

**TOWARDS A STRATEGY FOR THE REDUCTION OF URBAN
TRAFFIC CONGESTION**

A Case Study of Nairobi Central Business District.

By

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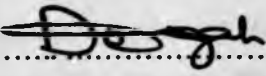
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**A THESIS SUBMITTED IN PART FULFILMENT FOR THE DEGREE OF MASTER OF
ARTS (PLANNING) IN THE UNIVERSITY OF NAIROBI**

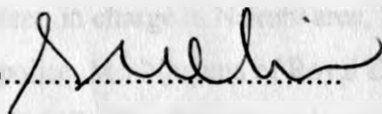
JULY 2002

DECLARATION

I hereby declare that this thesis is my original work and has not been submitted for the award of a degree in any other university.

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This thesis has been submitted for examination with my approval as University Of Nairobi supervisor

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DEDICATION

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ABSTRACT

Traffic congestion refers to the incremental costs resulting from interference among road users. These impacts are most severe during peak hours when traffic volumes approach a road's capacity. The resulting congestion reduces mobility and increases drivers' stress, vehicle costs and environmental pollution. Traffic congestion is considered one of the main urban transportation problems with an estimated cost of approximately \$100 billion annually in the U.S., and comparable costs in other countries (TTI, 2001).

Urban traffic congestion in the Nairobi Central Business District (CBD) is a fast growing phenomenon and it is a big challenge for the city planners, the city administrators and the general residents of the city. Most of the trips generated in the suburbs and beyond seem to be directed to or through the CBD of Nairobi. Many factors, such as the clustered land uses, in terms of location of utilities and functional arrangements contribute towards this problem. The urban traffic congestion, if ignored can grow to become a nightmare in the entry into, and exit out of the main service areas of the CBD of Nairobi especially in the morning and in the evening peak hours.

The traffic congestion on the main channels of mobility brings about slow speed, infrequent and irregular runs, unreliable schedules, poor riding comfort, uncertain arrival times, delays, long waiting on the road, long waiting at the bus stops, crowded vehicles which leads to psychological and emotional stress and frustrations to the passengers, drivers and other roads users. All these are the consequences of unethical human behaviour coupled by poor urban traffic management with laxity and inadequate traffic management policy enforcement in the city enhanced by obsolete and inadequate transport systems in the CBD of Nairobi. The idle running petrol or diesel engines of the stationary vehicles in the traffic congestion emits raw fumes, which are high damaging to the general environment.

This study attempted to understand the causes of urban traffic congestion on the roads leading into and out of the CBD at peak hours with special reference to any motor vehicle driver in the CBD and the NMT as the principle means of transport in Nairobi. The study considered the Nairobi area traffic police and the city council of Nairobi as the main traffic managers in the city

on a daily basis. The objective of this study was to develop a strategy towards the reduction of urban traffic congestion to decongest the CBD of Nairobi with a view to suggesting ways to improve the quality of the speed of mobility within the CBD and suggest ways of optimising the use of the existing meagre traffic facilities within the city at a larger extent. Different research techniques were applied. These included focus group discussions, informal interviews aided by questionnaires, scheduled interviews with stakeholders, mapping, literature review, photography and physical observations in the field.

The lack of traffic segregation system in the CBD of Nairobi means that the non-motorized users who include pedestrians, hand carts, animal drawn carts and bicycles as well as wheel chairs and wheel barrows, which move very slowly, have to share the same urban streets with buses, trucks, mini buses and cars. The electronic urban traffic congestion management signals installed in the late 1960's and early 1970's are either vandalised, non-functional or obsolete and are not synchronised to allow a fast flow of motorised traffic up or down the city centre streets.

The clustered urban land use in the CBD of Nairobi with centralised services attracts and generates a lot of traffic per hour, causing most of the trips generated in the Nairobi area and beyond to be directed at the CBD

The human behaviour and negative attitudes indicated that the unruly public transport operators, especially the matatu drivers block the city centre streets at will, whenever they are picking or dropping passengers sometimes at undesignated spots on the road.

The recommended strategies need to be applied in combination (e.g. congestion pricing, traffic restraint, Teleworking, ring roads around the CBD etc) because a particular strategy may be highly effective in one situation but provides no benefit in other situations. Traffic planning models are used to predict the impacts of congestion reduce strategies.

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CHAPTER 1- INTRODUCTION

1.1 General overview

Strategies to reduce urban traffic congestion in the Central Business District (CBD) of Nairobi are a challenge to the city physical planners, city business community, city administrators and the general city residents. The urban traffic congestion, if ignored can become a nightmare in the access to the major urban services as well as entry and exit in the CBD of Nairobi during the peak hours. There is a need for effective urban traffic management to decongest the CBD of Nairobi, but there appears to be laxity and inadequate urban traffic congestion reduction personnel and policy enforcement in the CBD of Nairobi. Day after day, the urban traffic congestion in the CBD of Nairobi seems to be growing at an alarming rate, since most of the trips generated in the suburban areas and beyond seem to be directed at or pass through CBD of Nairobi (Daily Nation, 13th September, 2001)

This research had an aim to establish the main causes of urban traffic congestion and identify an effective way of managing it with an intention to decongest the roads leading into, out of and within the CBD especially during the peak hours. The peak hours, either in the morning at around 7:00 am to 9:00 am and in the evening from 5:00 pm to around 7:00 pm seem to be the most congested times, when either entering or leaving the CBD of Nairobi respectively. The study is based on both the analyses of secondary and primary data. The study also investigated and recommends alternative approaches for urban traffic congestion reduction and policy enforcement measures to decongest the CBD of Nairobi.

1.2 Background of the research problem

In the 1920s the road pattern in Nairobi started gaining shape but these needed better planning and alignment. The 1948 Nairobi Master Plan for a colonial city laid down the zoning and segregated land use patterns for the city of Nairobi principally demarcating the urban transport system routes in the city of Nairobi. But not all the recommendations of the master plan were implemented to the letter and this left several key open gaps in the transport system in the city. The 1973 Nairobi Urban Study Group came up with the Nairobi Metropolitan Growth Strategy, which had several proposals for the road system, which were to be urgently implemented to serve as the CBD bypass roads. Many of the 1973 Nairobi metropolitan growth strategy plan proposals were not implemented, and this has greatly reduced the status of many roads in the city. For example Uhuru highway is still used as traffic by pass instead of the Trans-Africa Highway, which was to pass on the

western suburbs of Langata and join the Naivasha Road at Kikuyu. The proposals for other roads have not been acted upon accordingly. In the 1990s, Nairobi experienced an influx of used (second hand) vehicles, including, mini buses and even buses. (This was due to the free market and liberalization policy in the Kenyan economy. The influx was in addition to the already existing motor vehicles and non-motorised transport and the pedestrians in the CBD). All this happened regardless of the unexpanded roads and terminal facilities. It brought about unprecedented and unexpected urban traffic congestion in the city of Nairobi with no corresponding increase in the capital works programme neither in the CBD nor in the urban traffic congestion reduction measures in the CBD of Nairobi.

1.3 Statement of the research problem

The lack of traffic segregation system in the CBD of Nairobi means that the non-motorized transportation carriers which include pedestrians, hand carts, animal drawn carts and bicycles as well as wheel chairs, which move very slowly, have to share the same urban streets with buses, trucks, mini buses and cars causing enormous urban traffic congestion in the city streets. This becomes more serious during the peak hours. The electronic urban traffic congestion management signals installed in the late 1960's and early 1970's are either vandalised, non-functional or obsolete and are not synchronised to allow a fast flow of motorised traffic up or down the city centre streets. The unruly public transport operators, especially the matatu drivers' block the city centre streets at will, whenever they are picking or dropping passengers sometimes at undesignated spots on the road. The bus stations and other terminal facilities appear to have been greatly ignored, dilapidated, mismanaged and the urban local authorities seem to have secretly lost hope in the repair processes. This has eventually turned the terminal facilities into urban traffic congestion points. It has given rise to mafia like cartels that select which vehicle should enter the bus station and which should not. In the process of turning away the "undesired" vehicle, the unmanaged traffic jam can run into several metres along the busy streets and delays of several hours generally occur. The inadequate roads system, the issue of frequently broken down vehicles on the streets, the poor quality of the roads, obsolete urban road junction designs, insufficient urban road capacities, decline in the urban road capacities, decline in the urban road maintenance and lack of provision of appropriate city precincts such as pedestrian precincts, shopping precincts, matatu only sections, and buses only sections have combined to promote a serious urban traffic congestion in Nairobi CBD the adequate and dilapidated urban access and traffic filter roads as well as several open key gaps in the urban roads hierarchy networks e.g. a local street opening directly into a highway e.g. Harambee avenue and Uhuru highway junction , all appear to combine together to cause a

lot of urban traffic congestion in the CBD of Nairobi. Past research by ministry of Local Government (UDD, Transurb Consult 1988): Mazingira institute 1999 and media reports suggestion in the local dailies like the Sunday nation on January 10th 2002 out line a wide range of factors as contributing to poor urban traffic congestion management in Nairobi. The traffic police have a lot of discretion in the implementation of the Traffic Act Cap 403. The Ministry of Roads and Public Works is not really concerned with the city streets but rather maintains only the classified roads, which only connect the city of Nairobi to other big towns and which are mostly used as traffic by pass. The Transport Licensing Board seems to allow the operation of all types of carriers and cartels to operate in the city centre streets without any restrictions. The City Council of Nairobi central district the UDD of Local Government appears to have lost hope in the repair and maintenance of the transport system in the CBD of Nairobi. The Ministry of Local Government and the Urban Development Department appear to be too much engaged with national projects else where forgetting that Nairobi is the capital city of Kenya and it requires more attention.

The clustered urban land use in the CBD of Nairobi with centralised services attracts and generate a lot of traffic per day, causing most of the trips generated in the Nairobi area and beyond to be directed at the CBD

The combination of all these factors, indicate that there is need to examine the main factors behind poor urban traffic congestion management in Nairobi with a view to recommending effective ways to reduce traffic congestion and decongest the CBD of Nairobi.

1.4 Research goal / research purpose

To identify an effective urban traffic congestion reduction strategy to decongest the CBD of Nairobi

1.5 Research objectives

This study was carried out with the following specific objectives.

1. To examine the urban transportation system in the CBD of Nairobi and identify the urban traffic management problems, which lead to urban traffic congestion.
2. To assess the urban land use patterns and their relationship to the urban transportation system and how this relates to the urban traffic congestion in the CBD of Nairobi
3. To establish the general human behaviour and attitudes, which leads to traffic congestion with a special interest in urban, traffic management and the operators' behaviour in the CBD of Nairobi.

4. To make recommendations on an effective urban traffic congestion management strategy to reduce the urban traffic congestion in the CBD.

1.6 Research questions

- What urban traffic management problems lead to urban traffic congestion?
- Is there any relationship between the urban land use, the urban transport system and the urban traffic congestion in the CBD of Nairobi?
- What are the social and cultural physical factors contribute to urban traffic congestion in the CBD of Nairobi?
- What can be done to reduce urban traffic congestion in the CBD of Nairobi?

1.7 Research assumptions

The study makes the following assumption:

The CBD will continue to experience high rates of development with sky-scrapers and various types of buildings coming up and still remains a major employment zone. The demand for transport services and urban traffic congestion generation, non-motorised transport and motorised transport will correspondingly continue to increase. Subsequently more and more vehicles will be on the roads and on the streets heading to the CBD for specialised and ordinary services. This requires a high sense of specialised urban traffic congestion management techniques and modern transport systems to decongest the CBD of Nairobi.

1.8 Research hypotheses

1. Inadequate and obsolete urban transport system is a major cause of urban traffic congestion in the CBD of Nairobi.
2. Centralised service system of urban land use with inadequate development control measures are the main causes of urban traffic congestion in the CBD of Nairobi.
3. Urban Traffic congestion is caused by poor enforcement of the Traffic Act, Cap 403 and other traffic rules and policies in the CBD of Nairobi by the city traffic authorities (The traffic police, the Transport Licensing Board, and the city council)
4. Negative behaviour and attitudes by some transport operators and road users are the causes of urban traffic congestion in the CBD of Nairobi.

1.9 Conceptual framework

1.9.1 Rural- urban migration

With the attainment of independence from the British colonial masters in 1963, Nairobi started to experience a huge wave of rural urban migration because the African became free to live and own property in the city of Nairobi and many other urban centres in Kenya. The poor Africans lumped together in the poor residential areas whereas they needed daily transport to the industries for work and to the to the CBD area for manual and semi-skilled jobs. The rural urban migration trends have persisted since 1963 and the expansion of the existing transport system seems to have been minimum since the attainment of independence. By the year 2010, rural-urban migration will result in half the world's population living in cities. Concomitantly, four-fifths of the world's mega cities will be found in developing countries. Rapid urbanization and economic growth comes with motorization, accompanied by the negative externalities of urban traffic congestion and pollution. The external effects constitute problems to planners despite heavy expenditures in infrastructure and technical progress in transportation over the years (Hau, 1999).

1.9.2 Natural population increase

Natural population increase has been tremendous in Nairobi since the foundation of the railway town in the late 1890s. General census statistics indicate that on average the city of Nairobi experiences a population increase of 250,000 people per year since 1963. This has put a lot of pressure on the existing transport system, because the transport demand in the city has effectively out paced the transport system capacity and supply of new ones. This is clearly seen in the morning peak hour's urban traffic congestion when the most important trips of going to school, going to work and going for shopping are made. A recurrent of the traffic congestion is also clearly seen in the evening peak hours when most of the people have to make their return journey to their respective homes and other residential areas.

1.9.3 Centralised and specialised services in the CBD of Nairobi

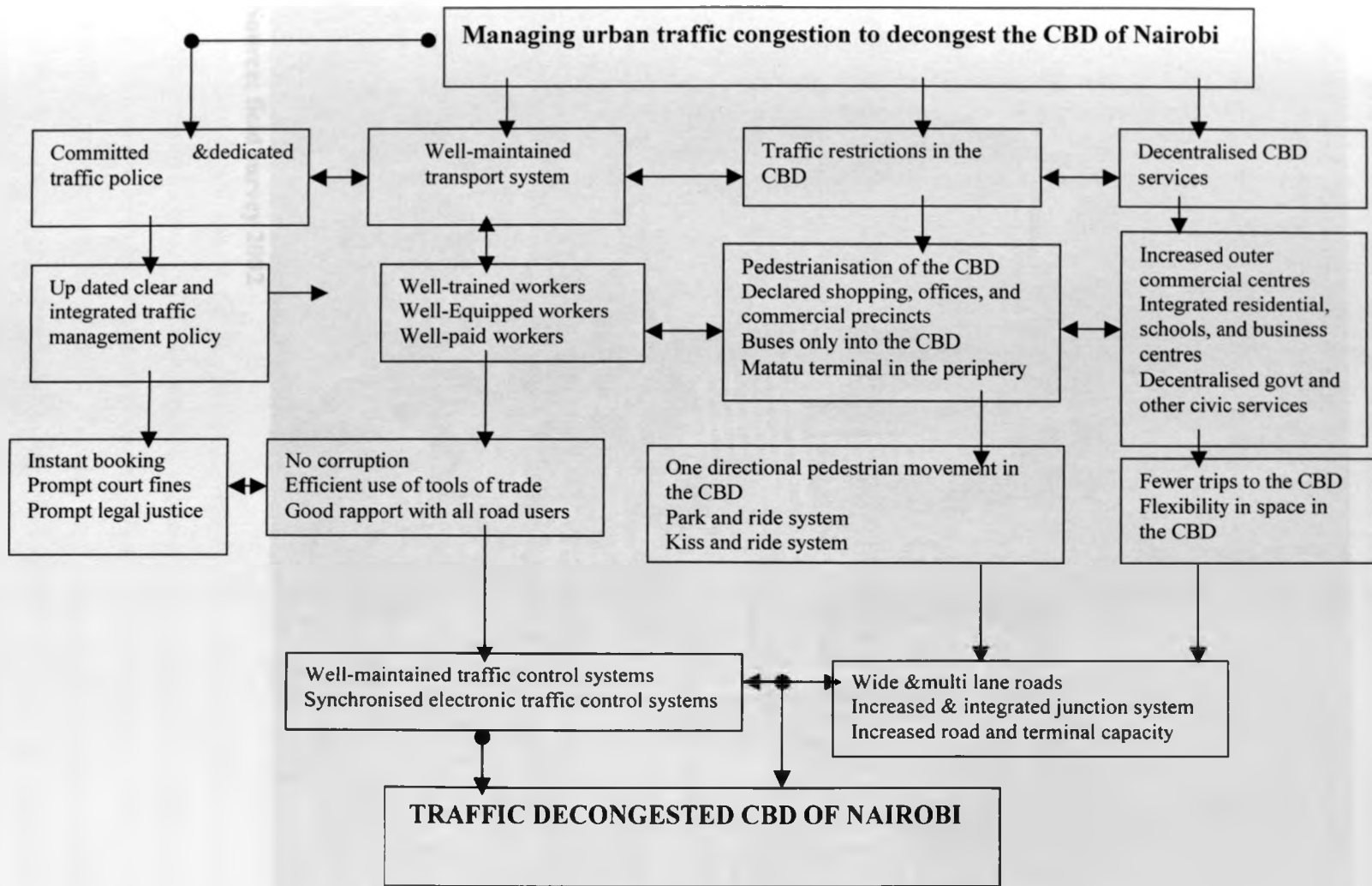
The CBD of Nairobi offers very specialised services and goods, which cannot be easily available in the residential areas and the upcountry district town. This necessitates the daily transport needs in search for such specialised goods e.g. permanent jobs in the sky scrapper offices, purchase of major motor and electronic as well electrical units or their spare parts. Legal services, civic services, wholesale services, specialised education and training facilities, the special medical attention and acquisition of special drugs are mainly available in the Nairobi CBD.

1.9.4 Traffic congestion management in the CBD

Traffic congestion management in the CBD of Nairobi needs a total overhaul if Nairobi has to attain a traffic free flow for industrialisation by the year 2020. Visiting a change on the exiting transport system can attain this traffic flow reform.

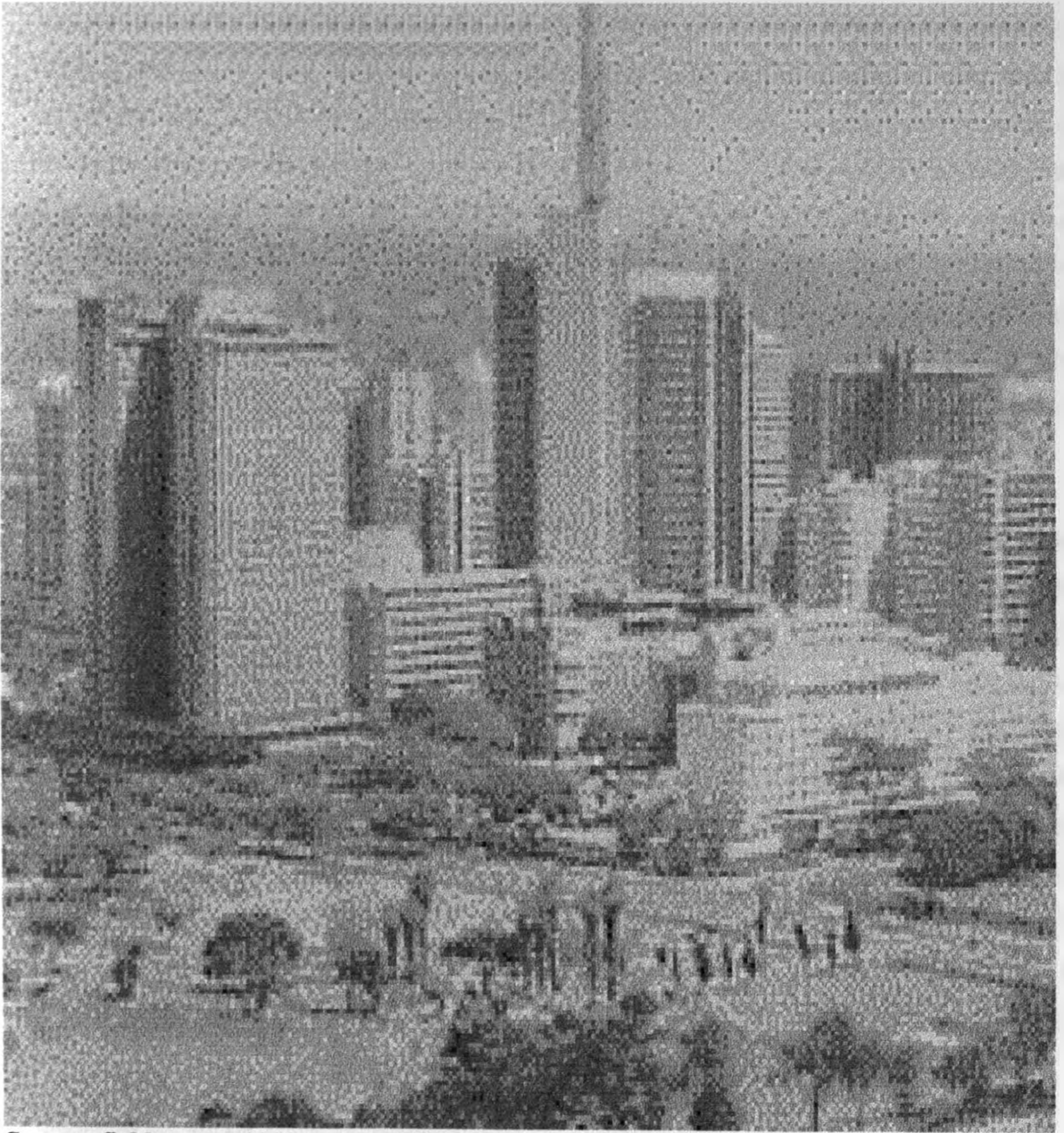


Figure 1-1 Conceptual frame work



Source: Author's model 2002

Plate 1-1 The clustered offices in the CBD of Nairobi



Source; field survey 2002

1.10 Social and scientific significance of the study

This study is significant socially, economically and scientifically because it aim was to shed light on the hidden losses incurred by the Nairobi breadwinners in their endeavour to get to their working places, shopping facilities and children going to school. The employers also stand to realise that they loose a lot of man-hours in the traffic jam. The environmentalist stands to realise the impact of the idle running petrol or diesel engine to the general environment in terms of raw fumes emitted by stationary vehicles. The motorist stands to realise that the amount of fuel lost in the waiting line on the congested urban streets of Nairobi is actually enormous per year. At the end of the research, the researcher hoped to enlighten the public policy makers and the investors, in Nairobi that free flow in the streets of Nairobi is their basic human right despite the fact that urban traffic jam in Nairobi has come to be taken as “normal” in the CBD of Nairobi.

This study was stimulated by two fundamental observations. There has been increased urban traffic congestion when either entering or leaving the CBD of Nairobi during the peak hours since the 1990s despite the presence of urban traffic management police officers at strategic positions of the CBD of Nairobi streets. There is a lot of time lost in terms of person-hours per day due to urban traffic congestion in the Nairobi city. Nairobi city is chosen for this study because comparatively it has the best roads network and highest concentration of urban traffic management police officers in the Republic of Kenya, yet it experiences the biggest urban traffic congestion in the streets and major roads. A part from being the capital city of Kenya, and the biggest city in East Africa, Nairobi is also the fastest growing city in the region, and the trend it takes will have a high chance of being followed by other towns in the region. This will offer a conceptual framework to control and continece of traffic congestion in many cities as need may arise.

1.11 Scope of the study

The research was carried out in the Nairobi area as it is delineated on the national map, with a special emphasis on the CBD as sampled and described on the area of study for this research. The researcher collected information on the following main factors: general conditions of the existing urban transport system, Training and experience of urban traffic congestion management personnel, urban Land use and their relationships to the urban traffic congestion perception and attitudes of urban traffic jam builders on the transportation systems, urban traffic

congestion management Policies, laws and institutions governing urban traffic congestion management in the CBD and the urban capital works programmes in the CBD of the city of Nairobi.

1.12 Limitations of the study

The study faced a number of limitations, which delayed data collection and final compilation of the work. The study was conducted amidst limited resources, time and money. This constrained data collection since it was not possible to hire many research assistants to facilitate faster data collection but those few hired worked around the clock to make the exercise a success. The researcher could not obtain a bus to drive in the urban traffic congestion, to get a primary contact with the urban traffic congestion managers when a bus is concerned but was able to gather a lot of information as an ordinary bus passenger and sometimes posing as the bus conductor on arrangement with the true bus conductor. A Section of the target respondents; the matatu crew were rude, hostile, very suspicious and uncooperative. However, tactics were devised where some of their own were used for purposes of introduction. My little brother who is a matatu driver was very handy to diffuse the suspicion once I took him in as research assistance. He even organised for a matatu for the researcher to drive in the urban traffic jam in the CBD for a direct contact with the urban traffic congestion managers and especially the traffic police officers in the city centre. The tight government bureaucratic red tape was a major limitation, which forced the researcher to obtain a valid research permit to access almost all of the much-needed secondary data in the government offices. City residents had a negative attitude towards the researcher on the basis that researches bare nothing, but this was eventually overcome after a lot of negotiations and time wasting explanations. The rarely available city traffic engineer who always seem to be attending endless meetings and kept giving rarely reliable appointments was a major problem, but eventually he was available for research discussions. Despite all these problems, no efforts were spared to collect the relevant information to draw the conclusions recommendations and the proposals.

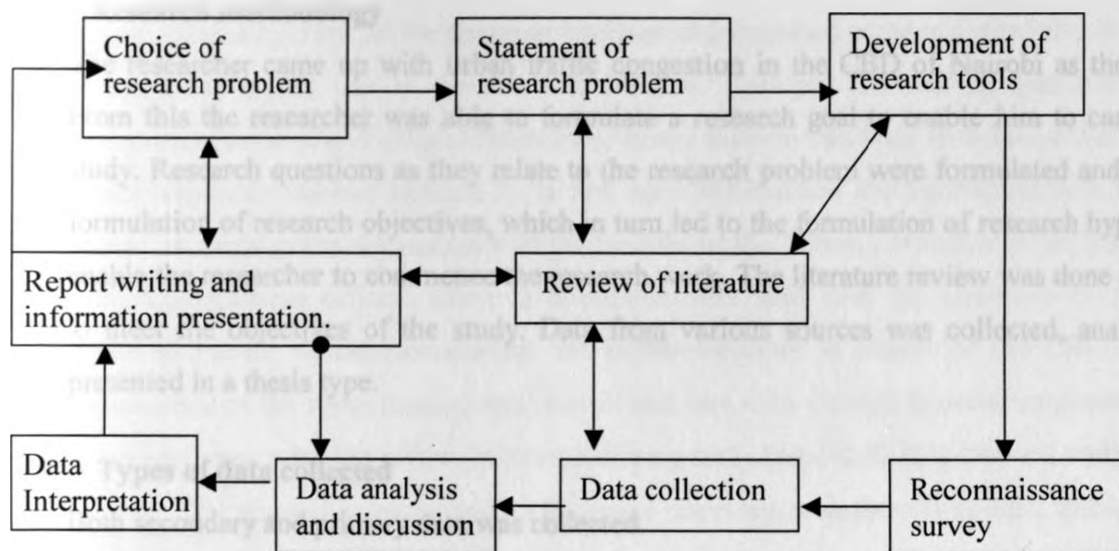
1.13 Research design and research methodology

1.13.1 Introduction

This section presents the research design and the research methodology. It discusses the issues on how the research was organised from the beginning, followed by the data types of the data needed, the data collection process, the methods of data collection, and the organization of the

data collection process. Further, it discusses the data analysis process and presents the tools of data analysis.

Figure 1 – 2 Flow of the research



Source: Author's model 2002.

1.13.2 Restatement of the research problem

There is need to evolve a strategy towards the reduction of urban traffic congestion in the CBD of Nairobi for efficient and effective transportation and efficient provision of necessary services within the CBD and the whole city of Nairobi.

1.14 Research design

Formulation of the study problem preceded the study process. The process of data collection was followed by Data analysis and data presentation. Data collection began by a reconnaissance survey of the study area. This assisted the shaping of the problem and the research objectives. Of more importance reconnaissance survey guided the formulation of the research tools and designing the sampling procedure and field survey. Data was collected from both primary and secondary sources. This research was designed for any motor vehicle driver in the CBD, any motor vehicle conductor in the CBD of Nairobi, the workers in the CBD, and the Non Motorised Transport operators as the daily users of the traffic system, the city traffic managers i.e. the Nairobi area traffic police, the Nairobi city Council traffic and road engineers and the Transport Licensing Board. The KUTIP of Urban Development Department was integrated in the research

as the provider of urban road infrastructure. Due to the high mobility of the study units, a sample of 160 observation units was randomly picked, 70% road users and 30% traffic managers. This was taken to be an adequate representative of the study population.

1.15 Research methodology

The researcher came up with urban traffic congestion in the CBD of Nairobi as the problem. From this the researcher was able to formulate a research goal to enable him to carry out the study. Research questions as they relate to the research problem were formulated and led to the formulation of research objectives, which in turn led to the formulation of research hypothesis to enable the researcher to commence the research work. The literature review was done essentially to meet the objectives of the study. Data from various sources was collected, analysed, and presented in a thesis type.

1.16 Types of data collected

Both secondary and primary data was collected.

1.16.1 Secondary data sources

This included Library materials, Central Government and local authority documents, the provisions of Traffic Act cap 403, the stipulations of the city council transport by laws, the city council traffic road engineers' records and the Urban Development Department records. Police records, Registrar of motor vehicles records Transport Licensing Board records etc. Published and unpublished materials, on traffic jam pamphlets, Journals, past thesis, paper hand outs, class lectures, news paper cuttings, thesis proposals and any other relevant written materials like sign boards, road signs, drivers instructions manual and the traffic police records. The Internet was basically used as source of up-to-date data on traffic congestion worldwide. Data on traffic count for various roads was collected from Ministry of Roads and public works and the City Council Traffic Engineer.

1.16.2 Primary data sources

The research categorised different target groups as the sources of information. The City council urban traffic wardens, terminal and route management cartels, any drivers and conductors in the city centre as the people who are directly affected by the urban traffic congestion. It is from the motorists that the study was able to gather information on the factors that should be considered in managing urban traffic congestion in the CBD of Nairobi. E.g. extra facilities such as road

signs, painted roads, bad road junctions and traffic police behaviour. Any worker in the city centre, the pedestrians in the city centre, the workers in the CBD, the hawkers in the CBD and the Non-Motorised Transport operators in the city of Nairobi. The Matatu welfare association officials and the Nairobi CBD association were considered as special groups that were perceived to have special interests in the transport services and therefore possessed immense information on the urban traffic jam in the CBD of Nairobi. Visiting the Nairobi area traffic police headquarters for oral and official interviews, casual talks in taxi bays with taxi drivers, visiting matatu terminals and bus stations for a first hand information and interaction with the traffic cartels. A focus group discussion with the Nairobi traffic liaison committee in the Nairobi area traffic commandant offices, where a discussion was held with the chairman of the newly registered matatu welfare association, the police inspector in charge of the CBD and three chairpersons of the route management cartels and one City Council highway engineer. A visit for an interview with the officer in charge driving test school at Traffic Police Headquarters at Ruaraka. The researcher conducted an exclusive interview with the city council traffic engineer in his office in City Hall, an exclusive interview with the city council transport engineer also in his office in city hall. The researcher also had a face-to-face interview with the administrative secretary of the TLB in his times towers office. The researcher also interviewed the director of KUTIP in his Cianda House office.

1.17 Data collected

1.17.1 Transport demand data

The researcher systematically looked at the Trip, trip generation, trip purpose, trip distribution, trip assignment, and modes of transport, modal split, and modal choice in the CBD of Nairobi.

1.17.2 Transport system data

1.17.2.1 Roads

The researcher did an examination and assessment of the existing roads and street system in the CBD, the signalling synchronisation system, existing roads capacity, condition of existing roads, junctions and junction types in the CBD, city centre roads alignment, other uses of the CBD roads, temporary road blockages in the CBD, sizes of the CBD roads and the general road improvements in the CBD like painting, segregation, and existing user information sign boards.

1.17.2.2 Vehicles

It was very necessary for the researcher to collect data on motorised road users like the bus, the matatu the private car drivers, the motor cycles riders and the Tuktuk drivers. Of much necessity were the heavy commercial vehicles operators on Uhuru highway, the non-motorised transport operators and other road users including the pedestrians, the bicyclists, and the handcart pushers. The up country (bus) travellers and country bus management institutions e.g. (the Akamba, the Bus scar, and the Sun bird), and the upcountry matatu management systems. All have an integrated part to play in the traffic jam in the Nairobi CBD. Diligent inquest into transport constrains and pedestrianisation schemes were also critically done systematically. Data was also collected on minor and major road accidents in various condition of the weather. The researcher looked into Break down services, volume of urban traffic on the roads at the hour, types of vehicle on the road at the hour, and types of various road users at the hour. Of much importance was the data on the number of registered vehicles operating in Nairobi CBD roads.

1.17.2.3 Terminal facilities

Critical examination of the design and capacity of the existing terminal facilities like the Hakati bus stations, matatu stations, designated car parks, the street parking bays, off street parking bays, lay bay design and usage, long term parking, and the total parking spaces available in the CBD.

1.18 Data on the CBD land use patterns

Assessment of the urban land use in the CBD and their subsequent traffic generation capacities, the alignment of the traffic flow channels, the provision of parking facilities in relation to the built up area and the provision of specialised services in the CBD. Data was also collected on the centralised provision of Civic and Government services in the CBD .the CBD services were compared with the services offered in the up coming business centres like the upper hill area, Westlands, Parklands Ngara, South B, and Nairobi west as the major business areas that cushion the CBD against major waves of traffic attraction.

1.19 Data on the general human behaviour on the road

Evaluation of the urban traffic congestion management by the traffic police, the Nairobi city council traffic wardens, route management cartels, driver's behaviour on the road, condition of

the drivers, touts behaviours, pedestrians and hawkers behaviour on the roads and public education and awareness creation on the effects of traffic jam in the city.

1.20 Data on traffic management policies

The researcher did a systematic probing inquest on the existing and application of City Council urban traffic management by- laws, police discretion on Cap 403, the effectiveness of the Highway Code, the general activities of the Central Highway Authority, the effectiveness and reliability of the Transport Licensing Board. The provisions and applications of the Traffic Act (Cap 403) Transport Licensing Act (cap 404)

1.21 Sampling methods and sample size

1.21.1 Sampling methods

The unit of analysis, which were sampled, included the road system, the vehicles, and the terminal facilities. The study sampled 160 units of observation for all the categories of study. Sampling was done along the existing traffic facilities in the CBD. In each traffic facility area, two key informants were selected randomly to give specific information such as the use of the roads, parking space and the terminal stations when the traffic volume goes down, and the usage of the transport facilities at night. **Random sampling** was applied to select specific roads, Parking areas and terminal facilities **Purposive sampling** was applied in selecting specific individuals such as the key informants and government officials who were relied upon for accurate information. **Spatial sampling** was used to select the areas of occupation, which basically formed the major spatial framework of traffic generation centres; various job locations facilitated easy and un-biased spatial coverage of the CBD. **Cluster sampling** was used in the Bus terminals to obtain information from the Management teams and the route management cartels.

1.21.2 Sampling of busy routes

A base map of Nairobi City was used to zone the CBD into busy entry and exit routes. The three busy routes are differentiated by identical factors of density and types of developments.

1. Uhuru highway

This route was chosen to given an insight of characteristics of heavy commercial motor vehicles involvement in the urban traffic congestion in the city of Nairobi. This road links Nairobi to other principal towns in Kenya such as Mombasa, Nakuru, Eldoret and Kisumu. International

traffic towards Tanzania also uses this route. It also services Westlands Shopping Centre, Kangemi, Kabete and Uthiru estates. The route is also used for transporting agricultural products from Limuru, Kiambu and other surrounding areas.

2. Murang'a road

This road links the CBD to Thika road, which serves major residential areas such as Zimmerman and southern residential areas of Ruiru Municipality namely Kahawa Sukari, Kasarani, Githurai and most of North Mathare residential estates. All the traffic to Murang'a, Maragua, Kirinyaga, Embu, Mbeere and northern Kitui pass through this road. Other traffic which uses this road are those destined to Eastern province towns such as Meru, Isiolo, Marsabit and Garrisa. International traffic to Ethiopia also uses this highway.

3. Kenyatta Avenue This road is a dual carriage, which links the CBD and the residential areas. Of which are both medium and low-density residential areas. As the city experiences expansion, this avenue links other small upcoming CBD such as Kenyatta market, Hurlingham, and upper hill. Kenyatta Avenue serves Kibera and Kawangware, which are low-income, residential areas. It also serves Dagorretti and Kikuyu towns. Among other users, it also links Kenyatta National Hospital to the CBD of Nairobi.

1.21.3 Sample size

In order to obtain an over view of the urban traffic congestion situation in the CBD of Nairobi, a representative sample of 160 total observation units and a random sampling of the streets and terminal facilities was picked.

1.22 Data collection methods

1.22.1 Secondary data collection methods

The information in this report in addition to any other were collected using a combination of various methods: This included taking brief notes on managing urban traffic congestion, reading and internalising previous researches, sketching and drawing to scale. Photocopying, stenography and newspapers cuttings were widely used, down loading from the Internet was very much used.

1.22.2 Primary data collection methods

A reconnaissance tour was necessary for the researcher to have an overview survey of the CBD of the city of Nairobi. This was necessary in order for the researcher to get insight of the field in

relation to the research problem. Keen examination of the prevailing urban traffic congestion management was undertaken, and the pre-test administration of the general questionnaires, was carried out. The reconnaissance survey included brief pre-interview survey with Nairobi City Council – Planning Department officials the city traffic engineer and the city roads engineer to get the spatial distribution of the known urban congestion point in the CBD. During the tour, it was possible to map out the busiest and commonly congested urban streets. It was also during the tour that the researcher was able to verify on the ground the information provided by the Nairobi City Council officers.

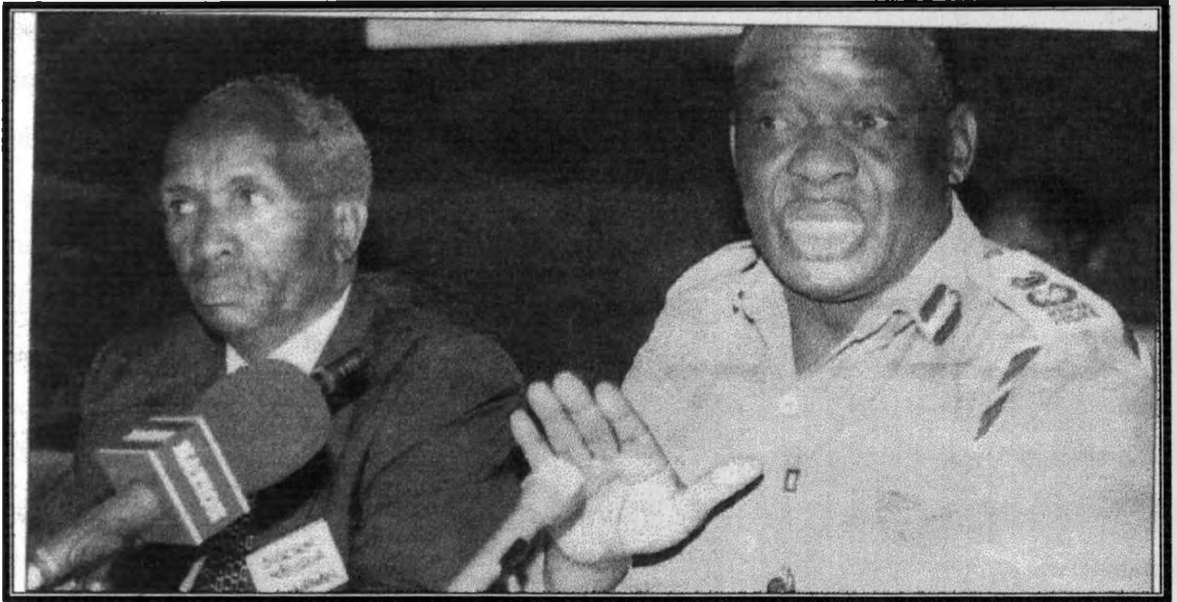
A focus group discussion with a traffic liaison committee was held at the Nairobi area traffic police headquarters in the upper hill next to Kenyatta Hospital on 9th January 2002. The focus group included traffic experts like the Nairobi area traffic police in charge, and the chairperson of the newly registered matatu welfare association a provincial administrator from PC's office. NCBDA representative, City traffic Engineer, Transport Licensing Board representative.

Participant driving was basically a technique of data collection applied deliberately by the researcher because he possessed a valid heavy commercial driving licence. A matatu was made available on arrangement by a younger brother for the researcher to jostle with thick urban traffic congestion during the evening and the morning peak hours.

Administration of questionnaires, the questionnaires were used to gather information on drivers' perceptions, attitudes, behaviours, characteristics, and the general operators' perception of the urban traffic congestion management in the CBD of Nairobi. The questionnaires were used to assess the basic management styles applied in parking areas and on the roads and the traffic management process, and also to assess the policy issues and conflicts in as far as the acts of parliament and other laws are concerned. The Questionnaires were designed so as to gather an in-depth understanding of urban traffic congestion management in Nairobi. **The first** type of questionnaire was addressed to the urban traffic police managing the sampled corridors. **The second** type of questionnaire was designed for all the drivers in the CBD. These questions were designed to find out whether motorists considered detouring the CBD in order to avoid the CBD in anticipation of dense traffic congestion. **The third** type of questionnaire was addressed to the workers in the CBD. This was to help to seek information about compatibility of the dense traffic congestion and working opportunities. Information on the views of the workers who normally must cope, arrive, and exit the CBD during the peak hours daily was very important

because they live with the traffic congestion on a daily basis. A detailed questionnaire is attached to the Appendix.

Plate 1-1 The traffic commandant (Samuel Ang'ote) and the matatu welfare association chairman (Dickson Mbugua) during the focus group discussions



Source; field survey, 2002

Practical measurements on urban roads alignment and sizes, junctions and terminal facilities. Issues measured included sizes of the roads, distance from the nearest buildings, area under disused roads, and areas under used roads, areas under curb parking and in estimating amounts of total available space in the transportation system in the CBD of Nairobi city.

Oral interviews with the public transport drivers, conductors, and some of the committee members of the route management cartels. This included the people with specific functions in the transport system and the experts who can trace the historical changes in urban traffic congestion management in the CBD of the city of Nairobi.

Face-to-face discussion was held between the researcher and the city planning officers, the City traffic engineer, the city roads engineer and the traffic wardens in city hall. Another official interview was held with the ministry of roads and public works officers and the ministry of local authorities especially the Kenya Urban Transport Infrastructure Program officials to highlight the possible ways of managing urban traffic congestion in the CBD of Nairobi city by provision of more roads.

Physical Observation Physical observation was used to collect observable information. This technique verified the physical state of the roads, types of the roads, maintenance levels of the bus stations, extra uses on the entire road system, physical erosion on the roads, the physical situation of the terminal facilities, and the vehicles themselves, the legal and illegal developments, the abominable state of other infrastructure, systems and pedestrian volumes and their behaviour on the busy CBD streets.

Physical Survey and field survey was applied on 10 long distance transport operators who do not operate from suitable bus terminals and are conceptually a big cause of urban traffic congestion in the CBD of Nairobi i.e. the Akamba bus company, coast bus operators, Nakuru matatus, Malindi bus operations companies, Nanyuki matatus, Nyeri and Murang'a matatus, Embu and Meru matatus, Kajiado and Namanga matatus, Kisii operating buses, Ken silver minibuses and Sunbird bus company. It was also applied to determine the sizes of the road reserves along which they operate and also used to reveal the general land uses in the study area.

Photography was used to capture the relevant issues of interest to the research. Specific urban traffic congestion management situations and possible causes of traffic congestion, the negative and positive traffic management situations, and the actual local urban traffic congestion and management situations. Photography was used to complement other methods of data collection. Photographs were taken to illustrate various scenarios in the field

Mapping was done before the fieldwork, in the field and after the fieldwork. These mainly covered features such as streets, existing terminal facilities, other infrastructure, and relief of the study area.

1.22.3 Data collection Tools

The tools for data collection included the research permit, a writing pad, a fountain pen, a biro pen an exercise book, a sketch pad, a set of clutch pencils, a rubber, pen, a set of relevant questionnaires, interview schedules, observation sheets, checklists, a loaded camera, relevant Nairobi maps, a scale rule and a tape measure.

1.23 Methods of data analysis and interpretation

Mugenda (1999) observes that data obtained from the field is in raw form and is difficult to interpret. In order to harmonize data collected from the field, coding, general thinking process to present the facts as they are on the ground combined inferential and statistical tools of analysis was done. Methods of data analysis in this study also included organising, summarising, cross

checking and punching in the computer. After coding, all the information was analysed by the use of various relevant computer programs such as the Statistical Package for Social Scientists (SPSS), excel and Microsoft word. **Qualitative analyses** was used for the data, which could not be coded, but could be summarized and presented in descriptive form in tables, pie charts and plates. It is from SPSS package that frequencies and percentages were gotten the means, modes, the medias, and the standard deviations of the smallest and highest values of various variables were also drawn from the package. Checking the questionnaires and editing for the purposes of checking the completeness, clarity and consistency in answering the research questions was thoroughly done. Analysis of the data was mainly based on the study objectives to help to confirm the objectives of the project. **Quantitative analyses** techniques were used in analysing and presenting correlations and cross tabulations. These were mainly for interpreting relationships between factors affecting urban traffic congestion management. The cross tabulations for example analysed relationships between factors such as education and age on the drivers' perception of urban traffic congestion in Nairobi. The correlation was used to test the association between urban traffic congestion management in the CBD and rest of Nairobi. The Likert scale of rating was applied in appraising values the people attach to a congestion free city and a congested city. **Statistical analysis** was used to analyse the statistics considered to be necessary and relevant in the management of urban traffic congestion in Nairobi e.g. the population dynamics in Nairobi and the traffic counts in the CBD **Descriptive analysis** was used to analyse and clearly describe the situation as it is on the ground. This is basically supported by photographic illustrations. **Spatial analyses** was used to indicate and map out all the space conceived to be relevant to the traffic congestion management in the CBD of Nairobi

1.24 Urban traffic congestion model specification

Congestion in this study was defined using the Congestion Index (CI) (Van Vuren and Leonard, 1994):

$$CI = \frac{\text{mean travel time}}{\text{free - flow travel time}} \approx \frac{\text{delay} + \text{cruise time}}{\text{cruise time}}$$

This definition was used in part, because its meaning is easy to interpret because the lower the index the less the intensity of the traffic congestion and it can be readily calculated from available data. Potentially appropriate input information to the model was considered to consist of CI values for the chosen link and for upstream and downstream links at delay =5, d=10 and

1.26 Analytical framework

Table 1-1 Analytical framework

Research objectives	Specific questions	Type of data	Technique for analysis	Expected results
To examine the urban transportation system and identify their shortcomings, which lead to urban traffic congestion.	Is traffic congestion a temporary and manageable problem in the CBD of Nairobi?	Road system, Name of street, Length, capacity, type of junctions, signalling system, condition of the vehicles, and terminal facilities Numbers.	Tabulation, name, measurement, capacity, frequency, traffic counts, and participant driving.	Tabulation of streets, nature & magnitude. Links with road users and demographic effects
To assess the urban land use patterns and their relationship to the urban transportation system and how they relate to the urban traffic congestion in the CBD.	What are the social, cultural, physical, and economical, factors that lead to traffic congestion in the CBD of Nairobi?	Data on height of buildings, the CBD plot ratio, land users, traffic generation, traffic attraction and parking facilities provisions	Qualitative and quantitative analyses -Spatial analyses -Descriptive analyses	Explanations of observed relationships and recommendations of policy remedies
To establish the general human behaviour and attitudes which leads to traffic congestion, especially the management and operators behaviour in the CBD.	How effective is the traffic management and enforcement policies in the CBD of Nairobi	Skill requirements, Education and training of the controllers. Existing traffic mgt structure of the Nairobi City Council, the traffic police, and the route management committees. And traffic management Hierarchies	Qualitative and quantitative analyses -Spatial analyses -Descriptive analyses Behavioural analyses	Improved policy implementation, expose laxity, and street and human behavioural characteristics on the CBD roads.
To make recommendations on effective urban traffic management strategy to reduce the traffic congestion in the CBD of Nairobi.	-Who are the key players in the envisaged decongestion of the CBD -What capacities do they have to: -How do they participate in the Planning, Implementation, management and control of traffic flow in the CBD of Nairobi? -What role will each partner play?	Primary data on: Key actors in traffic mgt and transport facilities provision & mgt. of transport carriers. -Mgt by cartels The city traffic engineer The city transport engineer The Nairobi area traffic police The Nmt operators All drivers	-Qualitative And - quantitative analyses -Descriptive analyses	-More efficient and demand oriented CBD and empowered urban communities. -A participatory model for traffic decongestion in the CBD & sustainable mgt. in the traffic mgt policies

Source: Author's framework 2002.

1.28 Organisation of the study

The study is divided into six chapters:

- Chapter 1;** This chapter covers the study proposal and contains the introduction, study issues (statement of the problem), study assumption and the study questions. It also details the study objectives, significance of the study, scope of the study, conceptual framework and research methodology. Further to this, the chapter contains details on operational terms, and limitations of the study.
- Chapter 2;** The chapter covers literature review concerning the various issues as they relate to the strategies of the reduction of urban traffic congestion in various urban areas. Others issues tackled in this chapter include the historical development of urban public transport and a brief history of urban traffic congestion. It also tackles the general issues to consider in transport demand and transport supply. It gives the general major characteristics of the CBD of an urban centre. It also covers the general management of urban traffic congestion in specific major urban centres in the developed and developing countries before zeroing in to urban traffic congestion management in Kenya and also gives the legal framework of transportation management in Kenya.
- Chapter 3;** This chapter gives details on the background information of the study area. The information covered here includes the physical location, geographical, historical and population growth of the city of Nairobi.
- Chapter 4;** This chapter basically evaluates the general transport demand and transport supply in the City of Nairobi. It also evaluates the causes of urban traffic congestion in Nairobi, the management of urban traffic congestion in the CBD of Nairobi city, and the urban environmental concern in Nairobi. Lastly, the chapter looks at the role of Kenya Urban Transport Infrastructure Program in the provision of transport system facilities in Nairobi. The chapter then covers urban traffic congestion in Nairobi in general before zeroing on the special aspects of the sampled routes and terminal facilities, and pertinent organisation of sampled terminal facilities.
- Chapter 5;** This chapter covers analyses of the field findings. It covers the research field discussions, observation analyses, and the field experiences. The organisation and shape of the chapter is so tailored to be in line with the objectives to of the study.
- Chapter 6;** This chapter covers summary, conclusions, recommendations, and proposals, based on the findings of the study and recommendations of further research.

CHAPTER 2-LITERATURE REVIEW

2.1 Introductions

The objective of urban traffic congestion management is the attainment of the overall best use of the existing transport facilities, subject to the constraints of environmental preservation and public acceptability (Wells, 1975). The 'best use', which may or may not be the maximum utilisation, involves the imposition upon the traveller and vehicle operators of rules and regulations governing the use of urban transport facilities (Wells, 1975).

2.2 History of urban highway development

The great highway systems of our modern civilization have their origins in the period before the dawn of recorded history. Before the invention of the wheel, which is supposed to have occurred some 10,000 years ago movement of people undoubtedly took place. The earliest travel mode was on foot, later pack animals were utilized; and then simple wheeled vehicles came into being. This led to the development of a more or less regularly travelled routes, extending to the limits of the then known world. As civilizations reached a higher level, many of the ancient people realised the importance of improved roads where people lived. The streets of the city of Babylon were paved as early as 2000 BC. There were also management roads constructed to aid the building of the great pyramid in some 3000 before the Christ. By far, the most advanced highway of the ancient world was that of the Romans. The Romans created great system of military roads reaching to the limits of their empire. Traces of these magnificent road systems are still in existence in European continent. Some of them still serve as the basis for sections of some modern highways. After the decline and fall of the Roman Empire, road building and a variety of other scientific activity practically collapsed for a period of 1000 years. Interest in roads building was revived in Europe in the late 18 century. The regime of Napoleon in France 1804 – 1814 gave a great inspiration to road construction for military purposes, and led to the establishment of a National system of highways in France

2.2.1 Historical development of urban traffic congestion

During the pre-historic period when man was primarily a hunter and gatherer the main mode of movement was walking. At this time, man moved from place to place in search of food and fresh water and seldom stayed at one point for long. The earliest human settlements showed evidence of the influence of transportation not only in urban growth but even the structure of the

settlements. Initially the transport routes within the urban centres were mostly used, leading to congestion, and were made to conform to the existing mode of travel- walking. The social and economic pressure for continued urban growth was to be balanced and controlled by the availability of public transport during the industrial revolution, (Creswell, 1979). The towns with existing radial form of road pattern tended to grow outwards in relatively high-density bands of development following these routes. Congestion on the routes has the routes has experienced gradually, starting with the horse buses, then trams and trolley buses and lastly the motorbuses. All of which exploited the same main lines of transportation, cause congestion and delays especially when two vehicles met on narrow roads where they could not by pass one another (Dimotriou 1992). As the towns' spreads and absorbed smaller settlements, the main roads continued to act as the community focus as well as public transport routes. Thus, they became concentrations of employment and community facilities of all kinds as well as forming the linear centres for bands of high-density housing. Similarly, jobs were concentrated in the town centres, which became more and more dependent on public transport. Traffic congestion on radial roads therefore increased and the efficiency or road-based public transport was correspondingly reduced (Creswell, 1979).

2.3 Theories in support of urban free access

2.3.1 Von Thunen

Underlying most land use models is the assumption about the form of urban growth. Following the work of Von Thunen, a concentric pattern is visualised for the growth of cities, with the central point of the city, which is easily accessible from all directions, without any impediment located on a homogenous plain. The implication of such land use is that all the economic activities of the urban area take place in the city centre, which is surrounded by the concentric bands of residential areas. The bands tend to budge out into the rural periphery as far as it is needed to support the economic base of the CBD. As the urban centre economic base grows, the residential rings around the CBD spread outwards with new agricultural land being converted into urban land use and the length of CBD goes up. This theoretical situation assumes that the transport system is supplied in all directions within the urban area and there is no location advantage in any choice of direction from the residential to the Centre Business District. Conceptually, one can include comfort, convenience, and other dimensions of the travel. It is also conceptualised that most of the trips made end up to the CBD for services tending to build

up traffic congestion, which is eventually disintegrated on radial and concentric ring roads around the CBD (Andrews 1976).

2.3.2 Walter Christaller

Originating from the works of Christaller³ in the 1930s a body of theory has been developed to explain urban form and urban spatial characteristic. Christaller recognised a two-fold function of a site, the space and transport/communications. These two attributes have led to a theoretical framework for explaining the expanse of the city and especially the central Business areas there by attracting more traffic congestion to it. There is also the notion of the 'central place' where by the centre is seen to represent the area, whose chief purpose is to facilitate face-to-face contact with people from all the directions of the Central business district. The two ideas are complementary in explaining the functions, which the CBD performs. The 'central place' function is more valid in maintaining a particular location for decision making once these have been established. (Hovel, 1975).

2.3.3 Alonso

He broadened the discussion by Walter Christaller³. The central locations are more highly valued because of route convergence, which tends to make them more accessible. The change in accessibility is the key element in the understanding of the centrifugal forces, which are modifying the traditional urban setting (Hovel, 1975).

2.4 Urban transport demand

2.4.1 Trip

Trip is the one-way movement by one person of sound mind of more than 5 years of age from one place to another for a particular purpose. The trip maker should be in control of himself. A trip used to refer to the involvement of a mechanically propelled carrier during or on a part of the journey, but of late, the use of walking mode as a trip maker has been appreciated. The trip can be made on any mode of travel like on foot, by car, by bus or by aircraft. The purpose of the trip is the reason for making the journey to work, to go shopping, going to school and so on. The trips made at the same time to the same locality quickly condense into traffic congestion leading to impeded movements, and necessitating traffic management.

2.4.2 Trip purpose

The majority of the trips are essentially made for essential purposes. Work, business and school trips account for 85% of total daily urban trips. Of all the daily trips, 30% are made in the evening causing a great traffic jam within the terminus and CBD routes in the cities.

Externally produced trips, and through trips formed less than 5% of the trips made in Nairobi residents in the early 1980s. Trip purposes can be as many as an individual wants to travel e.g. to work, to shop, to school, to conduct personal business, to enjoy social recreation, to visit friends, to go to church etc. A trip purpose is related to trip length, and the length has an important bearing on the type of transport mode used to make the trip. The important trips especially work, business and school trips are generally made in the morning and the trip home is generally made in the late afternoon to the early evening. This leads to enormous urban traffic jam necessitating bold steps in traffic management in the city.

Table 2- 1 Types of Urban Travel

Type of Journey	Purposes of trips
Work trip	Trips made to a persons place of employment such as a factory, store or an office.
Shopping trips	Trips to a retail establishment regardless of the size or type of purchase. Trips to stores, window-shopping.
Social or recreational trips	Cultural trips made to recreational or entertainment facilities e.g. church, civic meetings, concerts, sporting events. Travel to social activities, parties and visiting friends.
School trips	Trips made by students to institutions of learning.

Source: Meyer et al (1984)

2.4.3 Trip generation

Trip generation refers to all modes used by people to make a trip e.g. walk, bicycle, private car, public means or cart. It is determined by the trip purpose. The numbers of the trips made are a function of many factors such as the family structure, family size, family incomes and the car ownership and the distance from the intended activity site. Trip generation is a basic factor of traffic congestion. Land use is a big determinant in trip generation because it enables travel to be related to a tangible and relatively practical and predictable quality. Trip generation is often related to the dwelling place and population density. The dense the population the more the trips made. The rate of trip generation per dwelling unit varies from one place to another, and from city to city, and from one part of the city to another within one city. The implication of trip generation is that the type of land use and the type of density of land use can be forecast, and the

amount of travel can also be predicted. As trip length increases progressively, few trips are made. The short trip is relatively inexpensive, and made more often, for less important purposes e.g. a trip to the local shop to buy a cigarette. Trip generation point e.g. schools or churches causes enormous traffic congestion especially when it becomes clear that all the people are needed on the site at the same hour. This necessitates the need for organised urban traffic congestion management to ease the movement of the vehicles at the site on the hour.

2.4.4 Trip distribution

This is a British concept where certain land uses are segregated. It is characterised by mass movement of people to, or from one activity site to another. The mass movement of people from the CBD to various residential estates can be said to be site specific. Most of the trips made are so distributed dispersing from the CBD towards the residential areas, especially in the evening and vice versa in the morning.

2.4.5 Trip assignment

This refers to the volume of urban traffic on a given route, towards a given direction.

2.4.6 Trip mode

Modes of travel on the urban roads include, Private car, Para transit, Bus, tram, bicycle (Non-Motorised Transport), open Truck, motor cycle and Rick Shaw, these modes may need to be combined and their terminals need to be located as close to one another as possible for convenience. There is the hierarchy of mode of transport from the lowest to highest. The modes include the (means) carriers and the channels of travel, (Voorhees 1973) when all the travel modes use the same travel channel when some are very slow and others are very first; it leads to urban traffic congestion.

2.4.7 Modal split

Modal split refers to the proportion of the available modal choices. It refers to the possibility of alternative choices e.g. Bus 20% matatu 30% private car 40% walking 5% others 5%. This modal split is normally expressed in percentage of likelihood of choice and the possibility of alternative choice it gives i.e. for goods and passenger traffic. The modal split helps to plan for the more dominant mode, and the as well as provision of more suitable routes, and terminal facilities and reduction of traffic congestion.

2.4.8 Modal choice

The modal choice refers to what mode to use for travel purposes on the transportation system. The modes available can be chosen from e.g. private car, Bus, Non-Motorised Transport, or the matatu or a combination of all or part of them. The mode choice is pegged on the cost and efficiency in travel as well as comfort in travel. The factors for modal choice include- Alternatives available, the mode itself, the affordability/cost, Household income, Car ownership, duration and time of travel, House hold size and family structure and purpose of the trip. Other factors determining the choice of travel mode include type of goods and services consigned, physical/health condition of the traveller, behavioural factors, Terminal and transfer/transshipment arrangements and terminal facilities, more flexible modes are chosen for travel e.g. the private car, the taxi and the Para transit, this reduces urban traffic congestion due to their high likely hood to change the routes and a high degree of manoeuvrability in the city streets (Goodman 1968).

2.5 Road transportation as a system

A system is a complex whole. It is a set of connected things and parts. A system can also be described as a body of organised operational materials or immaterial things. A system can also be said to be a group of operating and functional objects related or interacting so as to form a unit whole. Any external influence on one part of the system can cause a major impact on the rest of the system. The planners burrowed the systems idea from the biological sciences. Transportation has three basic interrelated functional landuse subsystems: - Travel ways, the vehicles and the terminal facilities (McLaughlin 1974)

2.5.1 Travel ways

Transportation takes place over permanent pathways namely roads, streets, avenues, highways, pathways and walkways of all types where accumulated vehicles lead to traffic congestion. The quality of the travel way directly influences the volume and orientation of travels within the city and the region. The travel way is a location in space along which people and goods flow. It needs to be used appropriately for the purpose it is designed to avoid traffic congestion, misuse and failure of the system in the urban area. This subsystem comprises of streets, which can be classified into four categories: - The local street/Access road, the collector street/secondary distributor, Arterial street/primary distributor and urban highway (Goodman 1968).

2.5.1.1 Local road /Access Street

It is the lowest rank of the road urban transport system. It is designed such that movement here is secondary, with a mainly primary function of accessibility to the individual plot sites. Generally, it has a road reserve of 15 metres, however it can be as small as nine metres (Goodman 1968) it is not meant for through traffic or heavy traffic, except where it passes in the commercial part of the town. In town, the width of the local street can be more than 15m. In the residential areas, these streets are used as access roads conducting the light traffic from the dwelling places to the collector street. The main purpose and function of the local street is the direct access to residential property. These streets are not supposed to be more than 200 metres long, otherwise. It is also used as a service lane. (Goodman 1968) The local street serves as an easement for all types of public utilities like sewers, water lines, gas mains, electrical and telephone conduits and poles. The local street also serves as an open space between buildings to provide light, and air to adjoining property and serves also as a fire- break (Keeble 1952). Bringing every local street into an arterial street creates unnecessary friction points, which also cause accidents, and slow the traffic flows into the arterial streets. This makes it reasonable to bring the local street into a collector street, which then feeds into an arterial street.

2.5.1.2 Collector street/secondary distributors

This is the second lowest in hierarchy of the transportation system. It is also a street in the local urban area. It filters the urban traffic to the next rank of street known as Arterial Street. Its main function is to conduct local urban traffic to service areas like schools, health centres, shopping centres and other facility areas. Plot walls should be moved away from the road for at least 4 metres away. These streets have segregated pedestrian walkways on separated esplanades. In the commercial areas, urban traffic build so rapidly for the efficient use of collector streets, and local or land access streets should therefore connect directly with an arterial street (Chapin 1976). Parking on this street is generally discouraged, and residential buildings should not have driveways entering the collector streets. It has functions of easements for utilities, as an open space furnishing light and air, as well as a design element in the residential area (Andrews 1976). With truncations instead of right angles as well as staggered junctions. Local streets should not cross the collector streets directly. The spacing of these streets is controlled by various reasons such as trip generating factors, local car ownership, population density, and the use of mass transport. Spacing will also be delineated by the fact that the collector streets may be used to

mark neighbourhood boundaries, or their focus on community centres such as shops and parks. Traffic volumes on the collector streets may vary greatly per day.

2.5.1.3 Arterial streets/primary distribution

These streets move a high volume of vehicle traffic from one zone of the city to another. They have names, for example Kenyatta Avenue, Jogoo road, Ngong road, Langata road and Mbagathi way. This is a major road for all types of vehicles including buses, cars, lorries, trucks and trailers. Its major function is to carry through traffic movements to joint the freeway. It has a road reserve of 50 – 75m, and the nearest plot building line should be 50 - 70m from the road reserve. The access to the plots and other property from this road is not encouraged. It is generally a high-speed road. Service lanes in the industrial areas are allowed to join these plots. T-junctions are highly discouraged, and non-motorised traffic is greatly discouraged, and pedestrian crossings are encouraged at segregated points, over or below the road levels by use of flyovers or tunnels respectively (Werner 1985). The arterial street is also an open space, providing light and air to the nearest building. The great width of these streets offers an opportunity for impressive design on a grand scale. The arterial streets are also with utility poles, advertising signs, billboards and tasteless architectural designs (Goodman 1968). Cross section of these streets is extremely variable with median strips and service line. These streets have electronic signals and turning lanes .The adjoining plots should have building lines of 50m to 60m deep accessing by service lanes e.g. Kenyatta Avenue, Moi Avenue and Haile Selassie Avenue. These designs make the arterial to become a small-scale free way (Goodman 1968). The traffic volumes of vehicles in these roads may rage from 2,000 to 25,000 per day. The capacity of Arterial Street is generally given by the number of lanes it has, but the rule of the thumb is vehicles per hour. The common ratio of directionally split movement on the arterial street during the pick hours is about 40% in one direction 60% in the other direction.

2.5.1.4 The urban highway

This is a high-speed highway for all types of traffic except the Non-Motorised. It has graded separations and functional interchanges. For example Mombasa road, Uhuru highway, Waiyaki way and Thika road. Direct junctions are highly discouraged, and other traffic should join either from under or above by use of tunnels or flyovers, using acceleration and deceleration lanes (Goodman 1968). These roads are also known as urban bypass roads and only pass through or near major urban centres. They are also known as the national trunk roads, in the UK they are

known as the motorways, and in the USA, they are known as freeways (Claire 1973). Stopping on these roads is prohibited unless on emergencies. They carry very big volumes of vehicle traffic, on more than four lanes of very fast moving carriers. No pedestrian crossing on foot is allowed unless on pedestrian flyovers and tunnels. It is generally a high efficient road, with specialised controlled access, with no parking and no stopping on the carriageway. These roads are not used as sites for public utilities, or communication lines. It is a major barrier separating land uses on either side of the road. The traffic capacity here can be 1,500 vehicles per hour per lane although 2,200 vehicles per hour per lane have been recorded. It has a directional split of 40% to 60% on a 4-lane freeway at the pick hour, and can carry as many as 60,000 vehicles per day. It is generally very expensive to build, and it consumes enormous tracts of urban land. The closer it goes near the CBD, the higher the cost of construction due to the high land values, and the utility relocations, and the grade separation, which are generally done at close intervals

2.5.1.5 Urban transportation as land use

Urban Transportation is a major urban land use in its own right. In the urban areas, transportation can consume as much as 30% of the built up area. As a land use, it shapes the urban design pattern and the form of the urban structure. The fundamental relationships between transportation linkage and land use is the trip making patterns, volumes and modal distribution, which are largely a function of spatial distributions of land use. The pattern of land use is influenced by the level of accessibility provided by the transportation system from one activity area to another. This circulation involves the movement of people and goods throughout the city. These movements can easily lead to accumulate traffic, which leads to traffic congestion necessitating urban traffic management.

2.5.1.6 Transportation and other land uses

Land uses are the human activities sited permanently on one site. The urban land use can be defined as the regular human activity taking place in a specific locality e.g. the market space, the industrial area, the school, the church, the mosque etc. It is not practically possible to locate all the human activities on one site. This leads to the need of transport linkage from one site of activity to another this leads to traffic generation points. The land uses are linked to the human beings by transportation system. General urban land uses are Residential, business, transportation, industrial, public buildings, institutions, and vacant or unused, recreation/open spaces. All these land uses need to be located in an accessible area by way of a transportation

channel like roads, paths, waterways, railways when the need to access the land uses arises, this leads to traffic congestion. The land uses are located in various localities due to several factors e.g. site suitability, terrain and support services. In the real world, each land use has an optional limited space or location suitable for its economic, social or physical activity. Some land uses cannot coexist but are easily connected by transport channels e.g. a bar and a residential area, an industrial area and a high class residential, hospital and industrial area, schools and bars, mosque and pig stay etc. Function integration is a natural aspect of urban land uses. The urban land uses should be mixed as systematically as possible to allow co-existence e.g. a residential area and a playing ground, residential area and offices. (Peterson 1974) Transportation itself becomes a land use when regular transport channel and carrier use a similar space for that activity. In the eventual connection of the activity sites, traffic generated accumulates to traffic congestion, leading to a dire need for traffic management.

Plate 2-2 Nairobi CBD transportation as a land use



Source; Transurb consult 1990

2.5.2 Urban vehicles

The vehicles include the buses, matatus, cars, taxis, Tuktuk, Bodaboda, trailers, and any other automobile and the non-motorised such as the bicycles, handcarts and animal drawn carts. Each vehicle has its function and efficiency in transporting people and goods (Omwenga 1994). The vehicles can be divided into various transport arrangements like private transport, public transport for hire and public transport as a common carrier.

2.5.2.1 Private vehicles

These are carriers operated by their owners for their own use, usually on public streets e.g. motorcycles, cars, bicycles etc. Walking is also a private mode of transport. They are generally much entangled in the urban traffic congestion.

2.5.2.2 Public transport vehicles

The public transport for hire is a service available for use by the public upon agreed terms of payments. This could be a contract, expressed or implied by fare payments, written agreements or monthly payments. This can also apply to any vehicle using the public streets on private arrangement. This kind of transport service can be for goods, Cargo or passengers. It can be provided by public sector or private sector. This service is always available, subject to affordability of the payments required by the service provider. It may or may not be on a fixed route, time, or schedule. It may be offered by various modes like the taxi, buses, Coaches, Bicycle or the Tuktuk.

This is also known as mass transit or mass transport service. It is a service normally offered on a fixed route, fixed schedule and fixed fare. It is available for use by all members of the public who can afford to pay the required fare. This kind of service is normally offered in Nairobi by the Bus, (KBS) and the co-operative bus service. But unfortunately, the two bus companies no longer follow their fixed routes and fixed schedules, even if maintain fixed fares.

This is a transport service offered by a public transport carrier, which comes according to circumstances. Its route of operation highly depends on the operator or the passenger's will, the weather, and the time of travel. It has no fixed routes, no fixed fare or schedule of service. They are locally known as matatus. However, these Para transits take the behaviour of the common carrier by having a known fare, which might change without notice. These carriers are a major cause of urban traffic congestion, especially when they are running away from congested routes.

These are transport modes operated on the streets mixed with any other carrier. They include the Buses, taxi, matatu, rickshaws, the trolley Bus, trains, streetcars and any other transport carrier on the road. They have rubber tyres, and run on urban streets. As a part of public transport carrier, the street mode experiences problems such as urban traffic congestion lack of enough parking and other terminal facilities, narrow streets, slow speed and irregularity of travel times.

2.5.2.3 Public transportation and traffic congestion

By its very nature, public transport is a more efficient means of transporting large numbers of people in urban areas than private car. A public transport undertaking provides a service to the public in return for a pay (Wells, 1975). Public transport is a solution to the urban traffic congestion in the CBD of the city (Creswell, 1979). The nature of the relationship between public and private transport is inadequately understood by those with the power to make decisions. Many measures taken to improve general accessibility and operation of public transport prove misguided and counter productive at the face of tight urban traffic congestion in the main service area of the city (Giannopoulos, 1989, Creswell 1979, Bus and Coach Council 1986). Though the changes in lifestyles and patterns of development have increased the use of private car and reduced the contribution of public transport vehicles, they (public transport vehicles) still continue to play a major role in the transportation of urban dwellers (Bus and Coach Council, 1986). The urban public transport service is thus essentially to enable people without access to private transport to satisfy their economic and social needs, which cannot be fulfilled within walking distance, and to provide an alternative to the private car where physical or economic reasons restrict car use in the CBD (Bus and coach council, 1986; Giannopoulos, 1989). Urban public transport has the basic role of collection of people from widespread residential areas and/work places or from town to town; it also helps in the distribution of people to work places and shopping areas or residential areas.

This is the area where emphasis is put on the urban traffic management signal equipments and online computers that can play a big part in improving urban traffic flow in urban areas. The range of free way and streets urban traffic management equipments and facilities put in use include covering detectors, signals, local controller, inter-linking, data transmission computers and other associated central office, equipments. Other methods of management and control include open and closed loop methods of control, and the use of stored programme computers at the central office. Two basic types of free way urban traffic management systems, which are widely used in traffic controls, are the traffic responsive pre-timed area control system and the fully flexible vehicle actuated area control system.

2.5.3 Terminal facilities

The terminal facility is any facility providing for the delivery, receipt and temporary storage of freight, or the embarking of passengers. They provide temporary storage of the vehicles

themselves and other goods from the time of arrival to the time of departure (Transurb 1998). Terminal facilities are the off street automobile parking lots, on street parking lots, trucks terminals, Bus stations, the lay bays, and the Bus depots. The facilities are presented as major components of the transport system and have a major cost in construction and maintenance in the whole transport system. They are possible points of urban traffic congestion, especially when they are used for a purposed of which they were not intended originally e.g. long period parking in the Bus Station (Goodman 1968). They are supposed to provide comfort amenities to the passengers e.g. foods and drinks and shelter. They also offer documentation of movements in the operations offices goods are weighed, billed and fares paid here. Passenger ticket sales, passenger operations and passenger information are available here (Claire 1976). Minor vehicle/carrier services as well as overnight storage can be done here. They also act as the collection points for good and passengers for easier loading and transportation delivery. For convenient sake, these facilities should be located as much together as possible.

2.5.3.1 Bus stations

The bus station is the end of the journey point where the matatu and the bus terminate one-way trip, disembark all the passenger and luggage, possibly for a fresh load of passengers and luggage for a different trip or a return trip.

2.5.3.2 Lay bays and bus stops

The lay bay is a point on the route where passengers and luggage can be either added into or removed from the vehicle enroute to its destination.

Plate 2- 2 Several vehicles squeezed in a lay-by meant for two buses at a time



Source; field survey, 2002

2.5.3.3 Off street parking

These include private parking, basement parking and multi-storey parking. Off street parking is a requirement at the developer's expense. A good city design should relate compact building areas to open parking areas, so that the end result does not resemble a war – damaged city as is often the case. (Goodman 1968). The off street parking can be owned by the municipal authority, the parking metres department or completely owned by the private commercial establishment. In most cases, the parking space attracts a charge, and the vehicle owner is required to pay for the parking space. The rates for these charges are highly varied to discourage all-day parking, in commercial areas where the facility and space is limited.

2.5.3.4 On street parking

These include angle parking: flash parking, and curb parking as well as the lay bays. It is the short time terminal storage of vehicles, while drivers and passengers are occupied elsewhere. Where on street parking storage is not enough, back up in streets and excessive hunting for parking, space may affect the traffic circulation in the street and this can cause excessive urban

traffic congestion, especially in the CBD. The introduction of the parking metre was an effective way of controlling parking and increasing the revenue turnover.

2.6 Traffic Demand Management

2.6.1 The impacts of urban traffic congestion in cities

All around the world, developed countries are discovering urban road traffic congestion is no longer simply confined to commuter trips in urban areas. Congestion is everywhere. It affects the work trip, the shopping trip and the school trip both in the rural areas and intercity corridors. Traffic free flow is disrupted by accidents, maintenance operations, detours, and congestion on tourist routes, among other causes. To the traveller, congestion means lost time, missed opportunities, frustrations and waste of personal resources. To the employer, congestion means lost worker productivity, delivery delays, and increased costs. Nationally and internationally, speed, reliability, and the cost of urban and intercity freight movements are increasingly affected by congestion.

2.6.2 Significance of traffic free flow

The over all-purpose of free flow urban traffic is to provide an effective and convenient means to those person and goods movement on which the economic and social life of the urban area depends. The effectiveness or success of an urban traffic flow system should be judged by the extent to which it satisfies the needs of residential and other users. Traffic congestion affects the time spent in travelling or carrying out other activities and will also be critical when an individual is choosing a residence and place of work. Traffic flow also affects individuals or communities access to public as well as the operations of the housing market and the value of land. The quality of the travel way greatly affects the volume of vehicle flow.

2.6.3 Traffic densities

Traffic density is also known as traffic concentration on the transport channel. It is defined as the average number of vehicles that pass at a point along a roadway or traffic lane per unit of time. Its commonly measured in units of vehicles per day, vehicles per hour, or vehicles per minute. Therefore, the impended movement causes delays, frustrations and stress in the essence of transportation. (Van Vuren and Leonard 1994)

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2.6.4 Traffic congestion management

Management of traffic congestion entails methods and means of alleviating traffic congestion in the city streets. Traffic congestion in the city streets is caused by various city aspects and urban dynamics as they occur from time to time.

2.6.4.1 Causes of traffic congestion

The causes of urban traffic congestion can be categorized as either recurring or nonrecurring. Recurring urban traffic congestion is the predictable delay caused by high volumes of vehicles using the roadway during the same daily time periods (e.g., peak commuting periods, holiday periods, or special events) and at critical locations (intersections, interchanges, major long-term construction areas, or toll plaza areas). Nonrecurring congestion is unpredictable delay generally caused by spontaneous, unplanned occurrences such as road traffic accidents, incidents, emergency road maintenance, or weather conditions and the general urban dynamics like riots, strikes and demonstrations, which are very prevalent in the 3rd world cities such as Nairobi.

2.6.4.2 Objectives of traffic congestion management measures

Implemented individually or in concert with one another, urban traffic congestion management measures can help achieve one or more of the clearly measurable objectives. These objectives, which can also be considered as positive impacts, are: Reducing the need to make a trip, reducing the length of a trip, promoting non-motorized transport, Promoting public transport, Promoting carpooling, Shifting peak-hour travel, Shifting travel from congested locations and Reducing traffic/traveller delays. On the demand-side, economic measure of congestion pricing can have a significantly, positive impact on promoting public transport and carpooling. Congestion pricing can also have a significantly, positive impact on shifting peak-hour travel, shifting trips from congested locations, and reducing traffic delays. On the supply-side, preferential treatment and measure of bus lanes can significantly promote public transport. The bus lanes can also have some positive impact on shifting trips from the peak hour or from congested locations and on reducing traveller delays. Comprehensive programs involving both demand-side and supply-side measures produces the most successful results in urban traffic congestion management. Some examples of comprehensive approaches are the Congestion Management System Regulations in the United States, the London Red Routes Program in the United Kingdom, the Structure Plan in the Netherlands, and the Olympics Traffic Management Program in Barcelona. For a variety of reasons, such comprehensive approaches are more the

exception than the rule. The conclusions are; Road traffic congestion can be better managed. Low-cost conventional measures can be effective, Pricing techniques can be effective in congestion relief, Public support for congestion management is essential, Traveller information is important to relief congestion. Coordination between public agencies is an essential aspect of urban traffic congestion management. Congestion management efforts need to start small then grow. The private sector should be a partner with the public sector in managing urban traffic congestion. Comprehensive policies and laws are needed for effective congestion management. New technologies will offer tools for congestion management. Accessibility to commercial, residential, retail, and resort areas must be maintained with congestion management. Evaluations are needed in urban traffic congestion management. Training in the practices of congestion management is needed.

Traffic congestion is the impended movement of the motorised and non-motorised vehicles on the Roads and other channels of transportation. The objective of better roads is to cope with more vehicles and the movement of people and goods from one place to another, but not necessarily the movement of vehicles. It's essentially a service, which enables people, firms and various institutions to carry out activities at the sites selected for those activities in separate locations (Ombura, 1989). By connecting activity sites it is expensive in terms of times, money, energy, comfort and stress. Transportation can also be defined as the circulatory system in a city or region. It brings people and goods into the community and provides the means by which they can move freely from one location to another, linking activities like residential areas, the shopping complexes, industrial area, CBD and social amenities (Dimotriou 1992). Urban traffic congestion is a significant and growing problem in many parts of the world. Moreover, as urban congestion continues to increase, the conventional approach of "building more roads" does not always work for a variety of political, financial, and environmental reasons. Building new roads compounds congestion, by inducing greater demands for vehicle travel and demands that quickly eat away the additional capacity. This was also found out in 1998 when the construction of Langata road into a dual highway soon attracted many users to abandon Ngong road, especially in the Karen area, and When the Organization for Economic Co-operation and Development (OECD) established an expert panel to study and report on the worldwide state of traffic congestion management and control based in Nottingham, UK (Dougherty 1994).

2.6.4.3 Demand-side traffic congestion management measures

These are measures that address traveller demand on the transportation system. These measures are designed to reduce vehicle demand on the system by increasing vehicle occupancy, increasing the use of public transport, reducing the need to travel during a specified peak-time period, and/or reducing the need to travel to a specified location of the city.

2.6.4.4 Supply-side traffic congestion management measures

These are measures that address the transportation supply, as afforded by the existing system. These measures are designed to increase the system's existing capacity and to improve traffic flow for all modes of transportation (Van Vuren, 1994)

Within these two logic strategic types, there are almost 40 conventional and innovative congestion management measures, which are categorized into nine strategic classes: these are Land use and zoning, Communications substitutes, Traveller information services, Economic measures, Administrative measures, Traffic operational measures, preferential treatment, Public transport operations, Freight transport operations.

Table 2-2 Classification of congestion management measures

Types of measure	Strategy class	Measures
Demand-side	Land use and zoning	<ul style="list-style-type: none"> · Land-use and zoning policy · Site amenities and design
	Communications substitutes	<ul style="list-style-type: none"> · Telecommuting · Teleconferencing · Tele shopping
	Traveller information services	<ul style="list-style-type: none"> · Pre-trip travel information · Regional rideshare matching
	Economic measures	<ul style="list-style-type: none"> · Congestion pricing · Parking pricing · Transportation allowances · Transit and rideshare financial incentives · Public transport pass programs · Innovative financing
	Administrative measures	<ul style="list-style-type: none"> · Transportation partnerships · Trip reduction ordinances and regulation · Alternative work schedules

Supply-side	Traffic operations measures	<ul style="list-style-type: none"> · Entrance ramp controls · Traveller information systems · Traffic signalisation improvements · Incident management · Traffic maintenance during construction
	Preferential treatment	<ul style="list-style-type: none"> · Bus lanes · Carpool lanes · Bicycle and pedestrian facilities · Traffic signal pre-emption
	Public transport operations	<ul style="list-style-type: none"> · Express bus services · Park-and-ride facilities · Service improvements · Public transport images · High-capacity public transport vehicles
	Freight transport operations	<ul style="list-style-type: none"> · Urban goods movement · Intercity goods movement

Source, Dougherty, 1994

2.6.4.5 Relieving traffic congestion through management

A growing body of evidence proves that simply expanding the road dimensions infrastructure cannot solve urban traffic congestion problems. Many countries are working to manage their existing transportation systems to improve mobility, safety, and traffic flows and to reduce demand for vehicle use. When properly applied, measures taken to manage the existing transportation system can have a profound impact on trip-making behaviour and traffic congestion. Wide array of technologies for motorized, no motorized transport and administrative policies have been used successfully around the world to manage traffic congestion and influence travel demand. These measures are referred to collectively as congestion management and are designed to improve the operating efficiency of the existing transportation system, i.e. the infrastructure, modes, and services in three ways: By increasing the use of alternative transportation modes including public transport, carpooling, and bicycling/walking by altering trip patterns through the application of measures such as land-use policies, alternative work-schedule arrangements, telecommuting, and pricing. This improves traffic, flow through measures such as route guidance systems, traffic signal improvements, and incident management.

2.7 Traffic flow and road safety

The primary function of a road is to carry traffic wishing to use it at maximum speed consistent with safety. The capacity of road varies with its width and the average speed of traffic using it. The speed of traffic depends largely on the road alignment and the amount of interference from cross traffic junctions, turning and manoeuvring at junctions and accesses and traffic signals. (Sedgwick, 1969) Most highways in the urban area must be designed to accommodate the smallest sub compact automobile as well as the largest articulated truck trailer. It is imperative that the highway Engineers should have in mind that different driver have a wide range of ages and skills on the highway. The World Bank (1984) noted that in order to reduce expenditures, accidents and pollution through urban traffic management programmes in the third world countries there is need for the creation of one-way streets networks designed to reduce congestion and increase speeds. Also, there is the need to improve the accidents and congestion black spots through out the provision of coordinated traffic signal systems, including signals for pedestrians and priority phases for public transport vehicles for effective low cost urban traffic management. Introduction of segregated rights of way for public transport vehicles, bus lanes, public only streets, and the introduction of pedestrian streets in the CBD with provision for delivery of goods are necessary for road safety measures. The one-way traffic system can by itself increase the capacity of a road by 50%. Road accident Fatality rates in the some developing countries have been reported to be as much as 30 times greater than the rates in the USA. A 1979 world health organisation report showed that the number of deaths from diarrhoeal diseases only exceeded total deaths by road accidents.

2.7.1 Traffic accidents and traffic congestion

It is estimated that 85% of vehicles miles travelled are in the urban areas, and as such, an improvement of road safety conditions will have a great impact in the urban areas (Wright, 1979). Road accidents causes heavy traffic congestion in the CBD of Nairobi, especially when they are serious and totally blocks the road carriageway. When the scenes of accidents are not immediately and promptly cleared, the traffic congestion so created can trail to kilometres within a very short period of time in the CBD of Nairobi. Various aspects on the road utilisation cause these accidents.

2.7.2 Causes of traffic accidents in Nairobi city

Table 2-3 causes of accidents in Nairobi

Drivers	5651
Pedal Cyclists	1073
Pedestrians	4543
Passengers	750
Animals	48
Obstruction	110
Vehicle Defects	767
Road Defects	189
Weather	45
Others	1166

Source; The Central Bureau Of Statistics 1999

2.7.2.1 Drivers

These are the people who drive all the cars on the roads. Many of them have been fatally involved in road accidents in Nairobi. They cause the vehicles to over speed, so as to end their trips quickly, and if necessary make other trips. They try to out do each other on the road by avoiding traffic jam, using short cuts and over speeding. They operate when drunk, under drugs, or when sick. They drive defective vehicles, and don't use the safety belts. The drivers' behaviour and attitudes are a major cause of road traffic accidents in Nairobi, which in turn causes heavy traffic congestions.

2.7.2.2 Poverty

Most young people migrate to the urban areas and especially Nairobi for a better job and a better living. Once in the urban areas, some of the less educated youths engage in driving practices without acquiring the driving as a cheap way of entering a lucrative business to alleviate their poverty. The lack of the required skills occasionally ends in a fatal road traffic accident that causes traffic congestion for long hours in the city highways.

2.7.2.3 Traffic police

Some have been blamed for accepting money from vehicle operators as bribes to allow defectives and over loaded vehicles to continue with their journeys. This has lead to several accidents in Nairobi.

2.7.2.4 Vehicle owners

They make the drivers to work for long hours regardless of the work fatigue. They prefer to engage the youths as drivers, and sets for them a daily target for their returns in terms of money because they need to pay the car/matatu loans or buy another matatu. Many accidents have occurred due to this, and the need to make many trips per day has lead to traffic congestion in the central business district streets of Nairobi.

2.7.2.5 Passengers

They normally see the vehicle is full, and still insist on getting on causing human traffic congestion inside the vehicles, some passengers force the drivers to go faster to reach their destinations early.

2.7.2.6 Pedestrians

The pedestrians in the CBD of Nairobi are commonly seen Carelessly crossing the roads, luckily the essential knowledge of the Highway Code and ignorant of the traffic rules. Most of them rarely use the road in the recommended ways. This has made the pedestrian to become the highest and the most vulnerable victim of road traffic accident in Nairobi and they cause enormous human traffic congestion the city streets and lead up to vehicles traffic congestion in the Nairobi city streets.

2.7.2.7 Contractors

The contractors sometimes put up the roads without following the required specifications. They put up shoddy road signs, which fade away shortly with no replacement, leading to traffic accidents and traffic congestion, especially in the points where the information lacks seriously.

2.7.2.8 Driving schools

Some driving schools use inexperienced driving school instructors thus recommending incompetent drivers to attain driving licences. These incompetence people on the road have been a major source of traffic congestion for many years in the Central Business District of Nairobi.

2.7.2.9 Garages and mechanics

Some of the mechanics especially the highway mechanics do shoddy jobs on vehicle mechanical repairs. They have a habit of removing good parts and replacing them with worn out parts in order to sell the better part to other motorists. This may lead to serious accidents. The tyres are the basic contact between the car and the road. Defective tyres cause many accidents and leads to severe traffic congestion especially when the accident has not been cleared in time.

2.7.2.10 Shape of the road

May roads in the outer parts of the CBD and the environs of Nairobi are in a poor state. The potholes are a major cause of accidents in effort to avoid them. Other roads in the Central Business District of Nairobi such as Luthuli streets, and Hakati road have been completely ignored in terms of repairs, and a big source of traffic congestion in the Central Business District of Nairobi.

2.8 Congestion reduction strategies

Transport demand management improve transportation options or provide new rewards for reduced driving. These are in addition to indirect benefits to motorists, such as reduced traffic congestion, facility costs and pollution emissions, and benefits to non-motorists from reduced crash risk. Motorists can travel to most destinations with reasonable speed, comfort and safety,

Transport Demand Management cause changes in trip scheduling, route, destination or mode. Others reduce the need for physical travel through more efficient land use, or transportation substitutes. These include Congestion Pricing strategies, reduction of peak-period travel demand or improve transportation alternatives, and various ways to increase roadway capacity. Strategies that increase peak period roadway capacity or shift vehicle travel times on routes that generate traffic congestion so as to increase their long-term congestion reduction benefits. They provides multiple benefits, including reduced congestion, road and parking facility cost savings, crash cost savings, consumer cost savings, pollution reduction, and more efficient land use. The major transportation problems facing most communities (traffic and parking congestion, inadequate mobility for non-drivers, and external costs from traffic) are the types of problems that Transport Demand Management can effectively address. The factors that affect traffic congestion, and potential strategies for reducing congestion problems include pricing strategies, Congestion Pricing, Parking Pricing, Distance-Based Charges, and grade separated Transit Improvements can reduce overall traffic congestion. Roadway capacity expansion or Flexitime (which frees up

peak-period road space) is likely to generate traffic, and so will provide relatively little long-term congestion reduction, depending on circumstances. Strategies that improve transportation choices, such as Ridesharing or Transit Improvements are unlikely to provide significant congestion reduction if implemented on a small scale, but may provide some benefit if implemented on a large scale that affects a major portion of total peak-period travellers.

Congestion Pricing has a higher rate during congested periods. Transport Demand Management strategies reduce peak-period travel demand or improve transportation alternatives, with various ways to increase roadway capacity. Strategies that increase peak period roadway capacity or shift vehicle travel times or routes tend to cause generated traffic, which reduces their long-term congestion reduction benefits. The capacity of a road depends on various design factors such as lane widths and intersection configurations, Traffic speed, volume and density for a highway. Traffic speed and flow on urban streets are determined primarily by intersection capacity, which is affected by traffic volumes on cross streets and left turn signal phases.

Table 2-4 Highway speed, flow and density under each level of service (los) rating

LOS	Speed Range (Mph)	Flow Range (Veh. /hour/lane)	Density Range (Veh. /mile)
A	Over 60	Under 700	Under 12
B	57-60	700-1,100	12-20
C	54-57	1,100-1,550	20-30
D	46-54	1,550-1,850	30-42
E	30-46	1,850-2,000	42-67
F	Under 30	Unstable	67-Maximum

Source; TDM Encyclopaedia, 2000

Table 2-5 Maximum traffic volumes (vehicles per hour per lane)

	LOS A	LOS B	LOS C	LOS D	LOS E
4-lane Freeway	700	1,100	1,550	1,850	2,000
2-lane Highway	210	375	600	900	1,400
4-lane Highway	720	1,200	1,650	1,940	2,200

Source; TDM Encyclopaedia, 2000

Traffic congestion is a non-linear function, meaning that a small reduction in urban-peak traffic volume can cause a proportionally larger reduction in delay. For example, a 5% reduction in traffic volumes on a congested highway may cause a 10-30% reduction in congestion delays. As a result, even relatively small changes in traffic volume or capacity can provide relatively large changes in travel time. "Traffic incidents" (disabled vehicles and accidents) account for an estimated 60% of delay hours. Although random events, they tend to cause the greatest delays

where traffic volumes approach road capacity and so are considered congestion costs. In uncongested conditions an incident causes little or no traffic delay, but a stalled car on the shoulder of a congested road can produce 100-200 vehicle hours of delay on adjacent lanes. Larger and heavier vehicles tend to require more road space and are slower to accelerate, and so cause more traffic congestion than smaller, lighter vehicles. The relative congestion impact of different vehicles is measured in terms of “Passenger Car Equivalents” or P C E s. Large trucks and buses tend to have 1.5-4 P C E s, depending on roadway conditions, as shown in Table 3, and even more through intersections or under stop-and-go driving conditions. A large SUV imposes 1.4 P C E s and a van 1.3 P C E s when travelling through an intersection (Shabih and Kockelman, 1999).

Table 2-6 Passenger car equivalents

	Traffic flow	Level	Rolling	Mountainous
Two-Lane	PC/lane/hr			
Trucks & Buses	0-300	1.7	2.5	N/A
Trucks & Buses	300-600	1.2	1.9	N/A
Trucks & Buses	> 600	1.1	1.5	N/A
Recreational	0-300	1.0	1.1	N/A
Recreational	300-600	1.0	1.1	N/A
Recreational	> 600	1.0	1.1	N/A
Multi-Lane				
Trucks & Buses	Any	1.5	2.5	4.5
Recreational	Any	1.2	2.0	4.0

Source; TDM Encyclopaedia, 2000 PC=passenger cars

A vehicle’s road space requirements increase with speed, because drivers must leave more “shy distance” between their vehicle and other objects on or beside the roadway. Traffic flow (the number of vehicles that can travel on a road over a particular time period) tends to be maximized at 30-55 mph on highways with no intersections, and at even lower speeds on arterials with signalised intersections. When a roadway approaches its maximum capacity, even small Speed Reductions can significantly increase flow rates as indicated in Table 2-7.

Table 2-7 Traffic speed and flow

Level of Service	Speed (Km/hr)	Flow (vehicles/lane/hour)
A	60 mph	720
B	60 mph	1,200
C	59 mph	1,650
D	57 mph	1,940
E	55 mph	2,200

Source; **Homburger, Kell and Perkins, 1992**

Transport Demand Management strategies tend to be particularly effective at reducing traffic congestion.

2.8.1 Road pricing

Road Pricing involves charging motorists directly for driving on a particular road or in a particular area. Congestion Pricing is Road Pricing with higher rates during congested periods. It can reduce traffic congestion on a particular roadway, particularly if implemented as part of a comprehensive Transport Demand Management program. Road Pricing applied on just one roadway may cause traffic to shift routes, increasing traffic congestion on other roads.

2.8.2 Commute trip reduction programs

Commute Trip Reduction programs encourage commuters to use alternative modes for trips to work and school. Such programs tend to be particularly effective if they incorporate suitable Financial Incentives, such as Transit Benefits or Parking Pricing. In most areas, commute traffic represents the majority of traffic on congested roads so Commute Trip Reduction programs can be particularly effective at reducing traffic congestion.

2.8.3 Flexitime

Flexitime means that employees are allowed some flexibility in their daily work schedules. Rather than all employees working 8:00 to 4:30, some might work 7:30 to 4:00, and others 9:00 to 5:30. This shifts travel from peak to off-peak periods, which can reduce traffic congestion directly, and it can assist commuters in matching transit and rideshare schedules, allowing mode shifts.

2.8.4 Transit improvements and rideshare programs

Transit Improvements and Rideshare Programs can be effective ways to reduce vehicle travel, particularly under urban-peak travel conditions when congestion problems are most severe. Some communities with good transit systems have significantly less traffic congestion than those that do not, because they tend to encourage more efficient overall transportation and land use patterns (Social Benefits of Public Transit).

2.8.5 High Occupancy Vehicle priority

High Occupancy Vehicle Priority gives Transit and Rideshare vehicles priority over general traffic through special lanes and traffic control devices. This benefits High Occupancy Vehicle riders directly and by shifting travel from automobiles, it can reduce congestion delays for other road users.

2.8.6 Access management

Access Management is a term used by transportation professionals for coordination between roadway design and land use to improve transportation. It involves changing land use planning and roadway design practices to limit the number of driveways and intersections on arterials and highways, constructing medians to control turning movements, encouraging clustered development, and creating more pedestrian-oriented street designs. This reduces “friction” along the roadway, which tends to increase traffic speeds, reduce congestion delays and reduce crashes.

2.8.7 Parking management and pricing

Parking Management and Parking Pricing strategies are an effective way to reduce automobile travel, and tend to be particularly effective in urban areas where congestion problems are greatest. Driving and parking are virtually perfect complements: you need a parking space at virtually every destination (except when driving a vehicle on its final trip to a dismantling facility or to be teleported into space). Since most urban-peak highway trips are for commuting, employee-parking pricing can have a similar effect as a road toll.

2.8.8 Pricing impacts on traffic congestion

The most effective pricing strategy for reducing traffic congestion is congestion pricing, followed by parking fees, fuel taxes and emission fees. Of course, these other fees may be more

cost effective at achieving other objectives, such as parking cost savings and emission reductions.

2.8.9 Distance based fees

Converting vehicle insurance and registration fees into distance-based charges provides a significant financial incentive to reduce driving, comparable to nearly doubling fuel prices. Unlike Road Pricing, distance-based fees affects all travel, not just travel on certain highways, and so provides congestion reduction benefits on surface streets without shifting traffic to other routes.

2.8.10 Freight transport management

Freight trucks represent a relatively small portion of total traffic but make a relatively large contribution to congestion, due to their large size and slow acceleration. A large truck can contribute as much congestion as 3-6 passenger cars. Freight transport management can reduce total freight traffic and shift freight to less congested routes.

2.8.11 Traffic calming and roundabouts

Traffic Calming includes a variety of roadway design features that reduce vehicle traffic speeds and volumes. Some Traffic Calming result in smoother traffic and more optimal speeds, causing overall reductions in congestion delays. In particular, Modern Roundabouts are an alternative to stop signs and traffic signals at small and medium-size intersections that can reduce stopping requirements and avoid traffic “platoons” (vehicles bunching up at intersections).

2.8.12 Speed reductions

Reducing traffic speeds to 55 mph or less on congested roads often increase traffic flow and reduce conflicts. This is achieved by reducing posted speed limits, improving enforcement of existing limits, or implementing road design features that discourage excessive speeds.

2.8.13 Car-free planning and vehicle restrictions

Comprehensive Car-free Planning and Vehicle Restrictions that support other Transport Demand Management strategies (non motorized transport, transit, efficient land use, etc.) reduce vehicle use in an area. If applied on a small scale they shift traffic from one area to another. In some areas, certain types of vehicles (such as freight trucks) are only allowed during off-peak periods.

2.8.14 Telework

Telework involves the use of telecommunications to substitute for physical travel. It includes telecommuting, tele-shopping, tele banking etc. Employees with mobile work and people who are self-employed and able to work from a home office due to efficient communications. This gives people a way to avoid travelling under congested conditions.

2.8.15 Road capacity expansion

Road widening is often advocated as ways to reduce traffic congestion. However, it tends to be expensive, and may provide only modest congestion reduction benefits over the long run, since a significant portion of added capacity is often filled with induced peak period vehicle traffic. It encourages Traffic Rebound Effects. A large amount of additional capacity would be needed to reduce urban traffic congestion. Some research indicates that roadway capacity expansion provides only slight reductions in urban traffic congestion (STPP, 2001).

2.8.16 Grade separation

Grade separation can significantly increase roadway capacity, since intersections are a major cause of traffic delay. A typical arterial lane can carry less than 1,000 vehicles per hour, while a grade separated freeway can carry more than twice that amount. Grade separation of rail lines can increase traffic flow where railroad crossings are a major cause of traffic delay.

2.8.17 Intersection improvements

Various strategies that increase intersection capacity reduce delays, since intersections are often a limiting factor in roadway traffic flow. These include additional lanes at the intersection approach, left- and right-turn lanes, and improved signal synchronization.

2.8.18 intelligent transportation systems

Intelligent Transportation Systems include the application of a wide range of new technologies, including driver information, vehicle control and tracking systems, transit improvements and electronic charging. These provide a variety of transportation improvements, including driver convenience, reduced congestion, increased safety, more competitive transit, and support for pricing incentives.

2.8.19 Incident detection and management

A significant portion of traffic congestion results from some sort of traffic incident, such as a disabled vehicle, a crash or dangerous driving. Many urban regions have coordinated programs that prevent, identify and respond to such events quickly and efficiently. These may include centralized traffic management centres, video traffic surveillance, emergency response teams and special resources for dealing with specific problems, such as cranes and even helicopters to move disabled vehicles. Motorist information includes changeable message signs, radio reports and Internet information about traffic conditions. These can reduce motorist stress by letting them anticipate conditions.

2.8.20 Ramp metering

Ramp meters control the number of vehicles that can enter a highway ramp. This tends to maintain smoother traffic flow on highways.

2.8.21 One-way streets

Converting from two-way to one-way streets increase traffic flows and simplify intersections, although it makes access to buildings less convenient. It is possible to have a traffic lane that is reversed to carry traffic in the direction of maximum flow, for example, into a city centre during the morning rush hour and outward during the evening rush hour.

2.8.22 Implications of generated traffic

Generated Traffic is the additional vehicle travel that results from increased roadway capacity (Litman, 2001). This consists of a combination of diverted vehicle trips (trips shifted in time, route and destination), and induced vehicle travel (shifts from other modes, longer trips and new vehicle trips). Over the long run, Generated Traffic often fills a significant portion (50-90%) of added urban roadway capacity.

Table 2-8 Indication whether a strategy is likely to generated additional traffic.

Significant generated traffic	Depends on circumstances	Little or no generated traffic
Flexitime Roadway Capacity Expansion Highway Grade Separation Intersection Improvements Incident Detection & Management Motorist Information Systems Ramp Metering One-Way Streets Reversible Lanes	Access Management ITS Commute Trip Reduction Programs Transit Improvements Rideshare Programs Traffic Calming & Roundabouts Vehicle Restrictions	Road Pricing HOV Priority Distance Based Fees Freight Transport Management Speed Limit Enforcement

Source; TDM Encyclopaedia, 2000

2.9 Urban traffic congestion control

An obligation of urban traffic congestion control and management is to enhance the efficiency of urban transport system, not only to respond to locally generated movement requirements but also to relate to the countries national urban development strategy. Such a strategy could indicate the phasing of transport investment in relation to other aspects of urban national policy. This will include the preferred transport inter-modal mix, the use of urban movements as a tool of spatial development policy and the use of transport as a tool of national urban policymaking. The very heart of Traffic management planning is concerned with the design of a circulation system which can maximize accessibility for essential movements between linked activities, giving due consideration to safety, comfort and amenity as well as cost. World Bank 1993 refers to urban traffic accessibility as the ability of reaching various destination or places offering opportunities for a desired activity. Urban accessibility is the concept, which combines the geographical arrangements of land use and the transport that serves these land uses. It is a description of how conveniently land uses are located in relation to each other and not how easy or difficult it is to reach them. Where many land uses are located close to one another and the transport connection is very good, high accessibility is achieved. When activities are located far a part, and the transport system connection is poor, low accessibility results. Different geographical locations do not have the same accessibility because land use activities are distributed unevenly and transport is neither of uniform coverage nor quality. Some land uses have a dispersed pattern e.g. residential estates, while others have a more clustered establishment e.g. shops, and a few special activities have one site location e.g. Airports in city public transport is usually better and has a high accessibility degree especially when connecting the city centre. (Hovel 1975)

2.9.1 Traffic congestion and the professionals

The physical planner, views urban traffic congestion as mere symptom of wider urban development problems and therefore a wider comprehensive approach is need for urban traffic congestion management. They use deterministic approach to address urban traffic congestion problems. The physical planner tends to view urban traffic problems more in spatial and physical terms. The broad-brush approach almost inevitably places the planner in a position of conflict with the economist and the engineer who tackles local urban traffic congestion problems outside any pre-agreed citywide planning framework.

The civil engineer/traffic engineer/road engineer emphasises the operational aspects of urban traffic congestion management systems rather than the systems contribution to wider urban goals. They thus see urban traffic problems and transport problems as a sub-optimisation difficulty associated with the performance of the transport system. It is notable that the origin of this perception is from the highway and traffic engineers most influential in road transport sector.

The economists do not have standardised criteria for evaluation and will depend on different underlying factors to evaluate a given urban transport infrastructure project.

The politician. One of principal concern of urban traffic congestion problems is their interface with professionals in the business of resource allocation in urban transport development in time scale and priorities. In the Third World cities where urban infrastructure projects become visible before elections it's more important to the politician than policy measures advocated by the professional. In spite of the differing perceptions, it is observed that urban traffic congestion management problems are joint product of the dynamics of their complex interaction. Any one professional or interest group cannot effectively tackle them. What is required in urban traffic congestion management problems is a pre-set framework of priorities and resource constraints.

2.9.2 Organisation of traffic management

The organisation framework of urban traffic management affects the productivity and the overall operation of the transport system and determines indirectly the level of service provided to the travelling public (Giannopoulos, 1989). The organisational framework implies the: Supervisory and financing structure, policy formulation and operating agencies, the form of ownership of the vehicles and the co-ordination between the various elements of urban transport. These are very critical for the efficiency and effectiveness in the operations of the urban system and urban

traffic organisation. The ultimate goal of any urban traffic organisation agency is to produce and sell acceptable transportation services to the travelling public (Giannopoulos, 1989).

2.9.3 Traffic congestion control devices

The city council maintenance department virtually has change of marking and painting traffic signs, installation, repair and replacement to promote safe and efficient motor-vehicle operations. Very light traffic, operating under ideal conditions can move easily and safely following rudimentary transport rules. As the traffic volume increase conflicting movements brings about delays and traffic congestion in the transport system. The traffic control devices have two main purposes, which are to; Increase road safety and Reduce traffic delays and traffic congestion.

2.9.3.1 Pavement markings

This has a main reason to regulate and provide guidance to the traffic and to channel and separate movements with minimum physical equipment is to bring about the desired driver behaviour. They have an advantage in that they cause no physical obstruction on the path of the traffic movements. They are low cost, and can easily be removed in case of need. The pavement markings include centre line – a broken or unbroken yellow line used to separate opposing traffic flows on a multilane road, the undivided pavement of 2 or more lanes is divided by a white line for all the traffic going in the same direction.

Plate 2-3 Urban traffic management road signs



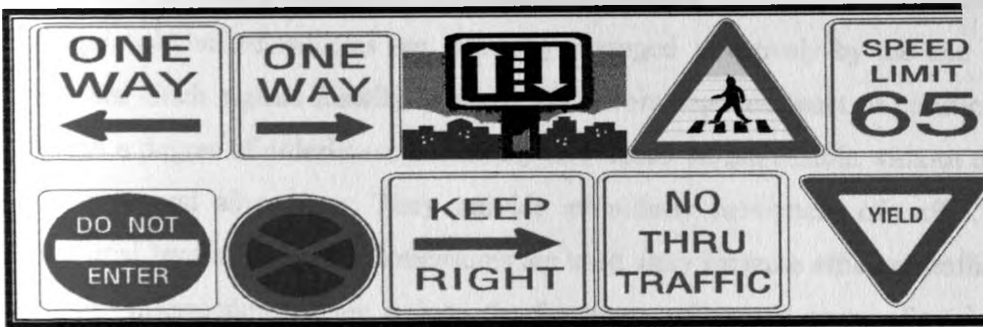
Source; The Kenya Highway Code, 1976

This is the most common and the oldest method of urban traffic control and management. The signs main faction is to control the movements of vehicles to reduce hazards of traffic operations, and to improve the quality of traffic flow. The classifications of road signs are to enable the drivers to rapidly determine the category of any particular sign and behave as expected. The classifications are: Regulatory signs, Warning signs and guiding signs.

2.9.3.2 Regulatory signs

These signs help to manage urban traffic movements and without which enforcement cannot be easy. These signs are posted where they can be readily seen and the section of the road which the regulations applying. Such signs include the management of way, speed signs, movement direction signs, parking signs, pedestrian crossing signs and miscellaneous signs.

Plate 2-4 Traffic regulatory signs in Nairobi



Source; The Kenya Highway Code, 1976

2.9.3.3 Warning signs

Caution is necessary, including the reduction of speed or special alertness to condition the road or close to the road. These signs include horizontal charges in road surface, intersections and junctions, traffic control devices ahead, converging traffic lanes narrowing roads, changes in road geometry, indicating sudden changes in surface conditions indicate unexpected entrances and crossings, speed advisory, clearance limits, animal crossings etc. These signs are traditionally yellow and blue with black lettering. They can also be rectangular in shape.

Plate 2-12 Traffic warning Signs In Nairobi



Source; The Kenya Highway Code, 1976

2.9.3.4 Guide signs

These signs guide the drivers to find desired routes and identify items of need and interest. They are made of three categories. The route markers, designation and distance signs and general information signs.

Plate 2-6 Traffic guide signs in Nairobi

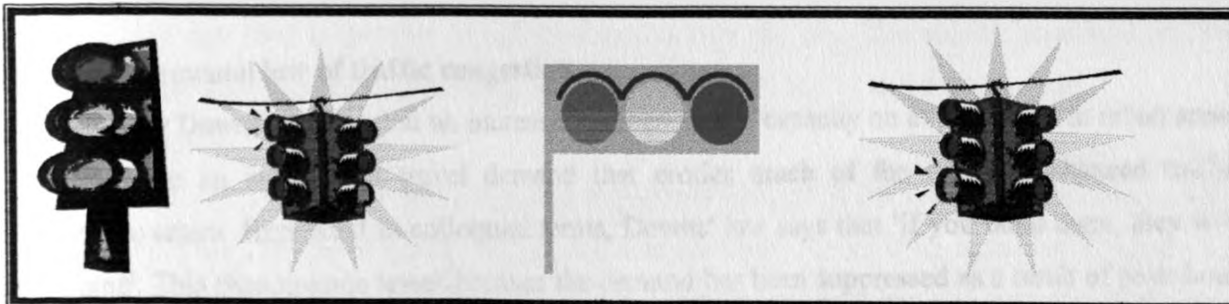


Source; The Kenya Highway Code, 1976

2.9.3.5 Electronic traffic congestion management signals

Large volumes of vehicles are generally managed effectively by the use of electronic traffic signals. Such signals installations can effectively separate most of conflicting flows bringing about a degree of orderliness and safety that would be impossible without them. Traffic signals have several advantages: They provide an orderly movement of traffic, where proper and physical layouts and control measures are used, they increase efficient traffic handling capacity of the intersection. They reduce the frequency of certain types of accidents. They can be controlled to provide continuous or nearly continuous traffic movement at a definite speed on a given route. They can be used to interrupt heavy traffic at intervals to let other traffic like pedestrians to cross.

Plate 2-7 Electronic traffic Signals



Source; Hovel 1976

2.9.3.6 Managing urban traffic congestion

The aim of the urban traffic congestion management policy is to facilitate the needs and efficient movement of people and goods while promoting safety and amenity (Bus and Coach Council, 1986, O'Flaherty, 1974). Wells, (1975) observes that urban traffic congestion management measures are usually expensive though they achieve impressive economic benefits. The urban traffic congestion management measures must; be relatively inexpensive and capable of early implementation. Improve the performance and/or capacity of existing transport facilities. Reduce the incidence of accidents or at least prevent an increase. Be sufficiently flexible to adapt to minor land use changes, to cater for construction of new roads, adoption of new public transport measures and to the development of new parking policies and where possible appropriate to generate adequate economic benefits to warrant their implementation (Wells, 1975). There is a rapid growth of urban traffic congestion and the many problems caused by such factors; as wide spread poor driver and other operators behaviour, inadequately and poorly maintained vehicles and infrastructure, lack of regard for traffic regulations, the common absence of adequate road signs and markings and a growth of uncontrolled street hawker activities. The resultant need to make city transport systems more efficient through selected urban traffic congestion management and control measure including; the installation and maintenance of traffic control signals, the re-routing of traffic, the designation of one way street system and the banning of conflicting turns have placed a great deal of pressure on urban traffic management enforcement agencies (the traffic police, the city council and the ministry of local authorities) in excess of resources at their disposal. The urban traffic problems have been considered further to deteriorate and aggravated by the perception of the various experts in the field of transport planning. (Hovel 1975)

2.9.3.7 Fundamental law of traffic congestion

Anthony Downs' showed that an increase in urban traffic capacity on expressways in urban areas results in an increase in travel demand that erodes much of the capacity-enhanced traffic improvement. Expressed in colloquial terms, Downs' law says that 'if you build them, they will come'. This phenomenon arises because the demand has been suppressed as a result of peak-hour congestion (otherwise known as latent demand) is released as soon as the traffic situation is improved. After all, everyone opts to travel at his or her most convenient time via the most favoured route and in the most preferred way (mode). Yet everyone is impeded from doing so

most inefficiently at times by the only form of abatement –urban traffic congestion itself - so that any improvement in travel time will induce hitherto early birds, for instance, to commute later and closer to their official work start time. Traffic volume will accordingly rise until congestion worsens to a barely tolerable level (such as that of the inferior local arterials) and the peak period narrowed unless there is appropriate government intervention. The reason why conventional supply-side measures of road construction and improvement as well as traffic management are bound to fail over the long term in reducing urban traffic congestion is that they do not fully take into account the fundamental law of traffic congestion. Since the average cost is borne by the motorist in the form of time cost and vehicle operating cost, the public sector's task is to charge for the external congestion cost so that quasi-market measures can be established and the "right" prices emitted. If free-flowing traffic happens, then road pricing (or congestion pricing,) would call for a zero charge; if congested urban traffic occurs, it is the presence of excess demand that justifies charging the difference of the social and private costs of a trip. Simply stated, urban traffic congestion merely reflects excess demand on transport system. . Thus, one could either increase the supply side (in the form of positive supply measures of road construction and public transportation improvements) or strengthen transport supply demand management. These stand-alone supply side measures are ineffective over the long run.

2.10 Urban land use patterns

2.10.1 Three models of urban land use

The study of urban land use generally draws from three different descriptive models. Because these are general models devised to understand the overall patterns of land use, none of them can accurately describe patterns of urban land use in all cities. The models are static; they describe patterns of urban land use in a generic city. They continue to be useful generalizations of the way in which land is devoted to different uses within the city. The models examined are the Concentric Zone Model, Sector Model and Multiple Nuclei Model of urban land use.

2.10.1.1 Concentric zone model

The concentric zone model was originated by Earnest Burgess in the 1920s. The concentric zone model depicts the use of urban land as a set of concentric rings with each ring devoted to a different land use (see Figure 1). Major routes of transportation emanated from the city's core, making the CBD the most accessible location in the city. Burgess identified five rings of land use that would form around the CBD. (1) Central business district, (2) zone of transition, (3) zone of independent workers' homes, (4) zone of better residences and (5) zone of commuters.

An important feature of this model is the positive correlation of socio-economic statuses of households with distance from the CBD.

2.10.1.2 Sector model

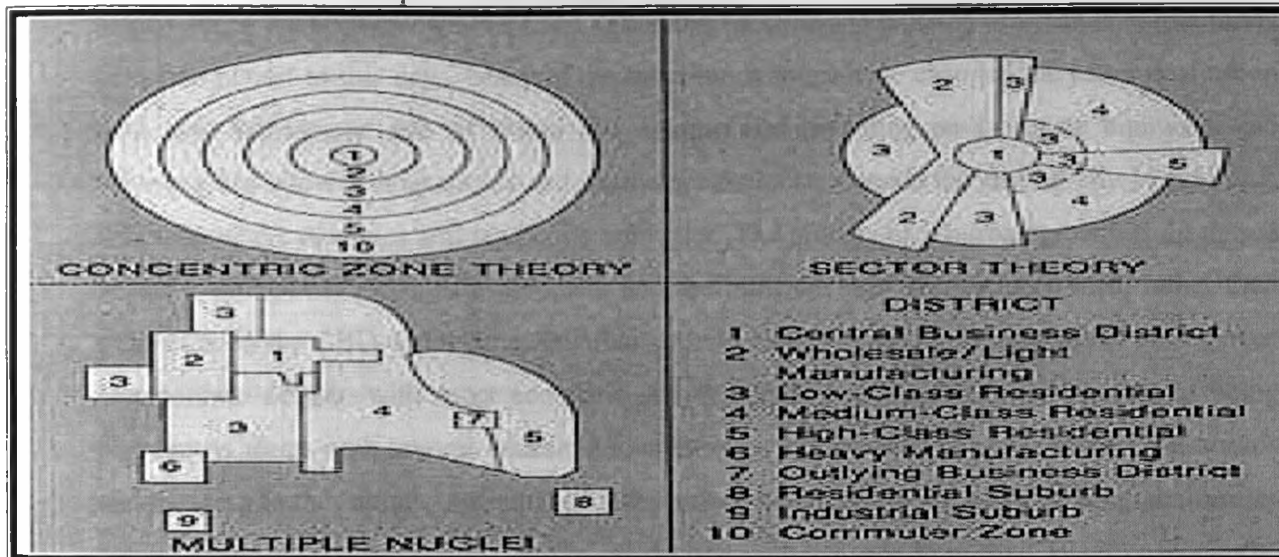
Homer Hoyt recast the concentric ring model while recognizing the value of the concentric ring model. He observed that it was common for low-income households to be found in close proximity to railroad lines, and commercial establishments to be found along business thoroughfares. In 1939, Hoyt modified the concentric zone model to account for major transportation routes. Most major cities evolved around the nexus of several important transport facilities such as railroads, seaports, and trolley lines that emanated from the city's centre. Recognizing that these routes (and later metropolitan expressways and interstate highways) represented lines of greater access, Hoyt theorized that cities would tend to grow in wedge-shaped patterns, or sectors, emanating from the CBD and centred on major transportation routes. Higher levels of access translate to higher land values. Thus, many commercial functions would remain in the CBD, but manufacturing activity would develop in a wedge surrounding transport routes. Residential land use patterns also would grow in wedge-shaped patterns with a sector of lower-income households bordering the manufacturing/ warehousing sector (traffic, noise and pollution making these less desirable locations to live) and sectors of middle- and higher-income households located away from industrial sites. Hoyt's sector model is simply a concentric zone model modified to account for the impact of transportation systems on accessibility.

2.10.1.3 Multiple Nuclei Model

Chauncy Harris and Edward Ullman found out that many cities did not fit the traditional concentric zone or sector model. Cities of greater size were developing substantial suburban areas and some suburbs, having reached significant size, were functioning like smaller business districts. Smaller business districts acted as satellite nodes, or nuclei, of activity around which land use patterns formed. While the CBD is the major centre of commerce the specialized cells of activity develop according to specific requirements of certain activities, different rent-paying abilities, and the tendency for some kinds of economic activity to cluster together. At the centre of their model is the CBD, with light manufacturing and wholesaling located along transport routes. Heavy industry locates near the outer edge of city, surrounded by lower-income households. Smaller service centres occupy the urban periphery.

Figure 2- 1 Three generalizations of urban structure

Upper Left: Burgess' Concentric Zone Model; Upper Right: Hoyt's Sector Model; Bottom Left: Harris and Ullman Multiple Nuclei Model.



Source; Department of Geography and Earth Sciences, University of North Carolina at Charlotte. 1998

2.10.2 Theories and models

Cities are distinctive ensembles of people, businesses and institutions and are easily distinguished by the number and density of economic, social and cultural activities that take place within them. Many cities have unique characteristics such as Nairobi, Kampala, Dar-es-salaam, and Federal buildings of Washington, DC that make them distinctive places to see and visit. The most visible characteristic of cities is the form of their built environment -- tall buildings located at the city's centre, outlying areas of manufacturing and distribution, and residential areas with greater density near the centre than in the suburbs. It is the location of these, and other, activities that define patterns of urban land use. As industrialization proceeded, many types of business found it advantageous to cluster together and form agglomerations of economic activity. Benefits from agglomeration, called agglomeration economies, is an important concept in understanding why cities developed. Technological change in industry, transportation, communications, and building techniques provided the necessary requisites for urban growth. The basic structure of cities has been remarkably resilient. The core of urban places typically evolved around the nexus of transportation routes (roads, streetcar lines, railroads, ports, etc.), which were critical in shipping and receiving industrial products. The same lines of transportation that radiated from the city's central business district

(CBD) also brought people to the centre for work and shopping. Innovations in building practices, including the use of reinforced concrete, allowed large structures to be erected which helped shape the built environment and define the function and patterns of urban land use, many of which persist to this day. Many of the same innovations have changed the patterns of urban land use. Widespread use of trucks and automobiles travelling on interstate highways and beltways has allowed households and businesses to locate outside the central city in suburban locations where densities and land costs are lower. The process of suburban growth is discussed in terms of "sprawl" where development and the built environment are horizontal, rather than vertical as in the CBD. Over time, suburban growth has changed the form of urban places from being mono centric, with most economic activity located in the centre of the city, to being polycentric forms with several nodes in the urban area around which businesses and households locate. Despite the unique attributes of many urban places, there are some striking similarities among cities. As a general rule, land prices decline with distance from the CBD. Consequently, land use intensity increases as one moves closer to the city's centre. Even in urban areas with large suburban commercial developments, called edge cities, land prices are positively correlated with accessibility (i.e. more accessible parcels of land are more expensive). Producers and consumers make trade-offs between the price of land and its characteristics in terms of location, accessibility, quality, and other attributes. The outcome of numerous location decisions by businesses, households and governments produce a complex urban mosaic of business districts, shopping centres, government centres and residential neighbourhoods characterized by different land uses.

2.10.3 Clustered urban land use

Clustering refers to common destinations located close together, which tends to increase accessibility. Clustering affects travel patterns. Clustered land use tends to increase accessibility by reducing travel distances and by creating walkable centres that can be connected efficiently by public transit and ridesharing as well as automobile travel. Clustering is most effective at improving access if it includes complementary land uses (Haughwout, 2000). Clustering is most effective at reducing automobile use if it includes other land use strategies. Automobile commuting tends to decline if employment centres are clustered with shops, restaurants and day care centres. Trip Reduction strategies tend to be more effective if worksites are clustered. Office buildings, campuses, shopping malls, commercial districts, towns and cities are examples

of clustering. Clustering also facilitates Shared Parking, particularly if the buildings have different types of land uses with different peak demands. Buildings with peak parking demand during weekdays, clustered with restaurants with peak demand during the evenings, and a church with peak demands weekend mornings, can share parking and reduce total parking requirements, which allows even greater clustering. Clustering often requires changes to development policies and practices that allow and encourage higher densities and more flexible parking requirements. This can help reduce regional traffic congestion, road and parking facility costs, consumer transportation costs, crashes, energy consumption, pollution emissions and urban sprawl. These benefits tend to be greatest if complementary land uses are mixed and supported by other TDM and land use management strategies (Coffey and Shearmur, 1997). One published study found that doubling a county-level density index is associated with a 6% increase in state-level productivity. This explains why cities and commercial centres develop and are so important for economic development: clustering of common destinations reduces the costs of activities that require frequent interactions. Clustering can also increase exposure to noise and air pollution. Clustering increases some costs, including some types of infrastructure costs (such as some utility costs), traffic congestion within the cluster, although regional traffic and pollution emissions tend to decline if clustering reduces total vehicle use. Reduced automobile use and improved opportunities for Parking Management can reduce road and parking facility costs.

2.10.3.1 Clustering as transportation demand management strategy

Clustering supports and is supported by Transportation Demand Management. It is an important component of Access Management, Location Efficient Development, New Urbanism and Smart Growth. Clustering tends to facilitate Pedestrian Improvements, and since most transit trips include walking links, it is important for efficient Transit. If located near transit stations or corridors it results in Transit Oriented Development. Clustering becomes more feasibility with Parking Management, particularly Shared parking, to reduce the amount of land needed for parking facilities around buildings. The efficiency of Transportation Management Associations, Ridesharing and other Commute Trip Reduction strategies increases if worksites are clustered together.

2.11 Urban traffic congestion management in the developed countries

In the developed western world planning for movement and access in the CBD has in the recent years often followed a planning concept where by the CBD is defined, ring roads are constructed

around it, serving car parks and adjoining several shopping streets which are made into pedestrian areas. This has been applied to many cities of various CBD size, with a varying degrees of success in historic cities where the scale of existing roads is small, while civilised conditions for pedestrians have been made on some streets to the extent of providing car parks, and the outer modern roads have often been so great to an extent to isolate the CBD from the rest of the city.

Table 2-9 Number of vehicles per km of road network in some developed countries

Number of vehicles per km of road network, 1988-92		
1	Hong Kong	279
2	Singapore	145
3	United Kingdom	65
4	Germany	62
5	Japan	55
6	Mauritius	37
7	France	36
8	Central African Republic	32
9	Egypt	32
10	United States	30
11	France	543.6
12	Ireland	276.5
13	Tunisia	219.5

Source; The Economist World in Figures, 1995 edition

Table 2-10 Some cross country statistics

Highest car ownership		
Number of cars per 100 people, 1988-92		
1.	United States	56
2.	Germany	47
3.	France	42
4.	United Kingdom	35
5.	Japan	31

Source; The Economist World in Figures, 1995 edition.

2.11.1 Managing urban traffic congestion in America

In North America massive injection of new roads have been done in the recent years, the creation of cheap parking on empty sites has eliminated traffic congestion at the peak hours; which the new roads were designed to solve. New efforts being made to improve public transport are by giving priority to buses into the CBD over other private vehicles or by long-term measures of building new rapid transit systems. New off street parking are designed near free ways and away from the CBD.

2.11.1.1 Atlanta, Georgia.

The town flyer shuttle bus service operates as part of project intercept, running between two car parks associated with a stadium and civic centre and carries shoppers into the CBD. The estimated benefits from this kind of service admittedly released 3500 parking month in addition, to 320 parking spaces, which were released for more valuable land use like sales areas.

2.11.1.2 Minneapolis.

New off street parking are designed and constructed adjoining the free ways, or built over the free ways and linked into the CBD by either elevated weather protected walk ways or

mechanical systems. And escalator and conveyor belt systems. All the non-essential vehicles are parked next to the free ways away from the CBD.

2.11.1.3 Los Angeles.

Peripheral parking station are linked with 4,000 cars, adjoining the Hollywood free way with the central city (part of the Bunker Hill Renewal area) by an automated vehicle system 1.7 km long. No non-essential are vehicles allowed into the CBD.

2.11.2 Managing urban traffic congestion in Europe

Many European cities of up to 1 million people are currently adopting the severe methods of traffic restraint, aimed at giving over existing road space for use by public transport. It is already accepted by most urban authorities that shoppers and commuters should be encouraged to use public transport service vehicles to ferry them into the CBD. The problem which remains is how to deal with the would be car borne shoppers, and are not prepared to take public transport into the large city, the medium sized and the small cities. An approach which has been considered is that shoppers, like commuters are prepared to 'park and ride' provided that the public transport service is good and the distances are short. The parking at the peripheral points around the centre need not necessarily be within walking distance to the shops or connected directly to the pedestrian areas. The restraint measures are undertaken in order to give public transport, buses, and trains more road space to move on into the CBD. If there is no new road to be built, the European authorities have no alternative but to restrain movement by private car into the CBD such efficient traffic management systems – shuttle bus, improved pedestrian walkways, or the use of mechanical vehicles like escalators and conveyor belts automatically vehicles can be allow parking for short term use maximise the used of parking spaces serving shoppers or visitors. The parking spaces are sited on land outside the CBD, freeing acres of land, which were previously used for parking spaces for other uses, and freeing the streets for the movement of Buses, taxis, and certain classes of delivering vehicles. In practice, so much off street privately owned parking spaces already exists away from the CBD imposition of road pricing in the CBD or a system of supplementary licensing for all the vehicles entering the CBD other than buses has lead to possibly more than 50% reduction in vehicles on the CBD streets in most European cities. This means that considerable improvement in the walking environment has left room for essential vehicles to move on. Planning which places a high priority on the needs of the pedestrian or a cyclist to visit a corner shop or school and allows private cars a 2nd

place are proving to be popular in most European cities. Most European city councils have been in favour of investment in public transport and especially a mass rapid transit system to provide mobility to a resident population of 1.5 million plus and a visiting population of around 4 million per year. Realistically it could well be around the year 2020 by the time that such capacity is fully available and operational. The immediate management objective, therefore, ought to be putting in, as a matter of urgency, all the Quality Bus Corridors, the three Light Rail Lines and improvements to the existing diesel Suburban rail system.

2.11.2.1 Cumbernoud new town, Scotland

Has a very complete roads network and has $\frac{1}{4}$ of the accidents rate of any other new town in Scotland.

2.11.2.2 Essens, Germany

This is a city with a centre containing a mile of excellent pedestrian streets surrounded by a six-lane ring road and 8,000 car parks along the ring road. At the same time, an under ground railway was built in an effort to link the pedestrian streets, across the road system, with the neighbouring residential area.

2.11.2.3 Munich, Germany

This is a city with a much larger CBD area, well-designed pedestrian precincts and a six lane inner ring road, and a reduced parking area in the CBD.

2.11.2.4 Gothenburg-Sweden

The CBD is divided into five sectors. Vehicle access is attained from entry and exit points along the existing ring roads. Buses and trams are allowed to cross between the zones and across the CBD, but no cars, trucks, or taxis into the CBD, although they are allowed to cross at certain points only. People with cars, wheeled cycles, or mopeds are not allowed between the zones, and the pedestrian networks of existing streets are extended across the CBD linking each zone, and eventually connect the car parks to the ring road, which has a parking space of 5000 cars. There has been an improved environment in the CBD with some roads carrying only 30% of their capacity, with 50% of it being through traffic. The pavements are wide and landscaped. Road accidents have decreased by 20% with the noise level down by 9%. In the CBD, 66% of

the merchants have supported the situation, while others prefer to have more cars parking for large-scale businesses and big volume shoppers.

2.11.2.5 London- England

Central London suffers from significant road congestion. Each morning the equivalent of 25 busy motorway lanes of traffic (more than 40 000 vehicles an hour) cram onto roads in central London. These facts help illustrate the problem. More than one million people enter central business district of London by all forms of transport every morning.

- Drivers in central London can now expect to spend around one third of their journey time at a complete standstill, and travelling at less than 10 mph for another 50% of their journey.
- Some roads entering central London now carry as much traffic as UK motorways, for instance, the Brampton Road carries 63,600 vehicles a day - nearly as many as the M5 and more than the M11 and M8

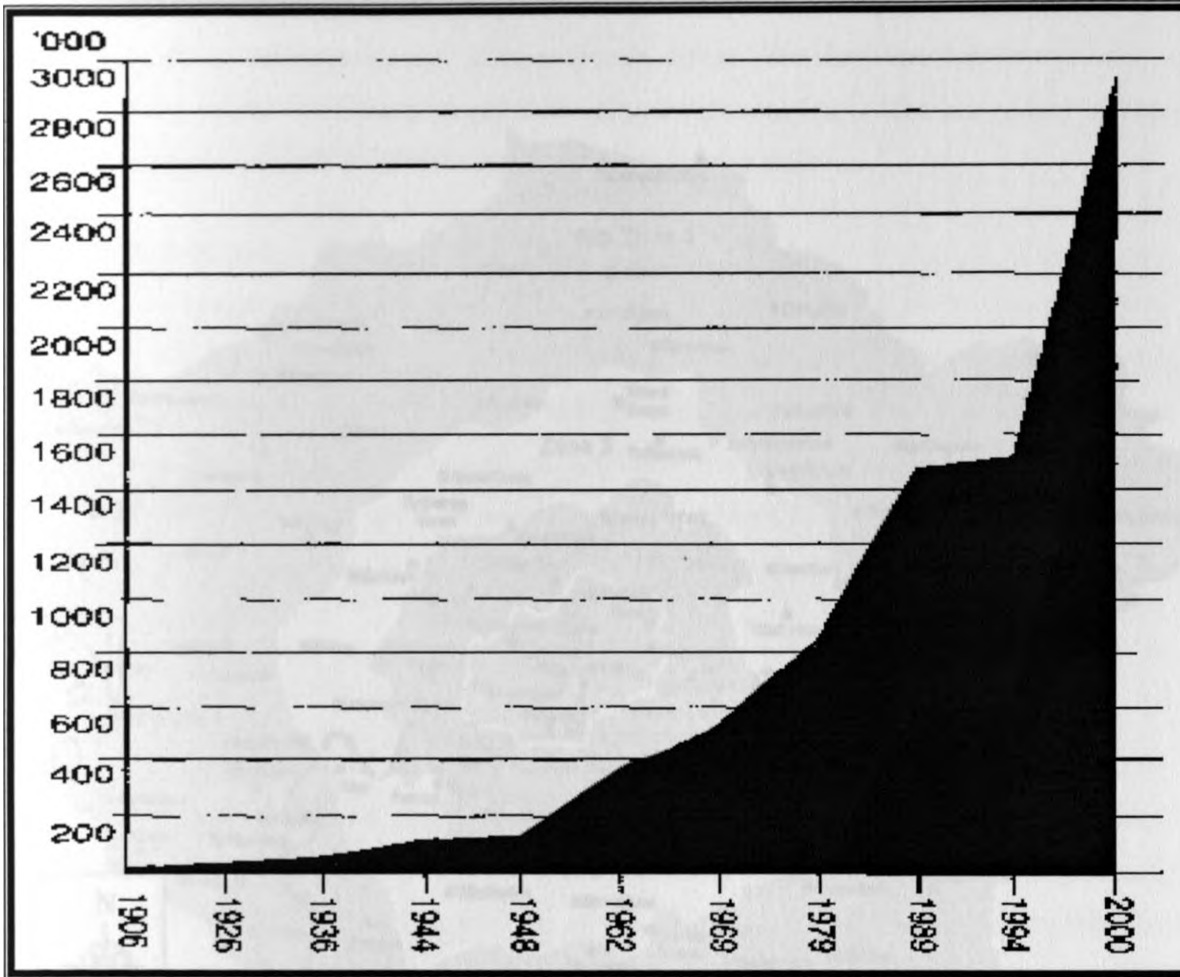
the merchants have supported the situation, while others prefer to have more cars parking for large-scale businesses and big volume shoppers.

2.11.2.5 London- England

Central London suffers from significant road congestion. Each morning the equivalent of 20 busy motorway lanes of traffic (more than 40 000 vehicles an hour) cram onto roads in central London. These facts help illustrate the problem. More than one million people enter central business district of London by all forms of transport every morning.

- Drivers in central London can now expect to spend around one third of their journey time at complete standstill, and travelling at less than 10 mph for another 50% of their journey.
- Some roads entering central London now carry as much traffic as UK motorways, for instance the Brampton Road carries 63,600 vehicles a day - nearly as many as the M5 and more than the M11 and M8

Graph 2-3 Growth of vehicle numbers in London since 1905 to 2000



Source; Transport For London, 2000

Due to worsening road congestion in central London, motorists have to pay a congestion charge of 5 (approximately US \$7.11) each weekday to enter the central area of the capital from 7 am to 6:30 pm. About 230 cameras positioned on the zone's entry points match car license plates against a database of vehicles that have paid the charge. Any motorist who has not paid by the end of the day is fined 80 (approximately US \$113.69). People in London have turned to motorcycles, mopeds and scooters to commute to work. They offer a viable alternative to the car and public transport and are more suitable for long journeys than walking and cycling. Motorcyclists are exempt from paying the charge.

proceed into the CBD, moving on existing roads mixed with other vehicles, maintained at a volume restrained to the capacity of the road within the CBD. The measures of traffic restraint enable many streets to be paved and this has greatly helped free movement within the city. It also has greatly helped free shoppers and buses circulation on a loop. The car parks available are only for a short-term use with excessive fines for long-term parking.

2.11.2.7 Runcorn, England

This is a town designed with a round transport system, buses only roads, and twelve miles long and permits the buses to run at an operating speed of 21 km/h. Bus stops are situated at a maximum of 500m walk from all houses, or much closer. Local shopping centres are placed at bus way stops, and often planned to cross to bus way. The bus way is segregated and runs at high level through the CBD but elsewhere runs at the ground level. The bus way also cuts crossing neighbourhood roads through light controlled junctions, which gives the buses priorities over other vehicles.

2.11.2.8 Dublin Ireland

Automatic measures used to combat urban congestion could drive away customers from the city forcing them to use other town centres where restrictions do not apply. Despite the perception that one cannot get a parking space in the city centre, which has over 10,000 car parking spaces, except for Saturdays, there is spare capacity in city centre car parks. The closing down of the city for the Tour de France was disastrous for city centre business and freedom of movement. Confidence in the credibility of the authorities in making decisions on traffic management has been totally undermined by their actions, which are not transparent or accountable and visibly lack balanced judgement. Many of these bodies are carrying out functions that are well past their shelf life, are unproductive and not needed in the 21st century.

2.11.2.9 PortGrimaud–France

This is a town designed on the principle of restricted access by private car. Adjoining the Mediterranean Sea, the houses face onto an artificial lake on one side and a pedestrian street the other side. Vehicle access to each house or residents with permission only. Two police operated gates at the entrance to the town control the vehicle access into the housing area, where all vehicles are stopped and checked. Visitors' cars are excluded and parked at the ground outside the gates. A total of 1250 parking spaces are provided. All movement within the town is

on foot or by cycle along the pedestrian streets. Due to high human traffic, delivery vehicles move continuously. A free waterbus also circulates around the lake at about 10 minute intervals stopping at various landing stages.

2.11.3 Managing urban traffic congestion in the developed Asia

2.11.3.1 Japan

Japan has one of the most extensive road systems in the world. Major expressways and roads connect practically every major city, town and village. The expressways are major arteries for the transport of goods and materials. Today, trucks and other motor vehicles carry over half of the goods and other materials transported nationwide. By making use of "Just in Time Delivery", supermarkets and retail stores do not have to maintain large storage areas nor have to take the risk of overstocking the merchandise they may not be able to sell. Because many of the supermarkets and retail stores do not have adequate parking facilities, delivery vehicles must be parked on streets when the delivery person carries in the order. This often adds to traffic congestion on busy thoroughfares. On narrow roads, delivery vehicles frequently block traffic entirely. Drivers of privately owned motor vehicles are the main users of Japan's road system. Today, 70 million Japanese nationwide own a vehicle. And 1 out of 1.5 Japanese hold a driver's license. Japanese cities suffer from traffic congestion like many other cities in the world. The expressways and roads in and around metropolitan areas are often congested and traffic is backed up. Traffic accidents are one of the leading causes of deaths in Japan. In 1995, there were over 760,000 traffic accidents in which over 10,000 people were killed and over 920,000 were injured. Chronic traffic congestion clogs a city street. One of the major problems car owners face is finding a place to park. Parking spaces come at a premium in the major cities in Japan. Before a Japanese person can purchase a car, he must establish that he has a parking place to park the car when he is at home. Often Japanese living in the cities must rent a space to park their cars. Rentals range in price from ¥20,000 (approximately US \$ 200) in a moderately densely populated area to ¥30,000 and higher in a bigger cities. In the central district of Tokyo it costs ¥100,000! Commuters often need to find their own parking space when they drive to work near their office. Many companies in the cities cannot provide their employees with adequate parking spaces. Nor do they pay for the mileage and for the parking fees. Unmanned, automatic parking is spreading in urban areas. When drivers cannot find a spot to park, they park illegally. This has created headaches for police and traffic controllers. Drivers park anywhere

'temporarily'. In lanes reserved for buses. In loading zones. In no parking zones. Still, those who insist on driving to work in the cities have to incur a large expense for parking.

2.11.3 .2 Hong Kong

It should not come as a surprise to find that Hong Kong's road network is five times more crowded than Japan's (and twice as crowded as Singapore's), with citizens squeezing ten times more usage out of its small road network as compared to Japan's. Hence Hong Kong appears with the world's most crowded and used road network, when measured by the number of vehicles per unit of road length and the number of vehicle-kilometres per kilometre of road network as recorded in *The Economist's World* in, 1995.

2.11.3 .2 .1 Fiscal restraint (FRT. and ALF)

The preferred option of combating growing urban traffic congestion is a fiscal measure of auto ownership restraint. The drastic fiscal restraint measure on the ownership of private cars and motor cycles involved: i) a doubling of the First Registration Tax (FRT) to 70%-90% of a vehicle's value; ii) a tripling of the annual license fees (ALF); and iii) a doubling of the petrol tax. As expected, such a combination of First Registration Tax and Annual Licence fee measures led to a decline in the number of motorcycles and private cars (for two and three years respectively); Indeed, it is the two drastic ownership measures of 1974 and 1982, which were primarily responsible for the interruption of the rising trend in the private vehicle fleet of private cars and motorcycles in Hong Kong. With differential pricing, the congestion toll revenues collected are resources, which can then be used to improve people's well being by providing public goods and services. Otherwise, enormous waste results from travel time lost in congested traffic on the part of both passengers and freight.

2.11.3 .2 .2 Electronic road pricing (ERP)

In 1983, Hong Kong embarked through 1985 on the world's first technical feasibility study of electronic road use pricing with automatic vehicle identification technology. The Hong Kong Electronic Road Pricing System (ERP) involved fitting a sample of 2500 vehicles with electronic number plates on the underside of a vehicle. This videocassette sized transponder permits radio wave communication with the electronic loops embedded below the road surface. Roadside microcomputers installed at selected charging points in turn relay the vehicle's identification code to a control centre. Car owners are then sent monthly billing statements (similar to

telephone bills) listing the amount of actual road use subject to ERP. Noncompliant vehicles, either without electronic number plates or with defective ones are photographed by closed-circuit television cameras just as radar technology is used to catch speedsters. Based on a true subset of the full ERE system, the ERP pilot experiment proved to be an overwhelming technical success at 99.7% reliability, which well exceeded the 99% accuracy requirement specified by the Government. Time wasted in traffic congestion is gone forever whereas the revenues collected can be recycled to finance more public goods and services.

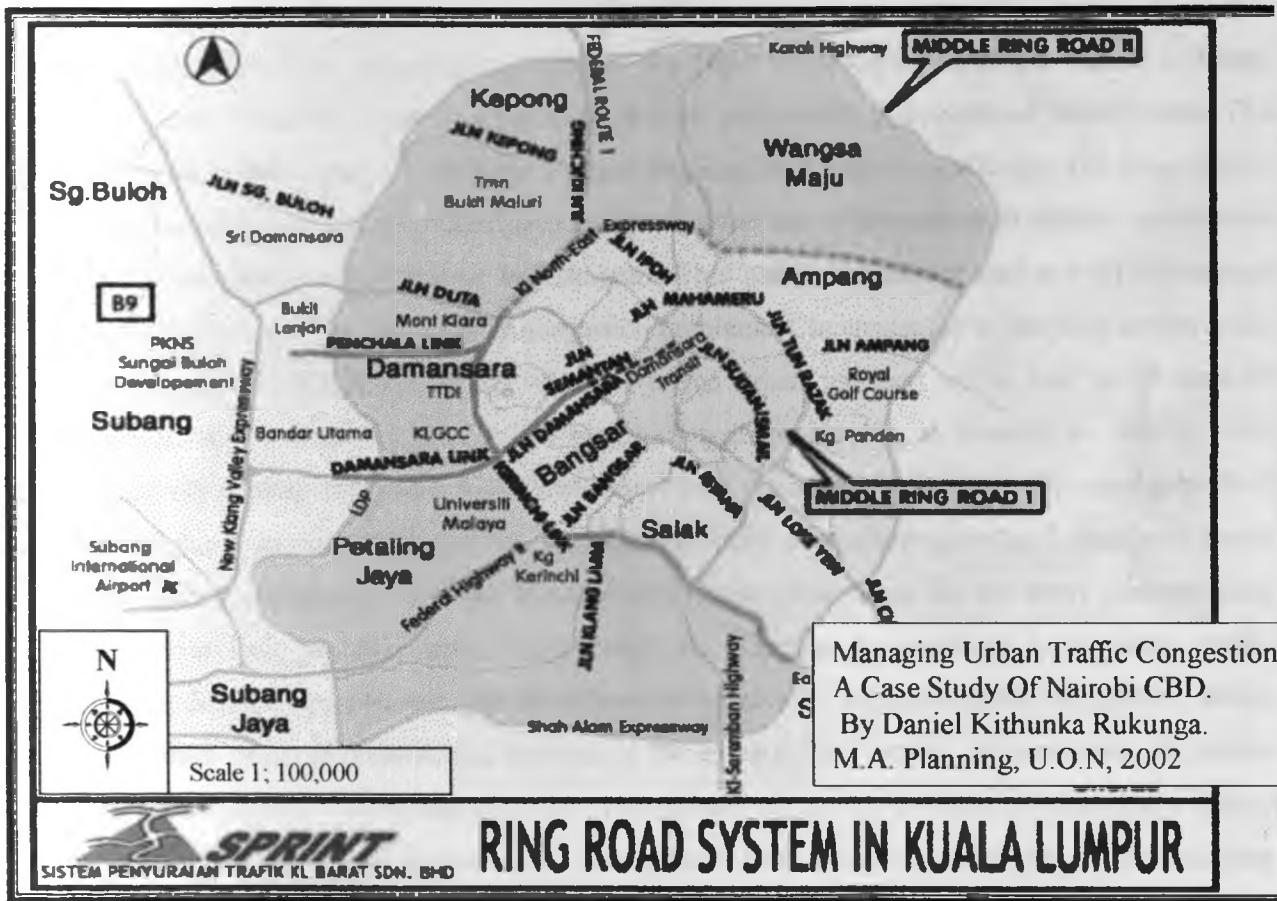
2.11.3 .2 .3 Area licensing

This is a 12-hour manual-based area-licensing scheme. It requires that private cars and motorcycles entering the Restricted Zone in the CBD during the hours of operation prominently display a colour-coded area license on their windshields. Current charges for the morning and afternoon peaks are S\$3 per day whereas the charge for the inter-peak is S\$2 per day. Enforcement is carried out straightforwardly by traffic wardens eye balling the non-stop traffic moving at city speeds past the gantries.) Similar to the car restraint measure, the daylight period charging scheme achieves a quarter of the benefits of the theoretical optimum but at a fraction of the cost of the ERP schemes.

2.11.3 .3 Malaysia

Kuala Lumpur's road network system consists of concentric circles of ring roads. These ring roads skirt around the city to link one suburb to another and allow motorists to bypass congested city areas. Radial roads cut across these ring roads to provide direct connection from the suburbs into the city. In the Greater Kuala Lumpur Plan, this concept of ring roads began with forming a small ring road, the Inner Ring Road at the city centre. As the city expanded, the city boundary extended to a bigger ring road, the *Middle Ring Road I (MRR I)*. With rapid expansion of the city, the MRR I became severely congested. The *Middle Ring Road II (MRR II)* is the third ring road to allow motorists to bypass the city centre. However, as the *MRR II* is too far out and meant for longer distance regional traffic. It is unable to efficiently ease traffic congestion in the city. Findings in a traffic survey in late 1996, found that more than 40% of commuters using the *MRR I*, are headed beyond the immediate suburbs of *MRR I*.

Map 2-2 Ring road system in Kuala Lumpur



Source; System Penyuraian Trafik ,2000

2.12 Managing urban traffic congestion in the developing countries

Most of the professionals in the developing countries have tried to influence the management of urban traffic congestion to suit their needs. The influence of the engineers in the Third World Countries has been more where they constitute an elitist and scarce groups of trained technocrats without whom Governments are unable to design and implement or maintain urban transport and other infrastructure projects. The major role of urban traffic congestion management in comprehensive transport planning is to obtain the optimum use of the existing urban transport facilities at largely insignificant cost. Co-ordination among traditional and modern as well as informal transport operations takes place with varying degrees of efficiency in African cities. The structure, mix and organisation of such working relationships are however, more a product of the evolution of the city in question and less an outcome of the city's management and investment programmes (Dimotriou, 1992). Many of the third World cities contain a rich

mixture of traditional and modern modes of transport. In some places, they share the same routes although competing for road space caters for different market segments of the public. The urban traffic congestion management problems of the Third World Cities inevitably take on a variety of forms depending on their location associated with wealth and levels of motorisation. The increase in the number of vehicles in Third World cities has been quite rapid. The urban traffic growth is taking place at a faster pace in excess of the rate of investment in suitably constructed and maintained urban transport infrastructure. This has in turn contributed to both widespread and location specific urban traffic congestion problems. Circumstances of this kind are typically as a result of insufficient funds allocated to the urban transport sector and the absence of appropriate fund raising mechanism by which and local public authorities are able to raise adequate finance from those who benefit most from the transport facilities. The rapid growth of cities due to increased commercial, industrial and other productive capacities have placed heavy and new demands on the urban transportation system that many Governments in developing countries have not been able to cope with the planning for solutions to the urban traffic congestion management problems these have been based on assumptions and perceptions, which owe their origin to professional practices in the industrialised world. In considering the public transport needs in developing countries. One should not simply consider of importing a system designed and, operational control and management from the developed world. The developing countries should endeavour to make proposals that are practical and responsive to their needs, with respect to their local social, economic and cultural conditions. The application of these standardised urban traffic congestion management and transport planning procedures and perceptions to the Third World settlements have not only failed to resolve their urban movement problems but have themselves created additional complications. This has been due to employment of inappropriate and misconceived assumptions and perceptions (Ombura, 1989).

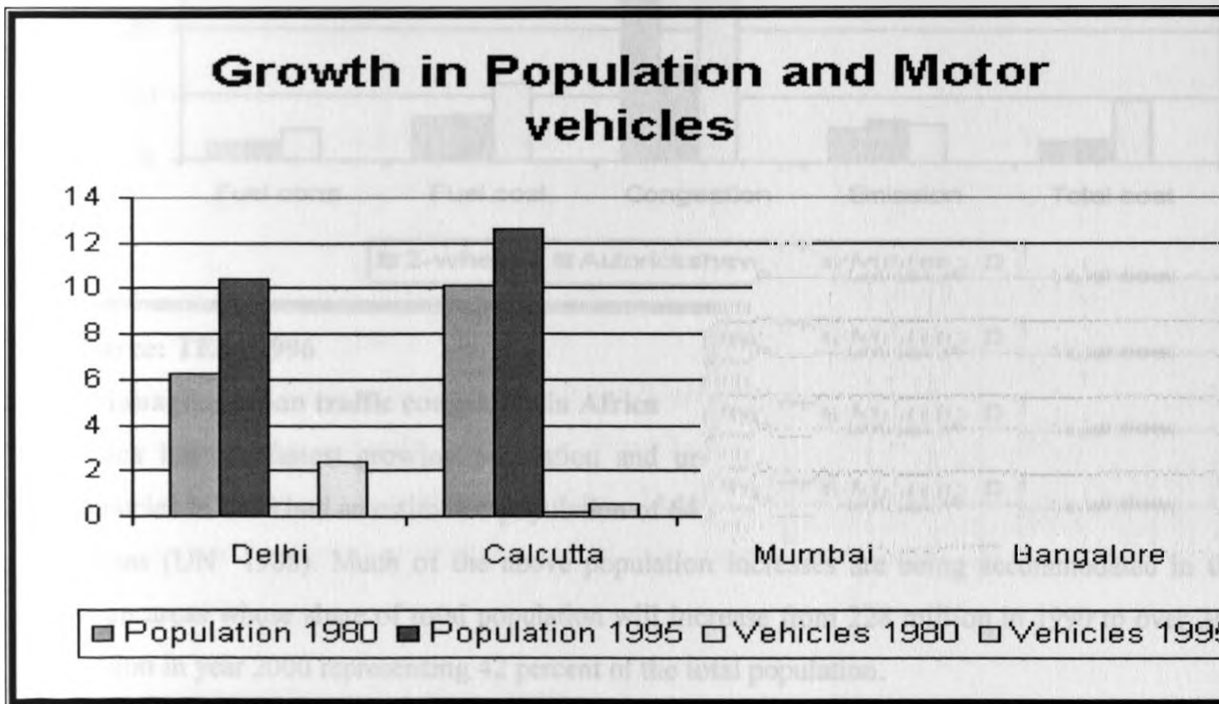
2.12.1 Managing urban traffic congestion in developing Asia

2.12.1.1 New Delhi traffic congestion- India

"Delhi traffic in chaos..." is the often-repeated concern of the citizens and administrators of Delhi. The city of Delhi, like other cities in the developing world faces acute transport management problems leading to air pollution, high-energy consumption, traffic congestion and resultant loss of productivity. There are 2,097,000 registered Vehicles in Delhi. Motor scooters and motorcycles account for nearly 70 percent of the registered vehicles. Another 4 percent are

locally designed three-wheeled scooter rickshaws with the rest as taxis, public buses, and trucks. Cars, trucks, and buses compete for space with two- and three-wheel motorized vehicles as well as camels, elephants, stray cattle, bullock-carts, rickshaws, and handcarts. There is no formal segregation of vehicles in the city. Bicycles and pedestrians continue to share the roads with cars, where they impede traffic and are exposed to a high risk of accidents. Delhi ranks third in population among other Indian cities. However, its vehicle population exceeds the total vehicle population of Mumbai, Calcutta and Bangalore, put together.

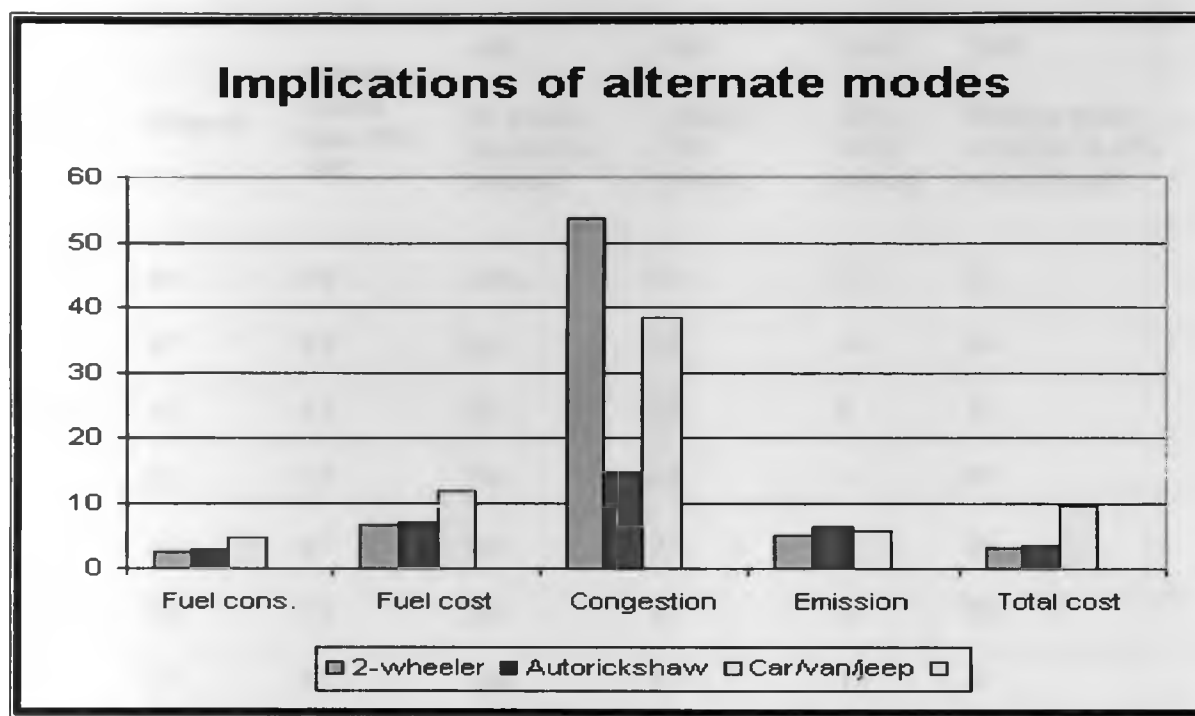
Graph 2-4 Growth in population and motor vehicles (million) in India



Sources: GOI (1991), GOI (1996) and Reddy (1995). Cited in Bose (1998)

Requests to provide separate facilities for non-motorized transport are typically met with the argument that scarce resources cannot be wasted for a mode that is going to disappear in the future. Accommodating the needs of all of its citizens, including the poorest ones, for safe and affordable transport, cities such as Delhi can create an equitable and environmentally friendly transportation system (World Resources 1996-97, Urban Transport In Delhi) Personal Vehicles account for almost 90% of all vehicles in Delhi while the occupancy of these vehicles remains largely single. Therefore, their efficiency as a transport mode for a city like Delhi is also low. Personal vehicles in Delhi have risen in number largely because of inadequate public transport.

Graph 2- 5 Implications of alternate modes compared with bus index with bus = 1



Source: TERI 1996

2.12.2 Managing urban traffic congestion in Africa

Africa has the fastest growing population and urbanisation rates in the world. Its fifty-two countries in 1990 had an estimated population of 647 million 35 percent, of which lived in urban areas (UN 1988). Much of the above population increases are being accommodated in the urban areas whose share of total population will increase from 228 million in 1990 to over 360 million in year 2000 representing 42 percent of the total population.

Table 2-11 Infrastructure provision in some African countries

Country	Urban %	Population Growth Rate 1980-1992	1988 Rd. density (Km/million Persons)	1988 Vehicles /1000 persons.	1990 Tele. /1000 persons	1988 Roads in good Condition as a % of paved roads
Algeria	54	4.9	1366	51	32	40
Morocco	47	3.8	618	35	16	20
Cote D'Ivoire	42	4.7	357	22	5	75
Nigeria	37	5.7	376	13	3	67
Ghana	35	4.3	430	7	3	28
Kenya	25	7.7	278	12	8	32
Zimbabwe	30	5.9	1389	27	13	27
South Africa	50	2.8	1579	125	87	NA

Source: World Development Report, 1994 * World Bank Atlas 1989

In most cases, the responses of African cities have been conditioned by traffic - functional perception of the urban transport problem. Thus, their focus has been at removing traffic congestion without seeking to understand its root causes. Consequently, the responses have had limited success.

2.12.2.1 Traffic nightmare in Cairo- Egypt

Cairo is a city where two million cars compete daily with a population of 14 million for space on the streets. With 8,000 driving licenses issued monthly in Cairo alone, and on average 380,000 traffic offences committed in Greater Cairo every month, motorists and commuters can never guess when traffic will be bearable. Over the past few years, the government has considered various measures in attempts to alleviate traffic congestion. These include attempts such as designating days when only vehicles with odd or even-numbered license plates can travel on Cairo streets. This idea, however, has fallen flat on its face. Another plan was implemented when a number of crossroads, mainly in Heliopolis and Mohandessin, were sealed off to better streamline traffic. Instead of going straight over crossroads, vehicles take a U-turn a few metres

down the street. The detours were an ingenious way of solving the problem of rarely respected traffic lights, and saved traffic officers from the scorching sun and angry drivers who drive for over 100 metres to make the U-turn on this once peaceful street. Cars don't go straight upwards. They go forwards: in Cairo by inches. Cairo is accurately infamous for its traffic congestion; masses of people and vehicles continually clog the streets throughout the day. There are over 1.5 million vehicles in Cairo city. In an emergency fire brigades and ambulances are always be allowed into the streets. Residents leave their cars in nearby parking areas and take a 10 to 15-minute walk to their destinations. For the disabled and the aged, there are 12 electric shuttle vehicles, each seating 10 persons, to carry them home from car parks. A Street has been turned into a one-way thoroughfare, and public buses shuttling in the area were reduced in number and assigned alternative routes. A multi-level car park has also been built in Al-Darrassa and work in under way on two pedestrian tunnels at the tunnel's exits. The tunnel is one part of a comprehensive plan to streamline traffic in the capital. The government has spent large amounts on planning traffic, almost to the tune of LE 17 billion, over the past decade. Establishment of a new department of traffic planning experts, and their efforts have, borne fruit. These are a few examples of recent achievements. Yet despite all these the traffic remains chaotic. To encourage public transport, the government is also considering establishing a third underground metro line to connect Cairo airport with Ataba Square, and increasing air-conditioned public buses to 200 from the current 100. Parking and pedestrian problems are also high on the governor's list of priorities. There is a plan to build 12 underground parking structures. A garage has already been built under the Heliopolis sporting club. Although the building code stipulates that each housing bloc should have a parking area in the basement, the law is not strictly enforced. Many landlords prefer to rent or sell basements to investors who open up shops, restaurants or supermarkets - wreaking more traffic chaos on already overcrowded areas. The scarcity of parking areas makes motorists and pedestrians vie for space on the sidewalks. And it is a losing battle for pedestrians who are forced into the streets, where they are forced into another space battle with bumper-to-bumper vehicles. The disabled and the aged also have a hard time moving about on Cairo's congested streets where ramps and other facilities are scarce. That will hopefully change soon. Some streets have been widened, paved and repaired. Almost all sidewalks in downtown Cairo have been paved and pedestrianised a whole street (El-Alfi) for people to enjoy a leisurely stroll in the city centre. All new road works are planned with a high priority given to "sidewalks, ramps and green areas." But challenges remain. More cars are licensed every day, and traffic

jams will not end until the number of licenses is limited and the traffic law strictly enforced. Another idea, which seemed promising, was the partial closure of some downtown streets, which were converted into pedestrian promenades. The idea was introduced to reduce pollution and traffic congestion in the city centre. This resulted in wide, pedestrian-safe, bench-dotted areas on sections of Al-Alfi and Saray Al-Azbakiya streets stretching between Orabi and Emadeddin. Although the idea seems successful, further closures have not been forthcoming. City planners believe that another way to alleviate Cairo's congestion is to develop and maintain a better public transport system. The ever-expanding underground network is another indicator that people will use public transport if it is clean, cheap and efficient. There are just too many cars, and they have to shut down car dealers for a while.

2.12.2.2 Lagos- Nigeria

Lagos is the most populous city in Nigeria, the most populous country in Africa. The metropolitan area, an estimated 300 square kilometres, is a group of islands endowed with creeks and a lagoon. Public transport in Lagos operates in rather chaotic conditions. The city suffers from chronic traffic congestion, which makes it impossible for buses and taxis to operate efficiently, especially during the rush hours. There are many private bus companies and several thousand private minibuses. Traffic drives on the right. The national road system links all the main centres, although in some areas secondary roads become impassable during the rains.

2.12.2.3 Environmentally sustainable traffic congestion management in African cities

Evolving environmentally sustainable urban traffic congestion management development is an expensive and complex undertaking. It requires much time and resources in undertaking the diagnostics of the present situation and evolving appropriate measures. Present indications are that very few African governments are ready and willingly undertake that task due to the pressure for immediate results by their constituents and by resource constraints. And, perhaps, by lack of understanding and acceptance of the need for such an exercise especially given the lack of local technocrats to enlighten them. Basically, there are some pertinent issues to consider when developing an environmentally sustainable urban traffic congestion management framework.

(a) **Demand management:** as an environmental strategy, the objective is to reduce private motor vehicle trips to congested areas thus reducing vehicle emissions and increasing public transport

and non-motorised trips. Means for affecting such schemes include area licensing, parking charges, limited entry to certain areas, etc.

(b) **Traffic management:** to promote smooth traffic flow and thus reduce vehicle emissions from intense stop/go operation of vehicles, segregate different users of the road space and hence improve road safety and network efficiency.

(c) **Integration of transport modes:** promoting the use of the different elements of the transport system, from walking, cycling, etc. to rail rapid transit, in an integrated manner such that they complement each other

(d) **Urban land-use and transport planning:** another form of integration in which actions are directed at ensuring that land-use and transport developments go hand-in-hand. Within this framework conceptual land use, approaches favouring public transport may be promoted above those, which favour car use.

(e) **Community participation:** to provide political approval to the various policy measures outlined above.

2.13 National policy on traffic management in Kenya

In Kenya, the technocrats have been party to the running down of the infrastructure, which they are entrusted by the Government and by extension the public to develop and maintain. To the economist, the principal concern is to match transport supply with transport demand. The national government in the country is charged with the responsibility of ensuring that there is an orderly, manageable and viable as well as efficient public transportation system in the country. The government discharges this responsibility through the legal/legislative machinery and capital works programme. Government of Kenya is the overall agency in building and maintenance of roads through out the county. The main object here is to “keep transportation costs and travel time as low as possible, a safe quality system that is viable to all transport users (Development plan 1974/1978). It is the responsibility of the government (whether local or central) also to provide transport terminal facilities and the supporting facilities and services. The institution of rules, laws and other appropriate control measures are set in place, by either the central or the local government to ensure there is proper utilization of the public ways and terminal points. This is carried through enacted laws.

2.13.1 Traffic management legislation in Kenya

The transport operations in Kenya are regulated by various acts of parliament. However, there are no clear policy guidelines that govern the urban traffic management operations in Kenya. The legislations are also disjointed. The main acts that regulate urban traffic management in Kenya include among the following:

The Traffic Act Chapter 403: the act generally governs the conduct of motor vehicles operators on the roads and has relevant subsections, which are meant to regulate, control and punish misconduct on the part of the road users. It generally consolidates the laws relating to traffic on roads. It defines the various types of vehicles and states the guidelines on their operations on the roads. This can be said to be the main act dealing with transport sector in Kenya.

The Transport Licensing Act Chapter 404: This act is mainly concerned with the regulation of transport licensing. Gives rules and regulation for licenses given to vehicles for services and operations. Governs the ownership, operations and control of motor vehicle in Kenya. Has a rule to ensure that all the vehicles using Kenyan roads are registered appropriately (GK, private, parastatals, trailers etc). It is under this act that the Transport Licensing board is established (section 3 (1) a of the act). It Issues all kinds of licenses to allow the operation of vehicles and services redeemed.

The Public Roads and Roads of Access Act Chapter 399: The act generally defines all roads that are of public use. These are roads that are unlimited to public access; however, the use by each individual should not contravene the use by others.

The Streets Adoption Act Chapter 406: The act regulates the construction and improvement of streets in certain authority areas. It requires streets to be of satisfactory standards to provide for matters connected with the foregoing and incidental thereto.

The Central highway authority. Has a rule to ensure proper use of all roads in Kenya. All the road users have to abide with these regulations. Despite the existence of these regulations there, is no proper legislation so enacted to govern the transport operations in Kenya. The general usage of the traffic act cap 403, which is the major law regulating traffic operations might be appalling since they are subject to abuse and could be used by traffic officers to harass public transport operators.

City Council Of Nairobi has implemented some traffic management schemes and laws including one-way traffic systems, dual way traffic systems and two-way traffic systems with a small number of parking spaces in the CBD of Nairobi.

2.13.2 Driver licensing

Drivers in Kenya are licensed to drive under laws and regulations of the state. The Drivers could have formal or informal driving training. They can attend the driving schools which are well placed through out the country or they can receive driver training informally taught by family members, friends or self taught, regarded of the genesis of skill attainments, it's a requirement that every driver must pass the driving test as its conducted by the traffic police department. Despite the over 30 years effort to improve driver-licensing procedures by the traffic police department, this has not contributed much in terms of safe motor vehicle operation. Traffic police spot checks indicated the presence of over 1000 unlicensed drivers on the road on daily basis. Traffic reports indicate that 20% of the drivers involved in fatal crashes were unlicensed at the time of the crash. It is recommended that only adults or People of over 18 years can be licensed to drive in Kenya.

2.13.3 Strategies of dealing with increased traffic volume in Nairobi

The massive influx of imported used cars into the country is putting the road infrastructure under immense pressure. City Engineer Charles Chiuri acknowledges that the growth of the number of vehicles on Kenyan roads is not proportional to the development of the road infrastructure. However, he is quick to point out that this is a global phenomenon, which is not unique to Kenya alone. The implications of this congestion could be far reaching. There is loss of time and a waste of fuel, as motorists remain stuck for hours in traffic jams. At the same time, exhaust fumes posing a serious health hazard also heavily pollute the environment. Significantly, roads wear out faster when traffic is slow especially on a climbing lane unlike on fast lanes. This is due to concentration of stress owing to the weight of the vehicles. On the issue of parking within the city centre, the city engineers department is encouraging motorists to buy season tickets to avoid clamping or towing. This is more convenient when a driver needs to dash somewhere and the parking attendant is serving someone else. Besides, it's cheaper to have the season ticket especially if one comes to town frequently. The roads within Nairobi Central Business District cannot be expanded but they can be managed. But the roads in the intermediate areas have a capacity for expansion. The Langata and Jogoo roads have been duelled, and plans are also underway to dual Ngong' Road from the City Mortuary roundabout to Dagorretti Corner, and Limuru Road. The Juja and Outer Ring Roads will also be widened. Generally, to curb congestion Nairobi needs more roads and these roads are the missing links in the road networks

in the city. There is need to put in place the right measures to ensure the right utilisation of the available space that would help the situation on the roads. In the city centre, the City Council is working with the traffic engineer to ensure that they have all traffic lights operational and if possible install more, for example at the Moi Avenue-Haile Selassie roundabout. The city hall is reinforcing traffic regulations to prevent double parking, and careless overtaking among other bad driving habits. The city traffic engineer is controlling driving school lessons especially in the CBD, which tend to cause artificial inconveniences. Besides this, there are also plans to mark all traffic lanes to streamline the traffic. However where problems are acute, the city engineers department resorts to stringent measures, such as high parking charges to discourage motorists from the area. The city hall is also considering having cars of certain registration numbers parked in particular areas during specific days of the week (Chiuri, the city engineer, said.)

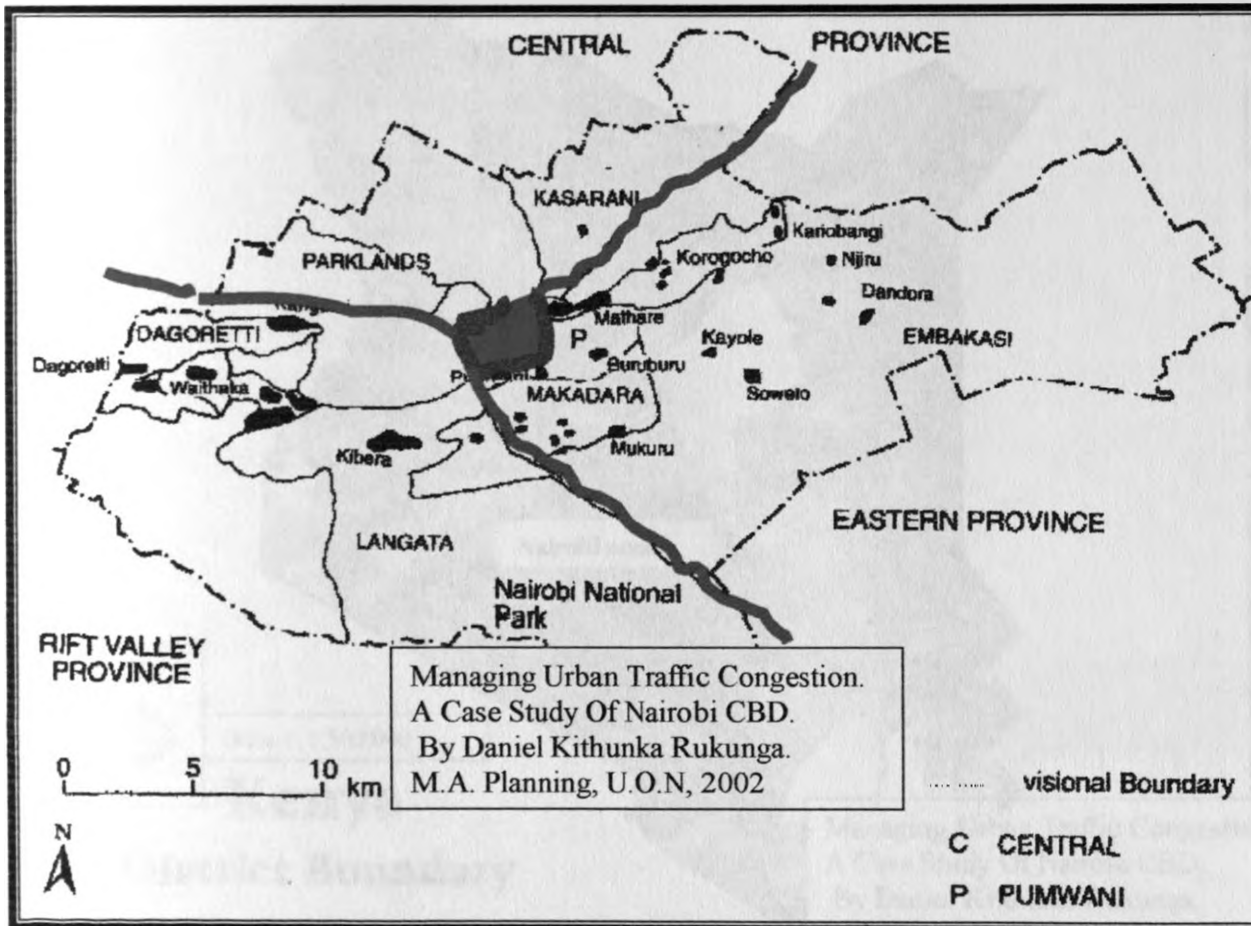


CHAPTER 3- BACKGROUND OF THE STUDY AREA

3.0 The Study area

The study covers the Central Business District of Nairobi city.

Map 3-1 Location of the CBD in Nairobi



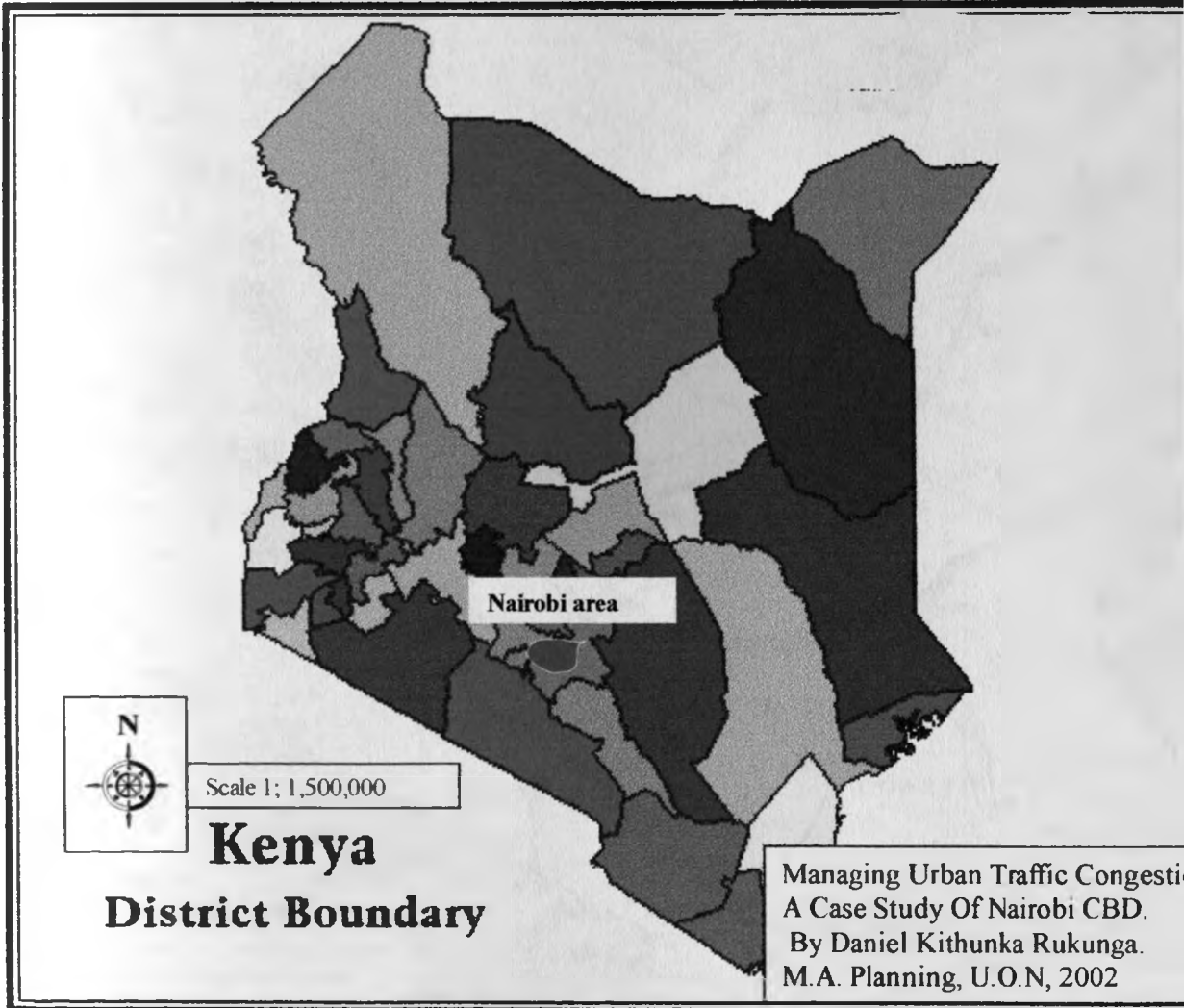
Source; Abiero 1979

3.1 Nairobi in the national and regional context

Nairobi is the capital city and one of the eight provinces of the republic of Kenya. It borders Thika District to the North, Machakos District to the East, Kajiado to the South and Kiambu district to the West. It is strategically located in central Kenya at 200 km south of Mt Kenya and at 500 km north west of the port of Mombasa, which is on the East Coast Of Africa at the shores of the Indian Ocean. Kisumu to the west of Nairobi lies at about 338 Km on the shores of Lake

Victoria. Tanzanian boarder town of Namanga is about 170 km to the south of Nairobi. Nairobi lies some 150 Km South of the equator and some 500 Km inland of the East Africa Coast Line at an altitude of about 1700m Above Sea Level.

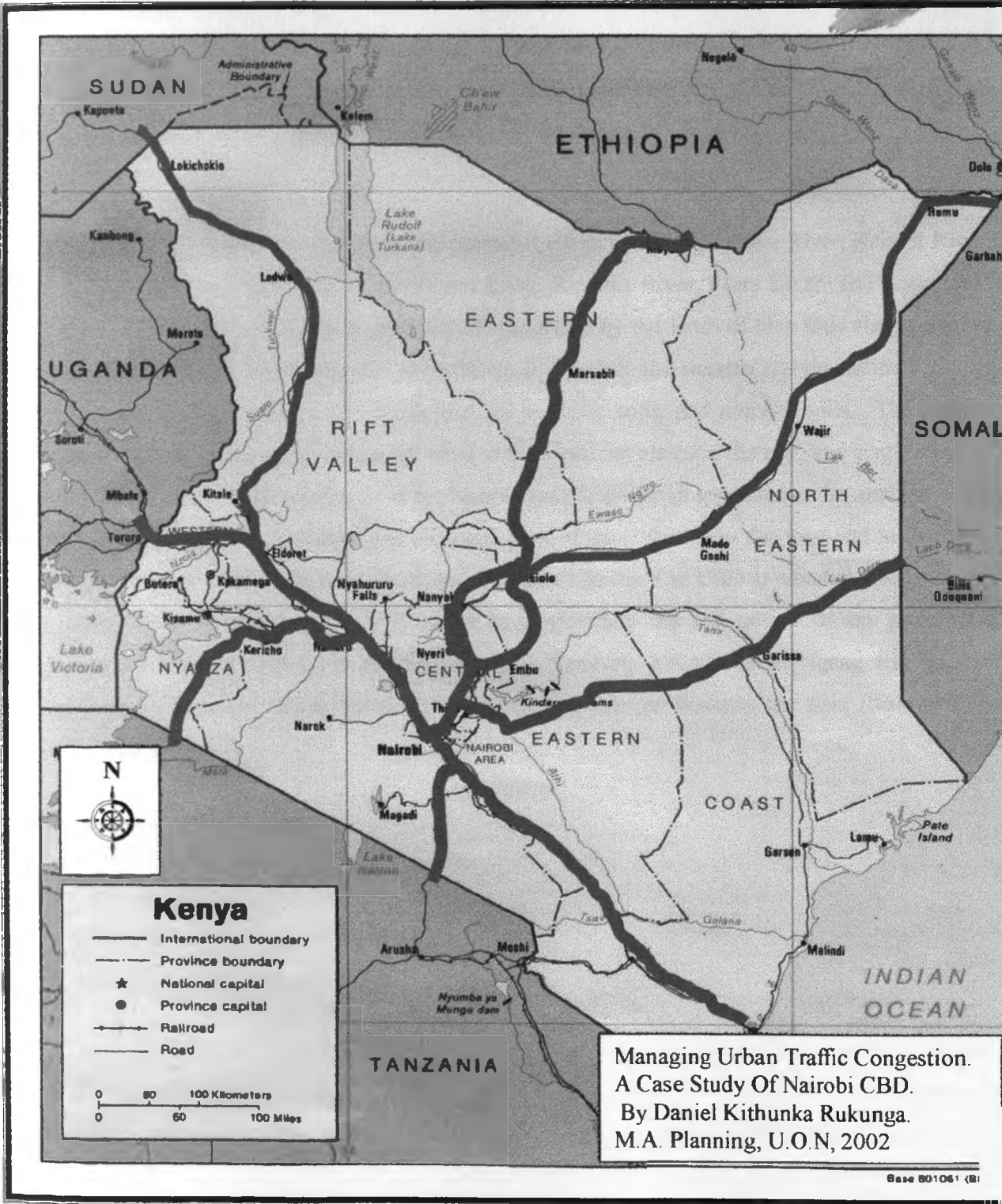
Map 3-2 The location of Nairobi in the national and the regional context



Source; Kenya Bureau of Statistics 1989

The City of Nairobi is at the intersection of two Trans- Africa Highways. The first is the Great Northern Road from Cairo To Cape Town and the second is Mombasa –Lagos Highway that passes through Kampala and Kigali in East Africa and the Great Lakes region. The city of Nairobi and lies astride the main road and rail routes from Mombasa on the east coast of Africa to Uganda on the West and Sudan on the northwest, Ethiopia to the north and Somalia to the east.

Map 3-3 International road convergence in Nairobi



Source Survey Of Kenya, 1980

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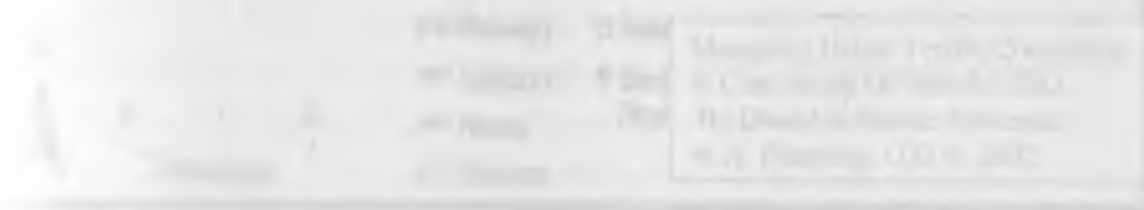
3.2 Geographical location and physical features of Nairobi

3.2.1 Location

Nairobi city lies between the attitudes of 1,670 m to 1700 m above sea level. It is located on longitude of 36°50' E at 3 hours ahead of GMT and on latitude of 1°17' South, at about 150 km south of the equator in the republic of Kenya, in East Africa.

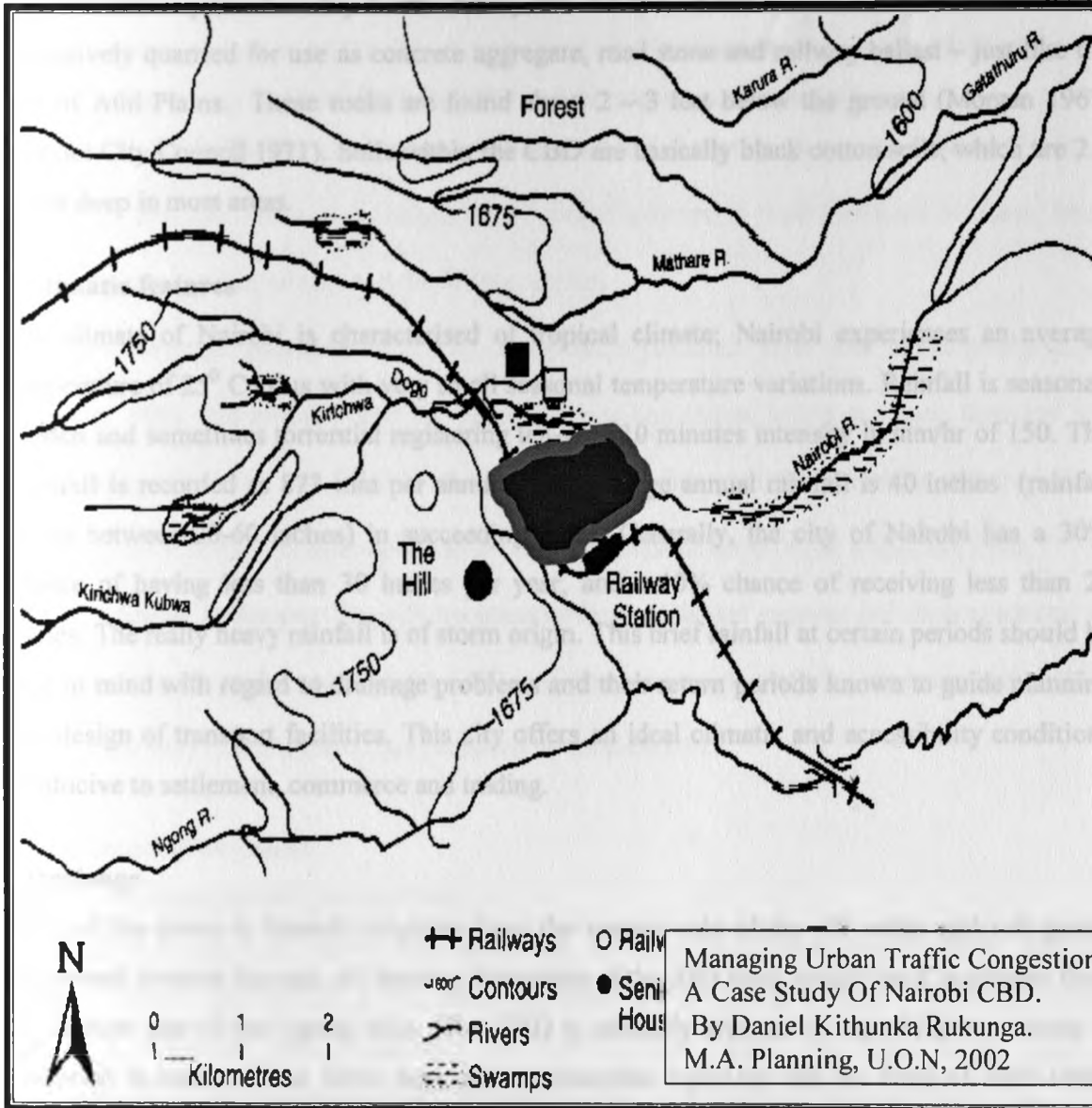
3.2.2 Physical features

Nairobi area is abundantly blessed with perennial rivers such as Mathare River, Nairobi River, Getathuru River, Ngong River, Gatharaini River, Ruaraka River, Riara River. The eastern and the southern side of Nairobi is generally characterised by flat lands of clay soils also known as black cotton soils, stone outcrops and murram soils, while the western and the northern side is generally characterised by hill bluffs and red volcanic soils, and murram soils. The general terrain of the city presents with a hill bluff to the west, flat plains to the east, and gentle slope to the south. The natural vegetation in the Nairobi area is savannah grassland to the east and to the south e.g. Kasarani, Embakasi and the game park, tropical forests to the west and to the north e.g. Karura forest, Ngong road forest and Dagorretti forest. The CBD is situated mainly on the Upper Athi Basin (Morgan 1967) where its is generally flat and devoid of any prominent, physical features apart from the Southern and Northerly boundaries of Ngong and Nairobi Rivers respectively whose valleys get progressively deeper towards the East (Nairobi City Council 1971).



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Map 3-4 Nairobi original CBD physical features



Source; Obudho 1976

3.2.2.1 Physical Base

Nairobi lies on the foothills of Aberdare's and on the valley of Nairobi, Mathare and Getathuru Rivers. Rocks are the Athi plains Phonolites weathering to black cotton soils (poorly drained) and pisolitic tronstone (murrum). Due to the low laying characteristic of the site of Nairobi and soil types the vegetation of the area range from grassland to forested areas towards Kiambu. To date more and more of the natural hinterland of Nairobi continues to be converted into human urban settlements.

3.2.2.2 Geology and Soils

The Nairobi is predominantly underlain by the Nairobi Phonolites of middle Pliocene rocks extensively quarried for use as concrete aggregate, road stone and railway ballast – just like the rest of Athi Plains. These rocks are found about 2 – 3 feet below the ground (Morgan 1967, Nairobi City Council 1971). Soils within the CBD are basically black cotton soils, which are 2 – 3 feet deep in most areas.

3.2.2.3 Climatic features

The climate of Nairobi is characterised of tropical climate; Nairobi experiences an average temperature of 25⁰ Celsius with very small seasonal temperature variations. Rainfall is seasonal, sudden and sometimes torrential registering ten-year-10 minutes intensity in mm/hr of 150. The Rainfall is recorded as 873 mm per annum. The average annual rainfall is 40 inches (rainfall varies between 20-60 inches) in succeeding years. Generally, the city of Nairobi has a 30% chance of having less than 30 inches per year, and a 10% chance of receiving less than 20 inches. The really heavy rainfall is of storm origin. This brief rainfall at certain periods should be kept in mind with regard to drainage problems and their return periods known to guide planning and design of transport facilities. This city offers an ideal climatic and accessibility conditions conducive to settlement, commerce and trading.

3.2.2.4 Drainage

Most of the rivers in Nairobi originate from the eastern side of the rift valley and roll gently downward towards the east, all forming tributaries of the Athi river, which itself originates from the eastern side of the Ngong hills. The CBD is naturally drained by Nairobi River, which is perennial in nature. Great flows have gone unrecorded especially the El- Nino of 1997-1998, which had a devastating effect on the CBD roads. The peak flows are only maintained for a few days. It is important to note that the Nairobi River is highly polluted by industrial and domestic wastes thus rendering its waters unfit for human consumption. In other words it is a dead river.

3.2.2.5 Environmental aspects

Nairobi area is predominantly an urban area and the environment is generally an urban environment, characterised by tall buildings, dense populations, air pollution, concrete jungle, marshy areas, savannah grasslands, forests, open drains, over flooding rivers, open dumping

sites, open quarry sites, soil pollution, river water pollution, dense informal settlements, industrial effluents, noise pollution and urban traffic congestion. The physical features of Nairobi dictate that most of the city of Nairobi is largely of scanty vegetation. The factors that lower environmental quality within the CBD and its environs are as follows:

- (i) **Noise pollution:** The city experiences noise pollution from the Railway lines to Mombasa, Kisumu, Thika, and Nanyuki and Aircraft's operating from Eastleigh Air Base, Jomo Kenyatta international airport and the Wilson airport.
- (ii) **Sewerage pollution:** The city experiences pollution from foul smell produced by sewerage pipes that empties into the Nairobi River and minor temporary open dumping site deliberately created in the CBD by the city residents. Some of the manholes and inspection chambers have cracked/broken covers thus resulting to the pollution right within the CBD.
- (iii) **Motor Pollution:** The city experiences both noise and gaseous pollution produced by vehicles using the major roads in the CBD. Carbon monoxide and other hydrocarbons, which cause respiratory complications, are produced by motor traffic.

3.3 Historical development

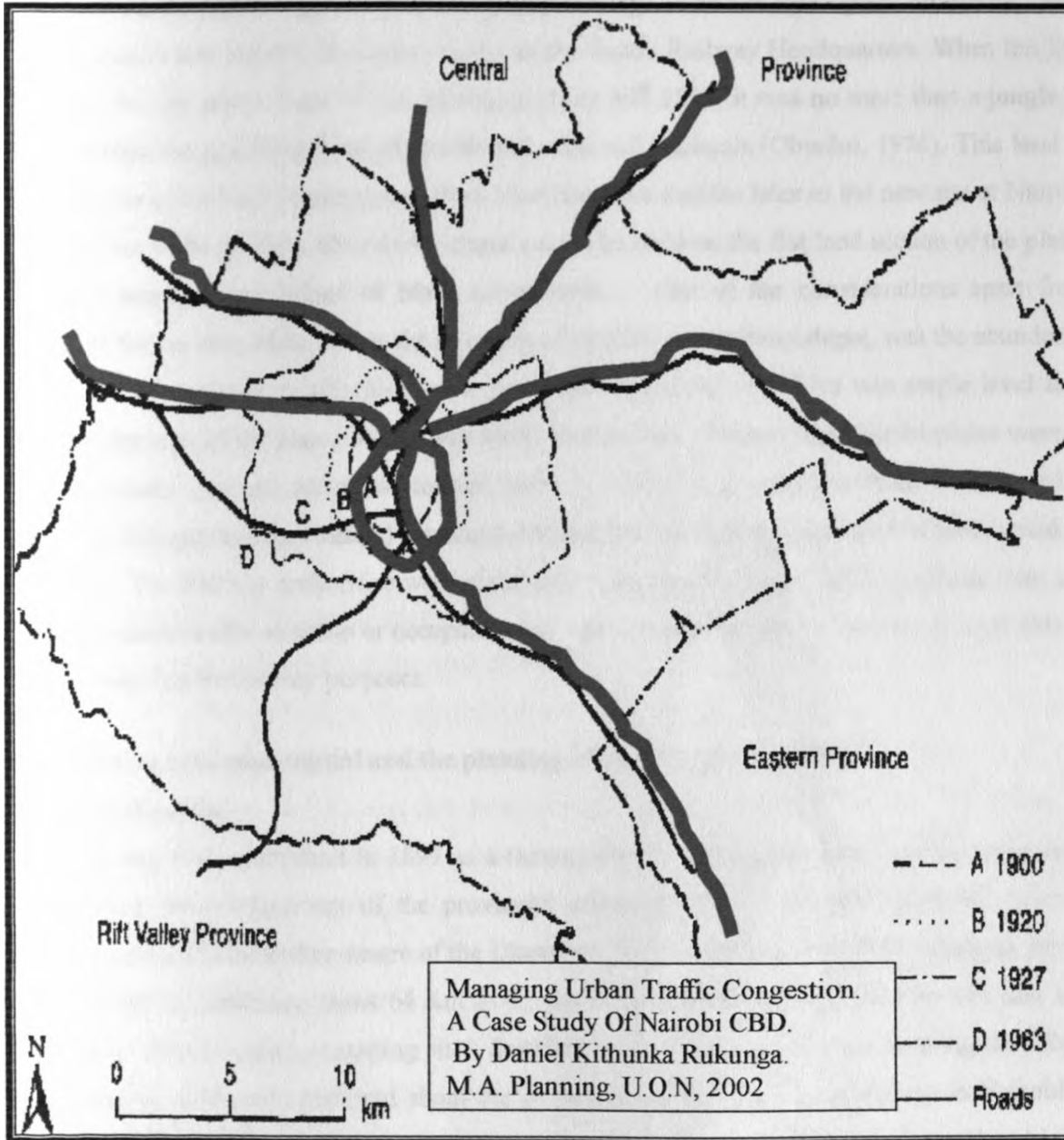
3.3.1 Pre-white man Nairobi (before 1890)

The present location of Nairobi was before the coming of the Europeans an ethnic front for Kikuyu, Maasai and Kamba. It was also a physical and ecological frontier between Savannah type and mountain type vegetation. The Kikuyu and Kamba are Bantu semi pastoral communities while the Maasai were entirely nomadic pastoral of Nilo-Hamitic Origin. The Kikuyu occupied the Kikuyu plateau towards Aberdare's, the Kamba were in the near east of the Athi hills outside present city boundary, while the Maasai occupied the Athi Plains. The area was fully covered by virgin forest and swamps as a natural buffer between them and their traditional enemies, the Kikuyu to the North and the Akamba to the east. The forested and swampy Nairobi land acted as a no man's land between the three warring communities. There were no frequent visitors to the Nairobi plains except for the nomadic Maasai, who, from time to time, built their manyattas on the higher ground risking an attack from either the Kikuyu or the Kamba.

The name of Nairobi was derived from the name the Maasai gave to the section of the Nairobi River passing through Kilimani, Museum hill and Kamukunji, which was part of the initial Nucleus settlement of the city. The Maasai referred to that section of the river as "*Enkare Ua: Nairobi*" (meaning the stream of cool waters). During this period, the dominant mode of transport in the Enkare Nairobi plains was pedestrianisation and to some extent, animal transport while pastoralism was the dominant land use activity. By 1850, Nairobi had become a popular spot along a caravan route operating from the East Coast of Africa to the Wanga Kingdom and the Eastern Uganda. (Kingoria 1983, Thornton-white 1948, and Nairobi City Council 1971) Upon the take over of their land by the railway corporation, the humble settlement pattern that existed was thrown into disarray.



Map 3-5 The physical and population development of Nairobi



Source; Obudho 1976

3.3.2 Kenya –Uganda railway construction and the development of Nairobi (1890 –up to 1910)

On 18th August 1896, the first rail of the new Uganda Railway was laid at Mombasa and the rail head was pushed steadily into the interior. It had been intended that the railway workshops and headquarters should eventually be sited at Kikuyu, but a report from the surveyors on the route advised against this decision, on account of difficult gradients, encountered at that point. A

letter signed by one of the engineers suggested that the project depot should be at a place called “Nyrobi” on the plains, eight miles below Kikuyu village. The site was agreed on and by 1898; it was known that Nairobi had been chosen as the future Railway Headquarters. When the line reached the site where Nairobi now stands, on May 30th 1899, it was no more than a jungle of open plains, the grazing ground of giraffe and other wild animals (Obudho, 1976). This led to the transfer of Railway Headquarters from Mombasa two months later to the new site at Nairobi plains. Due to the gradient, the railway depot was to be sited on the flat land section of the plains an area mainly characterised of black cotton soils. One of the considerations apart from gradient for the site, which led to the selection of Nairobi as a railway depot, was the abundance of clean and cool waters afforded by the perennial Nairobi River. There was ample level land and on the edge of the plains for railway tracks and sidings. Because the Nairobi plains were in an apparently deserted nature of terrain, being a buffer zone between three warring tribes (Kamba, Kikuyu, and the Maasai) it seemed that friction over the appropriation of land would be minimal. The Railway authorities were given carte blanche authority to lay the railway over any land irrespective of ownership or occupation and had to reserve a mile-wide zone on each side of the railway line for railway purposes.

3.3.3 Nairobi as a colonial capital and the planning of the city (1910—1963)

3.3.3.1 Colonial capital

Nairobi was first established in 1899 as a railway depot, and soon, became a communications centre and the headquarters of the provincial administration. In the late 1899 the colonial government’s administrative centre of the Ukambani Province to which Nairobi belonged, which was located in Machakos about 64 Km to the South East of the railway camping site was also moved to Nairobi railway camping site. Justification was the necessity for ordering the life of the growing community gathered about the goods sheds and the railway workshop in Nairobi. It was technically a duty of the Uganda railway authority to manage their campsite at Nairobi, but the protectorate government felt bound to assume some responsibility. These considerations led to the transfer of the provincial administration under colonel John Ainsworth C. M. - G, D.S.O from Machakos to Nairobi in 1899. He chose a site at an upstream location of the Nairobi River where there was enough supply of water, which was adequate, if not abundant for a small colonial provincial government settlement. He made his residence at Daraja, just above the present Ainsworth Bridge on the museum hill. In 1905, Sir Donald Stewart, moved the

headquarters of his colonial and protectorate Government to Nairobi from Mombasa and occupied the house which had been built originally for the Chief Engineer of the Railways. The town expanded its function to include administrative and religious functions. Although drainage and health problems plagued the early settlement of Nairobi, in 1906 the colonial government endorsed the location fixing Nairobi where it is.

In 1914 Nairobi became a military base from which the military forces of the British Empire advanced against the Germans in Tanganyika (now Tanzania). After World War I, Nairobi became increasingly a base for business, government, transportation and particularly air service, and for the royal armed forces of the British crown and was of major importance in enabling the army and the air force to push the Axis forces out of East Africa in World War I. This role of a strategic base, in peace and in war, which Nairobi has played for half a century, whilst it has made possible much of its development has, of course, brought in it a train of variety of problems. (Alderman, F. G .R Woodley, Mayor of Nairobi, March 1950).

3.3.3.2 The Foundations of Local Government

The Nairobi Municipal Regulations were published on the 16th of April 1900 under the powers vested in Sir Arthur Hardinge, H. M. the Commissioner at Zanzibar by Article 45 of the East Africa order-in-council. The regulations defined the township of Nairobi, as the area comprised within a radius of one-mile-and-a-half from the office of the provincial sub commissioner in Ukambani province. The order also authorised the sub-commissioner to nominate annually a number of the leading residents or merchants to act as the management committee for the local town of Nairobi. The committee had the town plan drawn, marked out the plots and roadways in the commercial area and registered the plot owners and the shopkeepers. Two months after the committee-started work, a hundred and twenty unsanitary shacks were being demolished. In December, the sub-commissioner presented his first budget for the township. Development of Government Road, then known as Station Road, was sufficiently advanced in 1901 for the municipal committee to assume responsibility for its policing, lighting and cleansing. Jevan Jee and Company were Railway contractors whose principal shareholder Mr. Haj Jevan Jee later donated the Jevan Jee (sometimes called the Victoria) Gardens to the town council of Nairobi. Two major problems overshadowed the work of the committee during the early part of 1902. One was plaque, which ravaged the township. The second was the doubt expressed by the medical authorities concerning the suitability of Nairobi as the site of the future capital of the

colony. A further epidemic of plaque occurred in 1904 and fanned the sparks of the old dispute concerning the suitability of Nairobi as the future capital of the colony.

3.3.3.3 Planning of Nairobi

By 1905, The Railway town of Nairobi was thus divided into two parts; the land controlled by Uganda railway and the land controlled by the provincial administration boma. Parallel roads of earth construction had been laid out between the railway and the Hill, and these were again intersected at right angles by roads to the west of the station. By 1926 there was a need to check the problem of urban sprawl. A Town Planning consultant, F. W. Jameson was appointed to make zoning recommendations for the entire municipality. This was followed by Master Plan for a colonial capital commissioned in 1948. This show the Nairobi Municipality issue a memorandum on density control. The 1948 Master Plan laid-down guidelines for 20 years from that year. The plan set out land for the various uses. The plan also set out the main density zoning regulations to govern physical planning of areas within the municipality. The 1948 Master Plan is said to be responsible for the present day layout of the industrial area and other land uses and also proposed important extensions to the existing road networks. It expired in 1968.

During the 1970s, Nairobi Planners expressed the view that there was virtually no co-ordinated planning of the city in the first decade of independence only that there were various sectoral plans. However, the sectoral plans never solved the sectoral problems. By 1973, it was also clear that the city's water supply could soon be insufficient while the existing transport facilities were already inadequate.

The Nairobi Urban Study Group (N U S G) was formed in 1973 under the auspices of World Bank to prepare the Nairobi Metropolitan Growth Strategy (NAGS) to 'arrest' the planning problems before they got out of control. The group proposed the decentralisation of industrial location into four locations apart from the existing area. This was aimed at producing a better integration of work and housing areas and a corresponding alleviation of transport problems. The proposals also were aimed at directing the city's growth towards the Eastlands and discouraged the city's growth towards the high potential agricultural lands of Kiambu. The Nairobi Metropolitan Growth Strategy stipulated policies related to the employment, housing, transport, among other major aspects of urban development. The Nairobi metropolitan growth strategy plan had a life span of 25 years. However, most of the Nairobi growth strategy plan proposals

were never implemented. One of the general problems as Stren, (1989), observed on implementation of the Nairobi Urban Study Group was the undoubtedly lack of powers associated with the planning function within the overall decision making system and the reliance on master planning as an approach, without appropriate mechanism of plan implementation. At the out set its site initially considered good /ideal for railway sidings proved disastrous when it came to sanitation, a problem that still features as an important constraint in the city's development. This however did put the full stop to enquiries on the ways to solve the problems of Nairobi - 'The search still continues' (Stren 1989)

3.4 Post independence Nairobi city (1963 --2000)

With the achievement of Independence from the British in 1963, the boundaries of the city were enlarged from the 'Old City' area of 90 square kilometres (35 square miles) to embrace area of 697 square kilometres (268.6 square miles) including Nairobi's peri-urban settlements and certain other important features such as the Game Park, Embakasi Airport and area of ranching land in the east. The boundary extension aimed at giving the city adequate reserve land for future expansion. The Africans never considered Nairobi as a suitable place for Africans to live. The Africans always considered the city as a place of work and not permanent residence. This was exacerbated by the colonial policies of marginalisation, cultural uniqueness and religious convictions, (Burn, 1983). The new government in its attempt to come to terms with its responsibility of the rapidly expanding and under-serviced population commissioned several studies. Housing was of particular concern and was a subject of United Nations (UN) study in 1964. In 1967, the National Housing Corporation (NHC) was established for the specific purpose of building rental housing for the low-income groups. The situation of rapid immigration and unaffordable housing led to what was characterised as help- the city in 1971. At this time about one thirds of the city's population was believed to live in the informal housing sector.

3.4.1 Present day Nairobi city

Present Nairobi city cover an extent of 697-km², with a gross population density of 3100 persons per km². (Kenya rep, 1999). The city of Nairobi has been severally referred to as the Green city in the sun, on a serious note. Derogatory language has been used against Nairobi also, like the city in the Garbage, the city of potholes, and the city of crime (UNCHS Habitat 1992).

Nairobi development form shows minor Business centre like the West lands, Nairobi West Yaya centre, and Adams arcade as up coming Business Centres. The structure shows the distribution of various high incomes residential e.g. Muthaiga, Lavington, Kileleshwa and Karen, to middle income residential areas like Langata, south C and south B, and the low income residential areas like Kaloleni, Umoja and Kayole, and the lower low income residential areas in the slum areas of the city like Mathare, Kibera and Mukuru. The city has various prestigious facilities such as Nyayo Stadium, City stadium, Moi Kasarani Sports Complex. Immaculate Religious Centres and educational institutions like the All Saints cathedral, Free Mason's Hall Salvation Army Head quarters, St. Andrews Church, St. Paul's Chapel and Jamia Mosque. Prestigious civic houses, e.g. the parliament buildings, the city hall, and the county hall. Prestigious sky scrapers like e.g. the times towers, the anniversary towers, and the Afya centre. Financial institutions like the Barclays bank, the Kenya commercial bank, the standard bank and the national bank of Kenya and transport and communication facilities like the Jomo Kenyatta international air port and the country bus station and government security offices like vigilance house and the department of defence.

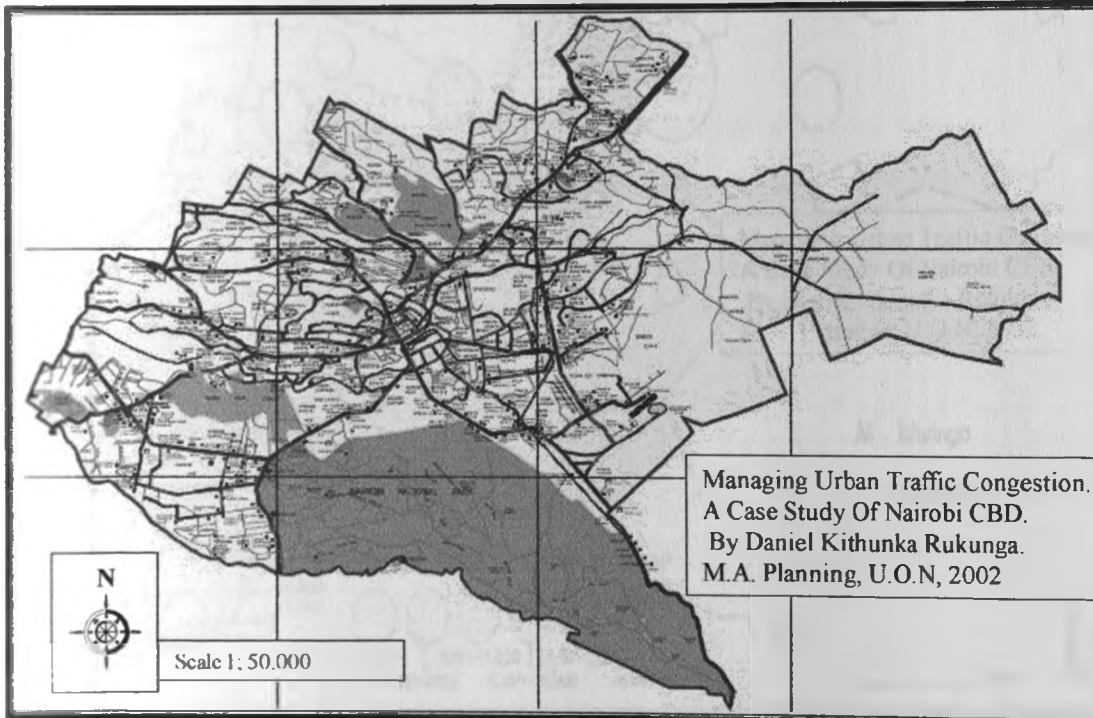
3.5 Population growth in the city of Nairobi (1900—2000)

In 1891, Captain Eric Smith established Fort Smith near Dagorretti, while Pangani was also declared a campsite for porters. Sergeant George Ellis, of the Royal Engineers was the first white man to live in the place we now know as Nairobi. He established a transport depot at Nairobi in 1896.

The Railway authorities were self-contained, with a full compliment of engineers, doctors, accountants, police officers and magistrates, all of whom controlled subordinate staff of European and Asians, and they were thus equipped to deal with the administration of their Nairobi depot. As early as 1901, Nairobi started to experience urban population problems. The early problems pressing Nairobi included lack of proper drainage, inadequate water supply, and low standards of low-income housing. In 1902, Nairobi population was estimated at less than 10,000 people. In 1901 to 1902 and 1904, Nairobi was hit by plague outbreak. In 1905 it became the capital of the colony, with a population of about ten thousand (Nairobi city council 1971). The first recorded population figures for Nairobi was in 1907, where the town was estimated to be the home of over 13,000 inhabitants, with its boundary limited to a circular area of 1.5 mile radius arbitrarily fixed in 1900 by the Nairobi Municipal Regulation. In 1919, Nairobi became

an incorporated municipality with the township: area extended to cover 9.8 miles radius and it was at this point that Nairobi became a municipality (Kingoria 1983). The municipality was further extended Again, in 1948 to cover 324 square miles with an urban population of about 110,000 people. And subsequently in 1950, Nairobi became a city on 30th March 1950, by a royal charter of incorporation. During these early times, the existing major problems included transportations, housing, drainage and sanitation. Nairobi population increased tremendously to over 260,000 people by 1962.

Map 3-6 Present day Nairobi city

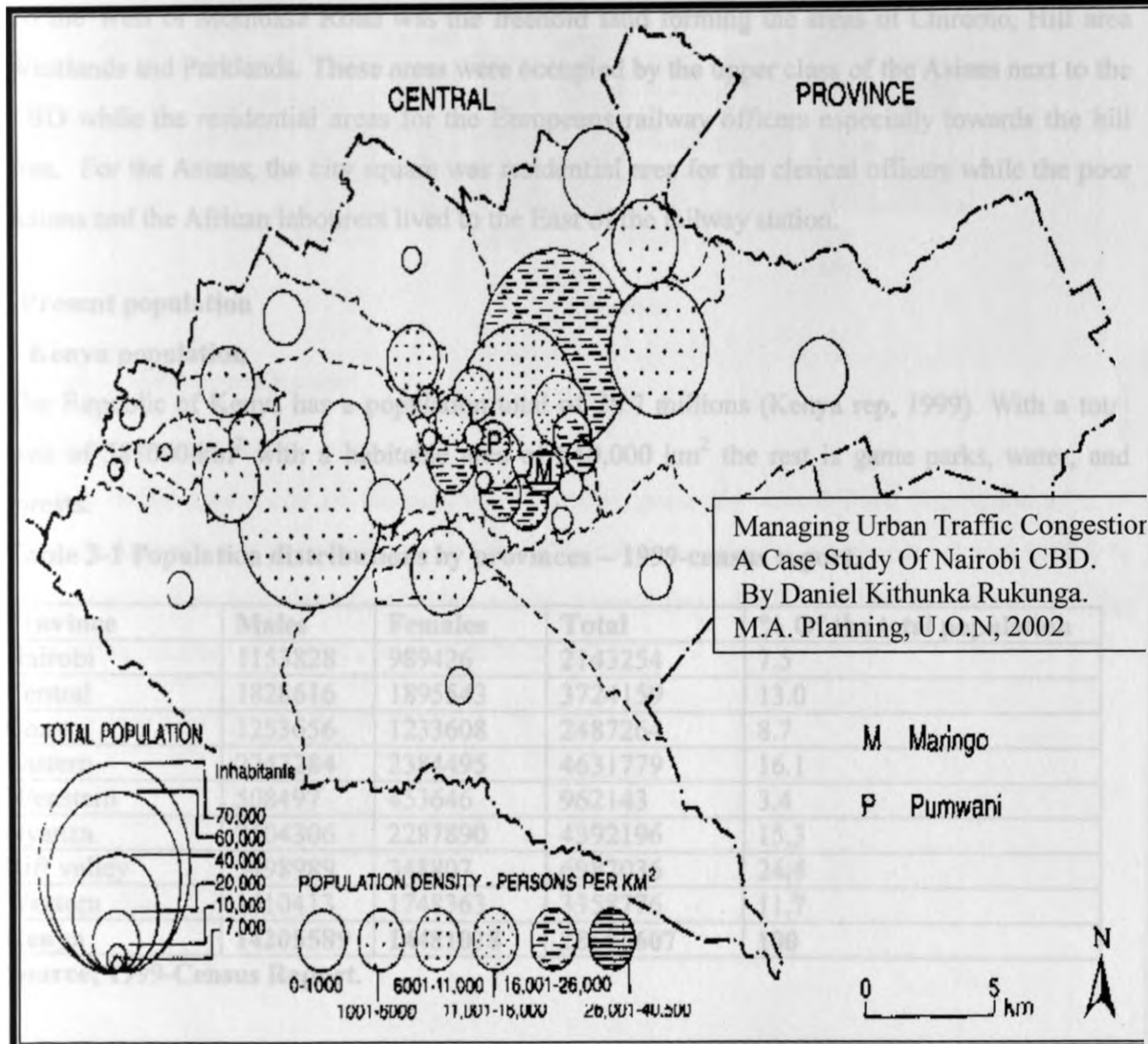


Source: The Survey of Kenya, 2000

At independence in 1963, the size of Nairobi was increased to cover 697 km², which is the size of Nairobi up to date. This increased the population steadily so that by 1969 the population of Nairobi stood at 509,286 by 1979, Nairobi population was at 827,775. By 1989, the population of Nairobi had risen to over 1,300,000. The 1999 census indicated that presently Nairobi has a population of about 2.1 million people. The annual increase of urban population of Nairobi in absolute figures is about 250,000 people Per annum. It as been observed that the factors that

stimulated the establishment and growth of Nairobi like expansive flat lands in the East later produce some of the worst problems the city faces as like poor physical drainage.

Map 3-7 Nairobi population density and distribution



Source; Obudho 1976

3.5.1 Initial settlements patterns in Nairobi

The initial settlement patterns of Nairobi shows that Nairobi was divided into three sections, which were clearly defined on racial basis. These were the three major ethnic groups, the Africans, the Asians and the Europeans. These ethnic groups were very stratified, by occupation and also residentially.

To the North West of the railway boundary was the freehold land, which forms the present day estates of Kilimani, Thompson and Lavington, which were mainly occupied by the Europeans. These residential units were mainly single units, fashionable homes of low population density. To the West of Mombasa Road was the freehold land forming the areas of Chiromo, Hill area Westlands and Parklands. These areas were occupied by the upper class of the Asians next to the CBD while the residential areas for the Europeans railway officers especially towards the hill area. For the Asians, the city square was residential area for the clerical officers while the poor Asians and the African labourers lived to the East of the railway station.

3.5.2. Present population

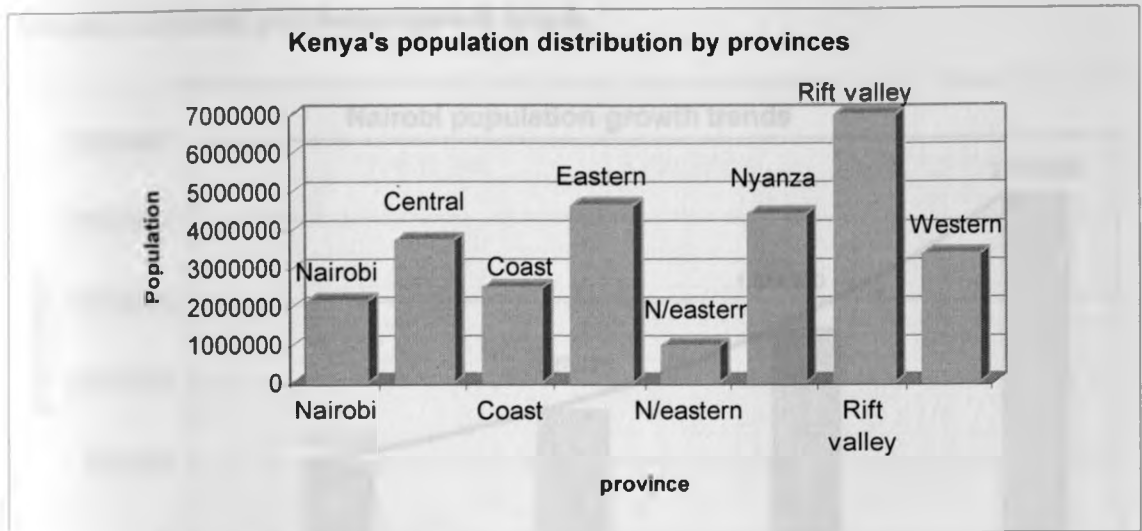
3.5.2.1 Kenya population

The Republic of Kenya has a population total of 28.7 millions (Kenya rep, 1999). With a total area of 583000-km² with a habitable area of 540,000 km² the rest is game parks, water, and forests.

Table 3-1 Population distributions by provinces – 1999-census report.

Province	Males	Females	Total	% Of the total population
Nairobi	1153828	989426	2143254	7.5
Central	1828616	1895543	3724159	13.0
Coast	1253656	1233608	2487264	8.7
Eastern	2247284	2384495	4631779	16.1
N/eastern	508497	453646	962143	3.4
Nyanza	2104306	2287890	4392196	15.3
Rift valley	3498989	348807	6987036	24.4
Western	1610413	1748363	3358776	11.7
Kenya	14205589	14481018	28686607	100

Source; 1999-Census Report.



Source; 1999-Census Report.

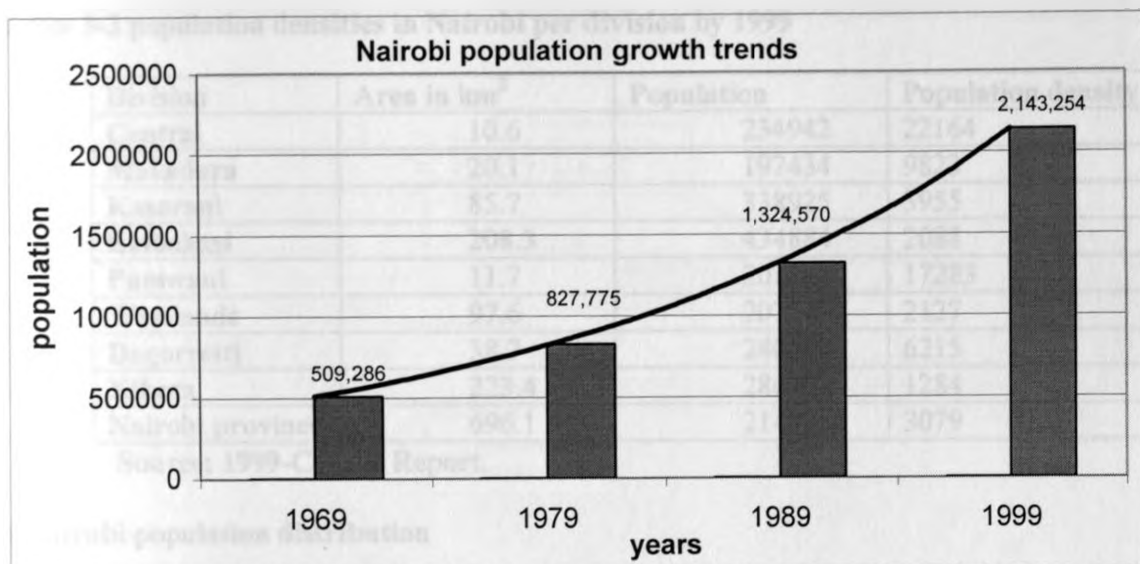
3.5.2.2 Population of Nairobi

Nairobi is the capital city of the republic of Kenya, presently with a Total Population of 2.15 million. According to the 1999 census report, Nairobi's population represented a total of 7.5 % of the entire Kenyan population. The census reports from 1969 to 1999 and has shown the population increase at 10 years interval to be as follows.

1963	350 000
1969	509,286
1979	827,775
1989	1,324,570
1999	2,143,254

Source; 1999-census report.

Graph 3-1 Nairobi population growth trends



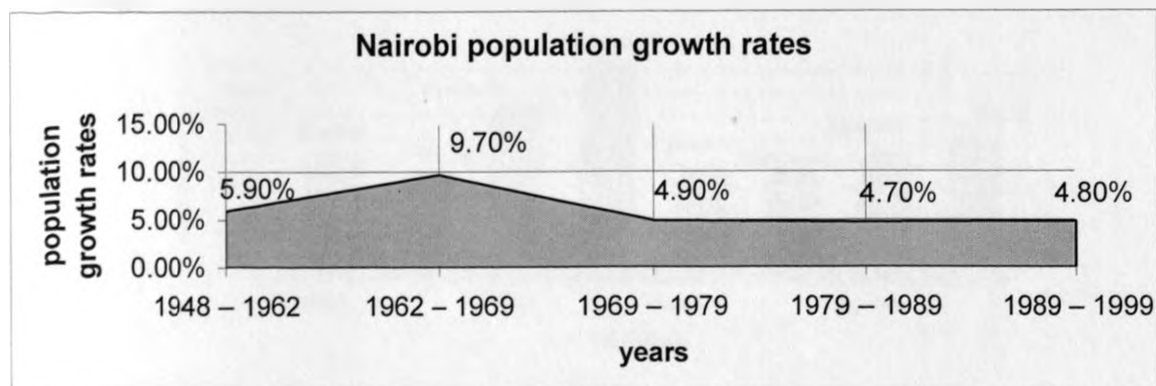
Source, Author's graphics based on 1999 Census Report

Table 3-2 The Nairobi population growth rate

Year	Growth Rate	Population	Crude death rate	Area	Population density	Fertility rate	Life expectancy
1948 – 1962	5.9%	350,000		324 miles	1081	7.6	
1962 – 1969	9.7%	509,286	33	696.1	732	7.6	50
1969 – 1979	4.9%	827,775	38	696.1	1190	7.8	54
1979 – 1989	4.7%	1324,570	34	696.1	1903	6.7	60
1989 – 1999	4.8%	2143,254	40	696.1	3079	4.2	47

Source; 1999-Census Report.

Graph 3- 2 Nairobi population growth rates since 1948



Source; 1999-census report.

3.5.2.3 Nairobi population characteristics

Table 3-3 population densities in Nairobi per division by 1999

Division	Area in km ²	Population	Population density
Central	10.6	234942	22164
Makadara	20.1	197434	9823
Kasarani	85.7	338925	3955
Embakasi	208.3	434884	2088
Pumwani	11.7	202211	17283
Westlands	97.6	207610	2127
Dagorretti	38.7	240509	6215
Kibera	223.4	286739	1284
Nairobi province	696.1	2143254	3079

Source; 1999-Census Report.

3.5.2.4 Nairobi population distribution

Population in Nairobi is basically distributed is by three categories of incomes.

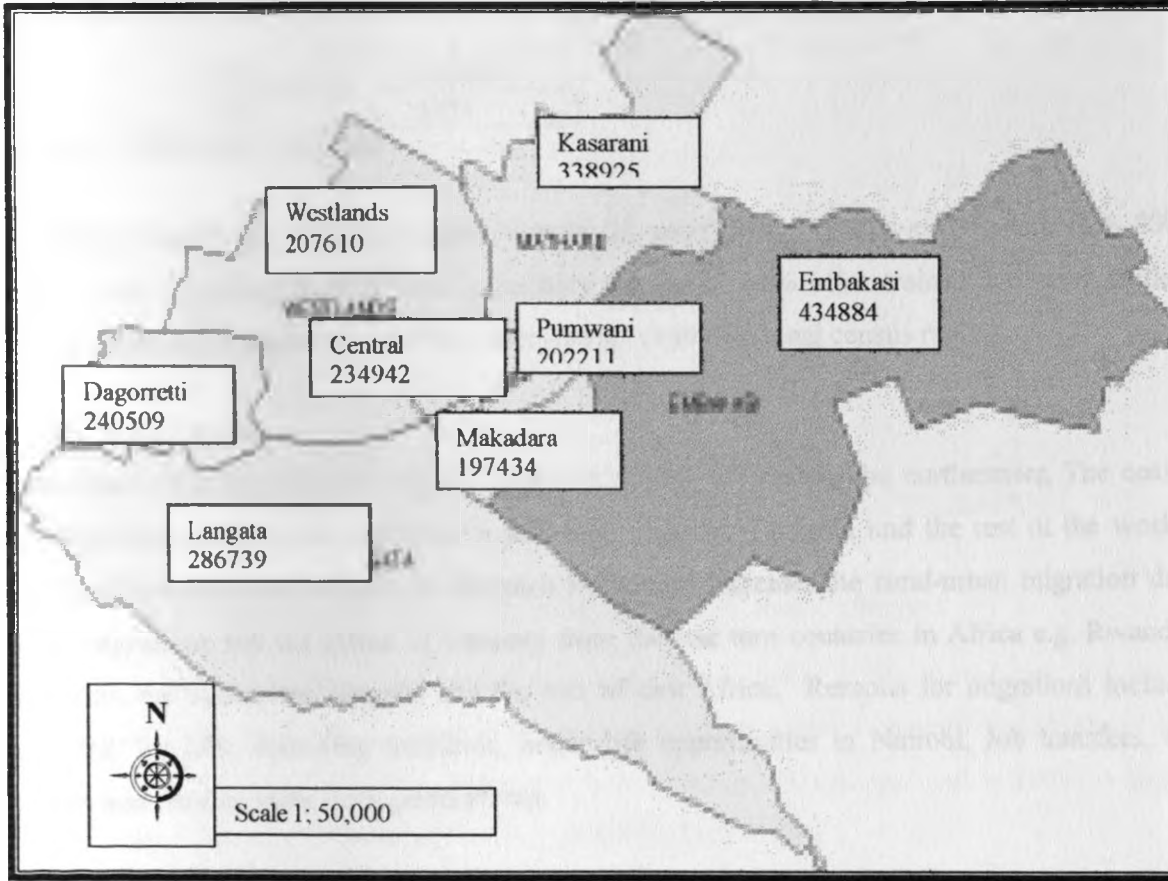
High income on the hill, and the other well drained area of the city especially the areas with volcanic soils

Middle income on the well drained eastern plains of the city especially the areas with laterite soils e.g. Hazina, plains view, Imara Daima and villa Franca

Low income on the relatively poorly drained plain on the eastern side of the city especially the areas with predominantly black cotton soils e.g. Kaloleni, Makongeni, and Mbotela and Umoja

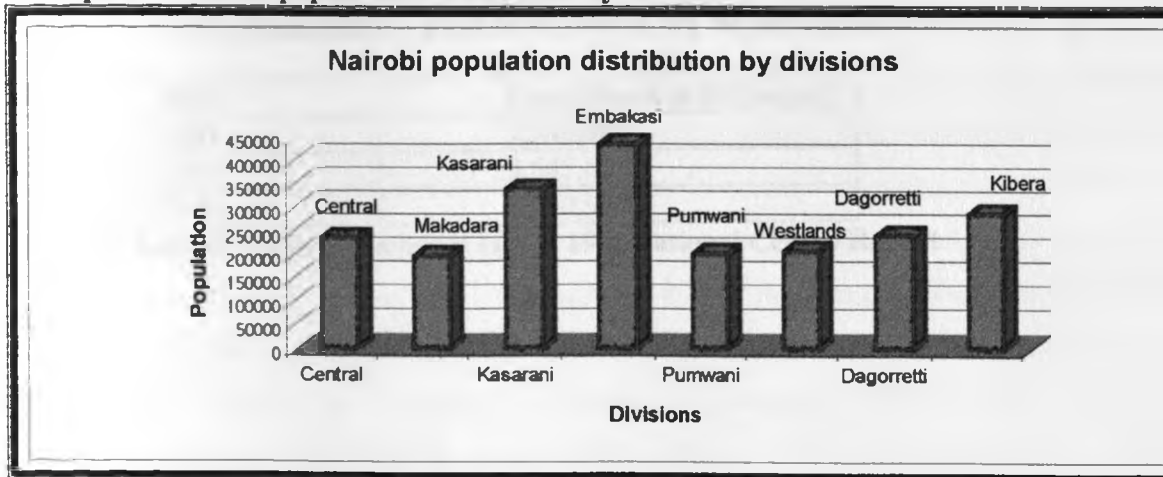
Lower low income on the hazardous areas of the city especially under the high voltage power pylons, the river valleys, the road reserves, on the utility way leaves and the idle private lands e.g. Mukuru Fuata Nyayo, Kaiyaba, Mariguini Kwa Reuben, Kwa Njenga Kware, and Lungalunga.

Map 3-8 Nairobi population distribution by divisions



Source; 1999 Population Census Report

Graph 3-3 Nairobi population distribution by divisions



Source; 1999-Population Census Report

3.5.2.5 Nairobi population profile

Table 3 -4 Nairobi population ratios by sex source 1999 census report.

Males	Females
52%	48%

Source; 1999-Census Report.

Working population- 56% Dependants -Under 20 years 30% -Aged over 60 years 14% 80% have primary education, 60% have secondary education 50% offer trained and semi skilled labour, 90% of the population is health and strong. (1999 National census report).

3.5.2.6 Migration trends

Movement of the people into Nairobi from the central, the eastern the northeasters, The coast, the Nyanza the rift valley the western province, Uganda, Tanzania and the rest of the world. Population increase in Nairobi is influence by natural increase, the rural-urban migration day time migrations and the influx of refugees from the war torn countries in Africa e.g. Rwanda, Burundi, the Sudan and Somalia and the rest of east Africa. Reasons for migrations include Looking for jobs, following husbands, better life opportunities in Nairobi, Job transfers, on transit and running away from persecutions.

3.5.2.7 Nairobi population projection up to the year 20 40

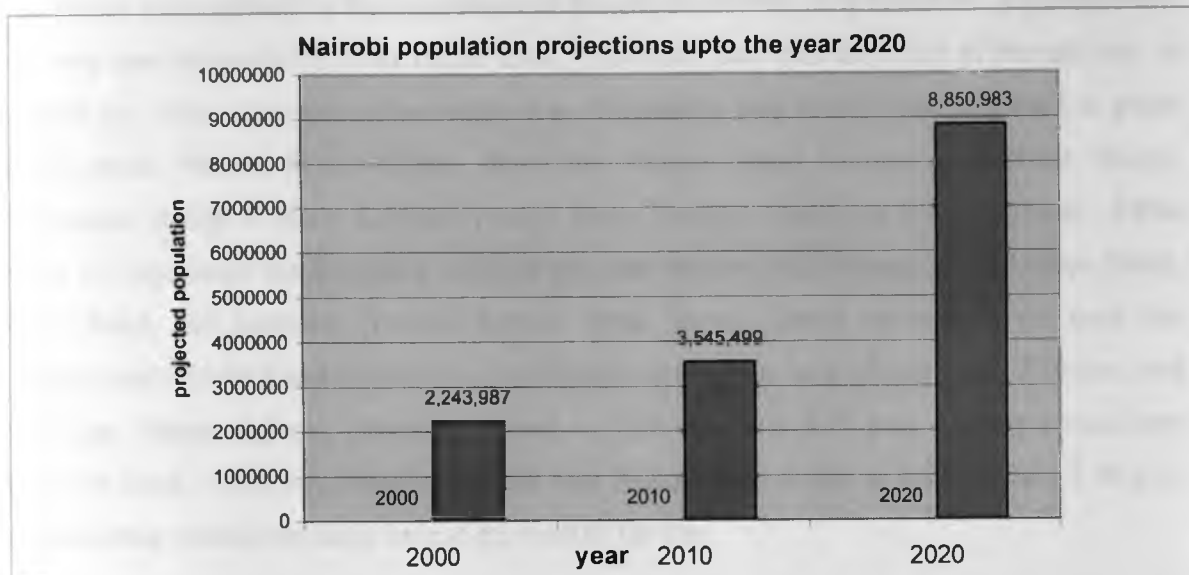
$PI = PO (I + r/100)^n$ PI = Future population, PO = Present population, r = Population growth rate, n = Number of future years, Present population =2143254, Population growth rate = 4.8

Table 3- 5 Nairobi population projection after every 10 years up to 2020

Year	Population size (Expected)
2000	2,243,987
2010	3,545,499
2020	8,850,983

Source; Author's projections based on the 1999 national Census Report

Graph 3- 5 Nairobi population projections



Source; Author's projections based on the 1999 national Census Report

It is projected that the population will continue to increase due to the rural urban migration; urban natural increase, international migrations and natural increase despite the effects of the scathing aids scourge. Therefore, this population increase needs proper and sustainable urban transportation planning especially to decongest the CBD of Nairobi.

3.6 The CBD

The small percentage of the city land occupied by the commercial land use (4% - 5%) is not a true indicator of the importance in value of the services it offers e.g. Wholesale, retail, and financial services, offices and storage facilities. Every city has various commercial activities in the CBD involving trade, administration, and record keeping, tertiary and quaternary activities. Trade activities involve transfer of ownerships of goods, and provision of services administration activities – office functions – are also categorised as commercial activities. The CBD is the heart of any commercial centre. This is the area of the city with the highest concentration of buildings, tallest buildings, and the highest daytime population density. It is the area of the city with the highest concentration of offices, retail shops, wholesale shops, and has the highest values of land. It is also the centre of civic and social aspects of life. The CBD is also the focal point of major urban transportation routes. In most cities including, the CBD is found in the original site of city.

3.6.1 The study area (the CBD of Nairobi).

This study was confined to the boundaries of the city of Nairobi as it is defined geographically, but was also compared to other major town. The study area was the CBD of Nairobi city as marked by: Uhuru highway to university way. University way to slip road, slip road to globe round about Nairobi River Bridge, down the Nairobi River to racecourse Road Bridge. Racecourse Bridge to Haile Selassie Avenue, Haile Selassie Avenue to Uhuru highway. Other roads of importance for the study in the study area include Moi Avenue, Tom Mboya Street, River Road, and Kenyatta Avenue. Ronald Ngala Street, Luthuli Avenue, Accra road and Latema road. Study Condon points included; Kenyatta avenue near Uhuru park –7.30 a.m. and 5.30 p.m. Uhuru highway near central park. – 7.30 a.m. and 5.30 p.m. Murang'a road near meridian hotel - 7.30 a.m. Racecourse road near Nairobi river bridge at 7.30 a.m. and 5.30 p.m. and any other road in the study area at any time of the day.

The cool weather conditions with little or no extremes variations are envied all over the world. It is a large, modern commercial and international business and tourist centre. There are many churches, mosques and temples where people of different faiths go to worship. There are restaurants, which serve almost every kind of food, from local dishes to the most exotic foods. Nairobi is a major urban centre, which has a game park with all sorts of wildlife situated within a few miles from the city centre therefore making it a lucrative tourist attraction town.

Map 3-9 The CBD of the city of Nairobi roads networks



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A Case Study Of Nairobi CBD.
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M.A Planning, U.O.N, 2002

Source; Survey of Kenya 2000

Plate 3-1 The CBD of Nairobi



Source; field survey 2002

3.6.2 Infrastructure developments and road net works in the CBD

The infrastructure developments in Nairobi CBD include long town streets, e.g. Haile Selassie Avenue Moi Avenue, Kenyatta Avenue. Murang'a road, Uhuru highway and several roundabouts. Also clearly visible is the river channels.

3.7 Planning for urban transport in Nairobi CBD

Serious urban transport planning in Nairobi gained recognition in the 1960s (Ombura, 1989). A report (Baswell, 1979) - proposed the possibility of a matatu assistance scheme that was to be funded by the World Bank. The report also proposed the improvement of informal repair facilities and construction of shelters for passengers at the terminals. The Transport unit of the Nairobi city council also proposed the provision for bus/matatu lanes, improved pedestrian facilities, and area traffic control systems. Road improvements and lay-bys for buses and matatus in specific areas were also articulated. Stren (1989) observes that the first study on matatus was done in 1977. The study identified the origins and destinations of matatus, and characteristics of their operations. Some of the proposals/recommendations was that matatu owners to form an association, insurance licensing vehicle inspection taxation and provision of terminals. It was later clear that some of these recommendations were taken up in matatu legislation. However, the city council itself failed to make good their part, to make provision for matatu in its physical planning. For instance, no provision was made to zone or allocate space for terminals where the matatus could wait at the route terminuses or to rationalise the space needed by them and buses at the stops. The physical planning response has been limited to allocation of terminals in response of lobby groups e.g. the recently registered matatu welfare association. Conclusion drawn by various authors indicate that despite formal legalisation by the government, the matatu still carries the stigma of extra-legality as far as the Nairobi City Council Physical Planners are concerned.

CHAPTER 4- ANALYSIS OF THE TRANSPORT SYSTEM IN NAIROBI

4.1 History of urban transportation in Nairobi

4.1.1 Railway systems

It could not be fair to discuss transportation and traffic congestion in Nairobi without mentioning that Nairobi originated as a transportation town. Nairobi as an urban centre and ultimately as the capital city of Kenya started by the arrival of the of the railway head at the Nairobi site in June 1899. The railway line was completed in 1901 and was mainly for inter urban transport services. As Nairobi continued to grow in population, the railway means of transport became very important, as it is connected Nairobi to Mombasa, through Voi, and Athi river. The railway also connected Nairobi to Kisumu through Kikuyu, Naivasha and Nakuru. The railway also connected Nairobi and the mount Kenya region through Thika, Murang'a and Nanyuki. Through out all the time since 1899, Nairobi has always been considered by the Kenya railways corporation to be small in size to warrant the use of an intra city railway commuter railway service. During the 1920s, the pattern of roads in Nairobi emerged. A trunk road dominated the city from the CBD, to the western hinterland and another one to the industrial area in the southern part of the city. During the colonial periods, there was a low usage of road as a means of transport in the city, given that the number of motorcars was very low. The Africans could adequately sustain their daily demands within the residential areas, and if any need arose, the distance to the CBD could be adequately done on foot or by bicycle. The European residential areas were well served with road networks due to the high number of motorcar ownership in the White man's residential areas.

4.1.2 KBS transport

Public transport in Nairobi points out that the age of the services can be equalled to the age of Kenya Bus Services in Nairobi. The birth of the Kenya Bus Service transport service in the 1930's led to the then Nairobi Municipal Council to explore ways of introducing a motorised public transport service. In 1934, the Overseas Motor Transport of London started a pilot project and during the same year, and the Kenya Bus Service came into being (Ndegea, 1996). Initially the Kenya Bus Service had 13 buses operating on 12 routes, which had no traffic congestion at all. In 1944, the Kenya Bus Service signed a franchise agreement with the city

council of Nairobi, where by the council controlled 25% shares of the Kenya Bus Service operations.

Post independence period witnessed a high increase in car ownership with mild traffic congestion setting in at the peak hours and the demand for better roads greatly increased. Like other African cities, after independence Nairobi experienced a high rate of rural urban migration, accompanied by mushrooming small-scale trade and petty commodity production including poorly serviced and unauthorized housing. Formal institutions, legislative, and physical planning structures were not adequate to cope with this form of economic activity, and it was labelled informal sector. All this greatly enhanced the need for better transportation services to ease the traffic congestion, which was accumulating and developing year by year.

4.1.3 Matatu transport

The matatu transportation in Nairobi is known to have emerged in the 1950s as a spontaneous generation of an informal transport network in a situation where the formal public services (Kenya Bus Service) were inadequate. The matatu were initially viewed as 'pirates'. In 1973, the Matatus as a mode of transport received an official recognition by the government, and began to operate side by side with the Kenya Bus Service in Nairobi and more widely through out the republic and increasing traffic congestion on the existing roads day by day. In 1978, the Transport unit of Nairobi City Council was set-up as per the recommendations of the Nairobi Urban Study Group. The Kenya Bus Service became very popular and efficient in the urban transportation business and by 1982 it controlled about 27% of all journeys in Nairobi. In 1986, the Nyayo Bus Service cooperation (NBS) was started as a government operated commuter service in Nairobi, aimed at supplementing the already overstretched Kenya Bus Service and other modes of transport. This brought about increased traffic congestion in the Nairobi CBD, since no corresponding transport, system capacity was increased. In the 1990s, the liberalisation policy in the Kenyan economy made many Kenyans to import cheap second hand cars, buses and mini buses from Dubai and the rest of the Middle East. The vehicles flooded the streets of Nairobi CBD with no increase in the already overstressed transport system in the city. This brought about unprecedented urban traffic congestion in the streets and in the terminal facilities in the CBD of Nairobi. The city continues to sprawl mainly along the major transport corridors. The urban population explosion continues to put more pressure on the available services.

4.2 Transport demand in Nairobi

4.2.1 Trip

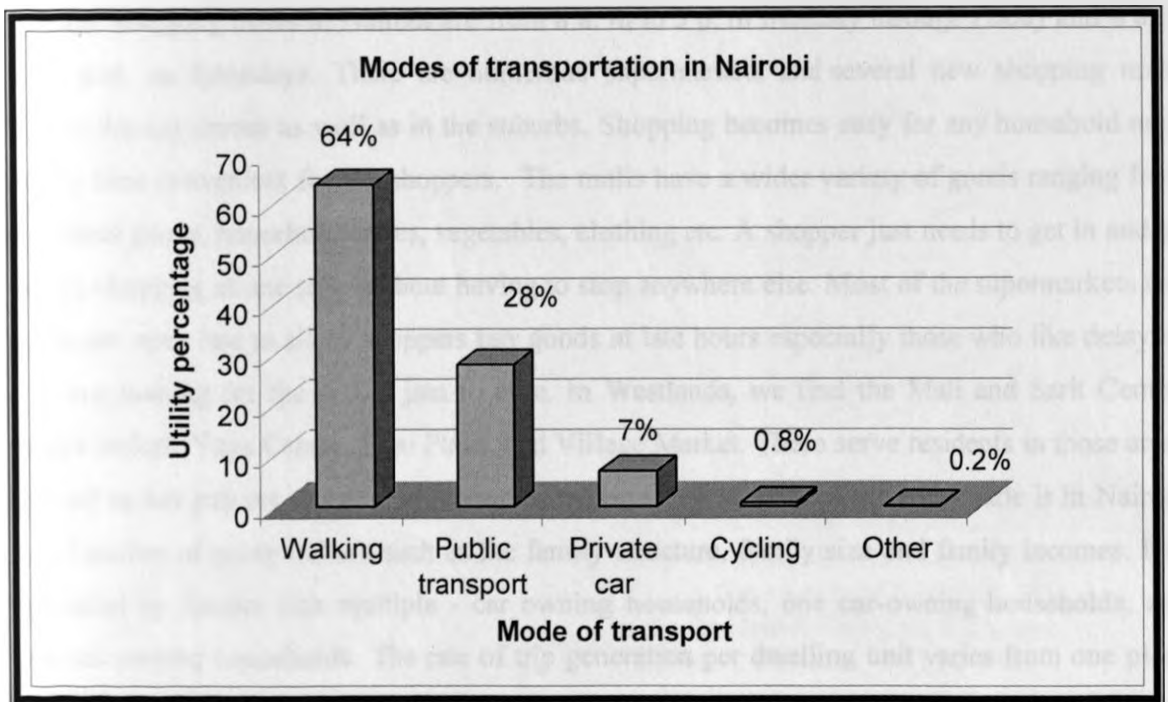
Trip generation and modal split helps to plan for the more dominant mode of transport as well as provision of more suitable routes, and terminal facilities. The most striking features in Nairobi and especially in the lower low-income areas are the journey on foot. In Nairobi, 38% of the trips are by private car and by vans, 14% by public means, 44.6% are on foot, 2.6% are by bicycle and 0.8% by train. The bulky of the Nairobi CBD trips are mode on foot. There is a considerable decline in the use of a bicycle as a mode of transport in Nairobi CBD. Modal split of 3:4 trips from the Eastland to CBD and industrial were recorded in 1994 (Omwenga, 1994)

Table 4 – 1 Modal split in Nairobi by percentages in 1997

Mode	Modal share (%)
Walking	64
Public transport	28
Private car	7
Cycling	0.8
Other	0.2

Source: Omwenga 1994

Graph 4- 1 Modes of transportation in Nairobi



Source: Omwenga 1994

A large portion of walk trips is made for less than 3.5 km. The proportion of pedestrian trips rapidly falls with increasing distance, but still remains a significant mode of transportation in Nairobi CBD short trips. The short trips made in the CBD are very inconveniencing when made by the private car due to lack of parking space and unnecessary delays due to the traffic congestion. The largest proportion of public transport trips (30%) in the CBD is done for a distance of more than 3.5 km. Car owners do not prefer to walk even for short distances of less than 1 km, but prefer driving, even in the congested CBD for trivial services.

4.2.2 Trip purpose

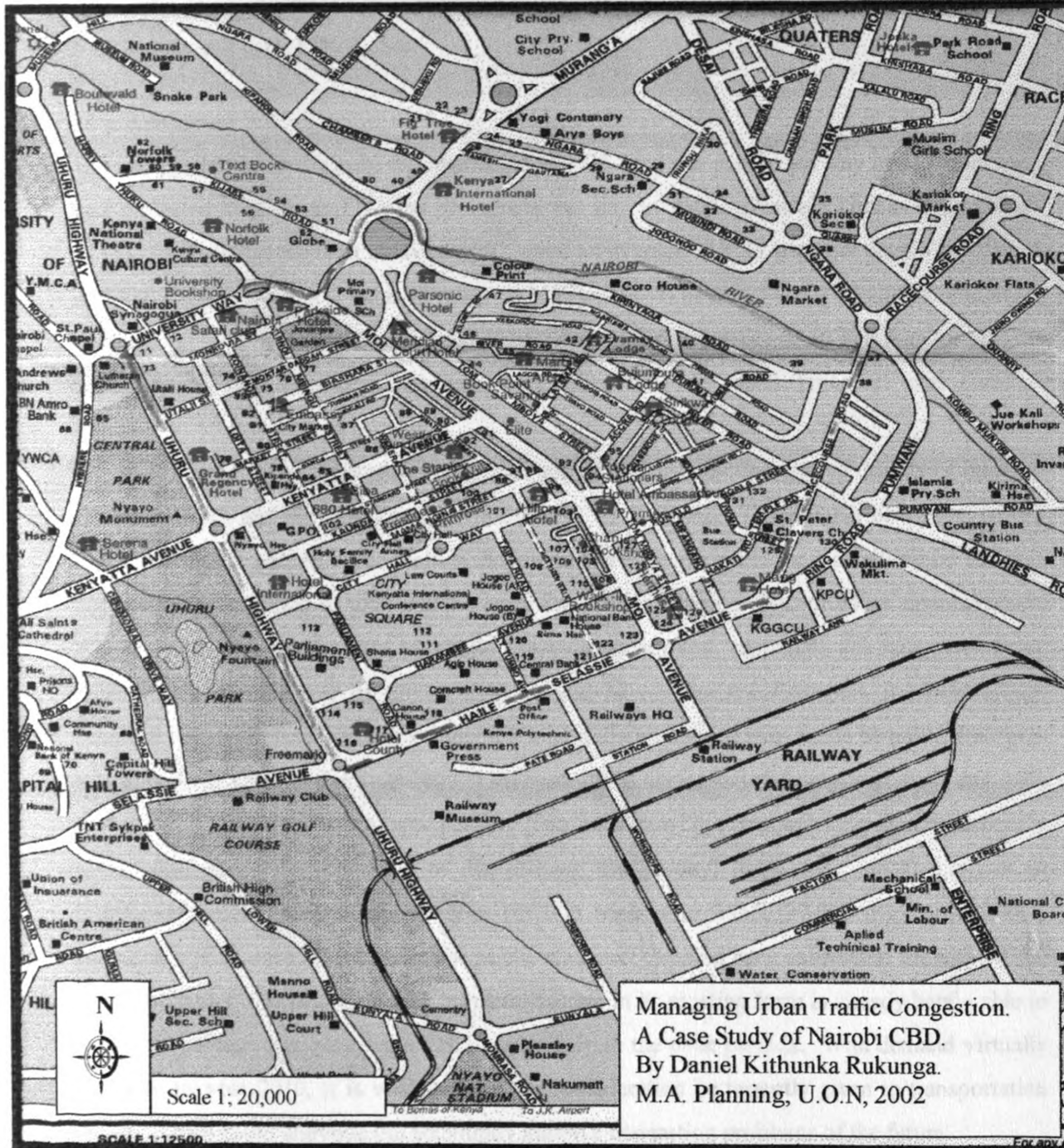
The majority of the trips made to the Nairobi CBD are essentially made for essential purposes. The trips are mostly for shopping purposes, going to work and going to school. These trips account for 85% of total daily trips made in Nairobi. Of the daily trips, 18 % are made in the morning, creating a major congestion on the roads. While Of all the daily trips, 30% are made in the evening causing a great traffic jam within the terminus and CBD routes. Coupled with the peak hour traffic congestion there is a parking problem, which increases considerably in the CBD. A trip purpose is related to trip length.

4.2.2.1 Shopping in Nairobi

Regular shopping hours in Nairobi are from 8 a. m to 5 p. m Monday through Friday and 8 a.m. to 1 p.m. on Saturdays. There are numerous supermarkets and several new shopping malls within the city centre as well as in the suburbs. Shopping becomes easy for any household need at any time convenient for the shoppers. The malls have a wider variety of goods ranging from electrical goods, household wares, vegetables, clothing etc. A shopper just needs to get in and do all the shopping at one stop without having to stop anywhere else. Most of the supermarkets and malls are open late to allow shoppers buy goods at late hours especially those who like delaying in town waiting for the traffic jam to ease. In Westlands, we find the Mall and Sarit Centre; others include Yaya Centre, Esso Plaza, and Village Market. These serve residents in those areas as well as any passers en-route to other destinations. The number of the trips made in Nairobi is a function of many factors such as the family structure, family size and family incomes. It is enhanced by factors like multiple - car owning households, one car-owning households, and non-car owning households. The rate of trip generation per dwelling unit varies from one place to another, and from one part of the city to another within the city. Externally produced trips, and through trips forms less than 5% of the trips made by Nairobi residents in the early 1990s.

Factors like characteristics of employment, population density and land use in the zone attracts a trip generation. Shopping trips are considered to be important trips. Those Walking 48%, Private transport 29%, PSV 12%, Buses 11%

Map 4-1 Shopping and educational facilities in the CBD



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Source; Authors specifications based on Survey of Kenya, 2000

4.2.2.2 School trip

School trips in the CBD are distributed as 60% - on foot, 0.5% - by pedal bicycle, 11% by buses, and 25% by passenger cars.

4.2.2.3 the work trip

The work trip and business trips are similar in distribution. 35% on foot, 16% in public transport, 30% by personal cars, 15% by bus.

4.2.3 Trip generation

The trip generation in Nairobi was estimated at 1.75 trips per person per day in 1975, and this was projected to grow to 1.9 trips per person per day in 2000. (Nairobi Urban Study Group, 1973). The Transurb consult study of 1992, gave an average of 1.85 trips per person per day. A study in 1994 by the world bank (Omwenga Mairura 1994) of the low and middle income in the Eastlands gives a much high mobility level of 2.5 trips per person per day. This was so, because the study not only considered motorized, but also Non-Motorised Transport trips made in Nairobi.

The implication of trip generation is that the type of land use and the type of density of land use can be forecast, and the amount of travel can also be predicted. The number of trips by length follows a regular pattern. The Nairobi population is projected to be 3.5 million by the year 2010 and it is expected to give rise to nearly 8.2 million trips per day, of which approximately 2,733,000 (33%) will be made by public transport (buses and 'matatus'), the remainder being undertaken predominantly by private vehicles and Non-Motorised Transport. It would appear from the various statistics examined that the total daily number of trips made by public transport within Nairobi CBD in the year 2000, 13% took place during the morning peak hour and 14% during the 1 ½ hour evening peak period. The balance of the demand for public transport is spread throughout the remainder of the 13-hour 'traffic day' (6.00 a.m. – 7.00 p.m.) at an average of approximately 7% per hour (47,000 trips: year 1985, 97,000 trips: year 2000). Hence, it can be seen that demand for public transport remains very substantial throughout the day. (Omwenga, 1994). The public transport system in its existing form is already barely able to cope with current demand, in the CBD particularly in the peak periods. With demand virtually doubling by year 2010, it is vital that serious consideration be urgently given to transportation modes, which could alleviate the potentially massive congestion problems of the future.

Table 4 –2 Urban transport modes in Nairobi.

Year	Mode	Percentage
1994	Walking	24%
	Public transport	50%
	Private Car	22%
	Institutional private cars	4%
	Total	100%

Source: S. Kapila et al 'Matatu Mode of Public Transport' Mazingira Institute, 1982.

Table 4-3 1992 Projected annul trip generation in Nairobi up to the year 2000 (trip index of 1.85)

Year	Population	Trips generated
1992	1.559.386	2884863
1994	1718895	3179956
1996	1894721	3505234
1998	2088532	3863784
2000	2302168	4259011

Source; Urban Development Department final report 1998 Transurb Consults.

The major employment areas in the city for all divisions include the CBD, and the industrial area. These employment centres account for a great number of trips made per day for work purposes.

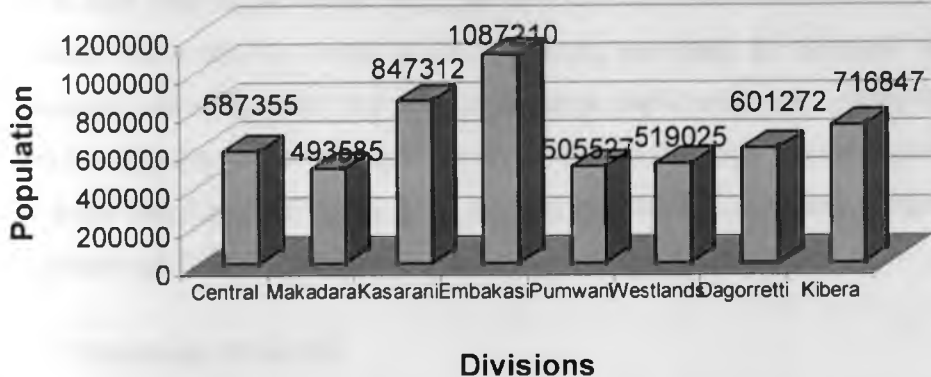
Table 4 – 4 Projected Nairobi trip generations per divisions to Nairobi CBD. (Trip index 2.5)

Year	Division	Population	Trip generation
2000	Central	234942	587355
	Makadara	197439	493585
	Kasarani	338925	847312
	Embakasi	434884	1087210
	Pumwani	202211	505527
	Westlands	207610	519025
	Dagorretti	240509	601272
	Kibera	286739	716847

Source; Urban Development Department final report 1998 Transurb consults.

Graph 4- 2 Trips generated in Nairobi per day

Trips generated in nairobi per day



Source; Urban Development Department final report 1998 Transurb consults.

Table 4 – 5 2001 Projected trip generation in Nairobi for the year 2010 (trip index 2.5)

Year	Division	Population	Trips generation
2010	Central	371209	928023
	Makadara	311954	7798885
	Kasarani	535502	1338755
	Embakasi	687117	1717793
	Pumwani	319494	798735
	Westlands	328024	820060
	Dagorretti	380005	950013
	Kibera	453048	1132620

Source: Author projections, 2001.

4.2.4 Trip distribution by daytime

The private car use is predominating to the west and north of the CBD. The differences between zones occur due to variations in income. About 40% of the trips from the Eastlands end up in the CBD and the industrial area. Most trips are local, and within the immediate residential neighbourhood.

Table 4 – 6 Distribution of trips to the CBD

Destination	Proportion % of Trips
CBD	40
Immediate Neighbourhood	33
Main industrial area	13
Ruaraka/Dandora industrial area	4
Others	10
Total	100%

Source: field survey 2002.

4.2.5 Trip assignments in Nairobi

This refers to the volume of traffic on a given route. Assessment of roads in Nairobi indicated that there is very little if any roads provided for non-motorized transport modes. The city's heavily loaded routes are on a west to east direction, including the Kenyatta Avenue, Haile Selassie Avenue, and University way and the north to south routes of Uhuru highway, Moi avenue and Tom Mboya street. Almost all the trips made to the great lakes region of Africa from Mombasa at the East Coast Of Africa must pass through Nairobi and most of the trips made to them Mt. Kenya region from the coastal region must pass through Nairobi.

Table 4 – 7 Frequency of service

Artery	Flow (Bus/hour)
Uhuru highway	750
University way	270
Moi avenue	260
Haile Selassie	500
Kenyatta Avenue	450

Source: Field Survey 2002

4.3 Transport system in Nairobi

Transport system in Nairobi is made up of the roads, the vehicles and the terminal facilities

4.3.1 Roads

The public road transport mode remains the dominant mode of transport in the whole city of Nairobi. The efficiency in the road transportation depends on the conditions and management of the roads transport network.

4.3.1.1 Road transport network in Nairobi

Nairobi city has trunk roads (highway) of up to 250 Km, local streets of 200 Km and the local access streets of over 400 Km. Most of the local access streets are private roads mainly in the residential neighbourhoods. The whole of Nairobi has a total of 1900 Km of classified roads. The primary road networks can be divided as follows. North-western to south eastern roads Waiyaki way, Chiromo road, University way, Moi Avenue and East to west roads includes: Kenyatta Avenue, Haile Selassie avenue and Ngong Road.

Uhuru highway Length 3.66 km, width of 18.80 m with 6 lanes of 3.5 m wide each. The surface is made of smooth tarmac, with smooth tarmac pedestrian walkways. The highway has a

deep building line and is bordered by the enormous Uhuru Park to the western side. Initially it was meant to be the western by pass highway of the city but presently its used as a general thoroughfare within the city centre.

Moi Avenue Length 1.43 km, width of 14.0 m with 4 lanes of 3.5 m wide each. The avenue has a smooth tarmac surface. It has a deep building line, and a wide road reserve, which has been completely used up for the carriage driveway construction. The avenue has no Kiosks, no utilities and it is a Dual highway all through. No direct access to property except a few new plots with very risky and squeezed access. Moi Avenue is a Dual highway with a planted middle strip in the lower section and has two lanes either way. Has a width of 60 metres road, with slated sidewalks.

Tom Mboya Street has a Length 1.06 km, width of 6.70 m with 2 lanes of 3.5 m wide each. The street has a smooth Tarmac surface, with wide pedestrian walkways but has no bicycle ways.

River road Length 1.07 km, width of 11.90 m with 2 lanes of 3.5 m wide each. It has a smooth tarmac, Dusty and poorly kept walkways with but with no Bicycle ways.

Haile Selassie Avenue Length 2.55 km, width of 18.6 m with 6 lanes of 3.5 m wide each. It has a Smooth tarmac surface all through. Pathways are wide and not with tarmac. Bicycle ways are never provided for.

Racecourse road has a Length 0.75 km, width of 15 m with 4 lanes of 3.5 m wide each. Has a Smooth Tarmac surface with patched potholes and open potholes. The Drainage is Open and piped the Bicycle ways are Non-existence. The Walkways are poorly kept and very dusty. This road extends from Kariokor round about to Join Haile Selassie Avenue near Mang' hotel.

Kenyatta Avenue has a Length 2.59 km, width of 12.80 m with 4 lanes of 3.5 m wide each. Has a Smooth tarmac surface with a rough tarmac in the lower section. It's a very busy road. It Connects the CBD to the western sub urban and the outer commercial centres of golf course, Yaya centre, Kawangware, Karen. Ngong, Dagorretti, and Kikuyu. With close sewages, open areas the grounds are not well maintained.

University Way has a Length of 0.46 km, width of 15.20 m with 6 lanes of 3.5 m wide each. With a Smooth tarmac surface with patches in the upper part. It has No pedestrian and bicycle ways. It is the main transport corridor from the northern and the Northeastern suburbs. It is a dual-way traffic channel all through. It joins Moi Avenue with no clear distinction.

Of all the roads in Nairobi, The three major ones are: **Uhuru Highway** extending to Athi River, Machakos, Makueni, Voi and Mombasa. **Waiyaki way** to Uthiru, Naivasha, Nakuru, Eldoret, Kisii, Kisumu and Uganda. **Thika road** to Thika, Murang'a, Nyeri, Nanyuki, Isiolo, Embu Meru, Northern Kitui and Garrisa. Each of the three main roads runs roughly parallel to existing railway lines. Other non-radial routes in Nairobi are Limuru to Roslyn route and the outer ring road from Ruaraka to Mombasa road. The roads in Nairobi are characterised by gaping potholes, congestion on roads especially at intersections, lack of parking areas; virtually all the types of maladies associated with transport affect the city of Nairobi. Nairobi's transport service is a muddle of magnificent misery

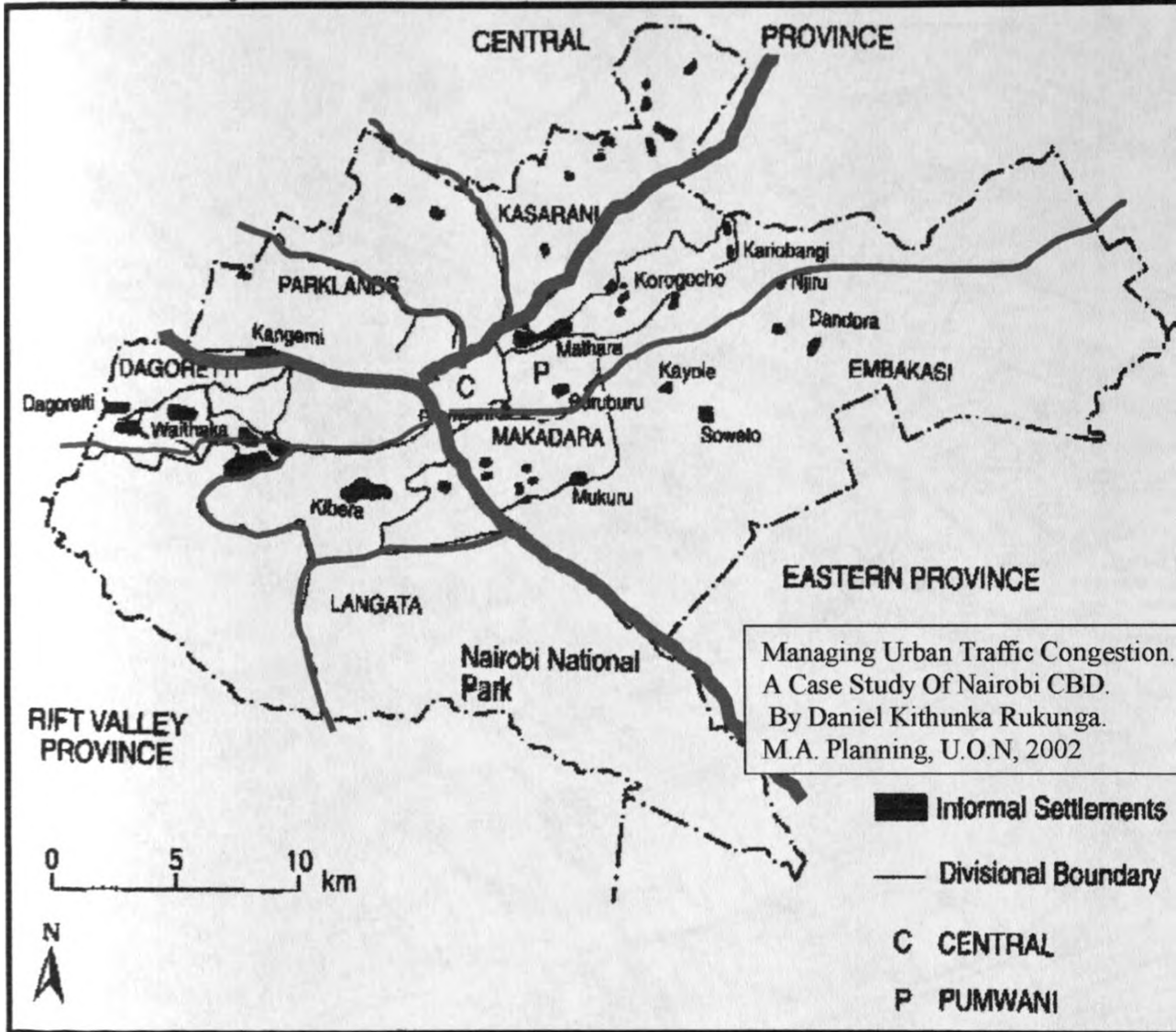
4.3.1.1.1 Urban arterial streets in Nairobi

They conduct the traffic from one zone of the city to another one. They have names in Nairobi CBD and a few examples include; Haile Selassie avenue, Moi avenue, Kenyatta Avenue, Tom Mboya street, and river road. They conduct the traffic to the urban highways, the other parts of the CBD and the outer zones of the city. They are generally wide and long and some are bordered by planted areas with a separation median strip column. They are roads for all kind of traffic carriers like lorries, cars, trucks and trailers. They appear like mini highways.

4.3.1.1.2 Urban highways in Nairobi

In Nairobi CBD, the only urban highway is the Uhuru highway. It is a high-speed highway, which should not have any level junctions with any other road. Roundabouts, with acceleration and deceleration lanes, characterize its junctions. Pedestrian crossings are poorly placed on Zebra crossings instead of under ground tunnels, and overhead flyovers. It carries large volumes of traffic per day, destined across the CBD, out of the CBD or into the CBD. It is a road for all types of traffic and vehicles including trailers, cars, buses, mini buses, sometimes with cyclists on bicycles, hand carts and animal drawn carts sluggishly dragging themselves along, causing a huge traffic jam behind them

Map 4-2 Major road networks in Nairobi area



Source; Transurb consult, 1989

4.3.1.2 Other planned roads in Nairobi

There are other planned roads but which have not yet been developed. These include the Northern extension of St. Austin's road to join the Limuru – Roslyn road. The trans African highway, which is to join Waiyaki way via Kikuyu in the north and Mombasa road to the south. The Eastern by pass, which is to connect Mombasa road near the airport and Thika road at Kasarani.

Map 4-3 The selected roads for this study



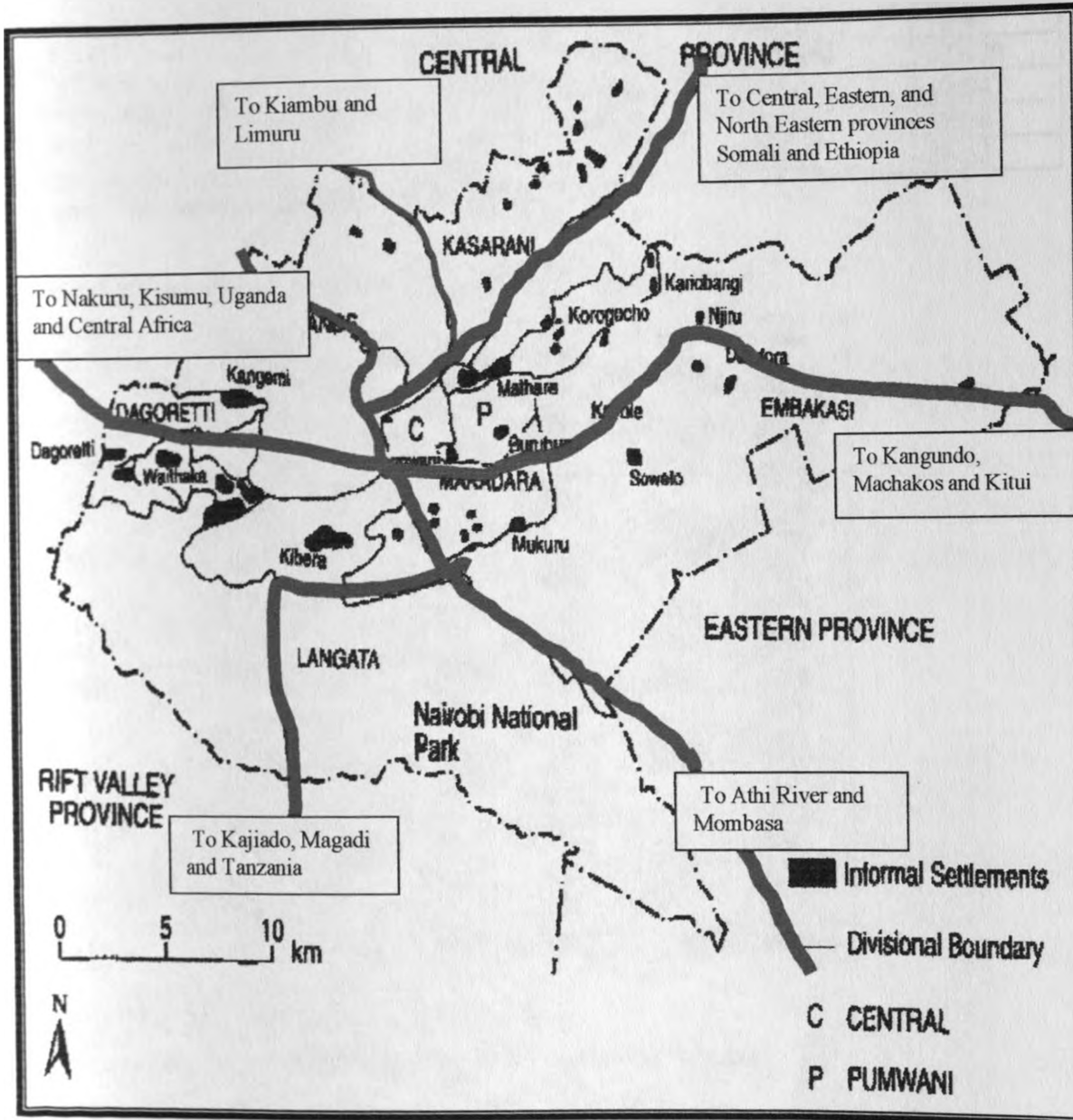
Source; Authors selection based on the major roads of the CBD (Survey of Kenya)

The road is a Dual highway. Has a wide separation with mature shrubs between Moi Avenue and Uhuru highway has two roundabouts.

4.3.1.3 Buses and matatu routes

Kenya Bus Services has the monopoly in commuter services in the city centre and the suburbs of Athi River. Kikuyu, Kiserian, and Wangige etc. The buses cover all the routes and start their

Map 4 — Regional connection roads to Nairobi



Source; Authors analyses based on Survey of Kenya

4.3.2 Vehicles operation in Nairobi

The vehicles operation in Nairobi CBD include the buses, matatus, cars, Tuktuk, motorbike, bicycles, people on foot and people drawn carts. The Kenya Bus Services, the cooperative bus and metro shuttle bus provide organised intracity transport. The handcarts and the open Truck provide the cargo and passenger transportation in Nairobi.

Table 4-8 Vehicles with current licences in Nairobi

Year	1992	1993	1994	1995
Motor cars	165136	171506	171569	172770
Common panel vans	97631	100141	100178	100947
Common trucks and heavy vans	31652	32402	32413	32570
Buses and minibuses	28855	29669	29681	29753

Source: The registrar of motor vehicles 1999

Table 4-9 Population of motor vehicles in major towns in Kenya

Town/year	2000	1996	1997	1998	1999
Nairobi	354478	266754	286542	313801	331275
Mombasa	75054	67684	59094	67359	74660
Nakuru	13447	9555	11905	11381	12558
Kenya	7766	7565	5866	7061	7861
Isiolo	1980	1114	1854	1625	1740
Thika	1772	1552	1509	141486	1730
Embu	1720	875	1552	1579	1483
Moyi	2136	2030	1682	1904	2175
Machakos	4169	2747	3537	3761	3807
Eldoret	2398	1433	2157	2044	2274
Kisumu	1303	1035	1121	1161	1236
Kaji	2762	1871	2415	2401	2521
Karicho	4430	3105	3838	3854	4103
Kakamega	6932	4100	6211	6037	6229
Garissa	1042	676	905	882	988
Voi	260	239	258	232	247
Nyuhurusu	203	222	189	185	173
Total	481852	372557	390635	566753	455060

Source: The registrar of motor vehicles 1999

Table 4-10 Licences issued for freight and passenger service vehicles

VEHICLE/YEAR	1994	1995	1996	1997	1998
PSV Minibus	20170	22120	24470	21662	24334
PSV Four Wheel	2399	2185	2042	1996	1952
FTV	8414	7752	6517	9301	7157
Total	30983	32757	33029	32689	33443

Source: The registrar of motor vehicles 1999

Table 4- 11 Number of psv matatus in Nairobi

1994	9294
1995	9827
1996	9908
1997	9806
1998	10032
Total vehicle population	531000

Source; The Registrar of Motor Vehicles 1999

4.3.2.1 Traffic composition in Nairobi CBD

The motor vehicles fleet in Nairobi is estimated to be growing at the rate of 3680 new registered vehicle per year (Mairura 1994). The motor vehicle fleets was estimated at 138,629 in 1987 and 157,000 in 1993. The pedal population continues to fall. In 1980, there were 8,000 bicycles licensed in the city, and this fleet hand shrunk to 3200 in 1988. The cars and the light goods vehicles commanded 78% and 3.4% respectively. Of all the registered, vehicles in Kenya 60% operate in Nairobi.

Plate 4- 1 Traffic composition in Nairobi CBD



Source; field survey 2002

4.3.2.2 Intra city transport vehicles in Nairobi

Intracity transport in Nairobi includes the public transport vehicles, the private transport vehicles, the utility transport vehicles and the non-motorised transport vehicles.

4.3.2.2.1 Public transports in the CBD of Nairobi

The public transport service in Nairobi commands 85% of the daily transport trips made by the Nairobi residents. Public transportation as a service is offered by the matatu, the KBS, the cooperative bus, several individual buses, the taxi and the Nmt service.

4.3.2.2.1.1 Kenya Bus Service

Most of the public transportation in Nairobi is provided by the Kenya Bus Services. This operates a big percentage of all the transport services with the city limits and to a lesser extent to the neighbouring districts. By 1994, the Kenya Bus Service had increased their fleet to 301 buses, but at one given time, there were 270 Kenya Bus Service buses on the Nairobi city roads (Ndegea, 1996). The Kenya Bus Service has so far increased their buses to over 340 and is operating both the intra-traffic services within Nairobi and up-country bus services as well as the metro shuttle serving the high-income residential area. The Kenya Bus Service and the cooperative buses in Nairobi operate on a fixed route. The Kenya Bus Service, in the CBD operates on a fixed schedule, fixed route and a fixed fare. The transport fare structure used by the Kenya Bus Service in Nairobi has been generally accepted as the yardstick and increases with distance. Recently the Kenya Bus Service have introduced a shuttle bus known as the metro shuttle to compete with the matatu on the routes serving the high-income areas like the Lavington and Kileleshwa areas. These modes operate a big percentage of all the transport services and are the dominant modes of transport within the city limits and to a lesser extent to the neighbouring district like Kiambu, Thika, Kajiado and Machakos.

4.3.2.2.1.2 Country bus services

Country Bus services (CBS) operate to and from areas outside the city and to a greater extent from far off provinces like Northeastern, Central, Coast, Western, Eastern, Nyanza and Rift Valley. The country bus services operate beyond the city limits, and have a variety of different operators. They essentially follow an approximately similar fare structure like that of the Kenya Bus Service. In the morning, there is a bus traffic peak from 7 –9 a.m. This is followed by low ebb, which lasts the whole of the middle day until 4 –6 p.m. when another peak period is

experienced. About 35% of country buses, which operate, into Nairobi CBD from 7 – 9 a.m. are short distance commuters, going for about 40 Km from the city centre.

4.3.2.2.1.3 The matatus

The matatus operated on the same route with the Kenya Bus Service. To-date the matatus is the workhorse of mass transits in Nairobi CBD and generally the republic of Kenya. The matatus have no fixed schedule, no fixed routes and no fixed fares. For the fixed route operations a flat fare of Kshs 10/= within the city centre is charged, while outside the city centre, fares increase with distance.

4.3.2.2.1.4 The taxi

The taxi is also a mode available to the public for transport but in Nairobi it is seen as a mode of travel for the rich people who do not have private cars. Taxicabs operate within the boundaries of the city, but to a lesser extent to the neighbouring districts. All these vehicles cause a lot of traffic jam in the Nairobi CBD especially during the peak hours. The vehicles operating in the Nairobi CBD ferry passengers from various residential estates like Kangemi, Dagorretti, Kawangware, Kibera, Embakasi, and Donholm etc to the Nairobi CBD.

4.3.2.2.2 Private transport in the CBD of Nairobi

4.3.2.2.2.1 Private car

Private motorised transport in Nairobi includes the motorcycle and the car. The private car operates only as a means of transport to the car owner. The use of the private car is a respected way of travel and transportation in Nairobi especially among those who can afford the private car. The Private cars and the motorcycles are also owned in various capacities (individual owners, company car, school bus, employers transport, government cars), for efficient and convenient transportation by their owners.

4.3.2.2.2.2 Utility Vehicles

Most of the government ministries have their headquarters located in the Nairobi CBD and all have fleets of private modes of transport, which can be seen trapped in the traffic jam on daily bases. Several tour companies operate from the CBD of Nairobi with formidable fleets of tour vehicles, which are a common site in the traffic jam in the CBD in the city centre. The Nairobi city council owns all types of vehicles ranging from ambulances, fire engines and small cars. All the se are seen caught in the traffic jam in the CBD of Nairobi on a daily basis. The police

department also has several car and trucks, which are normally seen, caught in the traffic jam on a daily basis. Several long distance transportation trucks and oil transportation companies have their lorries and trucks daily seen in the traffic congestion in the CBD of Nairobi, especially along the Uhuru highway.

4.3.2.2.3 Non- motorised transport vehicles in Nairobi

In Nairobi CBD, the handcart and the bicycle and the wheelbarrow and the wheelchair as well as the walking mode are a necessary menace in the CBD of Nairobi. They all move very slowly in the CBD streets, and have no roads and no terminal facilities for themselves and have to share the carriage way with the motorise transport, causing a huge and ugly traffic jam behind them. These are operated by the lower low-income earners in the society and are generally very poorly maintained and normally overloaded with fruits and vegetable bag for distribution in the CBD's various outlets. This is a section of transportation, which Nairobi cannot do without but it was not planned for in the transport system. The bicycle, the handcart and walking are vehicles and individuals who move at terribly slow speed in the urban highways and are an eye sore site to other vehicle drivers especially on the Uhuru highway where they cause traffic congestion running for several metres if not several kilometres. The bicycle and the handcarts are not provided for in the transport system in Nairobi despite they fact that they handle a significant percentage in transportation. The public and the private modes need to be combined and located as close as possible to one another for convenience. When not properly managed these modes cause dense traffic congestion because they do not move at the same speed on the travel ways.

4.3.2.3 Inter-regional and long distance transport

Long distance buses from the Central, Rift Valley, Western and Nyanza provinces as well as those from Uganda enter the city via Uhuru high way and the university way. Those from southern Machakos district, the coast province and Tanzania use Uhuru highway. Murang'a road is principally used as a major access from Central Province, Eastern and Northeastern Provinces. The matatu from the major towns of Nyeri, Nanyuki, Isiolo, Meru Embu and Kirinyaga District. In this category are the trans African trucks and articulated trailers, which normally pass along the Uhuru high way to the great lakes region and to the northern and the Northeastern Kenya. These vehicles cause formidable traffic jam when they pass via the city centre during the peak hours. They operate every morning and evening to and from Thika, Kiambu town, Ngong, Athi river, Kikuyu, Limuru and Gikambura. The area covered by these

centres can be considered as the larger metropolitan region of Nairobi, which serves as the dormitory suburban area of the city. The majority of the users of these buses are the city workers who prefer to commute to their homes rather than rent accommodation in the city.

4.3.3 Terminal facilities in Nairobi

The main bus stop facilities in Nairobi include the Kencom lay bay and the ambassador lay bay as the main bus stops. Other bus stops are the Teleposta house bus stop, the I C E A bus stop and the St. Peter Clavers bus stop. These are mostly used by the KBS for their CBD passengers' services. In addition, the KBS use the Hakati bus station as their terminus point. The matatus mostly uses the bus stops at the tom Mboya street post office, the commercial bus stop, the Ronald Ngara post office bus stop, the Haile Selassie post office bus stop, and the OTC bus stop. In addition, the matatus on route 108, 106, 118, and 119 uses the old nation house traffic island for their terminus. The matatus on route 111, 125, 33, 40, 42 and 8 uses the railways station as their terminus. The matatus on route 17b, 19, 60, 131, 2, and 39 uses the Hakati bus station for their terminus. Other matatu terminuses can be found on unplanned road junctions and back street allies.

4.3.3.1 Conditions of terminal facilities

All the terminal facilities in Nairobi are in bad condition. The basically planned bus terminus is the Hakati bus station, but unfortunately it's the most poorly maintained. The condition here portrays a very bad image of the city, because the terminal is also an illegal dumping site. The surface is not tarmac, and it's a dusty ground during the dry spell. During the rainy season this terminal becomes a site of logged water in the potholes. The terminal is normally a major source of traffic congestion due to the snail speed movement to avoid the potholes. The old nation house terminus has a tarmac surface, but it's a very small station with a very low capacity. The terminus is a major traffic congestion point, and it grossly affects the traffic flow on Tom Mboya Street, river road and Murang'a road. The railway terminus is just a parking space for train travellers being used as a matatu terminal point. Lack of planning is openly seen here as the matatus like operating on the drive way leading out of the terminus and they really hate waiting for the passengers on the parking points because they feel that the passengers can easily mistake them for escorting train travellers and refuse to board them. The country bus station is a station, which has been totally neglected. It's in a bad surface condition, and its used as an illegal dumping site. The terminal capacity has been greatly reduced by illegal shops and

hawking activities which have taken over the parking points. The station is a major traffic congestion generation point, clogging the Landhies road, Pumwani road, and Outering road.

4.3.3.2. Buses and matatu stations in the CBD

The bus stations in the Nairobi CBD include the Old Nation House matatu station, the Railways Matatu station, the Nairobi Country Bus Station, Kenya Bus Service station, and the Hakati Bus station next to the Kenya Bus Service station, which is normally used by Matatus. Most of the big transportation bus companies in Nairobi operate from informal bus stations along the road reserves and are a major cause of traffic congestion on the streets from which they operate. The Akamba Bus Company, Gold line and the Coast Bus Services operate from designated public roads and public parking space. The Matatus operate from other various designated and undesignated terminals. Other matatu informal termini include the Accra road, Latema road, and Ronald Ngala Street and Gill house.

4.3.3.3 Lay bays in the CBD

The major lay bays in the CBD of Nairobi include the Kencom and ambassador bus stops. Sometimes they are urban traffic congestion generation points especially when one vehicle overstays in the lay bay. They are pollution points as vehicles have running engines (idling) while waiting to enter the parking spaces. For the intra city buses, the Kencom and Ambassador bus stops are operation for the west bound and eastern bound buses respectively. The smaller lay bays are the biggest causes of urban traffic congestion in the Nairobi CBD especially during the peak hours in the morning and the evenings on the working days. The lay bays with the highest urban congestion in the CBD of the city of Nairobi are on Tom Mboya Street like posta and commercial stop points. Other normally congested lay bays are on Ronald Ngala Street, like ssd stage and Koinange stage. The St. Peter clavers lay bay on racecourse road is perennially congested.

4.3.3.4 On street parking facilities in the CBD

On street parking facilities are located next to Accra road, Latema road, Tom Mboya Street, upper Moi Avenue, middle Kenyatta Avenue, and middle Haile Selassie Avenue. Most matatu parking areas are improvised inside small streets, roadsides, on main highways, the petrol station etc. This signifies the seriousness of the lack of parking space for these operators in the city centre. Designated parking areas are 10 points reserved for Buses and 12 parking points

reserved for use by Matatus in the CBD. Legally located off street parking points are 1 Parking point along Harambee Avenue, and 7 Parking points in private car parks. There is a parking problem, which increases considerably in the CBD. In the CBD 42% of the parking space is on street. 25% of the parking space is within private developments 16% is off street private car parks and 17% is unofficial sites like vacant sites, traffic Islands and pavements. On both off and on street parking, 40% of the cars are parked on long-term parking. There is a clear need for a comprehensive parking policy.

4.3.3.4 Off street parking facilities

Most of the off street parking facilities are privately owned by major developers or by institutions for long time parking by their staff or short time parking by their customers. Within the CBD, the Nairobi city council owns only one sunken off street parking facility near the Kenya re house. The city council charges a fee of Kshs 70 for a day's parking as long as the motorist retains the parking ticket and can also park anywhere in the CBD using the same ticket. There are several other off- street parking facilities owned privately but are open to the public at exorbitant charges of Kshs 80 per parking event and their parking ticket is not recognised for council parking or change of parking. These include the Koinange parking near Kencom house, the NSSF parking opposite Nyayo house, the Hosea parking between Nyayo house and inter-continental hotel and the Maendeleo parking near Utalii house. The private off street parking facilities are favoured due to their high security and reliable characteristics as opposed to the normally insecure city council parking lots.

4.4 Land uses in the CBD of Nairobi

The land use in the CBD of Nairobi is highly dandified with 500 times plot coverage. These densifications are normally not catered for in the traffic demand side, yet they are a big traffic generation and attraction points. The CBD land use is mostly commercial, civic, transportation, religious, education, light industrial, recreation and social cultural activities.

4.4.1 Clustered land use

The hotels, schools, university, cinemas, bus stations and the civic facilities and other government facilities as well as religious facilities are clustered within walking distance within the CBD of Nairobi. This type of clustering discourages the act of driving in the CBD of Nairobi.

4.4.2 Centralised services

The civic, parliamentary and government services are centralised and in the CBD with very minimum decentralisation in Kariobangi and Adams arcade for the city council bills payments. The specialised service like medical consultancy, legal services, high court services and university education are all available in the CBD. The electrical and mechanical spare parts can only be available from the CBD.

4.4.3 Upcoming CBD and decentralised services

There are several upcoming business centres around the CBD of Nairobi. The centres cushion the CBD from immerse traffic congestion because they can offer some of the services which were only available in the CBD, costing dense traffic congestion to the CBD of Nairobi. These centres include the hill are, community, Kenyatta market, Adams arcade, Hurlingham, Westland, Parklands, Ngara, Kariokor, Eastleigh, south b and Nairobi west.

4.5 Causes of urban traffic congestion in the CBD of Nairobi

Traffic congestion in the CBD of Nairobi is caused by several factors, which cannot be resolved by one strategy to reduce the traffic congestion.

4.5.1 Transport system

Poor roads system with obsolete junction systems, inadequate terminal facilities, Obsolete transport system inadequate and out dated transportation system e.g. the obsolete junctions especially those characterising Moi avenue and Ronald Ngala street, Moi avenue and Kenyatta avenue and Moi avenue and mama Ngina street, and poorly planned outdated transport facilities e.g. the width of tom Mboya street is too narrow for the present day traffic using it. However, the added terminals were never re-oriented to serve as public transport terminus facilities because they lacked the basic passengers shades and shelters. The terminal facilities are grossly inadequate. The transportation sector in Kenya, like all other infrastructure services are undergoing decay. The terminuses occur haphazardly without any reference or link to other transport components, the terminuses are also insecure, polluted and have now become 'special' points as origins of urban traffic problems in the city.

4.5.2 Mechanical problems

Mechanical problems Un roadworthy vehicles, exorbitant breakdown charges and very old cars on the roads. It is a common sight especially with the Kenya Bus Service and the private cars.

4.5.3 Types of vehicles

The types of the vehicles operated in the CBD like the long articulated trailers on the Uhuru highway, the men drawn handcarts and the men propelled bicycles all move very slowly and causes broken down vehicles, un roadworthy vehicles.

4.5.4 Centralised services

The causes of urban traffic congestion in Nairobi includes CBD centralised services, e.g. the city council bills payments, Kenya power and lighting company power bills payments, telephone bills payments and the parliamentary services are only available in the CBD of Nairobi

4.5.5 Human behaviour, habits and attitudes

Bad habits of Nairobi drivers, pedestrian indiscipline, the traffic police attitudes, incompetent city council traffic wardens, the operators' behaviours e.g. the matatu operators passengers picking and dropping the passengers in the middle of the road attitudes. The matatu terminals and points at which they drop and pick passengers are not designated for such activities. Pedestrian carelessness, Inquest into the condition of the drivers revealed that 30 % of the drivers accepted to be drunk while driving, over speeding was clearly revealed to be a source of pride for the drivers, and especially matatu drivers, and overloading which came out as unconscious activity to some of the drivers especially, the chrome overloading which means placing one more extra passenger in the drivers carbine.

4.5.5.1 Cartels

The terminals are manned by 'cartels' and sometimes in cahoots with the traffic and city administrators. Matatu routes associations were formed by old transport veterans and based on the routes they operate they began to police themselves by setting up passengers queuing system and managing the terminals. It has become a common phenomenon where the terminuses are manned by use of excessive force by the employees of the cartels. It is now a common feature to see men wielding clubs and whips as they keep surveillance of a matatu terminus in a desperate effort to effectively manage the urban traffic congestion in the CBD of Nairobi, but only with an interest to guard the routes they manage. Personal observation and media reports of fracas and

physical confrontation at the matatu terminuses are a common feature in Nairobi. These confrontations have at times resulted in loss of life, serious injuries and destruction of property as the matatu warring groups wrestle in an effort to control and manage the terminus e.g. the mungiki and Kamjeshi organised cartels.

4.5.5.2 Matatu crew behaviour

Every evening the streets of Nairobi swarm with tired commuters beginning long journeys home in Kenya's notoriously accident-prone "matatu" minibuses. The multi-coloured matatus face a growing struggle to make ends meet in the Nairobi streets. Nairobi's matatu crews are legendary for their dangerous driving. Intense competition for passengers and hours behind the wheel without sleep takes its toll on drivers. Getting drunk before driving is normal. Others insist that it's not the norm. A new Nissans cost 600,000 Kenyan shillings (\$7,600) to replace. Shoddy maintenance, bad roads, and paralytic drivers all play their part, but speed is driven by money. The quicker you can get back to town, the quicker you can fill up and start earning again. In the mercenary matatu world, crews often approach minibus owners and Offer to work for a lower price than the existing driver and take over their business. This sometimes leads to terrifying duels on the roads as tempers boil over. Crews are required to present and update certificates of good conduct at Nairobi police headquarters, drivers say, but this is not always adhered to. The matatu business may be tough, but every driver and tout has the same dream: to one day own a Nissan and hire young men like themselves to run it.

Touts hang out of the doors shouting for passengers as the vehicles Career haphazardly through city streets, many glowing with fluorescent lights. Dressed in caps and baggy jeans, the touts whistle, shout and bang on the roofs to attract passengers into the sweltering confines of their Nissans. They hold fares with the notes intertwined between the fingers of one hand, as they hold on tight with the other. It is supposed to be impossible to grab the money from them this way.

Faced with an increasingly desperate battle for customers, matatu drivers are resorting to louder and louder stereos and ever more outrageous slogans to daub on their vehicles. Jobs with more regular businesses are hard to come by, prompting Increasing numbers of young men to turn to the matatu trade, pushing up the number of competitors. In the past matatu crews have gone on strike in despair, bringing Nairobi to an almost complete standstill. On

a normal day, Latema Road in central Nairobi is the place to see The Nairobi matatu marketing circus in action. Nissan Caravan minibuses with names like "Get Recognized," "Quick & Deadly" and "Stone Cold" swerve to a stop outside a notorious 24-hour bar called Friends' Corner. The centre of all activity is a blackboard in the middle of the street, policed by 30-year-old Joseph Muchiri, an expert in matatu marketing techniques for matatu route 48 to Kileleshwa. Dressed in a crisply ironed cream shirt and dark trousers, he is in complete control of a whirlwind of activity around him. As the matatus pull up and disgorge their passengers into the dusty heat, he chalks their registrations up on the board. When they leave, he crosses them off. Minutes later they lurch away, crammed to bursting point with every Section of Nairobi society. They are supposed to hold 18 passengers, but there is always room for one more.

4.5.5.3 Traffic police

Drivers say traffic police often stop decrepit vehicles, before sending Them on their way after the driver pays them "something small," a euphemism for the small bribes. The police always try to extort money from the matatus at makeshift roadblocks.

4.5.5.4 Personnel incompetence

Unlicensed drivers constituted 20% of all the drivers interviewed, inexperienced drivers on the roads i.e. the drivers with less than five years experience and those without a class A driving licence or a psv licence constituted 10 % of all the interviewed drivers. The learning drivers under instructions causes heavy traffic jam more especially when they venture out during the peak hours.

Plate 4-2 Drivers under instructions causes thick traffic congestion during the peak hours



Source; Field Survey 2002

4.5.5.5 Policy inadequacy

The policy inadequacy e.g. the over reliance on the traffic act cap 404.

4.5.5.6 Communication breakdown

Lack of proper coordination and liaison among the traffic managers e.g. the transport licensing board is not really concerned with what the city council does for the road users in Nairobi CBD. Attempts by Transport Licensing Board to control and regulate the operations of the matatus caused squabbles and verbal confrontations between the Government and the matatu operators. This study came across shifting of blames from the traffic police to the Transport Licensing Board to the city council, the city council to the traffic police, the city planners to the city traffic engineer and so forth

4.6 Environmental concerns in the CBD of Nairobi

The Government of Kenya and the Kenyan citizens organisations are becoming increasingly active in improving the city's environment by planting trees, sustaining existing trees and creating water ponds and water fountains e.g. at the Kenyatta avenue/Uhuru highway roundabout and generally rehabilitating roundabouts and other public facilities in the CBD of Nairobi. The environmental concerns include provision of green areas in the city e.g. Central Park, Uhuru Park, Jevan Jee garden, provision of storm drainage channels, maintenance of river circulation systems e.g. canalising of Nairobi river between globe roundabout and the racecourse road

Bridge. There are the paved motorways, and the planted roadsides along Uhuru highway, Kenyatta Avenue and Moi Avenues with rehabilitated and planted median strips with mature trees.

4.7 Kenya Urban Transport Infrastructure Program

Established in 1991 and Started feasibility studies in 1992, and started designs in 1995 and implementations started in 1997. It is a World Bank credit, project with 155m US Dollars. The Kenya government contributes 40m and, US give 115 Dollar, and became effective in 1998. In the year 2003, the credit shall be closed and all the projects will become the projects of the urban development department, Road and Transportation division, in the Transport management unit. The Project manager designs all of the Kenya Urban Transport Infrastructure Program's urban bus parks, township road, supervision and inspect costing of urban transport works Roads maintenance (routine maintenance) is done by the council regularly using funds from Kenya Urban Transport Infrastructure Program. The Nairobi City Council offers the tenders from the Petrol levy fund. Requirements for the funds to be released by Kenya Urban Transport Infrastructure Program include the annual work plan approved by the council and should be in line with the Kenya Urban Transport Infrastructure Program requirements of 30% of the funds should be used by local contracting and Must not use more than 30% of the money on the acquisition of the equipments. And the council must open a separate account for that fund.

CHAPTER 5- SYNTHESIS OF THE STUDY FINDINGS

5.1 The Transport system

The state of the transport infrastructure perhaps epitomises better the collapse of the city of Nairobi. The collapse is seen in the potholes on all major roads e.g. Uhuru highway, Waiyaki way and Thika road. Moonscape- like craters in the industrial area, broken pavements, gaping manholes, monumental traffic jams at peak hours, broken-down sewers, inadequate storm water drainage, non functional traffic signals and broken down street lights. The city transport system displays inadequate capital investment and lack of improvements to the capacity of the road transport infrastructure despite the rapid rate of population growth and increased vehicle population in the city. Encroachment on public facilities mainly the parking lots, which have been illegal allocated for private development e.g. in the Hakati bus Station without regard for the public demand for such spaces. The problems of transportation facing Nairobi include the inadequacies of rail system and the inappropriately located aviation facilities. There are many studies done about Nairobi traffic and transportation but not much has been done to implement the plans.

5.1.1 Route allocation:

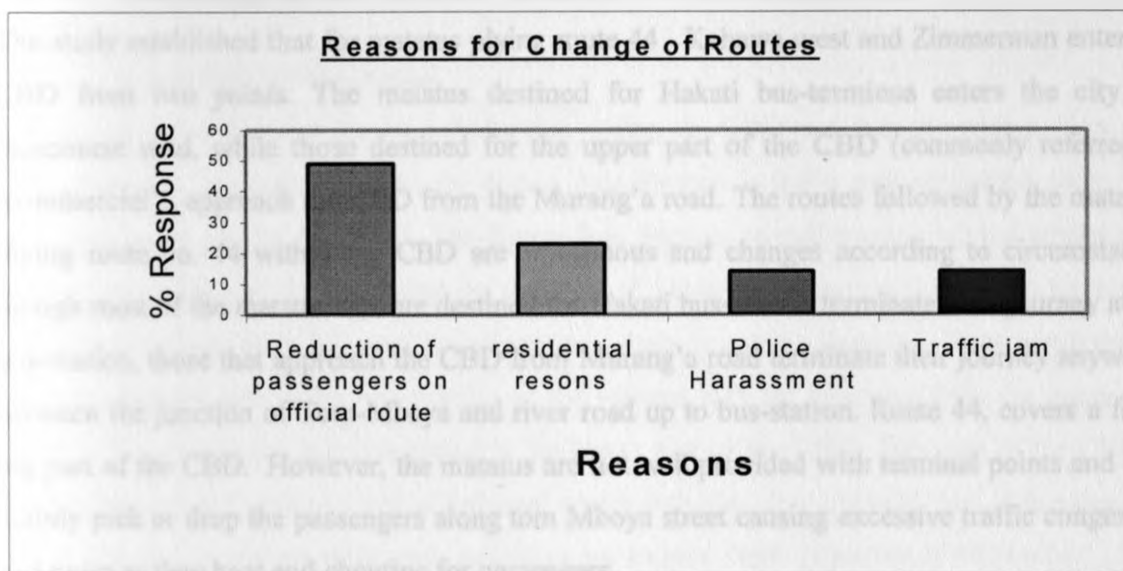
Routing of public transport vehicles is very critical in the efficient operation and management of urban traffic in the CBD of Nairobi. This may involve the determination of vehicles plying particular route and the network flow within the town. As noted earlier there is no particular order on terminal's allocation for different vehicles within the CBD. Apart from the Kenya Bus Service, the traffic police mainly do the flow-network for matatus within the CBD. The routing is mainly concerned with clearing the matatus from some streets of the CBD of Nairobi. Interviews with the operators as to how they joined their current routes of operations cited different reasons. The highest ranked reason why they were on the routes they operated on was exorbitant fees charged by 'cartel' on routes considered more profitable. It is out of the exorbitant fees that 'cartels' keep off other vehicles to avoid competition.

Table 5-1: Reasons for not joining routes of ones choice

Reason for not Joining Other Routes	Number of Respondents	% Response
Exorbitant Fees	21	45
Other Routes not profitable	20	43
Residential Reasons	3	6
No response	3	6
Total	47	100

Source: field survey 2002

Survey also indicated that apart from what the operators considered as their 'official' route often change the route during the day owing to various reasons. It was also established that some matatus that operate from city to up-country also operate within the city as they wait for their turn to get passengers. The major reason cited as to why the operators change routes was reduction on the number of passengers on some routes while others cited residential reasons.

Graph 5-1 Reasons for Change of Routes

Source: field survey 2002

Some routes are more favoured especially those, which do not experience serious traffic jams. Suburbs, which do not have purely residential activities, showed to have fairly good number of passengers throughout the day and more favoured by vehicle who change routes. Among these are satellite points, for instance Westlands, Hurlingham, and Kiambu among others.

5.1.1.1 Matatu routes

Because of the indiscipline of the matatus they are restricted from the upper part of the CBD. They have been restricted to the lower part of the CBD. This part of the CBD is mainly the

home of various types of informal sector activities. A survey of this section of the CBD indicates that it is worse hit by congestion, decaying infrastructure services, noise and other forms of pollution including mountains of rotting garbage.

5.1.1.1.1 Uhuru highway route 105 (Kikuyu) and 115 (Limuru)

The vehicle enters the CBD from the Uhuru Highway-University Way junction, follows Uhuru Highway, and joins Haile-Selassie Avenue up to the Railway terminus. The vehicles move along the line demarcating the CBD. Along this route, there is no designated bus stop or bus bay along Uhuru Highway. However, matatus drop passengers along the highway when the vehicles are stopped by the traffic lights. Sometimes when the traffic lights turn green with the passengers in the process of alighting the matatus causes dangerous traffic congestion in an effort to let the passengers alight safely amid hooting and name calling by other motorists and other road users.

5.1.1.1.2 Tom Mboya Street route 44 - Kahawa West and Zimmerman

The study established that for matatus plying route 44 - Kahawa west and Zimmerman enter the CBD from two points. The matatus destined for Hakati bus-terminus enters the city via racecourse road, while those destined for the upper part of the CBD (commonly referred as 'commercial'), approach the CBD from the Murang'a road. The routes followed by the matatus-plying route no. 44 within the CBD are amorphous and changes according to circumstances though most of the matatus that are destined for Hakati bus-station terminate their journey at the bus-station, those that approach the CBD from Murang'a road terminate their journey anywhere between the junction of Tom-Mboya and river road up to bus-station. Route 44, covers a fairly big part of the CBD. However, the matatus are not well provided with terminal points and they mainly pick or drop the passengers along tom Mboya street causing excessive traffic congestion and noise as they hoot and shouting for passengers.

5.1.1.1.3 Tom Mboya Street and Luthuli Avenue route 6/9 - Eastleigh

Vehicles number 9 enters the CBD from Murang'a road roundabout and joins Tom Mboya Street. They move down to Luthuli Avenue and connect to river road before joining Ronald Ngala Street and exit the CBD from racecourse road. Vehicles on route no. 6 enter the CBD from racecourse road then join Ronald Ngala road and follow Tom Mboya Street and exit the CBD from Murang'a road-roundabout. The two groups serve the same area and enter or exit the CBD at alternate points. The matatus have a better network within the CBD but they do not have a designated terminus. They stop along Tom-Mboya Street as they pick and drop passengers

mostly at road junctions causing big traffic congestion. Commuters working at the extreme part of the CBD will also walk long distances to and from the 'terminals'. Interviews with passengers using route 6 and 9 however showed that they do not consider long distances from the terminus to their work places as one of the most serious problem they encounter

5.1.1.1.4 Murang'a Road: Route 106- Banana/Karuri

The vehicles enter the CBD from Murang'a Road and join Tom Mboya Street and terminate at the off-street car park at the traffic island on the junction of Tom Mboya Street and River-Road (Old Nation round about). The vehicles take the same route out of the CBD. This indicates they cover a fairly small section of the CBD and consequently passengers walk long journeys to their final destinations. However a positive factor concerning the terminus location is that the vehicles leave the CBD almost immediately as they enter. This reduces congestion and delays due to traffic jams at the expense of long pedestrian walking.

5.1.1.2 Kenya Bus Service routes

Comparing the routing for Kenya Bus Service within the CBD and that of matatus, there is a great disparity. The route network for Kenya Bus Service is fairly well connected since they cover the better part of the CBD. The Kenya Bus Service normal routing is well designed to connect points within the CBD, and the suburbs of Nairobi. Comparing the routing for Kenya Bus Service within the CBD and that of matatus, there is a great disparity. There has been the argument that because of the indiscipline of the matatus they are restricted from the upper part of the CBD. They have been restricted to the lower part of the CBD. This part of the CBD is mainly the home of various types of informal sector activities. It is probably out of this that it is not an eye sore to anyone when such activities are located there. A survey of this section of the CBD indicates that it is worse hit by congestion, decaying infrastructure services, noise and other forms of pollution including mountains of rotting garbage.

5.1.2 Operations of the vehicles

5.1.2.1 Matatu

The matatus have no fixed timetable on their operations. They are usually flexible but at times they are notorious in that they drop passengers even before they reach the final destination in a bid to make more trips, competition or traffic jams. However, matatus drop passengers along the highway when the vehicles are stopped by the traffic lights. Sometimes when the traffic lights

turn green with the passengers in the process of alighting the matatus causes dangerous traffic congestion in an effort to let the passengers alight safely amid hooting and name calling by other motorists and other road users. Due to the lack of such a facility this causes confusion and traffic mix during the picking and dropping of passengers at this point. The matatu operators on the other hand expect to pick the passengers they dropped in the morning at this same point in the evening. This encourages the matatu to pick passengers at this point and since there is no bus stop or lay-by, the matatus stop on the traffic lane causing obstructions and traffic congestion. This calls for traffic police intervention, which the matatu operators view as harassment.

What was noted was that many matatus do not wait for passenger especially in the morning when the traffic generated from the CBD is much lower than the traffic generated from the residential estates. This coupled with panic of the travelling public gives the matatu operators an opportunity to increase the fares unfairly and sometimes the touts turn to be pick- pockets against the travellers. These are the touts who mainly harass passengers and demand money from the vehicle owners. Some of the touts are hired by the 'cartels' to keep-off operators who have not paid the route entrant fees to the 'cartels'.

5.1.2.2 Buses

Though Kenya Bus Service is believed to operate on fixed timetable, this is not the case since at the time of the study, at certain times some 20 to 30 buses some belonging to the Kenya Bus Service and others belonging to the cooperative bus would be seen queuing waiting to enter the lay bay and pick the passengers while creating a long line of traffic jam on Moi avenue because there is no bus lane approaching this bus stop. However, the problem with the matatus is that they pick their passengers while on the city hall way traffic lanes since they are not allowed to enter the lay-by. This therefore causes obstruction and unexpected traffic congestion along City Hall Way. However, observations showed that even the Kenya Bus Service at certain times pick or drop passengers at points not designated as terminals. In the case of Kenya Bus Service, they do not stop but in case stopped by the traffic lights passengers scramble and some would be seen hanging dangerously on the door in an effort to board their Kenya Bus Service number 23 home in the evening. The St. Peter Clavers' bus stop is perennially congested because of the Kisii buses uses the road confluence as their long distance trip starting and finishing points despite the fact that there are no facilities for such activities to take place at this point.

5.1.2.3 Handcart pushers operations in Nairobi

It is usual to witness an unusual sight in Nairobi: a long line of vehicles led by three or more packed buses crawling uphill behind a mkokoteni (handcart) loaded with sacks of fruits and vegetables. The mkokoteni are normally pushed and pulled up the hill by three men drenched in sweat - two pushing at the back and one pulling from the front, his eyes firmly focussed on the ground. The three seem oblivious of the fact that there are probably more than a hundred Nairobians behind them whose journey they have reduced to a snail's speed. When Joseph Kaguthi was the Provincial Commissioner for Nairobi, he tried to resolve the city's mkokoteni problem to no avail. A practical man to the core, Mr Kaguthi was flabbergasted that a trailer possibly carrying over \$1 million worth of economically significant goods could find itself stuck behind a mkokoteni. This regular battle of horsepower versus manpower on the streets of Nairobi is one of the odder aspects of our city normally causing irrelevant traffic congestion. Nairobians, and Kenyans in general, are among the most aggressive drivers in the world. Driving is a competitive activity that sees most drivers; especially matatu drivers behave as if it is the greatest humiliation to have another vehicle overtake you. This is all combined with an inordinate faith in the effectiveness and life-saving potentialities of car brakes to make for among the planet's most dangerous roads. The drivers don't like anybody hooting at them even if they have double-parked; and, at certain times of the night, they display confrontational indescribable behaviour when other drivers stop in front of them at a red light. While a Nairobi driver can splash water on a pedestrian without a second thought, double-parking at will, do wilful 'u'-turns, drive on kerbs, force cyclists off the road and hurl abuses at fellow drivers. All these change when matatu and others drivers are faced with a mkokoteni pusher and their attitude seems to soften. Indeed Kenyan drivers display surprising patience with regard to mkokotenis. They don't hoot at them as often and they'll crawl along in a traffic jam created by a single mkokoteni pusher. The typical mkokoteni is a handcart aspiring to be a car. While made mostly of wood, it has the wheels of a car and sometimes even an old number plate, or registration numbers crudely painted on. The men who push mkokotenis are usually down-and-out looking fellows struggling to make a living. Their ragtag appearance makes some drivers think that these fellows must be a little crazy. This might explain why even aggressive drivers don't often pick a fight with mkokoteni pushers - one cannot be sure how the confrontation will end. To survive on our roads successfully, mkokoteni pushers adopt an attitude that is more belligerent than even that of the most aggressive drivers, matatu drivers included. The sight of a

handcart slowing down traffic in a city like Nairobi and Nairobians resisting the temptation to display their frustration fascinates any researcher and visitors alike. The way the traffic managers treat mkokotenis makes one ponder about those little contradictions that sometimes complicate national development in a myriad small ways. The mkokoteni shares the road with vehicles in a manner similar to the way in which urbanites often find themselves sharing their homes, salaries, clothes and food with rural relatives. Then, of course, there is the inspirational side to the mkokoteni that tickles Kenyans who might be better off. The mkokoteni with its car wheels and "registration plates" can be seen as a statement of the station in life the handcart pusher might aspire to. At the end of the day, the mkokoteni serves a useful public purpose and it's as necessary in Nairobi as any other vehicle. When water rationing hit Nairobi last year, well to do people in the suburbs built tanks and hired trucks to fill them. Others grudgingly became accustomed to the regular chore of fetching water and delivering it home in jerry cans that filled their cars. In the poorer estates, women did the backbreaking work of fetching water. Those slightly better off, however, came to rely heavily on the ubiquitous mkokoteni for their supplies of the precious liquid.

5.1.3 Terminal facilities

5.1.3.1 Distribution and conditions

The location of terminal facilities within the CBD of Nairobi is not well rationalised. This is as far as they relate to vehicle routing and Non-Motorised Transport channels. This can be demonstrated with the flow and destination of vehicle on some randomly selected routes in Nairobi. The routing is tracked from the entry point to the CBD to the terminus and the way out of the CBD: a few terminal facilities have been sampled for this study and have been scrutinised to relate them to the traffic congestion as follows

5.1.3.1.1 Kenya Bus Service and Hakati terminus (Bus Station)

The terminus is commonly referred to as Bus Station or shortened to 'BS'. The terminus is located off Mfangano Street at the eastern part of the CBD. This can be said to be the only typically planned and developed as a public bus terminal facility (that is Kenya Bus Service section). The Kenya Bus Service section is well paved with 35 parking bays. The terminus has good sheds and a toilet, which is under the care of the Kenya Bus Service management. The flow of buses is well organised. The terminus is used for picking and dropping passengers, change of crew and minor servicing of the buses.

The section where the matatus operate, that is Hakati Parking area just next to the Kenya Bus Service terminus is a total contrast. The section is not paved and has large depressions. During the rainy season the depressions collect storm water and foul water from sewer leakage forming typical dams and cesspools, reducing the available area for the matatu operations. During the dry season, on the other hand the terminus becomes extremely dusty posing serious respiratory disease hazards. A big number of matatus park at the terminus but with no specific order. Matatus operating within Nairobi and those from its environs terminate their journeys at the terminus. This section of the terminus has no sheds, has a public toilet which is poorly maintained, filthy and at the time of the study it was under the control of street urchins who were charging some money per visit. The section is also not well lit and matatus usually shift to Mfangano Street at night due to insecurity. The two approaches to the terminus are in very poor state of repairs and maintenance and vehicles literally wade into and out of the terminus especially during the rainy season causing perennial traffic congestion points. This also causes congestion and spills-over to Mfangano Street which itself is very narrow for the number of matatus and buses using it. During the day, the matatus queue as they wait for passenger with an average waiting time of 20 minutes. During the peak hours, the terminus is characterised of long queues of passengers as they wait for their buses home. The average waiting time at the terminals depend on the particular route, however on average the estimated waiting time at the terminal was 17 minutes. The situation becomes chaotic during the rainy season when passengers scramble as they board their vehicles home. On the side of Kenya Bus Service section various bays are reserved for different destinations while each bus has a number displayed in front.

1.2 The Old Nation House terminus

The terminal is located at the roundabout of River Road and Tom- Mboya Street. This was also an off-street parking bay that was converted to serve as a public bus terminus. The location of the terminal indicates that the matatus operating at this terminal enter the CBD. The flow of the vehicle to the terminal show that the accessibility of the travelling public to other parts of the CBD is mainly by walking. A survey of the terminal indicated that the terminal is well paved but located at a point of traffic confluence. The entry and exit from the terminal cause traffic congestion along River Road and along Tom Mboya Street. The terminal is also not served with any public toilet, lacks sheds while sales services available are mainly those provided by

hawkers. A part from the small size of the terminal it provides a good example of a well-paved terminal where the authorities can control the operations of terminals facilities.

Map 5- 1 The location of the most busy and congested terminal facilities in the CBD



Source; Survey of Kenya 2000

5.1.3.1.3 The Railways matatu terminus

The terminal is located next to the Kenya Railways Headquarters - off Haile Selassie Avenue and at the lower end of Moi Avenue. The site where the terminal is situated was initially an off

street parking bay that was to serve the Railway Station. A survey of the terminus indicated that it is poorly maintained. Since the site was not designed and developed as a public bus terminal facility, there is no order of parking, while the unpaved section becomes muddy and impassable during the rainy season. This causes traffic mix at the terminal and more conflict occur at the Haile Selassie Avenue/Moi Avenue round-about as the large volume of pedestrians try to cross the roads and as the matatus and other vehicles manoeuvre to make to their destinations this causes a heavy traffic congestion on Haile Selassie and Moi avenue confluence. A survey of the terminal also revealed that, it is not only the matatus that pick or drop passengers at the point. Institutional vehicles like Kenya Bureau of Standards, Jomo Kenyatta Foundation, and Co-operative Bank Staff Buses among others pick their staff at this point. The terminal is poorly served with amenities. The terminal has only one small shed while the available public toilets are poorly maintained and under the control of street urchins who demand Kshs 10 per visit. The terminal is poorly lit and most matatus shift to the CBD at night due to insecurity. The location of the terminus gives a good example of the possibility of creating an interchange. This is because the terminal is located next to the Railway Station. The major problem is the serious traffic mix at the junction due to large volume of pedestrians flow from the Railway Station causing impenetratable traffic jam for the better part of the working day.

5.1.3.1.4 The Nairobi Country Bus station

The country bus station is also known as the Machakos bus station. It is located in the lower part of the Central business district of Nairobi. This section of the Central business district is worse hit by congestion along he Landhies road and Pumwani road decaying infrastructure services and occasionally bust sewage pipes, direct dumping and sewage release into the Nairobi river, noise and other forms of repugnant pollution including mountains of rotting garbage and littered on the streets and the country bus station. The terminus is located between Pumwani road and Landhies road, with the Nairobi River separating Gikomba informal light industries and the country bus station. It is one of the typically planned and developed public bus terminal facilities in the city. The country bus station was originally well paved with 60 parking bays. Presently all the public facilities are in a total disrepair and appalling desperate state of misuse and have crumbled down. Travellers dispersing from the terminal follow different directions. The flow of pedestrians thus causes serious traffic mix and possible occurrence of accidents. The Country bus Station is poorly maintained, poorly lit at night and insecure especially at night.

The operations of the Country bus station are under the control of 'cartels' sometimes that operate in cahoots with individuals in authority. The Nairobi country bus station has a public toilet, which is poorly maintained, filthy and under the control of street urchins who were charging Kshs. 10 per visit. The station is also not well lit especially at night and buses slowly shift to convenient sections of the CBD streets due to insecurity. The two approaches to the terminus are in very poor state of disrepair and maintenance and vehicles literally wade into and out of the terminus especially during the rainy season. The terminal is not only used by the country buses to pick and drop passengers, but also matatus, institutional vehicles like Kenya bureau of standards Jomo Kenyatta foundation, and co-operative bank staff buses among others pick their staff at this point. Institutional vehicles park for longer periods than the country buses and the matatus as they wait for their passengers. Hawkers peddling different types of wares to the operators and the travelling public provide sales services. The terminus is also poorly maintained and is characterised of large water bodies during the rainy season. The country bus station has 60 parking spaces and 3 rows of disused traveller shelters, and has no space provided for NMT parking. The public transport service consumers seek for shelter under building canopies or use umbrellas when it is raining because petty traders have taken the bus shelters. Other activities at the terminus include sales and services mainly provided by hawkers are mobile merchandisers.

5.1.3.1.5 Latema road terminus

The terminus is located along Latema Road and spans almost along the entire section of the Road. This is an off-street parking that was converted to serve as a public bus terminal facility. Matatus operating from this section are mainly those destined for Nairobi and its environs. It was also notable that various matatus that operate on up-country routes operate from this terminus. The terminus does not have any terminal shed but has a public toilet, which is poorly maintained and is under the control of the street men and women. The terminal is not well lit and matatus usually shift to Tom Mboya Street at night due to insecurity. This causes congestion at the junction of Tom Mboya Street and Latema Road due to obstruction. Estimates showed that a matatu can take over 10 minutes out of the terminus a distance of less than 50 metres. It was not possible to establish the number of available parking bays along this street as initially designed due to lack of road markings and the city council of Nairobi could not avail the design brief.

5.1.3.1.6 Accra road terminus

The terminus is located along Accra Road. This terminal on off-street car park that was converted to serve as a public bus terminus. The terminus spans for almost the entire section of Accra Road. Along the road, there is a public toilet, which is in poor state of repairs and maintenance and it is under the control of the street boys and girls whom are more of men and women than boys and girls who were charging Kshs 10 per visit. The toilet itself had inscriptions of the charges. Vehicles using this terminus either approach it from Tom Mboya Street or from River Road. It was also notable that matatu plying up-country routes operate from this terminus. The terminal experiences serious congestion at the Accra Road-Tom Mboya and at the Accra Road-River Road junctions. The congestion at the Accra Road and Tom Mboya junction is compounded by matatus plying route 9, which stop along the traffic lanes as they pick and drop passengers. During the peak hours, long queues of passengers are commonly seen along Accra Road and this causes obstruction to pedestrians. This forces people to use traffic lanes causing serious traffic mix. At the Accra Road and River Road junction, congestion is mainly caused by matatus destined for up-country since they park for long hours before they get the optimum load.

5.1.3.1.7 Kencom bus stop

The bus stop is located along City Hall Way, off Moi Avenue. The bus stop is a typical lay-by with a provision for two buses at any one time. Kenya Bus Service staff controls the bus stop and matatus are not allowed to pick or drop passengers at this point since there are no matatus routed to pass along this length. But it is common to see matatus picking passengers, especially those going to the Kenyatta national hospital at the middle of city hall way. Though Kenya Bus Service is believed to operate on fixed timetable, this is not the case since at the time of the study, at certain times some 20 to 30 buses some belonging to the Kenya Bus Service and others belonging to the cooperative bus would be seen queuing waiting to enter the lay bay and pick the passengers while creating a long line of traffic jam on Moi avenue because there is no bus lane approaching this bus stop. The traffic congestion spill over extends to Moi Avenue and Haile Selassie roundabout causing immerse obstruction and traffic congestion along Moi Avenue and Ronald Ngala Street. This therefore distorts the operating timetable of the buses. Observations revealed that though it seems it is the Kenya Bus Service and the cooperative bus which is

authorised to pick or drop passengers at this point, even the matatus pick passengers at this point especially during off-peak hours.

5.1.3.2 Capacity of the terminal facilities

The size of terminal facilities highly affects their service delivery. The size and capacity of a terminal facility depends on the number of passengers and vehicles expected to operate from such a terminal and the amount of waiting time at the terminal. Attempts were made to measure the amount of space required to accommodate all the public transport buses within the CBD of Nairobi. The study considered the possible number of passengers using a particular terminus, the number of buses operating from a particular terminus. Also considered were bus arrivals, waiting times and departures. Field data estimates showed that on average a matatu waits for 15 minutes at the terminal during the off-peak period. This implies that: 1 matatu berth will take 60 min /15 min = 4 matatus per hour. Thus 6000 matatus require, {6000 matatus /4 matatus per hour}= 1500 berths per hour. Assume 1 berth is 20m² (Konyango, 1991). Area needed to accommodate the matatus; 1500x20 = 30,000m². Assume the berth takes 45% of the total terminal area; then total area required: - (30,000 m²/45%)=66,667m², Say 67,000m². The matatus operations is very amorphous, where some will terminate their journeys at the terminals while others may drop passengers a distance from the terminus may be to avoid traffic jams or in hurry to make return trips. It was also noted that even those that terminate their journeys at the terminals not all would wait for passengers while others immediately change the route of operation.

5.1.3.3 Passenger dispersal from the CBD terminals

Observation on the main Non-Motorised Transport routes followed showed that the pedestrians disperse on different directions from the terminals. On all the sampled terminals, there are no properly defined walking routes for pedestrian dispersal from the terminals. This mainly results in a common problem at all the terminals causing serious traffic mix, which can easily lead to accidents.

5.1.3.4 Management and operations of the terminal facilities

The study assessed the manner in which the terminal facilities are management so as to ease the traffic congestion and to determine the efficiency of the facilities. In Nairobi, there is a gross inadequacy of the terminal points in terms of space and amenities. What now appear, as terminal points are located at any 'available space' where some of the terminal points are located at the

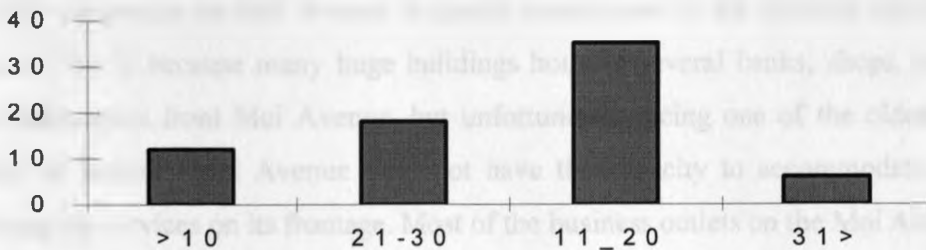
back streets of buildings or between narrow alleys while others occur on traffic lanes or on off-street car parking bays. The study established that various 'terminal' points might exist for vehicles plying the same route. To maintain the control of terminuses, matatus pay some money, either after every load, daily or even monthly.

Table 5-2 Mode of payment for operations of the terminals

Mode of Payment	Number of Respondents	% Response
Per Trip Made	14	30
Daily	27	58
Weekly	2	3
Monthly	4	9
Total	47	100

Source: field survey 2002

Graph 5-2 fee paid per trip to man terminals



Source: field survey 2002

The figure shows that on average the money paid is between Kshs. 100- 240 per day. The survey revealed that on average a matatu would have paid about Kshs 250 per day either to the 'Kamjeshi ' or touts.

Table 5- 3 Fee paid per day

Amount (Kshs)	Number of Respondents	% Response
50 and below	2	5
51-100	8	16
101-200	22	47
200 and above	15	32
Total	47	100

Source: field survey 2002

5.1.3.5 Congestion aspects in the terminal points

The terminal points are a major traffic congestion generation points in the CBD of Nairobi. The moonscape crater ridden terminal station surface grossly hinders movement in the terminal facility and leads to major traffic congestion over spilling to the streets and stretching to the avenues near the terminal facility. The bad behaviour of turning the terminal point into a long-term parking facility, especially by the long distance drivers during the day creates unnecessary tragic congestion origination from the terminal facility

5.2 Traffic congestion situation in the CBD

Traffic congestion situation in the CBD is normally experienced at the several obsolete junctions on Moi avenue, the lay bay points along tom Mboya street, race course road, the Haile Selassie avenue, all the round about and in all the terminal facilities.

5.2.1 Traffic congestion on Moi Avenue

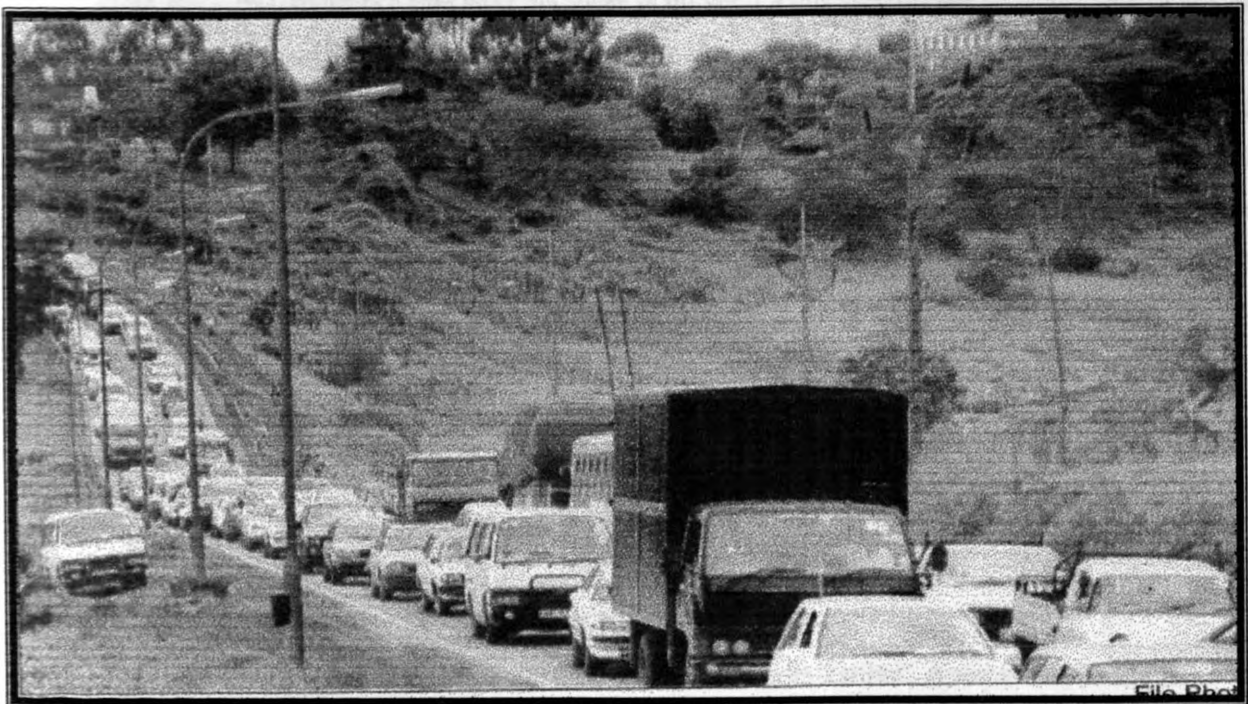
Traffic congestion on Moi Avenue is greatly experienced in the morning and the evening peak hours. This is because many huge buildings housing several banks, shops, and supermarkets and restaurants front Moi Avenue, but unfortunately, being one of the oldest avenues in the CBD of Nairobi, Moi Avenue does not have the capacity to accommodate all the vehicles coming for services on its frontage. Most of the business outlets on the Moi Avenue do not have any parking space for the traffic they attract. The little parking space on the Moi avenue can only be found on the street, and this leads to double and triple parking which dangerously blocks the carriage way. Moi Avenue has some of the worst road junctions in Nairobi e.g. the junction with mama Ngina Street, the junction with Ronald Ngara and the junction with Kenyatta Avenue. These are very busy and out dated traffic confluences, which promotes traffic congestions, especially because the traffic congestion on the points don't work at all. The section of Moi avenue between mama Ngina street and Kenyatta avenue all the way to biashara street is the one experiencing terrible traffic congestion and seriously needs planning intervention to decongest the street.

5.2.2 Traffic Congestion on Haile Selassie Avenue

Jam on Haile Selassie Avenue is caused by the acute lack of an effective bus lane to filter out the buses and other wheeled traffic ending to Mombasa road. In Addition to the lack of a bus lane the traffic lights at the junction of Uhuru highway and the Haile Selassie avenue are perennially out of function. At such a junction the matatu drivers turn out violently to take advantage of any

little available space to squeeze out of the traffic congestion including driving on the pedestrian walk way and the median strip causing more temporary traffic congestion especially when they get to the end of the pedestrian walk way. The junction of Haile Selassie avenue and Moi avenue is characterised by a round about which is major traffic impediment point because is rarely police operated and the traffic lights at this junction are greatly vandalised and ceased to operate a long time ago, say ten years ago.

Plate 5-1 A matatu busts the traffic congestion by driving on the dusty pedestrian walk way



Source; field survey, 2002

5.2.3 Traffic congestion on Kenyatta Avenue

Traffic congestion on the Kenyatta avenue is normally experienced at the ancient junction with Koinange street and aggravated at the 19th century junction with the Kimathi street near Kimathi house. The junction of Moi and Kenyatta avenues is one of the many obsolete junctions in the CBD of Nairobi, which are known by the Nairobi city council traffic engineer as notorious traffic congestion points. However the city council traffic engineer cannot do anything to improve traffic flow on this junction due to lack of funds. The junction of Kenyatta Avenue and Tom Mboya Street is a very bad one, and hardly can a day pass without a traffic accident occurring here. All the junctions between Kenyatta Avenue and other road crossing it are obsolete junctions, which should ideally be made pedestrian only areas.

5.2.4 **Traffic congestion on University Way**

The vehicles enter the CBD at the University Way-Uhuru Highway roundabout. At this point, there is a bus stop. The next stop is the terminus along Latema Road (Odeon) -an off street car park. The map showing the routing followed by the matatus to the CBD terminus indicate that they enter and exit the CBD after covering fairly a big section of the CBD. This implies that some passengers walk long distance to their final destinations within the CBD, while others will board other matatus to access a point within the CBD. It was also noted that as the vehicles enter the CBD, there is a bus stop but there is no such a bus stop on the opposite side of the road on the way out of the CBD. Since some people are always dropped at this point in the morning, the same people expect to pick their vehicles home at this point due to the lack of such a facility this causes confusion and traffic mix during the picking and dropping of passengers at this point. The matatu operators on the other hand expect to pick the passengers they dropped in the morning at this same point in the evening. This encourages the matatu to pick passengers at this point and since there is no bus stop or lay-by, the matatus stop on the traffic lane causing obstructions and traffic congestion. This calls for traffic police intervention, which the matatu operators view as harassment. In the case of Kenya Bus Service, they do not stop but in case stopped by the traffic lights passengers scramble and some would be seen hanging dangerously on the door in an effort to board their Kenya Bus Service number 23 home in the evening.

5.2.6 **Traffic congestion on Ronald Ngara Street**

This street has received most of the traffic overflow from Luthuli Avenue due to the poor state of the latter. Most of the traffic leading to the Eastlands passes through this street as well as most of the urban public transport traffic to the western suburbs. This street is a street with a one-way traffic flow in the lower part and a dual traffic street on the upper part, with an obsolete junction with Moi Avenue, which normally exaggerate the traffic congestion on this street.

5.2.7 **Traffic congestion on Racecourse road**

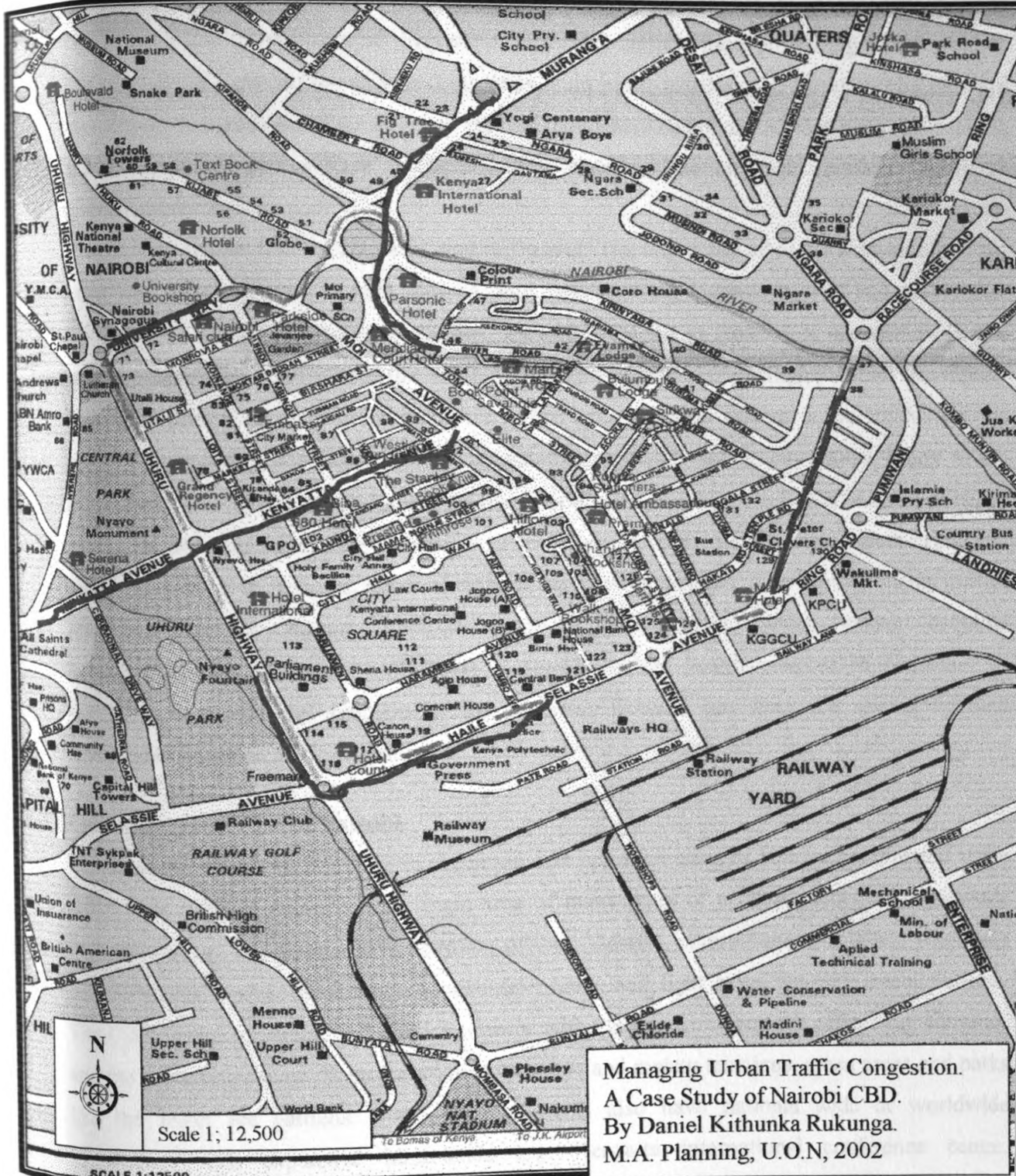
The traffic congestion on the racecourse road is mainly experienced at the peak hour but it is a daylong experience especially at the Koinange total petrol station and the OTC bus stop. This is because the matatus treat these two bus stops as their bus terminal points for the trip start and trip finishing points. The St. Peter Clavers' bus stop is perennially congested because of the Kisii buses uses the road confluence as their long distance trip starting and finishing points despite the fact that there are no facilities for such activities to take place at this point. This street has no

traffic lights either dead or working. This street is a dual carriage street with a one directional drive on the upper part but it still experiences terrible traffic congestion due to poor traffic congestion management.



Map showing the location of the study area in the city of ...

Map 5-2 The most jammed roads sections in the morning and the evening peak hours



Source; Survey of Kenya 2000

5.3 Land use in Nairobi

Nairobi is East Africa's most important commercial, manufacturing, financial, and tourist centre. Since independence, Nairobi has practiced import substitution—that is, the production of goods that formerly had to be imported. Important industries include food processing; motor vehicle assembly; and the production of beer, cigarettes, auto parts, textiles, and clothing. The railways also employ a significant percentage of Nairobi residents. National and multinational banking and insurance companies have headquarters in Nairobi. The city also receives significant revenues from tourism.

Nairobi is a regional hub for air, road, and rail travel. The city is linked to the Kenyan coast, the Lake Victoria and Mount Kenya regions, and neighbouring Uganda by rail and all-weather roads. Jomo Kenyatta International Airport, located southeast of Nairobi, is the nation's largest airport, while Wilson Airport to the south serves charter and private flights within the region. Population growth severely taxed Nairobi's public transportation system in the 1990s, and the proliferation of matatus, has caused traffic congestion, especially in the city centre. Many of the city's streets and highways are regularly in poor condition and subject to floods in times of heavy rainfall. Nairobi has experienced a variety of problems in recent years, ranging from crime and traffic congestion to periodic water shortages and power outages. The rapidly rising rate of infection with the human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS), is a serious public health concern in Nairobi. A significant environmental problem of the past two decades has been the seizing by land developers of land set aside for parks.

5.3.1 Land uses in the CBD of Nairobi

Mostly all the travels taking place in the urban and suburban areas of Nairobi are directed at the CBD. The CBD of Nairobi is the main area of many types of establishments, which include both private e.g., and public administration offices, theatres, entertainment facilities, wholesale establishments, warehouses, hotels, convention halls, and light manufacturing establishments. The CBD is also a cultural and religious centre with various Ambassador's offices e.g. libraries, and the national archives. Transportation routes, bus and matatu terminus, green areas and parks like the Jevan Jee gardens. Some establishments also have national wide or worldwide significance with expansive hinterlands e.g. Kenyatta international conference centre. Parliament. In the CBD also are Schools like, Moi Avenue Primary School, Universities like University of Nairobi, and various other utilities like the Post Offices e.g. and the city markets.

Business offices in the CBD present a dominant function. The CBD of Nairobi is well spatially dotted with integrated urban land uses, which are major traffic attraction and a big source of traffic jam. **Transportation facilities** such as the Terminals for Kenya Bus Services, in the CBD, Matatu Station, next to Kenya Bus Service, Akamba bus terminal Kisii Buses terminal Meru and Embu Matatu terminals etc. **Markets** and produce sale points such as City market also exist in the CBD of the city of Nairobi. **Police Station** and other administration centre posts such as Police Department Head quarters or Harambee Avenue. Kenya Police Headquarters, and various CBD Police Posts. Nairobi is Kenya's principal economic, administrative, and cultural centre and is one of the largest and fastest growing cities in Africa. Manufactures include processed food, textiles, clothing, building materials, and communications and transportation equipment. The city also has a large tourist industry. The University of Nairobi (1956), Kenya Polytechnic (1961), and Kenya Conservatoire of Music (1944) are here. Nairobi National Park, a large wildlife preserve on the outskirts of the city, is a major tourist attraction. Other points of interest include the National Museum of Kenya, known for a display on early humans in Africa; the Parliament buildings; the law courts; City Hall; McMillan Memorial Library; the busy Municipal Market and nearby bazaar and the Kenya National Theatre; Like most modern cities, Nairobi has crowded markets and trading areas, middle class suburbs, and spacious mansions for the rich and powerful. It also has vast overcrowded tenements and slums, exploitation, and high unemployment. Between these two worlds, the city offers big screen film, theatres, restaurants, bookshops, cafes and bars full of tourists from all over the world. Bus stations and train stations are within an easy walk of the City Centre. Uhuru Park sits to the west of City Centre and, just beyond, are some of the city's better middle to top-range accommodations. Also west of the park are a number of government ministries, hospitals, and a popular youth hostel. The middle class suburbs of Ngong and Hurlingham sprawl out beyond the western boundaries of the city. The University of Nairobi, Kenya's National Museum, and the International Casino dominate the area north of City Centre. One of Nairobi's original colonial hotels, The Norfolk, is also located here. Aga Khan Hospital is in the Parklands suburbs, an area dominated by Asian minority. Due east of this area are the African suburbs of Eastleigh and Pangani along with the country bus station.

5.3.2 Clustered land use

The CBD of Nairobi is a zone, of clustered landuse which is mostly commercial and is currently experiencing redevelopment as the land rates are high and to cope with the situation the investors have opted for storey buildings. Offices and business such as supermarkets, cafes, hotels and textiles shops dominate the CBD. The choice of this development area for study was based on the rationale that they have a high number of urban traffic flows causing great urban congestion

5.3.3 Centralised services

The CBD of Nairobi is the focus of major urban transportation routes, and it is the centre of civic and social aspects of life. This brings a lot of congestion and traffic jams in the CBD of Nairobi. The CBD of Nairobi is generally a crowded place with a lot of urban traffic congestion during the daytime, and deserted at night. The Eastern side of the CBD is a zone of discard.

5.3.4 The Central Business District of Nairobi

Nairobi CBD was initially designed and planned to accommodate very low traffic flow, as the colonialists perceived it. After independence in 1963, Nairobi experienced an influx of rural urban migration, when the African became free to migrate, stay and own property in Nairobi.

The Central Business district is the location of the City offices, fire brigade, several police stations, specialty shops and businesses, offices and other small business services. These uses are all located in an area immediately adjacent to the largest employer, the industrial area. To promote a healthy downtown economy, the older downtown business district's infrastructure needs to be upgraded and improved as well as property owners encouraged to make improvements to their buildings. Consideration should be given to creating a separate Central Business Zoning District, which would create zoning requirements that are unique to the downtown area.

5.3.5 Local commercial district of Nairobi

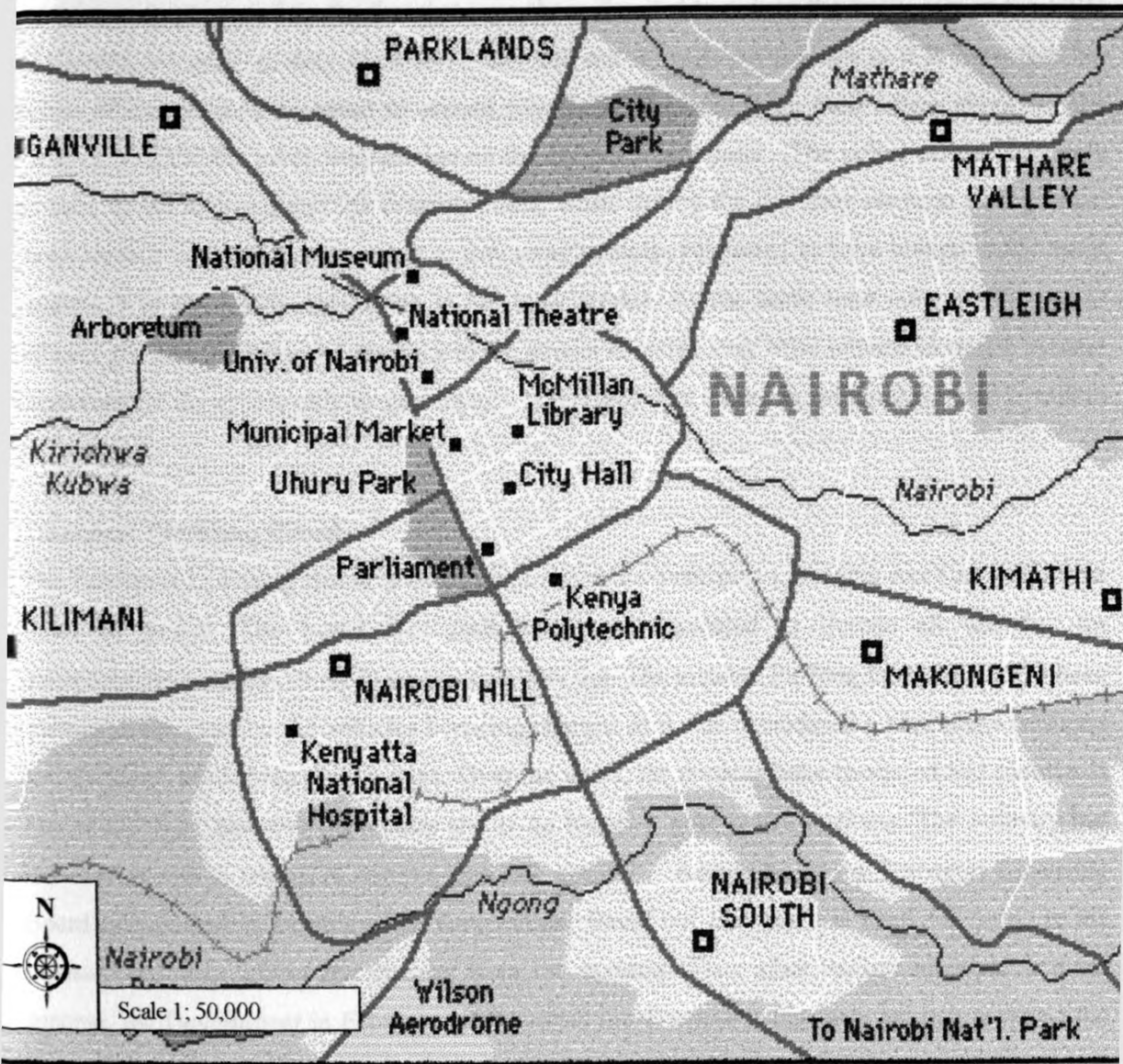
The primary central business facilities are located in the river road and Kirinyaga road area in the eastern side of the CBD. There is also a small business and light industrial cluster located at the Kamukunji area to the South of the CBD .the Ngara and Kariokor corridor is expected to be another area that will experience commercial growth in the very near future. The Kirinyaga road business area has the largest motor and electric stores in town. Other small businesses and

services have relocated to this area including simple motor vehicle maintenance garages to complicated crankshaft grinding. This area has a future for continued change and growth as a business district provided present plans for rehabilitation and redevelopment continues. The District needs to adjust to more competitive commercial uses, which are uniquely amendable to such a business district. Further developments in this commercial area should be encouraged to use landscape architecture techniques to maximize natural and man made greenbelt areas especially along the Nairobi river belt. Significant new commercial growth is expected to continue in the river road area.

5.3.6 The industrial area of Nairobi

General, large or heavy types of commercial uses, which are not the general run for dispensing small retail and service components, but which tend toward large scale or wholesale types of products and services are included in this category. Nairobi has such uses in the form of building contractors, farm and hardware supply stores, warehouses, auto parts reclamation from junk areas, public works, truck and car repair shops, welding shops, etc. The areas in the City where these types of facilities are located are in the south of the Central Business district in the industrial area. The industrial area is bounded by south B established residential area with Mukuru slums sandwiched in between, and is an undesirable relationship as a result. The heavy industrial activities can be shifted towards the Mombasa road to develop this area into a General or Heavy industrial area. This would offer the heavy industries an alternate route of access through the Mombasa road thus relieve the conflicting traffic between heavy commercial vehicles and residential traffic and family activities. Further expansion of general or heavy commercial uses can be expected as the City and the surrounding region grows.

Map 5-3 The expanded Nairobi CBD



Source; The City Planning Department 2000

Traffic management and the general human behaviour and attitudes

Traffic police

The traffic congestion management in the CBD of Nairobi by the Nairobi area traffic police is far from enough. The Nairobi area traffic police commandant expressed the feeling that the CBD requires at least a thousand traffic police officers to be deployed per day for effective traffic control in the streets of the CBD. Presently only one hundred traffic policemen are deployed to control the traffic flow in the CBD. This shows that the police personnel are ten times

inadequate in the traffic control in the CBD of Nairobi .the inadequacy of the traffic police operations is aggravated by the fact that even those detailed to reduce the traffic jam in the CBD of Nairobi, are only on duty for a few hours and not through out the day as it is expected. No police officer on duty accepted to answer any question touching on their where about for the better part of the day when they are not on the assigned duty point. The police officers can only be seen in the morning and the evening hours, while during the day they are seen sitting brake down service land rovers very ready to tow away vehicles suspected to have broken traffic rules regardless of the traffic congestion in the busy streets. At the same time other traffic police officers are seen walking and strolling in the streets showing very little interest in traffic matters happening on the streets only to gain interest when they spot a matatu, which they need to talk to for a bribe.

5.4.2 Transport Licensing Board

The Transport Licensing Board is established under the Transport Licensing Act Cap 404 of the Laws of Kenya. The board was established and mandated to license all vehicles for transportation purposes (both Passengers and goods). The matatus for long have since 1973 been exempted from paying the vehicles licensing charges as it was considered a poor mans business and therefore needed support to grow. Over the years, the matatus have increased and today it is one of the most lucrative businesses and is no longer a poor man's business. The industry has however grown in unguided manner and lack control. According to the Transport Licensing Board administrative secretary, the Government found out that there is need for order in the industry and also collect the charges from the matatus. Thus after various attempts without success, the Government in February 1999 evoked the Transport Licensing Act that required the matatus and other public transport vehicles including goods' vehicles to pay for the transport license charges.

The Transport Licensing Board package included the removal of what the board refers to as 'cartels' that are comprised of some individuals who patronise various routes and exhort money from new entrants into the business. The board also aimed at disciplining errant matatu operators and remove touts (intruders) from the terminal areas. The board suggested that the operations of the terminals to be spear headed by local authorities. The Nairobi City Council on their side moved in to the terminals but not necessarily to assist in the operations of the terminal points, but to collect parking charges. The matatus pays Kshs 50 per day failure to which their vehicles

are towed away and subjected to pay hefty fines. Accordingly, it is estimated that the City Council collects over Kshs. 20 millions per month from the parking fees. Accordingly, interview with the public bus operators on the impacts of Transport Licensing Board regulations, felt that the Government was only interested in collecting some extra taxes from them.

Table 5-4 View on transport licensing board rules by vehicle operators

View On Transport Licensing Board Rules	Number Of Respondents	% Response
Extra Taxation	11	24
To Discipline Operators	9	19
Removal of Touts From Terminals.	8	17
Not Necessary.	19	40
Total	47	100

Source: field survey 2002

According to the Transport Licensing Board administrative secretary, the board has been challenged severally on their role in the operations of the matatus, however he laments that the board has limited powers and at the same time expected to do a lot.

5.4.3 The TLB measures to ease traffic flow in Nairobi city CBD

Stringent measures have been taken to ease vehicle congestion in Nairobi's Central Business District. The Transport Licensing Board (TLB) described the traffic flow as disorderly. The board's administrative secretary admitted that the city centre is congested and the board needs to assign alternative routes to matatus. It is the board's mandate to allocate routes to vehicles. More than 300 matatu operators propose new routes or change their routes and apply for TLB licences every month. The board issues them with the licences after a monthly meeting. About 22 City Bus operators have their routes of operation already approved by the board.

Deputy motor vehicles registrar Cyril Maroba said only transporters with valid police inspection reports were eligible to be licensed. He however added that the TLB was empowered to cancel or revoke a license depending on the charges laid against the motor vehicle in case they committed traffic offences.

5.4.4 The Nairobi City Council

The Nairobi City Council has duty to maintain all the roads and terminal facilities in the city of Nairobi. The type of maintenance effected by the Nairobi city council in the city terminal facilities is really wanting because the city council traffic wardens are mostly instructed to

collect parking fees, without any regard to the traffic congestion, and without caring where the vehicle owner parks the vehicle, and they offer no security to the parked vehicles. The Nairobi city council has grossly neglected the rehabilitation programmes for the terminal facilities and local roads in the CBD.

5.4.4.1 The City Traffic Engineer

The traffic engineer and the roads engineer in the city council always keep on insisting that the council has man power but not the money to effect any capital programme works in the needy areas of the city. The traffic lights are no longer working in all the junctions, because of lack of maintenance funds. The lights are only functional on specific deserving junctions. He laments that he disparately tries to keep pace with the vandals as far as the installation of traffic signs is concerned, but they normally out pace him in destruction of what is put in place. He also blamed the age-gone planners for not having a vision beyond the year 2000. They only gave road reserves only enough for a few vehicles and presently the roads have nowhere to expand. The only alternative available is traffic restraint, like what he had seen in Nottingham England, but unfortunately, we do not have a very reliable public transport system or very reliable city shuttle bus. The matatu needs to be relocated away from the CBD, but unfortunately, there is no space on where to place a terminal point for them. There is a possibility of re-routing the buses to use outer roads like river road and Haile Selassie Avenue only. The Nairobi city traffic engineer lamented that political interference and the protection of many interest groups and cartels operating in the CBD terminals and city routes makes it very difficult to manage the traffic congestion effectively since once these cartels are arrested, you find them out and operating more ferociously the following day.

5.4.4.2 City Roads Engineer

The city roads engineer expressed the fact that El Nino funds were not enough to repair all the roads and terminal facilities, which were destroyed by the 1998, El Nino rains. The Urban Development Department acted selectively when repairing the roads, and left out the jam filter roads unrepaired. This made the vehicles to shift from the unrepaired roads to the repaired roads, bringing with them formidable traffic congestion. This can easily be contained if the left out roads can urgently be repaired. He felt that the Urban Development Department is kept busy by other project in the country, and Nairobi has not been given its fare share. The fuel levy funds are not shared out proportionately e.g. Nairobi contributes 45% of the total fuel levy kitty but get

back only 2% for construction and maintenance of its roads. This is not fair. The roads we use today were meant for capacities of the 1960s when the traffic volume was very low. We cannot do any major capital works programme due to lack of funds and the low budget provision from the central government. The phenomenon of heavy traffic jam is a feature of the 1990s. This was due to relaxed importation rules, which lead to influx of used cars, buses and mini buses from Dubai and the Middle East. All this was not accompanied by any expansion on the existing transport system. This lead to an authorised parking in the drive way and in the carriageway among areas, misuse and overuse of the terminal facilities. The traffic management measures were never increased at all. This also brought about the huge volume of unauthorised buses, matatus and private cars swarming the CBD streets.

The underground tunnels and fly over Pedestrian bridges are not in effective use due to insecurity, especially after dusk. There is a need for traffic by law to regulate the operations of taxis, matatus, buses, handcarts and pedestrian movements in the CBD of Nairobi.

5.4.4.3 Nairobi city engineers strategies of dealing with increased traffic volume in Nairobi

The massive influx of imported used cars into the country is putting the road infrastructure under immense pressure. But the critical question is, "Can our road networks continue to accommodate the ever growing volume of vehicles?" City Engineer Charles Chiuri acknowledges that the growth of the number of vehicles on Kenyan roads is not proportional to the development of the road infrastructure. However, he is quick to point out that this is a global phenomenon, which is not unique to Kenya alone adding, "But even if we were able to develop the infrastructure, there is always a limit since available land cannot be expanded. This has led to congestion on our roads." But the implications of this congestion could be far reaching. Foremost, he explained, there is loss of time and a waste of fuel, as motorists remain stuck for hours in traffic jams. At the same time, he added, the environment is also heavily polluted by exhaust fumes posing a serious health hazard. But, significantly, it has been established that roads wear out faster when traffic is slow especially on a climbing lane unlike on fast lanes. This is due to concentration of stress owing to the weight of the vehicles. On the issue of parking within the city centre, Chiuri said: "We are encouraging motorists to buy season tickets to avoid clamping or towing. This is more convenient when a driver needs to dash somewhere and the parking attendant is serving someone else. Besides, it's cheaper to have the season ticket especially if one comes to town frequently." In other words, we are saying that roads within Nairobi Central Business District

(NCBD) cannot be expanded but they can be managed. However, roads in the intermediate areas have a capacity for expansion. "Already, we have duelled Langata and Jogoo roads. And, plans are also underway to dual Ngong' Road from the City Mortuary roundabout to Dagorretti Corner, and Limuru Road," Chiuri said in the interview. "We will also have Juja Road and Outer Ring Road widened. Generally, we are saying, to curb congestion we need more roads and these roads are the missing links in the road network." The City Hall official says this requires hefty funding but assured, "We are working towards acquiring funds." He said it is the measures that they put in place to ensure the right utilisation of the available space that would help the situation on our roads. In the city centre, he said, City Council is working with the traffic engineer to ensure that they have all traffic lights operational and if possible install more, for example at the Moi Avenue-Haile Selassie roundabout. "We are reinforcing traffic regulations to prevent double parking, and careless overtaking among other bad driving habits. "We are controlling driving school lessons especially in the CBD which tend to cause artificial inconveniences," Chiuri said. Besides this, there are also plans to mark all traffic lanes to streamline the traffic. But where problems are acute, the official says, they'll resort to stringent measures, for instance, high parking charges to discourage motorists from the area. "We are also considering having cars of certain registration numbers parked in particular areas during specific days of the week," Chiuri said.

5.4.4.4 The Nairobi City Council Planners

The city planners show the problem of traffic congestion the Nairobi CBD as a result of the original set up of the city centre. The CBD is at the intercession of many radial roads, with all the directional roads feeding into the CBD every morning and emptying the CBD every evening at specific hours only. The planners felt that the CBD is a major traffic generation points, with condense land use systems and being final service centres for the high order goods. However, the Urban Public transport system in the CBD is very unreliable and for the people with private cars, using them into the CBD is unavoidable. The matatu is a very small capacity vehicle and they are very many all the matatus want to enter the CBD for passengers if they must keep themselves in Business. This brings a lot of congestion. The Kshs. 50 parking fees has given the motorist the guarantee for a long time parking in the CBD instead of short time in the CBD. The planners expressed concern that they are not listed in the traffic management liaison committee and this means that the police and the Engineers take all the responsibility in traffic management

in the CBD. The city council is not in a position to put LRT in place, its very expensive. The planners expressed the opinion of getting out all the vehicles from the CBD, and encourage buses entry into the CBD. The planners also expressed the issue of encouraging the upcoming minor business centres to encourage relocation of services to avoid every body coming to the CBD for services. The CBD services can also be extended to Ngara area and the parkland area. The Non-Motorised Transport is desirable in the city, but it is a very dangerous means of transport and needs to given its own routes and carriageways. The planners also expressed the need for out ring roads and outer secure parking areas for the shoppers to come to the CBD by use of public transport.

5.5 Other Stakeholders

The other stakeholders in the CBD and transport industry in the CBD have realised that that there is a need to decongest the CBD of Nairobi. The other stakeholders like the Central Business Association, the Matatu Welfare Association and the Provincial Administration have set their ways of decongestion the CBD. Such ways includes a common strategy to discipline errant drivers by taking away the cars ignition keys for a long period of time.

5.5.1 Matatu drivers and touts

The hooliganism of the matatu drivers produce a transportation system, which only a few cities in the world can rival in terms of traffic management inefficiency. The situation could have come about due to negligence, infective or lack of preventive management by the Nairobi city council traffic engineer and the city traffic police. There seems to be a gross failure in the management of the traffic system.

The various matatus operating from the terminuses are organised in small groups, which control the use of the terminal facilities. These groups employ touts who police the terminus and choose which vehicles to pick passengers and those, which are to be turned out of the terminal facility. Other activities at the terminus include sales services mainly provided by hawkers. Hawkers peddling different types of wares to the operators and the travelling public provide sales services. Passengers dispersing from the terminal flow in different directions. The flow of pedestrians thus causes serious traffic mix and possible occurrence of accidents. Observations also indicated that early in the morning there is a large volume of pedestrians moving from the Railway Station traversing through the terminus. This is also experienced in the evening though

the flow of pedestrian is reduced and spread over time. It was noted that the institutional vehicles park for longer periods than the matatus as they wait for their passengers especially at the railway matatu terminus. This behaviour effectively reduces the terminus into a long period parking facility. The three-matatu terminal points and the two bus stations are a major source of traffic congestion. This is mainly due to the unruly behaviour of the matatu operators. It was also observed that when there is police intervention at this point the traffic congestion is under control. The problem is more serious when the matatu get their load as they join Tom Mboya Street and often make quick u-turn along Tom Mboya Street causing further obstruction which often spills over up to Ronald Ngala Street. The congestion at the Accra Road and Tom Mboya junction is compounded by matatus plying route 9, which stop along the traffic lanes as they pick and drop passengers. During the peak hours, long queues of passengers are commonly seen along Accra Road and this causes obstruction to pedestrians. This forces people to use traffic lanes causing serious traffic mix. Kenya Bus Service staff controls the bus stop and matatus are not allowed to pick or drop passengers at this point since there are no matatus routed to pass along this length. But it is common to see matatus picking passengers, especially those going to the Kenyatta national hospital at the middle of city hall way. The survey also revealed that touts managing the terminal areas are equipped with all types of crude weapons to keep away the rivals. Interviews with the matatus operators showed that some of them use excessive force to keep away operators suspected to be rivals, that is those identified as not members of their group. Questions to the police why touts use all manner of weapons to control the terminuses even in their presence were never answered. Further enquiries from the operators revealed that some terminals are organised and are under protection of the police. Attempts to photograph touts wielding whips and clubs was met with allot of hostility. The control of the terminal facilities by use of force has resulted to certain routes with fewer vehicles and therefore operators force passengers to pay hiked fares and subjected to harassment and the occurrence of dense traffic congestion at such points is inevitable. There is no free-entry into such routes. These groups now commonly referred to as 'Kamjeshi' has severally been cited as the major course of poor public transport operations. Attempts by the Government to control the terminals and the matatu industry in general have ever been met with hostility from the operators. In the past attempts by the Government through the introduction of Transport Licensing Board regulations with the assistance of the City Council (for the case of Nairobi) seem to have achieved very little, but only facilitated collection of charges from the matatus. However, the

Transport Licensing Board officials' feels that was improper and express the view that the Governments role in streamlining the operations of the matatu sector be stepped up. To the operators, the rules resulted in confusing the operations of the public transport sector. This indicates poor communication among various stakeholders dealing with public transport policies.

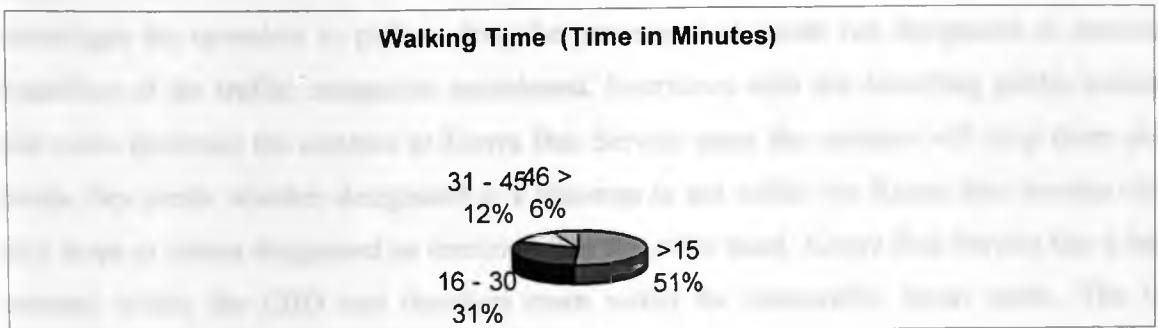
5.5.2 Non-Motorised Transport operators

The non-motorised transport operators also have taken a clue to induce some discipline to decongest the CBD of Nairobi. Such actions include trying their best to push and pull their handcarts on the extreme left of the carriageway. However these are some of the transportation vehicles operators who are very insensitive to the traffic rules applying in Nairobi.

5.5.3 Travellers and workers in the CBD

Interviews with the travelling public revealed that some people walk for more than 30 minutes from the terminal points to their place of work. This causes strain and inconveniences.

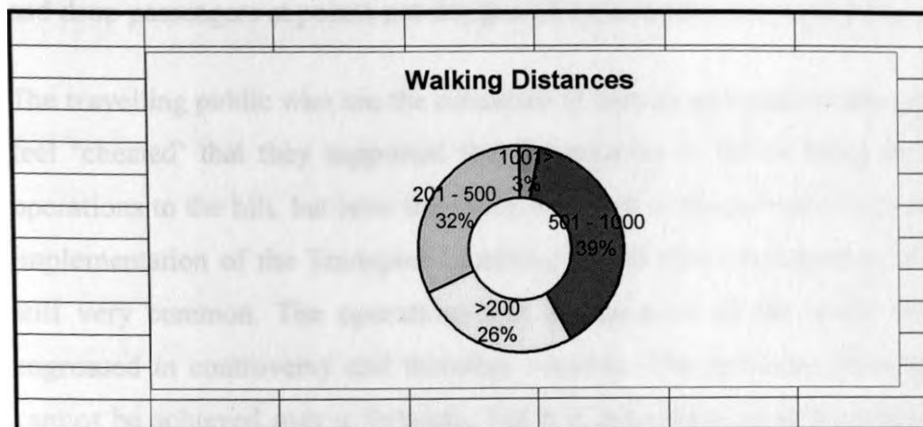
Figure 5-1 Time to terminals from places of work



Source: field survey 2002

The statistics show that a good number of people walk for 15 minutes or less. However, it was notable that some pick their vehicles at points not designated as terminals or bus stops. Though it was not possible to establish the actual relationship between the residential patterns and the routing and the location of terminal facilities, some commuters indicated that they preferred staying in certain estates because of convenience in transport mainly as related to the location of terminals and free flow and their places of work. The data from the field reflected that a big section of the travelling public walk over 500 metres from their place of work to the terminal points.

Figure 5-2 Walking distances from work place to terminal points



Source: field survey 2002

The long distances and longer walking journey times to the terminals covered by the passengers coupled with low income levels that prohibit the passengers to pay extra fares to access other points within the CBD. This is a good reason why some of the public transport users will wait for their vehicles home or demand to be dropped at points near their places of work whether designated as terminals or not whether it causes traffic congestion or not. This further encourages the operators to pick or drop the passengers at points not designated as terminals, regardless of the traffic congestion occasioned. Interviews with the travelling public indicated that some preferred the matatus to Kenya Bus Service since the matatus will drop them at the points they prefer whether designated as a bus-stop or not unlike the Kenya Bus Service which only stops at points designated as terminals. On the other hand, Kenya Bus Service has a better network within the CBD and therefore more suited for intra-traffic travel mode. The long distances from the terminals encourage the occurrence of terminal points at any point where the passenger and operators will deem 'convenient'. The traffic police insist on disciplining the operators mainly on charges of obstruction. Passengers on the other hand have learned the game where they keep on shifting from the point where the police are stationed. Observations and interviews also showed that passengers who wait for vehicles few metres away from the terminals argued that they chance for matatus who do not want to queue. Passengers also indicated that such matatus are usually fast and some will charge less especially on the direction against the traffic; for instance those connecting from CBD to other parts of the town in the morning. The behaviour of the matatu operators and the travelling public alike indicates signs of

the 'survival game' From the above foregoing, it is notable that the behaviour of matatus to pick and drop passengers at points not designated as terminals is contributory.

The travelling public who are the consumer of service provided by the public transport operators feel 'cheated' that they supported the Government in bid to bring some sanity in the matatu operations to the hilt, but now they have been left at the pawns of the operators. Years after the implementation of the Transport Licensing Board rules, harassment of the travelling public is still very common. The operations and management of the public bus terminal facilities is engrossed in controversy and therefore wanting. The provision of adequate terminal facilities cannot be achieved over a fortnight, but it is possible to first streamline the operations for the existing 'terminals' as plans are put in place to plan and develop adequate public bus terminal facilities to ease the traffic congestion in the Nairobi CBD.

CHAPTER 6- SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

The study examined the present traffic management strategies in the CBD of Nairobi and various summaries, recommendations and conclusions were drawn from the study findings.

6.1 Summary of finding

6.1.1 Transport Demand Management

Transportation Demand Management is a general term for strategies that result in more efficient use of transportation resources. Transportation Demand Management can help create a more sustainable transportation, including resource conservation, equity, environmental protection, efficient land use, and public involvement.

6.1.1.1 Trip generation

The CBD has since 1990 experienced the construction of several tall sky scrappers such as anniversary towers, Ufundi Sacco House, garden plaza Teleposta House, the Bazaar House and the times towers.

These relatively new houses have been constructed after the original short structures were pulled down, and this has meant a tremendous increase in traffic, both human and vehicle into and around these buildings practically these buildings owners have not shown their conceptualised or practical way of dealing with the traffic attracted by the human activities in these building. This has considerably increased the traffic congestion the CBD of Nairobi because structure developments are not accompanied by expansion in the transport system leading to such structures.

Plate 6-1 The Teleposta House



Source; field survey 2002

6.1.2 Transport systems

The transport system in Nairobi is far from being enough. The roads and the terminal facilities are generally in poor state and are poorly maintained.

6.1.2.1 Roads system

The CBD roads are generally the 19th century roads, which were never meant to accommodate the volumes of traffic seen in Nairobi today. These roads still have obsolete junction system with very poor signalling system. The roads capacities are very low compared to the demand exerted on them. There are open gaps in the road system with primary roads directly opening into urban highways, thereby causing traffic congestion on the primary distributor.

6.1.2.2 Vehicles

The 1990 liberalisation policy, made Kenyans in Nairobi to import all types of cars to Kenya. This led to extensive expansion of vehicle volumes in the CBD of Nairobi, when still there was no expansion of the road system. The CBD of Nairobi originally had the Kenya Bus Service and the matatus as the only public transport operators of late the operations of the co-operative bus has taken the city streets by a whirlwind and this has brought stagnating traffic congestion in the CBD of Nairobi.

6.1.2.3 Traffic terminals facilities

The terminal facilities in the CBD of Nairobi are far from being adequate. The question of who is responsible to provide such facilities can only be answered upon the establishment of who is responsible to provide, develop and maintain public bus-terminal facilities. The Nairobi City Council, an institution mandated to give service to the residents of Nairobi has demonstrated its inability to address issues at its docket. One can simply conclude that the introduction of Transport Licensing Board rules was 'meant' to facilitate more taxation. The roads and terminals in Nairobi continue to crumble. Touts are still patrolling the terminals while the routes are still under the control of 'cartels'. All this is happening with the full knowledge of the authority concerned. Nairobi City is grossly under-served with public transport terminal facilities. The planning of the city of Nairobi predicts that, as other sectors of the urban organism changes, public transport is considered to be 'static' by the planners. Apart from what was planned to accommodate the Kenya Bus Service buses since its inception, nothing tangible within the CBD of Nairobi, that is typical of pro-active planning on public transport terminal facilities has taken place. Since 1950s within the entire CBD of Nairobi there, is no single terminal facility planned and developed to take care of the matatus. The current points used by matatus as terminals are mainly off-street parking bays or small bus-stops used as terminal as well as traffic island which have been converted into such matatus terminals.

6.1.2.3.1 Problems experienced at the terminals

The study found out that there are various problems identified by the travelling public and the public transport operators at the public bus terminal points. Interviews with the travelling public indicated that the most common problem was lack of terminal sheds and other amenities like sanitary facilities.

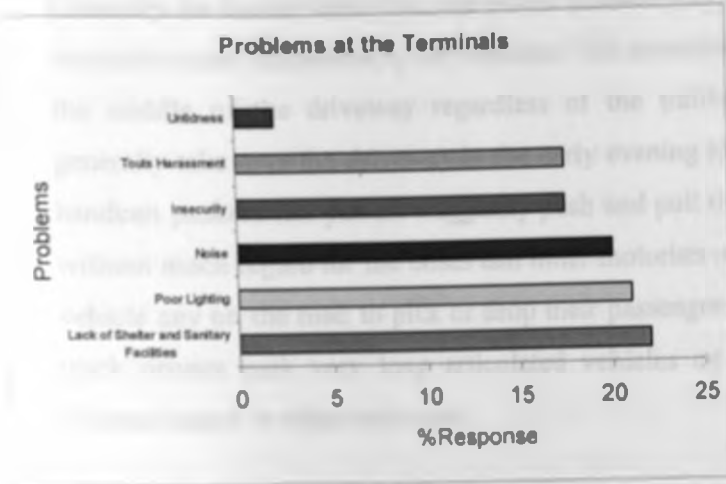
Table 6- 1 Problems experienced at the terminals by the commuters

Problem identified	Number of respondents	% Response
Traffic congestion	20	28
Poor Lighting	15	21
Noise	14	19
Insecurity	10	14
Touts Harassment	10	14
Untidiness	2	3
Total	71	100

Source: field survey 2002

The study found out that most of the terminals are congested and cases of insecurity are more rampant at the terminals especially after dusk. Consequently, matatus shift from the congested and insecure points to the road junctions, which in most cases happen to be along the traffic lanes. This causes delays and congestion at night even when the traffic volume is very low. Street men and women and other petty thieves are the main perpetrator of insecurity at the terminals. The commuters also complained of noise mainly by the touts as they try to woo passengers to their vehicles. The touts' shouting is accompanied by jostling for passengers who, in most instances results to harassment and assault of the passengers. The matatu crew on the other hand complained of different problems, but some of the problems were common to those identified by the commuters. To the operators the most pressing problem was poor maintenance of the terminal facilities, which results to congestion due to avoidance of the worn out corners of the terminal facility. Other problems include poor accessibility, insecurity and congestion. For the case of congestion by people, the operators complained of street entertainers including preachers, who invade the terminal points to preach and more so to attract more people into the terminal point and greatly boosting the traffic congestion.

Graph 6-1 Problems identified by bus operators



Source: field survey 2002

Most of the terminals surveyed were not well paved. At the bus-station, the only paved section was that of Kenya Bus Service and the Old Nation matatu terminal. Most of those unpaved sections are characterised of gaping potholes and are usually impassable especially during the wet seasons as they collect water forming typical 'lakes'. From the above fore-goings, apart from lack of terminal amenities (sheds, sanitary facilities among others), insecurity and poor maintenance of terminals are the most critical problems that afflict the operations of the existing public bus terminal facilities.

6.1.3 Land use

The high-density landuse in the CBD is a major traffic attraction, with very low terminal facilities capacities. The tall buildings demand that parking facilities be provided to cater for the expected traffic attracted by the services rendered by such buildings. Unfortunately parking provision is not really taken seriously when approvals for such houses are granted.

6.1.3.1 Centralised services

The centralisation of specialised services in the CBD means that any body seeking for the specialised services such as medical consultancy, legal services, civic services and some government services has to make a trip to the CBD. The centralised services are due to the economies of scale provided by the high level of services in the CBD.

6.1.4 Human behaviour and public attitudes

Generally the human behaviour and public attitudes in Nairobi reflect a negative activity towards the road system utilisation by the vehicles. The pedestrians normally like walking undisturbed in the middle of the driveway regardless of the traffic congestion they cause. The hawkers generally take over the driveway in the early evening to display their merchandise for sale. The handcart pushers and pullers sluggishly push and pull their vehicles on any side of the driveway without much regard for the buses and other motorists on the road. The matatu drivers stop their vehicle any on the road to pick or drop their passengers, regardless of the other road users. The truck drivers park very long articulated vehicles on traffic islands obstruction road vision without regard to other road users.

6.1.4.1 Cartels

The operations and management of the transport routes and terminal points within the CBD is under the control of 'cartels'. The 'cartels' are partly responsible for the emergence of several undesignated terminal points, some of which are located at back streets or along dark-alleys. These are as a result of splinter groups that are unable to pay hefty fees charged by the 'cartels' to join their operational groups. The authorities legitimises such terminal points and it was clear that some 'cartels' exist under the cover of the authorities who share the loot charged from new matatu operator's by the 'cartels'. Recently the Government evoked Traffic Licensing Act and actually implemented the Transport Licensing Board regulations against protests that culminated into a matatus strike. The common belief was that the Transport Licensing Board regulations were to streamline the operations of the public transport sector. However, the Government's effort seems to have weathered and the situation is back to the old jungle laws and rules operational style. This puts into suspicion the role and commitment of the Government in the streamlining of the public transport and traffic flow within the CBD of Nairobi.

6.1.4.2 Matatu culture and the public behaviour and attitudes

There is a great breakdown in discipline by matatu crew; with total disregard for traffic rules by the matatu sector many of the problems of and urban traffic congestion (noise and smoke) are attributable to the matatu culture. The bus companies like the KBS, the cooperative Buses and the Privately operated buses have all descended their discipline to the matatu level or below due to their huge road occupancy. The behaviour has investigated to the many middle class potential public transport away from the public transport.

There is a gross breakdown in the discipline of all road users arising from the cynics engendered by the collapse of the planning and law enforcement agencies. The failure to implement various planning recommendations dating back to 20 years especially the recommendations of the NMGS, and the over politicising of the city government has given rise to little or no maintenance of professional standards in the city management.

There is little evidence and effort put in place to provide the city traffic management with necessary infrastructure. Where as some of the reactions sound emotional regarding the ‘matatu culture’; stigmatisation of the matatus is not the solution. The matatu, buses and private motorists problem in Nairobi is a complex combination of various factors and cannot be tackled sectorally by punishing the matatu operators only. All the stakeholders must be held responsible for the part they play. The behaviour and attitude of the society was found to have a significant role in the operation and management of traffic within the city of Nairobi. The matatu operators are undisciplined, arrogant and totally disregard other road users. The public transport users on the other hand are unwilling to change and often respond to circumstances emotionally. In most cases they react individually giving the matatu operators an opportunity to mistreat and exploit them. To the authorities dealing with traffic management in Nairobi, the public buses, and matatus are a nuisance that should be cleared as much as possible from the CBD. The relationship between the administrators and the public bus operators is that of suspicion. For those who use their private cars, mostly belong to the middle and the upper income segment of the society feel dishonoured to use the public buses. They insist on taking their private cars into the CBD despite the limited space and congestion. The parking charges currently introduced by the city council is not deterrent enough to keep-off the small vehicles out of the CBD. At the same time those charged with the responsibility of collecting the parking, fees from the vehicles collude with the owners, where the vehicle owners pay less and which money is never remitted to the city council. From the analysis, it is clear that how people behave, their attitude towards other road users affects negatively on the traffic management in the city of Nairobi. Indeed indiscipline on our roads is purely Kenyan; unfortunately, the matatus have perfected the game.

6.1.4.3 Inadequately trained Staff

This constitutes a root cause of many urban traffic congestion problems in the CBD of Nairobi. The Nairobi area Traffic Police officer has not been given enough qualified police officers for traffic management in the CBD of Nairobi. This has come as a result of the fact that it has always been a problem in explaining the importance of manpower development training

programmes to the government and other stake holders, and especially the NGOs and the international development agencies. Many such programmes are sponsored as a sense of duty rather than a commitment. This is so because training is often viewed as distracting from the work programme.

6.1.5 Policy and institutional inadequacy

There is no single overall coordinating policy unit ready to provide guidelines for urban traffic management in the city of Nairobi and in the republic of Kenya generally. The traffic Act cap 403 is a mere law, which grants penalties to traffic offenders, but keeps adequate silence when it comes to the traffic needs and transport demand. There are no clear policy guidelines on the operations of public transport in Kenya. Various documents that detail transport seems to consider transport in general and sectoral policy guidelines within the transport sector are lacking. More deficient is the area regarding the provision and management of public roads and terminal facility system. The most common operational tools in public transport are the Traffic Act and Transport Licensing Act, which are mere general laws and does not detail on public transport infrastructure provision.

6.1.5.1 Nairobi city council database

Though there is the common belief that a lot of research work has been conducted on public transport in Nairobi, it is evident that there is a serious deficiency in terms of traffic management data in the Nairobi city council records. It was also found out that the up dating of the maps for Nairobi on developments undertaken is very poor and therefore what appears on the maps do not tally with what is on the ground. This problem is compounded by the fact that the concerned institutions do not have the capacity to build such database while at the same time attempts to build such database always face rejection from such institutions. To make reliable data banks for purposes of traffic congestion management is a costly undertaking, but this is inevitable, as no proposals will be effective without proper database.

6.1.5.2 Inadequate traffic management equipments

Disfunctional traffic control lights are fairly well distributed in the CBD of Nairobi. These facilities are often vandalised by iron and steel mongers. Drunkard drivers often overrun them. Once this happens the city council normally pretends not to see their situation may be until when a foreign president from the Western Europe or America visits the city. Road makings and driver information signboards are forgotten phenomena in the CBD of Nairobi. If need be, these

facilities are placed on only the junctions and roads that serve the dwelling areas of the high-income areas. The roundabouts are a major traffic conflict zones, more especially where the traffic islands are already over grown with thickets or have been turned into homes for the street families.

6.1.5.3 Nairobi City Council and The Transport Licensing Board rules

The City Council of Nairobi as an institution is mandated to provide necessary public utilities including traffic flow channels and the terminal facilities. However, even the existing streets and terminal points are poorly maintained. The City Council which is supposed to assist in the operation's of the terminals has never been seriously concerned until recently when the Transport Licensing Board regulations were implemented, and they got the opportunity of collecting extra charges from the vehicle operators in the form of parking fees. They are now only more efficient in towing vehicles, which have not paid the parking fees. From the analysis, it was evident that the occurrence of bus stops at points not designated for such purposes was a complex combination of factors. These factors include uncoordinated location of the terminal points, attitude of the operators and the travelling public. The location of the terminal points is at unfairly long distances from one another along some routes. This encourages passengers to demand to be dropped at points not meant for terminal area activities. The matatus on the other side comply and often causing obstruction and traffic congestion to other road users.

6.1.5.4 Communications break down

The study found out that there is a communication problem among the various bodies mandated to guide traffic management in Kenya. This was revealed by the poor communication between the City Council of Nairobi, the Transport Licensing Board, and the Traffic Police. Each body seem to be concerned with the roles they are charged with and totally disregard what other bodies are doing that directly or indirectly affect their work. There is evidence that there is little or no consultation among the traffic management and administration bodies such that at times each body is giving conflicting guidelines with other bodies on similar issues. This results in further confusion on the already muddled transport sector in the CBD of Nairobi.

6.1.5.5 Urban traffic congestion managers role conflict

There is a widespread evidence that the urban traffic management in Nairobi CBD has a duplication of responsibilities in the daily urban traffic management which has lend to a general

lack of clarity as to what is to be done by the Nairobi city council traffic engineer, and Nairobi city council roads engineer and the Nairobi city council, Transport Licensing Board inspectorate section. This conflict of duties has also extended between the Transport Licensing Board, the city council and the Nairobi area traffic police duties e.g. the Nairobi city council can give a day long parking ticket which gives the car owner the authority to park any where in Nairobi regardless of the lack of a parking space. In case the car owner double parks or obstructs other parked cars, the traffic police step in to impound the double parked car whereas the car owner has a legal claim of having a legal authority to park any where in the CBD of Nairobi including on the pavements and at the end of the lay bays. The traffic police normally loose such cases because the city council has already collected the parking fees, which is not refundable. Lack of clarity in duties and roles have also been noted in the roles of the urban developed department and the ministry of roads and public works. The role conflicts has been brought about and aggravated by policy inadequacy or absence of it at the National level.

6.1.5.6 Present strategies used to reduce traffic congestion in Nairobi

Traffic congestion in the City of Nairobi has progressively worsened in recent years, manifesting itself at its worst during the morning peak hour when commuters travel to their places of employment, notably the city centre and the Industrial Area. A similar situation re-occurs during the evening in relation to the commuters' return journey, although spread over a slightly longer peak period. During the 'off-peak' periods generalised substantial trafficking continues, leading to pockets of congestion, which arise and dissipate recurrently throughout the day in Nairobi CBD. All traffic management like parking and other terminal facilities are managed by the Nairobi city council. Efforts have been made to manage the traffic congestion and a smooth flow is occasionally attained by use of the following decongestion tactics.

By pass roads By pass, roads have been planned and others have been constructed to filter out the vehicles, which do not have any business in the CBD. E.g., Nyerere road, slip road, Haile Selassie Avenue and the outer ring road. **Cartels** Unofficial management of urban traffic congestion is aided by the route management cartel in the bus terminals and the employees of the Kamjeshi and mungiki unregistered organisations. And the employees of the matatu welfare association. **Converted spaces** As the associations lobbied for terminals facilities management, the Nairobi city council added some space previously zoned for other activities such as car parks and traffic island to be used as matatu terminal facilities e.g. the railway station vicinity and the

old nation house roundabout. **Decentralised services.** Decentralised services, especially the government offices located on the upper hill, and the Kenya power idea of having their bills payable in certain banks, the city council decentralised office, some in Kariobangi, Eastleigh and Kawangware have conveniently saved the local population the pains of travelling to the city hall for local services. The major super markets have also decentralised to the residential areas like Uchumi chain of super markets has a branch in Langata residential area, and along Ngong road and a most recent branch in Buruburu residential area, which have a huge parking facility, which can only be a dream in the CBD of Nairobi. **High parking fees.** High parking charges for all the vehicles entering and parking in the CBD, a cost of Kshs 50 per day or a part of the day is a major step taken by the city council to deter the motorists from parking in the CBD of Nairobi. Those who do not pay usually have their cars clamped. The car owners in the CBD are scared off and discouraged by the prohibitive parking fees. For the short time shoppers, they do not find it worthwhile.

Outer business centres The up coming periphery business centres, like the Yaya centre, the Westlands, Hurlingham and Kenyatta market have reduced the would be urban traffic congestion in the CBD of Nairobi. Small low order Business centres have start emerging in the residential areas and hence no need to travel to the CBD e.g. Adams Arcade and Village Market.

Outer integrated residential area The well of individuals can afford increased travel costs and prefer to live in the lower density areas away from the CBD e.g. Ongata Rongai, Runda and Muthaiga. These are the residential areas with schools, shopping malls, and working places.

Pedestrian tunnels and fly over foot bridges Pedestrian tunnels were introduced and maintained by the city council for use by the pedestrians for safe crossing of the very busy urban highways e.g. at the globe round about, but these have been grossly misused and have been turned into dumping areas, mugging zones and usually used as toilet facilities. Fly over bridges, like the one on the Haile Selassie avenue were constructed to reduce the vehicle and pedestrian conflict of the high speed high way. It is also a very insecure facility especially after dusk.

Ring roads. Ringing the city with a ring road has helped to solve the problem of congestion in the CBD e.g. the Outering road and Ngara ring road. From these ring roads, unfortunately lower roads penetrate the CBD and hence creating traffic congestion points. All the ring Roads in Nairobi are no longer serving as Ring Roads, and there is an urgent need for a true Ring Road.

Road signs the use of brightly painted roads, roads signs and neon lights give drivers information. These are constantly vandalised and used to manufacture jua kali metal implements.

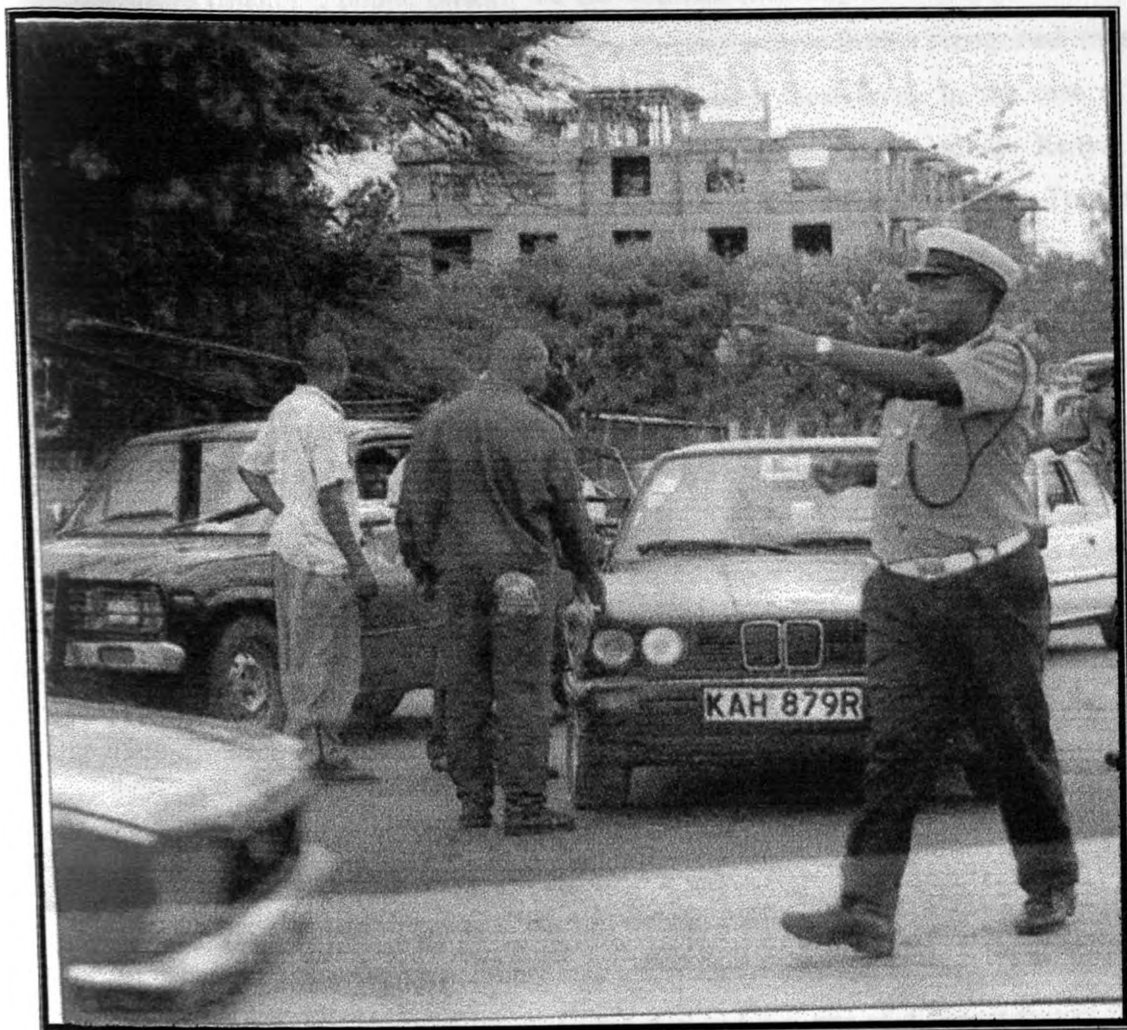
Roundabouts. Roundabouts and traffic island are conveniently located in the road junctions to ease the traffic conflict at the junctions but they are not adequate and seem to be an obsolete type of junction. But they are still useful in the Nairobi CBD. **Slip roads.** Short and convenient slips roads have been strategically constructed in the CBD have shortened the u-turn routes in the CBD.

Streets segregation. One-way streets systems were introduced to decongest the mostly clogged and congested streets in the CBD of Nairobi. E.g. the lower Ronald Ngara street and the upper race course road, and the temple road. Use of one-way traffic movement has really eased traffic congestion in the Nairobi CBD. There is an exclusive pedestrian zone in the CBD, like Aga Khan walk. **The high-speed highways,** e.g. Haile Selassie Avenue and Uhuru highway makes it possible and desirable to decongest the CBD of Nairobi. The expressway like Uhuru highway was originally meant to be a city by pass and not to penetrate the CBD. **Towing away** Towing away of all the wrongly parked vehicles in the CBD at the owners expense is a step, which is very scaring to the motorists who would otherwise leave their cars carelessly parked in the city streets blocking the urban streets. **Traffic lights.** Electronic traffic control lights are constantly maintained by the city council to direct the traffic on very busy junctions. But they are constantly vandalised.

Traffic management committee There exists a traffic management committee in Nairobi. The committee is known as the Nairobi traffic management liaison committee. This committee is chaired by the Nairobi area provincial traffic police officer in charge situated in the Milimani area next to Kenyatta hospital. The members of this traffic committee includes; The traffic police officer in charge Nairobi area, The pc Nairobi, The Nairobi CBD Association, The matatu welfare association, and The traffic engineer Nairobi city council and the matatu welfare association.

Traffic police .The traffic police department has deployed specifically trained police officers to operate the streets of Nairobi to control and direct traffic appropriately within the city. The use of well-trained traffic police officers, and the deployment of city council traffic wardens especially in the terminal points. They have helped to ease traffic congestion especially during the peak hours when nobody what to give way to anybody else.

Plate 6-2 Police officer at work in the management of traffic congestion



Source; field survey 2002

6.2 Recommendations

From the analysis and conclusions, the study makes a number of recommendations and proposals as intervention measures to improve the urban traffic congestion management in the CBD of Nairobi. The proposals can be categorised as those requiring immediate attention and those for long-term measures.

6.2.1 Policy recommendations

Comprehensive policy framework to guide the operations of public transport needs to be formulated. This can be undertaken through the formation of 'Nairobi traffic Authority' to balance the Kenya roads board authority, a body that could be all inclusive in terms of

membership to guide public traffic management. The body members should include; the operators (matatus, public buses), the Government (Ministry of Transport and Communication, the Ministry of Roads and Public Works), a representative from a recognised transport research institution and Local Authority in question at each local level. In the case of Nairobi, the Provincial Commissioner Nairobi, The Representation should include Kenya Bus Service, Matatus welfare representatives, Nairobi city council, The Traffic Police, Transport Licensing Board (Moth). The composition should show expertise knowledge in traffic management and traffic operations. Such a body should be mandated to draw guidelines on the urban traffic management and to advise on the provision of the necessary public transport infrastructure. The body should also be responsible on matters of public sensitisation on their role on the streaming and operations of public transport. This will be in view of trying to change the attitude of the people on how they conduct themselves and the subsequent impact on traffic management.

6.2.1.1 NCC database

The City Council of Nairobi needs to establish and maintain a strong database on public transport within the area of its jurisdiction. This should be coupled with regular updating of the development activities within the city. The database will be very vital in guiding the planning for public transport within the city of Nairobi.

6.2.1.2 Integrated stakeholders approach in urban traffic congestion management

A sustainable management strategy for urban traffic congestion requires an integrated approach both in terms of the stockholder's knowledge and in terms of different factors that affect urban traffic congestion management. Desegregation of such knowledge has first to be done and latter followed by the integration and merging of the issues.

6.2.2 Transport system recommendations

6.2.2.1 Ring roads around the CBD of Nairobi

Ring the Nairobi CBD with a wide ring road, which has large parking spaces located along the ring road and allow all the CBD travellers to go the rest of the way into the city by fast moving and reliable public transportation. Removing the car traffic from the inner city streets abolishes the need for road widening.

6.2.2.2 High-rise parking facilities

Multi-storey car parking facilities can help to reduce the problem of the lack of parking space. This type of parking facilities can be constructed on the presently existing low rise parking area like the sunken parking lot next to the Kenya re- house.

6.2.3 Land use recommendations

6.2.3.1 Decentralisation of services

The upcoming business centres like Kenyatta market, Hurlingham, Westlands, Parklands, Ngara and Nairobi West should be highly encouraged for utility upgrading to include other services and decongest the CBD of Nairobi from traffic and service concentration.

6.2.3.2 Development control

The building rules and standards and requirement for site coverage and provisions for parking facilities should be strictly implemented to alleviate parking space demand.

6.2.3.3 Conservation and preservation of the old buildings

The old buildings in the CBD do not have a lot of traffic generation to induce traffic congestion. The preservation of these old buildings would retain the historical treasure of the CBD as well as a strategy of discouraging high traffic generation points.

6.3 Implementation proposals

6.3.1 Traffic restraint

Though various studies have been conducted on transport in Nairobi and on parking space provision, a comprehensive study and plan need to be undertaken on the viability of improving the operations of public transport in Nairobi and keep off the private car and the matatu out of the CBD of Nairobi. Caution must be taken that proposals to reduce private car within the CBD has ever failed because most of the private car owners are the policy makers and are the ones who are responsible to implement such proposals and therefore they feel dishonoured to use the public buses. This may then require inclusion of masses through advocacy to enforce the removal of the private car from the CBD. The failure of public transport is grossly affected by the fact that the policy makers never use public transport means and therefore they do not know the experiences of the users.

6.3.2 Parking fees valid per street

The study proposes that in order to reduce traffic congestion the most laden streets can easily be decongested by introducing varied parking fees per streets in the CBD. The most laden streets which includes Kaunda streets mama Ngina street, Moi avenue Kenyatta avenue and tom Mboya streets should attract a highly scaring and deterring parking fees which can only be limited for a period of ½ day so as to discourage the motorists who park for the full day for a fee which is also operational on the less laden streets like river road and Kirinyaga road.

6.3.3 Shuttle bus services

Use the stadiums for secure parking facilities and Terminals area for the motorists and allow them to proceed to the CBD by use of a very reliable shuttle bus service, operating between two parking stadiums and the CBD using strict schedules e.g. a shuttle bus from Kasarani stadium to the Nyayo stadium via Moi avenue in the CBD can do.

6.3.4 Pedestrianisation

Some streets in the CBD of Nairobi are ripe for pedestrians' only zones. These are the streets between Moi Avenue, Haile Selassie Avenue, Uhuru highway and Kenyatta Avenue. This is mainly a service street with many banks, civic authority facilities and central government offices. This are already has a pedestrian's only walkway on the Aga Khan walk way.

6.3.5 Re routing the public transport buses

Almost all the Eastlands bound buses pass through ambassador bus stop and almost all the western bound buses pass through ken com bus stop. It is possible to reroute these buses and make them use the less utilised roads of Haile Selassie Dual Avenue for the western bound buses and the better use of the river road for most of the eastern bound buses. The matatus need not to penetrate the CBD unless they have very essential duties to perform other than picking and dropping their passenger, because they can very well pick and drop their passengers on the outer streets of the CBD who can then walk to the CBD by use of the wide clear roads with no vehicles to scare them off the carriage way. The traffic police can be used where certain categories of vehicles are not supposed to proceed to allow only the authorised vehicles to proceed on certain streets. The present of a large, signboard regulation the desired vehicles are highly ignored by some operators who pretend not to know how to read the sign boards.

6.3.6 Remove the terminal cartels

Though the Government seem to have given up the fight to control the routes and terminal facilities, more effort must be concentrated on the traffic management with an aim of weeding out 'cartels'. The major constraint to this is political meddling and partiality on the part of the authorities. The removal of 'cartels' will improve entry/exit into the transport industry and will thus reduce touts harassment and control the unruly behaviour of the operators.

6.3.7 Public education

In order to immediately step up the efficiency of the transport system and traffic flow patterns, a serious campaign to educate the public on road use by various bodies, like the police, Automobile Association of Kenya stressing the need for courtesy and careful driving. Enforcement of the traffic Act, preferably by a newly constituted Nairobi metropolitan police force, which should be free of campaigns. There should be a flexitime for working hours to stagger flow of traffic more eventually throughout the day. The police should operate major city intersections throughout the day instead of only at morning and evening peak hours. There should be introduced special lanes for public transport (Buses, Matatus) and other heavy occupancy vehicles, in a newly designed mass transit system. Improvement of the signalling system with urgent repairs and connections of new junctions should be carried out. All signalling implementation proposals in the city engineers department should be implemented.

6.4 Long-term recommendations

6.4.1 Rehabilitation of the transport system in the CBD of Nairobi

The study also proposes that the money collected from the vehicle owners in the form of parking charges be set aside as a fund that should be directed towards the rehabilitation of the road systems and the public bus terminal facilities and the related amenities. The road system around the city should be upgraded to six lanes for efficient and swift movement in the city.

The terminal areas need to be rehabilitated. They should be tarmacked and the rotting garbage removed. Drainage to those areas to be unblocked, existing public toilets rehabilitated and street urchins barred from controlling the public toilets. The terminals also require to be provided with sheds, properly lit and where possible small sales areas. During the rehabilitation period, various environmental issues must be taken care-of. These include; traffic disruptions, which often cause congestion and time wastage, excessive noise from the earth moving machines, dust and other forms of pollution and inconveniences to the public, loss of business to the operators. This

implies that the authorities concerned must make good the loss anticipated to avoid un-necessary stress to the users.

6.4.2 Increase the terminal facility capacities

The terminus at the Railway Station is a good example of interchange, which can link rail transport and road transport. However, its capacity to handle such a role is constrained by its size. Else it is possible to rehabilitate the same and serve as an interchange through the collaboration of Kenya Railways, The City Council, the Central Government and other interested bodies. The Nairobi city council should construct high-rise parking facilities e.g. on the site with a sunken parking facility opposite Jogoo house. Such a facility can accommodate 3 or four times the capacity of vehicles it accommodates regularly. All the new up coming sky scrapper owners also need to be controlled to provide adequate parking facilities for the house users. The new house should have office rations based on the expected traffic generation it creates.

6.4.3 Construction of a common city bus terminal

The city of Nairobi is estimated to require 67,000 square metres in terms of terminal area excluding the current Kenya Bus Service terminus. Lack of space within the CBD of Nairobi has often been cited as the major obstacle in the provision of adequate public bus terminal facilities. The study makes a proposal that space for public bus terminal facilities can be realised through the existing legal framework of law regarding physical development. This implies that areas where leasehold are expiring not to be automatically renewed but reclaimed by the Government/City council for the purposes of public bus park development. However, due to lack of precise and up dated information it was not possible for the study to state with certainty the specific areas where the bus park could be located. The study therefore suggests that the city council to identify possible areas where public bus station could be located within the CBD. The urban traffic congestion problems require urgent solutions so that the residents may feel sheltered again in the social environment of the town.

6.4.4 Induction courses for the CBD public transport operators

The operators need to be vetted and there is need to establish an institute within the public universities to train drivers and public transport operators and teach them the basic principles on public relations. The drivers trained as such need to be at least of secondary level of education.

The present method of licensing conductors and drivers by requiring them to have a certificate of 'good conduct' lacks merit in sense that there is no yardstick to determine the degree of one's fitness to be a public bus operator or crew. The mere fact that one has never been convicted in a court of law does not imply that one is more qualified to be a public bus operator. In fact, there is no rigorous exercise conducted to evaluate whether the said certificate of good conduct is genuinely awarded to the beholder. The operators should be taught introductory courses on human organisation theory. Before any one is licensed to be a matatu crew or public bus operator should first undergo such training. This will instil some professionalism in operations of the public transport.

6.5 Area of further study

The study concentrated on urban traffic congestion management. However, the study considered other options on public transport mainly the rail transport. The study suggests a thorough study on the viability of the rapid rail transit be undertaken. The rail transport is considered more efficient as it moves large number of people at a go and subsequently reduces congestion in space both for terminal areas and the transport corridors. The passenger train currently being operated by the Kenya Railways is very popular among the users from the Eastlands of Nairobi. This indicates the potential of train services in Nairobi.

6.6 Conclusions

6.6.1 Best practices

Congestion reduction programs should consider a wide range of possible solutions, including transport demand management. The impacts of generated and induced travel should be considered when evaluating potential congestion reduction strategies. Congestion reduction programs should favour strategies that provide long-term congestion reductions. Grade separated Transit Improvements and High Occupancy Vehicle facilities can reduce traffic congestion on parallel highways. Pricing strategies such as Road Pricing, Distance-Based Fees and Comprehensive Market Reforms tend to shift the demand curve, reducing the overall congestion equilibrium. And use management strategies such as New Urbanism and Smart Growth may increase local traffic congestion (within a neighbourhood), but reduce per capita vehicle travel, and reductions in regional traffic congestion, resulting in overall reductions in congestion costs.

6.6.2 Telework

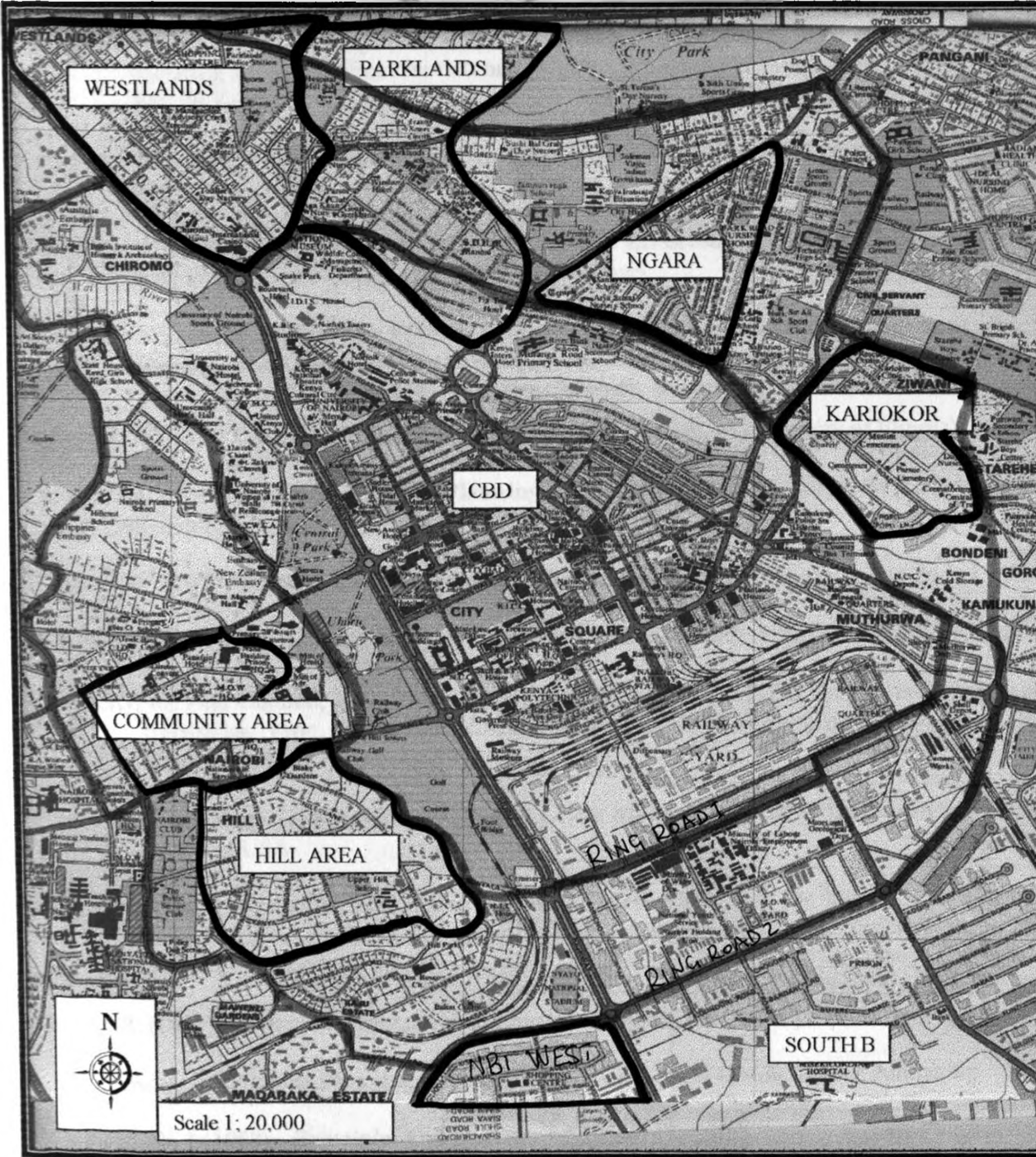
Telework includes various programs and activities that substitute physical travel for telecommunications (telephone, fax, email, websites, video connections, etc.). Telework is appropriate in any geographic area. In urban and suburban areas it helps reduce congestion. In rural areas it improves access to employment and services. Telework can be encouraged by the state and local governments through transport demand management programmes, but is implemented by individual businesses. Telecommuting can be implemented as part of a Commute Trip Reduction program. Other forms of Telework, and other applications of telecommunication are implemented by businesses and government agencies to improve services, reduce costs, reduce vehicle travel or help achieve other objectives. Telecommuting is often performed on a part-time basis, with employees working from home in one or two days a week to reduce travel trips. It can also be used on a temporary basis, while an employee is working on a particular project or when ill. Telecommunications by teachers and students can substitute physical travels for meetings. Colleges and universities can offer distance-learning classes. Tele Shopping (Internet Shopping) can also be used to facilitate retail purchases and avoid physical visit to a store. Tele Banking (Internet Banking) is used to perform banking and bill payment transactions. Electronic Government services refer to the use of telecommunications by government agencies to provide services that would otherwise require visiting a government office within a region. Internet Business-to-Business (B2B) refers to Internet interactions between businesses, such as bidding, sales and planning. It can also reduce the need for physical meetings between staff. Teleworking can significantly reduce a participating employee's commute travel. For a twice-a-week teleworker reduces commute trips by 40%. Telework tends to be particularly attractive to longer-distance commuters. A telework program that reduces 10% of vehicle trips may reduce 15% of vehicle mileage. Neighbourhoods' telework centres reduce commuting by about 50%. Telework provides net reductions in vehicle travel averaging 30 miles per telecommute day, with no evidence of increased sprawl (Nilles, 1996). If 10% of the workforce Telecommutes on any given day, total vehicle travel would decline by 4%. Mokhtarian (1997) concludes that a more realistic estimate is that 1-2% of vehicle travel could be reduced by telework, and long-term impacts may be even smaller if it encourages more urban dispersion. Since Telework reduces commute trips it can significantly reduce congestion and parking costs. Telework can provide consumer benefits by increasing Transportation Options, convenience and financial savings. If Telework results in increased non-

commute trips or more dispersed land use, road safety and environmental benefits are reduced or eliminated. Telework may increase community Liveability by reducing vehicle traffic and allowing more people to work and shop from home and It can improve Accessibility for people with mobility constraints.



Figure 2. Telework and mobility constraints

Map 6-1 The preferred spatial strategy to decongest the CBD of Nairobi



Source; Author's preferred strategy 2002

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Appendix 1 Definitions of pertinent operational terms

The study adopts various concepts whose meaning may contradict normal usage. For the purpose of this study, it is necessary to define some of the terms that may have different meaning and so implied in this paper:

Bus: A large vehicle that carries passengers. Especially one that travels along a fixed schedules and fixed route stopping regularly to let people on and off. In the study, therefore where the term is adopted it includes the country operating buses, including the Kenya Bus Service and the city operating Buses.

Cartels; Interest group. The Nairobi routes and terminals management groups, which are illegal in their operations, but the authorities, know they exist.

CBD; The most busy part of the city of Nairobi, where the tallest buildings, very busy commercial activities, the civic activities, the highest land values, the most specialised activities and the area favoured by most urban trips made in the whole city area and beyond.

Congestion; The condition of being too full or blocked up especially because of traffic. It is the state of being crowded and blocked, with impended movements.

Decongesting means the efficient and effective management and utilisation of the existing transport system, the free flow on the roads, the flexibility of space in the carriers and terminal facilities.

Jam: to crowd with people, or cars, so that movement is difficult or impossible.

KBS - Kenya Bus Service, a private and formal public transport company offering public transport services in Nairobi. This company was sold in December 2001 to a new transport company known as the Bus Truck.

Location: The total urban environment in which a specific urban land use interacts at a specific time. Total urban environment can be conceived of as including the economy, the social and institutional structure, the physical setting and design of the urban areas, and the psychological reaction of the population to these variables.

LRT; light railway transport.

Management; the control and the making of decisions.

Matatu - The study adopts the Traffic Act (Cap 403) definition of a Matatu as “public service vehicle (psv) having a seating accommodation of not more than twenty five passengers exclusive of the driver but does not include a motorcar - (which has a seating accommodation of less than ten passengers).

Manyanga: A new matatu with a capacity of 25 seating a capacity of 25 seating accommodation. The term does not include an 18-seater matatu.

NBS - Nyayo Bus Service: This was a public transport corporation owned by the state. After operating for a couple of years the corporation wound-up its operation

NMT; 'Non- Motorised Transport'; this is a mode of travel where by the vehicle is not necessarily motorised. Includes such modes as, the handcarts, the animal drawn carts, the bicycles, the wheelbarrow and the walking (self-propelled vehicles), among others.

Personal car; its used to mean the 'private transport service, such as the personal car, the employers car or the company car.

PSV: Passengers service vehicles. These are vehicles licensed to carry passengers on commercial basis. They include the bus, the matatu and the Matatu Manyanga.

Terminal Facilities: Points at which goods and passengers enter and leave the transport system or change modes or vehicles. In this study where the term is used it includes, the Bus stations, bus stops, interchanges, and lay-bys. The term was so used since even areas designated as merely bus stops or lay-bys are currently used by matatus as terminal points.

Traffic congestion and traffic jam shall be used interchangeably to mean a long line of vehicles that cannot move or that can only move very slowly because of too much traffic on the road.

Traffic vehicles moving along a road or a street. Traffic also includes the number of people or the amount of goods moved from one place to another by road, Rail, Sea or air. The traffic also includes the wheeled carriers, the motorised, non-motorised and human traffic. For the purpose of this study, only the traffic on the city streets and the city roads shall be considered relevant.

Traffic light and stop light shall be used interchangeably to mean the automatic signal lights that controls road traffic, especially where roads meet or cross one another by means of red, orange and green lights.

Traffic policeman and traffic warden shall be used interchangeably to mean a person whose job is to check that people don't park vehicles in the wrong places or park in the correct places for longer that its allowed, and control the movements of the vehicles in the CBD.

Transport/traffic managers: Ministry of Roads and Public Works Traffic Engineers, Transport Planners, Traffic Police, and Nairobi City Council Traffic Engineers.

Transport demand; the unexaggerated needs for transportation in a city.

Transport system the three closely related sub systems of the vehicles, the roads and the terminal facilities involved in the efficient and effective movements of persons and goods.

Appendix 2 Bus Route And Matatu Routes
Zone 1

Bus Routes	Bus Numbers
Bahati Mlangoni	7, 8B, 23, 36, 37
City Stadium	19C, 19, 23, 34, 36, 37
Community	2, 4, 7, 8B, 28, 34, 36, 37, 40, 42, 103, 111
Kenyatta Mlangoni	4, 7, 8B, 28, 34, 36, 37, 40, 42, 42B
Pumwani	7, 8B, 18, 28, 41,
Kariokor	32, 40, 42, 46
Gikomba	7, 8B, 18, 28, 41
Bus Station	2, 103, 105, 108, 110, 111, 119, 126
City Centre (the CBD of Nairobi)	All buses
Valley Road	41, 46, 46B

Zone 2

Westlands	23, 105, 119
Kwa Meno	23, 105
Kenya Air Force Gates	18, 28, 40, 41, 46
Chiefs Camp	14C, 18, 28, 32, 40, 42B, 46
Eastleigh Section 3	4, 8B
Shauri Moyo	7
Jerusalem	7, 8B, 23, 36, 37
Nairobi West	126
Ngumo	36, 37, 40, 41
Kibera	8B, 28, 32, 42,
Mbagathi	126
Yaya Centre	46, 46B
Kangemi	23, 105
Ruaraka G.S.U.	42B
General Waruinge Street	8B
Pangani Roundabout	29C, 42B, 108

Zone 3

Gertrude's Hospital	108
Huruma	18, 28, 40, 41, 42, 42B, 46
Kariobangi (Roundabout)	36, 37
Donholm	34, 61B
Jericho	23
Rabai Road	19, 19C, 36
General Motors	110
Carnivore	34, 126
Wilson Airport	34, 126
Lenana	2, 4, 103, 111
Dagorretti Corner	2, 4, 103, 111
Wanyee Road	2, 4, 103
Adams Arcade	4, 2, 5, 103, 111
Kanungaga	46B
Kawangware	46

Zone 4

Green fields	34B
Waithaka	2
Riruta Satellite	4
Kabete Dukas	103, 105
UNEP	103
Umoja II	61B, 18
Outering Road Estate	19C, 19, 23, 36, 23
Buruburu	19, 19C, 36
Dagorretti Market	2

Zone 5

Mlolongo	110
Otiende	24
Ongata Rongai	125, 126
Gachui	2
Dagorretti Market	2
Muthiga Dukas	103, 105
Gitaru	103, 105
Wangige	103, 108, 119
Mwimuto	119

Gachie	108
Karura	108
Gichagi	108
Dandora	32, 36, 37, 41, 42, 42B
Komarock	18, 19, 19C
Kayole	18, 61B
Pipeline	34
Kihara	108
Kikuyu Station	105
Kinoo	103, 105
Soweto	18, 61B
Zone 6	1234
Ngong	111, 126
Jomo Kenyatta International Airport	34
Karen	111

Zone 7

Kiserian	111, 126
Athi River	110
Matatu Routes	Matatu Number
Baba Dogo	25
Banana	106
Buruburu/Hamza	58
Buruburu/Outering	23
Community	2, 42
Dandora	32
Dandora Via Buruburu	36
Donholm	33
Donholm/Green fields /Savannah	34B
Donholm/Tena	34C
Eastleigh	9, 6
Eastleigh	9
Gachie	108
Githurai	44
Githurai/Kahawa West/KU	45
Jericho, Rabai	8B
Jerusalem	23, 8B
Jomo Kenyatta International Airport	34
Kawangware	46
Kayole/Komarock	19/60
Kiambu	100
Kibera	8, 42
Kikuyu	102
Mountain View/Kinoo	30
Ngumo	41
Ongata Rongai	126
Pangani	9, 6
Peponi	119
South B	11
South C	12
Thika	237
'Thome'	53B
Umoja	35
Umoja II	35/60
Umoja I	35
UNEP	105
Uthiru	22
Valley Road	46
Wangige	115
Wangige/Kabete	118
Westlands/Kangemi	23

Appendix 3



UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING.
TOPIC reducing Urban Traffic Congestion. A Case Of the CBD of Nairobi
QUESTIONNAIRE FOR ANY DRIVER IN THE CBD OF NAIROBI

The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only.

Questionnaire No:

Date of Interview: **Place of interview**

GENERAL

- 1. Re
- 2. Sex of respondent _____ Age _____
- 3. Education level

Level	Tick Appropriately
Not gone to school	
Primary	
Secondary	
Colleges	
University	
Others (specify)	

- 4. Occupation _____
- 5. Period of stay in Nairobi _____
- 6. Family Size

Members	Age	Sex	Occupation
Spouse (s)			
Children			
1.			
2.			
3.			
4.			

- 7. Type of vehicle operated (please tick one)
 - A Private car
 - B Matatu
 - C Bus
 - D Others (specify)
- 8. Number of route mostly followed e.g. NO. 2 to Dagorretti market, or No. 44 to Githurai. Please specify.....
- 9. Trip origin..... trip destination.....
- 10. Trip Purpose (Tick appropriately)
 - A Work
 - B Services (specify)
 - C Leisure
 - D Others specify
- 11. Apart from your 'official' route, do you drive on any other route(s)?
 - Yes No
 - If yes
 - a) State which one(s).
 - b) Give reasons why you sometimes change route(s) operated on.
 - c) At what times do you drive on the other route(s)?
 - d) How many trips do you make per day?
 - e) If you offer public transport service do you charge the same fares throughout the day?
 - Yes / No
 - f) If no in (e) above, please give reasons
 - g) If you operate a matatu or a bus about how many matatus/buses are there on the route you operate?
- 12. In respect to the route on which you operate, do you consider the route to be jam free Yes /No If No give reasons
- 13. Average Time taken on the road from home to the CBD
 - A In the morning
 - B In the afternoon
 - C in the evening

14. Any jam on the road (Tick one)

- Yes
- No

If yes
 Where _____ and at what time _____

What was the cause? _____
 How was it being controlled _____?

15. For how long have you driven On this route

Period (years)	Tick
1 year & less	
1 - 2	
3 - 4	
5 - 6	

16. a) How did you start /join your current route of operation?
 b) Why didn't you join other routes? (Tick appropriately)

- ❖ Exorbitant fees to join other routes
- ❖ Dense traffic jam
- ❖ Other routes considered unprofitable
- ❖ Routes allocated by traffic officers/Transport Licensing Board
- ❖ Other reasons (specify).

17. What is your view about the traffic police in their effort to enforce the traffic regulations to manage traffic jam in the city?

18. Do you know about the Transport Licensing Board regulations?

- YES
- NO

If yes

A), state the requirements of Transport Licensing Board that you know or understand

- 19. What is your view about the Transport Licensing Board attempts to control and regulate the operations of all vehicles in the city
- 20. What is your view about the attempt by the city council to operate and manage the parking and the bus terminuses?
- 21. What would like to be done to streamline he operations and management of traffic jam in the city
- 22. What is the effect of the jam on your trip?
- 23. What problems do you face in the CBD due to traffic congestion?
- 24. What are your views on traffic jam in the CBD of Nairobi?
- 25. Comment on the following transport management.
 - A. Nairobi city council Poor
 - B. Traffic Police Good
 - C. Kamjeshi Better
- 26. What would you propose the government to do in order to manage the traffic jam in Nairobi as a whole and the city centre of Nairobi?

THANK YOU and have a jam free driving.

Appendix 4



UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING.
TOPIC: Reducing Urban Traffic Congestion. A Case Of The CBD Of Nairobi
QUESTIONNAIRE FOR ANY TRAVELLERS IN THE CBD OF NAIROBI

The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only. Your cooperation will be highly appreciated.

Questionnaire No:

Date of Interview: Place of interview

- 1.
- 2.
- 3.

Sex of respondent _____ Age _____
Education level _____

Level	Tick Appropriately
Not gone to school	
Primary	
Secondary	
Colleges	
University	
Others (specify)	

4. Occupation _____
5. Period of stay in Nairobi _____

6. Family Size

Members	Age	Sex	Occupation
Spouse (s)			
Children			
1.			
2.			
3.			
4.			

7. Trip origin _____ trip destination _____

8. A) what mode of public transport do you commonly use?
 Matatu Kenya bus service taxi

b) Which one do you prefer?

c) Give reasons

d) Other modes of transport frequently used _____

9. For how long have you been using the public transport?

10. Do you come to the CBD daily?

- Yes
- No

If yes, a) state the purpose of your trips to the CBD

11. A) _____ at what time do you leave your place of work after job

b) About how long do you wait for the bus/matatu once at the bus terminal?

12. At the terminal do you queue as you wait for the bus/matatu home? Yes / No

a) If No, how do you board your vehicle home?

b) From your place of work, how long does it take you to your home?

Time in minutes	Tick
30	
45	
60	
> 1 hr	

c) Do you encounter any traffic jam on your journey? If yes what area the causes and how can they be managed?

13. Do you consider the present state of the roads in the CBD as appropriate?

- Yes
- No

a) If No Give reasons

b) Give suggestions what you would like to be done on the roads and the bus stations in the CBD to manage the traffic jam

Appendix 5



UNIVERSITY OF NAIROBI

DEPARTMENT OF URBAN AND REGIONAL PLANNING.

TOPIC: Reducing Urban Traffic Congestion in Nairobi. A Case Of the CBD

QUESTIONNAIRE FOR NON-MOTORISED TRANSPORT OPERATORS IN THE CBD

The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only. Your co-operation will be highly appreciated.

Questionnaire No:

Date of Interview: **Place of interview**

GENERAL

1. Respondents Name _____ (optional)
2. Sex of respondent _____ Age _____
3. Education level

Level	Tick Appropriately
Not gone to school	
Primary	
Secondary	
Colleges	
University	
Others (specify)	

4. Occupation _____
5. Period of stay in Nairobi _____
6. Type of NON-MOTORISED TRANSPORT operated

NON-MOTORISED TRANSPORT	Tick all that applies
Bicycle	
Hand cart	
Wheel barrow	
Walking	
Others (specify)	

7. How many Non-Motorised Transport do you own and operate? _____
8. Trip origin _____ trip destination _____

9. Can you fulfil the trip purpose elsewhere without coming to town?
YES
NO

IF yes what is the trip purpose for this trip to the CBD?

10. Time generally taken in the trip.....

11. Routes normally used in the CBD

Street	Tick as applies
Tom Mboya	
River road	
Moi Avenue	
Uhuru highway	
Haile Selassie avenue	
Kenyatta avenue	
University way	
Racecourse road	

12. Side of the road normally used in operation
 Left
 Right
13. Do you experience any traffic jam on your daily trips?
 Yes
 No

14. If yes, what do you consider to be causes of the traffic jam?

Street section	Cause of jam

15. Give your suggestion on the possible way to manage the jam in the CBD of Nairobi

16. Are there any specific routes reserved for non-motorised transport?

yes

No

If yes do you use them and how frequently

Why do you use the main street all the times?

17. Comment on the behaviour of other road users towards NON-MOTORISED TRANSPORT. Use good, bad and fair to comment

Buses	
Matatus	
Passengers	
Private car	

18. How do you relate with the traffic officers?

The city council officers

Relationship	Tick as applies
Good	
Bad	
Fair	

The traffic police officers

Relationship	Tick as applies
Good	
Bad	
Fair	

The route management officials

Relationship	Tick as applies
Good	
Bad	
Fair	

19. Comment by crossing the arrows on the behaviour of

- a) Private personal driver poor
- b) Matatu driver fair
- c) Bus driver good
- d) Traffic police better
- e) City council best
- f) Conductor
- g) Pedestrians

Thank you and take care

Appendix 6



UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING.
TOPIC: Reducing Urban Traffic Congestion in Nairobi A Case Of the CBD
QUESTIONNAIRE FOR WORKERS IN THE CBD OF NAIROBI

The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only. Your co-operation will be highly appreciated.
Questionnaire No:
Date of Interview: **place of interview**

GENERAL

1. Respondent's name (optional) _____
2. Sex of respondent _____ Age _____
3. Education level

Level	Tick Appropriately
Not gone to school	
Primary	
Secondary	
Colleges	
University	
Others (specify)	

4. Occupation _____
5. Period of stay in Nairobi _____
6. Family Size

Members	Age	Sex	Occupation
Spouse (s)			
Children			
1.			
2.			
3.			
4.			

7. What is your monthly income?.....
8. What is your basic mode of travel?

9. Trip details (please tick appropriately.)

Division of Residence	On which road is your place of work	Division you go for other services (please tick as appropriately)
Kibera		
Dagorretti		
Parklands		
Kamukunji		
Kasarani		
Embakasi		
Makadara		
Starehe		
CBD		

10. Family vehicle ownership

Member	No of cars	No of other vehicles
Father		
Mother		
Others (specify)		

11. In your opinion what is the cause of traffic jam in the CBD of Nairobi
12. How does the traffic jam affect you? (Tick one)

- Badly
- Goodly
- No effect

Others (specify)

13. What is your comment on the roads system and traffic management in the CBD of Nairobi?
14. What benefits or losses can you attribute to poor traffic jam management in the CBD of Nairobi?

15. What are the effects of traffic jam on your trip?

Effect	Tick appropriately
Environmental pollution	
Time wasting	
High Fuel consumption	
Loss of Income	
Others (specify)	

16. Time spent on the road from home to the CBD during the peak hours

Time	To town	To home
Less than 1 HR		
More than 1 HR		
Others (Specify)		

17. Time spent on the road from home to the CBD during the off peak hours

Time	To town	To home
Less than 1 HR		
More than 1 HR		
Others (Specify)		

18. Comment on the behaviour of the following in the management of traffic jam in the CBD of Nairobi. Use good, fair and bad to comment.

People	CBD roads	Other roads
Traffic police		
City council		
Conductors		
Drivers		
Non-Motorised Transport		
Pedestrians		

19. Suggest ways, which can be used for effective management of traffic jam in the CBD of Nairobi during the peak hours

Thank you for your co-operation.

15. What are the effects of traffic jam on your trip?

Effect	Tick appropriately
Environmental pollution	
Time wasting	
High Fuel consumption	
Loss of Income	
Others (specify)	

16. Time spent on the road from home to the CBD during the peak hours

Time	To town	To home
Less than 1 HR		
More than 1 HR		
Others (Specify)		

17. Time spent on the road from home to the CBD during the off peak hours

Time	To town	To home
Less than 1 HR		
More than 1 HR		
Others (Specify)		

18. Comment on the behaviour of the following in the management of traffic jam in the CBD of Nairobi. Use good, fair and bad to comment.

People	CBD roads	Other roads
Traffic police		
City council		
Conductors		
Drivers		
Non-Motorised Transport		
Pedestrians		

19. Suggest ways, which can be used for effective management of traffic jam in the CBD of Nairobi during the peak hours

Thank you for your co-operation.

Appendix 7



UNIVERSITY OF NAIROBI

DEPARTMENT OF URBAN AND REGIONAL PLANNING.

TOPIC: Reducing Urban Traffic Congestion. A Case Of the CBD of Nairobi.

QUESTIONNAIRE FOR TRAFFIC POLICE AND THE CITY COUNCIL TRAFFIC WARDEN ON DUTY.

The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only.

Questionnaire No:

Date of Interview: place of interview

GENERAL

1. Respondents Name (optional) _____

2. Education level

Level	Tick Appropriately
Not gone to school	
Primary	
Secondary	
Colleges	
University	
Others (specify)	

3. Occupation _____

4. What Authority do you represent? _____

5. What Specific duties are allocated to you? _____

6. Do you manage traffic jam on some specific Streets?

Yes

No

If yes which one(s) _____

7. What types of traffic do you deal with?

Motorised

NON-MOTORISED TRANSPORT

Pedestrian

Others (specify)

8. What specific reasons can you give as the causes of traffic jam build up in streets you manage in the CBD of Nairobi?

9. How can they be avoided or controlled?

10. Comment on the behaviour of the traffic vehicle operators. Use fair, good and bad to comment

Drivers _____

Conductors _____

Kamjeshi _____

Owners associations _____

11. In your opinion where do you place the Non-Motorised Transport as a mode of transportation in Nairobi CBD?

Desirable

Undesirable

Necessary menace

Others (specify)

12. What do you think of pedestrianisation of the CBD of Nairobi?

Acceptable

Not acceptable

Others (specify)

13. Is the traffic policy adequate?

Yes / No

If no, what are the weaknesses?

14. Comment by crossing arrows, on the behaviour of the following individuals or the road

a) Personal poor

b) Matatu fair

c) Bus good

d) Other driver better

e) Non-Motorised Transport best

f) Pedestrian

15. In your opinion do you find the capacity of the road system adequate?

Yes

No

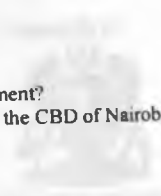
If no, what are the problems _____?

16. Are the roles of the police and the Nairobi City Council complimentary?

- Yes
- No

If yes how?

- 17. What is the role of he Kamjeshi in Nairobi urban traffic management?
- 18. What can be done to effectively manage the traffic congestion in the CBD of Nairobi?



Thank you and have an acceptable day

Name of Respondent		Signature	

Appendix 8



UNIVERSITY OF NAIROBI

Topic. Reducing urban traffic congestion. A case study of Nairobi CBD.

INTERVIEW SCHEDULE TO NAIROBI CITY COUNCIL.

Declaration: The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only. Your co-operation will be highly appreciated.

Date of interview _____

Respondent name and (Position/ Responsibility) _____

1. A) How many bus/matatu terminuses, bus stops etc. are there within the city centre?
- b) How many of these terminuses are officially designated and developed for public buses?
- c) What is the capacity of each of these terminuses?

	Terminus name	Location	Parking capacity
(i)			
(ii)			
(iii)			
(iv)			

- d) Of these terminuses, how many are operated and managed by the Nairobi City Council? (Give details)
- e) What is the estimated number of matatus that operate within Nairobi and its environs?

- 2 A) Does the Nairobi City Council take part in allocation of routes for matatus? Yes/No
- b) If yes, give details
- c) Is the Nairobi City Council involved in allocation of bus/matatu-terminuses within the city centre?
Yes/ No
- d) If yes, give details

3. A) what criterion does the city council follow to allocate the various matatu terminuses within the CBD?

- 4 The recent proposal by Transport Licensing Board suggest that the local authorities, Nairobi City Council included will be charged with the operation and management of terminal facilities, what is your view about this proposal?
- 5) Does the Nairobi City Council charge all the matatus operating in NAIROBI? Yes/ No
- a) If No give details on the criteria used to select which matatus that qualify for charges?
- 6) How much does the City Council collect daily or weekly from the matatus?
- 7 Which are the main traffic management techniques used by the Nairobi City Council to decongest the CBD of Nairobi
- 8 the most important road sign boards are conspicuously missing in the CBD of Nairobi streets, why is that so?
- 9 The capacities of most roads in the CBD of Nairobi seem to be really inadequate,
What are the opinions of the city council towards restriction and the construction of ring roads around the CBD of Nairobi?
- 10 Why does the council present its self poorly in roads construction, maintenance and management in the city of Nairobi?
- 11 The CBD of Nairobi exhibits several obsolete and outdated street junctions e.g. Ronald Ngala and Moi avenue junction, Mama Ngina street and Moi avenue, Kenyatta avenue and Moi avenue, tom Mboya street and Kenyatta avenue, Ronald Ngala and tom Mboya street is the worst in town.
What is the city engineer's opinion on these?
- 12 Does the city council hold traffic management liaison meetings with other city authorities regularly? If yes how regular and with which other city authorities?
- 13 How reliable are the city traffic control lights and what is their major problem
- 14 When was the country bus station constructed and by who
- 15 What were the objectives of the project?
- 16 Apart from the Machakos airport, which other country bus stations are there in the city of Nairobi
- 17 what is the hierarchical organisation chart of the city engineer roads like

The city planner

- 1 In your own opinion do you consider the location of the public Transport terminuses appropriate? Yes/No
If No, Give reasons and your suggestion/ Examples
- 2 Does the city council have intentions to provide more public bus/matatu terminal facilities Yes/No?
If yes, please give details?
- 3 What is the latest traffic control plans to decongest the CBD of Nairobi
- 4 There have been several research work proposals on the operation of public transport in Nairobi, why has the Nairobi city council failed to implement the proposals?
- 5 What are the major causes of traffic congestion in the CBD of Nairobi?
- 6 How do you think they can be overcome?
- 7 Most pedestrian tunnels in the CBD of Nairobi seems to be no longer in use, why
8. What is the council's position towards the conversion of the utilisation of the roads in the CBD to be used as hawking areas and market places even during the daytime.
9. What is the hierarchical organisation of the city-planning department like?

Appendix 9



UNIVERSITY OF NAIROBI

Topic. Reducing urban traffic congestion. A case study of Nairobi CBD.

Interview schedule for Transport Licensing Board

Declaration: The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only. Your co-operation will be highly appreciated.

Date of interview _____

Respondent name and (Position/ Responsibility) _____

1. What are the Transport Licensing Board Licensing requirements for public transport vehicles?
2. Which types of vehicles are authorized to operate in the CBD of Nairobi?
3. Is the board aware of the Existence of bus terminus management cartels?

Yes

No

If yes, are they licensed?

Yes

No

If no, what justifies their existence in the transport management activities?

4. Who allocates the city operation routes to the vehicle in Nairobi?
5. Who is in charge of the Organization of routes and routes management within the CBD of Nairobi after they area allocated?
6. What is the Route allocation procedure considered by the Transport Licensing Board?
7. What are the specific Roles of the Transport Licensing Board in traffic management in the CBD?
8. How do the road users benefit from the Transport Licensing Board funds?
9. Is the Transport Licensing Board funds used directly in the improvement of CBD transportation system?
10. How Synchronized are the activities of Nairobi City Council, Transport Licensing Board and traffic police traffic in the management of traffic activities in the CBD of Nairobi
11. Briefly describe the Relationship between Transport Licensing Board, the matatu welfare association and the route management associations.
12. Briefly discuss the significance of Transport Licensing Board in urban traffic management and the difference between Transport Licensing Board, road license, psv, and the driving license.

Appendix 10



UNIVERSITY OF NAIROBI

Topic. Reducing urban traffic congestion. A case study of Nairobi CBD.

Interview schedule for the traffic police on duty

Declaration: The researcher is **Mr. Daniel Kithunka Rukunga**, a Master of Arts (planning) final year student. This information is confidential and will be used for academic purposes only.

Date of interview _____

Respondent name and (Position/ Responsibility)

1. Which specific legislations authorize the traffic police to control the traffic on roads?
 2. Do the traffic police use any police discretion in Implementation of traffic act cap 403?
 - Yes
 - No
- If yes, to what extent is the discretion allowed?
- a) Stopping vehicles in the roundabouts
 - b) Allowing faulty vehicles to proceed and attend courts later
 - c) Towing away vehicles that can move themselves to the police stations
3. What is the police opinion in the Pedestrianisation schemes in the CBD?
 - Acceptable
 - Not acceptable
 - No comment
 4. What is the traffic Police opinion on the buses, which operate on road reserves e.g. Akamba bus services, the Embu and Meru matatus, Kisii buses, and Kajiado matatus?
 5. Why are there perennial jam points in the city? E.g. racecourse road towards Kariokor round about, the OTC building area, Ronald Ngara post office, commercial bus stop and the old nation house round about.
 6. Is there any police discretion in the implementation of Transport Licensing Board, road licence, and psv requirement?
 - Yes
 - No
- If yes, how flexible is it?
7. Under what circumstances can the traffic police allow roads blockages, road works, and broken down vehicles on the busy CBD streets.
 8. Is it the duty of the traffic police to management the terminal facilities, lay bays, and parking spaces within the CBD of Nairobi?
 - Yes
 - No
- If yes, how does the traffic jam come about in the very presence of the trained police officers?
9. How do the police handle the unruly matatu drivers and the makanga behaviour in the CBD?
 - (i) Instant fines
 - (ii) Immediate booking for court attendance
 - (iii) Immediate arrests
 - (iv) Friendship creation
 - (v) Just ignore them
 - (vi) Other ways (please specify)
 10. What is the relationship between the police, the city council officers, the matatu welfare association, and the terminus management cartels?
 11. Are there any special traffic Police management unit specifically detailed for the management of traffic jam in the CBD of Nairobi?
 - Yes
 - No

If yes, why do they seem to be overwhelmed by traffic congestion in the CBD?

