

**OPERATIONAL CHALLENGES OF PUBLIC TRANSPORT TERMINI IN
NAIROBI CENTRAL BUSINESS DISTRICT**

By

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for the Degree of Master of Arts Planning**

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Declaration

This research report is my original work and has not been presented for a degree in any other university.

Signed.....

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Date: _____

This thesis has been submitted for examination with my approval as a university supervisor.

Signed.....

Dr. Samuel V. Obiero

Date: _____

Dedication

To my beloved family for their patience continued support, encouragement and prayers. I thank God for the gift of life.

Acknowledgement

I acknowledge the unending efforts of my supervisor DR. Obiero for his encouragement and patience that enabled me to carry out this research. I also thank Dr Opiyo, Dr. Mugo, Mr Maleche and other departmental staff who assisted me during the process. I am also grateful to my classmates and research assistants. May God bless all of you.

Abstract

Terminal facilities are important elements in public transportation systems. They are used as entry and exit points in the public transport modes. In Kenya public transport mainly uses roads as a mode of transport. The vehicles used include matatus, buses and motor cycles which operate using a paratransit mode. The matatus offer about 80 % of the public transportation services in Kenya and therefore they are important to the economic development. These matatus require termini to facilitate efficient operations. This study concerns the operations of matatu termini located on Tom Mboya Street, Latema Road, River Road, and Timboroa Road. Termini siting, design of a terminal layout, adequacy of facilities and vehicle control methods have an impact on the quality of operations and management. The location and operations of matatu termini in the study area has been presumed to be one of the factors contributing to traffic congestion problems in the Nairobi CBD. The objectives of this research were to examine the procedure use in the siting of matatu termini, assess the adequacy of terminal facilities, investigate how the operations of the matatu termini affect traffic flow in the study area and propose spatial planning intervention measures that can be used to solve the identified challenges. The data was collected through a literature review of existing documents, administration of questionnaires to commuters and matatu crew. Interview of key informants who included Traffic policemen, Nairobi County officials from the Infrastructure and Inspectorate departments and matatu SACCO terminus managers were conducted. More data was collected by observations and photography. A case study was carried out at the Nation Roundabout terminus to determine the matatu turnover. The collected data was analyzed by Map Info and Arc GIS software, SPSS statistical package, Ms Excel and synthesis of field reports. The termini operational challenges found were, inappropriate siting, inadequate commuter and vehicle facilities, lack of coordination of traffic control by the concerned authorities, and disobeying of traffic regulations by both commuters and matatu crew. The above findings led to the conclusion that the matatu termini in the study area have management challenges that cause inefficient operations contributing to traffic congestion problems in the Nairobi CBD. The proposed planning interventions to achieve efficient operations at the termini include; formulation and enactment of siting guidelines and provision of adequate terminal facilities by the Nairobi county government. An operational framework for the matatu termini and conversion of the current termini into matatu stop points should be introduced to alleviate congestion in the Nairobi CBD.

Table of Contents

Declaration	i
Dedication	ii
Acknowledgement	iii
Abstract	iv
List of Tables	viii
List of Figures	viii
List of Maps	ix
Abbreviations	x
CHAPTER 1: INTRODUCTION	1
1.1 Overview	1
1.2 Statement of the Research Problem	3
1.3 Research Questions	5
1.4 Objectives of the Study	5
1.5 Assumptions of the Study	5
1.6 Geographical and Theoretical Scope	6
1.7 Justification	6
1.8 Definition of terms	7
1.9 Organization of the Thesis	8
CHAPTER 2: LITERATURE REVIEW	10
2.1 Introduction	10
2.2 Theory of Urban Transportation Planning	10
2.2.1 Urban Transport models	10
2.2.2 The Systems Approach to Planning	11
2.2.3 Theory of Landuse and Transportation Relationship.	12
2.3 Efficient Public Transport Systems (A Case of Mexico City)	13
2.4 Termini Operations Alleviate Congestion on the Roads	14
2.5 Design of Bus Terminals	15
2.6 Previous Operations of Public Transport in Nairobi	20
2.7 Background Study on Matatu Termini Allocations	21
2. 8 Terminal Facilities Serve the Needs of Vehicles and Passengers	23

2.9 Operations and Management of Matatu Termini.....	24
2.10 Traffic Policies and Legislation in Kenya	24
2.11 Conceptual Framework.....	28
CHAPTER 3: RESEARCH METHODOLOGY	31
3.0 Introduction.....	31
3.1 Research Design.....	31
3.2 Data Needs	32
3.3 Determination of Research Population	33
3.3.1 Target Population	33
3.4 Sample Design	34
3.4.1 Sampling Frame.....	34
3.4.2 Data Collection Methods/Instruments	36
3.4.3 Selection of Research Assistants	36
3.4.4 Sampling Techniques	36
3.4.5 Sampling of Commuters.....	36
3.4.6 Sampling of Matatu Crew.....	37
3.4.7 Sampling of Matatu Termini	37
3.4.8 Sampling of Key Informants	38
3.5 Observation.....	38
3.6 Photography	38
3.7 Mapping	38
3.8 Case Study	38
3.9 Data Coding and Analysis	39
3.10 Data Presentation	39
3.11 Conclusion	39
CHAPTER FOUR: THE STUDY AREA	40
4.0 Introduction.....	40
4.1. Study Area at National Context.....	40
4.2 Study Area at Local Context.....	40
4.3 The Study Area	43
4.4 Traffic circulation	43

4.5 Demography and Public Transport Demand in Nairobi	44
4.6 Landuse Pattern.....	45
CHAPTER FIVE: RESULTS OF DATA ANALYSIS AND DISCUSSIONS.....	46
5.1 Introduction.....	46
5.2 Allocation Procedure for Matatu Termini.....	46
5.2.1 Siting Characteristics of Matatu Termini	47
5.2.2 Old Nation Roundabout.....	47
5.2.3 Latema Road Terminus	50
5.3 Assessment of adequacy of passenger and vehicle at the matatu termini.....	54
5.3.1 Characteristics of the commuter population.....	54
5.3.2 Commuter Facilities	57
5.3.3 Commuter Matatu Boarding Areas.....	58
5.3.4 Availability of matatu facilities at termini.....	59
5.4 How the operations of termini affect traffic flow in the study area.....	62
5.4.1 Matatu Waiting Time.....	62
5.4.2 Availability of Parking Spaces	63
5.4.3 Matatu Control Methods.....	64
5.4.4 Pedestrian Access to Matatu Termini.....	65
5.4.5 Matatu Contribution to Traffic Congestion	66
5.4.6 Old Nation Terminus Vehicle Turnover Survey (case study)	67
5.6 Matatu Terminus Preference Sites	69
5.6 Synthesis of Findings	71
5.6.1 Inappropriate Matatu Termini Route Allocation and Siting.....	71
5.6.2 Lack of Passenger Facilities	71
5.6.3 Lack of Vehicular Facilities	72
5.6.4 Lack of Matatu Parking Spaces	72
5.6.5 Long Parking Periods	72
5.6.6 Inefficient Management Methods of Matatu Fleet.....	72
5.6.7 Ineffective Enforcement of Existing Traffic Regulations	73
5.7 Proposed Intervention Measures on Operational and Management of Matatu Termini.....	73
5.7.1 Appropriate Siting of Matatu Stops and Termini	73

5.7.2 Urban Transportation Planning Policy.....	79
5.7.3 Use of Efficient Public Service Vehicle Control Methods	79
5.7.4 Re- Design of Terminus Facilities	79
5.8 Conclusion	79
CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS	80
6.1 Overview.....	80
6.2 Summary.....	80
6.2 Conclusion	81
6.3 Recommendations.....	82
6.3 Further Research	83
Appendices.....	87
Appendix 1: Commuter Questionnaire	87
Appendix2: Matatu Crew Questionnaire	92
Appendix3: Traffic Police interview schedule	96
Appendix4: Nairobi County Interview Schedule.....	98
Appendix6: Matatu Turnover Entry Forms	101

List of Tables

Table 1: Data Needs Matrix.....	32
Table 2: Target Population.....	34
Table 3: Sampling Frame.....	35
Table 4: Existing Matatu Termini in the Study Area.....	47
Table 5: Available vehicle facilities	59
Table 6: Vehicle Entry and Exit Count.....	68

List of Figures

Figure 1: 45 ⁰ and 90 ⁰ platform orientations	18
Figure 2: Angular Layouts of Bus platforms	19
Figure 3: Conceptual Framework	30
Figure 4: Study Design	31
Figure 5: Commuter Population by Gender.....	55
Figure 6: Trip Purpose	55

Figure 7: Number of Years Commuting by Matatu.....	56
Figure 8: Existing Passenger facilities at Matatu Termini.....	57
Figure 9: Commuter Boarding Areas.....	58
Figure 10: Availability of vehicle facilities	60
Figure 11: Matatu Waiting Time	63
Figure 12: Availability of Parking Space.....	64
Figure 13:Matatu contribution to Traffic congestion (Commuter and Matatu Crew Opinion)....	67
Figure 14: Commuter Termini Preference Sites	70
Figure 15: Matatu Crew Termini Preference Sites	70

List of Maps

Map 1: Nairobi City at a National Context.....	41
Map 2: The Study Area at Local Context	42
Map 3: The Study Area.....	44
Map 4: Site Characteristics at Old Nation Roundabout Terminus	49
Map 5: Siting Factors at Latema Terminus.....	53
Map 6: Proposed Matatu Stops	76
Map 7: Matatu Stops Points 1, 2, 3 & 7.....	77
Map 8: Matatu Stops Points 4, 5, 6& Muthurwa Terminus.....	78

List of Plates

Plate 1: Montreal Montmorency Metro Station and U shaped Bus Station.....	17
Plate 2: One Island Bus Station	19
Plate 3: Matatu Parking on Lagos Road	51
Plate 4: Matatu Parking on Latema Terminus	52
Plate 5: Matatus Queuing at Old Nation Terminal Entrannce.....	61
Plate 6 : Extended Matatu Queue into the Neighbouring Street.....	61
Plate 7: Route Manager Record	65
Plate 8: Traffic Policeman Controls traffic on Tom Mboya Street.....	65
Plate 9: Pedestrians Crossings at Non-designated points	66
Plate 10: A Matatu Parked on the Pavement	69

Abbreviations

APTA	American Public Transport Association
BRT	Bus Rapid Transport
CBD	Central Business District
NCC	Nairobi City County
ITDP	Institute for Transport Planning
JICA	Japan International Cooperation Agency
NTSA	National Transport and Safety Authority
KeNHA	Kenya National Highways Authority
TLB	National Transport Licensing Board
TCRP	Transport Cooperative Research Program
UTP	Urban Transportation Planning

CHAPTER 1: INTRODUCTION

1.1 Overview

Public transport plays an important role all over the world by providing people with mobility and access to employment, community resources, medical care and recreational opportunities to communities (APTA, 2007). Public transport forms the basic mobility service to citizens causing nations to continuously develop new transport systems and improve existing ones to gain from the benefits of good transportation systems (APTA, 2007). Provision of an efficient public transport system has become a challenge to most nations all over the world. Operating an efficient public transport system faces many challenges which have to be overcome through continuous planning for public transport systems changing demands (Demitriou (2011).

Transport systems consist of three basic elements, travel ways, traffic and terminals. This concept also applies to public transport to public transport services and also includes operations and management. For public transport to be operated optimally there should be a proper match between the three elements and integration of operations and management (APTA, 2007).

Nairobi city in Kenya is one of the cities in developing countries that have challenges in managing its public transport system. The main mode of public transport used in the county is the road (World Bank, 2002). The challenges faced by the public transport system in Nairobi city include but not limited to, poor road infrastructure, provision of public transport services by Paratransit systems which lack good organization structures, increasing number of vehicular traffic and lack of appropriate transportation policy. These factors cause congestion in the road network leading to heavy traffic jams on the city's roads especially the Central Business District (CBD) of Nairobi. Problems associated with congestion include, economic loss, human stress, increased consumption of fuel, increasing pollution levels and insecurity (Kenya, 2009).

Operations of public transport service in Nairobi's CBD by Kenya Bus Service (KBS) Limited between 1934 to late 90's were efficient (Abiero, 1991). The KBS had an organized system of providing public transportation services which consisted of bus schedules for time, route fares and staff time tables (Abiero, 1991). It had designated bus stops and a terminal allocated at the CBD to it by the defunct Nairobi County Council (N.C.C).The existing road networks and infrastructure facilities were sufficient at that time to meet the needs of the population.

The increasing urban population and densification of landuse especially in the Nairobi CBD and Industrial Area led to an increased demand of public transport services which KBS was not able to provide especially on the infringes some of the city boundaries. The demand for transport continued to increase and was estimated at 2.2 % in 1972 (Obonyo, 1982). Middle class entrepreneurs started providing public transport services by operating low capacity vehicles named “matatus” in 1972. The Matatus were legalized to operate in 1973 through a presidential decree by the late President Jommo Kenyatta (Graeff, 2009). The matatus started to operate in the CBD without being allocated bus stops and terminals. The matatus were individual enterprises operated with the aim of making profits. They operated using a paratransit mode therefore, lacked organization in their operations and there was little control from the NCC. Studies conducted by Obonyo (1982) showed that the matatu industry had become chaotic with no terminals for operation, no fixed schedules, no fixed fares and no regulations to govern their operations. They started competing for space with the KBS buses at the bus stops and the terminals. The behavior of matatu crew of picking and dropping of passengers at any point in the road network interfered with the traffic flow (Otieno, 1991).

The matatus required terminal and bus stops facilities to facilitate their operation in the CBD and adopted bus stops previously used by KBS buses, traffic islands, on street parking spaces, back streets and roundabouts for their operations. The adopted spaces were later allocated to them by the NCC by use of ad hoc planning and lobbying by the defunct Matatu Vehicles Owners Association (Otieno, 1991). The matatus were not integrated in the urban transportation system and no planning was done for their terminal facilities in the CBD. The demand for public transport in Nairobi city has continued to increase over the years. The number of Matatus operating in Nairobi City in the years 1987, 1990 was estimated at 1,209, 1,570 (Aduwo & Obudho, 1988). Asengo (2004) estimated this number to reach 40,000 by 2012. This continuous increase in the number of Matatus using the terminals in the CBD has contributed to the increase in the number of vehicular traffic on the CBD road network which leads to congestion.

According to Oumarou and Kulemaka (2007) the demand for public transport was at 1.8 million daily trips in 2007 and projected to rise to 2.9 million trips by 2025. The matatus carry about 33% of the urban commuter traffic which is was estimate at by CES and APEC (2010) to be 3

million passengers per day. About 20, 000 matatus which operate in the Nairobi city are most likely to enter the CBD without restrictions.

In the Nairobi CBD most of the matatu termini are located in the eastern side, which includes minor arterials such as Tom Mboya Street, and River Road. Other roads are Mfangano Street, Latema road, Accra road and Lagos road. Tom Mboya Street and other adjoining roads have been experiencing a lot of traffic congestion which has continued to worsen recently. The traffic congestion in this area has affected the whole CBD traffic flow system and requires to be addressed. This research focuses on the Tom Mboya street area which is also in the eastern part of the CBD to resolve some of the challenges faced in management and operations of matatu termini. There is need to provide appropriate siting areas for termini in order to improve the quality of service offered by matatus.

1.2 Statement of the Research Problem

Terminal facilities are one part of the elements in a transportation system. They form an interface between travel ways/streets and vehicles and serve as points at which passengers do leave or enter a public transport system. In order to facilitate the efficient operations of matatus in Nairobi city, termini facilities are required to allow the setting down and picking up of passengers without causing obstruction on the roads. The termini should be properly sited, adequately sized for their basic purposes and in addition provide protection for passengers from adverse weather conditions, refreshment facilities and information on route schedules. They can also be used as points for efficient management and operations of public transportation services.

However observations at the matatu termini located along Latema road and Tom Mboya Street and the neighbouring roads show that there seems to be lack of effective control of the matatus at the termini. The matatus form long queues while trying to enter or leave the terminus. These queues extend into the neighbouring roads to the termini therefore obstructing other traffic. Lack of adequate parking spaces for matatus at the termini may be the cause of the matatus parking on the streets to offset or pick passengers. The methods used to control the matatus on the streets and the termini do not allow smooth flow of traffic especially in the areas where the termini are located. There is overcrowding of both passengers and matatus at the termini causing insecurity and lack of safety to those using the public service vehicles. The current operations and management of termini are likely to be one of the factors that contribute to the traffic congestion

being experienced in this area. Traffic congestion has become a major problem in Nairobi CBD. It is estimated that the economic cost of congestion in Nairobi is approximately 1.9 billion annually.

Previous studies on the bus terminals show that there is lack of enough termini and bus stops in Nairobi City (Otieno, 1991; Chitere et al., 2012). Nairobi County in its efforts to decongest Nairobi city formed a Transport and Urban Decongestion Committee that released its report in 2014. One of the mandates of the committee was to explore the existing (termini) and realign them by designating or re-designating them to the right place. Some of the measures proposed by the committee to reduce congestion were; expansion of existing road network, road space rationing and parking restrictions.

All the above studies have been conducted on a broad basis, including Nairobi City at large and provide some of the information required for future planning of an efficient public transportation system. Adequacy of terminal facilities is determined by factors such as adequacy of vehicle and passenger facilities versus the number of vehicles and passengers using the facilities. There is scarcity of data on these facilities. Data on these facilities is required to determine how adequate the termini serve as operation points. Previous studies did not focus on the factors that determine efficient operations and management of matatu termini such as siting characteristics and matatu control methods that are used in the study area. Despite the fact that there is some existing information on the siting criteria used by the relevant authorities, more information is needed on how siting characteristics and design can be used in the CBD to ensure that operations of matatu termini serve as points that alleviate traffic congestion. Solutions to the current problems caused by matatu termini operations in the CBD needs to be solved. The location of Matatu terminal in the CBD may not be a contributing factor to the traffic congestion problems in the CBD but other factors such poor road infrastructure, a large number of private vehicles on the roads, private vehicles cruising for parking, increased land use density which attracts a large commuter population. The problem of traffic congestion in Nairobi CBD can also be as a result of failure in the administrative authorities to control vehicular traffic due to poor traffic management system.

This study will investigate the operational and management challenges of matatu termini located on Tom Mboya Street, Latema road, Lagos road and the adjoining roads. It will provide information on siting characteristics, availability of passenger and vehicular facilities. It will also investigate how effective the methods used to control the matatus both at the terminus and on the street alleviate congestion and propose solutions to these challenges.

The Matatus play an important role in the Nairobi by providing public transport services needed for movement of people and goods and require adequate terminal facilities to facilitate their operations.

1.3 Research Questions

- I. What has been the procedure for matatu termini allocations in the study area?
- II. What is the adequacy of passenger and vehicle facilities at the termini in the study area?
- III. How do the operations of the termini affect traffic flow in the study area?
- IV. How can spatial planning be used as a solution for operation and management challenges of matatu termini in the study area?

1.4 Objectives of the Study

The general objective of the study is to investigate the matatu termini operational and management challenges in the study area and propose planning interventions.

Therefore the specific objectives are,

1. To examine the procedure used for siting of Matatu termini the study area.
2. To assess the adequacy of passenger and vehicle facilities in the study area.
3. To investigate how the operations of the termini affect traffic flow in the study area.
4. To propose how spatial planning can be used for effective operations and management of matatu termini in the study area.

1.5 Assumptions of the Study

During the research the following assumptions will be made,

- I. Matatus termini will continue to be located at the Nairobi CBD of the city of Nairobi.
- II. Demand for public transport in the Nairobi city will continue to rise in the city of Nairobi.

1.6 Geographical and Theoretical Scope

Most of the matatu termini are located on the Eastern part of the Nairobi CBD. The area of study will include River road, Accra road, Tom Mboya Street, Latema road and the adjoining lanes and roads which are located in the eastern side of the CBD. Tom Mboya Street constitutes those roads that are experiencing traffic congestion in the CBD due to the bottle necks caused by on-street matatu termini. The termini which will be studied serve Matatus from the eastern side and the Western side of Nairobi city, which enter the Nairobi CBD using Murang'a road, Uhuru Highway and Haileselesie Avenue. The termini are located around Tom Mboya Street as shown in map3 in chapter 4.

The study will focus on the spatial location and siting of the termini, how they adequately serve the needs of vehicles and passengers, the effects of their operations on the traffic flow in the study area and how the termini are managed. It will also propose measures that may be undertaken to improve the termini facilities and operations.

1.7 Justification

Previous studies on congestion problems in Nairobi city in relation to matatu termini were carried out on a broad level, covering the whole city (Chetire, n.d). They did not focus on specific matatu termini. This research is localized to the study area and is aimed at resolving intra-urban termini management challenges though they are associated with the larger Nairobi city. Studies on urban transportation problems in central areas of the city also require street level data to be used in analysis of traffic problems (Gonzales, Charis, Li & Dangazo, 2009).

Efficient public transportation systems require urban planning and design for the future to provide solutions for the increasing demand for public transport services in cities (Transport and Urban Decongestion Committee, 2014). Nations such as Singapore that have efficient public transport systems today had laid out their future plans for increasing demands of transport. Public transport termini are important components in the public transport system. This study will contribute to planning issues concerning provision of Matatu termini in Nairobi city in future.

The World Bank scoping study (2002) on Nairobi found that poor terminal organization and management restricts the optimum use of the available public transport capacity. Research on the organization and management of matatu termini on Tom Mboya Street will provide an

insight into the problems associated with terminal organization. The matatus constitute a large proportion of the vehicles offering public transport services in Nairobi city, with about 80% of the public transport trips (JICA, 2012). The city of Nairobi needs to find measures to alleviate the congestion problem therefore, is important that research is carried out to provide useful information that will be used for future transportation planning to establish efficient public transport systems in Kenya.

Graeff (2012) in her studies on the “Public Transport in the Nairobi Metropolitan Area; The Future Role of Matatus” observed that the structure and networks of matatus may become obstacles and opportunities in the transport reforms. The termini are part of this transportation network and require research to provide data for their effective management. She cited lack of data on general plans, congestion caused by licensing of matatus, and high level of pollution as some of the challenges in the matatu industry. The study will provide data on the current matatu termini locations, facilities and operation to facilitate terminus planning in the Nairobi CBD.

1.8 Definition of terms

“**matatu**” means a public service vehicle having a seating accommodation for fourteen or thirty three passengers exclusive of the driver, but does not include a motor-car. The Nissan and mini bus have these capacities.

Matatu terminus or terminal

It is a point where a matatu route starts or ends. It is also a point where vehicles stop, turn or reverse and wait before departing on their return journey. In Nairobi City it is commonly referred to as “matatu stage”. It is a Nairobi County government designated matatu parking spaces.

A bus station

It is a point where a bus route starts or ends; where vehicles stop, turn or reverse and wait before departing on their return journey for passengers to board and alight from the vehicles. It has some routes which pass through without terminating there. It has the functions of a bus terminus.

Paratransit

A “demand responsive transit”, any form of public transport which is purely demand responsive and which lies in the spectrum between conventional bus and taxis services.

Matatu waiting time

The time spent by a matatu at a terminus without moving to allow passengers to board and alight. This is the terminal waiting time for matatus operating on paratransit mode.

Operation

It is the quality or state of being functional or operative, a method or manner of function (Merriam Webster dictionary at www.merriam-webster.com)

Terminal operation of a matatu terminus can be considered as the reception, processing, staging and forwarding of passengers (McGraw-Hill Dictionary of Scientific and Technical Terms, 2003).

1.9 Organization of the Thesis

This study consists of the six chapters. Chapter one introduces the operations of matatu termini in the Nairobi CBD. It gives a highlight of some of the previous challenges that faced the operations and management of public transport termini up to the current situation. The chapter also contains the research problem, research questions, research objectives, a justification of the research and assumptions that were made during the research process.

Chapter two consists of the literature review on the theory and concepts used in transportation planning, available information based on the research objectives, transportation policies and regulations in Kenya. A conceptual framework that was developed from the literature review is presented in form of a flow chart.

Chapter three describes in detail the methodology used in this research. These details are given as sub-sections in research design, data needs, data collection techniques, determination of the target population, sampling frame, sampling techniques, methods used to analyze and present qualitative and quantitative data.

Chapter four describes the location of the study area at National, local and exact boundaries in the Nairobi CBD. It also contains information on the site characteristics of the study area.

Chapter five consists of data analysis of both the qualitative and quantitative data gathered from the field, results and discussions.

Conclusions that were drawn from the results based on the research objectives are presented in chapter six. The chapter also gives recommendations based on the research objectives.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter highlights the historical events that have occurred in the public transport services in Nairobi, theories used in urban transportation planning, a case study of efficient public transport systems and transport policies in Kenya. It also provides information on how the termini were allocated to Matatus by the NCC in the CBD giving a background of these allocations, the implications on the flow of traffic caused by the location of these terminals, their mode of operation, the quality of service they offer to the passengers and the efforts made by the Nairobi county and the National government to bring order into the industry.

2.2 Theory of Urban Transportation Planning

2.2.1 Urban Transport models

“Gravitational models” have been used in modeling urban transport demand by analysis of transportation demand patterns in urban areas (Mees, 2003). They are considered as first generation models. The models assume that the city is ‘an attracting magnet’ to economic activities in a given region. These activities in turn attract a big population who travel to the city to engage in them causing demand on transport facilities (Mees, 2003). The model can be applied to Nairobi City. Nairobi city has become “an attracting magnet” during its development process leading to increased traffic congestion in the CBD. This is illustrated in the previous spatial plans for Nairobi since independence. The plan for settler capital of 1927, the master plan of colonial capital of 1948 and the metropolitan Growth Strategy of 1973 show growth and changes in landuse (Vogel, 2008). The preferred metropolitan growth strategy of 2000 was aimed at decentralizing functions through the creation of satellite towns to avoid problems associated with growth of cities such as congestion (Kenya 2012). Concentration of economic activities such as trade, service provision and industry in the CBD has caused an increasing demand for transportation services. The factors that cause the “magnetic pull” need to be investigated to provide information required for traffic management. Nairobi CBD is a central place to residents in the Nairobi metropolitan region and other smaller towns within its vicinity. Its transportation systems consist of both intra and extra vehicular traffic. Trip generation models which have been commonly used in analysis of traffic patterns are based on the gravitational model (Demitriou, 2011).

Future developments in modeling have transformed these aggregate models into disaggregate ones by conducting analysis on smaller sections in the transportation system (Gonzales, 2012). Previous transport modeling was centered on aggregated analysis. This analysis included the city and its metropolitan area. However, solutions to urban transportation problems also require disaggregated analysis to be carried on street level because streets have their own special characteristics in the transport network (Gonzales et al., 2012).

The study of matatu termini as component of the transportation network in the Nairobi CBD is a form of disaggregating the transportation systems since the terminus is one of the components of this system. Disaggregation of models has led to a contemporary urban transportation planning based on the systems approach.

2.2.2 The Systems Approach to Planning

Transportation systems consist of the travel ways, vehicular traffic and terminal facilities which interact with other elements in the urban environment such as land use, population, and transport management systems (Dimitriou, 2011). The level of interaction of these elements determines the efficiency of the urban transport system. The operation of these components is controlled by transportation regulations. Transportation systems in urban areas need planning to operate efficiently despite the growth of the city. Dimitriou (2011) considered the Urban Transportation Planning (UTP) approach is one of transportation planning approaches undertaken in the urban areas. It uses the system approach as one of the new approaches to transportation planning. Improvement of travel ways is likely to attract a lot of vehicular traffic especially where there are no controls for access by traffic control department. Today there is a focus on the management measures to be undertaken in the transportation sector after previous increase in infrastructure has shown that it cannot be a solution to the demand for transportation services. The increase in infrastructure has led to increase in vehicular traffic negating the desired positive impacts of such development (Dimitriou, 2011). Urban transportation planning considers both internal and external factors. Internal traffic and traffic which passes through the city to other destinations affects the transportation system.

Policy interventions are also required to solve urban transportation problems and traffic management (Dimitriou 2011). Formulation of appropriate regulation and enforcement provides control to the functioning of transportation systems (Graeff, 2012).

Manheim (n.d) stated that “urban transportation planning has transformed from production of plan to the production of information to support short term planning decisions. Demitriou (2011) observed transportation systems management (TSM) has undergone a paradigm shift from long-range planning to short- range to solve day- to- day transportation problems. However, this does not mean that short range decisions do not contribute to long range planning goals. In essence, they should complement each other to achieve efficient transportation systems in the future.

The application of the systems theory in developing countries such as Kenya should take into account the culture, economic and social characteristics of the population (Demitriou, 2011). The World Bank (2002) studies found that the paratransit mode of transport is the dominant and development of other systems should consider integration of this system. Therefore, urban transportation planning in Nairobi city cannot be accomplished without considering the matatu sector. During urban transportation planning the land use activities need to be included. There is a relationship between transportation system and landuse (Litman, 2005).Travel is a function of landuse and vice versa (Demitriou, 2011).

2.2.3 Theory of Landuse and Transportation Relationship.

The changes in landuse patterns during the growth of the city affect the traffic patterns. The development of urban places resulting in different landuses cause gravitational forces that affect transportation systems. During transportation planning research on current and future landuse change is done to determine the impacts that they will cause on the existing transportation system. Land use strategies are put in place that will impact positively on the transportation systems (<http://www.windana.com>). The relationship between land use and transport is symbiotic. Previous growth strategies for Nairobi such as the Nairobi Metropolitan Growth strategy (MSG, 1973) proposed decentralization of functions of the city to sub-urban centers to avoid excessive concentration of activities in the CBD that cause traffic congestion (Kenya 2013). Human activities are a function of land use. Therefore, the control of change in land use in the city as an impact on transportation systems should be considered during planning.

The above theories affect planning of transport systems and require consideration during terminal planning in the urban environment.

2.3 Efficient Public Transport Systems (A Case of Mexico City)

Countries that have been able to successfully re-organize their public transportation systems can provide useful information for planning of the public transportation systems in Nairobi city.

According to the *New York Global Partners Report (2012)*, Mexico City is one of the cities that have a most efficiently operated public transport systems based on the Bus Rapid Transport Systems (BRT). It had a population of 20 million residents by the year 2002 when plans for the introduction of the B.R.T system were made. In the development of the B.R.T the following considerations were made (*New York Global Partners Report, 2012*);

- I. A reduction in air pollution by replacing old paratransit vehicles with a much smaller new fleet of buses.
- II. Reduction of travel times.
- III. Improving passenger comfort.
- IV. Giving opportunities for paratransit operators to formalize their business.

The B.R.T was developed on a single strategic corridor which was not previously served by a trunk mode. During the initial stages of development there was opposition by the paratransit operators who presumed that the new system was a threat to their source of income. The problems of paratransit operators were caused by lack of sufficient information that would enable them formalize their business. Various consultation meetings had to be conducted to build consensus on the issues which arose as a result of the development of the B.R.T. (*New York Global Partners Report, 2012*)

The Mexico B.R.T was a simple physical integration with other existing modes of transport that operated independently. The B.R.T system provided transport at selected key points and other operators operated on feeder roads. The buses could not operate on narrow roads therefore the other operators played an important role of providing their services on the feeder roads (*New York Global Partners Report, 2012*).

A renewal program provided registered owners of the old mini buses with finances to buy new buses. The benefits derived from the B.R.T system incorporation of paratransit operations into the BRT system through negotiation, reduction of air pollution by introduction of few new buses

and increased use of public transport by members of the public. (*New York Global Partners Report, 2012*)

The urban public transportation systems in Nairobi city can be improved using successful cases like the B.R.T of Mexico, Transmilenio of Bogota and Metrobus of Latin America Cities. Research in existing public transportation systems which include the matatu industry is important to provide planning information. The implementation of a successful BRT system that is modeled to on the economic conditions and existing culture of Nairobi should be considered. The study on the Mexico BRT reveal that paratransit transport systems such as matatus in Kenya can be incorporated into efficient public transport systems. They can still operate on independent routes and feeder roads to the BRT routes to provide the necessary public transportation services.

The Institute for Transport and Development Policy (ITDP) in collaboration with the Kenya National Highways authority (KeNHA) conducted a research on implementation of a BRT system in Nairobi city in 2015(TTDP, 2015). The Nairobi city BRT known as Nairobi Ndovu proposed the introduction of a BRT system to serve the public transportation demand in future. The planning and implementation process of BRT should consider the presence of matatus as a means of public transport in the city and formulate ways of integrating it into the system. Appropriate planning strategies for terminal facilities and implementation of efficient terminal control should be considered as part an efficient public transport system in Nairobi city. The operations and siting of termini should be done to avoid congestion on the CBD streets.

2.4 Termini Operations Alleviate Congestion on the Roads

Termini are necessary in reducing traffic congestion in the streets by allowing public service vehicles to stop without causing obstruction in the streets (Abiero, 1982; World Bank, 2006). Therefore, they are located a way from the traffic lanes. According to World Bank (2006) the choice of an area to locate a terminal facility is determined by;

- I. The volume and frequency of traffic.
- II. The need to meet peak traffic load for vehicular and traffic needs.
- III. The need for an ample site to cater for rising demand and allow extension.
- IV. Its relationship to the roads and general traffic flow of surrounding area.

- V. There are located where routes logically connect or terminate and are determined by passenger demand patterns.

Therefore, they require prior urban planning and design to determine their location to determine the appropriate site.

According to Otieno (1991) the criteria used for location of bus stops by the NCC in the early nineties were,

- I. Availability of enough space on the road reserve.
- II. Minimum walking distance from the main activity zones by commuters.
- III. The main traffic attraction points.
- IV. Non interference with smooth traffic flow, which was a difficult task while trying to balance with traffic attraction points.

The governing authorities in charge of siting of termini need regulations to determine the siting and design of terminal facilities. The design of bus terminals is one of the factors that determine the operations of the terminal facility.

2.5 Design of Bus Terminals

A bus terminal is where a bus route starts or ends; where vehicles stop, turn or reverse and wait before departing on their return journey (World Bank, 2006). Passengers board and alight from the vehicles at the terminal and it offers a convenient point of control of services. In Nairobi city both the buses and matatus offer public transport. The matatus stop at various designated parking spaces by the Nairobi county government. They may be equated to a bus terminal due to their functionality. Therefore, for the purpose of this research the words “matatu termini” are used. A study on the existing of bus terminals helps us to understand the location, design and space requirements for an efficient terminal facility which can be applicable to the matatu terminus.

The design of bus terminals facilities studies by Boer and Rossum (2015), also provide information on the siting characteristics of matatus termini. Bus terminals facilities have different designs depending on user requirements. There are simple ones with only shades provided for waiting commuters at bus-stops. Though these types of termini are referred to as

bus-stops in some previous research they can also be used as termini depending on their location. They provide facilities for vehicles to turn without obstructing or endangering other traffic (Boer & Rossum, 2015). They require sufficient space by the roadside for a reasonable number of vehicles to stop between journeys. There also those which are built off the road to provide a wide range of services such as servicing of vehicles and short term parking for buses operating away from their area of location. When space is not available for off-street terminal sites bus-stops are preferred for use in central areas rather than inconveniencing commuters by improperly sited off-street terminus.

The off road bus terminals offer convenience for passengers and reduce traffic congestion especially when the number of buses required at any single stop exceeds 10 or 12. It highly depends on the road layout and volume of traffic.

The purpose of CBD terminus is to provide passengers with easy accessibility to the CBD and also transfer between different modes. Therefore they may have both terminating routes or through routes to other destination. Some of the design layouts for terminals include one way clockwise loop, anti-clockwise loop, multi platforms and Dog bone as indicated in *Public Transport Association* (2015). The preferred choice of design depends on the available land and the integration with the neighboring infrastructure. Bus stations can be used both as terminals and through routes in the urban areas. They have been developed in urban areas to serve these purposes. Photograph 1 and 2 shows two designs of bus stations the roadside station at Montreal Montmorency metro station and one Island station located at Sittard bus station (Boer & Rossum, 2015). The layout of facilities and different orientations of bus platforms reveals how different orientations can be used to utilize available space at a bus station terminus.

I. The Roadside Station

Montreal Montmorency Metro station in photograph1 is one type of a roadside station that has only one side platform. Though it is extremely long in length it allows for independent arrival and departure at/from each stop. It requires an area of approximately $180 \times 10.5 = 1890\text{m}^2$. It has a moderate depth consisting of narrow zones for waiting passengers and buses. The bus platforms are at angle of 15 degrees. It length can be reduced by putting the platforms at different angles of 45 degrees and 90 degrees though some reversing space will be required (Boer and

Rossum, 2015). This type of station offers no conflict between buses and pedestrians. Plate 1 shows the layout of Montreal Montmorency metro station.

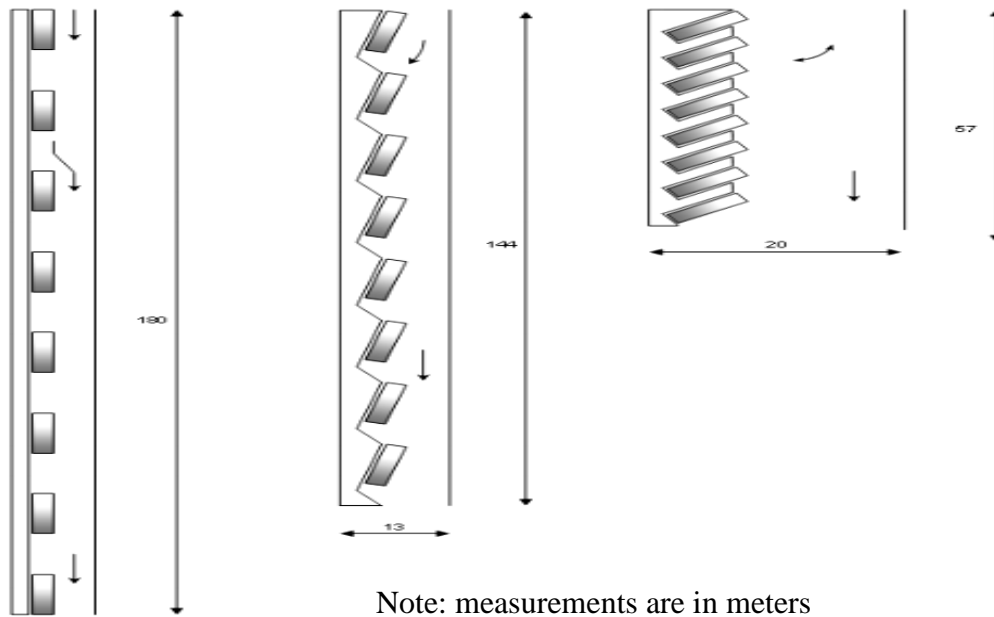
Plate 1: Montreal Montmorency Metro Station and U shaped Bus Station



Source; Boer.E & Rossum.J,(2015: 5).

According to Boer and Rossum (2015), the orientation of platforms to 45 degrees and 90 degrees reduces required space by 40% to 1107.6m².Figure 1 shows the 45⁰ and 90⁰ orientations.

Figure 1: 45° and 90° platform orientations



Source; Boer & Rossum (2015:6)

II. One island bus station

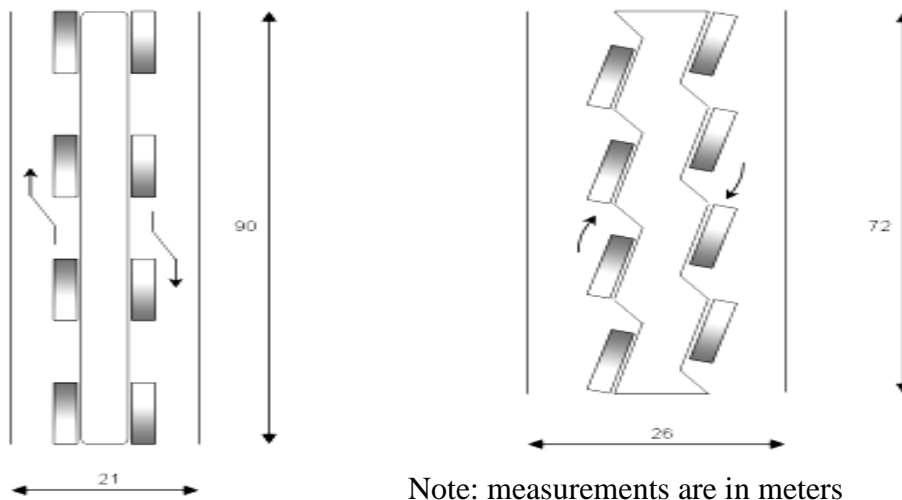
Sittard bus station is one such station (Plate 2). It has an isolated platform with two rows of stops in its basic shape. It has a central pedestrian crossing that minimizes the risk of accidents. The layout has four bus stops at each side of the platform as shown in plate 2. It requires an area of $90 \times 21 = 1890 \text{ m}^2$ without the surface needed for circulation around the platform.

Plate 2: One Island Bus Station



Source; Boer & Rossum (2015:8)

Figure 2: Angular Layouts of Bus platforms



Note: measurements are in meters

Source; Boer & Rossum (2015:7)

Changing the orientation of the axis of the island at an angle of 90 degrees towards the station building it reduces the distance to the furthest stop by twice the required distance.

The above examples of design of bus station and utilization of space to achieve functionality show how the current matatu terminal can be improved. Limitations of space especially in the CBD need effective utilization by design of the terminal facility to achieve the terminal purpose.

The location of matatu termini in the CBD is important to provide easy accessibility of public transport services to the Nairobi population. The design and siting of the termini of the facility should consider the existing traffic volumes, road network, passenger demand and available space in the CBD. Appropriate siting procedures by the county government will prevent the current traffic congestion o traffic on the CBD streets.

2.6 Previous Operations of Public Transport in Nairobi

The public transport services in Nairobi operate as paratransit systems. The vehicles used are buses, mini-buses and matatus which are privately owned. In the early 70's K.B.S was the only public transport service in Nairobi CBD. K.B.S had designated bus tops and bus terminals which it used in its operations (Otieno, 1991). There were two terminals, one in the CBD at Central bus station and the other one was located at Eastleigh Fourth Avenue. The bus stops were two main bus stops at KENCOM and Ambassador and others along Moi Avenue and Tom Mboya Street. The bus stops and terminals were allocated by the Nairobi City council. The KBS had an organized system of providing public transportation services which consisted of schedules for time, fares and staff time tables. The existing road networks and infrastructure facilities were sufficient at that time to meet the needs of the population. According to Abiero (1991) the KBS by African urban bus service standards was a very efficiently operated service.

Transport demand especially at the fringes of Nairobi city continued to increase and the matatus started operating illegally to meet this demand. The matatus were legalized to operate in 1973 through a presidential decree. They had no designated bus stops or terminal facilities allocated to them by the NCC and adopted traffic islands, open spaces, back street and on street parking. There was competition for space at the bus stops in the CBD and commuters by K.B.S and matatus. The entry of matatus into the public transport system brought chaos in public transportation services because there was no policy to guide the operation of this industry. K.B.S Company started experiencing challenges in its management and operations such as unfair competition, obstruction on the streets and reduced profits. Other players also joined the public service transport industry i.e. the defunct Nyayo Bus Cooperation, CITY HOPPA, and City Shuttle.

There were studies conducted on Nairobi City that recommended planning measures to be undertaken to accommodate the land use changes. The changes in landuse during the growth in

the City had an impacted on the transportation system. These studies were; The Metropolitan Growth Strategy of 1973, Nairobi Bus-Lanes and Bus-Ways feasibility Study of 1997, Nairobi Urban Project of 1979, The Matatu Mode of Public Transport in Metropolitan Nairobi of 1982, and Urban Transportation Needs of Nairobi of 1986. The recommendations of dealing with future transportation planning from these reports included; control of densification especially in the Nairobi CBD to reduce vehicle and human traffic, expansion of the road infrastructure and building of by-passes to divert transit traffic from the CBD. Some of the planning recommendations from the reports were not implemented causing the problems associated with the growth of Nairobi City. These problems include lack of enough road infrastructure facilities, increased landuse densification especially in the CBD and a large number of vehicles entering the Nairobi CBD causing congestion problems to persist.

To date the matatus provide 80% of the public transportation services in Nairobi and use termini which they adopted after formal allocation by the Nairobi City Council. There was no prior planning for the siting and no policy guidelines for these allocations. Chitere et al. (2011) studies on paratransit operations in Nairobi found that there were inadequate termini and routes to enable efficient operations of public transportation services. The study recommended the establishment of more termini at the outskirts of the city, concession of routes to well established operators and transition from low-to- high occupancy vehicles. The establishment of appropriate termini to sever the needs of commuters to Nairobi CBD will improve the efficiency of services offered by the matatu sector and eliminate congestion problems resulting from their operations.

2.7 Background Study on Matatu Termini Allocations

The matatu started to operate in Nairobi after a presidential decree in 1973 without designated terminal facilities and bus-stops. There were few bus stops and one major terminal in the Nairobi CBD which was used by the KBS buses which offered public transport services in Nairobi (Abiero, 1982; Obonyo, 1989). The available bus-stops were convenient for use by the KBS and the commuters in Nairobi at that time. The entry of matatus into the public transport services led to them competing for space at the bus-stop with KBS buses and among themselves. Otieno (1991) referred to the situation at that time as “a mismatch between supply and demand of space on roads, bus stops and terminals in the CBD despite the increasing number of public transport vehicular traffic”.

The matatus required terminal facilities to enable them provide public transportation services in the CBD and illegally occupied traffic islands, on street parking, back streets and open spaces termini to facilitate their operations (Abiero,1989). The NCC did not incorporate the matatus into its transportation plans and had no plan for the location of matatu termini in the CBD. The matatus continued to increase in number due to the increasing demand for public transport and they picked and dropped passengers at any point on the streets in the CBD. To bring order into the operations of matatu in the CBD, the N.C.C had to provide terminal facilities to the matatus in the CBD in 1984. N.C.C allocated matatu termini using ad-hoc planning and the M.V.O.A through lobbying for the matatus had other spaces allocated to them (Chetire et al.,n.d).

The Nyayo Bus Service Limited provided public transport services in the Nairobi in the 90's and was allocated three terminal facilities in the CBD which were previously private car parks. The terminal lacked parking for vehicles and waiting bays for passengers. Later, the Nyayo Bus Service collapsed and the termini were taken over by matatus and KBS buses (Otieno, 1991).

In 1982 the total number of matatu termini in the CBD was eighteen; eight located within the N.C.C relocated car parks, eight on street side and two on traffic islands (Otieno, 1991). . The number of matatu terminals in the CBD especially on Tom Mboya Street and the adjoining streets has continued to increase. At present it is estimated that there are about 10 termini located in this area alone. This number of terminals is too high to be on one street in the CBD. Cities should have at least one major terminal in the CBD and others located in the periphery of the city boundaries (World Bank & PPIAF, 2006) to avoid congestion problems caused by increased vehicular traffic within the city. Though the number of termini within the CBD can be a few and evenly spread out depending on the transport demand.

The office of the Registrar of Motor vehicles which was under the defunct National Transport Licensing board (TLB) was responsible for registration of all vehicles including matatus and determination of their passenger and luggage capacity. A registration fee was paid by the public service vehicles to the Kenya revenue authority (Asengo, 2004). The TLB would allocate the termini to matatus after registration. The TLB did not carry out research on urban transport planning and therefore could not determine the terminal requirements for different routes in the city (Orero, McCormk, Mutulla et.al, 2012). Instead, it allocated terminal facilities on application by the matatu owners who chose their own routes leading to overcrowding at the termini

(Chetire, 2012). Today the allocation of matatu termini is done by the Nairobi County government as provided for in the Nairobi County Traffic By-Laws.

2. 8 Terminal Facilities Serve the Needs of Vehicles and Passengers

Public transportation authorities in Kenya do not have guidelines on the type of passenger and vehicle facilities that need to be provide for use at the termini. Other countries have these guidelines that they use based on the bus as the vehicle for public transport. The guidelines can be applied to Nairobi city considering that the matatus are used as the dominant vehicles for public transport. The researcher has used bus terminal requirements from other countries in the world to discuss the basic terminal facilities for a terminus. The *Transport Cooperative Research Program* (TCRP, 1996) and *Travel Watch North West* (2008) reports were used to assess the conditions of termini in Kenya. Facilities for vehicles and passengers enable provision of services at the terminus.

Facilities for vehicles include lay-bays designed for vehicles to stop and enable passengers to alight and board safely. Some of the off road terminals have space for minor repairs, change of crew and host offices for traffic management and control (TCRP, 1996). Facilities provided for passengers include, protection shades from harsh weather conditions, information places on schedules, stops on the route and fares, and waiting benches. The design of terminals should provide safety for passengers entering and leaving the bus-stops and allow for change of modal split.

According to Chetire (2012) matatu termini in Nairobi lacked essential facilities for passenger and vehicles. There were no protected shades and information on route schedules making it difficult for newcomers on the route to know the fares and stops on the route (Abiero, 1982). Observation by the researcher during a field reconnaissance showed that some of the challenges found by previous researchers still persist today. Passengers at the termini have to wait for long periods before they can get unto the matatus especially at peak hours on some routes while others have extra vehicles waiting for passengers to board. There seems to be lack of efficiency in operations even where some of these facilities exist. The management standards of these facilities determine the quality of services offered.

2.9 Operations and Management of Matatu Termini

The World Bank Scoping study on *Urban Mobility in Three Cities* (2006) which included Nairobi looked at the development of urban transportation systems and identified poor terminal organization and management of terminal facilities as one of the problems facing urban transportation systems in developing cities. Earlier studies show that operations of the matatu industry in Nairobi had experienced some challenges.

Lack of a clear policy on the management and organization of Matatu termini has been a hindrance to improved operations of the Matatu industry. In the early 90's the NCC made efforts to improve the state of operations at the termini by introducing a queuing system for both the vehicle and the passengers (Otieno, 1991). Chitere et al. (2012), in their studies on "Matatu termini and routes in Nairobi city" found out that 50% of matatu termini were managed by NCC, 25% by SACCO's / Company committees/ groups/cartels/ property owners or route managers while 6.3 % by SACCO's in collaboration with NCC. Overcrowding at the termini was witnessed with lack of organization on the mode of a lighting and boarding of vehicles. The passengers scampered for space on arrival of the vehicles (Otieno, 1989). There seems to be no regulations on the role of SACCO's in the control and management of matatu termini.

At present route managers of matatu SACCO's are in charge of the queuing systems for vehicles and passengers at their respective termini. The question of how the queuing system is effective in management of termini operations needs to be investigated. Some of the queues are too long and passengers have to wait for long on these queues. There is need to reduce the lengths of these queues through scheduling of public service vehicles.

2.10 Traffic Policies and Legislation in Kenya

Urban transportation systems require regulations to govern the management and operations of public transport providers. Lack of regulations for the Matatu industry during its inception caused chaos at that time. The Matatus were individual enterprises and operated at their own will to maximize profit (Otieno, 1991). The enactment of transportation laws to regulate the industry has brought some sanity in the industry. A look at some of the important laws that govern the public transport industry is important.

The following laws govern the transport industry,

I. Integrated National Transport policy(2009)

The integrated national transport policy is an overall policy framework that governs all matters concerning transportation systems in Kenya. The policy provides guidelines on management of infrastructure, safety, private investment in public transport, control and management of traffic.

The following objectives in the policy are relevant to this research;

1. Integrating transport and land use.

The land use transport relationship makes it necessary for considerations to be made on how the changes in land use affect transportation corridors and siting of termini especially in the cities. Planning and development of transportation networks and termini require appropriate decisions to be made in order to achieve efficient transportation systems.

2. Establishing appropriate Institutional systems.

Institutional bodies provide resources and control over the construction and use of transportation infrastructure

3. Developing efficient and effective sector operations.

Efficient and effective operations of the transportation system encourage economic growth in the country. Economic losses caused by traffic congestion in cities should be avoided by good management practices.

4. Applying ICTS in the transport sector.

The use of ICT technology in transportation services for controlling traffic is important and cannot be ignored in transportation development.

5. Enforcement and compliance with sector laws and regulations.

Formulation of laws and regulations by the national and county government that are used as instruments of control are necessary for guidance to the all stakeholders in the transportation sector. Enforcement mechanism should be in place to ensure that compliance is achieved.

6. Improve safety security

The security and safety of users in the transportation system is an issue to be considered in the development of infrastructure components of which terminal facilities is one of them.

7. Facilitate public private partnership

Private investors are encouraged to take part in the development of transportation systems especially where the authorities are not able to raise the required resources.

Elements that are provided in the new framework for transport management policy include;

- i. The establishment of directorate of transport
- ii. Consolidation of transport functions under one ministry and separation of policy making, regulator and service provision functions.
- iii. Enhancement of the role of private sector in transport infrastructure and development.
- iv. Consolidation of urban transport system by shifting to high occupancy vehicles.

This policy recognizes several factors that need to be considered in transportation planning such as landuse characteristics, the use of ICT as modern methods of traffic management, formulation and enforcement of traffic laws and regulations and partnerships between private and government authorities. These factors are also important because they affect the planning and operations of the matatu termini in Nairobi CBD. Therefore, achievement of these objectives for the country will in turn improve public transportation services in the Nairobi city.

II. National Transport and Safety Authority Act (Revised ,2014)

The National Transport and Safety Authority (NTSA) was established by the NTSA Act in 2012(www.kenyalaw.org). The functions of NTSA include, implementation of policies related to road transport and safety; planning, managing and regulating the road transport system; ensuring that the provided road transport services are safe, reliable and efficient; regulating public service

vehicles and advising the government on national policy with regard to road transport system. Most of the NTSA functions focus on the road transport system and safety. The roads are transportation channels for matatus routes operating in the Nairobi CBD. The authority is also in charge of registering and licensing of all vehicles in the country.

Due to the above functions, NTSA should be able to determine the numbers of matatus operating on particular in the Nairobi CBD and contribute to the efficient functioning of the urban transport system through enactment and implementation of transportation policies.

III. Traffic Act (Revised,2013)

The traffic policemen use this as one of their main Acts in enforcing control of traffic on the roads in Kenya. A summary of the relevant sections of the Act for this study was done by the researcher (www.kenyalaw.org).

The act deals with

- ✓ Registration of vehicles; every vehicle in Kenya must be registered. Following this law all matatus must be registered by the NTSA in order to operate in the Nairobi CBD.
- ✓ Licensing of vehicles and requires that every vehicle in Kenya must have a registration license (Part III).
- ✓ In order to drive a vehicle on the road a driver should have a driving license(Part IV)
- ✓ The drivers have an obligation to obey the laid down rules for driving on the Kenyan roads.
- ✓ This Act contains driving offences such as adherence to authorized speeds, no driving on pavements and pedestrian walks.
- ✓ It has safety and obstructions rules for road users (Part V; 46).
- ✓ It empowers traffic policemen on duty to control traffic, keep order and prevent obstruction on roads and parking places (Part V, 69).
- ✓ The local authorities are given the mandate to make traffic by-laws in their area of jurisdiction. The by-laws should be consistent with the national transport policy (Part VIA; 72A).

IV. Nairobi County Traffic By Laws

The Nairobi County has by laws which apply to matatu termini in Nairobi City. The following are relevant to this study (www.nairobi.go.ke).

- A matatu should apply to the Town Clerk for a parking permit every year.
- Parking of any vehicle other than a matatu at a terminus is an offence.
- Matatus should only be parked at a terminus and will only stop to pick and drop passengers at a designated bus stop.
- All matatus at a terminus should be under direction of an enforcement official.
- It is an offence to drive more than 10km/hr within the terminus.
- Importuning of passengers on the streets or terminus is an offence.
- If there are six or more persons waiting to enter a matatu at a terminus or designated stopping place they must form a queue.
- All persons in a matatu terminus must follow directions and instructions of enforcement of police officer.
- No person in a matatu terminus should obstruct a person from entering and alighting from a matatu.
- No person should obstruct a conductor or hinder the driver from performing his duties.
- There is no parking on a pavement or a council garden.

The above laws and regulations provide mechanism for planning transportation facilities which include matatu termini, regulating the number of vehicles operating in the networks by registration and use of ICT and the need for private investors to be included when necessary to fund transportation projects.

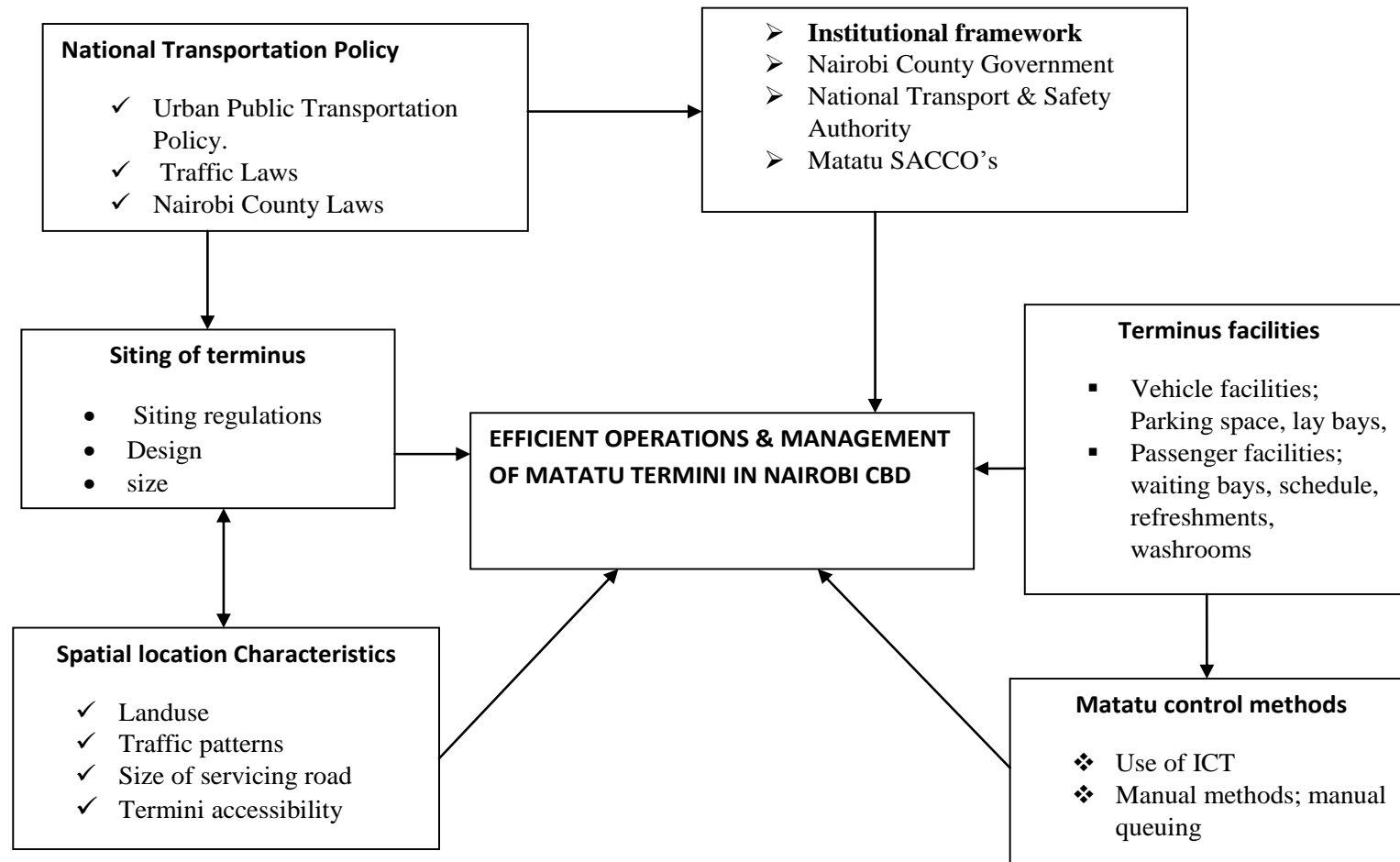
2.11 Conceptual Framework

A synthesis of the literature review in this chapter revealed relationships and factors which should be considered in establishing an ideal matatu termini management system in Nairobi CBD. The above literature review brought into focus that a public transport services consist of travel ways, public transport vehicles and public termini. The termini are important components of the public transport system and acts as points where passengers enter and leave the system.

They are located in the CBD to provide easy accessibility to the urban population. They should be appropriately spatially located to avoid interference with other traffic and alleviate congestion in the CBD. Planning for termini location should consider siting factors such as easy accessibility for passengers and vehicles, existing traffic flow patterns and the volume of traffic on the neighbouring streets. The public service vehicles that use a terminus operate on designated routes to sub-urban areas. Designation of public service vehicles to operate on routes depends on the number of commuters who determine the transport demand and application of operation permission by matatu owners to the concerned authorities. The existing land use activities in the city and the neighborhood of the terminus location in the CBD have an impact on the volume of human and vehicular traffic in the streets and need to be controlled through urban transportation planning. The land use activities are a factor of transport demand and it determines the travel behavior of the city residents. The demand for efficient public transport requires high quality terminal facilities. The quality of services provided by the terminus is determined by type availability of passenger and vehicle facilities that exist in it. The design and layout of the terminus also determines the level of service it offers to the users.

All the above components that are required for efficient management of termini in the CBD depend on the city terminal management authorities who use the existing policies and regulation to control the urban transport system. The relationships of the termini factors that need consideration during planning and their interactions are illustrated in the conceptual framework figure 3. The researcher used this conceptual framework to carry out the research.

Figure 3: Conceptual Framework



Source: Author, 2016

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

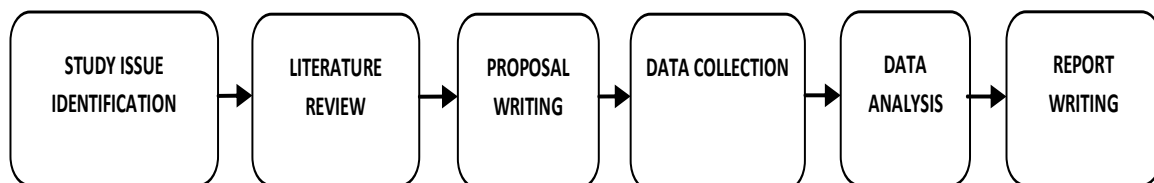
The chapter describes in detail the research methodology used to collect the relevant data to answer the research questions. The major steps in the methodology involved determination of a research design, data needs, sample size, data collection procedures, and data analysis and data presentation.

3.1 Research Design

A research design shows the scheme or plan that was used to carry out the research (Kombo and Tromp, 2006). It reveals how the major stages of the research were conducted in order to fulfill the research objectives. The research design used for this project was a descriptive. A cross-sectional survey was done in the study area by administering questionnaires to commuters, matatu crew and interviewing key informants (Orodho, 2003; Kombo & Tromp, 2006). The major steps which were followed in the research included study issue identification, literature review of existing materials, proposal writing, field work data collection at the matatu termini, data analysis and data presentation.

The study issue stage involved identification of the problem that was to be studied by the researcher. The researcher observed that there was traffic congestion on Tom Mboya Street and adjoining roads in the Nairobi CBD. The area had many matatu termini located there. This led to identification of matatu termini operations in this area as one of the likely contributing factors to this traffic congestion. Development of a study topic for the proposal was made, leading to the choice to study the management of matatu termini and traffic flow issues on Tom Mboya Street and adjoining streets consisting of, Moi Avenue, Latema Road and River road. Figure 4 represents the major steps undertaken in the research methodology.

Figure 4: Study Design



Source: Author, 2016

3.2 Data Needs

It is important to determine the required data and the sources from which it will be obtained before collecting data. An assessment of the type of data to be collected during the research in order to fulfill the research objectives was done before commencement of data collection. Table 1 shows a summary of the required data, methods of collection and analysis and how it was presented.

Table 1: Data Needs Matrix

OBJECTIVE	DATA REQUIREMENTS	DATA COLLECTION METHODS	DATA ANALYSIS METHODS	DATA PRESENTATION METHODS
To examine the procedure used in siting of matatu termini in the study area	Determine siting procedures, planning requirements for matatu termini in CBD, Policies and regulations	Literature review, Maps, key informants interviews, observations, photography	Mapping of sites, synthesis of literature, Field Measurements	Location factors, NCC allocation procedure. Maps, sketches, Reports
To assess the adequacy of termini facilities used by <ul style="list-style-type: none"> ✓ vehicles ✓ passengers 	Determine available facilities for vehicles and passengers. Layout and Design of terminus, management of facilities	Observation, Sketches, Review of literature on terminal facilities, Administration of questionnaires	Synthesis of Literature, statistical analysis of percentages, mean, mode, frequency using Ms Excel &SPSS	Graphs ,tables photographs, reports
To investigate how the operations of termini affect traffic flow in the study area.	Terminus vehicle control methods, Data on existing operation schedules, Terminus vehicle turnover at peak and non-peak hours	Interviews, Administration of questionnaires, Observations, Measurement of arrival and departure times.	Synthesis of Literature, statistical analysis of percentages, mean, mode, frequency using Ms Excel &SPSS, Computing vehicle turnover, Mapping	Photographs, Frequency tables, sketches, Maps, Graphs, Reports
To propose how spatial planning can be used as a tool for effective management of termini operations in the study area.	Effective public service vehicle control methods. ways to improve flow in CBD, future termini planning considerations	Literature review, Key informants Interviews, administration of questionnaires	Mapping determination appropriate termini and stopping sites in CBD	Reports, maps, future policy implications Proposed termini planning interventions

Source: Author, 2016

3.3 Determination of Research Population

Kosomo (2007) refers to a population as a possible group from whom information can be obtained to answer the research questions and fulfill the research objectives. The research population consisted of all the elements, units and subjects in the study that could be sampled to provide the necessary data. The research population consisted of all commuters (passengers) who use matatus as a means of transport in the study area to enter or leave the Nairobi CBD, traffic police officers who control traffic in the CBD, Nairobi city county traffic department and the officials of matatu SACCOs that operate in the study area. The study area, whose extent was bounded by River road, Accra road, Tom Mboya Street and Moi Avenue (refer to map3 pg43). All the termini in the study area were considered as a study population on the siting, design and management of matatus.

3.3.1 Target Population

This was the accessible research population, which could be easily reached in the study area (Mwakunjeru, 2011). The target population included commuters who use matatus that operate at the termini in the study area on specific routes, the SACCO termini managers, Nairobi county officials in the infrastructure department, traffic Marshalls in the City Inspectorate department and the traffic police officers who control traffic in the study area. The termini target population for qualitative research on siting, design and management of matatus fleet was Latema Road and Nation Roundabout termini.

Determination of the target population was done based on information obtained from matatu SACCO offices on the number of registered vehicles. The minimum number of crew on every matatu is 2, one driver and one conductor. This number was used to compute the total number of matatu crew target population. There are two categories of matatus with different occupancy, a 14 and 33 passengers which operate at the terminus. Information gathered from the SACCO's showed registration numbers and it was not possible to get the exact number of matatus in this categories. Therefore, the number of commuters per matatu vehicle was arrived at by getting the mean of the two matatu capacities which is 24 passengers. This average was used to calculate the target population of the commuters. A summary of the target population is shown in Table 2.

Table 2: Target Population

No	Name of Terminus	Surveyed Routes at Terminus	Name of SACCO	Number of vehicles	Number of Matatu crew (2 per vehicle)	Number of commuters (Average of 24 per vehicle)
1	Latema Road	23,107, 107A	KMO	182	364	4368
			LATEMA	150	300	3600
			LOPHA	175	350	4200
2	Nation Roundabout	119A,119B, 118,106,115 , ,107,108B	WALOKANA	170	340	4080
			HOME	155	310	3720
			KACOSE	148	296	3552
3	Timboroa Road	44,25	NAZINGI	174	348	4176
			BABA DOGO	120	240	2880
4	Commercial (on Tom Mboya Street)	105,6,145	105 SHUTTLE	143	286	3432
			EASTEIGH ROUTE	200	400	4800
5	Post Office(POSTA) (on Tom Mboya Street)	9	EASTLEIGH COMMUTER	105	210	2520
Total Target Population		16	11	1722	3444	42328

Source: Author, 2016 (Compiled from Data obtained from Matatu SACCO's & field observations)

3.4 Sample Design

3.4.1 Sampling Frame

A sample is a small group obtained from a population under study that represents the characteristics of the entire population (Mukwanjeru, 2011). It may not be possible to study the entire population due to other factors such as cost and time allocated to the research. Therefore a

carefully selected sample is studied and the results obtained are used to make inferences to the population. A descriptive survey was carried out in the study area. The sampling units were commuter, matatu crew, matatu terminus, Nairobi county infrastructure and inspectorate departments' official, Sacco route manager and the Nairobi CBD traffic policemen. Lindsely (1985) recommended a minimum of 30 sampling units to obtain results with minimum error. Mwakunjeru, (2011), proposes that the sizes of the sampling units should be chosen based on the requirements that a survey research can use 100 observations for major sub units. After considering the sample sizes proposed by Mwakunjeru (2011), Lindsely (1985) and the target population a sample size was selected that was not too small or too large but convenient for this research. Considering that the available resources such as time and finances allocated for this research the sample sizes used for commuters and matatu crew were 261 and 147 respectively. The Questionnaires were administered to the matatu crew and commuters. A total of 6 key informants were interviewed 2 from Nairobi county infrastructure and inspectorate departments, Sacco route managers and the Nairobi CBD traffic policemen. A qualitative analysis of the termini characteristic was carried out at 2 termini located Latema Road and Nation Roundabout. The total sample size used for all sampling units was 416. A summary of the sample sizes is shown in Table 3.

Table 3: Sampling Frame

Sampling unit	Size of sample
Commuter	261
Matatu crew	147
Traffic policeman(Nairobi CBD)	2
Traffic Marshall(Nairobi county	2
Infrastructure official (Nairobi county	2
Matatu terminus	2
Total	416

3.4.2 Data Collection Methods/Instruments

Collection of primary and secondary data was done by sampling, interviews, observation, photography, mapping, and terminus vehicle count and document analysis. The researcher prepared research instruments prior to commencement of the field data collection process. The research instruments administered to commuter and matatu crew samples were questionnaires with open-ended and close-ended questions. Interviews were conducted using interview schedules, observations were made at the termini by recording in note books and check list. A mobile phone camera was used to take photographs that showed the prevailing circumstances at the time of the survey. The researcher used GIS mapping for map analysis of the study area.

3.4.3 Selection of Research Assistants

Five research assistants were recruited from the university to enable the researcher collect data. The research assistants were trained for two days on the methods that will be used for administering the questionnaires to the target population. Training was done to enable them understand the questions and give the correct interpretation to the respondents when necessary. They carried out a pilot study in the Nairobi CBD to determine the type of response given to the questions and the time required by the responded to complete a questionnaire. Questions that did not illicit the desired answers were re-framed and a final questionnaire printed for the field work.

3.4.4 Sampling Techniques

Sampling techniques are methods that are used to select cases to be observed in the research (Kombo and Tromp, 2011). The techniques used in this research included, convenience sampling for matatu crew and commuters, and purposive sampling for both termini and key informants.

Convenience sampling was used based on the assumption that matatu crew and commuters are infinite populations. The results obtained from them could still be used to infer to the entire populations. Commuter sampling was done at the terminus and on-board a matatu. On-board sampling is a technique used to sample commuters (passengers) aboard a public service vehicle (Bruce, 2005).

3.4.5 Sampling of Commuters

Sampling of commuters was done at five termini in the study area. Random sampling was carried out on commuters at a matatu terminus or inside the matatu. A commuter was selected at random by the research team at a terminal facility while waiting to board a matatu and requested

to fill the questionnaire. Matatus operating on specific routes (refer to Table 2) were used for on-board sampling. The choice of the routes was done depending on route characteristics such as final destination outside the city, number of stopping points and commuter behavior. These factors were considered to enable the commuters complete the filling of questionnaires before alighting from the matatu. Routes that were convenient for the research were selected during a prior study of the routes by the researchers. Sampling of commuters on board a matatu was done by the researchers boarding a matatu at random at a terminus and administering questionnaires to the commuters who were willing to participate in the survey. The number of commuters sampled was 261.

3.4.6 Sampling of Matatu Crew

Random sampling of matatu crew was done by selecting a matatu crew at random at the terminus and requesting the crew to complete the questionnaire. The researchers took the advantage of long waiting periods by matatus at the terminus especially at non-peak hours before the start of another journey.

3.4.7 Sampling of Matatu Termini

Purposive sampling was done to identify matatu termini that were studied to determine the siting, design and movement of vehicles to and from the terminus. Purposive sampling is done by selecting information rich cases for the purposes of in-depth analysis of the central issues under study (Kombo and Tromp, 2011).

A prior survey was carried out by the researcher on siting and the operating conditions such as security, safety and number of matatus that use a terminus. Two categories of termini were identified on-street and off-street. The total number of on-street termini was 3 (Latema Road, Post Office, Commercial) and the off-street were 2 (Nation Roundabout and Timboroa Lane). Latema road and Nation roundabout termini were selected for in-depth analysis of termini characteristics. These two termini were considered as extreme cases of siting challenges due to the large numbers of matatus that operate there and the fact that one is on-a roundabout. They were found to provide secure and safe observation points for the researchers to collect information without interference from vehicular and human traffic

3.4.8 Sampling of Key Informants

Key informants from the Nairobi County infrastructure and Inspectorate departments, SACCO terminus managers and Nairobi CBD traffic policemen were selected by purposive sampling. They were selected because they were deemed to have knowledge and better understanding of the problem. They were interviewed by the researchers using interview schedules.

3.5 Observation

Observations were made on how the SACCO matatu terminus managers control vehicles, the techniques they use, matatu movements to and from the termini. The behavior of commuters and matatu crew was also observed. These observations were documented in observation schedule. Check lists were used to document the number of facilities at the termini.

3.6 Photography

Photographs show a vivid situation or phenomena. photographs convey information that may not be expressed by written words. They also used to reinforce explanations. Photographs of the existing situations during the field study were taken.

3.7 Mapping

Studies on existing maps and drawing of sketch plans during the field work enabled the researcher to analyze different sites in the study area.

3.8 Case Study

Terminus vehicle count survey was done at the Nation Roundabout termini to determine the available matatu parking space at the terminus (Smith and Associates, 2010, pg 7). The study was both quantitative and qualitative analysis of the capacity of the terminal, design and its functions. The purpose of the matatu turnover study was to provide an in-depth explanation on how a terminus functions in the study area. The Nation Roundabout is an extreme case scenario due to the fact that it is situated on a roundabout at the junction of Tom Mboya Street, River Road, Kilome road and Moi Lane, which are minor arterials with high volumes of public transport vehicles, a high activity zone consisting of retail shops, eateries and offices. It also had most of the characteristics of a typical terminus in the study area. A reconnaissance showed that it was used by a large number of vehicles resulting into the first bottle neck on the traffic flow system on Tom Mboya Street.

The vehicle count was done by research assistants who occupied an ideal position at both the entry and exit routes of the vehicles and registered the number plate on the vehicle count sheets (appendix III). The vehicle counts were done both at peak hours (7.00 A.M to 9.00 A.M and 4.00 P.M to 6.00 P.M) and non-peak hours (11.00 A.M to 12.00 P.M). This was done for two consecutive days in a week, Friday and Saturday. This vehicle count was done for six and a half hours per day giving a total of thirteen hours (13hrs) for two days. The vehicle counts were done to determine the available matatu parking space at different times of the day.

3.9 Data Coding and Analysis

After completion of data collection in the field, data cleaning and coding of questionnaires was done. The data was analyzed using the statistical package for social sciences (SPSS). The statistical techniques used for quantitative data were cross tabulation, range and mean. The former was used to calculate the average waiting times at peak and non- peak hours while the later was used to calculate the matatu parking demand. The results were presented as frequency tables and bar charts.

Qualitative data was analyzed by organizing the narratives into themes. Identification of facts that were relevant to research was done. spatial analysis of the termini characteristics was accomplished using GIS software (Arc GIS, AutoCAD and Map Info). A comparative analysis of siting characteristic of terminal facilities was used to discuss the quality of termini facilities in the study area. Quantitative data from the terminus vehicle count was entered into Ms Excel spread sheet. The matatu turnover was calculated by getting the difference between the number of vehicles recorded at the exit and the entry points of the terminus.

3.10 Data Presentation

Quantitative data from analysis of questionnaires was presented in form of frequency polygons pie charts and bar charts. Maps were used to present site spatial characteristics of termini. Discussion reports represented synthesis of qualitative data.

3.11 Conclusion

The methodology as described in this chapter was used to provide the necessary data and information required to fulfill the objectives of the research. All the stages in the research were presented in form of a research report. The next chapter provides information on the characteristics of the study area in Nairobi CBD.

CHAPTER FOUR: THE STUDY AREA

4.0 Introduction

This chapter describes the characteristics of the study area at national, regional and local context. It also provides information on the transport service demand patterns in the previous years.

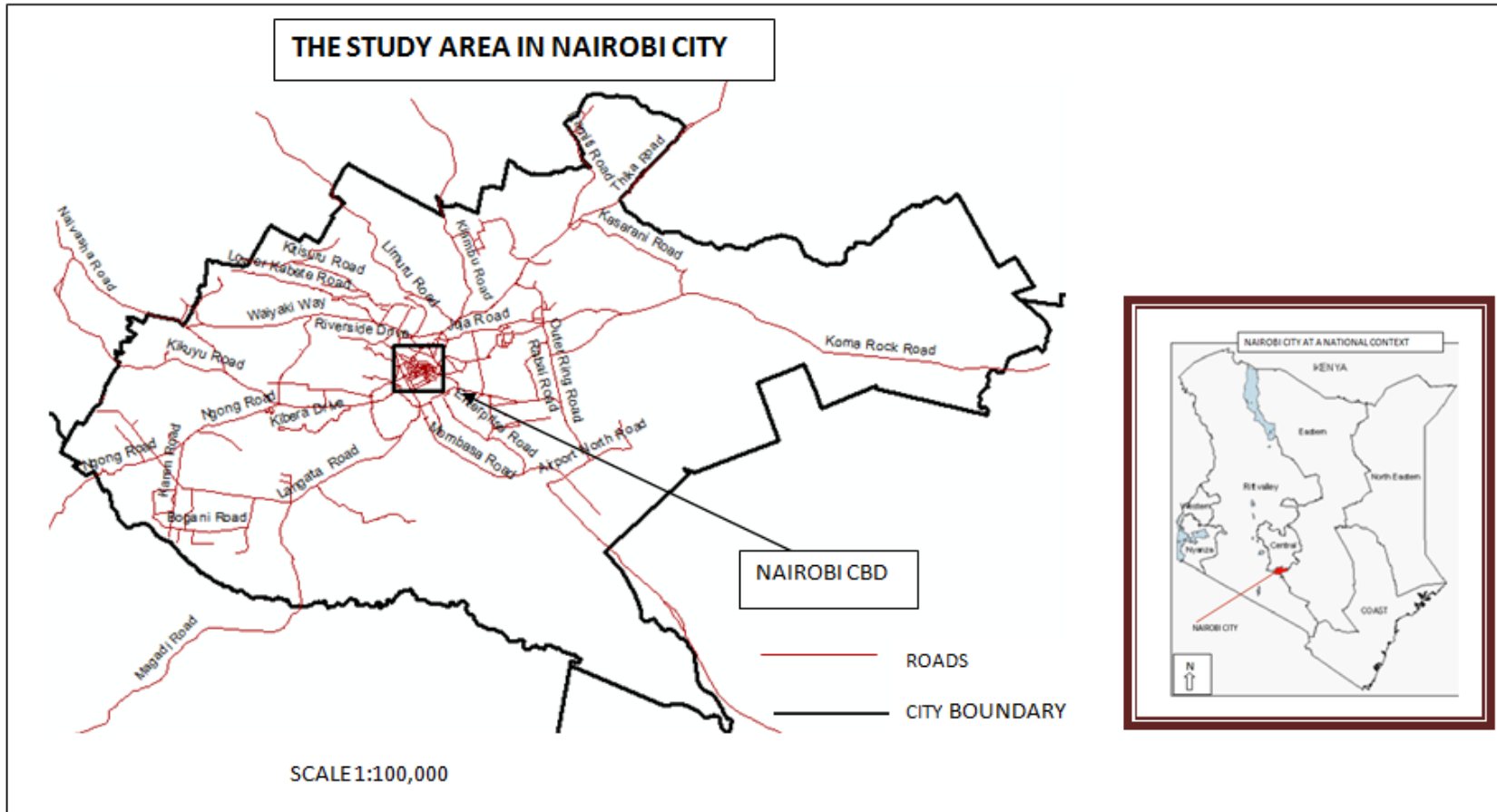
4.1. Study Area at National Context

Nairobi is located in the central part of Kenya (Map1). Nairobi City lies at 1.19° south of the equator and 36.59° East of prime meridian 70. The city is the international, regional, national and local center for transport and commerce. It serves as a connection point for eastern, central and southern African countries. It is connected to these areas by road, air and rail networks. The road network in Nairobi serves both local and international traffic. Transportation planning by road has to consider local and through traffic which have an impact on the number of vehicles in the city. This study concentrated on local traffic at the intra-city level. The matatus on the routes studied operate within the City boundaries. The matatus termini in Nairobi serve as link points to both local and international public transport systems. They are also used as points of interchange to other modes of transport locally and internationally.

4.2 Study Area at Local Context

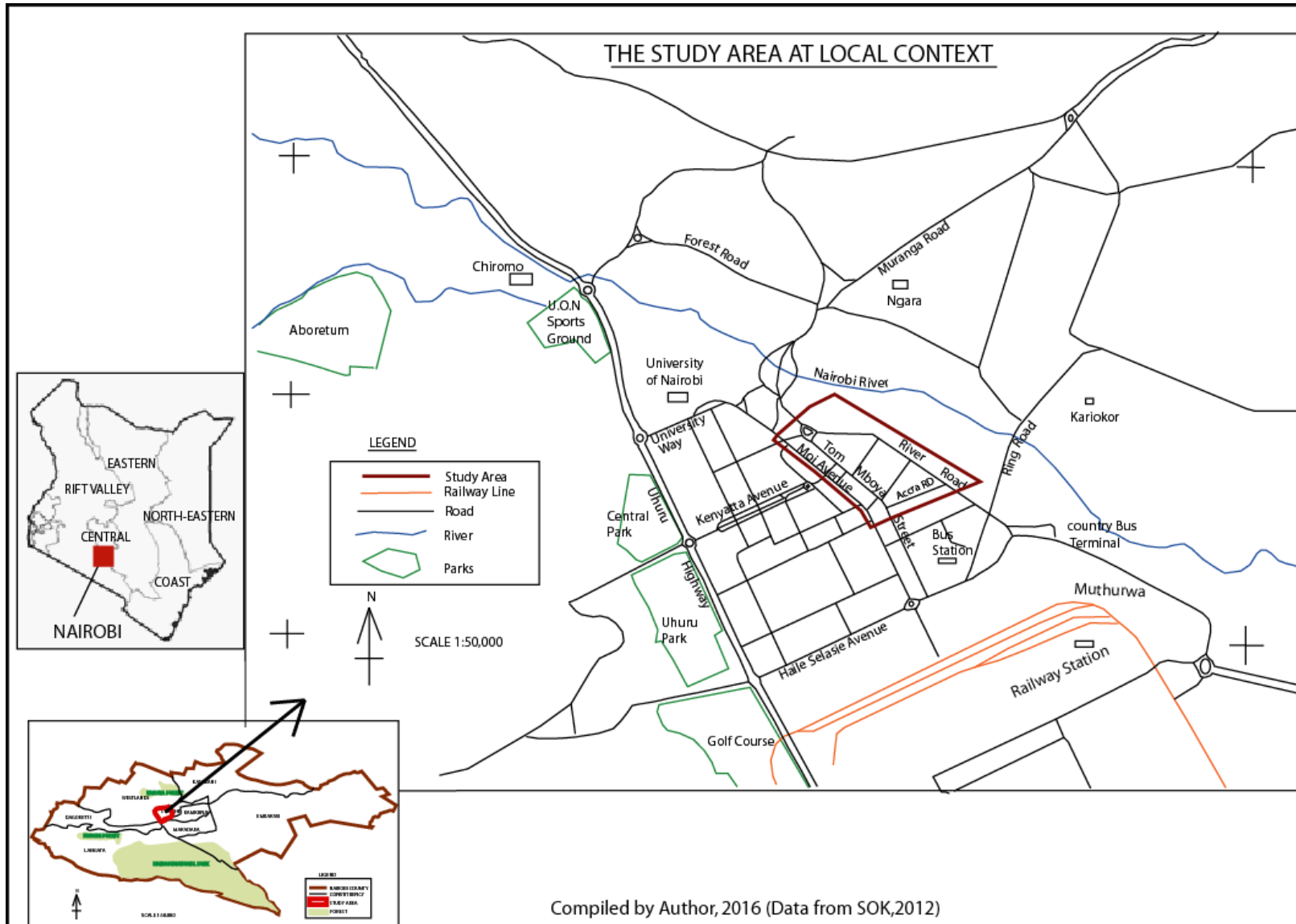
The city occupies an area of about 696 km². Nairobi city is governed by Nairobi county government. The Nairobi CBD which originally included Uhuru Highway, Haille Selassie Avenue and University way has grown into a larger precinct to include Uhuru Park, the railway station, Nairobi River and University area (Spatial Planning Concept, 2012). The study area is on the eastern side of the Nairobi CBD. Map 2(pg42) shows the location of the study area in Nairobi CBD in the city. The railway service which is located to the south is an alternative mode of transport in the CBD. Planning of efficient public transport services in the Nairobi CBD should consider the inter-linkages in the road and railway modes. The location of termini that serve as the two modes should provide good linkages between them.

Map 1: Nairobi City at a National Context



Source: Author, 2016 (Base data from SOK Topographical maps)

Map 2: The Study Area at Local Context



4.3 The Study Area

The study area was Tom Mboya Street and the adjoining streets, in the area bounded by River road, Accra road, Tom Mboya Street and Moi Avenue as shown in map3. Generally, it is a high density zone with high rise buildings up to ten floors usually overcrowded with vehicular and human traffic. There are retail shops for clothing, electronics, banks, eateries and offices. Tom Mboya Street is located in Nairobi CBD and its one of the main arterial streets. It is in the eastern side of the CBD which is a designated zone for matatus from Westlands and Eastlands parts of Nairobi city.

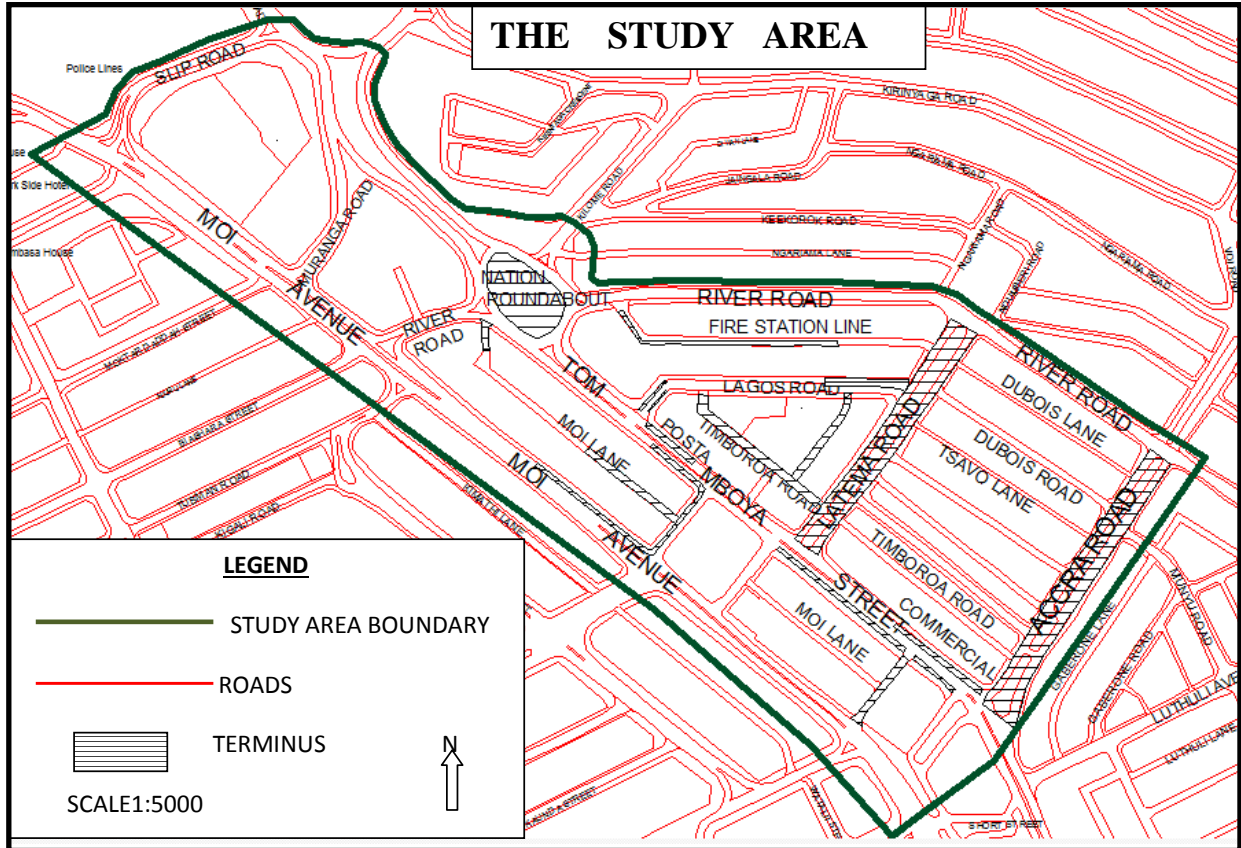
There are twenty two matatu routes on Murang'a road, Limuru Road, Parklands Road and Uhuru Highway. Nineteen of these routes have their termini on Latema Road, Old Nation Roundabout, POSTA (Post Office on Tom Mboya street) and Tusk's Stage(opposite)Post office, Commercial and Moi Lane (www.jambonairobi.co.ke/tag/nairobi-matatu-routes).The number of routes terminating on Accra Road is seven. Matatus on these routes enter the Nairobi CBD through Hailselasie Avenue and travel through Tom Mboya Street to access their terminus on Accra Road. The termini that were studied were those that serve matatus on routes from the eastern and western side of Nairobi city. Matatus on these routes enter the CBD through Murang'a road and Waiyaki way respectively.

The termini which were included in the research are located at Nation Roundabout, Latema Road, POSTA, Timboroa Road and Commercial (Map3 pg44).

4.4 Traffic circulation

Traffic circulation has an impact on the movement of matatus to and from the termini. Map7 shows the traffic circulation in the study area. Moi Avenue is a major arterial, while Tom Mboya Street is a minor arterial in the study area with a one-way traffic. River road, Latema road and Lagos road are two-way traffic. There are other traffic lanes in the study area with two way traffic. The operations of public service vehicles at termini should not interfere with the flow of other traffic in the CBD streets.

Map 3: The Study Area



Source: Author, 2016 (Compiled from data provided by Nairobi County and JICA, 2012)

4.5 Demography and Public Transport Demand in Nairobi

According to Olima (2011), Nairobi's population was 3,751, 860 in the year 2009. The growth rate was 4.6 % and the Nairobi population was estimated to reach 9 million persons by 2030. The day time population was approximately 3, 280, 00 in 2009 and 3,766,000 in 2013. This daytime population needs to access the city. The total number of jobs in the city was estimated at 1,813,000 (Kenya, 012). It was projected that the number of active employees who live in the city would reach 1,648,000 in 2013. This included a net inflow of commuters from outside the city which was estimated at 165,000(Kenya, 2012). Those who access the City by public means of transport are 80% (Katathira and Engineers International, 2006). Gachanja (2012) found out that matatus carry about 33% of the commuter traffic, which are about 3 million passengers per day.

According to Olima (2011) the projected population for Nairobi Metropolitan region is expected to reach 11.4 million (approximately) by 2030. Rural–urban migration is likely to contribute to this population increase. The increase in population has caused an increase in demand for public transport services. Oumarou and Kulemaka (2007) found that this demand was at 1.8 million trips per day and was projected to rise to 2.9 million daily trips by 2025. Most of the trips were concentrated into the city center in the west and East areas of Nairobi. Therefore, it is important that public transportation planning is undertaken to meet the growing demand of public transport services without causing more traffic congestion in the Nairobi CBD.

4.6 Landuse Pattern

The area is classified under zone 1A by the Nairobi county zoning plan (kenya,2013). This is a high density development zone with commercial, residential and light industries. The ground coverage is 80% and Plot Ratio of 600. The study area is a high activity zone with retail clothing shops, banks, supermarkets and offices.

CHAPTER FIVE: RESULTS OF DATA ANALYSIS AND DISCUSSIONS

5.1 Introduction

The findings from the field work are explained in this chapter according to the objectives of this study using data presentation instruments such as tables, maps and charts.

5.2 Allocation Procedure for Matatu Termini

After interviewing officials from the Nairobi County, the researcher found that matatus are given parking spaces by the Nairobi infrastructure department on application by the owners to the Town Clerk. The owner makes an application to the Town Clerk for a route license and a parking space. After payment of the requisite fee the Town Clerk allocates the parking permit.

Siting of matatu termini is done by the Nairobi County Transportation unit through a gazette notice. These matatu termini were published as parking spaces by the County (Kenya, 2000). Information from the infrastructure department revealed that, where the route is not indicated in the gazette notice an area is designated and matatus are allowed to use it as a terminus. The siting factors used by the infrastructure department include route of operation and availability of space. The space requirements for every termini being an area that is able to accommodate a minimum of two berths, one for picking and one for dropping passengers.

The gazette notice (Kenya, 2000) shows parking areas mainly located on the streets in the eastern side of the city center including the study area. Some of the routes operating in the study area have been allocated parking elsewhere in the CBD. Table 3 shows the existing matatu parking facilities (termini) in the study area which include Latema road, Old Nation Roundabout and Accra road. The routes served by these termini are also indicated. Therefore, the matatus have been officially allocated parts of the CBD roads as parking spaces which they use as parking zones. The parking of matatus on these roads blocks part of the road network system in the CBD hence causing interference with the flow of other traffic. Observations showed that the parking due to lack of enough parking space some matatus wait for the turn to park on Tom Mboya Street and River Road. The spatial distribution of these termini in the study area is shown in map 3.

Table 4: Existing Matatu Termini in the Study Area

TERMINUS	ROUTES	DESTINATION
LATEMA ROAD	48B	LAVINGTON
	23	KANGEMI
	22	KINOO
	11B	RUAKA
	11D	UKAY CENTER
	11A	HIGHRIDGE
	11C	AGHAKHAN HOSPITAL
	107A	KARURA
	107	NDENDERU
OLD NATION ROUNDABOUT	119A	MWIMUTO
	118B	WANGIGE
	108	KARURA
	106	BANANA HILL
	107	KARURA(KAMURIMO)
	118	WESTLANDS
	119B	GITHIGA
	25	BABA DOGO
	114	LIMURU
	115	LIMURU
ACCRA ROAD		EASTLEIGH SECTION3
	4	CARLIFORNIA
	7	EASTLEIGH SECTION1&2
	9	EMBAKASI VILLAGE/PIPLINE TRANSAMI
	33	GREENFIELD
	34B	BURUBURU
	58	MARINGO
	10	

Source: Author, 2016 (Data source; Kenya gazette, 19th May, 2000)

An in-depth study of the siting characteristics of the termini in the study area was done at two termini located at Nation Roundabout and Latema Road.

5.2.1 Siting Characteristics of Matatu Termini

An analysis of the siting characteristics was done using measurements, observations and mapping.

5.2.2 Old Nation Roundabout

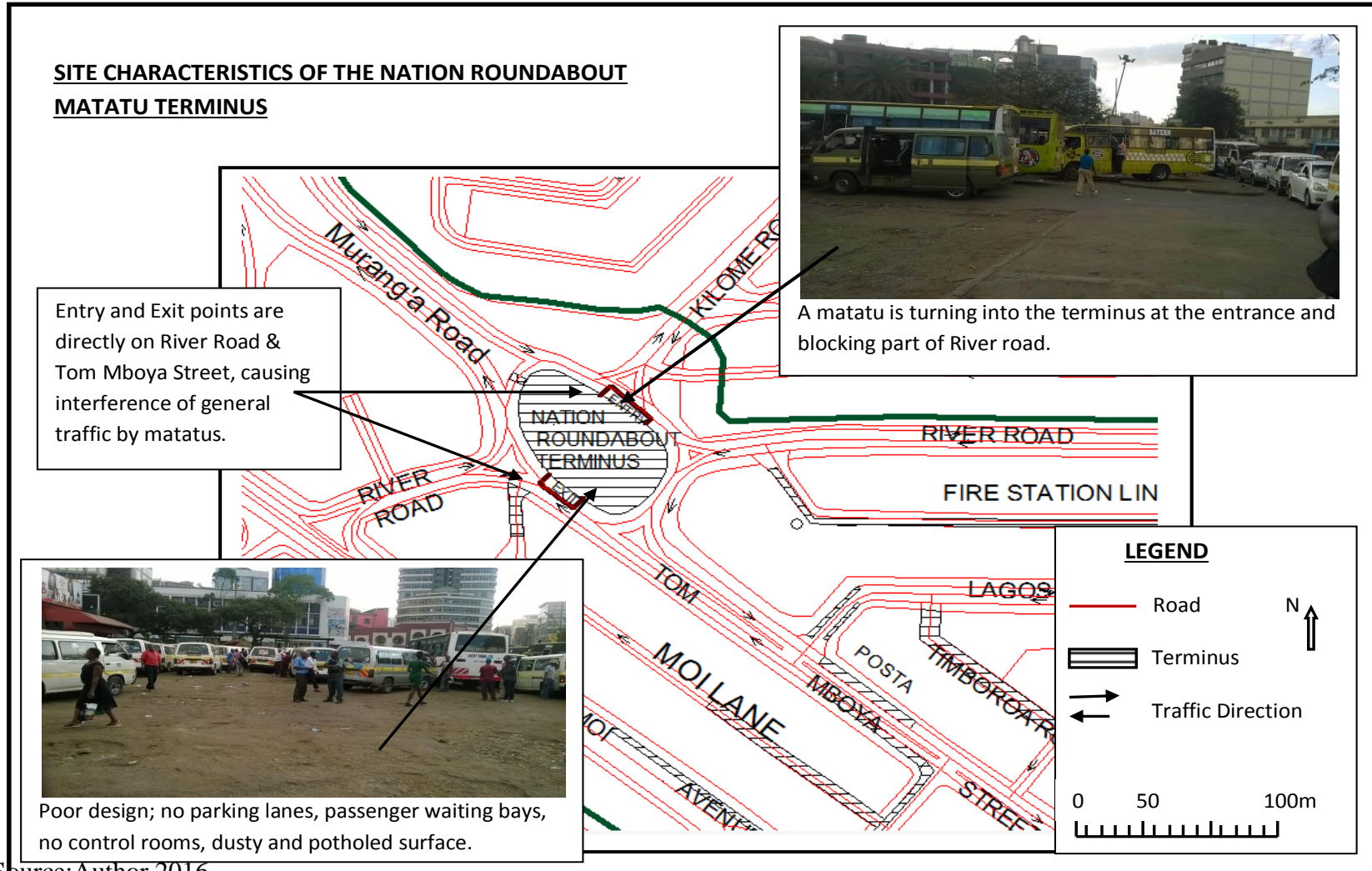
During the research it was found that the Nation Roundabout terminus has the following siting characteristics;

- i. It is located on a roundabout which is a major connection point for four roads, Murang'a Road, Kilome Road, River Road and Tom Mboya Street.

- ii. Tom Mboya Street and Murang'a Road are minor arterials with heavy flow of traffic especially at peak hours. This is partly due to the fact that all matatus that operate in the eastern and part of the western side of Nairobi enter the CBD through Murang'a road private vehicles also use the same road to enter the CBD.
- iii. The terminus has a direct entry and exit on River Road and Tom Mboya Street respectively. The entry and exit points have no deceleration or acceleration lanes. Therefore, matatus operating at the terminus interfere with the general traffic by blocking River Road and Tom Mboya Street while trying to enter or leave the terminus.
- iv. The location of this site in the CBD does not favour future expansion.
- v. The size is 2859.02m² which is big enough for a stopping point (refer to pg 17 and 18 in this report). However it lacks the design of a terminus, it has no parking lanes, passenger platform and control rooms.
- vi. It does not provide enough parking spaces for all the matatus operating at the terminus.

The recommended minimum standard parking size of an American and large European vehicle is 33.5 m² (*Planning and Building Regulations of Kenya*, 2009; MM15.3). This was used to compare the requirements of a minimum parking space for matatus operating at the terminus if all were 14-seater. The terminus can provide parking for 86 matatus. The number of matatus that use this parking space considered in the survey was 473. On average the available parking space for each matatu would be 6.00m², however not all of them may be parked at the same time. Some will always be on the road. If half the number (237) were to be parked, the available space for every matatu would be 12.06m². The available spaces of either 6.0m² or 12.06m² cannot accommodate a matatu. Therefore, some matatus cannot have parking at this terminus. Information from the matatu SACCO termini operations managers revealed that some of the matatus park in Ngara estate. It is also important to note that, the number of matatus operating at the terminus is higher because not all routes were included in the survey. Therefore, there is a shortage of parking space at this terminus. A summary of the siting characteristics is shown in Map 4.

Map 4: Site Characteristics at Old Nation Roundabout Terminus



The above siting characteristics do not conform to recommended siting characteristics by World Bank and PIAF, 2006 and the factors used by the Nairobi Infrastructure department.

The location of this terminus causes management challenges to the general traffic on the neighbouring roads and the terminus. These factors also cause it to operate inefficiently. A well designed terminus at this location would provide an easy access of commuters to the CBD and reduce traffic congestion problems.

5.2.3 Latema Road Terminus

The Latema Road terminus was found to have the following siting characteristics;

- a. The terminus is located on Latema Road. It has entry points at Tom Mboya Street, Lagos Road, Timboroa Road and River Road. The road has 10 T-junctions with other neighboring roads and streets. The traffic circulation on Latema Road is complicated by the many roads joining it.
- b. At the junction of Tom Mboya Street there are no acceleration or deceleration lanes for matatus to enter or leave the Latema terminus. Therefore, matatus interfere with the general traffic on neighbouring roads while entering or leaving the terminus.
- c. Private vehicles use Latema Road, taxis and up-county public service vehicles park there.
- d. Observations showed that matatus park on the road space on both sides of the road.
- e. The parking area on Latema Road is approximately 5,453.23m² which has been allocated to approximately 1350 vehicles excluding the up-country matatus which also operate there. Taking a minimum parking space of 33.5m² (*Planning and Building Regulations of Kenya, 2009*). The area can provide parking for 162 vehicles excluding parking area circulation space. Therefore, this leaves a deficit of 1118 vehicles without parking which causes parking on the road. Parking of matatus on Lagos Road and Timboroa Road blocks them causing congestion this area. The parking of matatus on the roads blocks them leading to congestion. This situation agrees with the World Bank studies (2012) that there is poor terminal organization and management of termini in Nairobi city. Plate 3 shows the overflow parking form Latema road to Lagos road.

Plate 3: Matatu Parking on Lagos Road



Source: field work, 2016

Observations showed that some matatus park on Timboroa road and Lagos Road to access the Latema terminus due to lack of parking space. The parking spaces used by the matatus were designed for private cars and hence too small for omni-buses (33 seater matatus). Matatus reverse while parking and leading the spaces obstructing general traffic on Latema road (Plate 4).

Plate 4: Matatu Parking on Latema Terminus



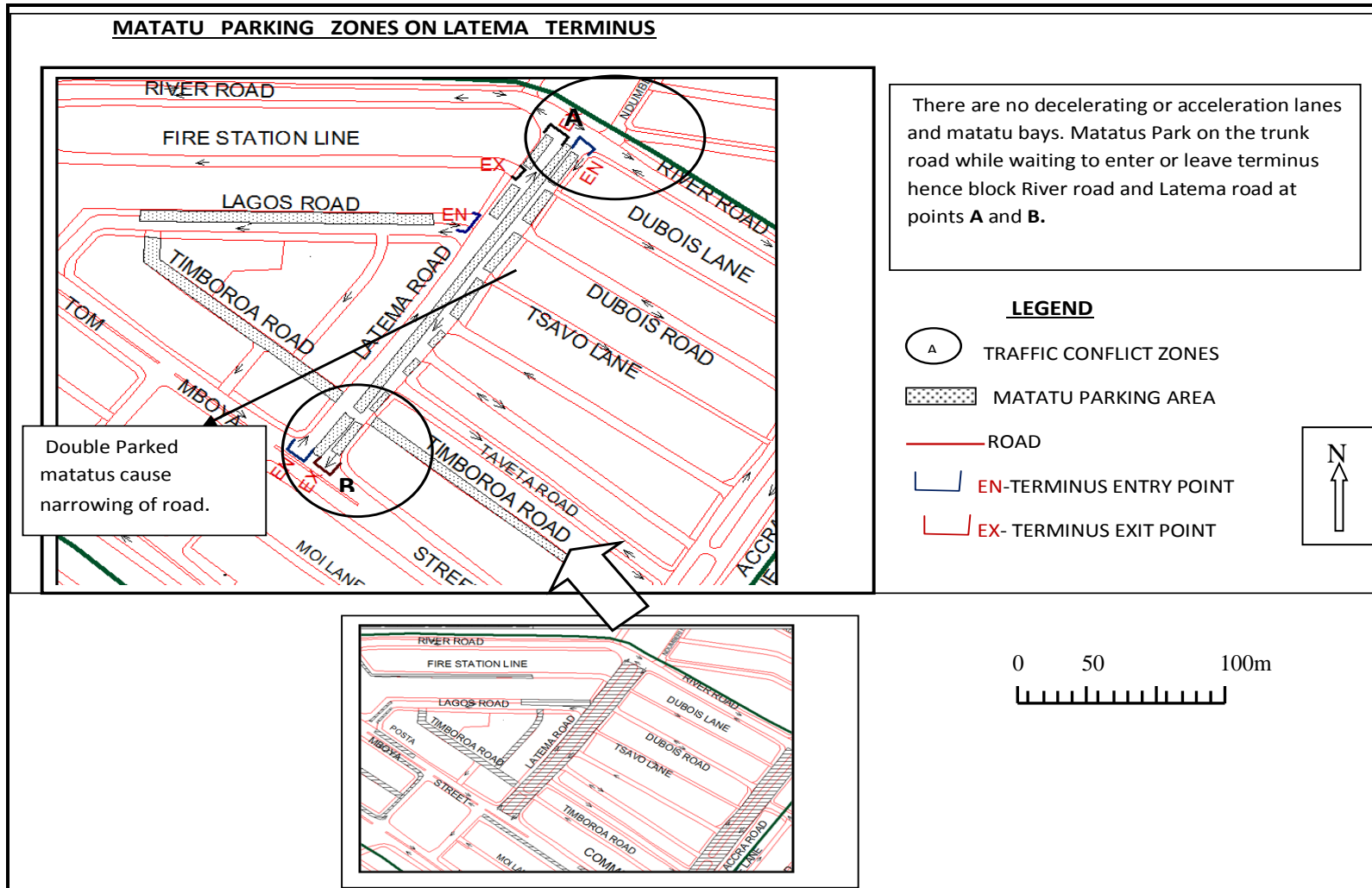
**POOR DESIGN AND
LAYOUT OF LATEMA
TERMINUS**

- Matatus use unmarked parking spaces previously used as private parking.
- They reverse to park and leave the parking blocking other traffic on Latema road.

Source: Field work, 2016

A summary of the siting factors of the Latema terminus are shown in map 5. The above terminus characteristics at Latema road causes this terminus to be inappropriately located compared to the World Bank (2006) recommendations. The operations of the termini have adverse effects on the general traffic flow in this area. However, the space at the terminus is adequate for siting a terminus or a matatu stop but requires a good design to enable it function efficiently (Boer & Rossum, 2015).

Map 5: Siting Factors at Latema Terminus



Source: Author, 2016

The key informants from the infrastructure and Inspectorate department informed the researcher that the matatu termini in the study area not appropriately located because they contribute to traffic congestion in the study area. The Nairobi County has future plans of re-locating them to other areas. The key informants in the inspectorate department and control traffic in the CBD would prefer that the matatu termini be located outside the city center to avoid the operations of matatus hindering the flow of traffic in the CBD.

Future plans on improvement of transportation infrastructure in Nairobi metropolitan region are contained in the *Spatial Planning Concept of Nairobi* (2012). The concept has guidelines on development of bus terminus in urban areas depending on the population size. Nairobi City having a population of over ten million people requires a class 'A' bus terminus for inter, intra and urban public transport services. However, these future plans are silent on the siting of matatu terminus in the Nairobi CBD. The existing siting factors by the Nairobi County cannot be used in siting of an efficient operating matatu terminus in the Nairobi CBD.

The termini provide services to matatus and commuters. The facilities of offered at the terminus determine the quality of services offered. The researcher assessed adequacy of these facilities at the termini in the study area.

5.3 Assessment of adequacy of passenger and vehicle at the matatu termini

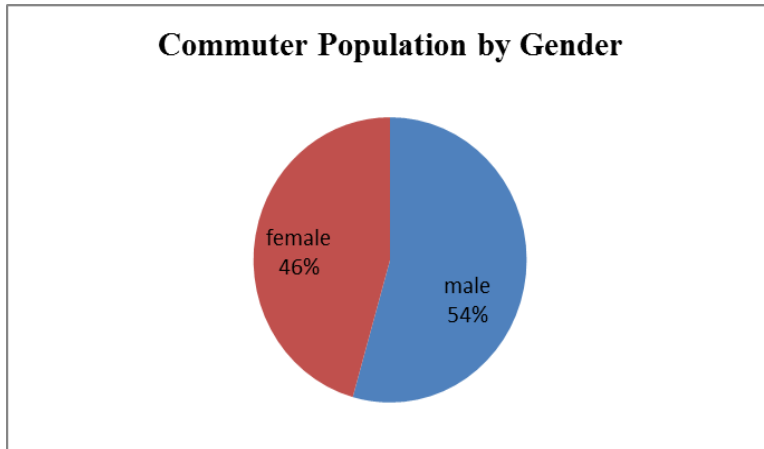
A terminus needs to be equipped with adequate passenger and vehicle facilities. The type of facilities provided depends on the type of terminus. The matatu termini in the CBD provide parking facilities and it is essential that they have facilities. The commuters and matatu crew are the users of matatu termini. They were used to provide data on facilities through questionnaires. Information on the social characteristics of the sample populations for the commuters and the duration they have used matatus as a public means of transport was collected.

5.3.1 Characteristics of the commuter population

I. Gender

The gender characteristic of the commuter sample used was 54% male and 46% female (Figure5).

Figure 5: Commuter Population by Gender

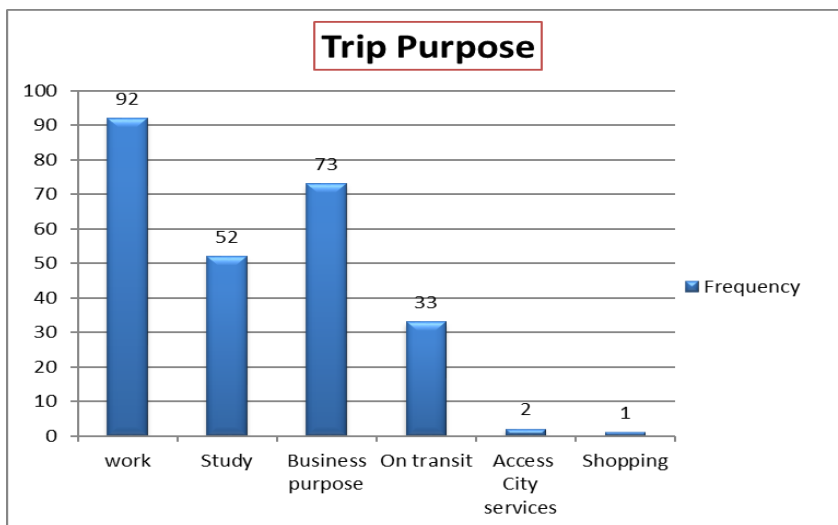


Source: Field Work, 2016

II. Trip Purpose

Trip purpose is associated with landuse activity in the Nairobi CBD. The landuse attracts commuter population who travel to the Nairobi CBD to fulfill a given purpose. The reasons for travelling to the Nairobi CBD showed that 92% travels to work, 73% to do business, 52% to study, 33% are on transit to other destinations, 2% to access services and 1% to do shopping. Figure 6 shows the trip purpose of the sampled commuter population.

Figure 6: Trip Purpose



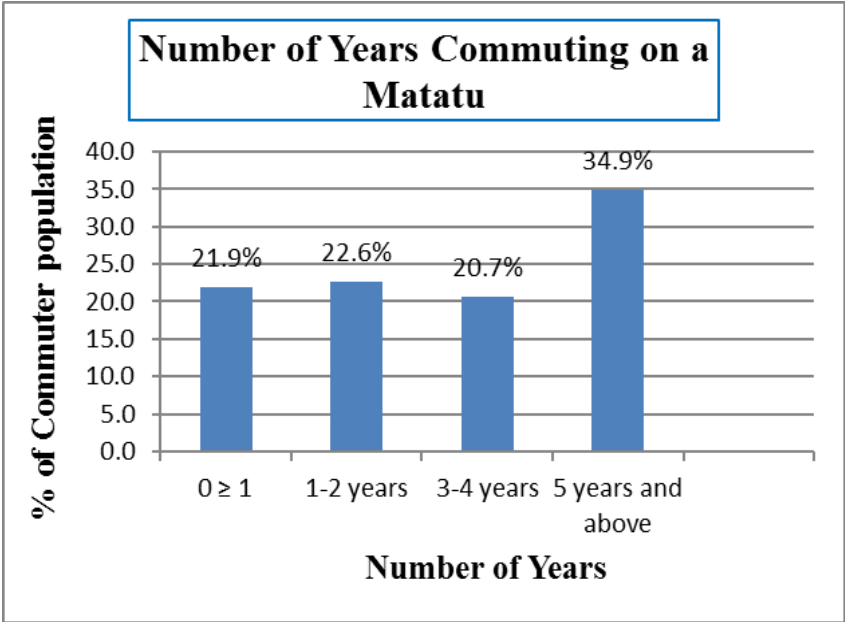
Source: Field Work, 2016

Public transportation planning for matatus should consider the distribution of land uses which determine trip patterns. Dispersal mechanism should be used to avoid traffic congestion in the CDB area. This was one of the recommendations of the Nairobi Metropolitan growth strategy of 1973(refer pg 21).

III. Number of Years Commuting by Matatu

The commuter sample used showed that 34.9% of the respondents have been using matatus as a means of public transport for 5 years and above, 20.7% between 3 to 4 years, 22.6% between 1 to 2 years and 21.9% in less than a year. This shows that those sampled have been using the matatus very frequently in the past five years (figure 7). Therefore, matatus are an important means of public transport in Nairobi.

Figure 7: Number of Years Commuting by Matatu



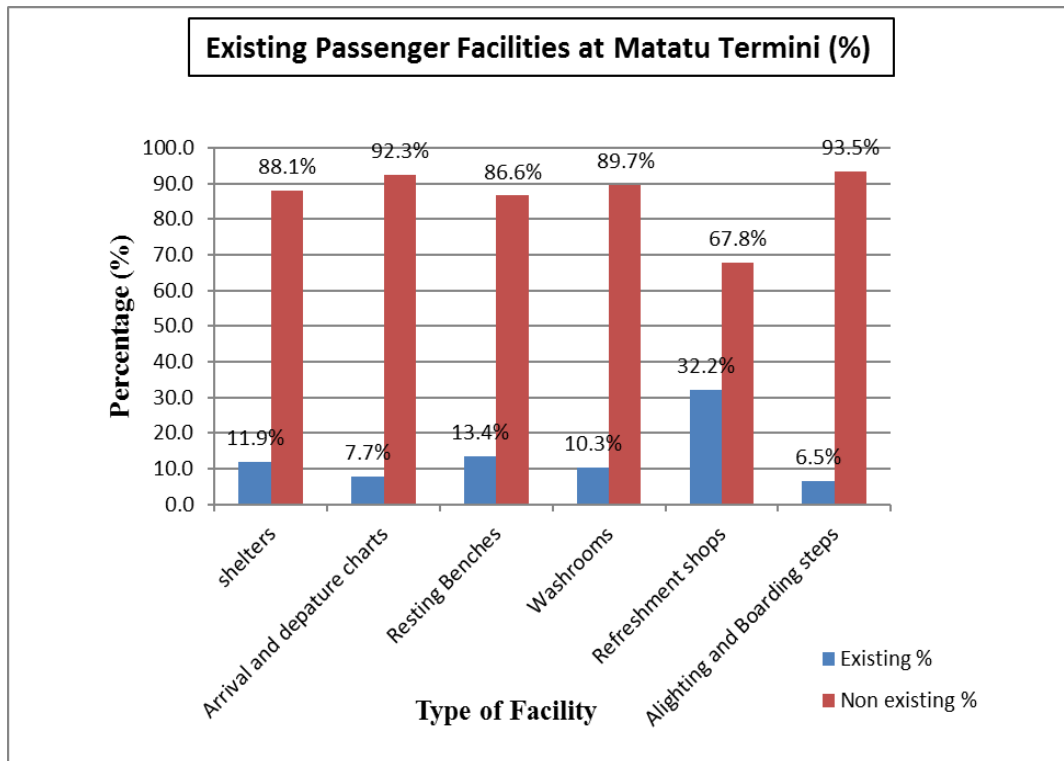
Source: Field Work, 2016

5.3.2 Commuter Facilities

Commuter facilities at the terminus are essential to enable them get information on the route schedules, board and alight safely from the vehicles. Passenger facilities are provided depending on the level of demand at every terminus. An assessment of the available facilities was carried out at the terminus in the study area by administering questionnaires to matatu commuters (passengers) and matatu crew. Observations were also done using a tally sheet to certain the information given by commuters and matatu crew who use these facilities.

The commuter response for the level of adequacy of passenger facilities showed that; the existing shelters were 11.9 %, arrival and departure charts, 7.7%, resting benches, 13.4%, washrooms 10.3%, refreshment shops, 32.2% and boarding steps 6.5%. The results show that most of the facilities required did not exist at the termini in the study area having recorded over 50% none existing for every category (Figure 8).

Figure 8: Existing Passenger facilities at Matatu Termini



Source: Field work, 2016

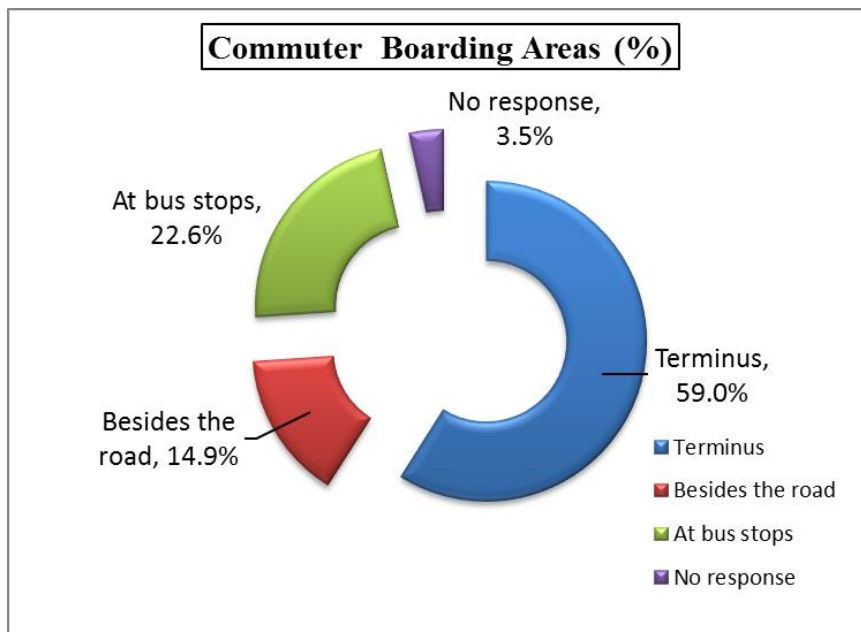
Lack of adequate commuter facilities contributes to low quality service at the terminal facility. It may discourage many people in Nairobi from using the matatus as a public means of transport.

The demand level for a terminus was assessed by determining the percentage of commuters who board the matatus at different locations in the CBD.

5.3.3 Commuter Matatu Boarding Areas

Commuter demand for a terminus in a given location is used as one of the factors used to determine the siting of a terminus or bus-stop. The commuter boarding areas for matatus in the CBD in the study area was found to be 59% at the terminus, 22.6% at the bus-stops, 14.9% besides the road and 3.5% did not respond (Figure 9). This shows that termini are highly utilized as boarding areas by commuters in the study area. Most commuters use them and therefore, they are important entry and exit points in the CBD. The quality of service offered at the termini needs to be improved. Boarding of matatus in undesignated areas in the CBD is likely to cause interruptions to the general traffic flow in the road system. Commuters should board matatus at only designated termini and bus-stops. The use of undesignated points by matatus to pick and set down passengers is contrary to the Nairobi By-laws and obstruction laws in the Traffic Act. It means that there is laxity in enforcement of the traffic laws in the CBD causing inefficient control of traffic. Figure 9 shows commuter responses on the matatu boarding areas.

Figure 9: Commuter Boarding Areas



Source: Field work, 2016

5.3.4 Availability of matatu facilities at termini

Matatu termini require facilities for use by vehicles in the operations. The level of availability of vehicle facilities at the terminus determines the quality of control on operations. Available vehicle facilities should provide efficient control and service to the users. Observations by the researcher showed that most of the matatu termini are located on streets utilizing the on street parking areas previously designed for private cars. There were parking spaces at every terminus though not enough to accommodate all matatus. There were no enough matatu lay bays/berths for vehicles to stop while waiting for passengers to alight or board. There were also no control rooms, schedules and garages. The results obtained are shown in table 6. (*X indicates presence of facility and – indicates absence of facility*).

Table 5: Available vehicle facilities

Location of terminus	Lay Bays/Berths	Reserved entry & Exit lanes for matatus only	Minor repair garage	Parking spaces	Matatu control rooms	schedules
Latema road	x	-	-	x	-	-
Timboroa Road	-	-	-	x	-	-
Old nation Roundabout	-	-	-	x	-	-
Commercial	x	-	-	x	-	-
Posta	x	-	-	x	-	-

Source: Field work, 2016

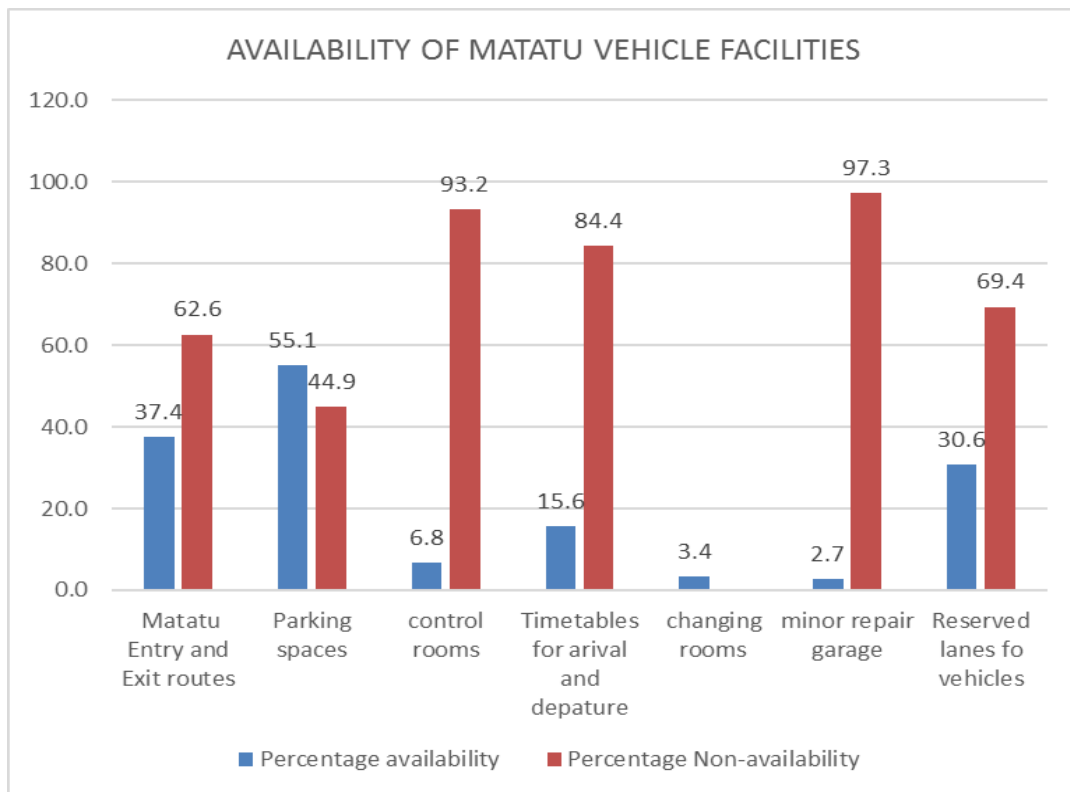
The information gathered by observation on the availability of vehicle facility was enriched by determining the percentage of availability from matatu crew who use them. The matatu crew response on availability of facilities at the termini showed the following percentages for non-existing categories of facilities; matatu only entry and exit; 62.6%, control Rooms; 93.2%, and time tables for arrival and departure at 84.4 % (Figure 10). The results showed that there is a lack of adequate vehicular facilities.

Interviews with SACCO terminal management officials revealed that lack of these facilities cause matatu crew to pick and drop passengers at undesignated locations and park on the streets. The lack of entry and exit lanes at the termini causes matatus to interfere with traffic flow while

entering and leaving the terminus. The traffic police and Nairobi county traffic marshals cited parking matatus at the Commercial and POSTA termini as a major contributor to traffic congestion on Tom Mboya Street.

Observations by the researcher showed that the matatus form long queues while waiting to enter the terminus which extend into neighbouring streets blocking the road as shown in Plate 5 & 6 (taken at the Nation Roundabout). The road space in the termini areas has been converted into parking zones reducing the carriage way for other vehicles. This contributes to traffic congestion in the study area.

Figure 10: Availability of vehicle facilities



Source: Field work, 2016

Plate 5: Matatus Queuing at Old Nation Terminal Entrannce

Long Queues formed by matatus entering the terminus extend into the roads



Source: Field work, 2016

Plate 6 : Extended Matatu Queue into the Neighbouring Street



Source: Field work, 2016

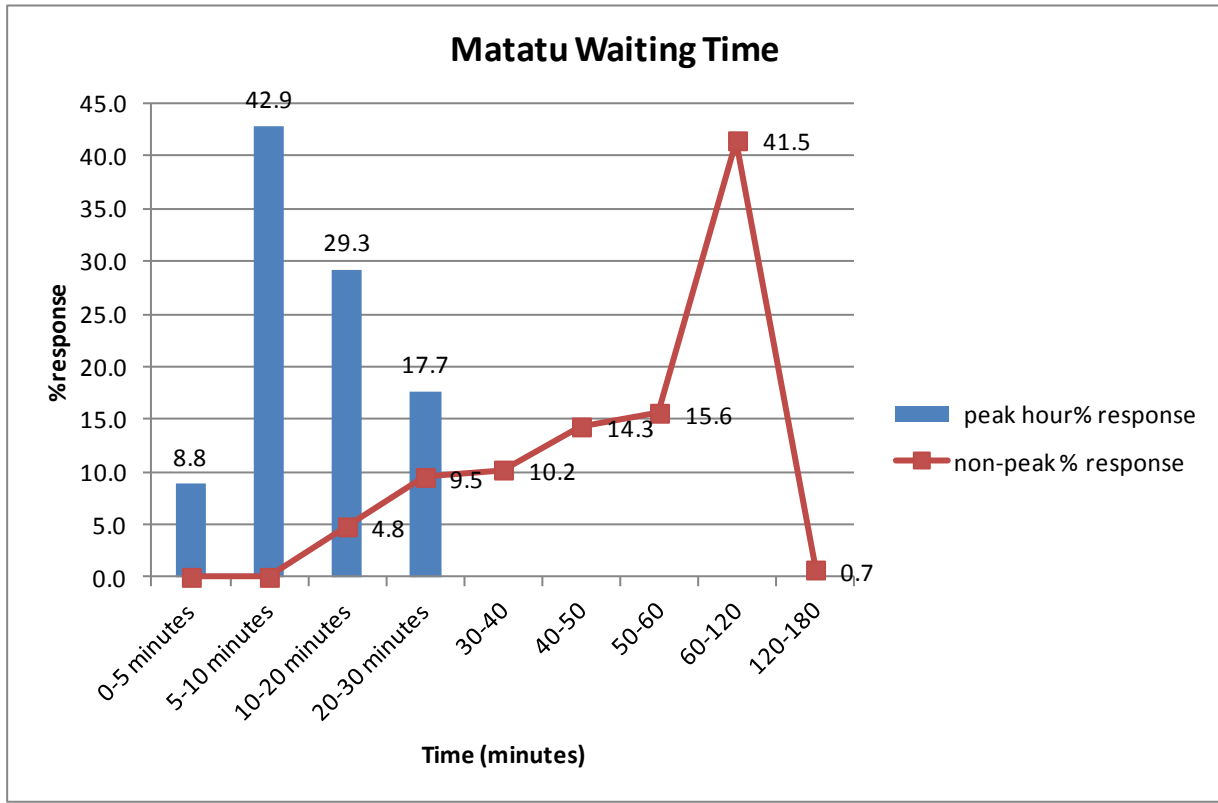
5.4 How the operations of termini affect traffic flow in the study area.

5.4.1 Matatu Waiting Time

The dwelling time for vehicles at terminus is used to measure the level of efficiency of the facility. It is used in bus scheduling for peak and off-peak hours. Although the matatus do not operate using a schedule it is important to know the time a matatu spends at a terminus to analyze the operation efficiency of the service. The matatus operate using the paratransit mode. Therefore, the researcher investigated the period of time the matatus spend at the terminus on arrival and departure. This time is referred to as “waiting time”. The matatu crew response for vehicle on waiting times in minutes at peak hours (7.00 A.M to 9.00A.M and 4.00P.M to 7.00P.M) is shown in figure 13. The waiting time of between 5 to 10 minutes had the highest respond of 42.9%, 10-20 minutes was 29.3%, 20-30 minutes was at 17.7% and 0-5 minute was the lowest at 8.8%.

The waiting time for matatus at off peak hours (9.00 A.M and 4.00 P.M) of between 60 to 120 minutes had the highest percent response of 41.5% while that of between 0 to 15 minutes had the lowest response of 4.1% in the line graph (figure11).The no response percentage was 3.4. These waiting times for both peak and non-peak hours are very high. Dwelling time for a scheduled bus services are usually limited to seconds except for laying over's and terminating routes(TCRP, n.d) which may be longer than 2 minutes but the matatu waiting times seems to be abnormal. Waiting times of up to two hours cause the terminus to be converted into parking lots. These aggravates the traffic congestion problems in the study area especially where the terminus are located on the CBD streets. There should be a realistic limit for the time matatus should park at the terminus to achieve an efficient transport system (World Bank, 2006). The long parking times cause a large number of vehicles to be stationed at the matatu termini which show inefficiency in control of the matatus at these termini and the public transport system. The long waiting times cause congestion at the terminus and should be eliminated by scheduling the matatu services.

Figure 11: Matatu Waiting Time

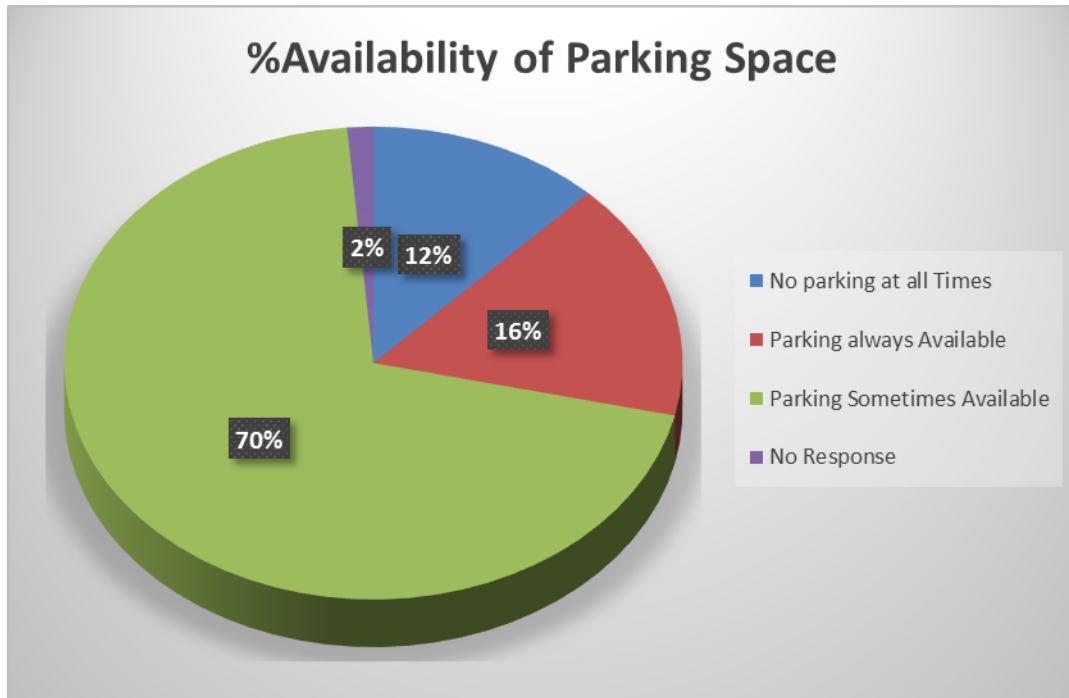


Source: Field work, 2016

5.4.2 Availability of Parking Spaces

Termini should provide parking space for vehicle to allow setting down and picking of passengers. Response from the matatu crew showed that on arrival of the matatu vehicles at the terminus, 70% sometimes find parking space, 16% find parking, 12% do not find parking as indicated by the pie chart in figure 12. Therefore, if 12% of the vehicles do not find parking space where do they stop? There is a possibility that they may park on road space or elsewhere within the CBD.

Figure 12: Availability of Parking Space



Source: Field work, 2016

5.4.3 Matatu Control Methods

Control of vehicles at the termini is done by the SACCO operations managers. Observations showed that there are several operations managers at one terminus with each controlling vehicles on different routes. There is no coordination among the managers in controlling the number of matatu entering and leaving a terminus. They use a queuing system to control the entry and exit of vehicles (photograph6). Black boards and counter books are used to book the number plate of vehicle on entering the queue at the terminus (Plate 7). The matatus pick passengers on first come basis. Lack of coordination among the SACCO operations managers causes competition for space by matatus from different SACCO's at the terminus. Information gathered from the SACCO terminus managers revealed that those matatus which lack parking space park outside the CBD. The managers use mobile phones to call the next matatu parked outside the terminus to pick passengers on the queue. They also use hand signal and shout to direct the matatus at the terminus. The managers cited lack of parking space, poor conditions of terminus facilities and lack of modern vehicle control systems as some of the major challenges they face in controlling the Matatus at the terminus.

Plate 7: Route Manager Record

A SACCO OFFICIAL RECORDING THE MATATU NUMBER PLATES ON THE QUEUE



Source: Field work, 2016

The traffic police and Nairobi County traffic Marshalls control the matatus at the terminus and on the streets using hand signals. There is lack of coordination among the three groups; SACCO officials, traffic police and traffic Marshalls contributing to inefficiency in management of the matatu fleet in the study area. Plate 8 shows a traffic policeman controlling traffic on Tom Mboya Street.

Plate 8: Traffic Policeman Controls traffic on Tom Mboya Street



Source: Field work, 2016

5.4.4 Pedestrian Access to Matatu Termini.

Observation showed that there is lack of passenger access routes to the termini. Therefore, pedestrians cross the road at any point while trying to leave or access the terminus. Information

from the traffic police showed that pedestrians interfere with traffic flow by crossing the streets in any location of the street. Lack of zebra crossings and signalized traffic control systems in some areas causes commuters to disobey traffic rules. The level of human traffic conflict is high due to the close proximity of termini in the study area which interfering with the flow of vehicular traffic (Plate 9).

Plate 9: Pedestrians Crossings at Non-designated points



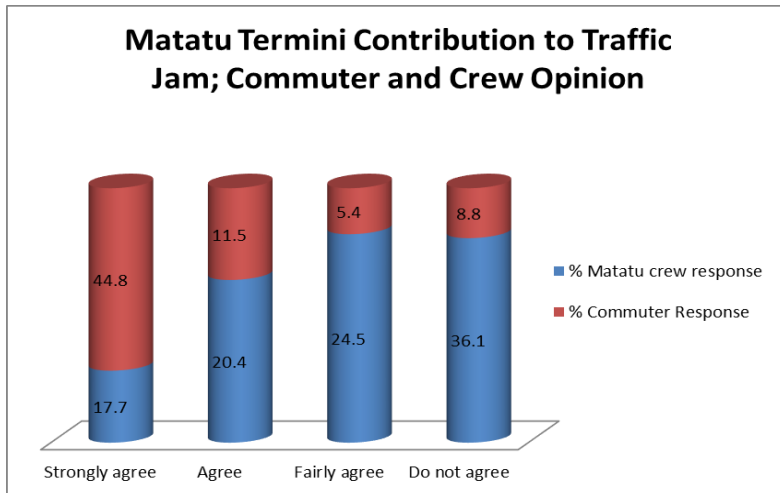
Note: Pedestrians crossing Tom Mboya Street at Various points with due to lack of Zebra crossings

Source: Field work, 2016

5.4.5 Matatu Contribution to Traffic Congestion

Opinion of commuters and matatus crew on the contribution of matatus termini on traffic congestion showed the percentages of commuter responses as follows; 29.9% strongly agree, 37.5% agree, 15.7% fairly agree, 12.3% do not agree and 4.6% did not respond. While the matatus crew response was 17.7 strongly agree, 20.4 5 agree, 24.5% fairly agree and 36.1% do not agree figure 13. This shows that the presence of the termini contributes to traffic congestion in the CBD, considering a total percentage of 83.1% for the commuters and 62.2crew who agreed.

Figure 13:Matatu contribution to Traffic congestion (Commuter and Matatu Crew Opinion)



Source: Field work, 2016

5.4.6 Old Nation Terminus Vehicle Turnover Survey (case study)

Vehicle turnover at a terminus is used as an indicator of availability of enough parking spaces for carrying out efficient operations. The terminus was used as a case study on the turnover research to provide an insight on the operations of matatu termini and explain the challenges experienced in controlling the use of available parking spaces in the study area. The method of determining the bus terminal parking space requirements in Ghaziabad India by Smith and Associates (2010; pg 7) was applied to the matatus at the Nation Roundabout terminus. A matatu vehicle count was conducted at the old Nation terminus to determine the vehicle turnover. A matatu count was carried out at two hour intervals for two consecutive days to determine the terminus vehicle turnover. The terminus turnover was determined by calculating the difference between the number of vehicles which entered and exited the terminus within a given period of time (Smith and Associates, 2010). The results are as shown in Table 6.

Table 6: Vehicle Entry and Exit Count

Day	Entry 7.00- 9.00am	Exit 7.00- 9.00am	Difference	Entry 11.00- 1.00pm	Exit 11.00- 1.00pm	Difference	Entry 4.00- 6.30pm	Exit 4.00- 6.30pm	Difference
1	639	572	67	273	182	91	292	170	122
2	243	358	-115	163	291	-128	179	230	-151

Source: Field work, 2016

Results obtained on a Friday showed that the terminus turnover was low at 67 during the morning period. This may have been caused by traffic congestion on the routes leading to the terminus, a high number of matatus entering the terminus but leaving without passengers due to high demand at the trip origin points(in the places of residence). This turnover increased towards the evening to 91 and 122. The increase may have been due to most of the vehicles being parked after dropping passengers and waiting on the queue to fill before leaving the terminus. It may have also been caused by most of the working population in the CBD leaving for their place of residence outside the city. The turnover on Saturday was low indicating negative figures of -115,-129 and -151. The negative figures also indicate that more matatus were already parked at the terminus than those which left during the counting periods and there was less traffic congestion since it was not a working day. Despite the negative figures recorded on Saturday the number of vehicles using the terminus could still be determined. Estimation of the parking space requirement for a working day was calculated to determine the space availability for the matatus.

The size of the terminus, which is 2,859.02m², can provide parking for approximately 85 matatus taking a minimum parking area of 33.5 m² (2859.02/33.5=85.34) for the 14 seater matatu. The average vehicle turnover at the terminus on Friday was 93, the mid-morning and evening periods showing large turnovers of 91 and 122. Therefore, the available space is not enough for the matatus operating at the Old Nation roundabout terminus. This may be one of the reasons why some of the matatus were found parked on the pavement (Kerbs) around the terminus (Plate 10). Observations showed that matatus enter and leave the terminus using any

available space by being driven over the Krebs due to lack of access to the entry and exit points which become congested.

Plate 10: A Matatu Parked on the Pavement



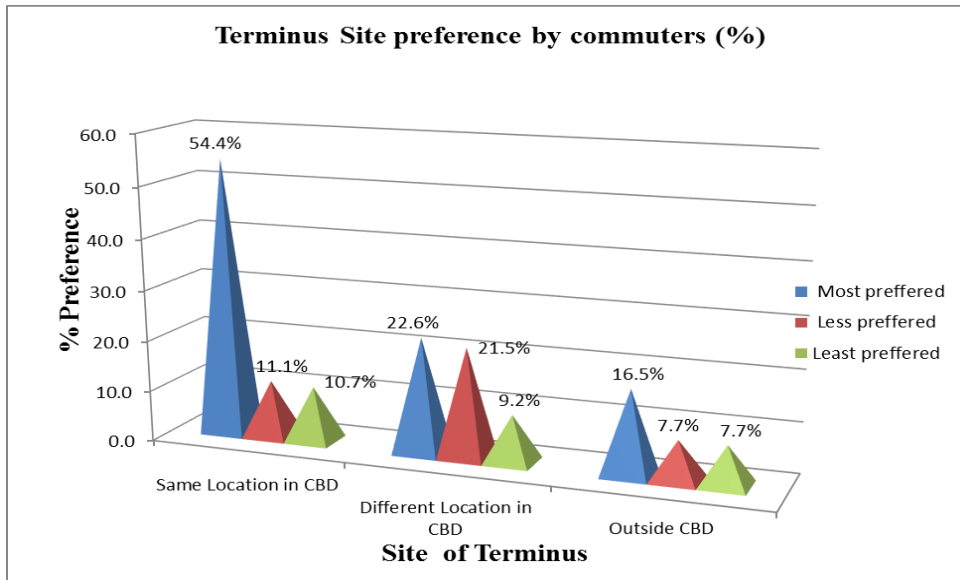
Source: Field work, 2016

The above results show that the operations of the matatu termini in the study area hinder the smooth flow of general traffic in the study area. A decision by the authorities managing the matatu termini has to be made concerning the location and control of matatu vehicles to achieve less interference with the general traffic flow. Public participation is important in decision making. The researcher sought the views of the matatu crew and commuters on matatu terminus location site in the CBD.

5.6 Matatu Terminus Preference Sites

Planning of the siting of matatu termini should be done by considering easy accessibility of commuters to the terminus and efficient operations of the matatu in the CBD. The researcher sought opinion from the commuter and matatu crew on the preference sites for matatu termini. The commuter preference on the site of a terminus was found to be 54.4% at the current location in the CBD, 22.6% at a different location but in the CBD, while only 16.5% preferred a location outside the CBD (Figure14). Despite the fact that a great number of commuters agree that the current termini facilities cause traffic congestion in the CBD they still prefer them to remain where they are located. This shows that the commuter choice may be related to easy accessibility to the CBD as a siting factor but the operations of the termini should not cause congestion.

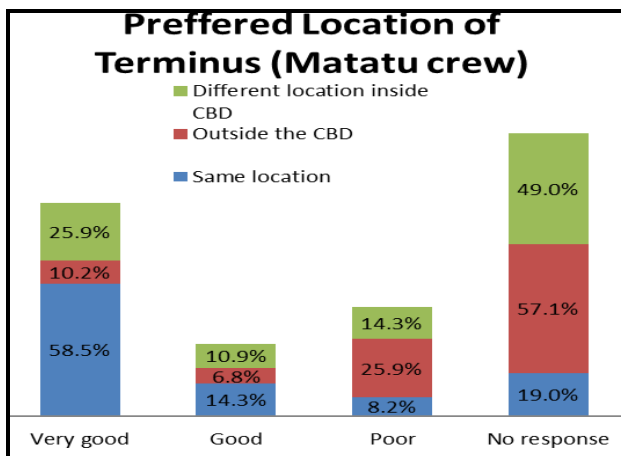
Figure 14: Commuter Termini Preference Sites



Source: Field work, 2016

The matatus crew response showed that matatu crew considered the current location to be 58.5% very good, 14.3% good, 19% gave no response. A different location but inside the CBD was preferred to a location outside the CBD (Figure 15). However, a large number of the crew did not respond to this question as indicated by 57.1%, 19.0% and 49.0 % for the three different locations.

Figure 15: Matatu Crew Termini Preference Sites



Source: Field work, 2016

This shows that the question of siting of termini facilities cannot be resolved literary by opinion without research and planning considerations. Therefore the concerned authorities have to consider terminus planning as a solution to the termini management challenges being experienced in the Nairobi CBD.

5.6 Synthesis of Findings

A synthesis of the above findings revealed the following key challenges in the management of matatu termini in the study area.

5.6.1 Inappropriate Matatu Termini Route Allocation and Siting

The procedure for allocation and siting of matatus by the Infrastructure department in the Nairobi County is not appropriate. Some of the factors used to allocate the parking space by this department such as route of operation and availability of space are not sufficient to determine the siting of a terminus. The County government lacks comprehensive guidelines to guide these allocations. The matatu terminus are recognized as parking spaces for matatus by the Nairobi County Government and therefore do not fully function as terminal facilities.

Information on the evaluation of applications by owners for permission to operate on routes of their choice could not be established by this research due to non-availability of data from the concerned authorities. Some routes were found to operate at more than one terminus in different locations in the study area. This means that there are duplications in the assignment of routes at the termini in the study area.

Further analysis on the siting characteristics of two termini in the study area showed that existing sites are not appropriate to be used as termini. The termini characteristics were compared to TCRP report (1996) and World Bank (2006) guidelines were found to be well below the acceptable standards.

5.6.2 Lack of Passenger Facilities

The termini in the study area do not provide adequate passenger facilities. Availability of these facilities was found to be below 50%. The Nairobi County government has not provided enough passenger facilities at the matatu termini.

The lack of these facilities caused passenger vehicle conflict zones. They may also be the cause of passengers lighting and boarding matatus at undesignated zones in the CBD. Alighting and

boarding at undesignated areas contributes to interruption of the general traffic by matatus on the streets and at the terminus. It was found that the use of termini as boarding areas was fairly high at 59%, which shows that they are important entry and exit points for commuters and need to be improved. The presence of a stop for matatus in the CBD is important to allow easy accessibility to public transport by the commuter population.

5.6.3 Lack of Vehicular Facilities

There is lack of vehicle operation facilities at the termini such as lay bays, exit and entry routes, service lanes especially at the termini that are located on the streets such as Tom Mboya, and Latema road cause matatus to block the streets when picking and dropping passengers hence interfering with other vehicular traffic.

5.6.4 Lack of Matatu Parking Spaces

The available parking space at the termini is not enough for all the vehicles allocated to the termini. 44.9% of the matatu crew interviewed did not find parking space on arrival at the termini. These causes long queues at the entry routes that extend into the main streets which interfere with the flow of traffic contributing to traffic congestion in the study area. Parking availability calculations showed that the number of vehicles allocated parking at a single terminus was high compared to the available space. The lack of parking space contributes to some matatus parking on the streets in the study area.

5.6.5 Long Parking Periods

Lack of control on the allowed period of matatu waiting time at the terminus at both peak and off-peak hours causes inefficiency in operations of the termini. This caused approximately 24.5% of the matatus to have long waiting periods of between 30 to 40 minutes at non-peak hours. Therefore, the matatus are parked in the CBD during this period reducing the space for vehicle circulation on the CBD streets.

5.6.6 Inefficient Management Methods of Matatu Fleet

The queuing method and use of registers and black boards to control the movement of matatus at the terminus does not provide an effective control mechanism for the number of matatus required to operate in the CBD at off-peak and on-peak periods. Neither the use of hand signals by the traffic policemen nor the Nairobi County traffic Marshals does not provide effective control of vehicles especially matatus on the CBD streets. Lack of coordination in control of matatus by the

three groups has not solved the congestion problems caused by matatus while operating in the CBD. The methods are ineffective in controlling of the number of matatus accessing the study area causing a large number of matatus to access the study area compared to the available parking space.

The opinion by commuters and matatu crew on how the operations of matatus in the CBD contribute to traffic congestion is high. The percentages of “generally agree” for commuters was 61.7% and matatu crew 62.6% respectively. The above findings show that matatu termini operations contribute to traffic congestion in the CBD. However, the level of contribution may be determined by further research due to other factors that relate to vehicular traffic in the CBD.

5.6.7 Ineffective Enforcement of Existing Traffic Regulations

Despite the fact that the existing traffic laws and Nairobi county regulations do not allow obstruction, disobeying of traffic rules by pedestrians, picking and setting down of passengers in undesignated zones, there is laxity in enforcement by the authorities. The matatus and commuters continue to disobey them preventing the smooth flow of traffic.

The above findings from the research show that there exist management challenges of matatu termini in the study area which need to be addressed. The following is a discussion on how some of these challenges can be resolved.

5.7 Proposed Intervention Measures on Operational and Management of Matatu Termini

5.7.1 Appropriate Siting of Matatu Stops and Termini

The siting of public transport termini facilities is important for efficient operation and management of public transport services. The siting of matatu terminal facilities should be easily accessible and safe for use by commuters.

The site should provide easy accessibility to passenger in the CBD without causing traffic congestion. The siting of the matatus terminus is a critical issue in spatial planning of public transport terminal facilities. During planning, the stakeholders’ opinion has to be considered in the siting of the public service vehicles terminals. However, the transportation planning authority concerned should be able to come up with the best location after undertaking research and establishing the correct site. The following is a proposal on how the siting of termini and matatu

stops can be undertaken in the study area to eliminate the traffic conflict zones and congestion problems associated with the operation of the matatu termini.

The challenges caused by the siting of termini in the study area can be overcome by appropriately locating matatu stopping points (matatu-stops) in the CBD. The stops should only be used to set down and pick passengers for a given period of time. They should not be used as parking areas for matatus. A matatu terminus at Muthurwa can offer long stops or parking for matatus. A dispersal strategy for matatu stops in the CBD can be used to reduce the matatu concentration zones and the large passenger congestions at the termini in the study area. The proposed matatu stops are based on the following factors as suggested by municipality of Anchorage, Design Criteria Manual (2007).

- I. At logical points where routes intersect or connect.
- II. On assumption that riders will transfer from one route to another at these intersection.
- III. The number of boarding's and a lighting by stop if the road has existing stops.
- IV. Forecasted boarding's and a lightings in cases in which development is anticipated.

The matatu stops indicated in map 6 are preliminary stops and further research has to establish the relationship between land use change, the demand for boarding and alighting of passengers, and the traffic flow patterns in the area. The matatu route is a clockwise loop with seven stops to enable easy accessibility by passengers to the CBD. The stops are dispersed in the study area to reduce congestion of passengers in the area. The siting of these matatu-stops will require redesign of roads at the stops areas to provide service lanes and lay bays for matatu vehicles to stop. The following considerations are to be made on the routes.

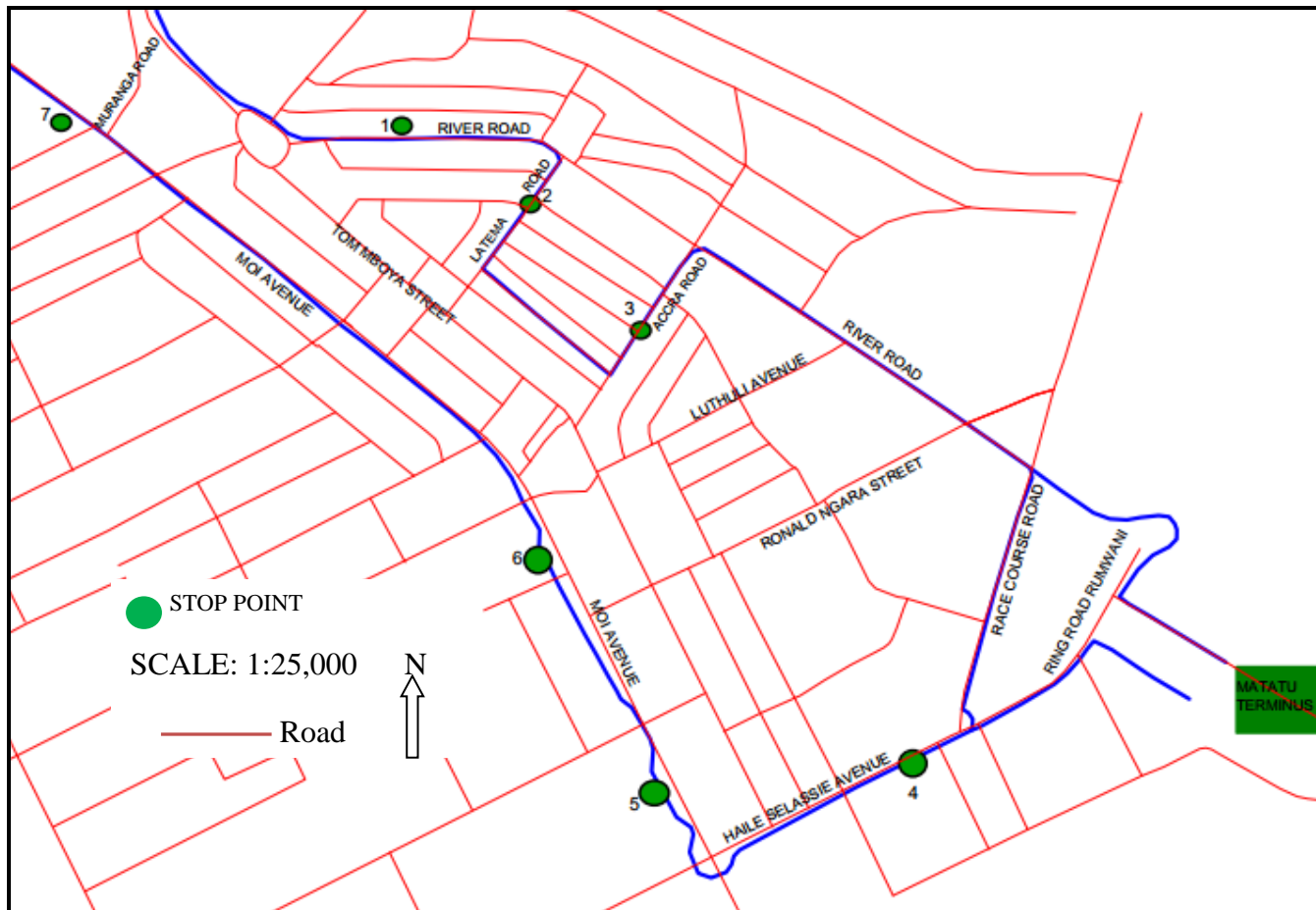
1. River Road should be designed to be one-way traffic with two lanes from stop 1 to the intersection with Racecourse road.
2. All the private parking to be removed from the matatu termini and routes. Alternative parking constructed in the back lanes currently used as termini by matatus or commercial parking facilities within the CBD can be used.
3. Provision of vehicular and passenger facilities at the matatu stops to be used as matatu stops.

4. A signalized control mechanism to be used to control traffic at the junction of River Road and Race Course road to allow priority to matatus to operate in the route with minimum delay in schedule.
5. Consolidation of routes to eliminate duplication and unnecessary competition among matatus.
6. Scheduling of matatus to be used to control the number of matatus operating on the routes and entering the CBD.
7. Development of Muthurwa and Ngara termini to be used as parking and through routes for matatus.
8. Stop 7 at the railways to be used as a mode transfer stop between rail and road.
9. A centralized control of operations of all public service vehicles in Nairobi CBD

The matatu route in map 4 is a clockwise loop covering the study area and connecting to the other parts of the CBD. It allows for change of mode of transport from road to railway at the railway station. The previous stops at Latema and Accra roads have not been relocated. However modification of the layout to suit operations should be done. Locating on- street stops in the CBD require a parking lane in the travel lane or an improved shoulder (MOA, 2007). The location of stops on the routes suggested will require parking lanes to allow free flow of general traffic on these roads. Stops at point 5 and 6 can utilize the already existing side lanes and parking.

PROPOSED MATATU STOPS IN NAIROBI

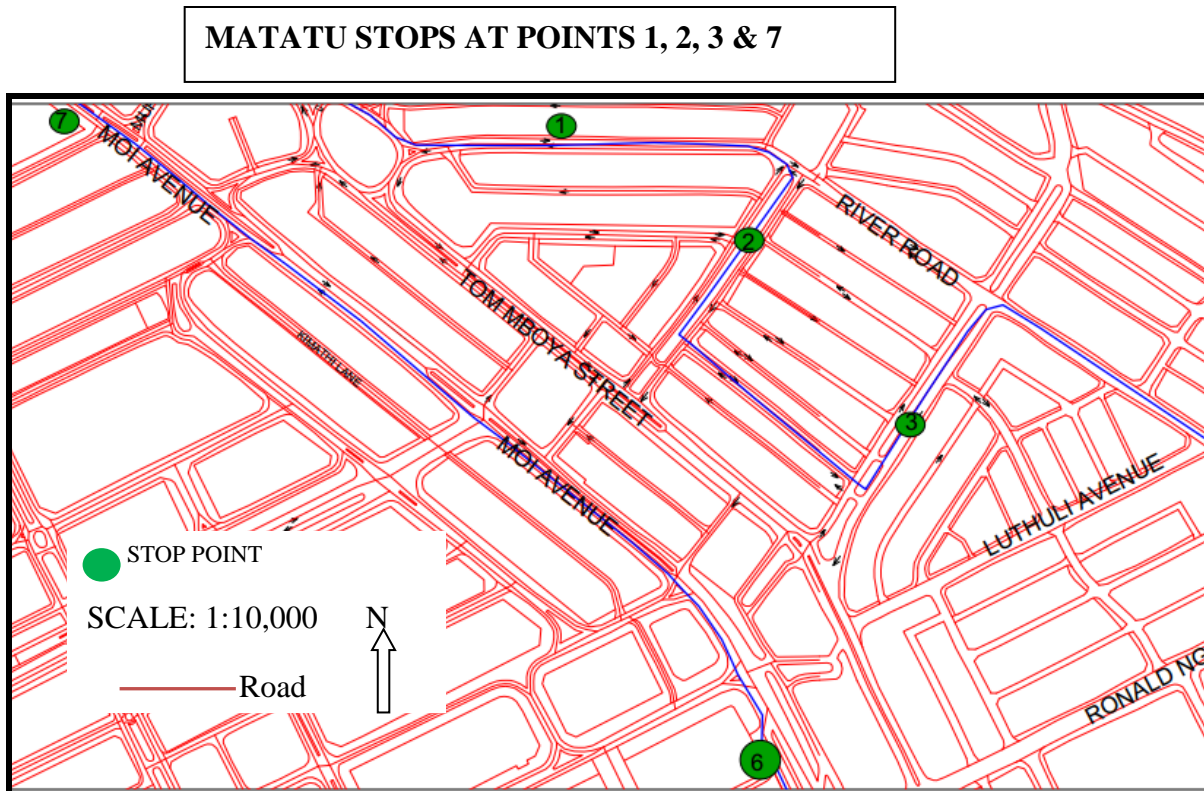
Map 6: Proposed Matatu Stops



Source: Author, 2016

Stops 5, 6 and 7(Map 7) have been introduced on Moi Avenue which is a major arterial. Access of matatu vehicle to Tom Mboya and Moi Avenue will be on condition that they have filled all the seats and are on express route outside the CBD.

Map 7: Matatu Stops Points 1, 2, 3 & 7

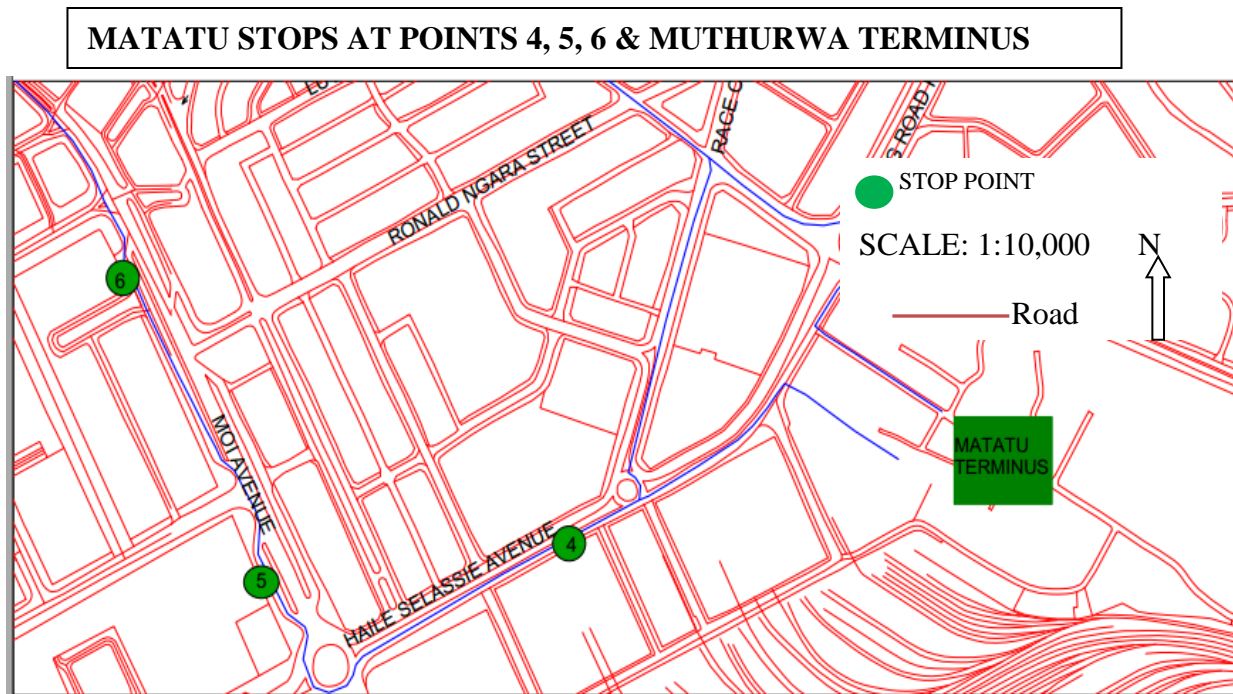


Source: Author, 2016

Stop 1 is immediately after the nation roundabout and will provide easy access to passengers on the first stop on River Road. Stop 2 is the only stop on Latema Road and will serve as an off-road stop if Latema Road terminus is exclusively redesigned to serve as a terminus. Stop 3 is on Accra Road and will serve as a long –stop(map5).

Muthurwa terminus (map 6) will be used for matatus that may not be required to operate at given times and will be parked for long periods. Stop number 4 at the railway station will allow interchange of travel mode from road to rail. It can also be used as a connection point of passengers travelling across the CBD who need to interchange matatu routes. Stops 5 and 6 on Moi Avenue were introduced to utilize the existing axialliary service lanes that can be adapted with minimum modification to provide matatu stops. However some of the existing private parking in this area should be removed.

Map 8: Matatu Stops Points 4, 5, 6 & Muthurwa Terminus



Source: Author, 2016

5.7.2 Urban Transportation Planning Policy

An Urban transportation planning policy provides planning guidelines for the urban transportation sector. Lack of an operational urban public transportation policy to guide planning of urban transport in the Nairobi CBD has contributed to improper siting of stops, termini and control of the number of vehicles including matatus entering the CBD. The increasing number of matatus to meet the increasing public transport service demand will continue to contribute to the increasing number of vehicular traffic in the CBD. Vehicle restraint policy and introduction of sustainable non-motorized means of transportation modes such as walking and cycling can serve as better alternatives for Nairobi City. Enactment and enforcement of policies on land use development in the CBD that allow sustainable land use activity and vehicular traffic volumes would enable effective control of traffic capacities on the city streets.

5.7.3 Use of Efficient Public Service Vehicle Control Methods

The use of ICT as proposed in the National transportation system to control operations of matatus in the CBD and the road network system would provide control of the number of matatus in the study area and the CBD in general. The current methods used by the terminus SACCO managers, traffic police and Nairobi Traffic Marshals to control matatus are out-dated and need to be reviewed. Public Vehicle control Intelligence systems

5.7.4 Re- Design of Terminus Facilities

The current matatu termini layout can be re-designed by transport engineers to provide long term and short term stops for matatus. The existing space at the termini in the study area is enough for locating matatu stops. Good designed termini allow operation of public service vehicles without interference with the general flow of traffic on the travel ways.

5.8 Conclusion

The above findings show that the problem of lack of adequate termini for matatus in Nairobi CBD still exists. This problem was previously identified by Chitere et.al (2012). The termini also lack adequate passenger and vehicle facilities. The siting of matatu termini by the Nairobi County Infrastructure department is inappropriate. Otieno (1991) referred to the termini allocation as adhoc and these finding show that the procedure has not changed since some of the matatu termini are not gazzetted by the Nairobi county government.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

The research was carried out to fulfill objectives previously set out in chapter 1. These objectives were,

1. To examine the procedure used for siting of Matatu termini the study area.
2. To assess the adequacy of passenger and vehicle facilities in the study area.
3. To investigate how the operations of the termini affect traffic flow in the study area.
4. To propose how spatial planning can be used for effective operations and management of matatu termini in the study area.

The objectives were to be achieved by answering the following research questions;

- I. What has been the procedure for matatu termini allocations in the study area?
- II. What is the adequacy of passenger and vehicle facilities at the termini in the study area?
- III. How do the operations of the termini affect traffic flow in the study area?
- IV. How can spatial planning be used as a solution for operation and management challenges of matatu termini in the study area?

Therefore, this chapter is a summary of the findings, conclusions and recommendations of the research.

6.2 Summary

From the research findings in the previous chapter the following are the challenges faced by the managers and users of matatu termini.

- i. The matatus have been allocated parking areas in the study area by the Nairobi county governments which are used as matatu termini. The siting and allocation procedures used do not provide appropriate locations of matatu termini. This is due to the fact that operations of the termini cause traffic interruptions in the area caused by long matatu queues from the termini which extend to the CBD road network.
- ii. Existing Passenger and vehicle facilities are not enough to facilitate efficient operations of the termini in the study area. Lack of enough parking spaces for matatus is a major factor leading to some matatus to be parked at undesignated places such as pavements.

Boarding and alighting of passengers at undesignated matatu stops and terminus causes obstruction of other vehicles on the streets by matatus.

- iii. The operations of matatu termini are inefficient and therefore interrupt the traffic flow in the study area contributing to traffic congestion in the CBD. Inefficient control of matatus by use of hand signals and note books on the streets and at the terminus contributes to a large number of vehicles operating at the terminus. The available parking space cannot accommodate these large number of matatus overflow into the neighboring streets. The long waiting times of the matatus at the termini cause the CBD streets around the termini to become parking zones. Efficient matatu control methods such as use of ICT should be adopted to solve these problems.
- iv. Lack of coordination between Traffic policemen, Nairobi county traffic marshals and the SACCO termini managers' leads to conflicts in vehicle control mechanism. The authorities should consider using a central control system to avoid these conflicts.
- v. The existing traffic rules and county by laws are not being followed to the letter by all the stakeholders. This contributes to the confusion that is surrounding the management and control of traffic at the terminal facilities. There is laxity by law enforcement agents to keep order at the terminus.
- vi. Lack of Nairobi city urban transportation policy to control the public transportation system and land use has contributed to the lack of appropriate planning in siting, uncontrolled activity densification, and effective vehicle control mechanisms to limit the number of matatus operating in the CBD network.

6.2 Conclusion

The following conclusions were arrived at during the research;

- a. The procedure for siting of termini by the Nairobi County is inappropriate. The Nairobi county government has allocated matatus in the study area parking areas. However, some of the matatu termini are illegal due to lack of evidence from the county government showing designation of parking areas. The matatu SACCO's have adopted them as termini.
- b. There are no adequate facilities for passengers and vehicles to facilitate efficient operations at the matatu termini.

- c. Inefficient operations of matatu termini in the study area are contribute to traffic congestion by matatus parking on the streets therefore blocking the general traffic. There are no specific regulations that guide the management and operations of matatu termini. This leads to competition for space between SACCO's and confusion on the roles played by the SACCo transport managers, Nairobi County traffic marshalls and the traffic policemen.
- d. The available space allocated to matatu termini can be planned to serve as short term stopping points to allow commuters access to Nairobi CBD while avoiding obstruction caused by parking of matatus inside the CBD. Matatu termini siting should be done through transportation spatial planning to control the land use change, and limit the number matatu vehicles operating in the Nairobi CBD at a given period of the day.

6.3 Recommendations

1. The Nairobi county government should formulate guidelines for siting of matatu termini that will allow efficient operations of public transport vehicles without causing congestion in the CBD. The County Traffic Marshalls in collaboration with the traffic policemen should enforce the laws to prevent operations of illegal matatu termini in the CBD.
2. The Nairobi County Government should provide adequate passenger and vehicle facilities. Partnership with private developers can be used to access the necessary funds for development, maintenance and operation of the matatu termini. The Nairobi county government may partner with the owners of matatus to invest in an organized system of public transport services. The current owners have financial resources that they may be willing to invest in public transportation services where there is lack of government funding. This is an opportunity that the county government should utilize in developing the public transport industry.
3. Development of a framework to guide the management and operations of the termini will enable efficient operations at the matatu termini. Research on commuter demand patterns verses the number of matatus with the aim of control the number of matatus operating within the CBD will enable resolve the challenge of lack of excessive matatus on the streets.

4. A transit mode of public transport through the city of Nairobi can be a solution to parking problems caused by matatus in the city center. Easy accessibility of the CBD population to the public transport services should be a priority, therefore the county government can introduce matatu stopping points within the study area. These matatu stops should be sited after carrying out research. The matatu stops have small space requirements compared to the termini and may be an appropriate solution to removal of matatu parking spaces. The Nairobi County government should reconsider relocating the termini in the study to appropriate site to provide enough parking facilities for matatus which are not en route.
5. The number of SACCO's operating in the study area is high leading to lack of efficient control of matatus at the terminus. Research findings reveal that there are eleven matatu SACCO's which independently control matatus at the termini on 16 routes in the study area. The number of organized operators and the routes should be reduced to enable efficient management of operations at the terminus.

6.3 Further Research

Consolidation of the current matatu routes operating in the study area is needed through route planning and scheduling. This will eliminate the excess number of matatus which require parking in the Nairobi CBD. Research into re-organizing of matatu routes, design of the type of matatu stops will enable appropriate siting of the required facilities for efficient operations of matatus in the Nairobi CBD. Easy accessibility to the Nairobi CBD using Non-Motorized sustainable modes of transport should be a priority to the development of public transportation services by the Nairobi county government.

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Appendices

Appendix 1: Commuter Questionnaire

THE COMMUTER QUESTIONNAIRE SERIAL NO. _____

TITLE: MATATU STAGE OPERATIONS IN TOM MBOYA STREET AREA OF NAIROBI CITY

DATE: _____

This questionnaire is for a study being carried by a student from the urban and regional planning department at the University of Nairobi (UON). The study concerns the operations of matatu stages (termini) in Nairobi City center. Any information provided will be confidential and used for this study only. Your cooperation in answering these questions correctly will be very useful for future planning purposes, for this industry in Nairobi.

Name (optional)..... **Route Number**.....

Sex M F **Area/Estate of Residence**.....

Mobile Number (Optional).....

1. How many times in a week do you travel to the city center in a **matatu** on this particular route?

Five (5) to seven (7) times Two (2) to four (4) times

Once per week other (please specify).....

2. Where is the location of the final stage (terminus) for this route in the city center?

.....
.....

3. Why do you always travel to the Nairobi city center?

To work in the city

To study in the city

To do business in the city

- To get means of transport to my final destination (please specify your destination)_____
- Other (please specify).....

4. Do you always a light at the matatu **final stage** on reaching the city center?

- Always
- Not always (sometimes)
- Never (*Please specify where you alight*).....

5. Which facilities are offered at the terminus on this route for passengers (commuters) to use? *Please tick in the box (boxes) where the facilities are available.*

- Shelter for passengers
- Charts showing arrival and departure times for vehicles
- Resting benches
- Washrooms
- Shops for refreshments
- Steps for boarding or alighting from the vehicles
- None of the above

6. During the times you have used the **main stage** (terminus) in the city were you satisfied with the type of facilities that were offered there for passengers?

- Very satisfied Satisfied Not satisfie Don't know

7. Does the matatu stage(terminus) you use have the following facilities for commuters (*Please put a tick(s) in the box(es) to indicate availability of the facility*)

- A special route for commuters used for entering and leaving the stage.
- Good lighting at night.
- matatu bays/lanes(where matatus stop for passengers to board or alight)

8. How do you rate the level of congestion by **passengers** at the terminus during **rush(peak) hours?**(*please tick in one box beside your choice*)

- Very congested
- Congested

- Fairly congested
- No congestion
9. where do you **usually**(most of the times) board a matatu for your journey from the city center on this particular route?(*Please tick only one box beside your choice*)
- At the terminus (final stage in city center)
- Besides the road.
- At a bus-stop
- other(specify)_____
10. Rank the following according to the level to which matatus contribute to traffic jam on Tom Mboya street. The ranking values indicate 1=highest, 2 = moderate, 3= low, 4= very low. (*Indicate the level of contribution by writing a number in the appropriate box.*)
- Parking on the road while waiting for passengers.
- Waiting on the queue to enter the main stage.
- Picking passengers on the streets away from the main stage.
- Moving from the main stage to the street.
11. Do you think the presence of matatu stages in the city center cause traffic jam(congestion)? (*Please put a tick in the appropriate box.*)
- Strongly agree Agree fairly agree do not agree
12. Please rank the following sites (location) for matatu stages according to the most preferred for use by you. The ranking scale ranges from 3 the least preferred to 1 the most preferred. 3=least preferred, 2=less preferred, 1= most preferred (*Please fill in a number in every box to indicate the level of preference of the site*)
- a. Inside the city center at the **same location.**
- b. Inside the city center but at **a different location.**
- c. **Outside** the city center
- d. None of the above(please give your suggestion)_____
13. What is the **major** cause of traffic jam on Tom Mboya street?(*please put a tick in one box*)
- Private cars Matatus Taxis
- Lorries others(hand carts, tuck tuck, motorcycles)

14. How should matatus operate in the city center

pick passengers at the bus stops(stages) without stopping in the city center at the final stage.

pick and drop passngers at the current main stages terminus.

pick and drop passengers at a terminus(stage) outside the city center.

other (*please specify*).....

15.

I) Do you think that the space provided for the matatus at the stage is enough for all the vehicles? (*Please tick inside one box to indicate your answer*).

More than enough

Enough

Fairly enough

Not enough

Not provided

II. Please give an explanation for your answer in part (i) above

.....
.....
.....
.....
.....

18. Is the space provided for passengers enough to serve their needs?

More than enough

Enough

Fairly enough

Not enough

Not provided

19. Rank the following on how they contribute to traffic jam on Tom Mboya street. The ranking scale is 1 = high, 2 = moderate, 3 = low, 4 = very low

Private car Matatu Trucks Tricycles others (e.g. hand carts, tuktuk)

16. How long have you been a passenger in a matatu on this route?

less than 1 year Between 1 to 2 years 3 years to 4 years
 5 years and above only once (today)

20. What improvements would you suggest that should be made to the terminus (stage) to make them good for use by passengers (*please put a tick in the box to indicate your choice or choices*).

- provide resting benches
- provide good lighting
- provide tuktuk shops
- provide route (schedules)
- provide passenger only entry and exit routes
- provide enough space for vehicles
- provide enough space for passengers
- other (please specify)

21. What is your age category

0 ≥ 18 18 ≥ 28 28 ≥ 38 38 ≥ 48 48 ≥ 58
 59 and above

22. Given an opportunity to choose the means of transport for use on your way to the city center and back to your place of residence which one would **prefer most**?

Bicycle

- matatu
- Personal car
- walking
- others(please specify)

Appendix2: Matatu Crew Questionnaire

THE MATATU CREW QUESTIONNAIRE Serial No. _____

TITLE: MATATU STAGE OPERATIONS IN TOM MBOYA STREET AREA IN NAIROBI CITY **DATE** _____

This questionnaire is for a study being carried by a student from the urban and regional planning department at the University of Nairobi (UON).The study concerns the operations of matatu termini in Nairobi City center. Any information provided will be confidential and used for this study only. Your cooperation in answering these questions correctly will be very useful for future planning purposes, for this industry in Nairobi.

Name (optional)..... **Route Number**.....

Sex M F **Post:** river Conductor

Mobile Number (Optional).....

1. Is the space provided for the matatus at the main stage enough for all the vehicles that operate on this route?

More than enough Enough fairly enoh Not eno Don't know

2. How do the following factors contribute to traffic jam in the Tom Mboya area? The level of contribution is indicated by 1= highest, 2= moderate, 3= Low, 4= very low. (Put a tick in the appropriate box to indicate the level of contribution.)

		1(highest)	2(moderate)	3(Low)	4(very low)
I.	Private cars	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
II.	Matatus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
III.	Lorries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IV.	Taxis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Which facilities for the vehicles are available on the matatu stage (terminus) where you operate? Please tick the box (or boxes) to indicate the existing facilities.

Charts showing matatu routes and stops

- Reserved lanes for vehicles to drop and pick passengers
- Minor repair garages
- Parking spaces for vehicles
 - Changing rooms for matatu operators
 - Control rooms for vehicles
 - Time tables showing arrival and departure of vehicles
 - Entry and exit routes for Matatus only
 - Lighting during the night
 - Other (specify)

4. What other facilities would you require to be provided at the stage for the

vehicles.....

6. Which site(location) would you prefer for operation of matatu services *indicate the level of preference by writing a number in the box (Please put a tick in one box to indicate the level of preference of the location)*

3=very good 2=good 1=poor

- | | | | |
|---|--------------------------|--------------------------|--------------------------|
| i. Inside the city center but at <u>a different location</u> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii. Inside the city center at the <u>same location</u> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iii. <u>Outside</u> the city center | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

7. How do the following matatu behaviour contribute to traffic jam in Tom Mboya street area? (*Indicate the level of contribution by ticking in the appropriate box.*) 1=highest, 2 = moderate, 3= low, 4= very low.

1=highest 2 = moderate 3=low 4= very low

- | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| i. Parking on the road to wait for commuters | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii. Waiting on the queue to enter the terminus | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iii. Picking passengers on the streets | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

iv. Moving from the terminus to the street

8. What do you think is the **major** cause of traffic jam on Tom Mboya street?

Private cars Matatus Lorries axis others(hand carts, tuck tuck

9. Do you think the presence of matatu stages in the city center cause traffic jam(congestion)? (Please put a tick in the appropriate box.)

Strongly agree Agree fairly agree do not agree

10. Please indicate how effective the following methods are when used to control traffic on Tom Mboya street. 1=most effective, 2=effective, 3=fairly effective, 4=not effective (Please put a tick in the appropriate box)

1=most effective 2=effective 3=fairly effective 4=not effective

i. Traffic police

ii. Nairobi county traffic marshalls

iii. Traffic lights

11. On average how long do you wait at the main stage to pick passengers from the City center at

I. Peak(rush) hours

0 ≥ 5minutes 5 ≥ 10minutes 10 ≥ 20minutes 20 ≥ 30 minutes

other(please indicate)_____

II. Non peak hours

0 ≥ 15minutes 15 ≥ 30minutes 30 ≥ 45minutes 45 ≥ 60 minutes

1hour ≥ 2hrs

other(please indicate)_____

12. Are you able to find parking for your matatu every time you arrive at the main stage. (Please tick in the appropriate box.)

No parking at all times

Parking is **always** available

Parking **sometimes** available

13. How should matatus operate in the city center (please put a tick in one box only)

pick passengers at the bus stops(stages) without stopping in the city center at the final stage.

pick and drop passngers at the current main stages terminus.

pick and drop passengers at a terminus(stage) outside the city center.

other (*please specify*).....

14. How many times in a day do you enter the main stage in the city center? _____

15. Are you satisfied with the method used to control matatus at the main stage in the city center?

Not satisfied less satisfied satisfied very satisfied Don't know

16. Why do you think matatus pick passangers besides the road in the nairobi city center?

.....
.....

17. Please give your suggestions on how best the matatu operations can be controlled at the main Stage(terminus).

.....
.....

18. For how long have you been working on this route?(*Please put a tick in the appropriate box*)

0 ≥ 1 years 2 ≥ 3 years 4 ≥ 5 years 5 and above years

19. What is your age category in years

0 ≥ 18 18 ≥ 28 28 ≥ 38 38 ≥ 48 48 ≥ 59 and above

Appendix3: Traffic Police interview schedule

THE TRAFFIC OFFICER INTERVIEW SCHEDULE

TITLE: MATATU OPERATIONS ON TOM MBOYA STREET IN NAIROBI

This questionnaire is for a study being carried by a student from the urban and regional planning department at the University of Nairobi (UON).The study concerns the operations of matatu termini in Nairobi City center. Any information provided will be confidential and used for this study only. Your cooperation in answering these questions correctly will be very useful for future planning purposes, to enable efficient operation of this industry in Nairobi.

DATE.....

Name (optional)..... **Current**

Post.....

Sex M F TELEPHONE NO.....MOBILE

NO.....

1. How does the location (site) of matatu termini along Tom Mboya street and adjoining streets such as Moi Avenue Accra road and Latema road affect the smooth flow of traffic in Nairobi CBD?
.....
.....

2. Please rank the following factors on how they affect traffic flow on Tom Mboya Street. The ranking scale ranges from 5 the least factor to 1 the highest. 5=Very low, 2=low, 3=Fair, 4=Good, 1= Excellent (*Please fill in a number in every box to indicate the level to which they affect traffic flow*)

Obstruction caused by picking up of passengers

Obstruction caused by alighting of passengers

Obstruction caused by matatus waiting for long to pick up passengers

Queues formed by matatus entering the terminal

Queues formed by matatus leaving the terminal

Other (please specify)

3. What are the other factors that affect the smooth flow of traffic on Tom Mboya Street?
4. Do you think that the space provided for termini for matatus around Tom Mboya area is enough for all matatus operating in that area?

YES NO

Please give a brief explanation for your answer?.....

5. Please indicate the level of adequacy of this space by putting a tick in the appropriate box

Very adequate

Adequate

- Fairly adequate
- Not adequate
- Other (please specify).....

6. Please rank the following sites (location) for matatus according to the most preferred to enable effective control of traffic. The ranking scale ranges from 5 the least preferred to 1 the most preferred.

5=Very poor, 2=Poor, 3=Fair, 4=Good, 1= Excellent *(Please fill in a number in every box to indicate the level of preference in site)*

- e. Inside the city center at the **same location.**
- f. Inside the city center but at **a different location.**
- g. **Far** from the city center
- h. **Near** the city center

7. In your own opinion where should the termini for matatus be located to reduce traffic congestion in the Nairobi CBD?

8. Does the presence of private parking facilities affect the flow of traffic on Tom Mboya Street?

9. Which methods do you use to control traffic in Tom Mboya area and adjoining streets? Please tick in the boxes to indicate the method (or methods) used.

- Traffic lights
- Hand signals
- ICT vehicle intelligence control systems
- supervision
- None of the above(specify).....

10. Which method do you suggest that will be more efficient in the management of the flow of traffic on Tom Mboya street?

11. How do you rank the following factors on how they contribute to traffic congestion in Tom Mboya street area?*(Please indicate the level of contribution by ticking in one box for every factor)*

	1(highest)	2(medium)	3(very low)	4(very low)
Private cars	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Matatus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Trucks

Pedestrians	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Others (handcarts)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Which traffic regulations should be followed by matatus operating within the city center?
13. Are their particular regulations concerning operations of matatus at their city center terminus(stages)?
14. How would you rate the level of compliance by matatu crew to these rules on Tom Mboya street?
 - Very compliant
 - Compliant
 - Fairly compliant
 - poorly compliant
 - None of the above(specify).....
15. How long have you worked in the traffic department.....years.
16. How does commuter behaviour affect the flow of traffic on Tom Mboya street?
17. Why do you think commuters board the vehicles in undesignated places(not at bus stops or termini) along Tom Mboya Street?
18. According to your opinion how can the operations of the matatus be improved to ensure a faster traffic flow on Tom Mboya Street?

IF YOU WOULD LIKE TO RECEIVE THE RESULTS OF THIS SURVEY PLEASE GIVE US YOUR CONTACTS ; P.O BOX.....

E- MAIL ADDRESS;.....

(Please find attached extra sheets for use in answering the questions)

Appendix4: Nairobi County Interview Schedule

AN INTERVIEW SCHEDULE WITH THE COUNTY INFRASTRUCTURE DEPARTMENT OFFICER

This questionnaire is for a study being carried by a student from the urban and regional planning department at the University of Nairobi (UON).The study concerns the operations of matatu termini in Nairobi City center. Any information provided will be confidential and used for this study only. Your cooperation in answering these questions correctly will be very useful for future planning purposes, to enable efficient operation of this industry in Nairobi. **The study area includes Tom Mboya Street, Moi Avenue, Latema road, Accra road, River road, Fire station Lane.**

DATE.....

Name

Designation.....

Sex M F

Department.....

Telephone No.....Mobile Number
(Optional).....

1. Do you think the operations of matatus in the Tom Mboya area contribute to congestion in the Nairobi central business district (CBD)?(please give a brief explanation to your answer?
2. Does the county government determine the location of matatu termini in the Tom Mboya area?
3. Which factors does the county government consider in determining the site (location) for matatu terminus (stages) in the CBD?
4. When did the county government start allocating matatu termini in the CBD?
5. How many matatu termini exist in the whole of Nairobi CBD?
6. Which procedure do you use for making these allocations?
7. In your own view are these termini appropriately located in the study area (*which is Tom Mboya Street, Moi Avenue, Latema road, Accra road, River road, and Fire station Lane*)?
8. Which facilities does the county government offer for use by matatus at the termini?
9. Does the county government provide facilities for use by commuters at the matatu termini in the study area (*which is Tom Mboya Street, Moi Avenue, Latema road, Accra road, River road, and Fire station Lane*)?
10. Do you consider the **number of commuters** that are expected to use the terminus (stages) during allocation of matatus terminus?
11. Which of the following facilities do you provide for commuters?(*Please tick put a tick in the box to indicate presence of the facility in the study area*)
 - Shelter for passengers
 - Charts showing arrival and departure times for vehicles
 - Resting benches
 - Washrooms
 - Shops for refreshments
 - steps for boarding or alighting from them vehicles
 - None of the above

12. Observations have shown that matatus park within the termini in the study area, is the space provided enough for use by these matatus?
13. How do you determine the space requirements for every matatu terminus (stage)?
14. Have other vehicles (not matatus) been officially allowed to park within the zones allocated for termini facilities (i.e. taxis, private cars, motorbikes, tuck tucks)?
15. In your own opinion do you think the operations of these other vehicles hinder the smooth operations of matatus termini?
16. What measures have been put in place to ensure that the operations of matatus in the termini do not hinder the flow of traffic in the roads/streets in the study area? (*Which is Tom Mboya Street, Moi Avenue, Latema road, Accra road, River road, and Fire station Lane*)
17. Which other government authority is concerned with allocation of termini within the Tom Mboya area?
18. What role does it play in these allocation processes
19. According to your own opinion where should the matatu termini be located?
- i. Inside the city center at the **same location.**
 - j. Inside the city center but at **a different location.**
 - k. outside the city center
 - l. other (please specify).....

Please give a brief explanation for your choice above.

20. What future plans does the county government have to accommodate the increasing number of matatus at their termini?

IF YOU WOULD LIKE TO RECEIVE THE RESULTS OF THIS SURVEY PLEASE GIVE US YOUR CONTACTS ; P.O BOX.....

E- MAIL ADDRESS;.....

Appendix6: Matatu Turnover Entry Forms

	ENTRY SHEET	DATE	
	TIME: 7.00 AM-7.30 AM		TIME: 7.31 AM-8.01 AM
	Registration No.(e.g J616R)		Registration No.(e.g J616R)
1			1
2			2
3			3
4			4
5			5
6			6
7			7
8			8
9			9
10			10
11			11
12			12
13			13
14			14
15			15
16			16
17			17
18			18
19			19
20			20
21			21
22			22
23			23
24			24
25			25
26			26
27			27
28			28