UNIVERSITY OF NAIROBI

DEPARTMENT OF ARCHITECTURE AND BUILDING SCIENCE

SCHOOL OF THE BUILT ENVIRONMENT

MANAGEMENT OF TRAFFIC CIRCULATION IN NAIROBI CITY, A CASE STUDY OF UPPER HILL AREA

BY

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BA (HONS) UNIVERSITY OF NAIROBI

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DECLARATION

STUDENT'S DECLARATION

I JONES E ONGECHI NYANGWESO hereby declare that this research project is my original work and has not been submitted to any other university or institution of higher learning for any academic award.

SIGNED…… DATE ……..

SUPERVISORS DECLARATION

This research project has been submitted for examination with our approval as the university supervisors.

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DEDICATION

I would like to dedicate this Research Project to my Parents Johnstone Nyangweso Mosongo ,Peris Gesare Nyangweso and Keresentia Moraa Nyangweso for providing the foundation for my early education and Wife Rita, Daughters Ruth, Paulette, Rachael and Son Justine for their encouragement and moral support during the period of study.

ABSTRACT

Traffic circulation in Upper Hill area of Nairobi City has been an issue of major concern to road users, planners, policy makers, employers, investors, the police department and many other stakeholders for a long time. The spillover of development and functionality of the CBD to the Hill Area in the last few years has seen densification of development of high rise buildings accommodating mainly office and commercial space as well as residential units. The population of both human and vehicular traffic in Upper Hill has increased tremendously and yet the infrastructure including the road network has remained almost the same. The study examined the traffic circulation characteristics in the area, the existing policy, regulatory and institutional mechanisms for the management of traffic circulation and evaluated the effectiveness of the existing policies regulatory and institutional mechanisms in the management of traffic circulation.

The study found that inadequate road capacity, careless driving accidents, ineffective public transport and its poor network integration, lack of parking facilities and poor planning rules in the area as some of the factors contributing to the poor traffic circulation in the area.
It has also been established from the study that existing mechanisms and policies on traffic circulation are not effective in the area.

The study therefore recommends that in order to alleviate the deteriorating traffic circulation in the study area, measures such as strict enforcement of traffic rules by the police and City authorities should be given priority. The procedures for reporting accidents and non-conformities should be streamlined. The roads within the study area should be redesigned in such a way as to convert some roads such as Ragati, Upper Hill and Lower Hill to one way. Parking on, and /or a long, narrow roads without adequate road reserves should be restricted. The roads should be widened as per the proposals that have already been put in place by the planning authorities to offer off-street parking and improve road capacity. The land use zoning plan for the area which is already approved should be implemented and those occupying part of the land earmarked for road widening asked to surrender them.

TABLE OF CONTENTS

DECLARATION ..... **i**
ACKNOWLEDGEMENT ..... **ii**
DEDICATION ..... **iii**
ABSTRACT ..... **iv**
TABLE OF CONTENTS ..... **v**
LIST OF FIGURES AND TABLES ..... **ix**
LIST OF FIGURES ..... **ix**
LIST OF TABLES ..... **x**
LIST OF ACRONYMS AND ABBREVIATIONS ..... **xi**
CHAPTER ONE **1**
INTRODUCTION **1**
1.1 Background to the study 1
1.2 Statement of the Problem 3
1.3 Research Questions 4
1.4 Aim and Objectives of the study 5
1.4.1 Aim 5
1.4.2 Objectives 5
1.5 Significance of the Study 5
1.6 Scope of the study 6
1.7 Assumptions of the Study 7
1.8 Operationalization of terms 8
CHAPTER TWO **9**
LITERATURE REVIEW **9**
2.0 Introduction 9
2.1 Theoretical Framework 11
2.1.1 Mathematical Theory 11

2.1.2 Economic Theory 12
2.1.3 Significance of the application of these theories 13
2.2 Empirical Review 14
2.3 Conceptual Framework 17
2.4 Causes and Impacts of Traffic Congestion in an Urban Area 20
2.5 Applied Solutions for Congestion Relief 21
2.6 Measures that have been used to address Traffic Circulation 26
2.6.1 Improving Traffic Operations 27
2.6.2 Improving Public Transport 27
2.6.3 Modifying Existing Infrastructure 28
2.6.4 Building New Infrastructure 29
2.7 Conclusion 29
CHAPTER THREE 31
RESEARCH METHODOLOGY 31
3.0: Introduction 31
3.1 Research Design 31
3.2 Area of Study 32
3.3 Limitations or Challenges encountered 36
3.4 Study Population, Sampling Techniques and Sample Size 36
3.5 Types of Data 37
3.6 Data Collection Tools 38
3.7 Data Collection Procedures 40
3.8 Quality Control 40
3.9 Questionnaire Pre- Testing 40
3.10 Data Analysis and Presentation 41
3.11 Chapter Conclusion 41
CHAPTER FOUR 42
RESULTS AND DISCUSSIONS 42
4.1 Introduction 42
4.2 Response Rate 42

4.3 Demographic Information of Households and General Public 43
4.3.1 Gender of Respondents 43
4.3.2 Age of Respondents 44
4.3.3 Location Where Respondents Live 45
4.3.4 Estimate Distance between House and Place of Work/Business/School 47
4.3.5 Mode of Transport Used 48
4.3.6 Means of Transport 48
4.3.7 Departure Time from Home and Time Arrived at Work/School/Business Place 49
4.3.8 Means of Transport Shared 51
4.3.9 One Direct Route/ Alternative Routes 52
4.3.10 Time Taken When Changing Routes 53
4.3.11 Time Embarked on Return Journey to House and Time Arrived 54
4.4 Traffic Circulation Challenges in Upper Hill 54
4.4.1 Traffic Circulation Challenges 55
4.4.2 Challenges of Traffic Flow 57
4.4.3. Longer commuting: 58
4.4.4 Public transport inadequacy 58
4.4.5 Difficulties for non-motorized transport 59
4.4.6 Loss of public space 59
4.4.7 High maintenance costs 59
4.4.8 Environmental impacts and energy consumption 59
4.4.9 Accidents and safety: 60
4.4.10a Land consumption: 60
4.4.10b Freight distribution: 60
4.5 Causes of Traffic Flow Challenges 61
4.5.1. Rapid Urbanization 61
4.5.2. High Rate of Motorization 61
4.5.3 Lack of Infrastructure, Enforcement, Management and Regulation 62
4.5.4 Resolutions to Challenges Experienced in Traffic Flow 63
4.6 Existing Policy, Regulatory and Institutional Mechanisms 67

4.6.1 Effect of Existing Policy on Traffic Circulation 67
4.6.2 Extent of Existing Policy on Traffic Circulation 68
4.6.3 Effectiveness of Existing Mechanisms 71
4.7 Measures to Enhance Traffic Circulation Management in Upper Hill Area 72
4.8 Factors Enhancing Traffic Circulation Management 73
4.8.1 Improving Traffic Operations 73
CHAPTER FIVE 77
SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS 77
5.1 Introduction 77
5.2 Summary of study Findings 77
5.3 Conclusion 78
5.4 Recommendations 79
APPENDICES 86
Appendix I: General Public Questionnaire 86
Appendix II: Household Questionnaire 94
Appendix III: Interview Guide for Professionals/Developers 102
Appendix IV: Work Plan 104
Appendix V: Financial Budget 105
Appendix VI: Attachments 106
Appendix VI (a) Registry Index Map (RIM) 106
Appendix VI (b) Zoning Plan 107
Appendix VI (c) Topocadastral Maps and Google map Attachments 108

LIST OF FIGURES AND TABLES

LIST OF FIGURES

Figure 1.1a: Residential Development Figure 1.1b: Commercial Development 6
Figure 2.1: Conceptual Framework 19
Figure 2.2: Road widening at Lower Hill and Haille Selassie Avenue junction 24
Figure 2.3: Improving road capacity at the junction of Upper Hill and Elgon roads 25
Figure 3.1a:Area of Study map -Upper Hill Area 33
Figure 3.2b: Image depicting the study area 34
Figure 3.2: Photograph of high rise buildings and upgraded roads in Upper Hill 35
Figure 3.3: Upper Hill Road showing a narrow width section within the study area 35
Figure 3.4: Lower Hill Road showing a narrow width section within the study area 36
Figure 4.1: Gender of Respondents 44
Figure 4.2: Mode of Transport 48
Figure 4.3: Means of Transport 49
Figure 4.4: Means of Transport Shared 51
Figure 4.5: One Direct Route/ Alternative Routes 52
Figure 4.6: Time Taken When Changing Routes 53
Figure 4.7: Traffic Circulation Challenges 55
Figure 4.8: Traffic Flow Management Policy Framework 64
Figure 4.9: Effect of Existing Policy on Traffic Circulation 67
Figure 4.10a: Extent of Existing Policy on Traffic Circulation 68
Figure 4.10b: Effectiveness of Existing Mechanisms 71
Figure 6.1: Sample Registry Index Map (RIM) of Upper Hill 106
Figure 6.2: Hill area Zoning Plan 107

LIST OF TABLES

Table 3.1: Sampling Frame 37
Table 3.2: Operationalization Framework 38
Table 4.1: Response Rate 43
Table 4.2: Age of Respondents 44
Table 4.3: Distance between House/Work/Business and Upper Hill 45
Table 4.4: How Often Do You Frequent Upper Hill Area? 46
Table 4.5: Estimated Distance Between House and Place of Work/Business/School 47
Table 4.6: Departure Time 50
Table 4.7: Arrival Time 50
Table 4.8: Traffic Circulation Challenges 56
Table 4.9: Traffic Circulation Challenges 56
Table 4.10a: Extent of Existing Policy on Traffic Circulation 69
Table 4.10b: Measures to Enhance Traffic Circulation Management 72
Table 4.10c: Hill Area Zoning Plan—Land Areas to be Excised to Facilitate the Proposed Widening of Roads 75
Table 6:1 Traffic Circulation Challenges In Upper Hill 89
Table 6.2: Existing Policy, Regulatory and Institutional Mechanisms 90
Table 6.3: Measures to Enhance Traffic Circulation Management in Upper Hill Area 92
Table 6.4: Traffic Circulation Challenges in Upper Hill 97
Table 6.5: Existing Policy, Regulatory and Institutional Mechanisms 98
Table 6.6: Measures to Enhance Traffic Circulation Management in Upper Hill Area 100
Table 6.7: Work Plan 104
Table 6.8: Financial Budget 105

LIST OF ACRONYMS AND ABBREVIATIONS

BPR	:	Business Process Re-engineering
CBD	:	Central Business District
HOV	:	High Occupancy Vehicles
ISO	:	International Organization for Standardization
ITS	:	Intelligent Transport Systems
JIT	:	Just In Time
Km	:	Kilometre
NLC	:	National Land Commission
QMS	:	Management system
QMS	:	Quality Management Systems
RIM	:	Registry Index Map
SPSS	:	Statistical Package for Social Science
TQM	:	Total Quality Management
TTI	:	Texas Transportation Institute
US	:	United States
USA	:	United States of America

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The urban transportation system is the engine of the economic activities in all-urban communities all over the world, and consequently sustains livelihood of the people living in them (Adams, 2007). Typical urban transportation facilities include railways, waterways, airways and roads. Among these, the big proportion consists of roads (Sanjay, 2005). Logically, most planning and research efforts have focused on the road system. In essence, road transportation system is the major player in the economic activities of most urban centers. In recent times, many cities have seen a large increase in road traffic and transport demand, which has consequently led to deterioration in capacity and inefficient performance of traffic systems, manifested in road traffic congestion (Kolowksky and Moshe, 2005).

There is no single, broadly accepted definition of traffic congestion. One of the principal reasons for this lack of consensus is that congestion is both a physical phenomenon relating to the manner in which vehicles impede each other's' progression as demand for limited road space approaches full capacity and a relative phenomenon relating to user expectations vis-à-vis road system performance (Bickerstaff and Walker, 2005). Park, (2004) contends that traffic congestion is a situation in which demand for road space exceeds supply. Congestion is the impedance vehicles impose on each other, due to the speed-flow relationship, when the use of a transport system approaches capacity. It is hard to say what is traffic congestion exactly, since there is no standard of traffic congestion worldwide and traffic system varies from one city to another.

According to Khayesi (2007), congestion prevents us from moving freely and it slows and otherwise disrupts the conduct of business within urban areas. However, it is important to note that unfettered movement is not the primary benefit we derive from living in urban areas. Cities provide access to a wide range of activities, people, services, goods, markets,

opportunities, ideas and networks. The benefits can be delivered either through speed or through greater proximity. Congestion may affect travel speed but in some circumstances, such as dense urban cores, congestion may both be expected and, to some degree, accepted. In these cases, cities have come to accept a degree of congestion and continue to get along relatively well as long as overall accessibility is high.

As McLeod and Healy (2006) offer, familiar tools (which are considered traditional) that are applied as traffic and demand management tools in order to increase the efficiency of the transport system include and not limited to: prioritization of road users (i.e. introduction of truck lanes, bicycle and pedestrian routes, peak lanes, etc.), road hierachisation (i.e. classification of road function), road markings and signs, enforcement devices (i.e. camera, police patrol, etc.), regulation of parking space, congestion charges, fuel prices, traffic restraints (i.e. limiting entry to city center, Pedestrianization of City Centre, etc.), improvement of public transportation, among others. These tools are relatively cost-effective and technologically affordable and are applicable both in developing and developed countries. Bell et al (2007) are quick to note however, that much as they may seem affordable, yet they are not effectively implemented in most developing countries.

Max Weber's Modernization theory (1964) posits that Cities and traffic have developed hand-in-hand since the earliest large human settlements. The same forces that draw inhabitants to congregate in large urban areas also lead to sometimes intolerable levels of traffic congestion on urban streets and thoroughfares. Effective urban governance requires a careful balancing between the benefits of agglomeration and the dis-benefits of excessive congestion. Road traffic congestion has become a common feature in major Kenyan roads especially in the big towns. Therefore the study looked at traffic congestion in Upper Hill, one of the most affected areas of Nairobi, with a view to providing management solutions to this phenomenon and easing local and citywide circulatory problems.

1.2 Statement of the Problem

Traffic circulation is one of the major pre-occupation of urban planners. Policy statements from across cities in developing countries highlight the importance the general public, road users, elected officials and road and transport administrators in many urban areas accord to management of traffic circulation. Yet, there is little consensus among those concerned on the types of policies that are best suited to tackling traffic circulation in cities. There is perhaps even less consensus on what precisely congestion or slow traffic flow is, whether or not it is a "solvable" problem and, in some locations and cases, whether it is problem at all (Anderson, 2004). Hook (2005) concedes that urban traffic congestion must be understood in the wider context of city dynamics and agglomeration benefits. In context, during the late 1970s and 1980s the Kenyan roads especially in the big towns were tar-marked and free from heavy traffic but during the last decade of the 20th century to the present, Kenya has experienced a steady increase in the number of motor vehicles in its roads, particularly in the urban areas leading to heavy traffic congestion on the roads. The city of Nairobi has had its share of the congestion and practically on all roads leading to the city Centre especially during the morning and evening rush hours, road users spend long hours on the traffic jam to cover a distance which could have otherwise taken less than 30 minutes in normal driving. Road users who begin their working hours at 8am have to begin their journey to the city 2 to 3 hours before this time and have to spend equally the same number of hours to reach their destinations after work.

The same applies to young children going to school. The traffic congestion in the City roads is of concern to the road users going to work in the city, to the school children and also the Government due to the amount of time wasted and loss of productivity. From literature, diverse perspectives on road traffic management are given by scholars across the globe. As Adedimila (2011) argues, traffic congestion in urban areas is often the outcome of successful urban economic development, employment, housing and cultural policies that make people want to live and work relatively close to each other and attract firms to benefit from the gains in productivity thus derived.

Davis (2004) observes that there are many indications that, even though they may not be thrilled by the prospect, urban road users are prepared to live with crowded roads so long as they derive other benefits from living and working in their cities. Congestion prevents us from moving freely and it slows and otherwise disrupts the conduct of business within urban areas. However, it is important to note that unfettered movement is not the primary benefit we derive from living in urban areas. According to Oduwaye (2007), cities provide access to a wide range of activities, people, services, goods, markets, opportunities, ideas and networks. These benefits can be delivered either through speed or through greater proximity.

Mackay (2012) notes that congestion may affect travel speed but in some circumstances, such as dense urban cores, congestion may both be expected and, to some degree, accepted. In these cases, cities have come to accept a degree of congestion and continue to get along relatively well as long as overall accessibility is high.

Despite the above arguments, slow road traffic flow in Nairobi poses a serious challenge to its residents. The research therefore sought to establish the causes and the implication of slow road traffic circulation in Upper Hill area of Nairobi and suggest practical tools that can be applied in managing the problem.

1.3 Research Questions

The study sought to assess - the traffic circulation situation in Upper Hill area of Nairobi City, with a view to easing it through management Upper Hill. To achieve this, the research addressed the following four questions.

i. What are the traffic circulation characteristics in the area?
ii. What mechanisms exist for the management of traffic circulation in the area (policies, regulations and institutions)?
iii. How effective are these mechanisms?
iv. What can be done to enhance traffic circulation management in Upper Hill area?

By answering these questions the research gathered information on the major causes of road traffic congestion in the city; the role of technology and road expansion , institutional arrangements and policies in place in the management of traffic circulation. From this, the study is in a position to make recommendations in an effort to reduce traffic road congestion.

1.4 Aim and Objectives of the study

1.4.1 Aim

As stated under Research Questions the aim of this research is to assess - traffic circulation situation in Upper Hill area of Nairobi City, with a view to managing the congestion.

1.4.2 Objectives

i. To examine the traffic circulation characteristics in Upper Hill area of Nairobi
ii. To identify and assess the existing policy, regulatory and institutional mechanisms for management of traffic circulation in Nairobi
iii. To evaluate the effectiveness of the existing policies, regulatory and institutional mechanisms in the management of traffic circulation in Upper Hill area of Nairobi
iv. To make recommendations geared towards the enhancement of traffic circulation management in Upper Hill area of Nairobi. (Recommendations- policy, design etc.)

1.5 Significance of the Study

Findings from this study will provide policymakers and technical staff with the strategic vision, conceptual frameworks and guidance on some of the practical tools necessary to manage congestion in such a way as to reduce its overall impact on individuals, families, communities and societies.

The study will inform various stakeholders who include the road users, the Nairobi City County, the planners, road Engineers and property developers on the pertinent issues and challenges pertaining to traffic circulation management in Upper Hill, The study will be an

insight into the ongoing redevelopment of roads and other associated infrastructure in the area. The study area is undergoing intensive development with an implication of an increase in the number of motorists and pedestrians.

The study was inspired by the need to look at challenges and characteristics of traffic circulation in the area and be able to document them with a view of providing practical solutions.

Figure 1.1a: Residential Development

Figure 1.1b: Commercial Development

1.6 Scope of the study

This study was based on a case study of Upper Hill, Nairobi. All aspects reported were the ones found in Upper Hill. The study focused on: traffic circulation characteristics, the role of technology, road expansion as well as the identification of the institutional arrangements, regulatory mechanisms and policies in place in the management of traffic circulation in Upper Hill area of Nairobi.

According to the report by the Nairobi Town Planning Liaison committee dated August 1993, the Hill area was a low density residential area but its character has changed since the late ‘60’s when the Ministry of Works building was constructed within the vicinity of the East African Community Headquarters. The area has undergone a transformation from the

low density residential development to high-rise office blocks mixed with high-rise residential flats as seen along Elgon Road.

The development of intensive commercial and office space have however been taking place without commensurate redevelopment of infrastructure. For instance, until recently when upgrading of the road network was implemented, the entire area had been served by narrow roads which were meant to serve residential private homes. The upgrading and expansion of the road network is going on.

1.7 Assumptions of the Study

1. The study assumed that the possible challenges inhibiting smooth traffic circulation in Upper Hill area are the same experienced in the larger Nairobi County.
2. Traffic congestion is one of the major problems of the traffic circulation in Nairobi and Upper Hill area in particular.
3. The road users are aware of the impacts of traffic congestion on their daily operations and would be able to give factual information when filling out the questionnaire. Respondents are expected to be honest when answering questions. The researcher also assumed that all respondents given the questionnaires were literate and would be able to read, understand, and answer the questions on the questionnaires.

It was also assumed that the respondents would willingly participate in the study by filling out questionnaires and giving information that was required in the study.

1.8 Operationalization of terms

Traffic congestion Physical phenomenon relating to the manner in which vehicles impede each other's' progression as demand for limited road space approaches full capacity

Quality Management Systems (QMS)-refers to processes used in the production of quality products and services (Quality Management Systems, pg. 1).

Just In Time (JIT)-is a production inventory control system in which materials are purchased and units are produced only as needed to meet actual customer demand(Accounting for Management, 2011).

Business Process Re-engineering (BPR)-is the analysis and redesign of work within and between enterprises (Search CIO, 2001).

Theory of Constraints-is a management approach that focuses on managing constraints. Constraints are obstacles that hinder attainment of objectives (Mabin and Balderstone, 1999).

Total Quality Management (TQM)-is an improvement programme that provides tools and techniques for continuous improvement based on facts and analysis (Accounting for Management, 2011).

International Organization for Standardization (ISO*)*-is the world's largest developer and publisher of International Standards. ISO 9001:2008 specifies the requirements for a Quality Management system (QMS) that may be used by the organizations for internal application, certification or contractual purposes (ISO, 2011).

Matatu- passenger carrying vehicle (minibuses and vans)

Bodaboda -passenger carrying motor cycles

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section presents a review of literature on management of traffic circulation in order to identify the variables to consider in traffic flow management, identify gaps in existing literature develop theoretical and conceptual frame work and lay a foundation for empirical analysis.

Road traffic jams continue to remain a major problem in most cities around the world, especially in developing regions resulting in massive delays, increased fuel wastage and monetary losses.

Most cities in developing countries try to adopt the traffic strategies of developed countries while the designs are different and the strategies are not sustainable. It should be noted that while there is need to learn from the developed countries, developing countries should develop strategies that suit their environment and designs. Thus traffic management in developing countries needs to be sustainable for the benefits of the locals. According to Baluja, (2004), traffic management and urban land use are inseparable as enough space need to be set aside for wider roads, parking, pedestrians and cyclists. Traffic management is the process of adjusting or adapting the use of an existing road system to meet specified objectives without substantial new road construction Newman and Jeffrey, (1999).

Categories for traffic management include consideration of pedestrians, traffic surveys, prioritisation of public transport and street management through the control of parking.

One of the strategies for traffic management is consideration of pedestrians, visitors and occupants of the city, (Amos, 2004). Thus participatory approach is very crucial if traffic management programmes are to be effective. Urban areas are associated with economic activities and hence the policies of cities tend to be political since they serve the interests of a particular group. In most cases these policies are just imposed to the people. There is therefore need for stakeholder participation on issues of traffic management for effective

implementation of the policies. The stakeholders include government, residents, motorists, donor community, industrialists and local authorities.

Knoflacher (2006) says there is a huge increase in car ownership all over the world including the developing countries. Urban planners and traffic managers need to take into consideration this rapid change in traffic so that correct measures will be undertaken to curb the traffic problems. Vehicles ownership statistics can be analysed so that predictions can be done for future planning purposes.

Prioritization of public transport is another useful strategy in traffic management and it has been adopted even in the developed countries, (Detr 1998). Public transport has the advantage that one vehicle will carry many passengers unlike a situation that every individual is driving. Too many drivers on the roads cause traffic congestion. In a way of promoting the use of public transport, private vehicles and vehicles with few passengers pay more at toll gates entering the city centre.

Due to the poorly planned road networks, a common outcome in many developing regions is the presence of small critical areas which are common hot-spots for congestion; poor traffic management around these hotspots potentially results in elongated traffic jams.

Inefficient road traffic management is the primary reason for extended periods of traffic congestion throughout the world.

According to the Texas Transportation Institute's 2011 Mobility report, congestion in the US (United States) has increased substantially over the last 25 years with massive amounts of losses pertaining to time, fuel and money. Sao Paulo, Brazil is known to experience the world's worst traffic jams where people are stuck for two to three hours every day in traffic jams. The issue of traffic jams has affected both the developing and the developed economies to different degrees irrespective of the measures taken to curb the issue.

It is observed that a common feature across road networks in many urban regions in the developing world is the presence of critical congestion areas; a critical congestion area is referred to as an area where a network of roads converge and a large amount of traffic needs to traverse the common congestion area.

As per free-flow traffic theory, a free flow traffic road segment can be associated with a traffic curve where the traffic exit rate is a function of the traffic density in the road segment. A free flow road segment is known to exhibit a critical density point where any traffic input that pushes the density beyond the critical value can trigger a “spiraling effect” that results in the road segment operating at a low-capacity equilibrium point. Worse still, small traffic bursts over short time periods can potentially trigger the spiraling effect resulting in a congestion collapse. Many critical congestion areas in developing regions have poor traffic management systems that if any of these critical congestion areas hits a congestion collapse, the road network can result in a massive traffic jam for elongated time periods.

2.1 Theoretical Framework

This study reviews the following theories pertinent to the management of traffic circulation in major city roads.

2.1.1 Mathematical Theory

Some traffic engineers have attempted to apply the rules of fluid dynamics to traffic flow, likening it to the flow of a fluid in a pipe. Congestion simulations and real-time observations have shown that in heavy but free flowing traffic, jams can arise spontaneously, triggered by minor events ("butterfly effects"), such as an abrupt steering maneuver by a single motorist. Traffic scientists liken such a situation to the sudden freezing of super cooled fluid (Koslowsky and Moshe, 1993)

However, unlike a fluid; traffic flow is often affected by signals or other events at junctions that periodically affect the smooth flow of traffic. Alternative mathematical theories exist, such as Boris Kerner's three phase traffic theory. Because of the poor correlation of theoretical models to actual observed traffic flows, transportation planners and highway engineers attempt to forecast traffic flow using empirical models (Homburger, 1992). Their working traffic models typically use a combination of macro-, micro- and microscopic

features, and may add matrix entropy effects, by "platooning" groups of vehicles and by randomizing the flow patterns within individual segments of the network.

Three-phase traffic theory is an alternative theory of traffic flow developed by Boris Kerner between 1996 and 2002. It focuses mainly on the explanation of the physics of traffic breakdown and resulting congested traffic on highways. Kerner describes three phases of traffic, while the classical theories based on the fundamental diagram of traffic flow have two phases: free flow and congested traffic. Kerner's theory divides congested traffic into two distinct phases, synchronized flow and wide moving jam, bringing the total number of phases to three (Kerner's2007).

2.1.2 Economic Theory

Congested roads can be seen as an example of the tragedy of the commons. Because roads in most places are free at the point of usage, there is little financial incentive for drivers not to over-utilize them, up to the point where traffic collapses into a jam, when demand becomes limited by opportunity cost (Hook, 1995). Privatizations of highways and road pricing have both been proposed as measures that may reduce congestion through economic incentives and disincentives. Congestion can also happen due to non-recurring highway incidents, such as a crash or roadwork, which may reduce the road's capacity below normal levels.

Anthony (2004) argues that rush hour traffic congestion is inevitable because of the benefits of having a relatively standard work day. In a capitalist economy, goods can be allocated either by pricing (ability to pay) or by queuing (first-come first-serve); congestion is an example of the latter. Instead of the traditional solution of making the "pipe" large enough to accommodate the total demand for peak-hour vehicle travel (a supply-side solution), either by widening roadways or increasing "flow pressure" via automated highway systems, Downs advocates greater use of road pricing to reduce congestion (a demand-side solution, effectively rationing demand), in turn plowing the revenues generated there from into public transportation proposals (Beck 1999).

2.1.3 Significance of the application of these theories

The study theoretical framework tries to capture congestion situations that may arise for drivers who commute daily on a single road. We assume that the population of drivers is homogenous. In particular, all of them travel at the same speed, start their trip from the same place, and want to arrive at the same place at the same time. Each driver chooses his departure time in order to minimize his travel costs, which equal the costs due to transportation time plus schedule delay costs, i.e., costs induced by a late or an early arrival at place of work. Uncoordinated decisions of departure time within the population may generate road traffic congestion.

Having defined road congestion resulting from slow traffic flow like in Arnott, de Palma, and Lindsey (1990, 1993) as a bottleneck in the transportation infrastructure with a maximum flow capacity, which is the maximal number of drivers that can pass on in each period without congestion. In a given time slot, if the number of drivers increases beyond that capacity, a queue develops. The time it takes for a driver to pass through the bottleneck depends on the length of the queue at the time the driver joins it. The congestion model is described more precisely as a normal form game in the next sub-section. An illustration with two drivers is given in the third sub-section. A characterization of equilibrium outcomes in some classes of n-player congestion games is provided in the fourth subsection. The last sub-section discusses in a dynamic setting the possible effects of public information about past choices on adaptive behavior and convergence towards equilibrium (Heda, 2003).

Traffic research still cannot fully predict under which conditions a "traffic jam" (as opposed to heavy, but smoothly flowing traffic) may suddenly occur (TTI, 2009). It has been found that individual incidents (such as accidents or even a single car braking heavily in a previously smooth flow) may cause ripple effects (a cascading failure) which then spread out and create a sustained traffic jam when, otherwise, normal flow might have continued for some time longer. Traffic congestion is not primarily a problem, but rather the solution to our basic mobility problem, which is that too many people want to move at the same time

each day, because efficient operation of both the economy and school systems required that people work, go to school and even run errands about the same hours so that they can interact with each other. The same problem exists in every major metropolitan area in the world. According to Thomson J M, (2000), peak-hour traffic congestion in almost all large and growing metropolitan regions around the world is here to stay.

In fact, it is almost certain to get worse during at least the next few decades mainly because of rising population and wealth. Although, traffic congestion is inevitable, there are ways to slow the rate at which it intensified. Several tactics could do that effectively, especially if used in concise, but nothing can eliminate peak hour traffic congestion from large metropolitan regions here and around the world.

2.2 Empirical Review

According to Ayeni (2007), congestion involves queuing, slower speeds and increased travel times, which impose costs on the economy and generate multiple impacts on urban regions and their inhabitants. Congestion also has a range of indirect impacts including the marginal environmental and resource impacts of congestion, impacts on quality of life, stress, safety as well as impacts on non-vehicular users such as the users of sidewalks and road frontage properties. Litman (2005) observes that policy-makers should ensure that cost-benefit evaluations or other policy evaluation methodologies include an assessment of these impacts as well as take into account broader considerations such as the type of cities people want. There exists a real tension between different models of congestion cost and estimates which in turn influences congestion management approaches.

Bickerstaff (2005) espouses that economic models can lead to the formulation of quite different congestion management objectives from physical models. Generally speaking, traditional approaches used by road administrations have focused on managing road systems in urban areas in ways that maximize their ability to handle current and expected future traffic demand. Such flow-based approaches seek to maximize the physical usage of available road capacity, taking into account other road management goals such as safety.

Harvey and Durbin (2004) concede that roads are rated at a set capacity as expressed in flow, density or, synthetically, as “levels of service”.

Achieving higher flows, higher densities and higher levels of service in keeping with the rated capacity of the roadway has traditionally been seen as performance “improvement”. Likewise, street networks are operated with an eye to reaching maximum intersection clearing capacities during peak hours. Approaches that seek to maximize vehicle throughput along major links inevitably take traffic levels into unstable zones and heighten the risks of recurrent and unpredictable congestion such operational approaches are well adapted to identifying the locations where bottlenecks exist. They aim to minimize traffic delays and the associated personal, business and resource impacts including personal and productive time lost, fuel wasted and adverse air quality. They allow administrations to highlight locations where action may need to be taken to respond to the delays experienced by users on a regular basis McLeod, (2006).

Newbery (2008), notes that approaches that seek to maximize vehicle throughout along major links inevitably take traffic levels into unstable zones and heighten the risks of recurrent and unpredictable congestion. Economically optimal levels of congestion take into consideration not only the cost of road provision but also what people are ready to pay in order to use the road. Economic assessments of congestion and its impacts have led to alternative approaches that seek to define an “optimal” level of traffic for a given road, intersection, network, etc. These define the cost of congestion as those costs incurred when traffic levels are beyond the “optimum” level. In particular, they account for the costs imposed by each additional user of the road on other road users and on society as a whole.

Downs (2006) has the notion that the traffic on any given artery can be considered congested when it is moving at speeds below the artery’s designed capacity because drivers are unable to go faster. If there is a street designed 50 miles per hour, and most of vehicles’ speeds on this street are lower than 50miles per hour, there is traffic congestion. So in Downs’ opinion, traffic congestion is closely related with designed standard. Generally speaking, it could be

defined as vehicles blocked on the street and their average speed lower than one level or people spend much more time on the road which is unendurable.

According to McLeod (2006), the relative rise in congestion can also be seen as a "natural" consequence of the "lumpy" nature of infrastructure provision. New road capacity can only be provided in large increments leading to a situation where new infrastructure is oftentimes underused in the short-term, well-used in the medium term and over-used in the longer term. New infrastructure provided in the 1950s through the 1980s is now often saturated with traffic and the possibilities for further large-scale expansion are often seriously constrained by the scarcity of available urban land and its costs. In some areas where there remain opportunities to expand or otherwise complete insufficient regional road infrastructure, as in the case of the greater Tokyo region or in Moscow, one can expect that a similar pattern of congestion relief, followed by traffic growth and saturation occur - absent of any pro-active traffic management policy (Bell, 2004).

Lee-Smith (2007) argues that optimal congestion approaches consider demand for road space as well as supply and seek an "optimal" balance between the two. Economically optimal levels of congestion take into consideration not only the cost of road provision but also what people are ready to pay in order to use the road. Economically "optimal" levels of traffic not only entail a certain degree of congestion as the term is commonly understood by roadway managers and users but this "optimal" level of traffic can also vary i.e. it is not related solely to the capacity of the infrastructure under consideration. According to Kerner and Verhoef (2007), one benefit of using an economic framework for describing and analyzing congestion is that these approaches allow policies to take into account the heterogeneity of road users and, in particular, the variability in users' value of time.

Well-constructed economic approaches can also inform policy-makers when it makes sense to invest in certain forms of congestion relief measures including the provision of new infrastructure. There are differences between the outcomes that result from the conceptual frameworks traditionally used and optimal congestion approaches. There are also gaps

between the theory and the practice in determining the “optimum” levels of traffic that policy-makers should be aware of when adopting conceptual models to describe congestion and prescribe policy actions. For instance, simplified economic approaches based on speed-flow relationships inadequately capture the manner in which the formation and discharge of queues impact roadway users. Likewise they are not necessarily well adapted to the description of congestion behavior on dense street networks where intersection clearance times (and not link performance) are the key variables. There are other approaches, such as bottleneck-based models that better capture the spatial and temporal impacts of congestion in these circumstances. Unreliable travel times impose real costs on individual road users and can have significant downstream impacts on productivity (TTI, 2009).

Another gap exists between the design of many traffic flow management policies and road users’ concerns relating to the reliability and predictability of travel times and not just their average duration. Unreliable travel times impose real costs on individual road users and can have significant downstream impacts on productivity (e.g. as in the case of increased inventory holdings by businesses). These impacts and costs should not be neglected when formulating congestion policy responses. Congestion cost calculations have often incorporated unrealistic assumptions relating to baseline travel conditions. Overall costs of slow traffic flow vary. Many traffic flow response strategies have been motivated by misguided, erroneous or misleading overall traffic flow cost estimates. Traffic flow cost calculations have often incorporated unrealistic assumptions relating to baseline travel conditions.

2.3 Conceptual Framework

There is rarely a uniform conceptual framework for addressing traffic circulation and appraising traffic circulation management policies across the variety and scope of actors involved. Furthermore, there exists a real tension between different conceptual models underlying traffic circulation cost and impact calculations which in turn can influence traffic circulation management approaches.

Talvitie (1997) says urban transport is very crucial because it facilitates the movement of people and goods which marks the backbone of economic growth and sustainable development of a country. Rapid urbanization has resulted in the increase in vehicles both for public and private use. Poku-Boansi (2003) says in Ghana most public transport is offered by the private sector in the form of buses, minibuses and taxis due to the high demand of the transport service, but public transport is inadequate as commuters are seen loitering around desperately looking for transport to and from work.

Urban life is integrated with transport for both social and economic activities. Talvitie (1997) says transport planning process requires stakeholders which include individuals, benefit groups, planners and decision makers, but in developing countries most projects in transport planning and management excludes the ordinary road users. The department of international development (2000) highlights the need for government to fully participate in traffic management because it has an important role in the development of projects and decision making process.

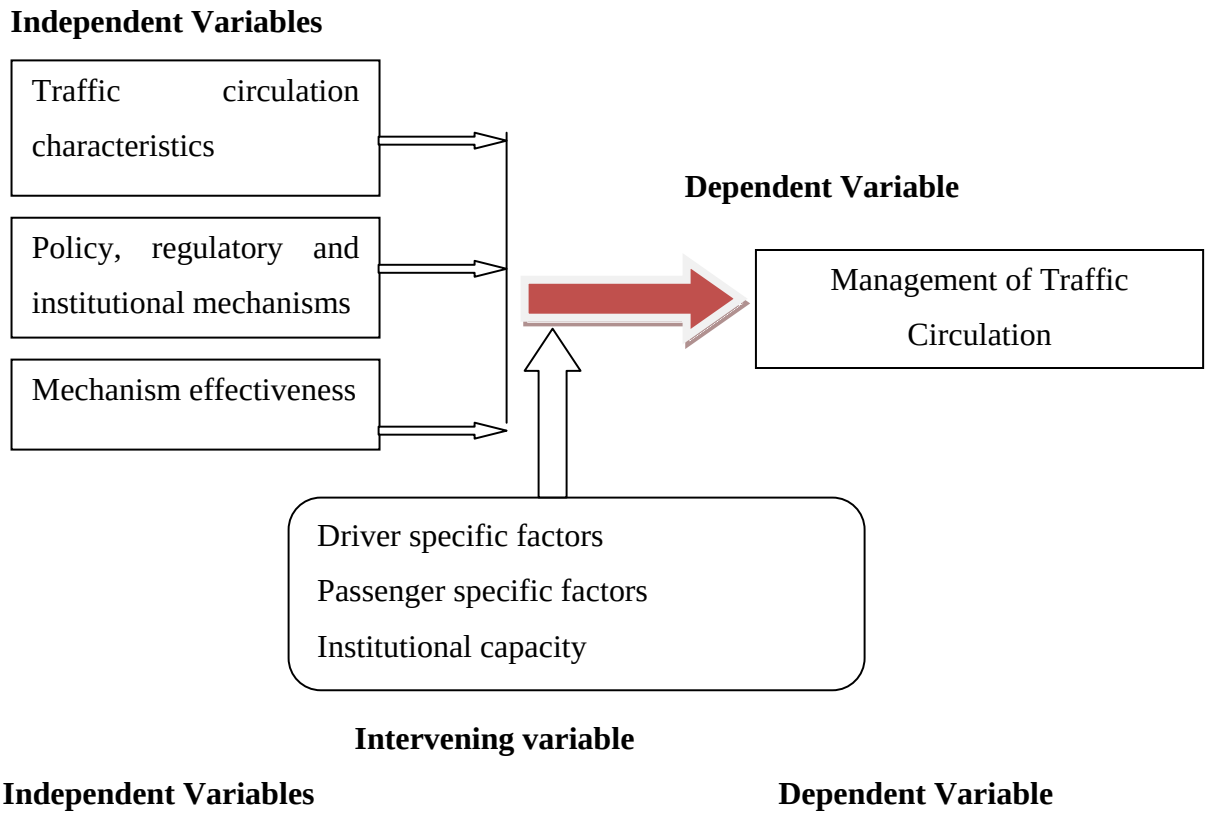


Figure 2.1: Conceptual Framework

2.3.1 Operationalization of the conceptual framework

Figure 2.1 above presents a diagrammatic conceptualization of the independent and dependent variables. From the diagram, the independent variables, Traffic circulation characteristics, policy, regulatory and institutional mechanisms and effectiveness thereof are conceptualized as influencing traffic circulation management, which forms the dependent

variable. This association is further conceptualized as being affected by other factors including driver specific and passenger specific factors as well as the institutional capacity, which form the intervening variables.

2.4 Causes and Impacts of Traffic Congestion in an Urban Area

The most known causes of traffic congestion are recurrent and non-recurrent congestion.

2.4.1 Recurrent Congestion

Regularly occurred on the transportation system, such as daily commuting or weekend trips, traffic is vulnerable to sudden breakdowns as demand approaches the maximum throughput capacity on a link or in the network. "Roads are operated near to their maximum capacity saturated intersections can quickly give rise to queues whose upstream propagation can swamp local roads and intersections" (European Conference of Ministers of Transport, 2007, p. 15).

2.4.2 Non-Recurrent Congestion

It occurs irregularly and unexpectedly, such as crashes, special events, snow, rain, fog and so on that affect parts of the road transportation system which is not easily predicted.

2.4.3 Inadequate infrastructure facilities

In literatures, most writers argued that traffic congestion has an impact on travel time and fuel consumption, among them Ogundipe, (2007, p. 170) illustrates that "traffic congestion can cause more fuel to be used." European Conference of Ministers of Transport, (2007) supports Ogundipe’s idea above.

Hours are lost or delayed due to various factors, among which the direct indicators are the imbalance between demand and supply: number of vehicles or traffic volume, like trucks, buses, private cars etc. exceeds the existing road capacity. Moreover, the capacity of a road can be measured by comparing the traffic volume and travel time. However, traffic management, like on-street parking conditions can affect the performance of the roads.

2.5 Applied Solutions for Congestion Relief

Even if there is no single best approach to overcome congestion as it takes on many faces(caused by many different processes and occurs in many different contexts), demand management strategies also called mobility management can help in solving multiply problems and provide various benefits of the transport system, including congestion reduction, vehicle fuel efficiency, and parking improvement (Litman, 2009). However, from various interrelated strategies, there are some more effective strategies in overcoming traffic congestion. This may include along with the supply side that account for how residents and roadway users as well as their longer-term mobility preferences are fulfilled (David, Karen, and Rebecca, 2001).

2.4. Parking Management

Parking Management, is an activity of supply, price and regulation of parking facilities (VTPI,2008), significantly affects travel behavior: if parking becomes more abundant and cheaper, will lead to increase automobile demand that result in large volume of vehicles. On other side, it can play a great role in solving congestion problem if it managed well. The provision of parking should not be too much as well as insufficient. Thus, parking policy and provision requirements are essential in reducing traffic congestion (Du Toit, et al, 2001). Moreover, Hitge and Roodt, (2006) state clearly as: ... the duration of car parking has a direct relation with the size of shopping center, economic activity of the center district, and policy, like parking cost. So that, from different alternative, factors like availability of suitable public transport, proximity of parking, and paid parking would lead to a reduction in parking demand.

2.4.1. Regulate Parking Use

Parking use should be regulated so as to use parking spaces and travel efficiently. Discount for residents parking and limit parking duration according to land-use type, and traffic volume, expected to increase the parking turnover rate and it favors shorter-term users or parking duration for deliveries and shopping. Regarding this, Victoria Transport Provision Institution, (2009) discussed the feature of good parking use that minimize congestion as follows: limit on-street parking of large vehicles (e.g., vehicles over 22 feet long) that obstacle the traffic movement, prohibit on-street parking on certain routes (arterials roads), during rush hour so as to maintain the smooth traffic flow, and special parking regulation to favor priority vehicles, like emergency, service, etc.

Obviously, in reducing congestion, it is important to eliminate or minimize free parking in a specific place (Seattle Urban Mobility Plan, 2008; Environment Pollution (Prevention and Control) Authority, 2009). Variable-rates parking price has a great role in reducing parking demand when compared with free parking, like higher rates during peak periods and lower rated during off-peak periods on-street spaces is more effective in reducing peak use (Shoup, 2005 cited in VTPI, 2009).

The empirical studies have supported the above concept. For instance, a case study by the Environment Pollution (Prevention and Control) Authority, (2009), carried in Japan shows a positive change after formulation and effective implementation of a new on- street parking regulation (high price with time variable-rates) since June, 2006 on major cities in Japan. Three months later, it is reported that nearly 74% and 73.3% decline in illegal on-street parking in Tokyo and Osaka respectively which reduced the traffic congestion level on main roads from 27% to 23% at 2 p.m to 4 p.m than the previous time. The same to Japan, Weinberger, Kaehny and Rufo (2009) have stated that, in USA variable pricing policy on-street parking in peak hours also encouraged the short stays, high turnover rate and faster deliveries.

2.4.2 Flextime

To overcome congestion problem, most writers, such as David, Karen and Rebecca (2001), and Orn (2002) suggested that flextime work schedule is one mechanism that allow some different working time for daily work of people. For instance, it is better to have different work schedule of the day instead of starting all works at the same time (start work at the same time in the morning and end in evening) that lead high unidirectional travel demand or making trip together.

2.4.3 Build and Improve Capacity of Roads

To Hokao and Sulaiha (2009), and Texas Transportation Institute (2005), increasing the roads network coverage through construction and enhancing the capacity of the existing intersection will have a positive impact in mitigating traffic congestion. By improving their design: widening the road space of entrance and exit by shifting the reservations areas to the existing road, providing exclusive lanes for large size vehicles that able to turn, and move easily, and proper traffic signs of arterial roads.

Figure 2.2: Road widening at Lower Hill and Haille Selassie Avenue junction

Figure 2.3: Improving road capacity at the junction of Upper Hill and Elgon roads

2.4.4 Land-Use Planning Measures

Land-use planning is another type of strategy that can influence congestion. In cities travel demand is increasing dramatically because of sub-urban expansion (William, 2008; John, 2009) People want to live at periphery in order to take the advantage of low land price and moved to the center of urban area for work. Thus, to influence the process, land use planning should be integrated with transportation planning strategies. These include land use controls (zoning), urban growth boundaries, and development policies (transit- oriented design, which provides land use densities and forms to favor transit use) and also taxation policy by providing incentives for high-density development so as to address transportation-related issues (Texas Transportation Institute, 2005; Hokao and Sulaiha, 2009)

These various and interrelated land-use management strategies can affect traffic movement of an urban area. For example, several studies indicate that transit- oriented development "encourages dense development within walking distance (0.4 to 0.8 km) of transit stops" (Litman, 2003; p. 13) can significantly reduce travel distance (Richard et al, 2003; Cervero, 2004; Gard 2007)by gathering residential and commercial buildings near to a transit center can minimize personal car ownership. In addition, same token by Victoria Transport Policy Institute (2008) indicates that improved access management via arranging shops together can improve access.

2.4.5 Improved Public Transport

Public transportation is one and the most important means of alleviating traffic congestion for it makes roads work better by reducing the number of vehicles on the road. As Timothy and David (2005) indicated, without public transportations, the annual increase of travel time due to traffic congestion would have reached 1. 1 billion hours globally. This shows that, a great concern should go towards the expansion of high- capacity public transportation system, like introduction of light rail, heavy rail, rapid buss transit, and high occupancy vehicles (HOV) lanes, which coupled with better management of the existing road network and traffic management (Litman, 2008).

2.6 Measures that have been used to address Traffic Circulation

Many strategies have been applied elsewhere to help improve travel speeds, increase system reliability and mitigate the impacts of traffic circulation problem. Traditional traffic circulation problem management strategies can be divided into four broad classes: those that seek to improve traffic operations, those that seek to shift urban traffic to public transport or otherwise reduce the demand for urban road travel, those that seek to modify existing infrastructure so as to increase its capacity and those that seek to provide new infrastructure.

Thus, while all of these policies are important and can deliver sometimes significant improvements in urban traffic conditions, they are likely not sufficient, alone, to deliver desired long-term reductions in traffic circulation problem (Kimani, 2004).

2.6.1 Improving Traffic Operations

According to Cole, (1996) proactive traffic operations management has much potential. Road Traffic information systems, pre-trip guidance, coordinated traffic signal systems and the implementation of dynamic speed and incident management policies have often proven to be cost-effective ways to deliver better travel conditions, allowing users to reschedule their trips away from traffic peaks and/or select other travel modes. These strategies all allow road managers to get more out of roads e.g. to allow for greater flows than could otherwise be realized. They should not be deployed with an eye to bringing traffic up to the limit of the physical capacity of the roadway as this inherently leads to major instabilities in traffic flow and increased probabilities of sudden breakdowns. In fact, many of these strategies can be helpful in managing traffic such that flows are held below these unstable threshold zones.

2.6.2 Improving Public Transport

Public transport has the potential to transport more people than individual cars for a given amount of road space in the case of on-street systems such as buses and trams or without consuming any road space at all in the case of off-road systems such as metros and surface rail systems.

The promotion of public transport remains a fundamentally important traffic circulation problem management strategy. When public transport provides a quality of service that approximates that which car drivers have previously been used to, it can maintain a high level of access throughout urban areas with a drop in overall car usage. Hurst (1999) for the traffic circulation problem mitigation potential of public transport to be realized, travelers must feel that the extent and quality of service provided are sufficient for them to forego using their cars for certain trips – especially those in peak periods. Thus, actions taken to

encourage a mode shift to public transport should address the perceived costs by the user, ease and comfort of travelling by public transport as well as its reliability, safety and security.

According to Hunte (2000), there are many measures that can improve the attractiveness and performance of public transport systems (e.g. extending services, adapting fee structures, operational improvements, public transport information provision, etc…) but these measures come at a cost and, alone, likely not be a sufficient traffic circulation problem management response. Urban areas with high levels of public transport use often also have high levels of road traffic as well. In this context, public transport is not so much a traffic circulation problem mitigation measure as a way of providing in certain locations a better level of service than users can find on the road network. Public transport services, even when augmented by paratransit services, likely not be able to provide the level of service that car users enjoy in many lower density or peripheral urban areas. Some road traffic circulation problem measures e.g. road pricing can only be undertaken if there is sufficient public transport capacity at a acceptable level of service to accommodate travelers displaced from the road Implementing mobility management. There are numerous mobility management strategies that can, when successful, reduce car use in urban areas. These include ride-sharing, promoting bicycling and pedestrian travel or supporting mobility management efforts targeting large trip generators such as companies.

2.6.3 Modifying Existing Infrastructure

There are many approaches that can squeeze additional capacity out of existing infrastructure. These include adding lanes, re-allocating road space, modifying intersections, modifying the geometric design of roads or creating one-way streets. These approaches can benefit either car users or public transport; however as with operational management policies – these interventions should not seek to bring traffic flows so close to the maximum capacity of the roadway that the probability of sudden traffic breakdowns becomes unacceptable. While these types of measures are ideally suited for treating bottlenecks, care should be given to consider the downstream impacts of releasing greater traffic flows

through previously contained bottlenecks. Great care should be taken to at least address what the network effects were over the mid- to long-term of such bottleneck treatments.

2.6.4 Building New Infrastructure

Building new road infrastructure is often constrained by a lack of space in dense urban cores and is nearly always an expensive proposition even in the outlying peripheries of urban areas. Many cities now view infrastructure expansion only as a last resort. The effectiveness of providing new road capacity as a traffic circulation problem management “solution” is oftentimes eroded by new traffic demand. However, there are instances where the provision of new infrastructure is an effective policy especially when subsequent demand for the infrastructure in question is actively managed as in the case of toll roads and HOT lanes.

The decision to invest in new road capacity (or parking capacity) should be motivated by a thorough cost-benefit exercise that addresses the wide range of traffic circulation problem impacts detailed earlier. These should also include costs such as environmental costs and impacts on non-road users. When the benefits of providing new infrastructure outweigh the costs of not providing it, then an argument exists for new construction Thomson J M, (2000).

2.7 Conclusion

Excessive traffic circulation problem and degraded road traffic conditions are not an unavoidable outcome of city life. These findings highlight that much can, and should, be done to better manage traffic circulation problem in large urban areas. Tackling traffic circulation problem can deliver lasting benefits for the entire urban region.

It is evident that t cities mainly in developing countries lack circulation plans. A circulation plan is a schematic empirical projection/model of how pedestrians and/or motor vehicles flow through a given area, like, for example, a neighborhood or a Central Business District (CBD). Circulation plans are used by city planners and other officials to manage and monitor traffic and pedestrian patterns in such a way that they might discover how to make future improvements to the system.

The two types of people most cognizant of circulation plans are developers and county planning officials. New multi- storey family residential and office developments such as the ones coming up in Upper Hill introduce increased volume (and thus density) of traffic flows into the area.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0: Introduction

This section deals and defines research methods, research instruments and research tools used in carrying out the study. It also presents the instruments and tools selected for this study. According to Kumar (2005) the main feature of research is the use of appropriate methods and involves the systematic, controlled, valid and rigorous exploration and description of what is not known and establishment of associations and causation that permit the prediction of outcomes under a given set of conditions. He further points out that research involves identifying gaps in knowledge, verification of what is already known and identification of past errors and limitations. The research plan and design was developed in the context of the study. The chapter further describes the methods and procedures that were used in collecting relevant data and how it was analyzed. It presents the research design, type of data, target population, the sample size and sampling procedure, methods of data collection and procedures, techniques of analyzing data and instrument validity.

3.1 Research Design

Yin (2003) defines research design as the logical sequence that connects the empirical data to a study's initial research questions and ultimately to its conclusions. It is a plan that guides the researcher in the process of collecting, analyzing and interpreting observations. A research design is a plan, structure and strategy of investigations so conceived as to obtain answers to research questions or problems (Kerlinger, 1986). According to Thyer (1993) a traditional research design is a blue print or a plan on how a research study is to be completed; operationalization variables to facilitate measurement; selecting a sample of interest to study; collecting data to be used as a basis for testing hypotheses; analyzing the results.

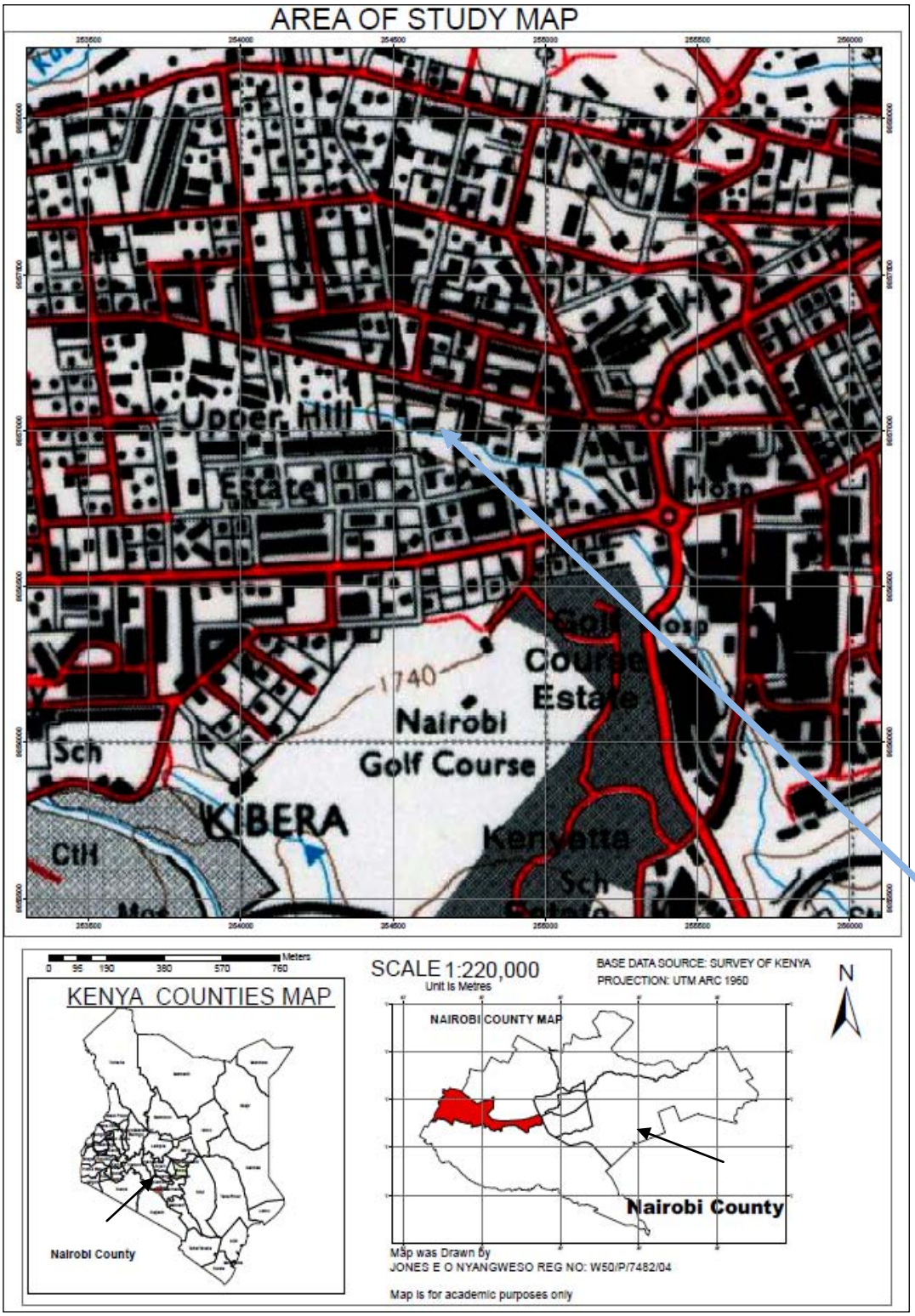
A qualitative descriptive survey study was used in this research. Qualitative research investigates subjective data, and focuses on the experiential state of the participants and their

perceptions of a situation (Strauss and Corbin, 1990). The objective of qualitative methods is to collect data and information and gain a better understanding of the research topic. The data gathered may be unstructured, at least in their raw form, but tend to be detailed, and hence rich in content and scope (Fellows, 1997).

One of the disadvantages of the qualitative method is that it is unable to support empirical judgments; the study may therefore not support completely the empirically held notions. However it can be employed to draw analytical conclusions (Maxwell, 1996). The advantage of this method is that it provides a greater range of insight, which improves the overall validity of the results.

3.2 Area of Study

The study area comprises the area bounded by Uhuru highway up to Bunyala road roundabout, Nairobi-Kisumu railway line, Mbagathi way, Ralph Banche, Valley road and Kenyatta Avenue



Upper Hill Area

Figure 3.1a:Area of Study map -Upper Hill Area

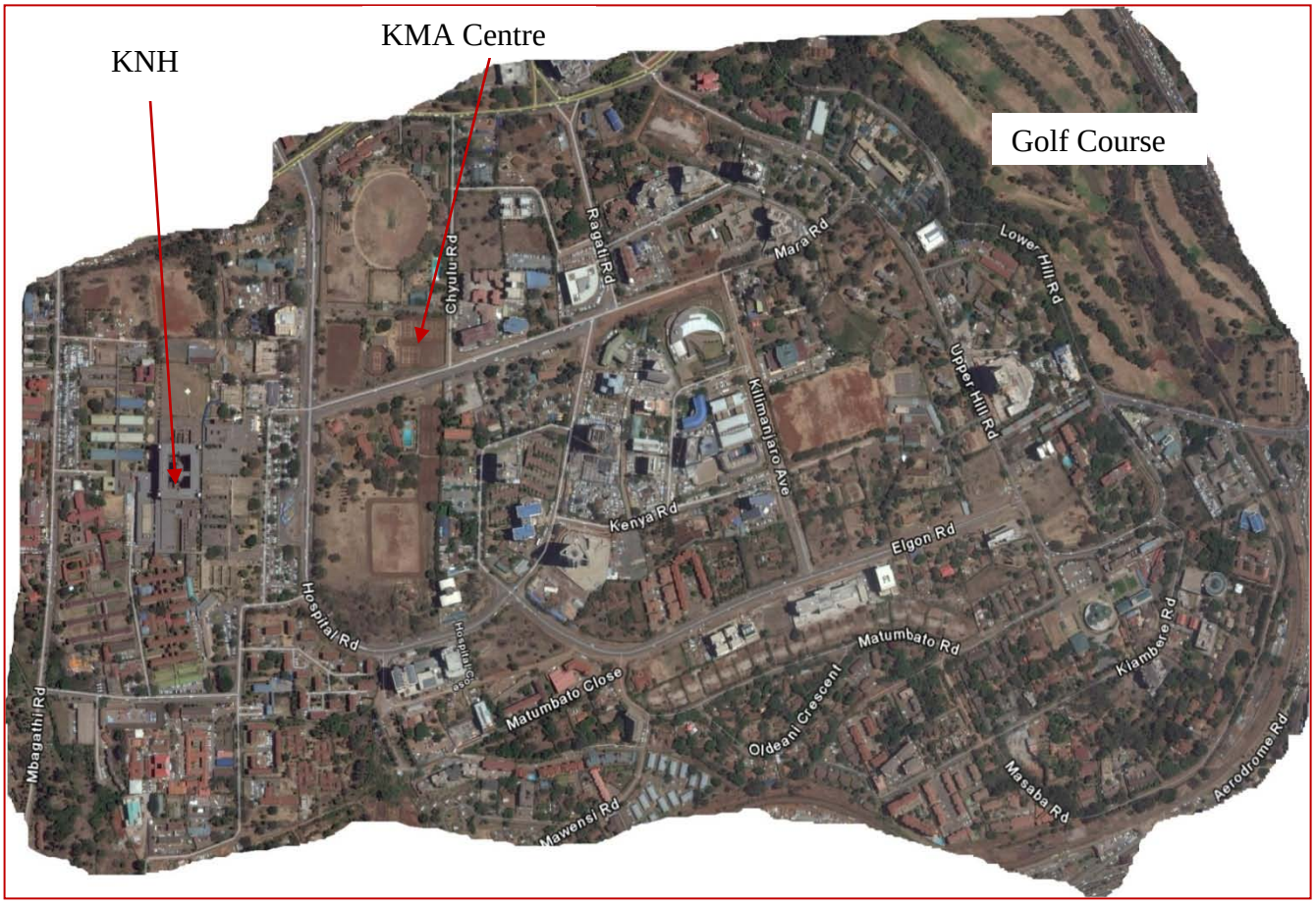


Figure 3.2b: Image depicting the study area

Figure 3.2: Photograph of high rise buildings and upgraded roads in Upper Hill

Figure 3.3: Upper Hill Road showing a narrow width section within the study area

Figure 3.4: Lower Hill Road showing a narrow width section within the study area

3.3 Limitations or Challenges encountered

The study could have widened its scope to examine the impact of traffic flow on productive time each day by road users in the entire republic, with samples drawn from all the major cities in Kenya. However, because of limited time and funds this could not be accomplished. Similarly, while a comparative study between the impact of road traffic flow on productive time each day by road users in Nairobi and those of outside Nairobi could have been undertaken, this was equally not possible.

3.4 Study Population, Sampling Techniques and Sample Size

The target population for this study comprised the general public, policy makers (institutions and agencies directly or indirectly involved in the realm of transport), professionals, developers and employers). In this study, a method of random sampling was embraced in selection of a sample. In this process, a sample was drawn from a wider population in a way that sought to be representative of the population.

According to Mugenda and Mugenda (2003), a sample of between 10%-30% is considered adequate for generalization of the findings to the whole population if the sample is well chosen.

Table 3.1: Sampling Frame

Population	Frequency	Percentage
General Public(households and motorists inclusive0	120	40
Professionals	80	26.7
Policy makers	65	21.7
Developers/Employers	35	11.6
Total	300	100

Our target population was three thousand (3000) people comprising of the general public, professionals, policy makers and developers/Employees. At least 10% of the total population is representative. Thus, 10% of the accessible population is enough for the sample size according to (Mugenda and Mugenda, 2008). The study took a sample size of 300 people stratified into general public, professionals, policy makers and developers/Employers. In this case, the study purposively targeted 120 general public(inclusive of households and motorists), 80 professionals, 65 policy makers and 35 developers around the Upper Hill area in Nairobi.

3.5 Types of Data

In this study, the types of data were distinguished as primary and secondary data, and also as qualitative and quantitative data. Both primary and secondary data were used in this study. Primary data was obtained from the field from respondents while carrying out the study while secondary data was obtained from records, reports, printed forms, journals, academic work, the Internet, and other sources.

3.6 Data Collection Tools

This study focused on both qualitative and quantitative data, collected by use of questionnaires for primary data and through a desk study for the secondary data.

Table 3.2: Operationalization Framework

OBJECTIVES	FACTORS	DATA TYPE	SOURCE OF DATA	DATA COLLECTION METHOD	DATA ANALYSIS
To examine the traffic circulation characteristics in Upper Hill area of Nairobi	Household characteristics, Road users-pedestrians, private cars buses, taxis motor cyclists, cycle lists, land use and land use changes, developments(commercial& residential) road width and network, road expansion programmes, parking spaces, security checks in buildings, type of business and offices.	Primary	Questionnaires, discussion guide	Interview schedule, Questionnaire	descriptive statistics
To identify and assess the existing policy, regulatory and institutional mechanisms for the management	Adoption of intelligent transport systems(its) e.g. over speeding video detectors, adequate and regular maintenance of roads and road infrastructure punitive measures to transport law and policy offenders, transport and traffic education especially on	Primary	Questionnaires, discussion guide	Government Reports,	descriptive statistics

OBJECTIVES	FACTORS	DATA TYPE	SOURCE OF DATA	DATA COLLECTION METHOD	DATA ANALYSIS
of traffic circulation in Upper Hill area	urban roads for drivers, commuters and pedestrians, involvement of trained traffic marshals by the Nairobi City County to complement the regular traffic police work within the CBD and its environs-Actors-City council, Traffic police KURA, KERA, Directorate of transport				
To evaluate the effectiveness of the existing policies, regulatory and institutional mechanisms in the management of traffic circulation in Upper Hill area of Nairobi	Adoption of intelligent transport systems(ITS) e.g. over speeding video detectors, adequate and regular maintenance of roads and road infrastructure punitive measures to transport law and policy offenders, transport and traffic education especially on urban roads for drivers, commuters and pedestrians, involvement of trained traffic marshals by the Nairobi City County to complement the regular traffic police work within the CBD and its environs-	Primary	Questionnaires, discussion guide		descriptive statistics

OBJECTIVES	FACTORS	DATA TYPE	SOURCE OF DATA	DATA COLLECTION METHOD	DATA ANALYSIS
	Actors City council, Traffic police KURA, KERA, Ministry of Transport.				

3.7 Data Collection Procedures

The researcher sought permission to carry out the research from the commission for Science Technology and Innovation, Ministry of Education and the University of Nairobi. Data was obtained using questionnaires which had both open ended and closed ended questions. The questionnaires were distributed to the participants i.e. the households, professionals, policy makers, and developers. The researcher distributed the questionnaires and had them collected within a period of one week for analysis. The motorists who comprised the general public were distributed with the questionnaires where by the respondents randomly chose to participate from the traffic jam by assistance of research assistants who picked the questionnaires immediately after the respondents filled them.

3.8 Quality Control

For a questionnaire to provide useful results, questions must be valid and reliable.

The data collected was reliable as the researcher was personally involved in carrying out the research together with a few well trained research assistants to minimize or prevent errors from occurring. Respondents were asked to clarify their answers. Questionnaires were made very simple to understand and this greatly reduced chances of errors occurring.

3.9 Questionnaire Pre- Testing

To determine the effectiveness of survey questionnaires, it is necessary to pre-test it before actually using it. An undeclared pre-test was used to pre-test the interview since it allows the checking of the choice of analysis and the standardization of survey (Mutai, 2008).

3.10 Data Analysis and Presentation

Data analysis involves assigning meaning to the data collected (Gliner & Morgan, 2000). It involves working with data, organizing it, breaking it into manageable units, synthesizing it, searching for patterns, discovering what is important and what is to be learned and, deciding what will be reported (Connaway and Powell, 2010). The quantitative data obtained from the research was coded and keyed into the Statistical Package for Social Science (SPSS) analysis software, (Hair et al, 2011).The quantitative data analysis involved using descriptive statistics to obtain an understanding of the data. To facilitate this, graphs, tables and charts were used for easy understanding and describing the data.

3.11 Chapter Conclusion

This chapter focused on the research methodology. It briefly defines what a research methodology is. It defines the research design, types of research design, study area, .limitations, population, sample size and sampling techniques, types of data, data collection tools, data collection procedures, quality control, questionnaire, ethical considerations, and data analysis and presentation. The chapter also includes the research timetable.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings of the study established from the questionnaires and interview guide in determining urban traffic circulation management in Nairobi. This chapter also explains the findings in comparison with relevant literature as established by other authors in the same field of study. Descriptive and content analysis was used in this study due to the fact that the research instruments used were questionnaires and an interview guide.

4.2 Response Rate

From the data collected, out of the 300 questionnaires administered, 247 were filled and returned. This represents 82.3% response rate, which is considered satisfactory to make conclusions for the study. According to Mugenda and Mugenda (2003) a 50% response rate is adequate, 60% good and above 70% rate is very good. This also corroborates Bailey (2000) assertion that a response rate of 50% is adequate, while a response rate greater than 70% is very good. This implies that based on this assertion; the response rate in this case of 82.3% is very good.

This high response rate can be attributed to the data collection procedures, where the researcher pre-notified the potential participants and applied the drop and pick method where the questionnaires were picked at a later date to allow the respondents ample time to fill the questionnaires.

Table 4.1: Response Rate

Questionnaires administered	Questionnaires filled & returned	Percentage
300	247	82.3%

Source: Author, February, 2015

4.3 Demographic Information of Households and General Public

The study sought to find out the demographic information of the respondents which included gender of respondent; age of respondent; where the respondents live; the distance between their house and Upper Hill road; distance between house and place of work; mode of transport used; the time arrived at place of work/school/business; whether the means of transport is shared; whether they use one direct route or they change routes; how much time it takes when there is a change in routes; the time embarked on return journey to the house in the evening and time arrived at home and whether they experience any delay in transport system during traveling. The findings of the study are discussed in the subsections below.

4.3.1 Gender of Respondents

The study sought to determine the gender distribution of the respondents. The findings were presented in the figure below.

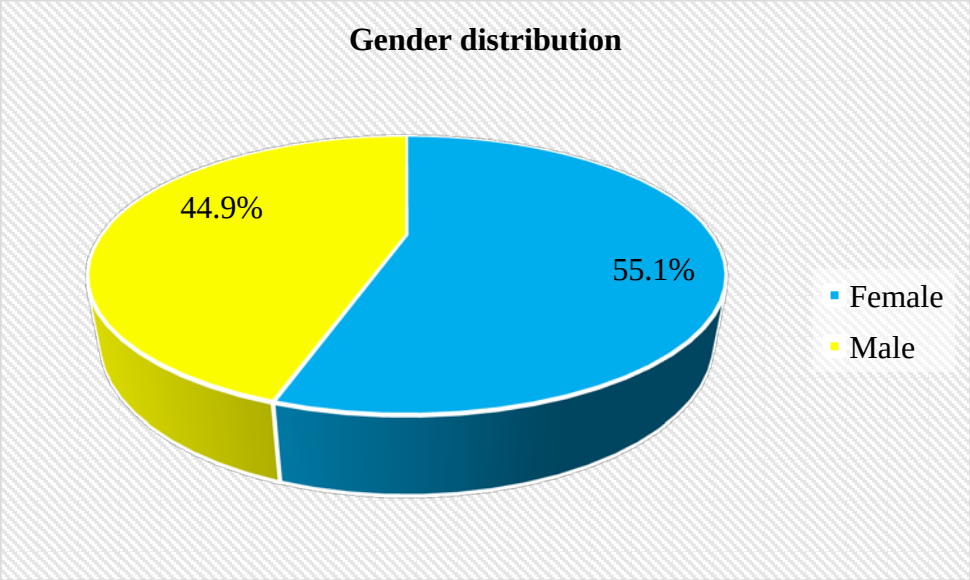


Figure 4.1: Gender of Respondents

From the findings presented in figure 4.1 above, the majority of the respondents 55.1% were females while 44.9% of the respondents were males. There was gender disparity among the respondents where by the females were willing to participate in the study more than the males. The findings suggest that there could be an attitude problem among the male drivers and that is why they probably could not respond to the request to participate in the study. Driver attitude has been known to be a traffic management problem which leads to accidents, congestion and other vices on the urban roads.

4.3.2 Age of Respondents

The study sought to determine the age bracket of the respondents. The findings were presented in the table below.

Table 4.2: Age of Respondents

Age bracket	Frequency	Percentage (%)
18-23 years	6	2.4
24-29 years	14	5.7
30-35 years	28	11.3

Age bracket	Frequency	Percentage (%)
36-40 years	57	23.1
41-45 years	76	30.8
46-50 years	28	11.3
51-55 years	11	4.5
56-60 years	9	3.6
61-65 years	14	5.7
above 65 years	4	1.6
Total	**247**	**100.0**

It is evident from the table above that the majority of the respondents (30.8%) were between the ages of 41-45 years. 23.1% of the respondents were between the ages of 36-40 years; 11.3% of the respondents were aged between 46-56 years and 30-35 years respectively; 4.5% of the respondents were aged between 51-55 years; 5.7% of the respondents were aged between 24-29 years and 61-65 years respectively; 3.6% of the respondents were aged between 56-60 years while 2.4% of the respondents were aged between 18-23 years and above 65 years accounted for 1.6% of the respondents.

4.3.3 Location Where Respondents Live

The study sought to determine where the respondents lived in order to estimate the distance between the participants house/work/business/school.

Table 4.3: Distance between House/Work/Business and Upper Hill

Distance between your house and Upper Hill	Frequency	Percentage (%)
1-5 km	86	34.8
6-10 km	32	13.0
11-15 km	20	8.1
16-20 km	49	19.8
21-25 km	29	11.7
26-30 km	20	8.1

Over 30 km	11	4.5
Total	**247**	**100.0**

The respondents indicated that they live within the areas of Jamuhuri estate, Karen, Ngong area, Woodlane, Kilimani, Ngumo, Mbagathi. According to 'Road distance between Nairobi Central and Upper Hill on the map, Upper Hill is located 4.5 kilometers by road west of the central business district of Nairobi.The coordinates of Upper Hill are:01 18 05S, 36 49 03E (Latitude:-1.3015; Longitude: 36.8175) (Google Maps).

The study further sought to establish the distance between the respondents' house and their place of work in kilometers (km). The respondents estimated the distance in respect to their house showing the distance from Jamuhuri estate to Upper Hill was 1.5 km; Karen to Upper Hill is estimated at 12 km; Ngong road area is estimated at 6 km; Woodlane is estimated at 3 km; Kilimani is estimated at 3.5 km; Ngumo is estimated at 11 km and Mbagathi is estimated at 8 km.

The study further sought to establish how often the respondents use Upper Hill roads on their way to work/home/business. The findings were tabulated as obtained on SPSS and interpreted below.

Table 4.4: How Often Do You Frequent Upper Hill Area?

How often do you frequent Upper Hill area?	**Frequency**	**Percentage (%)**
Daily	89	35.9
Weekly	45	18.1
Fortnightly	74	29.8
Monthly	13	5.2
Other (specify)	26	10.5
Total	**247**	**99.6**

It is evident from the findings in table 4.6 above that majority of the respondents (35.9%) use Upper Hill roads on a daily basis heading home/work/school or business place. 29.8% of the respondents indicated that they use Upper Hill roads on a fortnight basis; 18.1% of the respondents indicated that they use Upper Hill roads on a weekly basis; 10.5% of the respondents use Upper Hill roads on a varied frequency after two months, others on hourly basis while 5.2% of the respondents use Upper Hill roads on a monthly basis.

4.3.4 Estimate Distance between House and Place of Work/Business/School

The study sought to estimate the distance between their houses and places of work/businesses/schools. The findings were tabulated below in table 4.7.

Table 4.5: Estimated Distance Between House and Place of Work/Business/School

Estimated Distance	Frequency	Percentage (%)
1-5 km	48	19.4
6-10 km	51	20.6
11-15 km	47	19.0
16-20 km	101	40.9
Total	**247**	**100.0**

From the findings in the table above, the estimated distance for the majority of the respondents (40.9%) was 16-20 km. 20.6% of the respondents estimated the distance from their houses to work/business/school around 6-10 km; 19.4% of the respondents estimated the distance from their homes to workplace approximately 1-5 km while 19% of the respondents estimated the distance from their homes around 11-15 km.

The response form the respondents varied because the respondents lived and worked at different parts of Upper Hill and also away from Upper Hill. However, the respondents used Upper Hill roads to get to their desired destination.

4.3.5 Mode of Transport Used

The study sought to determine the mode of transport the respondents use while transiting along Upper Hill roads and the findings were categorized into two parts, namely, public transport and private personal transport. The findings were presented as per figure 4.3 below.

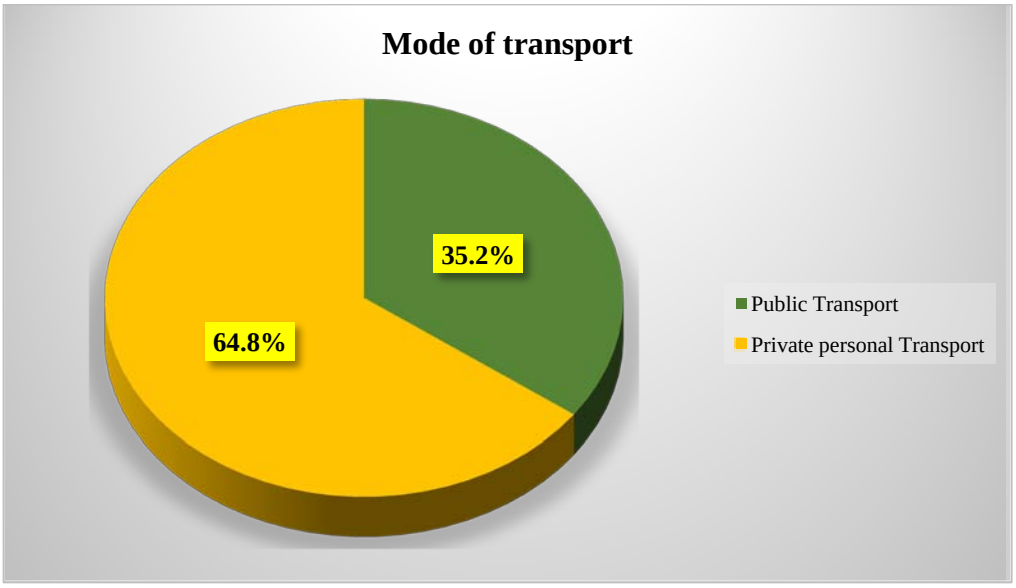


Figure 4.2: Mode of Transport

The findings in the figure above show the mode of transport that the households and the general public use in their daily transportation from house to work/school/business. The findings clearly depict that the majority of the respondents (64.8%) on Upper Hill roads use private/personal transport while 35.2% of the respondents use public transport means to their work/school/business.

4.3.6 Means of Transport

The study sought to determine the means of transport that the respondents use to their place of work/business/school. The findings were tabulated in the figure below.

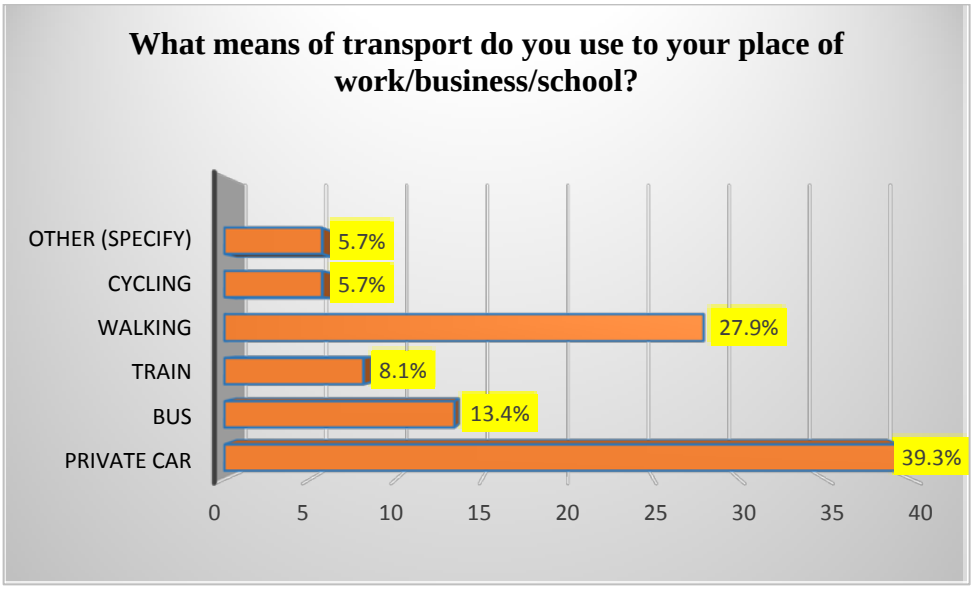


Figure 4.3: Means of Transport

From the findings in the figure above, the majority of the respondents (39.3%) indicated that their means of transport to work/business/school is via private car. 27.9% of the respondents indicated that they walk; 13.4% of the respondents indicated that they take a bus; 8.1% of the respondents indicated that they take a train from their homes to work place then commute through a bus to their place of work; 5.7% of the respondents indicated that they cycle to the place of work from their home and other respondents indicated that they take a taxi to work and others ride on motor bikes respectively.

4.3.7 Departure Time from Home and Time Arrived at Work/School/Business Place

The study sought to determine the time arrived at the place of work/school/business place. The findings of the study established that the arrival time to work/school and business place was dependent upon the time of departure an individual takes from his/her house. The study found out that at the wee hours of morning that is at 4 a.m. to 5:45a.m, the traffic jam on Upper Hill roads was manageable or sometime there was minimum traffic within these hours. Departure time from home at these hours enables the respondents to arrive to their desired destination on/in time that is 6.30am to 7:15 am also depending on where the respondents worked. The time between 6 am to 8 am also called the rush hours, experience

heavy traffic jam especially towards Nairobi city center. The respondents estimate the time they arrive at their desired destination at these hours to be 7:30 am to 9 am. Hence the study concludes that the best hours to travel via Upper Hill roads to work/school/business is 4 am to 5:45am. The respondents raised concern that these hours have been proved to be challenging especially to the children who have to wake up early to make it to school on time.

Table 4.6: Departure Time

Departure Time	Frequency	Percentage
5.00 am	86	34.8
5.30 am	50	20.2
6.00 am	33	13.4
6.30 am	61	24.7
others	17	6.9
Total	**247**	**100.0**

The findings show the departure time of the respondents from their homes to the workplace/school. The majority of the respondents (34.8%) indicated that they leave their homes at 5. 00 am. 24.7% of the respondents indicated that they depart from home at 6.30 am; 20.2% of the respondents indicated that they leave home at 5.30 am; 13.4% of the respondents indicated that they left home at around 6.00 am while 6.9% of the respondents indicated that they left home at other morning time from 7.00 am onwards.

The respondents also were required to indicate the time for arrival to their place of work/school and business. The findings were presented in the table below.

Table 4.7: Arrival Time

Arrival Time	Frequency	Percentage

6.00 am	141	57.1
6.30 am	105	42.5
7.30 am	1	0.4
Total	**247**	**100.0**

From the findings in the table above, the majority of the respondents (57.1%) indicated that they arrive at their place of work at around 6. 00 a m. 42.5% indicated that they arrive at their place of work at around 6.30 am and 0.4% indicated that they arrive at their workplace at around 7.30 am.

4.3.8 Means of Transport Shared

The study sought to establish whether the respondents share means of transport with others. The findings were presented in the figure below.

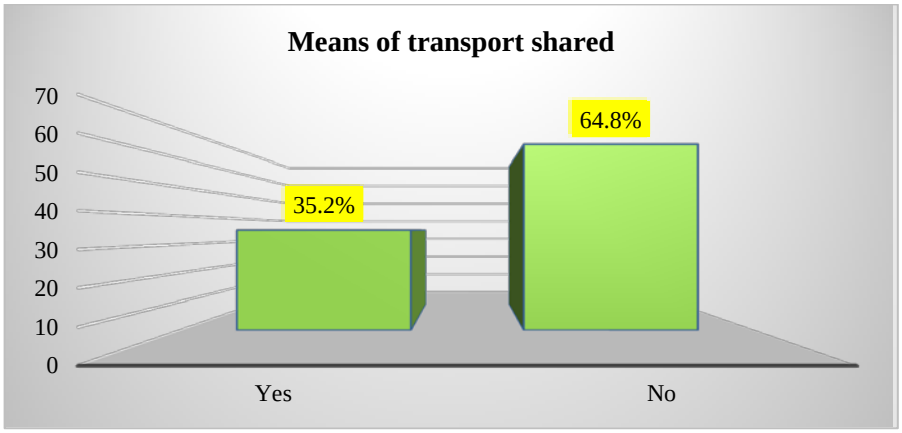


Figure 4.4: Means of Transport Shared

The findings in the above table illustrate that the majority of the respondents (64.8%) do not share their means of transport. This meant that other respondents had their own personal means of travel that they did not carry any passenger. However, 35.2% of the respondents

indicated yes, that the respondents had a means of transport that they shared. This was the case of public means of transport, where by it is shared by the general public.

4.3.9 One Direct Route/ Alternative Routes

The study sought to determine whether the public transport uses one direct route or whether they have an alternative route that they use. The study findings are presented in the figure below.

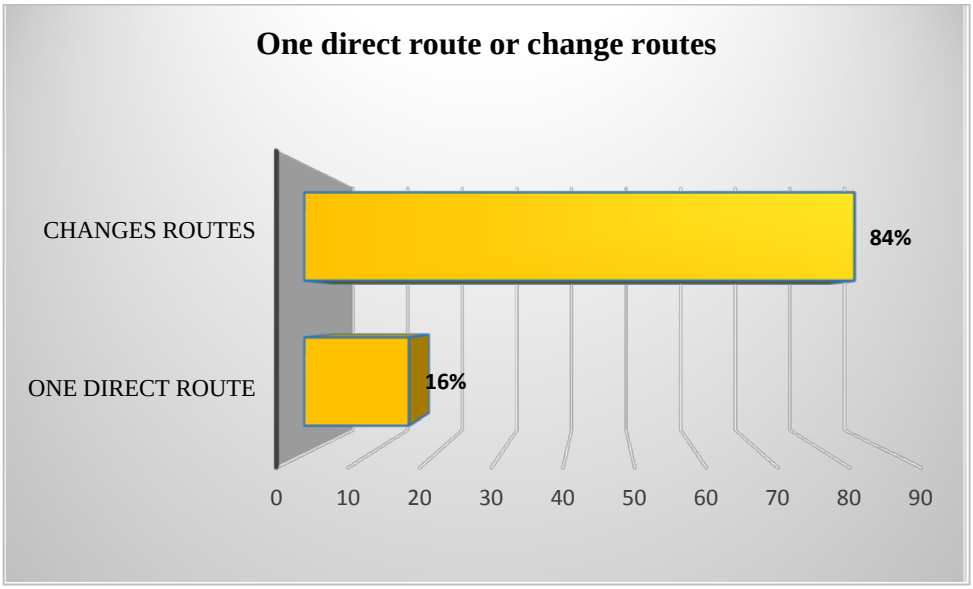


Figure 4.5: One Direct Route/ Alternative Routes

From the findings in the figure above, the majority of the respondents (84%) indicated that they change routes especially when traffic jam is unbearable. However, 16% of the respondents indicated that they use one direct route to and from the house. The change of routes depended on the knowledge of the routes that lead in and out of Upper Hill and also whether the alternative route has a history of immense traffic jam.

4.3.10 Time Taken When Changing Routes

The study sought to determine how much time it takes when there is a change in routes. The findings were presented in the figure below. The findings were presented depending on the desired destination of the respondents.

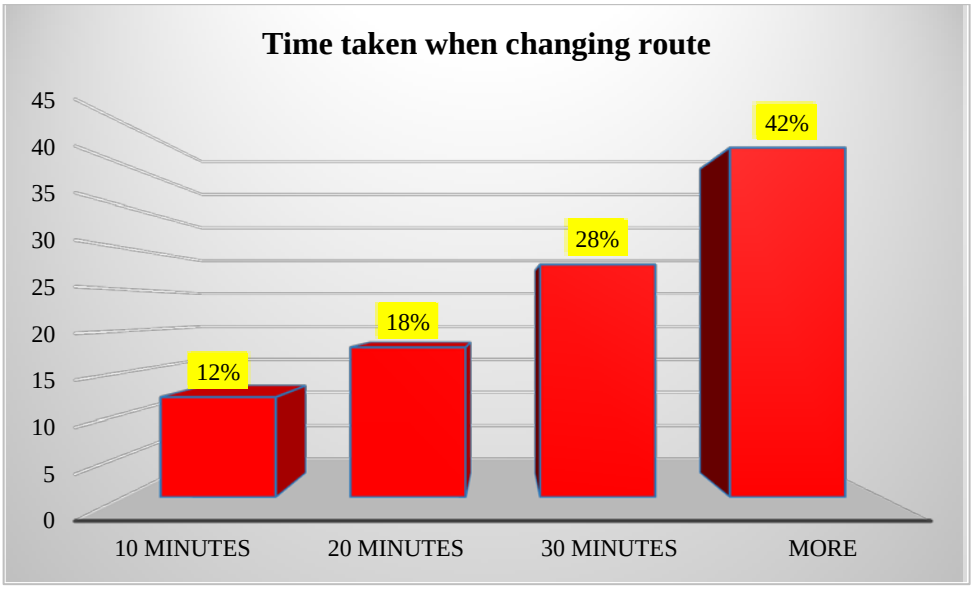


Figure 4.6: Time Taken When Changing Routes

The findings on the figure above show that the majority of the respondents (42%) take more time in changing routes rather than following the traffic jam. This indicated there was no difference in the change of routes, according to the respondents, in that the alternative roads are also notorious with traffic jam for example Ngong' road. 28% indicated that it takes 30 minutes when changing routes; 18% indicated that they take 20 minutes when changing routes while 12% of the respondents indicated that they take 10 minutes to the Nairobi CBD. The study findings were based on assumptions, depending on the time of departure from house and also depending on the distance from house to work/school/business. The *matatu* drivers were well knowledgeable about the alternative routes and they indicated that sometimes a change in route is inconveniencing to their business and that sometimes they make more trips to and from the Upper Hill to Nairobi CBD.

4.3.11 Time Embarked on Return Journey to House and Time Arrived

The study sought to determine the time embarked on return journey to the house in the evening and the time arrived at home also whether the respondents have experienced any delay in transport system during traveling. The study established that the time embarked on return journey to the house in the evening was around 5.00 pm to 6.00 pm. The time arrived at home in the evening was from 7.30 pm to 8.30 pm in the evening. This takes about 2 hours in the traffic jam especially in the rush hours returning home. However, some of the respondents indicated that sometimes they experience delays in the transport system during travelling such as long hours of waiting for means of transport; minimum means of transport in proportion to the number of people at the bus stops; hiking of fares in the event there is traffic jam along Upper Hill roads and also the change of routes by the public transport without consent form the passengers without regard to where they are alighting towards their destination.

4.4 Traffic Circulation Challenges in Upper Hill

The study sought to determine whether the traffic circulation challenges in Upper Hill influenced traffic situation prevalence and the findings are discussed below.

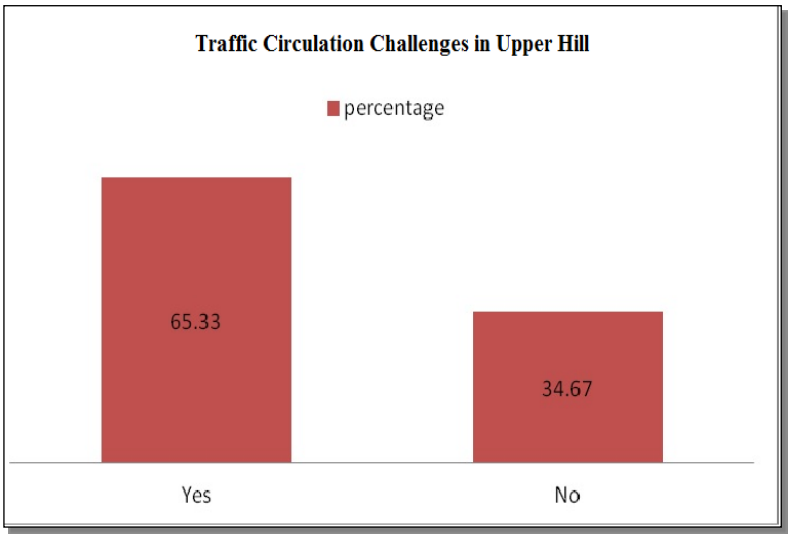


Figure 4.7: Traffic Circulation Challenges

The findings as depicted on figure 4.8 above confirms that majority of the respondents 65.33%, agreed traffic circulation challenges in Upper Hill influenced traffic situation prevalence. However, 34.67% disagreed with the statement that traffic circulation challenges in Upper Hill influenced traffic situation prevalence.

4.4.1 Traffic Circulation Challenges

The study sought to determine the extent to which the respondents rated some of the traffic circulation challenges experienced in the roads inUpper Hill. The respondents were requested to give their opinion in a Likert scale of 1-5 where: 1=Not at all; 2= Low extent; 3= Neutral; 4= Great extent and 5= Very great extent.

Table 4.8: Traffic Circulation Challenges

Statement	Not at all (%)	Low extent (%)	Neutral (%)	Great extent (%)	Greater extent (%)	Mean	SD
Traffic circulation challenges influence in traffic situation	3.4	5.7	11.5	39.1	40.2	4.07	0.654

From the findings majority of the respondents (40.2%) agreed to a very great extent that traffic circulations challenge in Upper Hill influenced the traffic situation with a mean of 4.07 and a standard deviation of 0.654.

The respondents were also asked to indicate whether they agree with certain identified traffic challenges. The responses are displayed in Table 4.9 below.

Table 4.9: Traffic Circulation Challenges

Statement	Strongly disagree (%)	disagree (%)	Neutral (%)	agree (%)	Strongly agree (%)	Mean	SD
Inadequate road capacity	6	7	8	29	37	3.97	1.215
Poor planning rules in cities and towns	4	4	14	24	41	4.08	1.112
Careless driving	0	6	28	24	29	3.87	0.962
Road accidents	1	8	2	35	41	4.23	0.961
Ineffective public transport and its poor network integration	0	11	15	29	32	3.94	1.027
Lack of transport demand measures such as parking policies	0	6	28	27	26	3.84	0.938

The findings depicted in the table above show that the respondents agreed that inadequate road capacity was one of the major challenges experienced in the management of traffic circulation in Upper Hill with a mean of 3.97. The respondents strongly agreed that poor planning rules in cities and towns is a major possible challenge experienced in the management of traffic circulation in Upper Hill with a mean of 4.08. The respondents agreed that careless driving contributed as a major possible challenge experienced in the management of traffic circulation in Upper Hill with a mean of 3.87; they strongly agreed that road accidents also is a possible challenge experienced in the management of traffic circulation in Upper Hill with a mean of 4.23; they agreed that ineffective public transport and its poor network integration is also a possible challenge experienced in the management of traffic circulation in Upper Hill with a mean of 3.94; they agreed further that lack of transport demand measures such as parking policies is a possible challenge experienced in the management of traffic circulation in Upper Hill with a mean of 3.84.

In the Interview Guide Professionals and Developers were asked questions on traffic circulation challenges. Their responses are discussed below.

4.4.2 Challenges of Traffic Flow

Some of the challenges indicated by the respondents point out that there is traffic congestion and parking difficulties. Congestion is one of the most prevalent transport problems in large urban agglomerations, usually above a threshold of about 1 million inhabitants. It is particularly linked with motorization and the diffusion of the automobile, which has increased the demand for transport infrastructures. However, the supply of infrastructures has often not been able to keep up with the growth of mobility. Since vehicles spend the majority of the time parked, motorization has expanded the demand for parking space, which has created space consumption problems particularly in central areas; the spatial imprint of parked vehicles is significant. Congestion and parking are also interrelated since looking for a parking space (called "cruising") creates additional delays and impairs local circulation. In central areas of large cities cruising may account for more than 10% of the local circulation as drivers can spend 20 minutes looking for a parking spot. This practice is

often judged more economically effective than using a paying off-street parking facility as the time spent looking for a free (or low cost) parking space as compensated by the monetary savings.

4.4.3. Longer commuting:

On par with congestion people are spending an increasing amount of time commuting between their residence and workplace. An important factor behind this trend is related to residential affordability as housing located further away from central areas (where most of the employment remains) is more affordable. Therefore, commuters are trading time for housing affordability.

The study found that inadequate road capacity, careless driving accidents, ineffective public transport and its poor network integration, lack of parking facilities and poor planning rules in the area as some of the factors contributing to the poor traffic circulation in the area.
It has also been established from the study that existing mechanisms and policies on traffic circulation are not effective in the area.

4.4.4 Public transport inadequacy

Many public transit systems, or parts of them, are either over or under used. During peak hours, crowdedness creates discomfort for users as the system copes with a temporary surge in demand. Low ridership makes many services financially unsustainable, particularly in suburban areas. In spite of significant subsidies and cross-financing almost every public transit systems cannot generate sufficient income to cover its operating and Capital Costs. While in the past deficits were deemed acceptable because of the essential service public transit was providing for urban mobility, its financial burden is increasingly controversial.

4.4.5 Difficulties for non-motorized transport

These difficulties are either the outcome of intense traffic, where the mobility of pedestrians, bicycles and vehicles is impaired, but also because of a blatant lack of consideration for pedestrians and bicycles in the physical design of infrastructures and facilities.

4.4.6 Loss of public space

The majority of roads are publicly owned and free of access. Increased traffic has adverse impacts on public activities which once crowded the streets such as markets, parades and processions, games, and community interactions. These have gradually disappeared to be replaced by automobiles. In many cases, these activities have shifted to shopping malls while in other cases, they have been abandoned altogether. Traffic flows influence the life and interactions of residents and their usage of street space. More traffic impedes social interactions and street activities. People tend to walk and cycle less when traffic is high.

4.4.7 High maintenance costs

Cities with an aging of their transport infrastructure are facing growing maintenance costs as well as pressures to upgrade to more modern infrastructure. In addition to the involved costs, maintenance and repair activities create circulation disruptions. Delayed maintenance is rather common since it conveys the benefit of keeping current costs low, but at the expense of higher future costs and on some occasions the risk of infrastructure failure. The more extensive the road and highway network, the higher the maintenance cost and the financial burden.

4.4.8 Environmental impacts and energy consumption

Pollution, including noise, generated by circulation has become a serious impediment to the quality of life and even the health of urban populations. Further, energy consumption by urban transportation has dramatically increased and so the dependency on petroleum. Yet, peak oil considerations are increasingly linked with peak mobility expectations were high

energy prices incite a shift towards more efficient and sustainable forms of urban transportation, namely public transit.

4.4.9 Accidents and safety:

Growing traffic in urban areas is linked with a growing number of accidents and fatalities, especially in developing countries. Accidents account for a significant share of recurring delays. As traffic increases, people feel less safe to use the streets.

4.4.10a Land consumption:

The territorial imprint of transportation is significant, particularly for the automobile. According to National Land Commission (2013), between 30 and 60% of a metropolitan area may be devoted to transportation, an outcome of the over-reliance on some forms of urban transportation. Yet, this land consumption also underlines the strategic importance of transportation in the economic and social welfare of cities.

4.4.10b Freight distribution:

Globalization and the materialization of the economy have resulted in growing quantities of freight moving within cities. As freight traffic commonly shares infrastructures with the circulation of passengers, the mobility of freight in urban areas has become increasingly problematic. City logistics strategies can be established to mitigate the variety of challenges faced by urban freight distribution.

Cities are locations having a high level of accumulation and concentration of economic activities and are complex spatial structures that are supported by transport systems; the larger the city the greater its complexity and the potential for disruptions; particularly when this complexity is not effectively managed. The most important transport problems are often related to urban areas and take place when transport systems, for a variety of reasons, cannot satisfy the numerous requirements of urban mobility. Urban productivity is highly dependent on the efficiency of its transport system to move labor, consumers and freight

between multiple origins and destinations. Additionally, important transport terminals such as ports, airports, and rail yards are located within urban areas, contributing to a specific array of problems. Some problems are ancient, like congestion, while others are new like urban freight distribution or environmental impacts.

4.5 Causes of Traffic Flow Challenges

The study required the interviewees to indicate some of the possible causes of traffic flow challenges in an urban area setting. The response of the interviewees showed that there are various factors which make traffic flow management challenging urban parts in Nairobi area. The most dominant factors are the ongoing urbanization which is taking place in both medium-sized and larger cities, the rapid motorization of some parts of the urban society and the poor transport infrastructure and services.

4.5.1. Rapid Urbanization

The migration levels from rural and urban to urban areas usually for employment purposes, is increasing rapidly and therefore a city as Nairobi faces a tremendous population growth. This has resulted in rapidly expanding cities with a low population density, causing long travel distances and fierce competition for limited space, particularly road space.

4.5.2. High Rate of Motorization

Despite the fact that the majority of urban dwellers are low income earners and depending on walking, cycling and low cost transport, expanding cities and high population size have led to the increase in demand for transport services. The privatized public transport sector, however, can't cope with the increasing number of passengers and it is competing with increasing numbers of private vehicles both cars and motorcycles which has already led to permanent traffic congestion in some cities.

4.5.3 Lack of Infrastructure, Enforcement, Management and Regulation

Lack of infrastructure beside road space also traffic lights, speeding controls and other ITS, poor enforcement of traffic laws and the absence of an efficient management of parking are all contributing to the traffic congestion problem in urban areas. This is accentuated by a lack of institutional knowledge and capacities on traffic management, a culture of disregard for and poor enforcement of weak regulations as well as poor road maintenance often resulting in the ubiquitous pot holed roads.

Research shows that there is a definite consensus that congestion is caused by several factors. First lack of planning was found to be the main cause of traffic congestion. This is supported by Heggie and Vickers (2008) who found that planning is important in managing traffic congestion. (Karuga, 2003) makes reference to deficiency in long-term vision as a cause of traffic congestion. Lack of planning was an issue in Europe almost 40 years ago Owen (1964). One could term the research response of "too many vehicles" as part and parcel of lack of planning.

Laxity in law enforcement of traffic offenders was also cited as another cause of congestion. This cause however was only identified in studies done in African cities hence it would appear to be localized.

The second major cause of traffic congestion as revealed by research is the absence of traffic lights. The literature review does not specifically refer to this factor as a cause of traffic congestion though as noted by Masetori (2008) this aspect would fall under lack of efficient traffic management policies. The third major cause was double-parking. One can safely deduce that double-parking is as a result of lack of adequate parking. However, Omwenga (2004) attributes it to indiscipline which is also cited as another cause of traffic congestion. Grant (1997) argues that motorist double park due to lack of adequate parking space and not due to indiscipline. He attributes the inadequate parking space to lack of funds for constructing parking spaces. The study also revealed that there was inadequate parking in new buildings which can also be attributed to poor planning. The shortage of parking space has led to parking boys levying fees to preserve parking space for those who are willing to

pay a premium to secure parking space. This seems to be a localized problem. Other identified causes of traffic congestion are; “matatus”, undisciplined motorists, and common office ‘rush’ hours. Malombe (2004) cites non-adherence to and enforcement of traffic regulations while Masetori (2008) makes reference to habitual law breaking particularly by public service vehicles. The differences in these issues may be because the research confined itself to the CBD as opposed to the entire city. Accordingly, the research findings did not find any reference to unreliable public transport or lack of school transport as causes of traffic congestion.

4.5.4 Resolutions to Challenges Experienced in Traffic Flow

The respondents were required to indicate some of the resolutions to the challenges experienced in traffic flow. The responses revealed that the first possible tenacity is to make city authorities aware of the importance of efficient, affordable mass transit and non-motorized transport as a means of ensuring traffic flow and economic growth. Secondly, it is necessary to provide governments with knowledge of how to implement cost-effective models that result in a maximum of environmental, social and economic benefits. These models will have to be able to address: ineffective public transport and its poor network integration; the lack of transport demand measures (i.e. parking policies, road pricing); the poor quality of cycling and walking infrastructure and the lack of integrated land use policies (to reduce travel distances and demand). An ‘Avoid-Shift-Improve’ approach could provide the opportunity to “leapfrog” to a transport system that provides efficient, convenient and attractive alternatives to the private car. However, there will be limitations such as political, technical and financial barriers to overcome in the country generally.

Traffic Flow Management Policy Framework

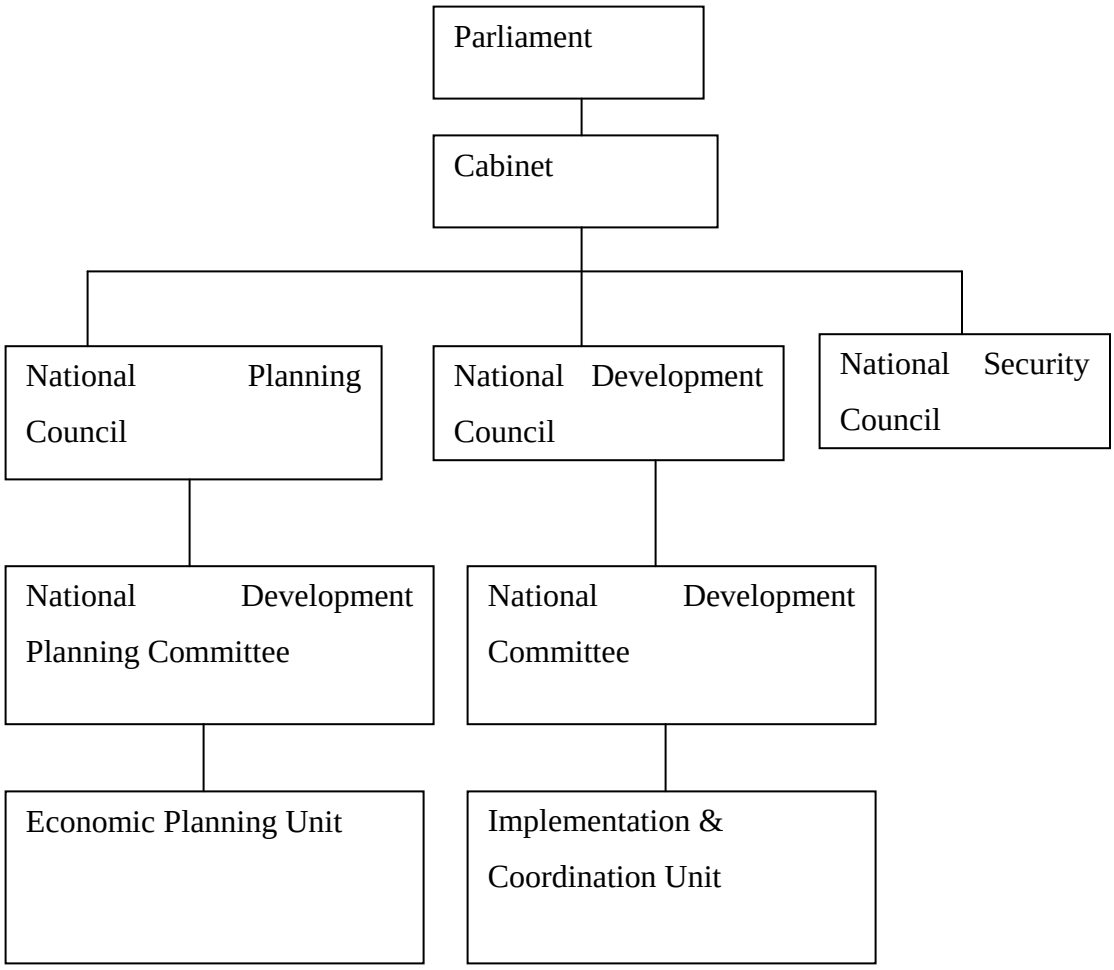


Figure 4.8: Traffic Flow Management Policy Framework

Source: Economic Planning Unit (2002)

The transportation planning and management system is made of various public and private actors. The issues and problems faced by the planning and management systems include lack of coordination between institutions, insufficient capacity and capability to carry out planning at appropriate scales (e.g. local, regional and national), enforcement problems, problems with private sector "profit maximizing" interests, incentives by both government and private companies that promote private auto use. The following describes in greater detail the background and issues for transportation planning and management system. At present, a range of public and private institutions have responsibilities for transportation for

the Upper Hill Nairobi Area. Kenyan Police have a role to play in maintaining law and order.

Economic Planning Unit carries out the following major functions in urban transport: formulates objectives, policies and strategies in development planning; plans the five-year development plans; coordinates and prepares the development budget for the five-year plans and coordinates the privatization program. Ministry of Transport and Infrastructure carries out these major functions: updates the revenue collection system; registers and license drivers of motor vehicles; ensures that motor vehicles are roadworthy; focuses on road safety issues and reduces the rate of road accidents and maintains records of information pertaining to motor vehicles and drivers.

Public Works Department develops plans, designs and constructs infrastructure projects, mainly roads, water supplies, government buildings, airports, ports and jetties. It also operates and maintains roads, water supplies and certain government buildings and provides technical advice to the Government at federal, state and district levels. Highway Planning Unit conducts periodical traffic count surveys and issue an annual report on traffic volume; formulates national road and network system plan and program and assists state government and other agencies.

Kenya National Highways Authority supervises and executes the design, construction and maintenance of highways as determined by the Government; supervises and executes the design and construction of the rest and service areas and other facilities that may be deemed necessary along highways; it collects toll from the users of the highways and other dues from the utilization of other facilities along the highways and it plans and conducts research to ensure the efficient utilization and other facilities.

Commercial Vehicle Licensing Board processes and issue and licenses of all classes of commercial vehicles in Kenya (including condition of licenses); determines the terms and conditions attached to all cases of commercial vehicle licenses issued (fares, operation area,

passenger capacity or type of goods, maximum load weight) and formulates policies, roles and regulations pertaining to licensing of commercial vehicles, and monitor their impact on the efficiency of the road transport industry.

The transport sector in Kenya encompasses a transport system comprising of road, rail, and air and maritime. The sector is crucial in the promotion of socio-economic activities and development since an efficient and effective, transport system is a mainspring for rapid and sustained development in terms of national, regional and international integration, trade facilitation, poverty reduction and improvement of welfare of the citizen. The Ministry has two Departments, namely, State Department of Transport and State Department of Infrastructure.

State Department of Transport plans and conducts research on the development of an urban transportation system that covers public and highway transportation system; designs and implements urban transportation projects financed by the government (bus/taxi stops, terminals for city buses and inter-town express buses and taxis) and coordinates and manages public transport facilities and services financed by the government through Nairobi City County.

State Department of Infrastructure plans, designs and implements road projects; coordinates with private agencies in the planning and development of road system and traffic management in Nairobi City; improves on road designs and to increase road capacity to cater to the needs of the increasing traffic volume; plans and implements traffic management schemes to improve traffic flow; maintains road networks to specific standards for the safety and comfort of road users; minimizes road accidents and contribute towards a healthy environment, improve public transportation and promote pedestrian traffic.

4.6 Existing Policy, Regulatory and Institutional Mechanisms

The study sought to determine the existing policy, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill, Nairobi.

4.6.1 Effect of Existing Policy on Traffic Circulation

The study sought to determine whether the existing policies, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill have an effect on the traffic circulation. The findings were discussed below.

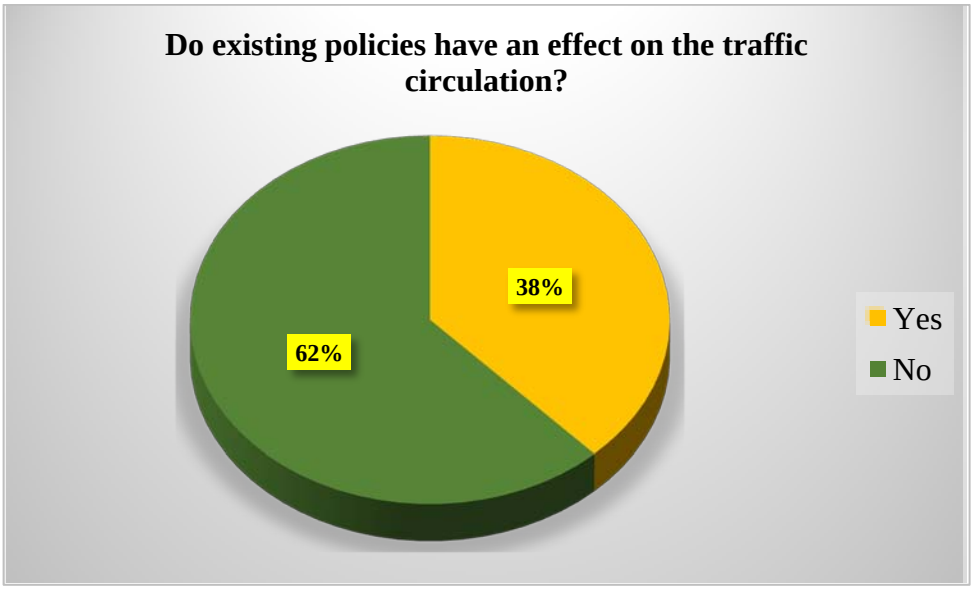


Figure 4.9: Effect of Existing Policy on Traffic Circulation

It is evident from the figure above that the majority of the respondents (62%) have an opinion that the existing policies, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill do not have an effect on the traffic circulation. While 38% of the respondents indicated that the existing policies, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill have an effect on the traffic circulation.

The study went further to investigate how the existing policies, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill have an effect on the traffic circulation. The existing policies, regulatory and institutional mechanisms facilitate for Traffic control devices in that there is traffic signals for road intersections; traffic circulation and management holds for capacity and capability building for traffic enforcement; geometric improvements to support signalization and roundabouts and adopt standard road signs and markings. The existing policies facilitate for pedestrian users such as sidewalk clearing, removing obstructions, including merchandise, construction and materials, etc. to clear space for pedestrians also road markings for pedestrian crosswalks–zebra markings for un-signalized, intersections or mid-blocks and parallel lanes for signalized intersections.

4.6.2 Extent of Existing Policy on Traffic Circulation

The study sought to determine the extent to which the existing policies, regulatory and institutional mechanisms are effective in the management of traffic circulation in Nairobi. The findings were presented in the figure below.

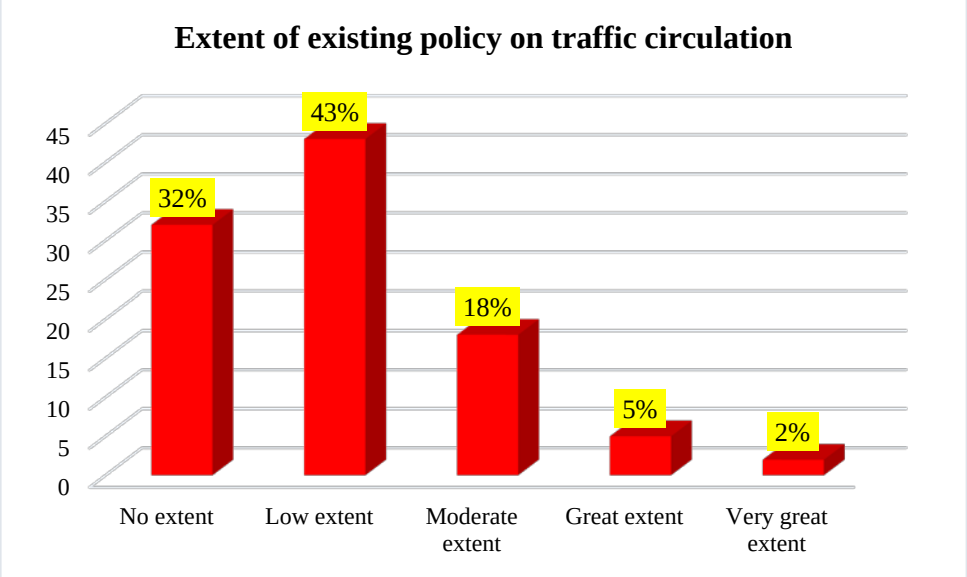


Figure 4.10a: Extent of Existing Policy on Traffic Circulation

The findings in figure 4.10 show that the majority of the respondents (43%) indicated that the existing policies, regulatory and institutional mechanisms were to a low extent effective in the management of traffic circulation in Upper Hill while 32% of the respondents indicated that the existing policies, regulatory and institutional mechanisms had no effect to no extent in the management of traffic circulation in Upper Hill. On the other hand 18% of the respondents indicated that the existing policies, regulatory and institutional mechanisms were moderately effective in the management of traffic circulation in Upper Hill. However 5% of the respondents indicated that the existing policies, regulatory and institutional mechanisms are to a great extent effective in the management of traffic circulation in Upper Hill while 2% of the respondents indicated that the existing policies, regulatory and institutional mechanisms are to a very great extent effective in the management of traffic circulation in Upper Hill.

The study provided a list of existing policy, regulatory and institutional mechanisms for the management of traffic circulation in Nairobi. The respondents were required to indicate the extent to which the following policies apply in the management of traffic circulation in Nairobi. The findings were presented in the table below.

Table 4.10a: Extent of Existing Policy on Traffic Circulation

Statement	Very great extent (%)	Great extent (%)	Moderate (%)	Low extent (%)	No extent (%)	Mean	SD
Adoption of intelligent transport system (ITS) e.g. over speeding video detectors	8	37	29	7	6	4.28	1.241
A proper public transportation system, integrating rail, road and water	14	41	24	4	4	3.98	1.321
Adequate and regular maintenance of road and road infrastructure	6	29	28	24	0	4.02	1.203

Statement	Very great extent (%)	Great extent (%)	Moderate (%)	Low extent (%)	No extent (%)	Mean	SD
Punitive measures against transport law and policy offenders	35	41	8	2	1	4.51	1.061
Transport and traffic education, especially on urban roads for commuters, drivers and other road users	0	29	35	11	15	3.52	1.025
Integrated and coordinated inter and multi-modal transport system involving road and rail transport	0	28	26	27	6	4.11	1.254
Involvement of private transporters and stake holders in public transportation in transport sector policy formulation	6	35	21	19	9	3.76	1.046
Effective clear-cut institutional arrangement on road transport management	5	7	12	24	39	3.81	1.641
Complete separation of vehicles e.g. separate lanes for freight/goods transport	9	12	14	20	32	4.25	1.045

The findings on table 4.6 above show that the respondents rated the adoption of intelligent transport system (ITS) e.g. over speeding video detectors to a great extent with a mean of 4.28. The respondents rated that a proper public transportation system, integrating rail, road and water to a great extent with a mean of 3.98; the respondents rated adequate and regular maintenance of road and road infrastructure to a great extent with a mean of 4.02; the respondents agreed

4.6.3 Effectiveness of Existing Mechanisms

The study sought to determine how the respondents would rate the effectiveness of the existing mechanisms in the management of traffic circulation in Upper Hill. The findings were obtained and presented in the figure below.

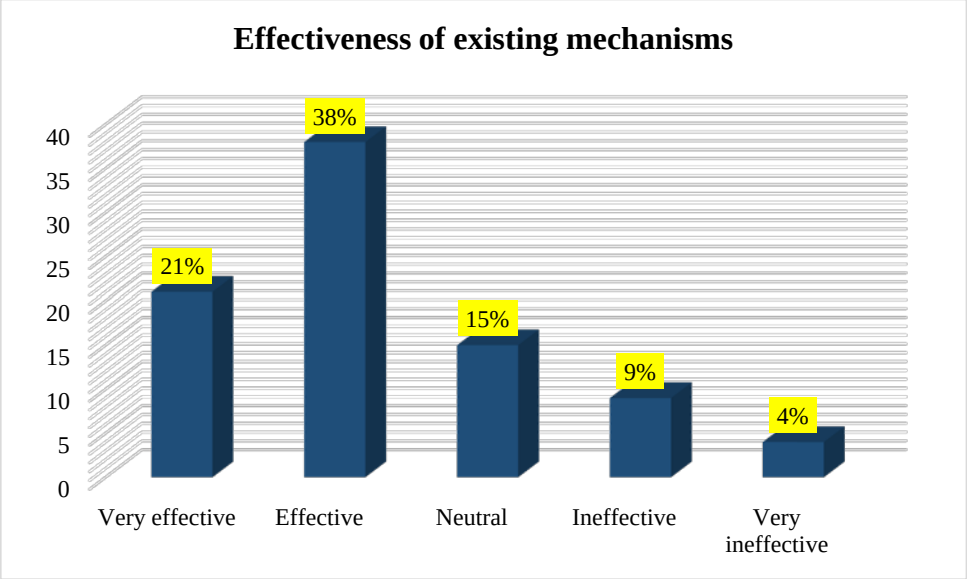


Figure 4.10b: Effectiveness of Existing Mechanisms

The findings in the figure above show that the majority of the respondents (38%) indicate that the existing mechanisms in the management of traffic circulation in Upper Hill was effective though it is not fully implemented as it is supposed to function. About 21% of the respondents indicated that the mechanisms in the management of traffic circulation in Upper Hill are very effective if they were fully implemented to carry out the function meant to mitigate urban traffic. However, 15% of the respondents indicated that they were neutral about the mechanisms in place to manage urban traffic in Upper Hill and these respondents indicated that they were not familiar with the existing mechanisms in the management of urban traffic. Lastly 9% of the respondents admitted that the mechanisms were ineffective and 4% of the other respondents also indicated that the mechanisms are not effective at all. The respondents further added that the mechanisms are not effective because they have

never been functional to reduce, mitigate or even control the urban traffic experienced at Upper Hill road.

4.7 Measures to Enhance Traffic Circulation Management in Upper Hill Area

The study sought to determine the measures to enhance traffic circulation management in Upper Hill area. Below is a list of possible measures to enhance traffic circulation management in Upper Hill area. The respondents were required to rate the measures to the extent to which they agree with the given statements.

Table 4.10b: Measures to Enhance Traffic Circulation Management

Statement	Strongly disagree (%)	disagree (%)	Neutral (%)	agree (%)	Strongly agree (%)	Mean	SD
Strict traffic enforcement by the police	6	7	8	29	37	3.67	1.105
Covert two way to one way	4	4	14	24	41	4.35	1.012
Restrict parking on roads	0	6	28	24	29	3.74	0.912
Procedures for reporting accidents and non-conformities	1	8	2	35	41	4.35	0.621
Procedures to prepare for and respond to emergency situations	0	11	15	29	32	3.87	1.247
Designate leaves according to the type of vehicle	0	6	28	27	26	3.69	0.138
Improve street lighting	4	8	28	35	12	3.59	0.249
Providing road dividers	5	6	10	34	32	3.02	1.341
Safe crossing points	4	3	32	16	32	3.91	1.325

From the table we can see that most respondents with a mean value of 4.35 prefer the conversion of the two way roads to one way.

4.8 Factors Enhancing Traffic Circulation Management

4.8.1 Improving Traffic Operations

The professionals and developers respondents indicated that traffic flow improvements represent those actions that can be implemented to enhance the person-carrying capability of the roadway system, without adding significantly to the width of the roadway. The range of roadway facility actions available generally fall under two classifications. Actions primarily oriented to urban freeways or expressways, and the second oriented to arterial and local streets. Most traffic flow improvements are implemented with a focus on the peak period work trip. However, for many of these actions such as the improvement of arterial signal systems, their applicability could as easily be expanded to include traffic conditions throughout the day.

Traffic flow operations consist of several types of roadway improvement projects. Converting two-way streets to one-way operation improves corridor travel times and increases roadway capacity by eliminating opposing left turn lanes and providing for better signal coordination. Particularly in many downtown areas where the width of roadways may be inadequate for two-way traffic plus parking and goods delivery, converting to one-way operation and especially in conjunction with other streets to develop a grid circulation pattern can be very beneficial in terms of improving the overall effectiveness of the system.
Two-way street left turn restrictions is a means of eliminating conflicts with left turn movements, thereby reduce congestion and delay for peak periods or throughout the day. At selected locations where heavy volumes of traffic provide few gaps for left turning movements, the restriction can dramatically reduce queuing and improve the overall capacity of the intersection by as much as 25 to 30 percent.

Continuous median strip turn lanes separate turning vehicles from through traffic by providing a "storage" lane separate from the movement of through vehicles. Where the roadway width permits, the median lane layout can provide overall capacity (and safety) improvements for an arterial corridor that are similar in scale to turning restrictions at an intersection.

Channelized roadway and intersections improves vehicular flow and capacity by clearly marking with striping and signage travel lanes and paths to reduce motorist confusion and uncertainty by channeling traffic in the proper position of the street. They also serve as a "barrier" for opposing streams of traffic.

Roadway and intersection widening and reconstruction may reduce bottlenecks along sections where traffic capacity is below that of the adjacent street. Roadway and intersection widening and reconstruction represents a host of traffic flow devices such as improved design, traffic islands, turning lanes and signage to improve the flow of vehicles and the safety of pedestrians. These measures, among other benefits, help to reduce the number of conflict points among vehicles and help to control the relative speed of vehicles both entering and leaving an intersection.

The primary objective for improving traffic flow operations is to enhance the efficiency of the existing roadway system and therefore to alleviate traffic congestion and related problems such as air pollution. The limitation to improving traffic flow operations include financial difficulties in supporting new major transportation projects, and the environmental and physical constraints associated with new infrastructure construction. Moreover, there has been a growing recognition that implementing programs consisting of several interrelated traffic flow enhancement strategies can lead to substantial reductions in travel time and delay.

4.9 Proposed Land Use Plan for Traffic Management in Upper Hill

Figure 6.2 (see appendix) shows the land use zoning plan for the study area andgives details of proposed road networks. The plan is making several proposals on the road networks in the study area. For instance the plan is proposing the widening of the major roads to a 40M width. These include Lower Hill Road, Upper Hill Road, Ragati Road, Chyulu Road Mara Road, Elgon Road and Hospital Road. The plan also proposes the widening of other roads to 30M. This will require certain landowners to surrender part of their plots as shown in the following table. From the table we can see that 45 plots will be affected with the size of land to be affected totaling to about 2.5 Hectares (about 6 Acres). This size of land could be

affordable but some of the plots are already built to the road boundaries thereby taking land from them may mean altering the buildings and this may lead to insurmountable costs in the road widening scheme. Therefore the feasibility of this scheme is not promising. It may be imperative to carry out a feasibility study to establish for sure whether this scheme is well informed.

Table 4.10c: Hill Area Zoning Plan—Land Areas to be Excised to Facilitate the Proposed Widening of Roads

Serial No	L.R No	Area in Sq. Metres	Serial No	L.R No	Area in Sq. Metres
1.	209/1069	204.55	24.	209/5012	1376.35
2.	209/1066	146	25.	209/5013	1308
3.	209/1065	135.32	26.	209/1731/1	773.84
4.	209/1064/1	112.377	27.	209/1796/2	107.33
5.	209/1063	128.15	28.	209/1796/3	523.77
6.	209/1132/2	110.64	29.	209/1461	73.78
7.	209/1132/1	25.39	30.	209/11408	387.42
8.	209/5847	478.01	31.	209/6747	353.50
9.	209/5848	88.42	32.	209/3861/1	282.76
10.	209/5789/3	105.	33.	209/16508	234.07
11.	209/5789/2	158.02	34.	209/8789/1	603.67
12.	209/5775/2	1415	35.	209/8789/2	345.22
13.	209/2473	1186.77	36.	209/5390	250.03
14.	209/290/4/2	452.57	37.	209/7210	480
15.	209/290/4/1	852.57	38.	209/1522/3	837.88
16.	209/10167/2	2479.16	39.	209/1522/2	1374.95
17.	209/8411	1892.0	40.	209/7199	1357.24
18.	209/296/1	484.77	41.	209/346/48	109.07

Serial No	L.R No	Area in Sq. Metres	Serial No	L.R No	Area in Sq. Metres
19.	209/297	379.98	42.	209/346/40	296.0
20.	209/6843/3	381.72	43.	209/359/13	101.53
21.	209/13920	232.13	44.	209/359/14	208.45
22.	209/13332	831.15	45.	209/359/21	36.87
23.	209/5775/1	1045.56		**Total**	**24746.99**

Source: Department of physical planning, Ministry of Lands Housing and Urban Development

Secondly the zoning plan proposes 40M wide link roads that would connect the study area to its backside. Currently Upper Hill is like a cul de sac where roads run in from the Haile Selassie Avenue-Ngong Road continuum and out of the same. There is no through road; the road network is circular from Lower Hill Road on the lower side to Hospital Hill Road on the upper side. For this reason the plan proposes two link roads to the backside; one that would link Mabagathi Way with Hospital Road on the northern side and another that would link Masaba Road with Matumbato Road. This in itself may not be a bad idea because Upper Hill area is a sort of cul de sac; all traffic from Langata Roads and Mbagathi Way have to circle around to access the study area through Uhuru Highway or Ngong Road thereby causing a lot of congestion in Nyayo Stadium and City Mortuary roundabouts respectively. Nevertheless the creation of link roads will also encourage through traffic in the area and lead to more congestion especially now that motorists cannot access Langata Road through Nyayo Stadium Roundabout due to the No-Right-Turn policy.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This final chapter discusses the findings of the study and maps out a general conclusion of these findings. Within the summary, attempts are made to integrate the findings from other related studies. The chapter consists of a summary of research findings, conclusion and recommendations. Towards the end, more recommendations for further research are presented.

5.2 Summary of study Findings

This study had a few objectives all leading to understanding the characteristics of traffic circulation in Upper Hill area; assess the existing policy, regulatory and institutional mechanisms for management of traffic circulation; effectiveness of the existing policies, regulatory and institutional mechanisms in the management of traffic and recommendations geared towards the enhancement of traffic circulation management in Upper Hill area. The main objective of the study is to improve the management of traffic circulation by taking a case study of Upper Hill, Nairobi

The study found that inadequate road capacity, careless driving, accidents, poor attitude among drivers, ineffective public transport and its poor network integration, lack of parking facilities and poor planning rules in the area as some of the factors contributing to the poor traffic circulation in the area.

It has also been established from the study that existing mechanisms and policies on traffic circulation are not effective in the area.

The study further established that there are no traffic lights and cameras used to control traffic in Upper Hill. This shows that the technology has not been properly integrated in the management of traffic circulation in the study area.

The study found out that a big number of people working in Upper Hill prefer to stay near their place of work. This category represents most of the middle class people who work for companies which have recently relocated to Upper Hill owing to the development of offices in this area.

There is also a group of people who prefer staying far from their place of work and this category represents employees who would like to be where they can afford housing and other living conditions and would not mind commuting long journeys. Those who use train are few as compared with those who use buses and those walking to their place of work while the majority prefers private means of transport.

5.3 Conclusion

Traffic management in cities of developing countries is crucial for sustainable development as it helps in the movement of people and goods. The research found out that the number of private vehicles passing through Upper Hill is huge and this scenario applies to other parts of the city which are undergoing redevelopment. Such areas of the City include Parklands, Ngara, Pangani, Kileleshwa, Lavington and Kilimani. This is posing a challenge to the efficient movement of goods and people.

Increase in traffic is also causing air, noise and environmental pollution which affect sustainable development. This trend indicates that traffic management in Nairobi is going to worsen and an active approach must be adopted as vehicle ownership is increasing and on the other hand little is being done to improve the infrastructure for sustainability. Projects in the city generate and attract traffic as most of the activities are concentrated in the city centre and its environment like Upper Hill which is an extension of the CBD. Decentralization of activities to the Metropolitan parts of the City and other towns will help develop them as well as ease congestion.

The shortage of parking space in Upper Hill is on the increase and this affects the smooth flow of traffic when motorists want to access services like banks, shops, medical facilities, social institutions and Government offices which are located here. The parking infrastructure is failing to curb the huge increase in traffic in the study area hence the entire City. Public transport still plays a crucial role in the movement of people in Nairobi like in other cities of developing countries and this is mainly provided by the private sector in form of buses, minibuses, taxis and motor cycles *(bodaboda*). The operation of these private public transporters causes a lot of accidents, traffic congestion and bad commotion in the city.

5.4 Recommendations

Recommendations for Efficient Traffic Flow Management

In order to improve traffic circulation in the area, the study recommends that the narrow road network should be widened and their design improved to facilitate smooth flow of traffic. This can be achieved through enforcement of policy and regulation. For instance there is already an approved land use zoning plan which requires implementation to facilitate availability of public space for road widening, pedestrian walkways, cyclist lanes and off-street parking.

Other measures that the study can recommend include**,** improved pedestrian and cycling network designs which are cost effective, parking management solutions, enforcement of public transport policies, road accident detection and prevention mechanisms, designing clear, safe and frequent crossing points, proper and clear road signals and working traffic lights, and use of roundabouts to reduce traffic jams and collisions at intersections. The removal of roundabouts need to be applied at intersections upon careful study as this action has been seen to aggravate the situation on some roads as recently witnessed along Uhuru highway at Bunyala road junction as a trial remedial action by Nairobi City County.

Legislation must be put in place for urban traffic management as a way of promoting sustainable development and protecting the environment.

In order to reduce congestion it is important to reduce the use of private car. Figure 4.2 showed that 64.8 percent of respondents use private means as opposed to public transport. Additionally Figure 4.2 showed that the same percentage (64.8) do not share transport meaning that the private motorists do not share their cars with others; even with family members. This could be the major cause of congestion. Therefore it is important to encourage public transport in the area by providing wide roads, bus stops and giving priority to buses.

In terms of mode of transport, the use of the train is limited especially because the rail line passes by the closed back of the study area. With the proposals to open roads to the closed back it is possible to ease the traffic congestion by encouraging the use of non-road based modes of transport by introducing a light rail service to serve the area. Using the modal-split concept the pedestrians could connect to their destinations using internally circulating public road transport. Currently only 8.1 percent, according to Figure 4.3, use train may be from other destinations but reach the area through road. For example two train stations could be built one at the crossing between Bunyala Road and the Railway just near the Commonwealth war graves. The other station could be built at the end of Kiambere road opposite Madaraka Estate.

In order to curb congestion arising from traffic offenders it is recommended that ITS be used as suggested by majority of the respondents in Table 4.10 where the system got the highest mean of 4.28 as an option.

At the junctions where roads like Upper Hill and Ragati meet Haileselassie Avenue, the study recommends that this being the exit from Upper Hill, new infrastructure like underpasses and overpasses should be constructed to reduce conflict experienced at these points during pick hours. This is also recommended at the junction of Ngong road and Hospital road.

The study further recommends research on the effects of improvement of road capacity in Upper Hill area.

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APPENDICES

Appendix I: General Public Questionnaire

UNIVERSITY OF NAIROBI
SCHOOL OF THE BUILT ENVIRONMENT
DEPARTMENT OF ARCHITECTURE AND BUILDING SCIENCE
MASTER OF URBAN MANAGEMENT

Name of student: JONES E O. NYANGWESO- REG NO: W50/P/7482/04

Research Title: MANAGEMENT OF TRAFFIC CIRCULATION IN NAIROBI, A CASE STUDY OF UPPER HILL AREA

Declaration: This questionnaire has been designed for the sole purpose of collecting data on the urban traffic circulation management in Upper Hill area of Nairobi. The data collected will be treated with a very high degree of confidentiality and it is meant for academic purposes only.

You are kindly asked to fill out this questionnaire by putting an "X" in front of the applicable answer or in the applicable cell or fill the blanks with the appropriate response for each item.

SECTION A: Background Information

1. Name of respondent (Optional)……..

2. Gender of respondent

Male [ ] Female [ ]

3. Age of respondents

18-23 years [ ] 24 -29 years [ ] 30 -35 years [ ]

36- 40 years [ ] 41- 45 years [ ] 46-50 years [ ]

51-55 years [ ] 56- 60 years [ ] 61-65 years [ ]

66-70 years [ ] 71- 75 years [ ]

4. Where do you live?

……

……

5. What is the distance between your house and Upper Hill?

1-5 kms [ ] 6- 10 kms [ ] 11-15kms [ ]

16-20 kms [ ] 21-25 kms [ ] 26-30 kms [ ]

Over 30kms. (Specify)

6. How often do you frequent Upper Hill area?

Daily [ ] Weekly [ ] Fortnight [ ] Monthly [ ] Other (Specify)

7. Where do you work?

……

……

8. Estimate the distance between your house and your place of work/Business/School?

1-5km [ ] 6-10 km [ ] 11-15 km [ ] 16-20km [ ]

Over 20km

(specify)……

9. What mode of transport do you use to your place of work/business /school?

Public Transport [ ] Private personal Transport [ ]

Train [ ] Other [ ] (specify)……

10. What means of transport do you use to your place of work/business/ school?

A. private car B. Bus C. Train D. Other (specify)

11. What time do you leave your house for your place of work/school or business place?

A. 5.00 am B. 5.30am C. 6.00 am. D. 6.30am E. Other

12. What time do you arrive at your place of work/school or business place?

A. 6.00 B. 6.30 C. 7.00 D.7.30 E. 8.00

Others (specify)……

13. Is the means of transport shared with others?

A. YES B. NO

14. If public transport, do you use one direct route or do you have to change routes?

A. YES B. NO

15. If you change routes, how time does it take you when changing routes?

10 mins [ ] 20 mins [ ] 30 mins [ ] More [ ]

16. What time do you embark on your return journey to your house in the evening?

5.30pm [ ] 6.00pm [ ] 6.30pm [ ] 7.00pm [ ] Others……..

17. What time do you arrive at home in the evening?

6.30pm [ ] 7.00pm [ ] 7.30pm [ ] 8.00pm [ ] Others……..

18. Do you experience any delay in the transport system during your travelling?

A. YES B. NO

19. Kindly explain answer in Q 18. Above

……

……

……

……

SECTION B: Traffic Circulation Challenges in Upper Hill

20. In your opinion, do traffic circulation challenges in Upper Hill influence the traffic situation prevalent in the areas?

A. YES B. NO

21. In your opinion how does the traffic circulation challenges in Upper Hill influence the traffic situation?

To a very great extent [ ] To a Great extent [ ] To a Moderate extent [ ]

To a Low extent [ ] To no extent at all [ ]

22. Below is a list of major possible challenges experienced in the management of traffic circulation in Upper Hill. Kindly indicate your level of agreement with the statements posed using the scale:

Table 6:1 Traffic Circulation Challenges In Upper Hill

1= Strongly Disagree; 2= Disagree; 3= Neutral; 4 = Agree; 5= Strongly Agree

	1	2	3	4	5
Inadequate road capacity					
Poor planning rules in cities and towns					
Careless driving					
Road accidents					
Ineffective public transport and its poor network integration					
Lack of transport demand measures such as parking policies					
Poor quality of cycling and walking infrastructure					
Accidents and safety					
Freight distribution					
Longer commuting					
Inadequate road connectivity					

SECTION C: Existing Policy, Regulatory and Institutional Mechanisms

23. In your opinion, do Existing policies, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill have an effect on the traffic circulation?

A. YES B. NO

24. If yes how?

……
……
……

25. To what extent do Existing policies, regulatory and institutional mechanisms for management of traffic circulation in Nairobi

To a very great extent [ ] To a great extent [ ]
To a moderate extent [ ] To a low extent [ ]
To no extent at all [ ]

26. Below is a list of existing policy, regulatory and institutional mechanisms for the management of traffic circulation in Nairobi. Kindly indicate the extent to which the following apply in the management of traffic circulation in Nairobi:

Table 6.2: Existing Policy, Regulatory and Institutional Mechanisms

1= Very great extent; 2= Great extent; 3= Moderate extent; 4 = Low extent; 5= No extent

Existing Policy, Regulatory and Institutional Mechanisms	1	2	3	4	5
Adoption of Intelligent Transport Systems (ITS) eg., over-speeding video detectors					
A proper public transportation system, integrating rail, road and water					
Adequate and regular maintenance of road and road infrastructure					

Existing Policy, Regulatory and Institutional Mechanisms	1	2	3	4	5
Punitive measures against transport law and policy offenders					
Transport and traffic education, especially on urban road for commuters, drivers and other road users					
Integrated and coordinated inter and multi-modal transport system involving road and rail transport					
Involvement of private transporters and stakeholders in public transportation in transport sector policy formulations					
Effective clear-cut institutional arrangement on road transport management					
Complete separation of vehicles e.g., separate lanes for Freight/Goods transport					

27. How effective do you rate the existing mechanisms in the management of traffic circulation in Upper Hill?

Very effective [ ] Effective [ ] Neutral [ ]

Ineffective [ ] Very ineffective [ ]

SECTION D: Measures to Enhance Traffic Circulation Management in Upper Hill Area

28. Below is a list of possible measures to enhance traffic circulation management in Upper Hill area. Kindly indicate your level of agreement with the measures stated, using the scale:

Table 6.3: Measures to Enhance Traffic Circulation Management in Upper Hill Area

1= Strongly Agree; 2= Agree; 3= Neutral; 4 = Disagree; 5= Strongly Disagree

	1	2	3	4	5
Strict traffic enforcement by the police					
Convert two way to one way					
Restrict Parking on Roads					
Procedures for reporting accidents and non-conformities					
Procedures to prepare for and respond to emergency situations					
Designing of large sized crossings					
Designate leaves according to the type of vehicle					
Improve street lighting					
Providing road dividers					
Safe crossing points					

29. In your opinion how do the following factors enhance traffic circulation management in Upper Hill area?

a. Improving traffic operations

……

……

b. Shifting urban traffic to public transport

……

……

c. Reduce the demand for urban road travel

……

……

d. Modify existing infrastructure so as to increase its capacity

……

……

e. Providing new infrastructure

……

……

THANK YOU FOR YOUR PARTICIPATION!!

Appendix II: Household Questionnaire

UNIVERSITY OF NAIROBI
SCHOOL OF THE BUILT ENVIRONMENT
DEPARTMENT OF ARCHITECTURE AND BUILDING SCIENCE
MASTER OF URBAN MANAGEMENT

Name of student: JONES E O. NYANGWESO- REG NO: W50/P/7482/04

Research Title: **MANAGEMENT OFTRAFFIC CIRCULATION IN NAIROBI, A CASE STUDY OF UPPER HILL AREA**

Declaration: This questionnaire has been designed for the sole purpose of collecting data on the urban traffic circulation management in Upper Hill area of Nairobi. The data collected will be treated with a very high degree of confidentiality and it is meant for academic purposes only.

You are kindly asked to fill out this questionnaire by putting an "X" in front of the applicable answer or in the applicable cell or fill the blanks with the appropriate response for each item.

SECTION A: Background Information

1. Name of respondent (Optional)……..

2. Gender of respondent

Male [ ] Female [ ]

3. Age of respondents

18-23 years [ ] 24 -29 years [ ] 30 -35 years [ ]

36- 40 years [ ] 41- 45 years [ ] 46-50 years [ ]

51-55 years [ ] 56- 60 years [ ] 61-65 years [ ]

66-70 years [ ] 71- 75 years [ ]

4. Where do you live?

……

……

5. What is the distance between your house and Upper Hill?

1-5 kms [ ] 6- 10 kms [ ] 11-15kms [ ]

16-20 kms [ ] 21-25 kms [ ] 26-30 kms [ ]

Over 30kms. (Specify)

6. Estimate the distance between your house and your place of work/Business/School?

1-5km [ ] 6-10 km [ ] 11-15 km [ ] 16-20km [ ]

Over 20km

(specify)……

7. What mode of transport does the household normally use?

Public Transport [ ] Private personal Transport [ ]

Other [ ] (specify)……

8. What means of transport does the household normally use?

A. private car B. Bus C. Train D. Other (specify)

9. What time do you leave your house for your place of work/school or business place?

A. 5.00 am B. 5.30am C. 6.00 am. D. 6.30am E. Other

10. What time do you arrive at your place of work/school or business place?

A. 6.00am B. 6.30am C. 7.00am D.7.30am

E. 8.00am Others (specify)……

11. Is the means of transport shared with others?

A. YES B. NO

12. If public transport, do you use one direct route or do you have to change routes?

A. YES B. NO

13. If you change routes, how time does it take you when changing routes?

10 mins [ ] 20 mins [ ] 30 mins [ ] More [ ]

14. What time do you embark on your return journey to your house in the evening?

5.30pm [ ] 6.00pm [ ] 6.30pm [ ] 7.00pm [ ] Others……..

15. What time do you arrive at home in the evening?

6.30pm [ ] 7.00pm [ ] 7.30pm [ ] 8.00pm [ ] Others……..

16. Do you experience any delay in the transport system during your travelling?

A. YES B. NO

17. Kindly explain answer in Q 16. Above

……

……

……

……

SECTION B: Traffic Circulation Challenges in Upper Hill

18. In your opinion, do traffic circulation challenges in Upper Hill influence the traffic situation prevalent in the areas?

A. YES B. NO

19. In your opinion how does the traffic circulation challenges in Upper Hill influence the traffic situation?

To a very great extent [ ] To a Great extent [ ] To a Moderate extent [ ]

To a Low extent [ ] To no extent at all [ ]

20. Below is a list of major possible challenges experienced in the management of traffic circulation in Upper Hill. Kindly indicate your level of agreement with the statements posed using the scale:

Table 6.4: Traffic Circulation Challenges in Upper Hill

1= Strongly Disagree; 2= Disagree; 3= Neutral; 4 = Agree; 5= Strongly Agree

	1	2	3	4	5
Inadequate road capacity					
Poor planning rules in cities and towns					
Careless driving					
Road accidents					
Ineffective public transport and its poor network integration					
Lack of transport demand measures such as parking policies					
Poor quality of cycling and walking infrastructure					
Accidents and safety					
Freight distribution					
Longer commuting					
Inadequate road connectivity					

SECTION C: Existing Policy, Regulatory and Institutional Mechanisms

21. In your opinion, do Existing policies, regulatory and institutional mechanisms for management of traffic circulation in Upper Hill have an effect on the traffic circulation?

A. YES B. NO

22. If yes how?

……

……

……

23. To what extent do Existing policies, regulatory and institutional mechanisms for management of traffic circulation in Nairobi

To a very great extent	[ ]	To a great extent	[ ]
To a moderate extent	[ ]	To a low extent	[ ]
To no extent at all	[ ]		

24. Below is a list of existing policy, regulatory and institutional mechanisms for the management of traffic circulation in Nairobi. Kindly indicate the extent to which the following apply in the management of traffic circulation in Nairobi:

Table 6.5: Existing Policy, Regulatory and Institutional Mechanisms

1= Very great extent; 2= Great extent; 3= Moderate extent; 4 = Low extent; 5= No extent

	1	2	3	4	5
Adoption of Intelligent Transport Systems (ITS) eg., over-speeding video detectors					
A proper public transportation system, integrating rail, road and water					
Adequate and regular maintenance of road and road infrastructure					

	1	2	3	4	5
Punitive measures against transport law and policy offenders					
Transport and traffic education, especially on urban road for commuters, drivers and other road users					
Integrated and coordinated inter and multi-modal transport system involving road and rail transport					
Involvement of private transporters and stakeholders in public transportation in transport sector policy formulations					
Effective clear-cut institutional arrangement on road transport management					
Complete separation of vehicles e.g., separate lanes for Freight/Goods transport					

25. How effective do you rate the existing mechanisms in the management of traffic circulation in Upper Hill?

Very effective [ ] Effective [ ] Neutral [ ]

Ineffective [ ] Very ineffective [ ]

SECTION D: Measures to Enhance Traffic Circulation Management in Upper Hill Area

26. Below is a list of possible measures to enhance traffic circulation management in Upper Hill area. Kindly indicate your level of agreement with the measures stated, using the scale:

Table 6.6: Measures to Enhance Traffic Circulation Management in Upper Hill Area

1= Strongly Agree; 2= Agree; 3= Neutral; 4 = Disagree; 5= Strongly Disagree

Measures to Enhance Traffic Circulation Management	1	2	3	4	5
Strict traffic enforcement by the police					
Convert two way to one way					
Restrict Parking on Roads					
Procedures for reporting accidents and non-conformities					
Procedures to prepare for and respond to emergency situations					
Designing of large sized crossings					
Designate leaves according to the type of vehicle					
Improve street lighting					
Providing road dividers					
Safe crossing points					

27. In your opinion how do the following factors enhance traffic circulation management in Upper Hill area?

a. Improving traffic operations

……
……

b. Shifting urban traffic to public transport

……
……

c. Reduce the demand for urban road travel

……
……

d. Modify existing infrastructure so as to increase its capacity

……

e. Providing new infrastructure

……

THANK YOU FOR YOUR PARTICIPATION!!

Appendix III: Interview Guide for Professionals/Developers

UNIVERSITY OF NAIROBI
SCHOOL OF THE BUILT ENVIRONMENT
DEPARTMENT OF ARCHITECTURE AND BUILDING SCIENCE
MASTER OF URBAN MANAGEMENT

Name of student: JONES E O. NYANGWESO- REG NO: W50/P/7482/04

Research Title: **MANAGEMENT OF TRAFFIC CIRCULATION IN NAIROBI, A CASE STUDY OF UPPER HILL AREA**

Declaration: This questionnaire has been designed for the sole purpose of collecting data on the urban traffic circulation management in Upper Hill area of Nairobi. The data collected will be treated with a very high degree of confidentiality and it is meant for academic purposes only.

SECTION A: BACKGOUND INFORMATION

1. Name of respondents (Optional) ……
2. Current position of the respondents ……
3. Respondent's profession ……...

SECTION B: MAIN QUESTIONS

4. In your opinion, does Upper Hill area experience traffic flow challenges? Explain

5. What could be the causes of traffic flow challenges in Upper Hill area?

6. How can traffic flow challenges experienced in Upper Hill area be solved?

7. What is your opinion on traffic flow management in Nairobi City in general and Upper Hill area in particular?

8. Are you aware of any traffic flow management policies for Nairobi city? Explain

9. In your opinion, does the existing traffic law have sufficient provisions for effective traffic flow management? If not, what are the shortcomings and how can this be solved?

10. What is the current institutional framework for traffic flow management? What challenges does the current framework experience? What would be your ideal institutional framework?

11. What traffic flow management instruments/tools/mechanisms used in Upper Hill area are you aware of? What is your opinion on their effectiveness?

12. As a developer within Upper Hill area, how does traffic flow within this area impact your business?

13. What proposal would you advance for efficiency in traffic flow management in Upper Hill area?

THANK YOU FOR YOUR PARTICIPATION!!

Appendix IV: Work Plan

The following is a schedule of activities indicating when each respective activity is due to occur:

Table 6.7: Work Plan

Event\Date	Jan-March 2014	Apr-May 2014	October 2014	Nov 2014	Dec 2014	Dec 2014
Concept note and proposal writing						
Defense and approval of study						
Data Collection						
Data Analysis						
Report Writing						
Defense and Presentation of Thesis						

Appendix V: Financial Budget

Table 6.8: Financial Budget

ITEM	**AMOUNT**
Typing, editing and printing	10,000
Data collection	10,000
Transport	15,000
Training enumerators/data collection	25,000
Stationery, photocopies and binding	20,000
Miscellaneous	20,000
TOTAL	**100,000**

Appendix VI: Attachments

This section presents the geographical map of the road network sampled that forms the study area.

Appendix VI (a) Registry Index Map (RIM)

Figure 6.1: Sample Registry Index Map (RIM) of Upper Hill

Appendix VI (b) Zoning Plan

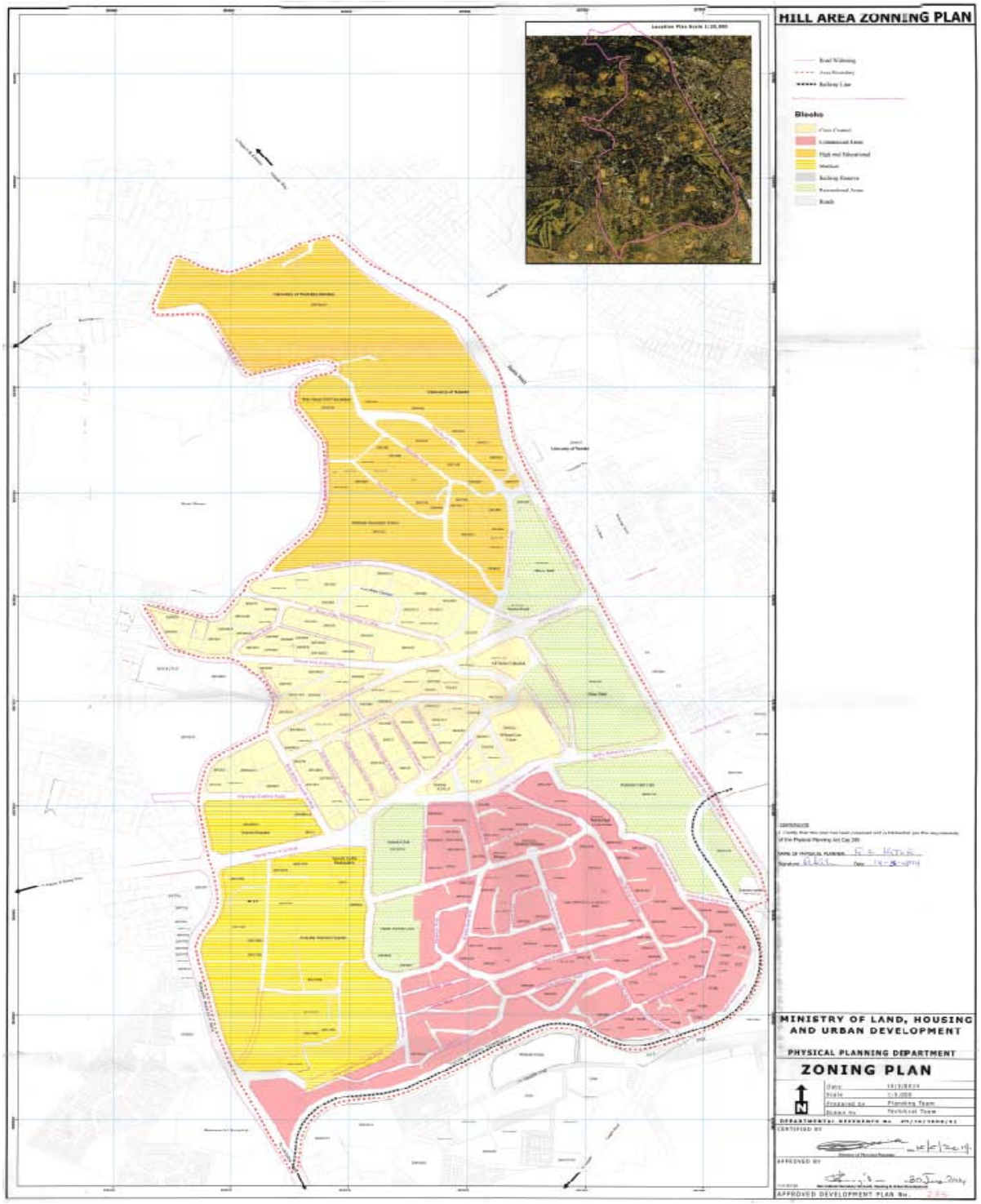

Figure 6.2: Hill area Zoning Plan

Appendix VI (c) Topocadastral Maps and Google map Attachments