virtually all of them are also used by the various NMT users within the town from various localities as

articulated elsewhere in this text. Another significance is that they are also the source of conflict between the motorists and the NMT users as explained by the high levels of accidents and black spots discussed in this text. A critical analysis of each route therefore illustrates each route's ability to public transport as well as NMT. Since the destination was found to be the CBD, the council has provided a bus park and a Matatu park that is patronized by heavy-duty buses and transport vehicles. Buses provide regular transportation between the town and the countryside.

Table 4.4: MT/NMT Traffic flows along major routes in Eldoret

Route	Pedestrians		Cyclists		Matatus		Other Vehicles	
	12hr	Peak	12hr	Peak	12hr	Peak	12hr.	Peak
Nairobi (East of CBD)	6,888	544	1,001	336	830	89	5,841	642
Nandi	10,954	1,314	1,427	356	----	----	1,827	335
Kipkaren-Sosiani	2,703	437	84	7	----	----	------	----
WB SSATP/EMC	6,999	971	200	23	----	----	------	----
Upper Oloo	12,171	1,014	1,443	324	----	----	2,974	391
Mitaa	11,552	1,552	2,651	339	1,553	52	2 ,224	254
Huruma (west of CBD)	4,197	450	1,544	171	1,799	250	4,589	396
Kisumu	14,408	2,000	2,919	412	1,585	100	6,693	734
Oginga Odinga	2,596	330	854	124	700	87	1,734	174
Elijah Cheruiyot	36,000	4,000	1,000	130	-----	-----	120	20
Kidiwa Tunnel	4,008	485	2,000	200	-----	-----	------	------
Elgon View (1)	988	212	315	58	-----	----	615	118
Elgon View (2)	300	30	26	6	-----	----	----	----

Note: (----) represent routes, which are currently used by NMT only

Source: field survey traffic count 2002

The table (4.4) comprises both MT and NMT routes although there are those specifically used by NMT. For instance, Kipkaren-Sosiani, WB SSATP/EMC and Elgon view (2). More details on the respective routes are covered under NMT review. The major MT routes discussed as highlighted in the above table were as follows: -

i) Langas Route

This route links Langas to the CBD. It also caters for on going traffic to either Kapsabet or Kisumu. The Langas route forms a loop on Kisumu road from Eldoret Polytechnic junction through Langas, then joining Kisumu road again at Corner Mbaya.

There are several Matatus operating on the route especially in the morning and evening rush ours. Due to the high volume of traffic during peak hours, residents walk to the main Kisumu road in the morning to time the few Matatus available to town. The situation is usually repeated in the evening where heavy volumes are usually witnessed as depicted by the long queues of people waiting to board the available Matatus. The situation is even worse during rainy seasons where people are forced to walk some distance from the town centre to board the Matatus.

The traffic count undertaken on the route revealed that some same vehicles went back and forth several times recording traffic volume of 1,555 vehicles on the route between 6a.m and 6p.m. a period of (12hours). The above counts however included traffic beyond Langas. The route mainly serves the low-income area where a substantial number of people are employed in the CBD and its environments.

In terms of quality, this route is well maintained thanks to the Ministry of Roads and Works. This improvement however is what has accelerated the numerous problems being experienced between MT and NMT. The scenario is so pathetic as you approach the CBD across River Sosian where, due to the narrow bridge and sloppy gradient, cases of accidents are high on the route thus calling for effective traffic calming.

ii) Huruma/Mwenderi route

This route was found to rely mainly on Uganda road and serves traffic volume from the Huruma and Mwenderi to the CBD and vice versa. Huruma and Mwenderi have a large concentration of low-income people who work in industrial concerns like KenKnit and Raymond's located 7Km away from the 2 areas to the east of the town. Save for a few of the residents who work at Rai plywood 500m away, as such can afford either to walk or cycle, most people use Matatus to town in order to connect to their respective work place.

From the traffic counts, some same vehicles numbering 1,799 were discovered to ply on this route between 6a.m to 6.p.m. The peak hour occurring early in the morning and evening, usually records a total of 250 Matatus. The number of Matatus plying along this route is large but not large enough to cater for all the needs of the residents. Most workers therefore walk to work place using the most direct route through the housing estates of Old Uganda Road, Macharia, Mayabi to town via Mitaa road. Like the case with Langas, this route also caters for traffic flow beyond Huruma. The route acts as a cordon point to Eldoret from the western direction and carries traffic flow

that goes beyond the satellite located in the western region such as Maili Nne and Baharini.

iii) Kapsoya route

This route links Kapsoya site and service-housing scheme together with its environment to the CBD. Compared to other areas, the traffic volume is low to an extent that many people walk even with adequate fares or hike to town from private vehicles.

The route goes beyond Elgeyo Border. The low Matatu traffic could be attributed to either the number of people with private vehicles or the rough road that is not paved. The estimated distance to town is about 3Km. As shown in plates 4.1 to 4.3, this route is dusty and usually muddy when it rains. Due to the poor road conditions, most of the sections are usually impassible during rainy seasons forcing passengers to either walk for along distance.

The condition of the route has also led to the emergence of routes through private plots as safe nets for passengers when the route is impassible. The condition and quality of this route however was found to be so pathetic as explained by the numerous breakages observed on the route as shown in plate 4.2 above. The route is not paved as a result usually impassable as well as insecure for the NMT users. Most of the problems facing the route were found attributable to the nature of maintenance conflict between the council on the one hand and the Ministry of Roads and Public works office.

iv) KCC/EATEC/SUKUNANGA

This route links the Central Business District and the industrial concerns of KCC, CPC, RVTI as well as Sukunanga estate and Moi University Annex Campus. It is a stretch of about 5km from the CBD. Due to its flatness, majority of people either walk or cycle to their respective places but depending on the significance or purpose of the trip being made. The emerging utilities such as the opening up of Moi University Annex Campus and numerous residential structures is however set to increase on the usage of MT as compared to NMT. The nature of the trips could entail making trips late in the evening with a purpose of going for parallel education programme.

As pinpointed in table 4.4, a high volume of Motor traffic is usually observed on the route either entering or leaving Eldoret town. The traffic counts undertaken revealed that a total of 830 vehicles mainly Matatus were observed to using the route in both directions between 6am to 6pm. The flow is however set to increase with the current developments taking place on the former EATEC land initially under agriculture but

has since been subdivided and changed from agriculture to include residential, commercial and educational.

v) Chepkoilel/Kimumu/ Munyaka route

This route covers a distance of about 5km away from the CBD to the North. It serves Chepkoilel Campus, Kimumu and Munyaka satellite centres forming Eldoret Municipality. The route experiences high Matatu volume as far as beyond Chepkoilel upto Iten, Kabarnet, Marakwet and Kitale.

The high traffic flow especially of Matatus along this route was found attributable to the major land use activities located within this region. They range from Moi University Chepkoilel Campus the numerous satellite centres forming part of Eldoret Municipality, Initially Moi University used to provide means of transport means to its employees. The situation has changed in that they are no longer provided by transport thus leaving them to rely on public transport. The service however is far from adequate and there is an urgent need for regular service.

vi) Maili Nne route

Along the main International Trunk road to Uganda about 6.5Km away to the west lies Maili Nne satellite urban centre. It is an upcoming centre dominated purely by residential activities, which have made it more of a dormitory centre to the town. Most of the residents work in the CBD and given the long distance to be covered, majority of them either use Matatus or Buses from upcountry with a small proportion either walking or cycling to their respective points depending on their location of work. Apart from linking up Maili Nne to the town centre, the route is also popular to traffic generated as far as Mile thirteen and Soy along Kitale road.

vii) Kamukunji/ Kidiwa/Mwanzo

This is one of the most used routes, carrying traffic flow from three densely populated residential areas. It serves also the famous west open-air second hand cloth market, which usually records heavy traffic flow during the market day; normally on every Friday. Traffic counts revealed a volume of 1,553 trips made by Matatus are recorded on this route between 6a.m. to 6p.m with the peak hour recording about150 Matatus. In relation to this study, further analysis of the above routes shall assist in determining how the respective routes can be integrated with the needs of NMT. Most of these routes are also used for NMT traffic, which therefore contributes to the high levels of traffic conflict between MT and NMT. As shown on the table 4.4, quite a number of routes carry heavy volumes of NMT.

Viii) Uganda Road

In relation to the above MT and NMT routes, there is need to pinpoint something on Uganda road, a route that divides Eldoret's CBD into two portions being the southern and northern region. Apart from the heavy traffic volumes experienced of both MT and NMT, Uganda road emerged as both a significant route in MT and NMT traffic flow as well as a source of conflict especially affecting NMT within the CBD.

With the absence of an outer ring route, the route has become instrumental especially for transit traffic passing through the town. The heavy volume therefore is what has led to the current problems or conflicts affecting NMT users especially at the major crossing points and intersections. Major traffic black spots tend to be found along the route.

The study survey revealed that, the road serves a number of (conflicting) functions: -

- It is the major national highway to/from Uganda
- It is the only East-West urban corridor in the Eldoret Road network
- It serves as access to public and commercial functions
- Caters for all types of local and transit traffic and;
- Has a major bearing on the development structure of the town.

The road is intersected by a number of major North-South roads, notably the intersections with Oginga Odinga Street, Oloo Street, Muliro and Mitaa road.

Although designed as a dual carriageway, the road width in either direction varies between 5 and 8 metres thus being mostly used as a rather wide single lane highway which greatly reduces its capacity. The carriage is also separated by a narrow (1.5m wide) raised median, although the absence of this median in a number of locations allows MT to make right turns, amongst others at the numerous petrol stations along the road.

This route stretches from Oginga Odinga Junction to Paul's bakery and beyond consisting of a wide dual carriageway (2 lanes in each direction separated by a narrow island) and has an angular and parallel parking provision on some sections for MT. It has no service lanes and verandas are used by informal business, which forces NMT users to share the road with MT. Due to the congestion on the road, MT average speeds vary between 15km/h and 45km/h within the CBD, but are higher as vehicles leave the area. During off peak hours, the v85 speed is 65 km/h also the high numbers

of heavy commercial vehicles cannot allow for the safe use of the same road space by pedestrians and cyclists.

As highlighted already in this text, Uganda road is one of the key NMT routes in the town in that it links various parts of the town to overall land use activities. Given the location of land use activities, there has been a tendency of many people either cycling or walking throughout Uganda Road to be able to reach their respective points.

A part from the various conflicting points, Uganda road is the only route that has integrated NMT in the overall land use development in the town. The route has both pedestrian walkways and cycle track existing on the stretch. For instance from Paul's Bakery towards the CBD, there exists a cycle track on the right hand side covering about 700m upto Tagore street thereafter, the World Bank under Sub Sahara Transport system constructed cycle track of 2m wide on the right hand side towards the CBD.

4.4. Non Motorised Transport Situation in Eldoret

The use of NMT system is well pronounced with many trips being made either on foot or by cycling. Of the various transport modes that exist in the study area, NMT traffic flow was observed to account for about 58% with walking accounting for 48% and cycling 10%, respectively.

The study also observed that a lot of walking is confined within the CBD and that the bulk of the NMT trips are relatively from the low-income residential zones. These were noted to include areas such as Huruma, Kamukunji, Maili Nne, Bondeni, Langas, Jerusalem, Municipal Council low income houses located to the western side of the town, site and site housing residential zones and from residential areas located in the town centre such Kenya Railways and police quarters.

Apart from trips emanating from the residential areas, NMT usage is also confined within the CBD where walking accounts for almost 80% of the trips made. Places such as Municipal wholesale and retail Markets, public offices, financial institutions, working places, health institutions and educational points appeared either as major origin points or destination areas of NMT mobility within the CBD. The actual structure and existing land use patterns were found instrumental especially in determining the modal split and distribution as observed from the heavy traffic flow witnessed on the main NMT routes.

The major NMT routes within the area of study were found to include the following:-

- Nairobi Road
- Nandi Road
- Elijah Cheruiyot Street
- Upper Oloo street
- Mitaa Road
- Oginga Odinga Street/Iten Road
- Uganda Road
- Kisumu Road
- Kidiwa tunnel route
- Residential/neighbourhood route
- Market/ Rotary /WB EMC footbridge
- Ronald Ngala Street
- Elgeyo/Kapsoya Road

As noted earlier in Table 4.4 and figure 4.2, most of the routes are confined within the CBD with notable ones being Elijah Cheruiyot Street, Uganda Road, Nairobi Road, Market Street, Ronald Ngala and upper Oloo Street. The rest act as either main collectors or distributors of traffic flow from the residential areas to major employment, health, education or and public areas.

In addition to the above routes, the study also established quite a number of routes which are popularly used either within the residential areas or on private property majority of which are demand driven. An analysis of each route however is as articulated in the next page.

4.4.1. Nairobi route

It is an extension of Uganda Highway on the eastern direction. It is a 2-lane 2-way road. The route was established to carry traffic mainly from the relatively low-income areas of Huruma to the West, Langas to the South and Kamukunji to the North through the CBD to factories located to the east i.e., Ken-knit, Rupa formerly Raymond and CPC. It is the only direct route from the CBD to the above factories as shown by high volume of pedestrians and cyclists (544 and 336 respectively) during the peak hour.

The route stretches all the way from Ronald Ngala junction eastwards. Apart from NMT traffic, the route also experiences high flows of MT traffic, approximately 6,671 per 12hour count and 2,000 during peak hour. The composition of MT traffic consists of both through and local traffic.

Traffic flow affecting both cyclists and pedestrians on this route was found to be at its peak early in the morning for those going to work, during shift hours for those working on shift and in the evening when majority of the workers are heading back to the residential areas . From the origin destination patterns, most trips are either made to work and back to the residential areas.

Another characteristic as concerns this trip is that many of its users either use MT up to the Bus park before walking to their place of work and for those who cycle do it for the entire journey of about 5Km depending on their place of origin. An analysis of the route established that although the route is paved for MT, it lacks cycle tracks and other infrastructures for use by NMT in general. This forces the cyclists to share the

carriageway with MT (that consists of more than 5% heavies). Further, the narrow road (each lane is about 3.5m) is bordered by high Kerb edges which cannot allow cyclists to give way to a flowing vehicular traffic whenever necessary.

The most affected place is along Nairobi Road near the Catholic Cathedral where most cyclists are usually forced to alight from their bicycles due to the raised and continuous Kerb on both side of the road making it impossible for them to escape. Another major problem on this route facing NMT users was found at the bridge near Ronald Ngala, which calls for further widening to provide ample protection of NMT users. For instance, there are no guardrails thus exposing users to danger. Inspite of the closure of most of the major industries such as Raymond (although it has resurrected as Rupa), EATEC, KCC, and this route is still significant for heavy volumes traffic flows are still noticed along the route. A part from the few footpaths that exist, there is still need for the widening and proper segregation of NMT from MT so as to minimize the cases of accidents especially at Catholic cathedral church.

4.4.2. Nandi Road

This route stretches from Oloo Street (Municipal whole sale market). The route acts as a collector route for traffic flow emanating from Elijah Cheruiyot Street, Oginga Odinga, Ronald Ngala, Oloo, Kenyatta Street and Kisumu Road. The significance of this route lies in the fact that it caters for traffic flow mainly heading to Moi Teaching and Referral Hospital located towards the eastern direction along Nandi Road which caters for all referral cases in the rift valley and western region of Kenya and even beyond Kenya as far as Uganda and Southern Sudan. The Hospital lies to the east of the town.

Apart from the hospital, the route also links both NMT and MT traffic flow to other significant areas such as Ken-knit, Rupa formerly Raymond factory, Kenya Co-operative Creameries, Corn Products Company (CPC) all located to the east together with traffic flow to the CBD especially to the Bus and Matatu parks. Most of the traffic flow on the route therefore consists of that emanating from within Eldoret and the up-country. Usually, high volumes of pedestrians and cyclists are recorded on both side of the route during peak hours.

NMT traffic counts carried out on the route indicated a total of 1,314 pedestrians and 400 cyclists on both sides using the route. The study also observed that the high traffic flow usually occur during lunchtime and in the evening. These are the hours set a side for visiting patients at the Hospital. Unlike other routes, this route also operates 24 hours depending on the nature of emergency to the Referral Hospital. Since MT flows are light, cyclists do share the carriageway with MT with no problem.

From the road side interviews however, inspite of the significant role played by this route, the route is hardly lit at night exposing its users to the danger of being mugged. The route analysis also revealed lack of pedestrian walkways and cycle tracks with both NMT and MT being forced to share the road thus the numerous conflicts encountered. The route also lacks basic infrastructure such as security lights, roadways furniture for the weak ones who cannot walk all the way to and from the Referral Hospital. The route is also poorly drained and given the sloppy gradient to the west, it floods during rainy seasons as such forcing users to make long detours via Nairobi road or Lumumba avenue to and from the hospital. The existence of bumps and ramble strips on the route especially near the hospital is what has helped in containing the anticipated over-speeding by either motorists or cyclists heading towards the CBD due to the gentle slope. This route covers a distance of 750m.

4.4.3. Kisumu Road

Like Nairobi and Uganda route, Kisumu route is a major national route serving both local and transit traffic to other towns to the south of Eldoret. Traffic count on the route revealed that 20,408 pedestrians, 4,002 cyclists, 3,085 Matatus and 68,693 other motor vehicles use the road between 6 a.m.- 6p.m use the route. This information was

far much higher as compared to the World Bank study of 1997 that indicated a population of 14,408 pedestrians, 2,916 cyclists, 1,585 "matatus" and 6,693 other vehicles found to be using the route in 1997. It also explains the level of traffic growth on the route since 1997.

This route carries NMT traffic flow from parts of Langas and its environs to the CBD and major industrial zones in the town. The high flows are usually witnessed in the morning hours and late in the afternoon. Like is the case with other routes, this route lacks the essential NMT facilities. Several accidents involving school children do occur along this route due to high MT speeds with both Sosiani and Hill schools identified to be major black spots. The same applied to Sosiani River Bridge, which is narrow to allow for safe NMT use. It should be noted however that through traffic calming undertaken through Sub Sahara African Transport Programme, it is now safe for NMT to cross River Sosiani along Kisumu road.

Apart from speed calming measures at Sosiani bridge crossing and at Harambee avenue junction, undertaken to create safety for cyclists and pedestrians, the entire route covering about 5Kms lacks NMT facilities leaving them to compete with MT for accessibility.

The route however is very wide (minimum width 15m) and can accommodate NMT users by creation of 2m on each side of the road. From the field survey, it was observed that the route acts as a detour route for NMT traffic flow during rainy seasons and at night for majority of pedestrians and cyclists heading towards Pioneer, Kipkarren and Langas Estates through Sosiani footbridge.

It also acts as a collector route for traffic flow from other streets such as Sirikwa Street, pioneer route and plateau road. The significance of this route lies in the fact that it is instrumental to traffic either from or to CBD to the low-income areas of the three estates highlighted above.

4.4.4. Oginga Odinga /Sergoit route

This route stretches all the way from Nandi Road and past the Railway crossing on Iten Road. On this route, the section between Nandi and Uganda junction has heavy NMT flows for it falls within the CBD. This route does not have provision for NMT users leaving them either to mingle with MT or to force their way along the verandahs that are equally congested with small-scale business activities. The route is characterized by a heavy presence of parking during the day and at night.

The study also observed that, this route is a major black spot for both NMT and MT users especially at the intersection with Elgeyo road. This was found to be associated with junction layout, which does not present Elgeyo road as the minor road so that traffic on it can give way to the other traffic stream. The other factor is that the gradient of Sergoit road from the northern side to the junction is steep and speeds of traffic are often high towards the Junction from Iten. This route is quite significant in that, it acts as a main collector of traffic flow for traffic from the northern estates of Kimumu, Munyaka, and Mwitiritia all covering a distance of 5kms. Other areas covered by this route include, Rock Centre, Jerusalem and Ngomongo area all falling along Iten Road and within a distance of 3kms away from the CBD.

Due to the sloppy gradient from the North, the route has been only ideal for pedestrians and cyclists especially when going to town. For the cyclists, it is easier to cycle from Kimumu for it takes about 20 minutes due to the slope. However it is usually the opposite from the town centre for it takes almost 45 minutes to cover a distance of 5kms due to the steep gradient covering a distance of 2.5 kms. Many people, it was discovered prefer making trips to town by walking and use public transport back to their residential places in the evening to avoid the steep gradient.

The route analysis also established the availability of adequate space within the CBD that could provide a 2 metre wide space for cycle tracks as the pedestrians resort to the use of verandahs especially if the shop owners are forced to keep their wares within shops. The upper section of the route also calls for proper provision of NMT facilities in that the entire stretch from Nairobi road Junction near the High court, all the way to Kimumu, there is no provision of NMT facilities as such the high level of

accidents involving the various users. Proper crossings are necessary at the intersection with Uganda road due to the lack of traffic control lights. The junction also acts as a Matatu park for public transport to Kimumu, Iten and Munyaka, as such calling for relocation to at least 25m metres away especially at night in order to minimize the occurrence of accidents at Uganda road/ Oginga Odinga Street junction near Paradise.

Apart from traffic flow emanating from the northern parts of the town, the route also serves NMT flow towards Dola Maize Millers, Queen of Angels and G.K. Prison primary Schools and G.K. Secondary School. Heavy human traffic volumes are also witnessed on Sundays heading to Deliverance church located a bout 1km away from the town centre along Iten Road. With the development of Alphax Computer College, NMT mobility is set to increase with time.

4.4.5. Mitaa Road route

This route is the main entry point of NMT to the town from the western direction of the CBD. Its main catchment's zone comprises of Eldoret Municipal Council low-income houses, Old Uganda road site and service scheme, Huruma and Kahoya estate and parts of Maili Nne to the far west.

Mitaa road is also the main distributor of traffic from the above-mentioned residential areas. It is fed by such streets like Muyodi, Stadium, St. Mary's and Kamukunji. The route joins Uganda road at a Y intersection near Paul's bakery. During peak hours, high traffic volume is normally recorded involving both NMT and MT. For instance, a traffic count undertaken revealed that at any given peak hour usually in the morning

and evening, a population of 2,552 pedestrians and 539 cyclists used the route on both side. Every Friday however, the volumes increase tremendously especially handcarts because of the West open-air market, which occurs every Friday. The market caters for catchment population as far as Uganda and the entire of north rift and western region.

The route's popularity, it was observed, is attributed to the gently flat surface especially for the cyclists heading towards Mile Nne. Majority of the cyclists it was established use the route as either a by-pass in order to avoid a steep gradient, rumple strips and bumps found immediately after National Petrol and Caltex Petrol Service stations.

The study also observed that the Y-intersection with Uganda road used to be one of the major accident black spot before speed calming measures that were undertaken in 1996 by the World Bank Sub Sahara Transport program. What used to happen however is still noticeable in that cyclists still protrude their hands as part of calming MT traffic before joining Mitaa road from town. In addition to the traffic calming measure introduced at the junction, further re-alignment to a T-junction could assist in increasing visibility for both MT and NMT.

Inspite of the tremendous role-played by the route; there is no infrastructure that caters for the NMT users with majority forced into sharing with the MT surface thus the increased dangers of being knocked. Another characteristic found on this route is that it is unpaved therefore impassable during rainy season, there are no streetlights thus making it insecure to its users especially at night. With adequate provision of the necessary NMT facilities, this route could become more popular in that it serves mainly traffic flows within a range of between 0.5 to 5Kms with the majority falling within the range bracket of less that 2Km.

4.4.6. Wholesale Market/Rotary/WB EMC footbridge

This is another significant NMT route popularly used by pedestrians who work in town and stay in Kipkarren, Pioneer, Langas and parts of Racecourse. It is a route linking the Southern part of the town to the CBD. Like other routes however, its popularity is only confined to daytime and dry season for in the absence of security lights it is subjected to mugging. The traffic counts undertaken at the footbridge across Sosiani River revealed a population of 8,999 pedestrians using the route in either direction for a period of 12hours with the peak hour recorded either in the morning or evening when people are returning from work or going to work.

The route's popularity could be witnessed by the construction of two footbridges that have been constructed across the river in order to contain the high traffic flow. As concerns the quality of the route, the study observed that from the wholesale market to the river, a paved walkway covering a distance of 600m has been constructed. It is paved and measures 1.5m wide. It is also segregated from the MT traffic running

parallel to the walkways by bollards and cut rails. The route however because of its popularity, has attracted quite a significant number of small business activities who in some cases have blocked the route forcing pedestrians either to use the unpaved MT surface lane or congest themselves on the small section left. As much as the small enterprises have brought services closer to the pedestrians who would prefer shopping as they go home, the establishment is only but a blessing in disguise with many cases of pick pocketing being pronounced and rampant. The route is therefore insecure.

Across the Sosian River, three distinct routes are observed one heading towards Kipkaren site and service residential housing, the second leading to Langas/Racecourse estate through Pioneer estate and the third heading towards Eldoret Municipal Council's residential units in Pioneer.

The split of the route after the bridge is due to the origin-destination patterns with the bridge acting as a point of convergence. Unlike the market footbridge section, which is paved, and in good condition, after crossing the river to the south, the three distinct routes do not have well planned surface. The pedestrians are forced to walk on private land, as no clear routes exist for NMT. Majority of users on this route do make long detours in the evening along Kisumu Road to avoid being mugged or to avoid muddy surface during rainy season. For the sake of this study, this route is quite significant for it could act as a starting point for NMT integration to other land use activities especially the small-scale business enterprises that have tended to locate besides the route.

4.4.7. Elijah Cheruiyot Street

This route is located within the CBD. It acts as a main link of traffic flow from the western direction to the east and vice visa. Its significance however is attributed to the various land use activities that exist on the various direction of the CBD. The route stretches from Oloo Junction to the west all the way to Ronald Ngala Street to the east. It therefore acts as a feeder of NMT traffic to either Oloo Street to the west or Ronald Ngala Street to the east. The route also cuts across Oginga Odinga and Kenyatta Streets; as such it is a potential feeder of traffic flow on the respective streets.

The location of Moi Referral and Teaching Hospital, Eldoret Nursing and Memorial Forces hospitals to the east together with a few industries such as Ken-Knit, Rupa (formerly Raymond) and CPC can be viewed as the force behind the heavy NMT traffic flows along the route. For instance, the traffic counts along the route revealed a population of 70 persons per minute, which transforms to 4,200 pedestrians per hour and during peak hour, the population stood at 120 pedestrians in either direction per minute, which could imply about 7,000 pedestrians using the route during the peak hour. On the western side, the location of the Bus Park together with a number of streets crossed by this route such as Oginga Odinga, Kenyatta, Oloo and Ronald Ngala streets have also contributed to the high volumes being witnessed. With the high volumes being experienced, this street is ideal for pedestrialization especially in the evening. The high traffic flow however is a blessing in disguise in that it has contributed to the emergence of small scale business vendors ranging from vegetable to second hand cloth vendors as well as an increase in the levels of pickpockets, congestion especially at the major crossing points. Since the route is located within the CBD, cases of mugging are minimal thanks to the streetlights.

4.4.8. Upper Oloo Street

The route stretches all along from Uganda road junction in the northern direction covering a distance of about 1.5Km. Its role includes linking traffic flows from the CBD to the far south of the town (Kisumu road) and to the North where the new District commissioner's offices, Law courts, Coca cola factory and Eldoret Municipal Council's water and sewerage departments are located. High volumes of both pedestrians and cyclists are usually experienced during the morning hours, mid day and evenings. Due to the administrative functions located to the north, this route has

emerged always densely populated to an extent that it is difficult to differentiate peak hours from the normal hours. On average however, 1,500 pedestrians and 524 cyclists are usually recorded on the route during peak hours.

Another characteristic with this route is that it has a downward gradient sloping towards River Sosiani in the south a gradient that has contributed to over speeding of MT users. Most dangerous points as such include the junction at Uganda road near National Bank building and Elgeyo road junction near Sirikwa hotel. The junction with Uganda highway is a major bottleneck for both users, as there are no traffic signals to co-ordinate the turning movements. Traffic jams are notable at the junction during peak hours.

NMT situation apart from the heavy traffic pedestrian and cyclists' flow, the route does not have special provisions inform of footpaths neither cycle tracks. The carriage way on the other hand is wide enough measuring about 10m wide and can accommodate at least 2m of NMT infrastructure on both sides of the existing road network. In the absence of traffic lights at the junction with Uganda road, the present situation could call for re-designing in order to ensure maximum visibility and safe crossing for NMT.

4.4.9. Kidiwa/ Tunnel route

This route mainly serves traffic volume emanating from Eldoret Municipal Council Houses located to the west of the CBD. The route is a short cut especially for traffic flow heading towards the old industrial zone which comprises the current Cereals silos, Coca-Cola, steel mill factory, slaughter house, water and sanitation and the new site for the law courts and District Administration headquarters.

The significance of the route is attributed to its closeness to the CBD through the Kidiwa tunnel and Furfural Street, which is not congested as compared to Mitaa/Uganda. It serves also traffic flow from Kamukunji in the north especially that heading to the CBD. For cyclists, majority are usually those engaged in the selling of charcoal within the neighbouring estates and the route is considered safe from MT for it is purely NMT apart from Furfural route, which however is not heavily congested.

The problems associated with the route is that immediately after crossing the tunnel, several routes do emerge as determined by the desire lines. For instance there is usually one heading towards cereals board, steel mill and another towards the railway

line. As indicated by the heavy erosion that has taken place, it is only the cereal Furfural route that is densely populated by NMT users.

One key characteristic with the route is that the tunnel is only used during daytime and during the rain season; the adjacent Malaria drain floods the tunnel thus making it impossible to use the tunnel. The route also passes through private land; as such it is difficult for any meaningful development to take place.

4. 5. NMT Origin-Destination lines

Origin Destination lines also known as desire lines are basically straight lines drawn on a map illustrating movement between various central points in an urban centre. They are used often to determine the frequency of mobility from one end to the other for instance movement from residential areas to industrial, CBD or other satellite centres. In transport planning, O-D patterns are instrumental in that they help in determining the characteristics behind a given movement in terms of modal split, cordon points, trip generations, purpose and route determination.

One major characteristic with Eldoret town as established from the field is that there is a strong tendency of movement originating from the major residential zones to industrial or the CBD. The reason behind this scenario was attributed to a number of push and pull factors behind each pattern. Among the pull factors identified included location of significant socio economic amenities such as recreation, education, health, commercial, government offices and industries within the CBD. For instance, the location of Moi Referral and Teaching hospital, Moi University Chepkoilel campus together with a number of schools within the CBD, has influenced high mobility of

NMT from residential to the CBD for the sake of the respective services. This was illustrated by the high volume of NMT traffic on the major routes as indicated elsewhere in this text.

On the other hand, movements based on the push factors were necessitated by the desire for employment opportunities, business, better education and health facilities. For those making trips for employment, long queues are usually observed during morning hours and vice verse. The study also noted that people's origin-and destination patterns are usually not permanent for they depend on the trip function, generation, time and the respective pull and push factors. For instance, during morning hours residential areas are viewed as areas of origin while in the evening, they end up as destination points. In the understanding of mobility patterns therefore, the element of trip function and time is quite instrumental.

As shown in Fig 4.3, the estimated distance covered as based on the desire lines could be scaled to range from 1 to 5Kms from either side. Movements from the satellite estates were estimated to cover approximately 5kms to the CBD while to major industrial about 1km since majority of residential areas are located closer to the industrial areas for example Huruma and Rai Plywood. Since most of the trips were made on foot or cycling, based on the desire lines, it emerged from the study that majority of the people either walked or cycled a distance of approximately 5km to their destination. The magnitude of how many trips to be covered therefore lay with the proximity of the respective land use activities forming each pattern.

One significant attribute with desire lines is that they assist in ascertaining the route quality and the various modes of transport used at any given situation. For instance with shorter distances to be covered, there is a tendency for people to walk while for a distance of about 5km, majority made their trips through public transport or by cycling with quite a substantial number also walking. In the case of this study, O-D patterns also assisted in determining major NMT routes arising out of each pattern.

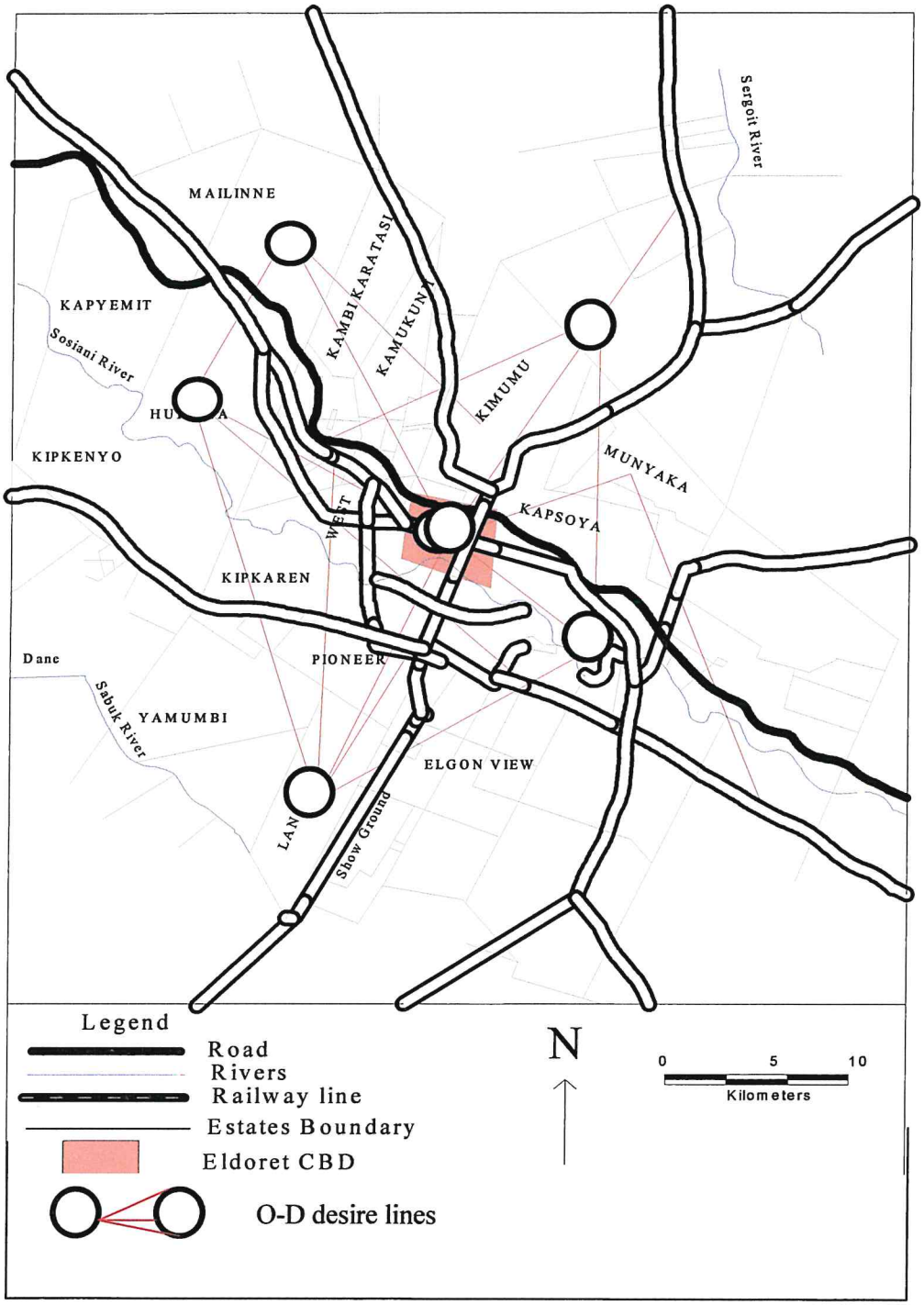


Figure 4.3: NMT Origin Destination desire lines

Source: field survey

4.6. NMT Mobility and Trip Distribution Analysis

Trip distribution is basically the building (or reproducing) of a matrix of person movements. In general terms, it also involves the relation ship between the number of trips in the matrix cell and the following characteristics:

- the origin or the production zone
- the destination or the attraction zone; and,
- the separation between the zones (trip distance, cost, safety, comfort, etc)

In order to articulate the above factors, a number of trip data was collected as analyzed below.

4.6.1. Mobility levels

Mobility level analysis focused on NMT mobility levels as per household, personal income, age group, residential zone and modes. As based on the seven residential zones covered for this study, the mobility levels (average number of trips made by each person per day), for the respondents in each zone, were as highlighted in the table 4.5.

Table 4.5. Mobility Level (trips/day)

Zone	Male	Females	Both
1-(Langas/Kipkaren)	2.6	2.6	2.6
2-(Huruma/Kahoya/Roadblock)	2.8	2.8	2.8
3-(Munyaka/Kimumu/Kapsoya)	2.9	2.7	2.8
4- (Elgon View/Racecourse)	2.9	2.9	2.9
5- (EMC/Kamukunji/Old Uganda Road)	3.0	2.8	2.9
6- (Kodhek/Bondeni/West Indies)	3.3	3.0	3.2
7- (CBD/Railway/Hospital/East. Avenue)	2.8	2.6	2.7
Overall	**2.9**	**2.7**	**2.8**

As indicated in the table, the study revealed that mobility levels of the males is marginally higher than those of females, and that those zones with relatively higher income levels had higher mobility levels. The study also revealed that, mobility levels, measured by the number of trips made by a person per day, is marginally higher for males (2.9 trips/day) than for females (2.7 trips/day).

Compared to data already available undertaken through SSATP, it was discovered that mobility levels tend to increase by increase in household income for all trip purposes for all households with or without cars. Distance was also observed as a major determinant when it comes to the number of trips to be made. For instance, due to its closeness to the CBD and major employment areas, many trips are made from zone 7 that comprises of CBD, Railway, police lines, Eastern, Hospital and Kapsoya than those from zone 1 which comprises of Langas and Kipkarren. This is true especially when determined from the origin destination map.

For the relationship between income levels and mobility, it was revealed that people with regular incomes and slightly higher income of above Kshs. 5,000/=, make more trips per day compared to those with none or small irregular incomes.

Table 4.6 (a). Household mobility level by income group

Income (Kshs/month)	Mobility Level(trips/day)
0-5000	2.6
5,001-10,000	2.8
10,001-20,000	2.9
Above 20,000	3.0

Table 4.6 (b): Personal Income by mobility level

Personal Income	Mobility Level (trips/day)
None	2.7
Small, Irregular	2.6
Regular	3.0

Table 4.6 (c): Mobility levels by modes

Mode of transport	Trip (trips/day)
Walk all way	2.8
Walk & public Transport	2.6
Bicycle	2.9
Private car	3.0
Employer and others	2.8

From the tables, the number of respondents who walk all the way is higher than for those who walk a short distance to the nearest bus stop for public transport (PT). This difference was attributed to a number of factors that included lost time in waiting for PT means, poor connectivity of PT routes with pedestrian routes and the cost of travel involved. It was an indicator that journeys made by PT take along time and only a few trips can be made per day.

4.6.2. Trip purposes and time of day

The study established that most significant trips were made to work, school and shops/ markets as already pinpointed under O/D pattern analysis.

Table 4.7: Distribution of all trips by trip purpose (%)

Trip Purpose	Trip 1	Trip 2	Trip 3	All trips
Work	55.1	14.6	53.4	48.3
School	13.9	2.0	20.9	13.8
Market/shop	18.1	42.1	11.1	20.7
Visiting	3.7	5.3	4.7	5.2
Business	1.2	13.4	1.7	3.4
Personal errand	3.4	10.1	4.7	5.2
Health care	1.4	2.4	0.9	1.7
Other	3.2	9.3	2.7	3.4

Source: field survey 2002

From table 4.7, trips, made to work (48.3%) are made to work irrespective of whether on NMT or by MT. Market/shop occupy 20.7% of all trips made while to school 13.8% followed by visits, personal errand, business and health care. Most of the trips are made between 6am and 8 am. The study also observed that most of the trips made to market/shops could be to work for those who sell products at these places. The same could be applied to trips made for business. In the evening most of the trips consist of people coming from their working places to their residential areas but through market places. In relation to evening trips, the routes identified to be densely populated at such a time included; Elijah Cheruiyot, Market street, Sosiani street and Oloo streets routes that lead to the bus park or municipal markets.

In relation to this study, the above analysis helped in providing vital information significant in addressing key questions such as why people make given trips, frequency and why they preferred certain modes of transport to others. From planning point of view, the analysis provides a framework under which activities could be located over space so as to minimize the distance traveled between one land use activity and the other. The trip purpose acts as a key pointer to how people travel, thus crucial in determining origin destination points.

4.6.3. Travel Time and Distance

The estimated travel time for the most significant trip fell between 10 and 19 minutes (40% of all trips). The travel time however was skewed, with 80% to 85% of all trips made below 30 minutes, 14% to 17% between 30 and 60 minutes, with only 1 to 3% lasting more than 60 minutes as illustrated in the table below.

Table 4.8. Travel time with different modes

Mode	Time (min)						
	1-9	**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	**above 60**
Walk all trip	32	33	19	9	2	4	1
Public Transport (PT)	4	50	27	11	4	2	2
Bicycle	18	36	23	16	4	1	2
Car/pickup	20	47	15	9	4	1	4
Employer and others	7	30	20	19	15	8	1

Travel time for cycling was established to range from 1 to 39 minutes, which translates to distances up to 8km. at an average travel speed of 12km/h. Most of the distances traveled by walking could add up to 1.5km and above.

4.7. NMT infrastructure analysis

As already mentioned, although quite a number of people make their trips by use of NMT, lack of infrastructure still is a major constraint towards their movement. Through various NMT route inspections, traffic counts and road site interviews it emerged clearly that the facilities do not exist. Where they existed, most of them are not continuous, congested thus enhancing pick pocketing or existed beside the MT facilities thus resulting into the MT/NMT friction. A few facilities however existed but within the CBD.

For instance, few planned NMT facilities in form of cycle track and pedestrian walkways although not continuous were found to exist along Uganda Road from Muliro Junction towards Mitaa/Uganda road junction on the lower side of Uganda Road cross-section thanks to the World Bank SSATP pilot project undertaken between 1995-1999.

These facilities are well segregated from the MT surface by the use of kerbs. But with the absence of a walkway thanks to the conversion of the verandas into display for wares by shopkeepers fronting Uganda Road, the pedestrians have taken over the cycle track (plate 4.7) forcing the cyclists back to the road surface thus the increased conflicts between them and the motorists.

A skeleton of NMT infrastructure comprising of cycle tracks and walkways also exist along on the upper side of Uganda Road, stretching all the way to Nairobi road towards Ken-knit factory to the east, along Kisumu Road near Sosiani River and across river Sosian. Key facilities on Kisumu Road included traffic calming measures to create room for cyclists and pedestrians and the introduction of rumple strips and bumps after the bridge to the south to control MT over-speeding towards the town. Across Sosian River from the main Wholesale market was a tarmac walkway measuring about 1.5m wide and about 100m long and two footbridges constructed by Rotary Club and WB SSATP. The two bridges as shown in plate 4.14, serve the population from and to Langas, Kipkaren, and Racecourse and beyond.

The raised stones together with a bolder play an instrumental role in enabling a cyclist in placing his or her leg on the raised stone as he awaits to cross to the other direction. The facility came as part of re-planning and re- designing of Mitaa-Uganda that was initially a black spot to cyclists crossing from Uganda Road to Mitaa Road near Paul's Bakery.

Apart from the CBD, the main routes from the residential areas to the CBD do not have adequate NMT facilities (walkways, separate cycle tracks), and NMT users in most cases share the road with MT despite high accident rates. The general absence of NMT infrastructure however was clearly explained by the numerous conflicts experienced between MT and NMT on the one hand and the agglomeration of problems facing NMT on the other as articulated elsewhere in this thesis. It has also led to a trend where most pedestrians chose the available route (most direct connection) between the origin and destination, and, to some extent safe in terms of

accidents and mugging a choice which was found to be neither influenced by the attractiveness nor the physical state of the pavement but so long as the conditions of directness (shortness) and safety are fulfilled. The same applied to cyclists.
The general quality of NMT infrastructure could therefore be summarised as being unattractive, badly paved, long detours, insecure, narrow, steep and congested. In the absence of the above facilities, most of the routes used therefore are impassable especially during rain seasons thus forcing users to make long detours, insecure thus being used only during day time.

4.8. Obstacles to NMT development in the study area

A number of reasons exist in our towns which tent to make the use of NMT in our towns unattractive. A transaction survey contacted in a number of towns in the western region (Bungoma, Busia, Kakamega and Kisumu) identified the reasons to range from inadequate infrastructure to gender issues and culture. Infrastructure and lack of enforcement is what has contributed greatly to the high accident rates facing NMT population. On the issue of gender, there is lack of cycling expertise among the urban population, mainly among girls and women because of the cultural beliefs. Other obstacles were discovered to revolve around the geographical setup of each town.

For the case of Eldoret, as compared to the above towns, most of the obstacles to NMT development were rather identical to those discovered in the above towns apart from those touching on the physical set up of each town. Based on the study analysis, obstacles towards the development of NMT system in the town were found

attributable to a number of factors ranging from institutional, planning, economic, land use patterns and the overall structure of the town. While majority of the obstacles established had a bearing towards lack of financial requirements, most of them were as a result of planning and management of traffic flow within the town by the major stakeholders.

Most of these obstacles were identified to include:-

Lack and/or poor NMT infrastructure quality and route network

As already highlighted, a few facilities exist within the CBD catering for the NMT system. These facilities however are only confined to some certain sections of the roads thus making continuity of the flow for NMT users impossible. A part from the lack of infrastructure, those available were also found in poor situation. For instance, within the CBD, most of the verandas meant for use by pedestrians have been taken over by businessmen thus forcing pedestrians to the MT surface thus the high accident levels.

Most of the crossings are potential conflict points and indeed, are black spots for MT/NMT accidents. In several places, important network links are missing or dangerous to use after dark (Sosiani River and Kidiwa Tunnel crossing). Poor junction designs and lack of traffic signals at major NMT crossings has also compounded further the problem of safety. It was also observed that high traffic volumes are usually recorded at the major crossing points as shown in the table 4.9. As sources of conflicts, these spots have ended up as major black spots.

Table 4.9: NMT traffic at major crossings on Uganda Road (12hours)

Crossing	Pedestrians	Cyclists
Ronald Ngala	7,888	2,008
Oginga Odinga street	17,085	556
Oloo street	20,280	1,827
Muliro street	19,295	935
Post office	8,999	400
Mitaa Road	14,552	3,651

Source: Field NMT counts

It is usually the most vulnerable in the society who are victims of lack of NMT crossing on the major MT networks as illustrated in the plate 4.18 above. Students from the neighbouring primary and secondary schools such as Harambee and UG were the major victims before the introduction of raised humps along Uganda road in 1997. Prior to that, several cases of accidents had been recorded affecting the school going children.

Poor traffic Safety

The study also noted that the combined effect of people walking on carriageways, NMT crossing at un-signalized and wide carriageway junctions, high MT traffic speeds (up to 80km/h within the CBD), high MT volumes, poor visibility at junctions, and heavy commercial vehicles within the CBD, resulted in many accidents involving NMT users. This was clearly illustrated by the available accident statistics obtained from Eldoret Police as shown in the subsequent tables and figures.

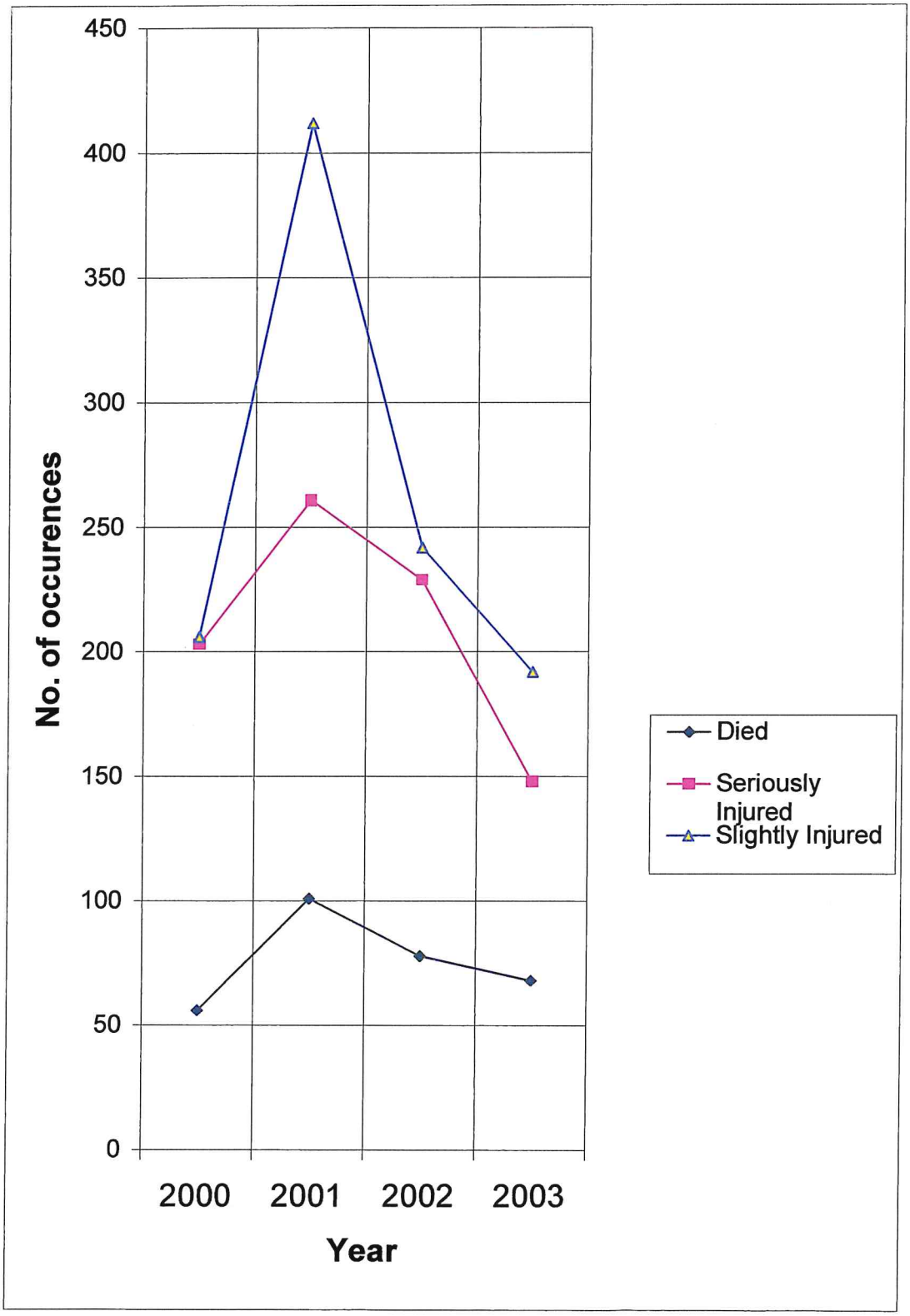


Figure 4.6: No. of Occurrences and related Deaths, seriously and slightly injured
Source Traffic Police Eldoret

Table 4.10: Various modes of transport involved in accidents in the year 2000-2003

Mode involved	2000	2001	2002	2003
Cars and utilities	106	157	157	109
Lorries	33	29	32	24
Tractors	5	4	5	2
Busses & Taxis	4	30	12	16
Motorcycles	7	5	2	2
Hand carts	1	-	-	-
Cyclists	9	22	17	8
Pedestrians	17	27	16	5
Not known	-	8	6	10
Total no of accidents	182	282	247	176

Source: Traffic Police

From the available accident statistics, there were 63 fatalities, 190 serious and 183 slight injuries in the whole of the municipality of Eldoret. Of these, there were 42 fatalities, 88 serious and 54 slight injuries involving pedestrians and cyclists.

Insecurity on the streets

A large number of people using a well-demarcated and lighted (street-lights) route strongly increase security compared to diffuse and scattered NMT movement on informal paths and shortcuts. The study however revealed that most of the routes lack security lights thus the problem of insecurity especially between the peripheral residential areas and the CBD. People are meant to cover long distances in order to avoid being mugged on the insecure routes.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

The main purpose of this study was to examine how Non Motorised transport System (NMT) can be integrated in the development and planning of medium sized towns in Kenya using Eldoret as a case study. This chapter therefore presents the conclusions and recommendations derived from the study based on the set objectives, research questions, literature, data collected from the field and as guided by the conceptual framework designed by the researcher.

5.1. Conclusion

First, is the fact that transport whether NMT or MT has a number of attributes to play in the social, political, economic and environmental endeavors of a human being. Man often looks upon the respective modes of transport so as to articulate his core needs as perceived from the various dimensions of development. Under this conclusion also it emerged clearly that the viability of each component of transport whether NMT or MT, is attributable to a number of factors ranging from affordability to physical set up, structure of the town and the land use pattern. For instance, many people prefer to use cheap systems so as to save for other necessities inspite of the harsh physical set up.

In relation to Non Motorised Transport System, the study observed that most of the problems are attributed to the fact that little is done for the system or so much is done against it. For instance, the land use and traffic planning does not just ignore Non Motorised System in a neutral way; but it often creates barriers of distance and physical layout which makes cycling and walking difficult.

The second conclusion is that a great potential exists for Non Motorised Transport System in the town inspite of the lack of the basic infrastructural facilities for the system. As noted elsewhere in this study, many trips some covering a distance of more than 5km are made on NMT especially from the residential areas to the CBD where majority of the economic activities are located. The main components for Eldoret were identified to include cycling, walking and handcart pushers. While cycling and walking goes beyond the CBD, the use of Handcart pushers is confined within the CBD.

Thirdly, the existence of NMT system in the town like is the case with other urban areas is attributable to a number of factors ranging from the physical setup of the town (terrain, structure and morphology); the towns historical and spatial growth; land use patterns especially zoning characteristics; socio economic characteristics; and overall transport analysis- classification and distribution.

Physical Set Up

As outlined above, an analysis of the town's physical set up forms the basis of ascertaining the potential and viability of the nature and type of mobility system to be expected for not all towns are NMT friendly physical wise. A synthesis of the town's physical setup gives a picture on the town's terrain, which therefore influences the kind of transport system to apply in a town. For instance, due to its location on a steep gradient, Kisii town compared to either Kakamega or Busia does not have the potential for NMT users. It also emerges that the physical set up could make some modes of NMT more applicable than others for instance while cycling is hardly used

on a steep gradient, people could prefer walking thus making walking pronounced as a component of transport.

Historical Development

The research findings also point out the fact that the way a town has evolved over time contributes effectively to the nature of transport set up within a town. Eldoret for instance has evolved based on a linear ribbon setup, which therefore confines various modes of transport system within a given locality. Its historical setup has also played a major role in the prevailing land use patterns thus the kind of mobility required to be expected.

The historical analysis is also instrumental in our understanding as to why some towns or sections of the town have the potential for NMT while others not. A good example being Lamu in that the way the town has evolved and is structured, has led to the growth of donkey cart pulling, a component of NMT while for Eldoret, the ribbon linear type of development as determined by the Northern Escarpment and Sosiani River is what explains the current confinement of NMT usage along the ribbon structure.

Land use and zoning characteristics

The way a town is zoned or the manner under which activities are distributed also contributes significant towards the identification of a given mode of transport. For Eldoret given the mixed type of settlement with no specific area designated for a certain land use activity, the tendency has been one where movements are virtually witnessed everywhere thus making it difficult to distinguish a permanent route from a

periodic one. Zoning also determines the travel patterns thus giving a town its O-D patterns, Trip generation and Distribution and composition of transport modes.

Socio economic Characteristics

A synthesis of a town's socio economic characteristics is significant. From the research findings, the town's socio economic indicators will assist in ascertaining why certain areas are prone to NMT use while others are not. For instance most of the walking and cycling tend to be confined within low-income areas since they cannot afford MT transport. Given the manner under which our towns have evolved and their structural development, this conclusion was therefore observed as crucial in the integration of NMT in the planning and development of our cities. The factors form a point of reference in our fulfillment of a more sustainable, environmentally friendly and economically viable transport system.

Fourthly, the study observed that the needs of NMT could not be articulated in isolation from those of MT in that improvement of a given mode of transport in isolation is only but a blessing in disguise. For instance, the traffic calming which is normally undertaken with a hope of enhancing the safety of NMT users also contributes to congestion of MT. Most of the problems, which occur, also focus on the challenge of lack of a balanced provision of traffic infrastructure for both MT traffic and NMT traffic. It should be known also that all MT users in a way are potential NMT users like wise to NMT being potential MT users.

5.2. RECOMMENDATION

The study recommends the following: -

1. In order to create a cost-effective, balanced and more durable urban transport system for our medium sized towns, priorities have to be reconsidered in order to reflect the strength of the users. The decision makers should as much as possible integrate the views of the users as part of minimizing the development of apathy among the users of the various modes of NMT systems.

2. In articulating the needs of NMT, the element of distance is significant for it also determines the viability of each component. When the distance to be covered is too long, it becomes less attractive or effective to the users. Integration therefore should strive to decentralize most of the economic activities away from the CBD in order to minimize on the distance covered and as a way of decongesting the cities.

3. Potential for NMT exists in our urban centres what needs to be done however is revisiting our transport policies so as to make them friendlier. Since most of the cities have no room for expansion due to poor planning, there is need to establish clear urban road design standards that incorporate proper NMT facilities. However, most of the transport planning designs brought from developed countries should not be applied blindly, due to the lack of capacity and the fact that some of them are not workable in Kenyan.

4. As deduced from the study especially from the O-D patterns, pedestrialization and pedalization is possible and that some routes can be closed in the evening and

weekends for NMT users. Some of the routes recommended for this include Nandi Road-Elijah Cheruiyot Street, Sosiani Street and Market Street. These are suitable for pedestrialization for they link NMT users to potential area such as Moi Referral and Teaching Hospital, the Municipal Retail and Wholesale Market and the bus terminus. With slight traffic calming, Uganda Road and Ronald Ngala and Kisumu Road, have the potential for Pedalization development.

The observed findings in relation to Eldoret can be replicated in other medium sized towns in Kenya but subject to each town's morphology, economic endowment and physical setup and that the conceptualised framework for this study is therefore instrumental for NMT integration to other land use activities.

References

Agevi, E. (1991). "Case study: Eldoret, Kenya" in: The management of secondary cities in Sub-Saharan Africa: traditional and modern Institutional Arrangements, Nairobi: United Nations Centre for Human Settlements, Kenya.

Alonso, W. (1964). Location and land use. Cambridge, M.A: Harvard University Press

Arnestein, S.R (1996). A ladder of citizen participation. AIP Journal, July, P216

Amos, O. (1997). Traffic Legislation and NMT Traffic. Urban Mobility and Non Motorized Transport Studies: Sub Saharan Africa Transport Policy Program. Kenya National Seminar, UN Habitat Headquarters, Gigiri, Nairobi, December 1997.

Asfaw, Mathewos (2001). Urban Mobility Management: Addis Ababa's Experience

Austin, L.M (1996). The Red Book. A tool for the Municipal Engineer, Paper presented at IMESA Seminar, May, East London.

Austin, A and Biermann, S (1998). Sustainable Human Settlements: Engineers and Planners get their act together. Paper presented at the ninth Annual SAICE Congress. April, East London.

Banjo, G.A. and Dimitriou, H.T. (1983). Urban transport problems of third world cities: the third generation Habitat International, Vol.7, no3/4 pergamon press.

Birk, M. and Zegras, C. Moving toward integrated transport planning. Energy, Environment, and Mobility in Four Asian Cities. IIEC.

Black, J. (1981). Urban Transport Planning: Theory and Practice, Johns Hopkins University Press, Baltimore.

Blunden, W.R. and Black, J.A. (1984). The land-use/Transport System, Second Edition, Pergamon Press, Oxford.

Boutek Report (2000). Guidelines for Human Settlement Planning and Design. Published by CSIR Building and Construction Technology, Pretoria South Africa.

Buchanan, C. (1963) Traffic in Towns. London: HMSO

Burgess, Ernest W. (1925). " the Growth of the City.'' In R.E.Park et al eds. The City, Chicago: University of Chicago Press.

Chapin F.S. and Kaiser E.J. (1979). Urban land use planning. University of Illinois press.

Choi, Y. (1986). ' Land Use Transport Optimization (LUTO) Model on strategic Planning in Hong', Asian Geographer, Vol.5, no.2, Hong Kong Geographical Association, Hong Kong.

Creighton R.L., (1970). Urban Transportation Planning. University of Illinois Press

Christaller, D.T. (1933). Central Place theory in Southern Germany, Englewoods Cliff, NJ: Prentice Hall.

Dimitriou, H.T (1977). " A call for effective integration of urban transport planning in developing countries, University of Warwick press.

Dimitriou, H.T and Banjo G.A. (1990). Transport planning for third world cities

Dimitriou, H.T., (1992). Urban transport planning a developmental approach.

De La Barra (1988). Integrated land use and transport modeling.

Doreen, B. M & Martin C.H (1971). The use of Models in Structure Planning

Edward K Morlok (1978). Introduction to transportation Engineering and Planning

Englen, R.E. (1982). 'Coordination of Transportation System Management', Highway Research Board, NCHRP Report, no.93, HRB, Washington DC.

Firey, Walter (1947). Land Use in Central Boston. Cambridge, Mass.: Harvard University Press.

Government of Kenya (GOK), Ministry of Lands and Housing Department of Physical Planning

Gutman J.S and Scurfield R.G. Urban Edge (1989). Towards a more realistic assessment of urban mass transit systems

Habitat (1991). The management of secondary cities in Sub Saharan Africa: Traditional and Modern Institutional Arrangements. United Nations Centre for Human Settlement (habitat) Nairobi

Hansen, W.G. (1959). How accessibility shapes land use. Journal of the American Institute of Planners, 25.

Hoyle B.S. and Knowles R.D (1989). Modern Transport Geography.

Hoyt, H. (1939). The structure and growth of residential Neighbourhoods in American cities, Washington DC: Federal Housing Administration.

Hudson, M. (1978). The bicycle Planning Book. Open Books/Friends of the Earth, London.

Human Settlements in Kenya (1978). A strategy for Urban and Rural Development. Government of Kenya, Physical Planning Department, Ministry of Lands and Settlement.

International Bank for Reconstruction and Development/ World Bank (1989). Sub-Saharan Africa. From Crisis to Sustainable Growth. A long Term Perspective Study

Koster, J.H. (2000). Low Cost Mobility in African Cities

Kothari C.R (1996). Research development

Josef Barat (1992). Institutional Frameworks for planning transport in third world cities.

John W Dickey (1992). Issues in Third world Urban Transport project Appraisal.

Margaret, P, Mitchell and Rimmer (1982). Social Science Research Methods. An African Handbook.

Marius De Langen Ed. (2001). Productive and Liveable Cities. Guidelines for pedestrian and Bicycle traffic in African Cities. A.A.Balkema Publishers

Marvin, L. M. (1992). Developments in Urban Transport planning: their relevance to third world practice.

Materu J.S. (2001). The Impact of Poverty on Urban Sustainability in Africa: in Mobility and Sustainable Urban Development in Africa. African Regional Congress on Mobility and Framework Held at the Ghion Hotel, Addis Ababa, Ethiopia.

Matovu, G. (2000)- Municipal Financing of Urban Road Infrastructure and Facilities for Pedestrians and Cyclists.

Meyer, M.D and Miller E.J. (1984). Urban Transportation Planning: A Decision-Oriented Approach, McGraw Hill, New York.

Mou C H (2000)- The state of Mobility in African Cities: Implications for poverty Reduction. Urban Management Programme, UNCHS

Modak S.K. and Patkar,V.N. (1984). 'Man and his transport Behaviour', Transport Review, Vol.4, no.3, Taylor and Francis, Philadelphia.

Mulongo L.S. (2001). The promotion of Environmentally Friendly Mobility Solutions: The African Experience: in Mobility and Sustainable Urban development in Africa: African Regional Congress on Mobility and Framework Held at the Ghion Hotel Addis Ababa, Ethiopia.

_____ (1997). Experience with User Participation in Transport Planning. SSATP Kenya National Seminar, UN Habitat Headquarters, Gigiri, Nairobi, December 1997.

_____ (1996). " Improved Urban Mobility Needs" A critical Analysis of Non Motorised Transport Infrastructure in Eldoret Town. Paper presented at a World Bank Sub Sahara African Transport workshop held at Habitat UNEP, Nairobi.

Ngugi, G.N (1997). Planning and willful community action. South African Planning Journal, No. 42, June, PP19-23.

Ombura C.O. (1997). Towards an environmental planning approach in urban industrial siting and operations in Kenya: the case of Eldoret town. Ph.D.thesis.

Opiyo T (2000). Human Resources Requirements in Local Authorities: Principles and Case Study of Kenya.

_____ (1997). Economic importance of NMT issue. Sub Sahara African Transport Policy Program Kenya National Seminar, UN Headquarters, Gigiri, Nairobi, December 1997.

_____ (2001). Traffic Safety and Mobility of Non-Motorised Transport in Urban Areas: The Kenyan and Tanzanian Experience: in Mobility and Sustainable Urban Development in Africa: African Regional Congress on Mobility and Framework Held at the Ghion Hotel, Addis Ababa, Ethiopia.

Oni, S.O. (2001). The Status of Mobility (Transport, Communications and Telematics) in Africa and its Relationships to Sustainable Development: The case of Nigeria: in Mobility and Sustainable Urban Development in Africa: African Regional Congress on Mobility and Framework Held at the Ghion Hotel, Addis Ababa, Ethiopia.

Papacostas C.S. and Prevedous P.D., (1987), Transportation Engineering and Planning

Putman, S.H. (1983) Integrated Urban Models, Pion, London.

Rao M.S.V and AK Sharma (1992). The role of Non-Motorised Urban Travel.

Richard, E.S (1992). Large Cities in the Third World. Metropolitan Planning and Management in the developing World: Abidjan and Quito. United Nations Centre for Human Settlements (habitat)

Rukunga, D.N. (1993). The Urban Transportation Crisis. The need for an alternative Low-Cost Non- Motorised Mode of Transport in Nairobi- the Bicycle Paper presented at the Non Motorised Urban Transport Studies 1st round table Milimani hotel Nairobi.

Tembele R (2000)- User Participation as a Condition for success

Thomson, J.M. (1984). " Toward better Transport Planning in developing Countries', World Bank staff working papers, no. 600, IBRD, Washington DC.

Wilbur Smith Associates in association with Otieno Odongo & Partners (1993). Road condition survey for municipality of Eldoret. Nairobi: Ministry of Local Government, Urban development Department, Kenya

World Resources (1996-97). A guide to the Global Environment. The urban Environment.

Why Eldoret (1996): A Guide to investment and Tourism

APPENDIX 1

Roadside questionnaire

While undertaking traffic counts at the various selected cordon points, the survey team will normally stop at least 50 pedestrians /50 cyclists to be asked few and brief questions

1. Name of interviewer.....
2. Date of interview.....
3. Time of interview.....
4. Location of the interview.....
5. Sex.....
6. Age.....
7. Occupation.....
8. Indicate whether the person being interviewed is
   (a) Pedestrian.....
   (b) Cyclists.....
9. Trip Origin (name of place or street) .....
10. Trip Destination(name of place or street).....
11. Purpose of the trip.....
12. Why do you prefer walking/cycling rather than taking a motorcar, bus or matatu.....
    .....
    .....
    .....
13. Do you always walk/cycle along this route
    (a) Yes.....
    (b) No.....

14. What other mode of transport could you prefer to use for this same trip

    .....

    .....

    .....

15. As a pedestrian/cyclist, what problems do you experience on the way? List them in order of importance

    (a).....

    (b).....

    (c).....

    (d).....

    (e).....

    (f).....

    (h).....

16. What do you think could be done to solve these problems facing you as a cyclist/pedestrian

17. As a pedestrian/cyclist, do you feel motorists respect you

18. For the time you have been in this town, which areas have you observed as being critical to either cyclists or pedestrians and why

    .....

APPENDIX 2

NMT/MT Traffic Counts

Location.....

TIME INTERVAL	NUMBER OF PEDESTRIANS	NUMBER OF CYCLISTS
7.00 AM-8 AM		
8.00 AM- 9.00 AM		
9.00 AM- 10.00 AM		
10.00 AM-11.00 AM		
11.00 AM-12.00 NOON		
12.00 NOON-1.00 PM		
13.00 PM-14.00 PM		
14.00 PM-15.00 PM		
15.00 PM-16.00 PM		
16.00 PM- 17.00 PM		
17.00 PM- 18.00 PM		
18.00 PM-19.00 PM		
TOTAL		

APPENDIX 3

STUDY AREA HOUSEHOLD QUESTIONNAIRE

HOUSEHOLD QUESTIONNAIRE:

1. Date of interview.....Interview team.....

2. Zone/Estate.....Household/Person Number.....

3. Place of residence.....

5. How many persons live in your household? Total No.
6.

HH Member	Age	Sex	Occupation	Work place	Monthly income	Stay in town
Respondent						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						

5. Respondents income per month

(1). 0-3000 (2). 3001-6000 (3). 6001-9000 (4). 9001-12000
(5). Above 12000

6. Vehicles owned by cyclists in household

Vehicle type	Bicycle	Handcart	Motorcycle	Car	Pickup
Number					
Age (Years)					
Year of purchase					
Acquisition					

Acquisition system: 1. Personal savings 2. Bank/co-op credit
3. Employer credit 4. Employer vehicle/gift
5. Family gift 6. Borrowed
7. Hire purchase 8. Other

7. Type of bicycles in the household

Type	Men		Ladies	Children
	Ordinary	Luggage		
Number				

8. In your present trip:
   i) Origin..... Time of Departure.....
   ii) Destination..... Estimated arrival time.....
   iii) Purpose of trip.....
   iv) Describe route/street followed.....
   v) Travel Time..... Distance.....

9. In the present trip could you identify problems encountered and the route?

Problem	Location
1.	
2.	
3.	
4.	

10. Suggest ways through which the above problems could be improved indicating if possible the person to be involved.....