

**AN ANALYSIS OF THE EFFECTS OF ENVIRONMENTAL AND
GOVERNANCE FACTORS ON ROAD SAFETY: A CASE STUDY OF ROAD
ACCIDENT BLACK SPOTS IN THE CITY OF NAIROBI, KENYA**

By

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THE DEGREE OF DOCTOR OF PHILOSOPHY IN TRANSPORT
GEOGRAPHY, DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL
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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

Signed ----- Date_____

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

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DEDICATION

This study is dedicated to all Kenyans and their relatives who lost their lives in road traffic accidents due to either poor road conditions at road accident black spots across the country; and also due to failure and lack of traffic laws enforcement by the institutions bestowed with powers to enforce those traffic rules and regulations for safe driving on our roads.

This thesis is also heartily dedicated to my son Kevin Munene Miriti who has had two (2) major road traffic accidents; the first one at the old Ruaraka GSU roundabout road accident black spot along Thika road. In this accident, Kevin and his friends miraculously escaped un- hurt but due to impact of this accident, the vehicle he was driving was declared a write-off by the insurers. The second was a fatal road accident at the infamous Nithi Bridge along the Embu-Meru road where he lost his dearest namesake cousin and closest friend and my nephew.

This research study is academically dedicated to my last born son Dennis Muthomi Miriti whom I have observed to have a keen interest in my transport studies and profession and has taken up to undertake a Bachelor of Business Administration (BBA) degree in Logistics & Supply Chain Management. It is my hope that this research study will enhance his morale to continue with his Logistics studies to post graduate levels in future.

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Finally I appreciate my employer Ethics and Anti-corruption Commission (EACC) where I have been working when undertaking this study. The errors or omissions that may arise in this study are entirely mine.

ABSTRACT

The study investigated the effects of environmental and governance factors on road safety in Nairobi. It was motivated by the rapidly deteriorating road safety trends observed globally and locally. The overall objective of this study was to analyse the effects of environmental and governance factors that contribute to RTAs. The specific objectives of the study were; to (a) assess the effect of environmental factors on road traffic accidents (RTAs) in Nairobi.(b) analyse how lack of road signs and road crossing points contribute to motor and pedestrian road traffic accidents (RTAs) on the roads.(c) examine the effects of vehicle speeding and speed controls on occurrences of road traffic accidents (RTAs). (d) evaluate the impact of the presence or absence of traffic police and the enforcement on traffic rules and regulations on the increase or decrease of road traffic accidents (RTAS).

There were four (4) hypotheses formulated for this study and their validity was tested using the obtained data; these were (a) There is no significant difference between wetness of the road and the number of RTAs, (b) there is no significant difference between pedestrian RTAs and lack of pedestrian road crossings (c)There is no significant difference between driver behaviour and RTAs, (d) there is no significant difference between law enforcement and RTAs.

Data was collected using questionnaires administered to drivers and traffic police officers. More data was also obtained through field observations of road side activities, road conditions, pedestrian road crossings and road side traffic signs along RTAs black spot areas. Data was also abstracted from traffic police records . These data were tabulated and analyzed using multiple regression analysis and chi-square test in testing the hypotheses.

The main findings of the study road accident black spots were that; there was (1) insignificant influence of weather conditions on RTAs and road accident black spots had poorly marked road sections/; (2) insufficient pedestrian road crossing facilities and fences to channel pedestrians to safe crossing points, pedestrians frequently do not use designated pedestrian traffic ways and safe road crossing points, (3) a high number of RTAs occurred when the traffic police officers were not present on the roads, no speed limits signs or speed limit traffic bumps, and the presence of traffic police officers on the

road has no effect on drivers and reduction of RTAs, (4) traffic police officers are not effective in reducing RTAs, lax enforcement of traffic rules/regulations leads to increase in RTAs, rampant indiscipline and non-compliance with traffic rules by drivers contributing to high RTAs.

Based on research findings, several key recommendations were made. They are:(a) enforcing more strict road traffic laws (b)road safety should be recognized as a national disaster and be included in the national development plans with adequate funding.(c) that appropriate countermeasures on speed limits be enforced to control vehicle speeding(d), traffic law enforcement be strengthened with a clear legal mandate of enforcing road traffic laws.

LIST OF ABBREVIATIONS AND ACRONYMS

AAK-	Automobile Association of Kenya
ADB-	African Development Bank
ASIRT-	Association for Safe International Road Travel
ARSR-	Africa Road Safety Review
ATSB-	Australian Transport and Safety Board
CBD-	Central Business District
CCN-	City Council Nairobi
CFR-	Case Fatality Rate
CDC-	Centre for Disease Control
DFID-	Department of International Development, UK
EACC-	Ethics and Anti-corruption Commission
EAJ-	East African Orthopedic Journal
FGs-	Focused groups
GRSP-	Global Road Safety Programme
GRSSC-	Global Road Safety Steering Committee
GOK-	Government of Kenya
GDP-	Gross Domestic Product
GNP-	Gross National Product
GSU -	General Service Unit of Kenya
GRSP-	Global Road Safety Partnership
IDS-	Institute of Development Studies
IHT-	Institute of Highways and Transportation
IPAR-	Institute of Public Policy Analysis & Research
KACC-	Kenya Anti-corruption Commission
KICC-	Kenyatta International Conference Centre
KIPPRA-	Kenya Institute of Public Policy Research and Analysis
KRB-	Kenya Roads Board
LDCs-	Less Developed Countries
MDCs-	Most Developed Countries
MoH -	Ministry of Health
MoR -	Ministry of Roads

MoT-	Ministry of Transport
MoTC-	Ministry of Transport & Communications
NEMA -	National Environmental Management Authority
NGO-	Non-Governmental Organization
NRSAP-	National Road Safety Action Plan
NRSC-	National Road Safety Council
NTSA-	National Transport& Safety Authority
OECD-	Organization for Economic Co-operation and Development
PRB-	Population Reference Bureau
PSVs-	Public Service Vehicles
RSU-	Road Safety Unit
RTAs-	Road Traffic Accidents
RTIs-	Road Traffic Injuries
TRL- UK	Transport Research Laboratory-United Kingdom
TLB-	Transport Licensing Board
UNDP-	United Nations Development Programme
USA-	United States
USA-	United States of America
USID-	United States Agency for International Development
WB-	World Bank
WHO-	World Health Organization

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CHAPTER ONE: INTRODUCTION

1.0 Over view

Transport is very crucial to the economic development of any country where without access to facilities, essential services and other amenities, the quality of life would suffer drastically due to lack of connectivity of transport means. According to the World Bank studies inadequate transport infrastructure is a constraint to agriculture productivity and distribution (World Bank 1996). An ideal transport policy should incorporate road and traffic safety plans and countermeasures.

Road transport is an important mode of transportation in many parts of the world and in Kenya, it is the most dominant means of travel due to its comparative advantages in terms of accessibility, flexibility and speed. More specifically in Kenya road transport accounts for approximately 80% of the transport traffic (Irindu 1995). Road transport is also very important in Less Developed Countries (LDCs) due to the limited opportunities for water transport and lack of developed railway transport systems. The main advantage of road transport is the door –to- door flexibility it allows. This means that travel by other transport modes almost invariably begins or ends with a road journey.

1.1 Background of the Study

The transport sector in Kenya is steadily growing and it is noted that the transport and communications sector of the Kenya's Economy contributes significantly to the overall growth. The benefits of transport and communications to an economy include the access they provide to other goods and services. Reliable and secure transport systems can contribute to higher and more stable incomes. It also enables the poor to manage risks and increase mobility for the urban population to search and reach areas of better economic earnings (GOK, 2006).

In the year 2013 the total value of output in transport and storage sector of the economy grew by 3.4% from 624.9 billion in 2012 to 645.7 billion in 2013. As shown in Table 1.1, the sub-sectorial output values of the transport and storage sector continued to grow from over 383 billion in 2007 to over 430 billion in 2008, over 444 billion in 2009, and over 502 billion in 2010, over 596 billion in 2011, over 624 billion in 2012 and to over 645 billion in 2013. As detailed on this table, the sector's value of output continued to be dominated by road transport which accounted for over 64 % of the total value of output. Road transport value of output grew from 233.2 billion in 2007 to 273.0 billion in 2008, 285.2 billion in 2009, 326.3 billion in 2010, 386.6 billion in 2011, 402.4 billion in 2012 and 415.0 billion in 2013. This shows that road transport is very important to the economic growth of Kenya.

Table 1.1: Transport and Storage (value of Output, 2007-2013) in Millions (Kshs)

	2007	2008	2009	2010	2011	2012	2013
Road Transport	233,224	273,044	285,262	326,318	386,636	402,452	415,031
Railway Transport	4,550	4,449	4,747	5,591	6,017	5,613	5,172
Water Transport	23,233	21,868	21,039	23,487	28,188	29,869	29,801
Air Transport	80,254	83,010	81,609	84,257	100,203	108,780	116,576
Services Incidental to Transport	33,971	38,822	40,019	48,342	60,097	60,484	60,466
Pipeline Transport	8,736	9,222	11,837	13,906	15,474	17,755	18,735
Total	383,968	430,415	444,513	502,261	596,615	624,953	645,781

Source: GOK: Economic Survey, 2014

1.1.1 An overview of Kenya Road Inventory and Conditions

There has been a continuous improvement of road network in Kenya from independence in 1963 when there was only 45,000kms out of which only approximately 2,000 km were paved while the rest was mainly earth. With the Government initiative to support the country's development objectives, programs of upgrading roads to bitumen standards and improving rural roads to gravel standards were expanded. As a result, the paved road network was expanded from 2,000 kms in 1963 to 11,189 kms in 2009 (GOK, 2010).

The Kenya Roads Board (KRB,2013) road inventory indicates that the road network in Kenya is 160,886 kms long; comprising of 11,189kms of paved roads and 149,689 kms of unpaved roads as detailed on table 1.2;

Table 1.2: Kenya Road Inventory

ROAD CLASS	PAVED	UNPAVED	TOTAL
A	2,772	816	3,588
B	1,489	1,156	2,645
C	2,693	5,164	7,857
D	1,238	9,483	10,721
E	577	26,071	26,649
SPR	100	10,376	10,476
U	2,318	96,623	98,941
TOTAL	11,189	149,689	160,886

Source: Kenya Roads Board(KRB),2013

Through the Government of Kenya initiatives, there has been some improvement in the road network condition for the classified roads which is currently estimated at 17% good, 51% fair and 31% in poor condition. However, majority of the unclassified roads are in unmaintainable condition with only 5% good, 22% fair while 72% is in poor condition as tabulated on table 1.3 below. Hence a large portion of the network is in either poor or failed condition and requires urgent rehabilitation to restore it to a maintainable condition (KRB, 2012).

This shows that a large portion of classified road network in Kenya is of very poor condition despite the importance of road transport to the economy. The poor condition of the classified roads and the low level of roads maintenance in Kenya lead to negative road use side effects. Some of the negative road use side effects are the occurrences of Road Traffic Accidents (RTAs). Road traffic accidents increase road safety problems. This is why RTAs are of major concern on our roads.

Table 1.3: Summary of Kenya road conditions

	Good (Kms)	Fair(Kms)	Poor (Kms)	Grand Total (Kms)
Classified	10,651	31,847	19,438	61,936
Unclassified	5,440	22,165	71,345	98,950
Grand Total	16,090	54,012	90,784	160,886
Condition Classified	17%	51%	31%	100%
Condition Unclassified	5%	22%	72%	100%
Condition All	10%	34%	56%	100

Source: Kenya Roads Board(KRB), 2012

1.1.2 Road Traffic Accidents Global and Regional Trends

From a geographer's point of view, it is worth to note that all modes of transport are prone to accidents worldwide. We have air crashes which air safety authorities are very much concerned with. We also have major rail derailments which are of concern to rail line operators. Then there are the ships and ferry disasters which are of concern to our marine operations. Road traffic accidents involve occurrences on road systems and network. The known background knowledge and reports of accidents shows that accidents on roads occur more frequently than the other modes of transport.

The Population Reference Bureau (PRB) , 2012 indicates that road traffic accidents is the leading cause of death by injury and the tenth leading cause of all deaths globally and it now make up a surprisingly significant portion of the worldwide burden of ill-health. An estimated 1.2 million people are killed in road crashes each year, and as many as 50 million are injured, occupying 30 to 70 per cent of orthopaedic beds in developing countries hospitals. And if present trends continue, road traffic injuries are predicted to be the third-leading contributor to the global burden of disease and injury by 2020. Developing countries bear a large share of the burden, accounting for 85 per cent of annual deaths and 90 per cent of the disability because of road traffic injury. And since road traffic injuries affect mainly males (73 per cent of deaths) and those between 15 and 44 years old, this burden is creating enormous economic hardship due to the loss of family breadwinners; Population Reference Bureau (PRB) , 2012.

In more recent annual global road crash statistics, the Association for Safe International Road Travel (ASIRT, 2012: a non-profit humanitarian organisation in the US that participate in Global road safety activities of informing travellers on safe travel in all countries) reports that nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day . An additional 20-50 million people are injured or disabled annually and more than half of all road traffic deaths occur among young adults of ages 15-44. It also reports that road traffic crashes rank as the 9th leading cause of death and accounts for 2.2% of all deaths globally and the leading cause of death among young people of ages 15-29. Each year nearly 400,000 people under 25 die on the world's road which is on average 1.000 a day. The ASIRT report also indicates that over 90% of all road fatalities occur in low and middle –income countries like Kenya whicj have less than half of the world's vehicles; ASIRT, 2012.

In the United States (US) 37,000 people die in road crashes every year and an additional 2.35 million are injured or disabled. Also 1,600 children under 15 years of age die each year from road crashes and nearly 8,000 people are killed in crashes involving driver's ages 16-20. It also reported that road crashes costs the United States 230.6 billion dollars per year or an average of 280 dollars per person. According to ASIRT road crashes are the single greatest annual cause of death of healthy US citizens travelling abroad; The Association for Safe International Road Travel (ASIRT), 2012

According to preliminary figures from the U.S. Department of Transportation, in 2012 there were 34,080 fatalities on U.S. highways and roads, including drivers, motorcyclists, cyclists, and pedestrians. Worse, the figure represents a 5.3% increase over 2011's total of 32,367, reversing a long-time trend in the United States of declining deaths from motor-vehicle crashes. According to the Centres for Disease Control (CDC), the estimated annual cost of traffic fatalities and injuries in the U.S. exceeds \$99 billion. A number of groups are particularly at risk for traffic accidents and fatalities. In 2011, there were 1,987 traffic deaths of drivers between 15 and 20 years old, while 5,401 people of 65 and older were killed in crashes. Motorcyclists accounted for 4,612 fatalities in 2011 and motorcyclists were more than 30 times more likely than passenger car occupants to die in a motor vehicle traffic crash. Of the motorcyclists or their passengers who died, 40% were not wearing helmets at the time of the crash. According to the CDC in 2011, 16% of traffic crash fatalities were vulnerable road users — pedestrians (4,432), bicyclists (667), and others (198); Seckan B, (2013)

In Asia, and according to the analysis of World Health Organization (WHO, 2004), 500,000 people are killed in road crashes each year. Although, number of deaths, injuries and property damages involved in road accidents are underreported, majority of these accidents involve people who are most of the time, head of households. Their deaths and being injured often significantly reduce family incomes and therefore have serious consequences on the household and quality of life (ADB, 2005 cited from Limbijo, 2004).

According to De Leon et al (2005), each accident entails economic cost, not to mention the social cost of pain, grief, and suffering of families of the victims. It also has an adverse impact on the resources of the government. Numerous studies conducted outside the Philippines have shown that road accidents are largely influenced by human error, 57% of total accidents was caused by human error alone (Green *et al.*, 2004 cited from WHO, 2004). And according to Cordero,(2008) of the University of Philippines, road traffic accidents have been growing rapidly with increasing population and rapid motorization.

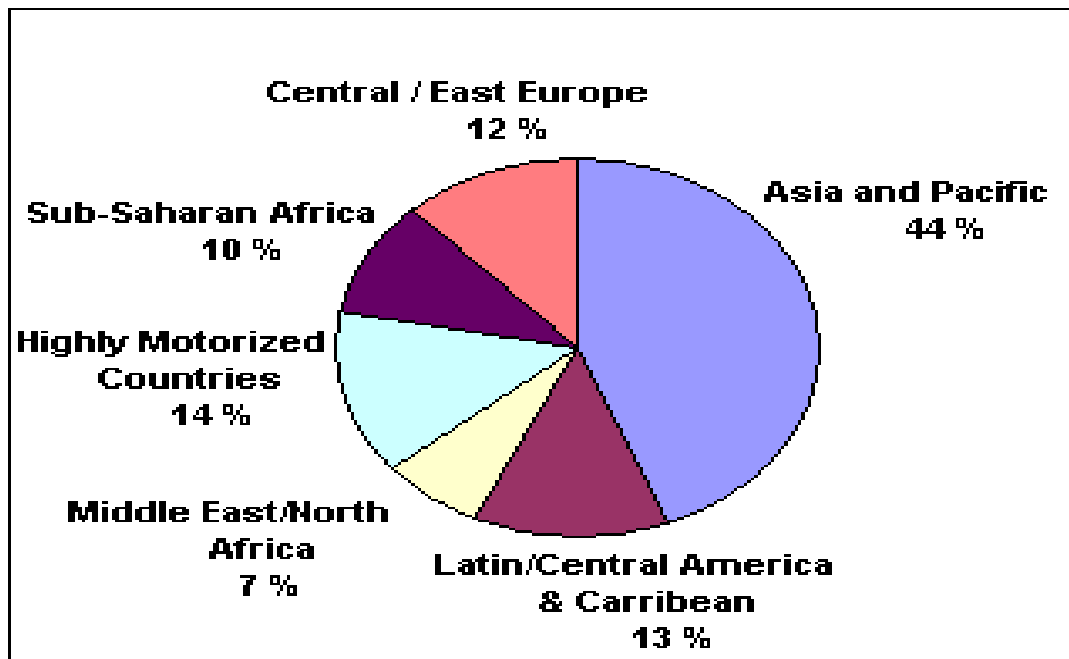
In Nigeria, Labinjo, et al , (2010) reports that, trauma is the main reason for emergency room visits and road traffic accidents are responsible for the majority of deaths. The overall road traffic injury rate is about 41 per 1000 population and mortality from road traffic injuries is about 1.6 per 1000 population. Traffic accidents have physical, social, emotional and economic implications. Nigeria loses about 80 billion Naira annually to road accidents. Of all subjects that are involved in road traffic accidents in Nigeria, 29.1 per cent suffer disability and 13.5 per cent are unable to return to work. Hence, the cost of road traffic accidents includes the cost of private property and public amenities damaged, the cost of medical treatment and the cost of productivity lost due to the accident.

In Ethiopia the federal police commission reported that the death rate due to car accidents was significantly increasing among pedestrians and passengers from time to time. A total of 25,110 accidents and 3,415 fatalities were recorded in Addis Ababa city during 2000-2009. The majority of fatalities were pedestrian, 2,970 (87%) followed by passengers 297 (9%) and drivers 148 (4%). A report from traffic Police office of Mekelle another Ethiopian town indicated that in 2008, there were a total 313 RTAs and in 2009 the total number RTAs increased to 353. On the other hand, the report showed that 96% of the causes were related to human risk behavior whereas 4% was due to vehicle problems; Hassen *et al*, (2011).

In Botswana, a report on the overview on road safety of 1992 indicated that to combat road safety problems, Botswana National Road Safety Council adopted among other strategies the principles of environmental and governance traffic laws enforcement factors. In this period Botswana had a national record of 7,614 injury accidents. It is reported that in 1998 six (6) years after the above 1992 overview, Botswana recorded 6,430 injury accidents. This was a substantial decrease of 1,184 injury accidents from 7,614 in 1992 to 6,430 in 1998 (ARSR-2000). This was due to the effects of the road safety environmental and governance enforcement measures initiated. In their plans to combat road safety problems, the Botswana case dwelt more on strict driver training and testing processes. This study analysed the environmental conditions under which the drivers and law enforcement officers operate; and the extent to which the enforcement of traffic rules and regulations are effectively enforced to deter would be occurrences of RTAs. However, the Botswana lesson was key guide in this study.

According to the Africa Road Safety Review (ARSR, 2000); the burden of road fatalities is in the developing world where 86 per cent of the world's roads fatalities occur, with almost half of all fatalities in Asia; see Figure 1.1;

Figure 1.1: Global distribution of road deaths



Source: Africa road safety review, TRL-UK Ltd 2000

From this it can be seen that about ten (10%) per cent of global deaths occur in Africa which is slightly less than those for the entire developed world or for all of Latin America, Central America and the Caribbean. It is noted that road deaths due Road Traffic Accidents (RTAs) are a common social phenomena in both developed and developing countries, but the problem is graver in developing countries despite the fact that they have fewer registered motor vehicles than the developed countries. Conversely it can be seen that only 14 per cent of road deaths occurred in the entire developed world (North America, Western Europe, Australasia and Japan) yet this particular region contains 60 per cent of all globally registered vehicles.

In addition to the devastating human toll through road accidents, the economic impact of road crashes is also enormous. The estimated annual cost of road traffic crashes in developing countries exceeds \$100 billion (US). This amounts to nearly double the total combined development assistance these countries receive every year from bilateral and multi-lateral government organizations (Global Road Safety Steering Committee report (GRSP, 2004).

In Kenya the total number of reported RTAs was on the increase from between 2007 and 2009 but with a slight decrease in 2008. The total number of persons injured or killed through RTAs rose from 23,512 in 2007 to 26,662 in 2009 but there was a slight decrease in 2008 as shown in Table 1.4 below. According to the GOK Economic survey report 2010 this was attributed to flouting of road traffic safety rules and regulations.

Table 1.4: Road Traffic Accidents, 2007-2013

RTAs	2007	2008	2009	2010	2011	2012	2013
Total No. reported							
Accidents.....	10,228	9,093	12,369	9,771	8,193	6,917	6,203
Persons Killed or							
Injured.....	23,512	21,420	26,622	22,121	19,093	15,612	14,324
Killed	2,530	2,463	4,072	3,055	3,302	3,141	3,191
Seriously Injured.....	10,658	9,481	10,644	,327	8,647	7,434	6,299
Slightly Injured.....	10,327	9,476	11,906	9,739	7,144	5,037	4,834

Source: GOK: Economic Survey, 2013

The total number of reported traffic accidents dropped by 10.3% from 6,917 in 2012 to 6,203 in 2013. Total casualties dropped by 8.3% from 15,612 in 2012 to 14,324 in 2013 on account of decline in the number of serious and slight injuries recorded. The number of casualties with serious and slight injuries recorded declines of 15.3% and 4.0% respectively in 2013, while the number of persons killed rose by 1.6%. This is a concern of the researcher the road accident trends in Kenya addressed in this study

The Government of Kenya through the Ministry of Transport (2003) had made a major contribution in road safety by introducing the mandatory requirement for all Public Service Vehicles (PSVs) to fit speed governors at 80 km/hr (Mbugua, 2008). This physical limitation on PSVs might have offered realistic prospect for the safer speeds in Kenya in 2003 which is noticeable in the above reduction of total number of RTAs in 2004. It is also noted that there was a significant decline in serious injury RTAs by 32.7% from 10,036 in 2003 to 6,751 in 2004 and slight injury RTAs by 25.6% from 15,935 to 11,858. Overall, the number of persons who were involved in traffic accidents in Kenya in 2005 stood at 22,771 compared to 20,873 in 2004. The fall in RTAs in 2004 might have some bearing on the road safety measures which were undertaken in 2003. But there was a noticeable drastic increase in the number of RTAs in 2005 which brings into question the contribution made to road safety through those PSV operational limitations. The research findings in the study assisted in analysing the causes of the increase in RTAs in 2005 after a successful reduction of the same in 2004 (GOK, 2006).

The decline in road accidents during the period under review could be attributed to the road safety measures taken by the Government of Kenya through the Ministry of Transport and Infrastructure and the newly created National Transport and Safety

Authority (NTSA) to reduce road carnage in the country. The road safety measures undertaken included road safety awareness campaigns, enforcement of traffic laws on speed governors and drunk driving, use of speed cameras on highway speeding motorists and stoppage of night travel by Public Service vehicles (PSVs). However more needs to be done to minimise road traffic accidents on our roads, and the results of this study recommends more measures to be taken to improve road safety through farther reduction of road traffic accidents in Kenya.

According to the East African Orthopaedic Journal (EAOJ); Vol. 5: September 2011 editorial report page 33 on road safety in Kenya, the mean annual fatality rate from all road traffic accidents in Kenya is estimated at 50 deaths per 10, 000 registered vehicles. The numbers of reported accidents have been showing an increasing trend from 10,300 in 1990 to 16,800 in 2000 and 17,400 in 2009. The annual economic cost of road traffic accidents is 5% of the country's Gross National Product. It is also reported that in Kenya, as it's in most third world countries percentage of all cars and motorcycles owned in the country are based in the capital city. In Iran and Kenya, the capital cities of Teheran and Nairobi contain over 50% of the nation's cars. And in Thailand about 75% of all cars are based in Bangkok city (with only 10% of the country's population). In developing countries higher income people tend to live close to city centres and even if they own personal transport they still make use of local public transport systems. Pedal cyclists also constitute a significant proportion on road victims in developing and emerging countries. In Kenya, cyclists have to compete with vehicular traffic for the existing road space.

1.2 Statement of the research problem

Road traffic accidents occur when a vehicle collides with another vehicle, pedestrian, animal, road debris, or other stationary obstruction, such as a tree or utility pole. Worldwide, road traffic accidents lead to death and disability as well as financial cost to both society and the individual involved.

Road traffic accidents (RTAs) are a preventable scourge. With man's invention of the wheel, the death knell has continued to toll for many, who are often innocent, but who may happen to be at the wrong place at the wrong time. Statistics show that mortality in road traffic accidents is very high among young adults in their prime and who constitute the work force. These are usually the breadwinners in many cultures. Innocent children are often direct victims of road mishaps and many become orphaned from these accidents. This imposes harsh social conditions made much worse in countries without social security services. The essential factors involved in RTA's include the person, the machine and the road. Most tragic accidents often involve all three. Often the person is involved with only one of the other two. A critical appraisal of factors involved in RTA's is necessary to identify and apportion responsibility for their prevention and redress to victims.

RTAs are a major cause of road safety problems in the world in terms of the number of people killed. In a study done by the Transport Research Laboratory (TRL-UK 2000) arranged by the Global Road Safety Partnership (GRSP) to review road safety world-wide, it was established that the number of people killed in road crashes in 1999 was between 750,000 and 880,000; and it was surprising that about 85% of those deaths occurred in developing and transitional countries of Africa, Asia, Latin America and the

Middle East. In the same year whilst about 10 per cent of global road deaths took place in 1999 in Sub-Saharan Africa, only 4 per cent of global vehicles are registered in the region. And conversely only 14 per cent of road deaths occurred in the entire developed world (North America, Western Europe, Australasia and Japan) yet this particular region contains 60 per cent of all globally registered vehicles (ARSR, 2000). The result from this study sets Africa in the global perspective in terms of road deaths due to road accidents.

Considering motorisation levels (vehicles per 1,000 populations), it is indicative from this study that vehicle ownership levels throughout Sub-Saharan Africa are amongst some of the lowest despite the fact that they record the highest number of RTAs. In Western Europe most countries have 500 to 700 vehicles per 1,000 populations, Eastern Europe 100 to 300 and in Latin America 40 to 200. In Asia, vehicle ownership levels ranges from 5 vehicles/1,000 people in Bangladesh to over 500 in Brunei. However, 60 per cent of countries were in the range 20 to 60 which is comparable with those calculated for the majority of African countries. South Africa had the highest motorisation level at 121, Congo in Central Africa at 20 and Kenya at 14. But in contrast RTAs are higher in sub-Saharan developing countries than the developed world (ARSR, 2000). This study attempts to explain this contrast through its research findings

The World Bank Report (2004) on five (5) sub-Saharan countries also revealed a high level of fatalities from accidents per 10,000 motor vehicles. This report indicates that in 1995 Tanzania had a record of over 66 deaths for every 10,000 vehicles on the road and Kenya about 60 deaths for every 10,000 vehicles on the road. The figure for the United Kingdom for the same year was 1.4 for every 10,000 vehicles. This position is rather grave for the two East African countries compared to a West African country like Benin

which had a record of only 23 deaths for every 10,000 vehicles on the road the same year (World Bank, 2004). These facts show that the developing countries; Kenya inclusive register more road deaths through RTAs than developed countries. The research in this study attempts an explanation of how environmental factors and governance factors might be contributing to this situation.

In 2010 the United Nations General Assembly unanimously adopted a resolution calling for a ‘Decade of Action for Road Safety 2011–2020’, and for further Global status reports on road safety to monitor the impact of the Decade at national and global levels. This report builds on the 2009 report, and provides additional data in a number of important areas. It serves as the baseline for monitoring the decade. The report shows that there has been no overall reduction in the number of people killed on the world’s roads: about 1.24 million deaths occur annually. However, this plateau should be considered in the context of a corresponding 15% global increase in the number of registered vehicles, suggesting that interventions to improve global road safety have mitigated the expected rise in the number of deaths. Eighty-eight countries – in which almost 1.6 billion people live – reduced the number of deaths on their roads between 2007 and 2010, showing that improvements are possible, and that many more lives will be saved if countries take further action. However, of concern is that 87 countries saw increases in the numbers of road traffic deaths over the same period. The report also shows that the highest road traffic fatality rates are in middle-income countries, particularly the African Region which includes our country Kenya.

In the world Report on Road Traffic Injury Prevention (2004); the then president of Kenya, Mwai Kibaki is quoted as saying that: “...Over 3,000 Kenyans are killed on our roads every year, most of them between the ages of 15 and 44 years. The cost to our

economy of these accidents is in excess of US 50 million exclusive of the actual loss of life and road traffic injuries are a major public health problem” (WHO 2004). The President was alluding to the high incidence of accidents, injuries, fatalities and the high cost to the economy. The President emphasised the need for the youth to observe road traffic rules and regulations in order to reduce RTAs.

Again during the official opening of the National Road Safety Stakeholders Conference at the Bomas of Kenya. Nairobi, October 19, 2010, President Mwai Kibaki ordered a crackdown on defiant traffic offenders. The President Kibaki directed the immediate enforcement of the laws that require all motorcycles to be insured and their riders properly trained and licensed. The President also directed the enforcement of the rules that require all motorcycle riders and passengers to use helmets and reflective jackets, and motorcycle taxis not to carry more than one passenger at a time. In addition, the President urged passengers and consumers of public means of transport to play an active role in ensuring that road safety regulations are enforced.

The president was concerned on the enormity of RTAs and at the same time, ordered an immediate crackdown of motorists who over speed while under the influence of alcohol and other intoxicants. He asked the National Road Safety Council to come up with applicable solutions to recurrent abuse of road rules and regulations by defiant motorists. Noting that some motorists tend to over speed on the improved roads, the Head of State said penalties should be stiffer as a deterrent measure to those abusing traffic rules. This portrays the President’s and the GOK concern on road safety challenges in the country.

In Kenya the Insurance industry estimates indicate that the economy loses in excess of Kshs. 14 billions annually due to road accidents, which translates to approximately 5% of

the Gross Domestic Product (GDP). Closer scrutiny revealed that 75% of the road casualties involve economically productive young people. It is a fact that these figures cannot illustrate the pain and tragic loss suffered by the survivors and the affected families. The human toll is tragic. Survivors and family members are affected not only by an immediate death or disability, but sometimes a lifetime of psychological and physical suffering. RTAs often result in orphans, and some victims, as young as infants, spend the rest of their lives in medical facilities. This was the same concern expressed by the president of the Republic of Kenya.

The tragic road accidents involving young people in Kenya while high on alcohol is on the rise (especially in Nairobi city) and the Kenya police warns that situations get worse during the holidays when they go out partying. In the first week of October 2006 twenty (20) young people all under the age of 35 died in road accidents, they were all from Nairobi city and their average age was nineteen (19 yrs). The total numbers of people reported to have been killed in road accidents in November 2006 was sixty eight (68) in Nairobi city alone, out of the total 194 deaths reported in Kenya in that month. This is about 35 % of all the total number of people killed in road accidents in Kenya during that month alone. This is not good for a fast growing city where safety on the roads should be of paramount importance for growth and tourism attraction.

The depressing state of deaths from road accidents in Nairobi city is confirmed by the records kept at Nairobi's City mortuary. Out of the one hundred forty (140) bodies of road accident victims received at the mortuary just over the two months of October and December 2006 alone, more than half were young people aged between seventeen (17) years and thirty five (35) years. If this trend continues, Kenya would be losing almost

500 young people in a year through road accidents in Nairobi City. Such a situation is unacceptable in a fast developing country like Kenya which relies heavily on the energetic young labour force which is also highly affected to a large extent by the rampant HIV/AIDS predicament .) Therefore, there is a problem a major road safety problem emanating from RTAs in Nairobi city. This study explains the nature and the factors that contribute to RTAs.

In view of this depressing state of RTAs in Kenya, the aim of this study was to analyse the effects of environmental and governance factors that contribute to RTAs, how lack of road signs and road crossing points contribute to RTAs on the roads, the effects of vehicle speeding and speed controls on occurrences of RTAs and the impact of the presence of traffic police and the enforcement of traffic rules and regulations on the increase or decrease of RTAs.

This study analysed the causes of RTAs from a geographical view on the environmental and governance perspectives that influence the occurrences of RTAs. It examined how environmental factors and lax enforcement of traffic rules and regulations contribute to road traffic accidents in Kenya. The following research questions on RTAs on road accident black spots in Nairobi city guided this study;

- (a) What is the influence of weather and other environmental features on certain city road sections deemed as black spots on road traffic accidents?
- (b) Does lack of road signs and safe road crossing sections make pedestrians and cyclists' engage in risky road user behaviour, thus increasing the risk for road accidents?

- (c) Why do drivers continue to cause road accidents despite their being traffic police enforcement and traffic laws court fines?
- (d) Does lack of enforcement of traffic laws, presence or absence of police traffic officers on the roads influence the occurrences of road traffic accidents?

1.3 Objectives of the study

The main objective of this study was to analyse the environmental and governance factors that directly or indirectly contribute to RTAs thus leading to road safety problems. The specific objectives of the study were:

- (a) To assess the effect of environmental factors on road traffic accidents (RTAs) in Nairobi.
- (b) To analyse how lack of road signs and road crossing points contribute to motor and pedestrian road traffic accidents (RTAs) on the roads.
- (c) To examine the effects of vehicle speeding and speed controls on occurrences of road traffic accidents (RTAs).
- (d) To evaluate the impact of the presence or absence of traffic police and the enforcement on traffic rules and regulations on the increase or decrease of road traffic accidents (RTAS).

1.4 Research Hypotheses

In this study, the following four (4) hypotheses have been formulated and their validity will be tested using the obtained data;

- 1) Ho: There is no significant difference in road traffic accidents between wet and dry road surfaces

Hi: There is a significant difference in road traffic accidents between wet and dry of road surfaces.

2) Ho: There is a significant difference between pedestrian accidents and lack of pedestrian road crossing points and road sidewalks.

Hi: There is no significant difference between pedestrian accidents and lack of pedestrian road crossing points and road sidewalks.

3) Ho: There is no significant difference between driver behaviour in vehicle speeding and road traffic accidents.

Hi: There is a significant difference between driver behaviour in vehicle speeding and road traffic Accidents.

4) Ho: There is no significant difference between lax enforcement of traffic rules & regulations and the increase in road traffic accidents.

Hi: There is a significant difference between lax enforcement of traffic rules & regulations and the increase in road traffic accidents.

1.5 Justification of the study

This study was motivated by the background of alarming statistics of death and injuries due to road traffic accidents (RTAs). According to the WHO report of 2004, 1.2 million people died annually and 20 to 50 million others were injured or disabled through accidents which constitutes 2.1% of all deaths reported globally. Despite the fact that Africa has only 5% of all registered motor vehicles, it still accounts for 10% of global deaths within Sub-Saharan Africa. This WHO report shows that the problem of road accidents is of grave concern in Africa. The Less Developing countries (LDCs) in Africa face poorly maintained roads, poor national policies and inadequate enforcement of traffic laws (GRSSC, 2004). The research in this study will investigate how these factors

contribute to RTAs and hopefully the research findings will guide in formulating countermeasures that can effectively reduce RTAs in Kenya.

The phenomenon of RTAs in Kenya is historical. During the Automobile Association of Kenya (AA-K) 1996 AGM, the Chairman's report on road safety indicated that..... ("Our Kenyan Road Safety standards are appalling. The road carnage continues unabated while we have piles of incomplete statistics, reams of imported traffic theory, political platitudes and public outrage. It is encouraging to note that the Government was in the process of forming a 'Road Safety Authority' (RSA) which urgently needs to spearhead the campaign against road carnage and co-ordinate various disjointed activities in order to come up with a national road safety policy"). This assertion was an honest assessment that road safety activities in Kenya were and are still disjointed and not well co-ordinated to fight the rampant carnage on our roads.

In the GOK Economic Survey, 2006 it is indicated that persons killed through RTAs in Kenya were 2,790 in 2001; 2,782 in 2002; 3,004 in 2003; 2,264 in 2004 and 2,531 in 2005. The annual numbers of those killed in RTAs were high in 2001-2002 and reduced in the year 2003-2004 but were increasing again in the year 2005 (RoK,2004). Because of these high numbers of persons killed in RTAs, the Government of Kenya (GOK) introduced new transport regulations and measures to improve safety on our roads in February 2004. It was expected that the introduction of those road safety measures would have positive impact on the road transport sector and reduce RTAs on our roads. This was not to be as accidents continued to increase from 2005. This study will attempt to investigate the causes of this increase in RTAs despite the new transport regulations and measures.

In spite of the implementation of road safety campaigns by the Government and other organisations, it was noted that since the beginning of the year 2006, more than 1,900 people have been killed in road traffic accidents. The reported 1,930 deaths were blamed on drunken driving, speeding, overloading and un-roadworthy vehicles according to nationwide traffic enforcement returns compiled by the Ministry of Transport (MOT) jointly with the Traffic Police Department (MOT, 2006)..

This scenario where RTAs were increasing while previously they were decreasing between 2003-2006 was of great interest in this study. What factors were in play when the RTAs were declining and what factors were in play when the accidents started to increase again was a great motivator in this study . This scenario motivated this study and the aim was to analyse what environmental and governance factors specifically were in play in those situations of increasing and decreasing RTAs in that period which would continuously lead to increasing RTAs in later years from 2006-2007.

Table 1.5 : Accident Toll January – November 2006

Month	No. of Accidents	Dead	Seriously Injured
January	860	166	809
February	603	111	589
March	1,018	184	721
April	893	186	722
May	909	177	794
June	902	171	720
July	755	126	683
August	926	222	965
September	880	205	788
October	998	188	896
November	862	194	815
Total	9,606	1,930	10,255

Source: Kenya Police , 2006

Comparisons of the classes of people killed in road accidents in Kenya indicates that there was a decline in the number of passengers killed in road accidents from 1,084 in 2003 to 684 in 2004 and to 684 in 2005. On the other hand, the number of fatalities involving drivers, pedestrians and cyclists has been on the increase. Pedestrian fatalities increased from 966 in 2004 to 1,272 in 2005 while pedal cyclists fatalities increased from 306 to 310 respectively as shown in table (1.6).

Table 1.6 : Classes of people killed and injured in road accidents 2003 -2005

Classes	Pedestrians	Passengers	Drivers	pedal cyclists	Motor cyclists	Total Deaths
Year	Killed/ injured	Killed/ injured	Killed/ injured	Killed/ injured	Killed/ injured	
2003	1276/ 5128	1084/ 16301	211/ 2179	333/ 1993	33/ 370	2937
2004	966 / 4394	694/ 10346	244/ 1621	306/ 1818	54/ 430	2264
2005	1272/ 5012	684/ 10975	251/ 1731	310/ 2115	44/ 407	2531

Source: Kenya Police, 2006

The accident toll figures above show that there was on average about 873 road accidents, 175 deaths and about 932 seriously injured people per month in Kenya from the beginning of this year 2006. The months of August and September had the highest number of deaths which points an indicator of possible road accidents problem during the Kenya schools holidays. This may be due youth driving and possible influence of alcohol when driving. This is another area of study to be proposed by the researcher. From the data collected from police traffic records it is noted that the number of those killed in road accidents continued to increase in the city as indicated in table 1.7.

Table 1.7: Numbers of Road Accident victims and nature of injuries; 2006-2011

Road Accident victims and nature of Injuries	2006	2007	2008	2009	2010	2011
Fatal	589	609	633	893	748	728
Seriously injured	1,217	1,377	1,275	1,814	1,799	1,594
Slightly Injured.	2,361	3,050	1,870	1,930	1,944	1,441
Non injury	-					
Total	4,167	5,036	3,778	4,637	4,491	3,763

Source: Kenya Police, 2011: Abstracted and tabulated by the author

Kenya Roads Board (KRB) statistics indicates that about 1.17 million deaths occur each year worldwide due to road accidents. About 70 % of the deaths occur in developing countries. Kenya has the highest road accidents in Africa. 'Out of 100,000 vehicles, about 510 are involved in fatal accidents in Kenya compared to 260 in South Africa and 20 in the UK. 65% of deaths involve pedestrians and 35 per cent of pedestrian deaths are children. Unfortunately, road safety trends in Kenya are worsening with the reluctance of the 'Michuki policy', which advocated for a maximum speed of 80 kph and that all vehicles must be fitted with safety belts. A new 'policy' of reckless driving seem to unfolding and taking over from the Michuki one; David Manoa, 2009.

The traffic police estimates on accidents throughout the eight provinces of Kenya for the years 2008 to the year 2011 show a consistently high rate of road accidents for the city of Nairobi as shown in the table 1.8:

Table 1.8: Number of accident victims for years 2008, 2009, 2010 and 2011

Month	Numbers of accidents per year				
	2008	2009	2010	2011	TOTAL
NAIROBI	2368	2919	2227	1170	8684
CENTRAL	1559	2181	1942	625	6307
NYANZA	986	1254	1008	591	3839
COAST	1660	1803	1272	624	5359
RVP	1830	2040	1626	820	6316
EASTERN	1520	1259	995	590	4364
WESTERN	945	836	671	387	2839
NEP	341	77	30	73	521

Source: Kenya Traffic Police Department, 2011

This table shows very high accident figures for Nairobi in comparison to the other regions in Kenya. Nairobi has a consistently high number of accidents for the four years running, followed by central, Rift Valley , then Eastern. North Eastern region has the lowest cumulative accident figures. It is also worth to note that some environs of Nairobi city are in central province This is why a research study of road safety problems in Nairobi city is justified.

The nature of road safety problems in Kenya is of grave concern to the economy. Road traffic accidents are by and large a health problem and they have a restrictive effect on the economic development of our country. Through road accidents, resources that are already strained; such as limited vehicle fleets, transport capacity and medical services are further constrained. An additional factor is loss of output which constitutes the cost to the communities when persons meet untimely deaths through RTAs or are so severely injured that they can no longer work. This study on road safety problems is justified because it attempts to investigate the causes of RTAs from a multi-sector point of view encompassing environmental and governance factors of road safety.

Countries throughout the developing world are characterised by rapid urbanisation and high growth rates in traffic. This leads to congestion which requires some regulation of transport. And because the majority of the developing world's inhabitants are dependent on public transport; the need for safe, efficient and effective public transport services is essential to ensure adequate and affordable accessibility, for sustaining livelihoods, rural and urban development (Pearce, 2000). The aim of this study on road safety problems is to seek for solutions that will enhance safety on our city roads in order to make resources and amenities more accessible and attract investments for development.

The Africa Road Safety Review-Transport Research Laboratory (ARSR-TRL, 2000) report indicates that there is inadequate road safety data from Africa and no comparable study of road safety in the countries of Africa has been undertaken in recent years. While there might be some doubts in the accuracy of this observation by the ARSR-TRL, this is a challenge to Transport Geography scholars and professionals in Africa. The observation implies that there is inadequate RTAs data in Africa for comparison and planning purposes, thus a research gap exists in road safety data in Africa. This study will attempt to fill such research gaps and improve road safety data for Kenya.

Road safety becomes an issue when people die or injured in RTAs, and there is significant damage to vehicles on the road. With the rapid pace of road development in Kenya, the road safety situation seems to continue to deteriorate. While a better road environment alone might not guarantee safe driving, road safety is aggravated through inadequate guidance and information to drivers and if the roads themselves are not designed to minimise risks of accidents to road users. It is the aim of this study to investigate the reasons behind this deteriorating state of road safety in Nairobi city-Kenya and suggest ways of reducing the problem through co-ordinated action plans of road

safety measures.

In developing countries, including Kenya and Tanzania, road traffic accidents are increasing with time and mortality due to road traffic accidents is also on the rise (Asogwa 1992). When taking the population figures into account, developing countries in Sub-Saharan Africa have the highest frequency of various accidents worldwide. Although an implication of this is that the risk environments in countries need further empirical attention, few studies have investigated how people in those societies perceive risk. This scenario calls developing countries to put more effort toward control and prevention of road traffic accident and their outcome. This can be achieved through multidisciplinary approach and research, Peden et al,(2004).

The frequency, magnitude and impact of road traffic accidents in Kenya are worrying. The bulk of crash victims are productive people who still have important roles to play in contributing to economic development. Many families have been rendered destitute due to loss of their economic providers as a result of road accidents. In some instances, entire families have died due to road accidents. The African continent averages 28.3 deaths per /100,000 thousand population representing 10 per cent of road fatalities in a continent with less than 4 per cent of the world's vehicle fleet. In comparison, Kenya's fatalities stand at 34.4 per/100,000 population; ROK, 2013.

In Kenya recent road transport policy measures that have some impact on road safety include road construction and rehabilitation, for instance, the erection of an over-rail at Maai Mahiu-Naivasha-Lanet road near Naivasha town and an interchange near Athi River as well as the expansion of the Nairobi-Thika highway. The ministry of transport also

launched the National Road Safety Council, comprised of various stakeholders in the road transport sector, to coordinate, monitor and evaluate road safety and accident prevention measures, maintain a database and conduct research to improve policy. However, the effect of the council is yet to be felt as it has not yet been elevated to a national authority and therefore lacks the power and legal authority to function as an independent body. With these and other inadequate reforms and uncoordinated efforts, it is no wonder then that RTAs continue unabated on our roads Ounga, (2011).

Road safety information and awareness plays a great role in teaching road users safer road behaviours and it informs them about the meaning of road signs and markings. If the road users are unaware of the meaning of road signs and markings, they are unlikely to obey them. If there are no road markings, road signs, pedestrian ways/crossings or traffic islands it may be more difficult or even dangerous for them to carry out the required traffic road use manoeuvres and the traffic police may find it even more difficult to enforce the traffic rules and regulations.

1.6 Scope and limitations of the study

The scope of this study examines the environmental and traffic laws enforcement factors that influence RTAs. The research in this study analysed the environment road safety factors which contribute to road safety problems on the roads. Some of the physical environmental factors considered in this study are road conditions, traffic road signs and pedestrian ways on the RTAs black spots. The study also examined traffic rules and regulations; and the traffic laws enforcement factors that influence road safety aspects. Some of the road safety governance factors to be considered in this study are driver licensing, the enforcement (or lack of it) on traffic rules & regulations. The broad view in this research is that road safety problems emanate from RTAs.

The other limitation of this study was the difficulties of interviewing PSV drivers at the bus stations and bus stops when available. As understood from the experience of PSV operations, drivers and conductors are generally rude and can refuse to answer questionnaires. The private car drivers were also very impatient and most of them were in a hurry to answer the questions in the questionnaire. The other limitation was that the traffic police officers were also very busy and were continuously interrupted during the study by call of duty and sporadic duty allocations.

The limitation of this study is that it does not cover the road construction factors and the road engineering aspects which might be contributing to road safety problems. It was expected that in the study of road accident black spots, some aspects of road engineering and road construction could crop up as contributors to RTAs. But this study will isolate only the environmental and the traffic laws enforcement governance factors for analysis as contributors to road safety problems on the roads through RTAs.

Another limitation of this study is that it does not consider how the aspects of motor vehicle type might be contributing to road safety problems on the roads. The type of motor vehicles on particular parts of a road can contribute to RTAs, but this study will focus mainly on the governance aspect of licensing of drivers and does not assess the licensing of motor vehicles (based on its condition) in consideration of the traffic laws enforcement as mitigations for road safety on the roads.

The other limitation of this study is that it does not consider the contribution of driver education and driver training to the road safety problem. But the study analysed driver licensing and driving experience conditions in order to verify their contribution to road safety on the roads. In order to understand the root causes and the reasons for the recurrences of road traffic accidents, this study critically analysed the contributions of the

environmental factors and the law enforcement governance factors to road safety problems on the roads through RTAs.

The other limitation of this study was the difficulties if interviewing PSV drivers at the bus stations and bus stops when available. As understood from the experience of PSV operations, drivers and conductors are generally rude and can refuse to answer questionnaires. The private car drivers were also very impatient and most of them were in a hurry to answer the questions in the questionnaire. The other limitation was that the traffic police officers were also very busy and were continuously interrupted during the study by call of duty and sporadic duty allocations.

In order to mitigate and circumvent the above limitations , research assistants were detailed on how to handle the PSV drivers carefully as they administered the questionnaires to them. In most cases they employed a wait method where the drivers were questioned when they had a rest period from their trips. The other method used to circumvent the limitations was by allowing the private vehicle drivers ample time to answer the questionnaires after finishing any matter at the bus stops and supermarket parking bays. To mitigate the traffic police officers limitation, the study concentrated very much on the traffic police records at the stations and closely liaised with the station traffic officer in charge of traffic records. All in all the study collected adequate data from the individual station traffic police records and counterchecked the same from the Nairobi area over all traffic records for all stations in Nairobi. Also ample data was collected from field observations of the road accident black spot sites studied.

1.7 Operational Definitions

The following are some of the operational definitions and terminologies used in this study;

a) Road Safety:

A secure and safe road for all road users devoid of accidents (Banda, 1994).

b) Road Traffic Accidents (RTAs):

Occurrences on the road either fatal, personal injury or damage to property (Agoki, 1992).

c) Traffic Conflict:

A traffic event involving one or multiple users who performs some typical or unusual action that places another or others in jeopardy unless an evasive manoeuvre is undertaken: (Banda, 1994).

d) Fatality Rate:

This is measured by the number of the people killed in road accident crashes per 10,000 vehicles in a particular Period: (ARSR-TRL, 2000).

e) Fatality Risk:

This is measured by the number of people killed in road accident crashes per 100,000 population: (ARSR-TRL, 2000).

f) Motorisation Level:

This is the measure of the number of vehicles in a region per 1,000 populations:
(ARSR- TRL, 2000)

g) Accident Risk:

This is the number of negative events (fatalities, injuries accidents) divided by some measure of risk exposure e.g. Vehicle/KM, Person/KM. Measures of risk for road sections are expressed as the number of accidents per vehicle KM and for road intersections it is expressed as the number of accidents per incoming vehicle: (ARSR-TRL, 2000)

h) Environmental Factors:

In this study, these are the social and physical factors that contribute to road safety

Problems on our roads. These include the road users' awareness /un-awareness of road safety concerns, driver driving fatigue, peer group influence, road surface and road furniture conditions which affects road safety: (Wasike, S.K, 2000)

i) Governance Factors:

In this study, these are the traffic laws enforcement factors that contribute to RTAs or assist in their reduction. Those factors includes the driver/ motor vehicle licensing, motor vehicle insurance, traffic rules & regulations, enforcement of traffic laws (or lack of enforcement) which affects road safety (KACC, 2006).

j) Road Accident black spots:

This refers to the road sections which are considered risky to the motorists due to the high number of accidents that have occurred in their vicinity. Motorists are advised to take extra care when driving on those road sections (Kenya Police website, 2010).

k) Case Fatality Rate (CFR)

In epidemiology studies this refers to the proportion of deaths within a designated population of "cases" (people with a medical condition), over the course of the disease. A CFR is conventionally expressed as a percentage and represents a measure of risk. In this study the term refers to road traffic accidents fatalities.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section expounds on the previous research findings on road safety problems, road traffic accidents and traffic law enforcements. The view here is to examine key factors or shortcomings on the adequacy of the information and any research gaps in this field of road safety.

There are inadequate data records on road traffic accidents in the LDCs of which Kenya is part. This inadequacy leads to a literature gap on road safety problems in Kenya. Due to this problem, this study relied mainly on relevant road traffic publications, road safety conference papers, specific road safety project reports, traffic police records, the print media and the internet. The literature review is in two parts, namely the theoretical literature review and the empirical literature review.

2.2 Theoretical Literature

This chapter captures the relevant literature reviews on the theories behind the origin and evolution of road transport systems in relation to the occurrences of road accidents, road safety experiences and the overall environmental and governance issues that relate to road safety. This review gives an account of the main theories employed in addressing the issues of RTAs and the factors that may affect their occurrences and their severity. This describes the major themes that have emerged from the literatures reviewed on road transport development models, transport operations and road safety problems in connection with RTAs.

Theoretical literature on transport studies gives an account of the origins and evolution of the modes of transport and in this case on road transport studies. Theoretical approach to transport studies has attracted interest by many scholars and it is very well postulated in a three factor typology model by (Ullman 1956) seeking to account for variations in spatial linkages between places and to explain the conditions that affect transportation development. The factors of complementarity and transferability as explained by Ullman are based on the notion of location spatial variations in the availability of resources and services, and how interactions between these locations depend on availability of space for infrastructure and other economic activities. The infrastructure in this view implies that the road conditions, the layout and the prevailing environmental factors have some effects on the road users both motor and pedestrians. These effects can be of either smooth usage of available road spaces or conflicts on the usage of the available road space which can lead to RTAs. Due to such conflicts eventually road safety problems occur in the exploitation of available resources and services. RTAs are as a factor in these road safety problems due to road user conflicts.

According to Ullman (1956), the concept of intervening opportunity is based on the relative location of places that generate traffic. Interaction tends to be highest when the interacting pair of places is close and there is no nearby substitute. The influence of intervening opportunities on traffic density and the amounts of traffic flows tends to be higher in a city like Nairobi due to the closeness of the interacting places like residential areas, shopping centres, schools and working places which increases the demand to meet a myriad of tasks and assignments at the same period. It is presumed here that the farther the travel the more likely that RTAs may occur unlike in shorter travel.

The views of Ullman (1956) on complementarity and transferability of services on relative locations where there are limited intervening alternatives have some relevance in the way road users strive to use the most convenient road connections to reach their destinations. Due to high interaction in cities and the lack of nearby substitutes in the intervening opportunities, there are tendencies of rushing to meet obligations and this can result in road user conflicts and errors leading to the occurrence of RTAs on the roads. This study embraces the views of Ullman (1956) to understand the causes of RTAs in Nairobi city.

From the Taaffe-Morril-Gould mode (1963) it is implied that radial road network developments around cities with no outer city expansions leads to short distance competitions for available road spaces and this can cause RTAs (Taaffe, Morrill, Gould, 1963). This development of roads has a paramount impact on the increase in road user traffic problems and in event influences the occurrences of RTAs on our roads thus affecting road safety. The road network environment in Nairobi city has some effects on the road users and this study goes farther and examines its influence on RTAs.

Rice (1987) indicates that towns act like magnets which attract people and commodities. Therefore transport routes radiate into surrounding peripheral areas, and he suggests that transport network is directly proportional to the population served by a particular town. Transport network is used to move people and commodities to and from town. As the population grows the requirements of transport increases and in effect competition by road user tends to increase as they struggle to communicate from one area to another. This communications model by Rice assumes that as the cities attracts more people and commodities and the infrastructure does not grow at the same rate, competitions for the

available road space will lead to road user conflicts and in effect RTAs would occur. This study examines whether the communications model by Rice has any influence on the causes of RTAs in Nairobi road safety problems.

According to Harris *et al.*, (1972), statistical estimates of accident probabilities through research revealed that real accident frequencies can be greater than expected after prolonged periods of driving under certain conditions. In the U.K., the introduction of a maximum number of permitted hours driving per day of 10 hours was associated with a decline in suggestive observations, with few exceptions Brown *et al.*, (1970). An unambiguous relationship between hours of driving and increased risk of accident has not been demonstrated experimentally. If a truck driver, or for that matter any driver, drives continuously for a prolonged period it is generally assumed that at some point his performance will deteriorate. Furthermore it is often assumed that attempts to continue driving beyond that point may be associated with an increased likelihood of accident.

This line of reasoning is implicit in road safety legislation which limits the number of hours a heavy goods or long distance passenger vehicle driver may drive either over a continuous period of time, or within a specified period of time such as 24 hours. These statistical estimates do not consider other environmental effects on the driver's increased risks of accidents when driving. A prolonged period of driving cannot be the only cause of accident risks. This study goes farther to identify how the driver working environment and the governance policy on driving regulations mitigates the causes of RTAs thereby affecting road safety.

Hofmeier (1973) indicates that transport system is not the only variable in a development process but rather it is an integral part of a country's infrastructure which affects all the decisive impulses that stimulate economic activity. Transportation is therefore one of the many ingredients necessary for accelerating the pace of economic activities and facilitates the exploitation of natural resources by overcoming the barrier of distance. In this scenario the barrier of distance as postulated by Hofmeier (1973), can be overcome by development of road systems which increases mobility. As mobility increases, the competition on the available road spaces by road users increases also. This leads to various road users conflicts on the roads which can result into RTAs. This study assesses the environmental factors that come to play when economic activities are accelerated in the exploitation of natural resources and their effects on the road user's safety on the roads.

Hurst, (1974), in the gravity model provides a fundamental theoretical base for analysing movement, and it creates a deterministic framework in which movement is always to the nearest area. Ongaro (1995) indicates that the gravity model does not state why spatial interactions occur. It is therefore, used as a device for analysing the relationship between traffic flow volumes and the distance covered as a guide for identifying factors which may account for the current structure of Kenya's road network.

If the gravity model had attempted to examine why spatial interactions occur, the element of competition would have surfaced to explain how the conflicts would cause friction and would have explained the possible causes of road accidents on the roads. However, the view in the gravity model that movement will always be to the nearest area or point, has some connotation in road safety where some drivers are tempted to take road shortcuts and manoeuvres on the roads with no consideration of the hazardous environmental

conditions or the existing traffic rules and regulations. Movement of either motor vehicles or people on different road environments can influence the safety on the roads, and this was considered in this study.

Ogonda, (1986) states that Kenya road network has gone through a series of changes from initial lines of trails, passing through a system of old tracks and earth roads to a complex network of gravel and bitumen highways. Road transport is the most dominant mode of travel due to its accessibility, flexibility and speed. It controls over 70% of passenger and public transport in Kenya (GOK, 2004; Chitere, 2006; MOT, 2006). The transformation of road network in Kenya seems to be similar to the Taaffe-Morril-Gould model (Taaffe, Morrill, Gould, 1963) on radial road network developments. Ogonda does not relate how the radial road network in Nairobi affects or influences the land use and the usage of roads by the various road users. In most cases competition for the available road space causes conflicts and due to the prevailing road environment and the governance policies in place RTAs can occur.

The economic development of any country requires an adequate and efficient transport system both for long distance and local uses in the exploitation of natural resources, the movement of passengers, the marketing of agricultural commodities, the distribution of farm inputs, the development of manufacturing industries, the expansion of trade, and the promotion of health and educational services as well as in exchange of ideas (Weightman, 1976, Howe, 1984). All these operations require safe and reliable transportation systems. It is with this view that Road safety becomes a vital factor in transportation systems in order to reduce transportation losses which can occur due to RTAs or unnecessary delays.

This literature review reveals that the growth of cities and the development of road networks do not consider the increasing populations, the various road users' needs, and the complementarity of service requirements in relative location of places that generate traffic and interactions. The growth of cities and the development of road infrastructure greatly affect the environmental conditions of road users. This also affects the setting and implementation of governance rules and regulations for road users in order to reduce RTAs and improve road safety.

With this theoretical background, the present study attempts to identify the environmental and governance factors that contribute to RTAs and propose ways and methods of reducing them and improve road safety in Nairobi city. Then this review will give an account of the main theories and applications employed in addressing the road user issues in road transport and the need for road safety planning.

2.3 Empirical Literature

Many researchers have tried to find out the causes of traffic road accidents in countries the world over. The research reports compiled on road traffic accidents forms the base of literature on road safety studies. Some of these researches on road accidents are carried out by government agencies, international organizations such as the UN, individual scholars and researchers. This chapter reviews the already available information on road traffic accidents as the causes of road safety problems from an environmental and governance point of view.

The aim here is to find out what others have learned, reported and reviewed with regard to RTAs and road safety. Due to the fact that there is a gap in road accidents data and literature reviews pertaining to road safety, this study relies mainly on publications, newspaper reports, conference papers, project reports and also the internet. Other

references in this study are Kenya police traffic records, the Ministry of transport road traffic accident reports and also the print media. The empirical literature review describes the themes that have emerged from the other literature reviewed on road safety, the causes of RTAs, the governance systems in place in the enforcement of traffic rules and regulations as road safety measures.

Verberckt (1987) suggests that environmental issues do not influence modal choice in passenger transport. He identifies speed, frequency of service, costs, comfort and accessibility to a place as the major determinants of modal choice in passenger transport. He further suggests that railway transport is the most environmentally friendly mode of transport, yet, as long as economic system allows people to freely choose a mode of transport, only a marginal proportion of them will voluntarily use trains in the interest of the environment. Does safety really influence the choice of mode of transport? This study attempts to address this question.

As argued by Verberckt, the modal choice in passenger transport identifies speed as one of the factors in play. Speed has causal effects in road accidents and in fact it is of major concern in road safety programmes of many countries. This study will attempt to identify the environmental and law enforcement governance issues which influence the need for speeding on roads and the need for all concerned parties to take cognisance of these issues to enhance road safety on our roads.

In Jordan, a report from a study of traffic accidents at hazardous Locations of urban roads indicates that road accidents represent a major social and economic problem that causes a lot of losses in lives and injuries (Mohammed T. O. and Thanaa M. R., 2012). In this study, a new approach was used to tackle the traffic safety issues in urban roads. The approach used stepwise regression statistical analysis concepts besides traffic accidents

contributing factors in order to check urban roadway design efficiency as far as safety is concerned during early design stages. This study found that logarithmic and linear statistical models could efficiently and practically predict the expected numbers of accidents, injuries, fatalities and their associated types as functions of numerous independent variables. It was found that the most important contributing factors to traffic safety issues at urban roads were geometrical, behavioural, traffic condition and environmental factors. The most contributing factors to accidents at hazardous locations on urban roads were speed, degree of curvature, road surface type, traffic properties, number of horizontal and vertical curves, lighting conditions, as well as roadway geometry and dimensions.

The traffic accidents study in Jordan undertook an engineering mathematical approach of statistics to study the causes of road accidents in the hazardous locations of urban areas in Jordan. From a similar point of understanding the causes of road traffic accidents in Nairobi city, this study took a geographical view to study the road accident black spots. Borrowing from the Jordan study, the scope chosen for this study were traffic conditions, environmental factors, speed, road surface type, traffic properties as well as roadway features and dimensions of the road accident black spots in Nairobi city.

In Bangladesh, a study was carried out with an objective of finding out accident and fatality rates and corresponding trends (Mohammad S. Alam ,2011;World Universiy, Dhaka, Bangladesh). In this study relevant data was collected and then accident and fatality rates and trends were calculated mainly in terms of unit motor vehicles and vehicle kilometres travelled for the whole country. Important aspects about accidents, rates, trends and other relevant factors were found throughout this study. Despite all those features that indicated a possibility of increase of accidents, number of accidents and

fatalities per 10,000 registered motor vehicles/vehicles plying on road and per 100 million vehicle kilometres that were calculated in this study, they indicated a decreasing trend over time. But it does not and should not bring about total contentment of the situation because the accident numbers were are still high and more and more cares and measures should be brought in action for further improvement of the scenario. This study strongly recommended that vehicle kilometres travelled are not only essential in calculating accident or fatality rates but also in many other important safety and economic analysis in transport sector and the government should officially perform and maintain such records for monitoring road accident trends for road safety measures.

In another study of road accidents in Bangladesh (Naila Sharmeen Islam ,2011) it is highlighted that driving speed has direct influence on the number and severity of road accidents. Driving speed combined with human factors like drivers' attitude, driving skills, pedestrians' road use behaviour and environmental factors like road condition, density of road side activities, weather condition etc. are the main contributing factors to cause road accidents. Speed restriction can be considered as the safest and fastest way to reduce number of accidents on roads. This target (lowering accident rates) cannot be reached without continuous cooperation with all stakeholders working in road safety and without Government support:

In Pakistan (Abdul Tehreem, 2012) a study was carried out with an objective of highlighting the main causes of road accidents, it was observed that the main reason of traffic accidents was due to lack of awareness about rules and regulations. In this study, it was recommended that the Government may create awareness in public by offering different courses in educational institutes and also distribute some material for drivers and for general public also. Government needs to make some core courses/ training before the

provision of license and traffic police should keep strong check and balance in this regard. These all issues that relate to traffic laws governance which is an area covered in this study.

The Transport Research Laboratory (TRL) under the funding of the British Government's Department for International Development (DFID) carried out a study on the extent and likely causes of bus accidents in Nepal, Zimbabwe, Thailand, Tanzania and in the Indian state of Maharashtra which were all assumed to be representatives of emerging nations (Tim Pearce-TRL, CIT World issue no. 2, 2000). The study covered the period 1992-1997. In Nepal, the study indicated that between 1995-1996 bus accidents represented 39% of all road fatalities and 60% of all road casualties and they represented a significant proportion of all road accidents, fatalities and injuries.

Driver error was the major factor in the 74% of the bus accidents and 18% was due to external factors. The Zimbabwe's 1996 Police statistics showed that 58% of bus accidents were classified as blameworthy by human error through reckless driving, inattention, lack of judgement, speeding, driver fatigue and the use of unqualified and inexperienced drivers. Thailand's 1997 police records showed that 74% of all accidents on the inter-city and inter-district highways were due to driver behaviour, with the remaining causes due to external and vehicle defects. Driver error was the overriding factor involving state-owned vehicles.

In all the countries studied, road accidents were increasing over time. Overwhelmingly driver behaviour was the major factor in bus accidents. The overriding factor was how to improve bus driver behaviour. In summary the report recommended that drivers needed to be better educated and trained and when initially learning to drive; taught technical, social and psychological skills; and to participate in refresher driver training courses. This study

dwelt very much on the driver behaviour as the main cause of RTAs and seems to ignore the social and physical environment under which the driver operates and the effectiveness of the traffic laws enforcements in place that can curtail occurrence of RTAs. It is agreed that one single factor was unlikely to cause an accident and that a combination of causes was the likely explanation. While not ignoring that driver behaviour has some contribution to RTAs, this study will critically examine how the social environmental factors, the driver's background and behaviour can influence the occurrence of a RTAs and how lack of effective governance structures contribute to RTAS.

The TRL- UK, 2000 research shows the effects of speed on crashes and collisions. First when exceeding the average speed by 25% a driver is about 6 times as likely to be involved in an incident in comparison with a driver adopting the average speed. Second the number of crashes and collisions increases with increasing average speed and the effect varies on different road types. Third the intervention measures like traffic calming measures (e.g. road humps) in 20mph zones reduces average speeds by about 10mph and this resulted in a 50% reduction in collisions.

This research shows that speed contributes to RTAs and relates the same to the road types, but it does not examine social environmental factors that influences over speeding by drivers and the speed control mechanisms in place to deter tendencies of the over speeding. This study will look at the road sections commonly referred to as accident "black spots" where drivers tend to over speed leading to vehicle crashes. Then the study will also assess the environmental factors that tempt over speeding causing RTAs and the governance measures that are put in place to control such tendencies of over speeding in order to reduce RTAs.

Sub-Saharan Africa has emerged as one of the worst hit areas in terms of road carnage. Komba (2006), notes that RTAs in Tanzania had increased by 60 percent in the ten year period between 1994 and 2004. Libinjo (2009), also noted that Africa's most populous country, Nigeria, had a high occurrence of RTAs killing up to 200, 000 road users annually. Road traffic accidents are, however, not a uniquely African problem. Peden (2004) notes that road traffic accidents are a common feature in Latin American countries such as Vietnam and Cambodia. In Vietnam, this problem is attributed to the increase in the number of vehicles especially motorcycles by an average of 10 percent every year. In Cambodia, a report by the Ministry of Works and Public Transport in 2007 ranked road accidents as the second biggest national disaster after HIV/AIDS with the devastating effects of loss of life, property and disruption of social harmony.

In Nigeria, a population based survey study on RTAs conducted in 2009 by Libinjo et al (2009) it was revealed that RTAs was a significant problem claiming approximately 200,000 Nigerian lives annually and injuring 4 million more. The loss to the economy was also considerably high at \$25 million per annum. The study also found that men were more at risk of being involved in road accidents than women, while younger people, especially those aged 18- 44 years, formed the bulk of road accident victims.

In Kenya, some issues and activities related to road safety are documented in the road safety improvement project study report by the Ministry of Transport and Communications, Kenya; the Ministry of Foreign Affairs, Finland and Viatek Consulting engineers, Nairobi in August 1980. The 'Matatu-relevant' recommendations for road safety were made in this report. The report addressed among other factors regular vehicle inspections, analysis of basic data on road accidents, intensification of traffic laws enforcement and acquisition of new enforcement equipments. The report recommended

that road safety be made an integral consideration in Urban planning. This report shows the importance of urban traffic planning for road safety and enforcement of traffic rules & regulations. This study will go farther in addressing the missing link where all the road safety stakeholders comes together to formulate road safety programmes and countermeasures in order to reduce RTAs in Nairobi city-Kenya.

Agoki (1992) indicates that RTAs causation factors may be traced to the road users, vehicles or the road environment; and in Kenya the proportion is 80% traceable to road users, 6% to vehicle and 14% to road environment. In Nairobi province the contribution by road user factors is as high as 94% and an analysis of road traffic accident characteristics in Nairobi Province revealed four major groupings of factors influencing RTAs namely; pedestrian factors; land use factors; road layout factors, vehicular factors and traffic control device factors (Agoki, 1992).

It was further noted in this analysis that these factors influenced one another and a single solution or an arbitrary set of un-researched measures cannot resolve the complex issues in RTAs particularly in urban areas like Nairobi. This analysis dwells to a large extent on the physical environmental factors as the major causes of RTAs and does not consider how the inter-dependence of the social environmental and governance factors causes RTAs leading to road safety problems which this study will cover.

The Economic survey of Kenya 1993 indicates that buses, Lorries, taxis (including Matatus) are responsible for most of the road traffic accidents (RTAs) in Kenya which is critical for road users' safety. Over 40,000 able bodied persons were killed in road accidents since independence, while over 300,000 sustained unwarranted injuries. This shows that since independence, Kenya was losing about 1,334 persons per year in RTAs thus a major road safety problem (Rok, 1993). The ridding factors in this study on RTAs

will explore in more details the road user factors, the environmental and the governance factors that contribute to the high accident levels in this case study of Nairobi city.

In Kenya, Irandu (1995) indicates that development and expansion of road transport system has been revolutionary because of efficient and quick exchange of goods and services between distant places which would not be accessible by any cheaper and convenient by other modes of transport. This development has led to increased road traffic accidents in Kenya. Among the recommendations by Irandu (1995) are that, drivers of Matatus and proprietors should be well trained and informed on traffic management and made aware of road safety issues. Irandu recommends that roads should be regularly maintained to make them motorable and to reduce road traffic accidents (RTAs) and all road users should be made aware of the importance of road safety in order to minimise RTAs. This recommendation by Irandu takes cognisance of the fact that there are some environmental and governance factors that to a larger extent affects road safety on our roads in one way or another. This study goes farther to examine the environmental and traffic laws enforcement factors which affect road safety in Nairobi city.

In road transport studies conducted on the matatu industry by Khayesi (1997) and Kapila, et al 1986 in Kenya show that the burgeoning matatu industry, estimated to employ about 160,000 workers currently, is not immune to road accidents. A study of drivers in Eldoret town completed by Muyia (2004) found that 97% of the drivers interviewed had been involved in one or several accidents. Based on the information collected from the drivers and conductors interviewed, it was concluded that poor work conditions were to blame for road accidents: the workers toiled for many hours for months on end, working on contractual basis with no added benefits. They were also not associated to any Sacco which could help better their livelihoods or matatu association to fight for their rights.

These studies also focused on employment patterns, educational and work qualifications of the drivers and conductors. It was discovered that employment of the workers was based on family and friendship ties. 80% of the drivers and conductors had good educational qualifications, up to upper primary and secondary level, and several years work experience in the matatu industry.

The Economic Survey of Kenya 2006 indicates that persons killed through RTAs increased from 2,790 in 2001 and 2,782 in 2002 to 3,004 in 2003; but reduced to 2,264 in 2004 but increased once again to 2,531 in 2005. It seems that the introduction of new road safety rules and regulations through a legal notice no. 161 of in 2003 (commonly referred to as “Michuki rules”) by the government brought some sanity that was experienced in the public service vehicles through this drastic reduction of RTAs. The Michuki rules of 2003 had very strict enforcement of traffic rules and regulations on the roads and this might have influenced the above reduction of RTAs (RoK, 2006).

Chitere and Kibua (2006) indicates that the enactment of the Ministry of Transport Legal Notice No. 97 in 2004 on Public service vehicles (PSVs) achieved a reduction of accidents in Kenya from 6,602 in 2003 to 3,907 in 2004 as tabulated on table 2.1;

Table 2.1: Road Accidents Comparisons in Kenya, Feb-July 2003-2004(in numbers)

Accidents	Feb-July, 2003	Feb-July, 2004
Fatal accidents	1,047	616
Serious accidents	2,110	1,199
Slight accidents	<u>3,445</u>	<u>2,092</u>
Total	<u>6,602</u>	<u>3,907</u>

Source: (MOTC, 2004)

Although there might be other factors that might have contributed to the decrease in RTAs by PSVs, the above achievement might be having some bearing on the governance instruments enacted in the legal notices in the enforcement of traffic laws in Kenya. This study will mitigate farther the governance factors and mainly the enforcement of traffic rules and regulations; and if deterrent measures employed through our traffic courts to control RTAs can improve road safety on the roads.

Chitere (2006) indicates that there was high non-compliance by PSV drivers with the traffic rules and regulations despite enforcement by the police and some policing by passengers. On Policy, legal and regulatory framework, Chitere indicates that the main governance problem in the PSV sector is that the policy and legal framework as well as the regulations have been unilaterally formulated and enforced by the government without consultations with key stakeholders.

This assertion by Chitere does not take into consideration the composition of the Transport and Licensing Board (TLB) where the PSV operators are also incorporated as stakeholders in the formulation of passenger transport policies. So the question is ‘why is there rampant non-compliance by PSV drivers with the traffic rules and regulations despite the existence of traffic police enforcements and court fines for offenders. This non-compliance to the traffic rules and regulations has some issues of governance and the operating environment of PSVs which this study will look into with the aim of understanding their contributions to RTAs.

During the launch of the National Road Safety Action Plan and Chunga Life Campaign by Shell Kenya on 04/04/2006, it was indicated that both private and commercial drivers in Kenya drive irresponsibly without courtesy creating a potentially disastrous situation on the roads. The need for a National Road Safety Action plan (NRSAP) was mooted to make the roads safer and prevent death and damage from RTAs. The Government and all stakeholders were included in this alliance to ensure the success of the National Road Safety Action plans through road safety enhancement efforts taken jointly by the Ministry of Transport, Traffic Department and the Transport Licensing Board. This was a good effort of tackling road safety problems and this study will examine if there has been any effort to implement the proposals given during this action plan, GOK-National Road Safety Action Plan report (GOK-NRSAP, 2006)

In Kenya, privately-owned minibuses (*Matatus*) are the most popular form of local transport (PSV) in Nairobi city and they generally have a capacity of 14 passengers. For over 2 decades the matatu mode of PSV has constantly been identified with chaotic operations that jeopardize the lives of passengers and other road users exposing them to the glaring dangers of RTAs (Chitere, 2006). In 2004, a law was passed in which all matatus had to include seat-belts, speed governors, and all be painted in a uniform white with yellow band across it. Many deaths had been caused by dangerous driving and overcrowding in matatus, hence the new traffic rules and regulations introduced in 2004. These are some of the governance factors to be considered in this study in order to verify the effects of good governance or lack of it in the occurrences of RTAs.

Accident toll in Kenya continues to be a problem on our roads in spite of the road safety campaigns by the Government and other organisations. A nationwide traffic enforcement returns compiled by the Ministry of Transport (MOT) jointly with the Traffic Police Department from July-November 2006 show that at the beginning of the year 2006 more than 1,900 people were killed in RTAs. The reported 1,930 deaths were blamed on drunken driving, speeding, overloading and un-roadworthy vehicles. The accident toll figures reported in this return indicated that there was on average about 873 road accidents, 175 deaths and 932 seriously injured people per month from January to November 2006 (MOT, 2006).

The quoted aspects of drunken driving and over speeding as the causes of deaths through RTAs have social environmental behavioural factors and governance issues which this study will attempt to cover and seek to explain their interplay in the occurrences and severity of RTAs. The literature reviewed shows that there are several determinants of RTAs that according to the objectives of this study can be classified into two broad categories; social (human)/ physical environmental factors and the traffic laws enforcement/governance factors. However, there is inadequate documentation on the broader underlying factors of RTAs such as the deficiencies in the records of court fines for traffic offences and the ineffective traffic laws enforcement procedures.

Mitullah and Asingo (2007) indicate that the implementation of the legal notice No.161 significantly reduced cases of road crashes in Kenya in the first part of 2004 compared to 2003. However from June 2004, road crashes began to escalate as people started reverting

to the old business as usual syndrome of non-compliance to the traffic rules and regulations. The begging question in this case is why this state of non-compliance to the traffic rules and regulations emerged after the initial compliance situation led to reduction of fatalities from RTAs.

Literature also reveals that introduction of traffic laws and effective enforcement of these laws are some of the key factors to be considered in road safety programmes for reduction of RTAs as implied by Mitullah and Asingo (2007). However, attempts in Kenya to enhance road safety through road safety programmes have been proven inefficient and ineffective due to limited authority and responsibility, lack of resources, qualified personnel and logistical support. The GOK introduced legal notices to streamline the road traffic operations in order to curb RTAs but enforcement problems seem to still persist. This study analyses the critical factors that contribute to RTAs from a wider perspective of environmental issues and the traffic laws enforcement/ governance regulations in order to understand the real causes of RTAs for efficient solutions to road safety problems.

This study examines if there is an element of laxity in the enforcement of the traffic rules and regulations which might be contributing to the issue of non-compliance to the traffic rules and regulations. This study examines and evaluate the road accident occurrences in Nairobi city road accident black spots in line with the introduction and enforcement of traffic rules and regulations.

In these studies, the link between human factors and road accidents has been clearly drawn out. Of particular emphasis is the effect of the use traffic laws enforcement mechanisms on vehicle drivers and road structures/conditions and how this influences road traffic accidents (RTAs). It is also important to note the recommendations given for reducing road accidents. For instance where road safety intervention measures included both general measures targeting the entire road industry and specific measures aimed at road users. Such a comprehensive approach is what is needed to curb the menace of RTAs as it not only deals with the symptoms of road accidents but also ensures safety is achieved in the long run with immense economic, social and other benefits to a country.

2.4 Theoretical Framework for Road Traffic Accidents

In theories of accident causation there are several major theories each of which has some explanatory and in predictive values understanding the causal factors of road traffic

accidents (RTAs). The initial theories of accident causations were developed by Heinrich (1932) a safety engineer and pioneer in the field of Industrial accident safety are the domino theory and the human factors theory. The other documented theories on accident causations are the Accident/incident theory, the Epidemiology theory , the Systems theory, Haddon's energy release theory, Behavioural theory and Combination theory.

(a) The Domino theory

The domino theory of accident causation was one of the earliest developed by H.W. Heinrich (1932). The theory posits that injuries result from a series of factors, one an accident of which is an accident. According to Heinrich's domino theory, an accident is one factor in a sequence that may lead to an injury. In the scientific approach of this theory there are five factors in the sequence of events leading to an accident; the mistakes in social environment, the faults/carelessness of a person, unsafe acts/performance, mechanical or physical hazard, the accident and the injury.

The critical issue of Heinrich's domino theory is that , the factors preceding the accident and mostly the unsafe act or the physical hazard should receive the most attention and those responsible be concerned with the proximate causes of all accidents. The t emphasis here is that accidents and not injuries or property damage be the points of concern in accident situations.

The scientific views of the domino theory as postulated by Heinrich have some relevance in this study of road traffic accidents on the accident black spots. The domino theory factors on the sequence of events leading to accidents applicable in this study includes; the mistakes in social environment in form of road side activities affecting motor flows, the faults/carelessness of persons in form of poor pedestrian road usage, unsafe acts/performances in forms of driver overspeeding, accidents occurrences due to pedestrian-motor conflicts and injuries occurring from those accidents. This study applies these views in analysing the causal effects of RTAs.

(b) The human factors theory

Heinrich posed this model in terms of a single domino leading to an accident. The human factors theory premise is that human errors cause accidents. The structure of human factors theory is a cause/effect format one. This theory of accident causation attributes accidents to a chain of events ultimately caused by human error. It consists of three broad

factors that lead to human errors categorised as overload, inappropriate worker responses, and inappropriate activities.

In overload the work is deemed to be beyond the capability of the worker on physical/psychological factors. There is the influence by environmental factors, internal factors and situational factors. In the case of inappropriate worker responses, there are hazards, safety measures/workers faults and compatibility of workstations that are deemed to cause accidents. On the case of inappropriate activities there is lack of training and misjudgement of risks as the causal effects of accidents.

In summary, the aspects human factors theory by Heinrich attributes accidents to human errors. These human errors are influenced by capability of the workers (driver/law enforcers), the environmental conditions (roads infrastructure /road pedestrian facilities), hazards (lack of safety measures/facilities), lack of training/ misjudgement of risks (driver overspeeding and road safety unawareness). These views in the human factors theory are relevant and are applied in this study.

(c) The accident/incident theory

The accident/incident theory of accident causation is an extension of the human factors theory. It introduces such new elements as ergonomic traps which are the compatible workstations, tools or expectations. It also includes the decision to err which is the conscious/unconscious (personal failure) and the systems failures (management failure).

These aspects of accident/incident theory on personal failures and systems failures as the causal effects of traffic accidents are very relevant in this study. The decision of vehicle drivers to err and overspeed with no regard to set rules and regulations on speeding, these are personal failures which this theory addresses in accident causation. When traffic law enforcers fail to strictly enforce the traffic rules and regulations, these are system/management failures alluded to in this theory. This theory was helpful in this study.

(d) The epidemiological theory

There is also the epidemiological theory of accident causation. This theory holds that the models used for studying and determining the relationships between environmental factors and disease can be used to study causal relationships between environmental factors and accidents. The theory considers the relationship between the environmental

factors and disease to study causal factors of accidents. The key components of this theory are the predisposition characteristics where tendencies may predispose a worker to certain actions and the situational characteristics of peer pressure, poor attitude and risk taking. Together these characteristics can cause or prevent accidents that a person predisposed to a given situation may succumb to.

The epidemiology theory looks at the surrounding factors that influence a worker to behave in certain ways and then act in ways which are detrimental and cause accidents or contribute in the occurrence of accidents. What drives the vehicle driver characteristics of peer pressure and poor attitudes which make them take high risks and cause accidents through overspeeding? What makes traffic law enforcers not enforce traffic rules and regulations strictly to reduce RTAs? These are very good questions on this epidemiology theory but they are beyond this study and therefore not applicable.

(e) The systems theory

There is also a systems theory model of accidents. The systems theory of accident causation views any situation in which an accident might occur as a system with three components: person (host), machine (agency), and environment. This theory asserts that accidents arise from interactions among humans, machines and the environment and not simply chains of events or linear causality, but more complex types of causal connections. It is believed that under normal circumstances chances of an accident are low. Rather than looking at the environment as being full of hazards and people prone to errors, systems safety assures harmony exists between individuals and the work environment. Safety is an emergent property that arises when components of system interact with each other within a large environment. In systems theory, road accidents are seen as failures of the whole traffic system through the interaction between the three elements rather than a failure of the driver.

There are two aspects of systems theory which are relevant in this study, and these are the person and the environment. Not that the machine as one of the third component on the systems theory is not important. But this study is on the environmental and governance factors of RTAs. The person as a component denotes the driver and the law enforcers

and the environment denotes the roads and road pedestrian facilities in this study. The views of system theory were of great value in this study.

(f) The Haddon's energy release theory

The Haddon's energy release theory (William Haddon, 1966) is a contrast of the systems theory approach. This theory treats the driver as a passive responder in his environment and an active participant regulating his/her level of preferred risk. William Haddon, a medical doctor helped to impose regulations of seat belts, steering columns, windshields and dual braking systems for new cars. These were to reduce during accident and post accident impacts.

This theory posits that risk compensation/behavioral adaptation and operators within a system may take advantage of safety measures in other way than to increase safety. The two basic forms of compensation to road safety measures are increased speed and reduced attention. The views of this theory are good but not relevant to this study.

(g)The Behavioural theory

There is the behavioral theory which is often referred to as the "behavioral-based safety"(BBS). There are seven principles of behavior-based safety; intervention, identification of internal factors; motivation to behave in the desired manner, focus on the positive consequences of appropriate behavior, application of the scientific method, integration of information; and planned interventions.

The behavioural theory considers the aspects of safety interventions , motivations to change behaviours/positive benefits of appropriate behaviours, and integration of informations on safety. These are very important factors to consider in accident studies and their views are applicable in this study.

(h) The combination theory

Finally there is the combination theory of accident causation. This theory posits that no one model/theory can explain all accidents. Factors from two or more models might be part of the cause. The combination theory stipulates accident causation factors can be explained and clearly understood by considering several theories and models together.

Many attempts have also been made to develop theories designed to predict or explain the findings of road safety evaluation. Amongst such theories includes various theories of human behavioural adaptation to road safety measures are cited in OECD 1990, Evans1991 and Adams1995) which are widely applied in road safety researches or enjoy widespread approval among road safety researchers because road safety problems have a behavioural connotations.

In reviewing the extent to which road safety evaluation research is based on behavioural theory, Elvik (1999) notes that most of the research is not based on behavioural , and mostly refers to it only informally or not at all. The functions that behavioural theory could ideally serve in road safety research are ; serve as the basis for designing roads and vehicles that are optimally adapted to human limitations with respect to perception, serve as the basis for regulating human behaviour within a given technical system in a way that is conducive to road safety and specify the behavioural mechanism through which road safety measures are intended to affect safety.

It is argued that road safety measures have to influence human behaviour in order to be effective. Logically speaking, a road safety measure must influence one or more risk factors that are associated with accident occurrences or injury severity in order to affect the number of accidents or severity of injuries. The concept of causal chain was introduced in order to describe the process through which a road safety measure affects safety. The causal chain through which a road safety measure influences road safety is modelled on safety measures, risk factors and the final outcome in form of accidents and injuries.(Elvik 2001).

After analysing the accident causation theories and considering the scope of this study, it is clear that the combination the views of several theories can address and explain the causation of accidents in a holistic manner and lead to a clear understanding of traffic accidents. It is with this view and understanding that shows why some aspects of the domino theory, human factors theory, accident/incident theory, systems theory and behavioural theory are combined and adopted to understand the causation of accidents. However to understand accident caustation applications in transport systems, the systems theory of accident causation is more relevant in this study of accidents on the determined road accident blackspots in road transport systems.

The knowledge on the role of theories in road safety research guided this study in understanding how environmental and governance factors influences the occurrences of road traffic accidents. The causal relationships of road traffic accidents on the perceived road accident blackspots was analysed in this study with the background knowledge acquired from the theories of accident causation.

2.4.1 A Systems Model of Road Traffic Accidents

A systems perspective views human performance as a function of many interacting system-wide factors in the context of human error and accident causation; where errors are a consequence of system failures rather than psychological factors (Aderamo, 2012). Risk theories have been used in the description of accident causation. Risk can be defined as the effect of uncertainty on objectives whether positive or negative. Its management is followed by coordinated economic application of resources to minimize , monitor and control the probability and impact of unfortunate events (Hubbard,2009; Rundmo,2004; Moen,2005) or to maximize the realization of opportunities.

System Risks can come from uncertainty in accidents, natural causes and disasters. Road traffic accidents according to Dejoy (1989) is a function of four(4) elements. The first is exposure or amount of movement or travel within the system by different users or a given population density. The second is the underlying probability of a crash, given a particular exposure. The third is the probability of injury given a crash. The fourth element is the outcome of injury. Risk can also be explained by human error (Reason, 2000; Rasussen,1999; Kinetic energy, tolerance of human body and post crash care (Bustide et al, 1989)

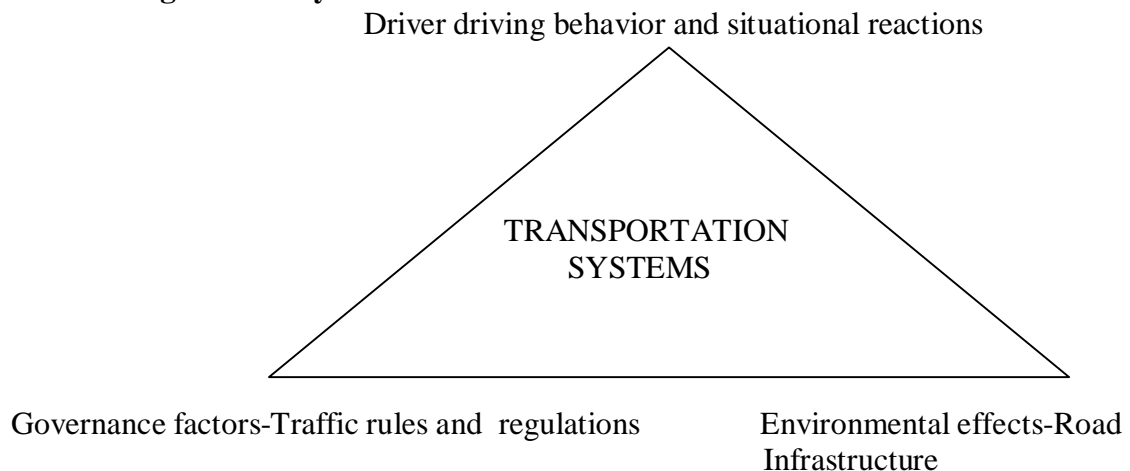
The systems model of road accidents proposes that accidents are as a result of the failure of the whole traffic system rather than solely the fault of the driver. The traffic system is represented by three major elements: the driver, the road infrastructure and the conditions of the vehicle. These three elements are what interact with each other to cause road accidents. Even where human error is present, the systems theory places blame on the interaction of all the elements within the entire transport system rather than the driver. The traffic system is said to be too complex and places high demands on the driver beyond his or her capability to meet those demands. Hence the solution is seen in

redesigning the system to make it less complex thus more manageable for the driver. As a result, a reduction in road accidents will occur Ounga N, 2011.

This systems model of road accidents by Nancy Ounga shows that RTAs occurs on the transport systems through the interactions of the human factors i.e the driver and the environmental factors; the vehicular conditions and the road infrastructure. In order to control the root causes of RTAs, a third force should come in i.e the governance factor of controlling the interactions of road users on the transport system through the enforcement of traffic laws. This aspect of the systems theory of RTAs was key in this study.

This model theory also proposes that the system be designed in such a way that it reduces the negative consequences of human error. For instance through the introduction of safety margins which will reduce the driver's chances of being seriously hurt in case of an error. This model asserts therefore that the risk of accidents can be reduced by modifying transport systems and reducing human error, since some workers sometimes tend to be careless or carefree. This theory can be summed up in the figure 2.1;

Figure 2.1: Systems Model of Road Accidents



Source: Adapted and modified from Ounga N. A., 2011

The model by Ounga concentrates more on drivers behaviours , human errors, the vehicle conditions and the transport system]s in the causation of RTAs. This study goes farther and modifies Ounga's model and incorporates the environmental conditions and governance factors to understand more the causation of accidents on the road transport

systems. The incorporation of these two factors enriches the understanding the systems theory in the causation of RTAs better.

System models of RTAs views accidents as a control problem. Accidents events are seen as the results of inadequate controls resulting from lack of enforcement of safety constraints. To understand accidents there is need to examine the control structure itself to determine why it is inadequate to maintain safety constraints and why accident events occur. This systems model is key in accident prevention and enhancement of road and traffic safety.

Accident causation theories and models guides road safety investigations in the study of road traffic accidents. The accident theories and models describe the scopes of accident investigations. The themes of these theories were applied in this study to determine how environmental and governance factors influence occurrences of road traffic accidents.

2.5 A Geographical approach to Traffic accidents and Road Safety

A geographical approach to the study of traffic accidents relates the concept of place, time and environment to accident occurrences. The landuse, the road element, the width of the road, the bending of the road, the hilly areas and topography are factors considered in the occurrences of RTAs and regional distributions. According to Cutter(1993), geographical scale is important for traffic accident impacts and their reduction. Landuse patterns, types of road network, local business and activity patterns will influence the system risks in an area (Komba,2006). There is also rural-urban differences. It is argued that in urban areas, there are more accidents with lower degrees of injuries, while in rural areas there are lower accident levels but more serious fatalities

Road transport is important for economic development due to its functional linkages with other sectors of the economy and it facilitates access to places of relative commercial economic advantages. Asingo and Mitullah, 2007 views road transport as a super structure supported by two functional pillars, namely road infrastructure and road transportation which are deemed to have a common objective of promoting safe and efficient road transport.

The efficiency and safety of road transport depends on the strength of its supportive functional pillars which in turn depend on the strength of its institutional foundations. The strength of each of the institutional foundation also depends on the extent to which they embrace stakeholders involvement and participation in the activities geared in the advancement of transport safety on the roads.

The areas of concern in road safety are the road environment development (management pillar), the road transport users (operator's pillar) and the road licensing (regulations pillar). In order for road transport to be safe, these three institutional and organisational pillars have to be efficient. Each pillar has to play its role and meaningfully relate to each other. Road safety problems emanates from the occurrences of Road Traffic Accidents (RTAs).

The causes of RTAs are classified into three broad categories; those caused by human factors, those caused by vehicular factors and those caused by environmental factors (Mbatia et al, 1998; Natulya and Muli-musiime, 2001; Odero, 2004; WHO, 2004; Chitere, 2006). However in adequate documentation is available on the broader underlying factors such as deficiencies in the lack of effective compliance and enforcement of road traffic laws.

Transport geography studies can be used to understand issues of road safety problems which are caused by RTAs. Other approaches used to understand the problems of road safety are sociological theories such as the socio- economic environment. The socio-economic environment encompasses the organisation of the road transport sector, the regulation of the road transport systems, the Policing and enforcement systems, the compliance to the traffic laws and how the levels of awareness would affect /influence the compliance or non compliance to the traffic rules and regulations.

In order to understand the geographical and social determinants of RTAs a comprehensive analysis of the environmental and governance factors is important. Also an analysis of the attitudes and perceptions of road users is important in understanding the salient causes/ features of RTAs and the magnitude of the road safety problems.

2.6 An overview discussion of models for traffic accidents.

Traffic accidents bear strong elements of man-environment adjustments and maladjustments and are a well-known approach in geography (Muhlrads et al 2005). Based on the logic of a modified human ecological model of a disease the approach can be transferred to studies of road traffic accidents. A model for traffic accident as inspired by the ecological model of a disease was developed by Jørgensen and Abane (1999) who made a heuristic adjustment of this basic model to suit road traffic accident analysis. The model is characterized by three main components: The vehicle (corresponding to the vector in disease ecology) which describes vehicles into its composition, age, technical conditions and safety equipments like seat belts in a car. The environment, comprising the road system and the wider physical and built up environment.

The physical environment splits further into different aspects such as; Daylight and climate (weather conditions and road conditions), Spatial conditions (arrangements and Macro structures), Settlement pattern (Urban or rural / sparse or populated area), situation of areas of residence and working areas, Principle of traffic separation, topography and road constructions qualities. the behavior of the population; including its characteristics such as age and sex ratio as well as attitudes and general traffic behavior. And it goes further into driving behavior, driving experience, driving style, risk compensation and risk driving (influence of alcohol and drugs). Superimposed on this model is a system of traffic laws, regulations and mode of enforcement designed to ensure that the population adheres to the controls and regulations so as to maintain some level of road safety i.e. traffic rules (speed restrictions, road signs), speed controls and convictions for various road traffic offences (Jørgensen and Abane, 1999).

The model by Jørgensen and Abane is used as a framework for understanding the multiple causes and prevention of traffic accidents. Available literature identifies traffic accidents in a place as having been caused either by physical factors in the road system (environment), the vehicle or behavior factors, and how they interact with enforcement regulations in unique settings. Thus, the relevance of Systems Theory in understanding road accidents can be seen at three different levels. First, the theory helps to identify the system of traffic laws, regulations and mode of enforcement designed to ensure traffic safety, vehicle environment, the driver behavior, the traffic controls and regulations. Second the model can help to identify the multiple causes of RTAs, interplay of risk

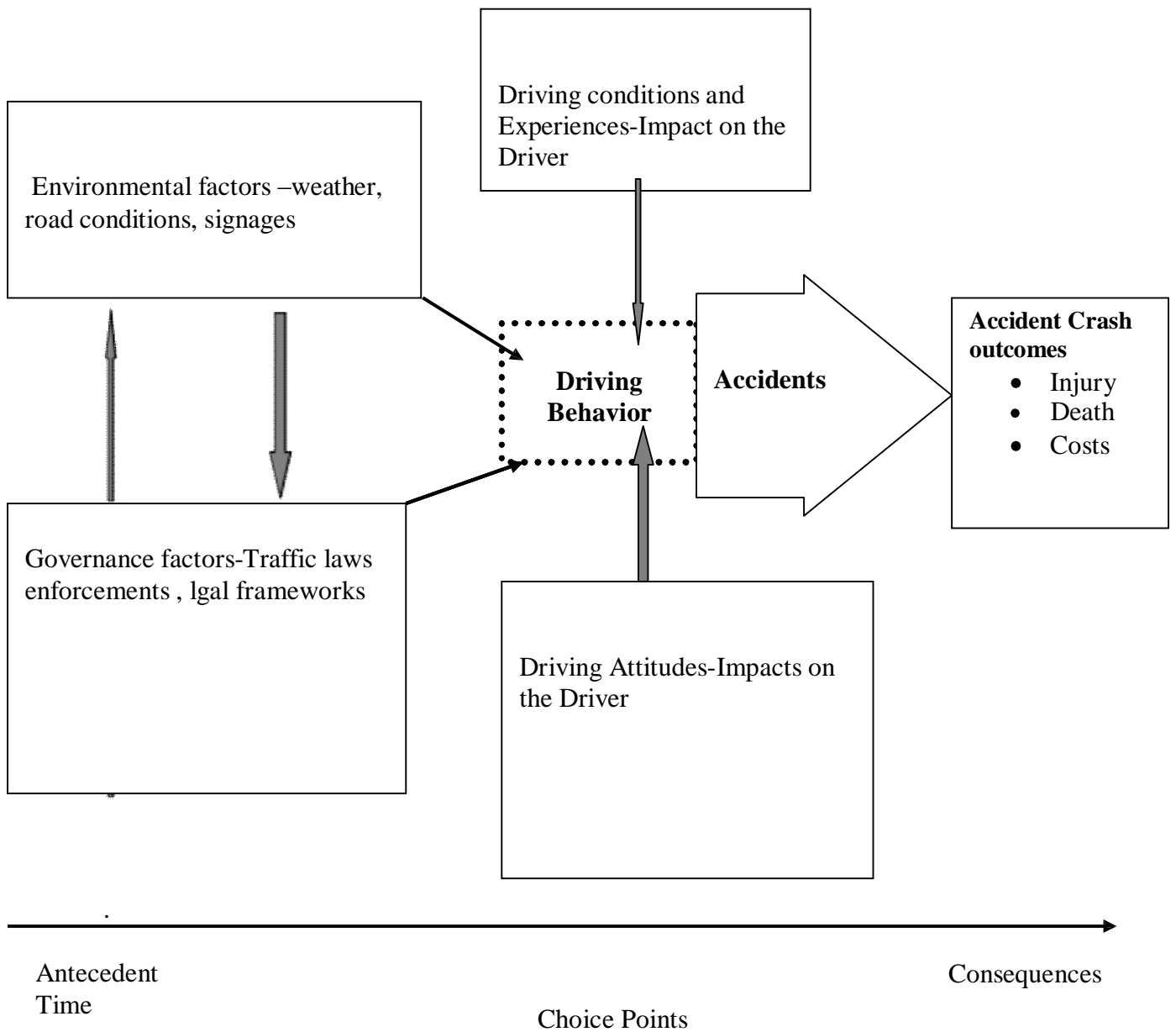
factors and prevention of traffic accidents. Third, the model also can assist in identifying/understanding the three major contributory factors of road traffic accident including human, mechanical (vehicle) and road environment factors. The views of this model of road accidents were a guide in this study.

2.7 Conceptual Framework Model

The conceptual framework adopted in this study is based on the occurrences of road traffic accidents that greatly contribute to road safety problems. The study framework is an investigation of risky driving behaviours. This conceptual framework is a multilevel based framework and it attempts to address the ways in which the physical environmental conditions influence driving behaviours. It also describes a framework for assessing drivers' perceptions of safety and attributes in order to predict the occurrences of road traffic accidents.

In this conceptual framework, it is observed that drivers continue to be at a higher risk of being involved in a motor vehicle crash and for fatal outcomes in bad road environments, when overspeeding and in the absence of traffic laws enforcement mechanisms. The theme of this framework is on a conceptual framework developed in USA on a study of driving behaviours amongst the youth with the aim of devising ways of reducing risky driving behaviours and the same can apply to all other driving behaviours. This conceptual framework will be a guide in this study in understanding the environmental factors that influence driving behaviours and affect driving operations; and the traffic governance laws that are in place or can be enacted to change driving behaviours and reduce RTAs as indicated on figure 2.2 .

This model indicates that driving behaviour is to a large extent influenced by the individual driver awareness of policy/traffic laws enforcement and the consequences or ignorance of them. The drivers' driving behaviour is confronted by the environmental factors, road conditions, vehicle speeds and weather conditions. These factors affect the driving consequences which in circumstances can lead to a safe drive or a vehicle crash outcome in form of injuries/death and costs.



Source: Modified from Juarez, P; *et al*, (2006)

Figure: 2.2: A conceptual framework for preventing motor vehicle accidents.

While this model of driving behaviour is presented as moving through time from antecedent, through choice situations to the consequences of driving behaviour; in reality it is an interactive process in which new events continually combine with antecedents to influence the choices of the individual driver behaviours in the present. Choices made in

the present affect subsequent behavioural decisions, creating new situations that influence and constrain future choices. It is in the present however, that an individual has an opportunity to make choices about driving behaviours that increase or decrease the risk of a traffic accident crash.

The original multilevel conceptual framework by Juarez et al, concentrated very much on the social cultural factors, neighbourhood and family peer influences, passengers, individuals and vehicles characteristics, vehicle designs and age, education and community interventions. This study goes farther and incorporates the environmental factors and governance factors and their interdependence , the driving behaviour and attitudes of drivers on speeding in order to comptualise the causes of RTAs better.

The environmental factors and peer influence have some impact on driving characteristics which influences driving standards and occurrences or non-occurrences of RTAs. The governance factors of driver/vehicle licencing, traffic laws enforcement, traffic fines/penalties have major impacts on driver and driving behavior. All these factors coupled with the physical environmental factors like lack of , speed limits bumps, stop lights, poor road conditions and potholes may make driving hazardous hence causing RTAs.

This model views driver behaviour as dynamically interacting and responsive to a series of expanding spheres of environmental influence. The environmental factors and peer influence and individual driver characteristics affect individual driving behaviours and this can cause RTAs. The other risk factors for motor vehicle accidents as cited in this conceptual framework are driver peer expectations, road conditions, weather conditions and traffic law enforcement factors.

To reduce adverse outcomes of motor vehicle crashes among the drivers, this conceptual framework proposes three strategic categories of interventions; namely those targeting the general population, and those interventions that specifically target and focuses on drivers in order to reduce RTAs and their effects. The focus on the driver interventions are applicable in this study as the drivers who drive on the perceived road accident blackspots have choices of changing driving behaviours and attitudes that can cause or not cause an accident.

The proposed road safety strategies targeting the general population identified in this framework as having the greatest potential for increasing road safety are changes in the policy in the enforcement of traffic laws and increased sanctions and fines in their violations. The proposed road safety strategies and interventions that target drivers in this conceptual framework are on the appreciation of how environmental factors causes RTAs and the need for enhanced Governance to influence driving behaviours and reduce RTAs. While the proposed strategies that target minority youth in this conceptual framework focuses on the influence of social norms/behaviours, community messaging, traffic law enforcement, the community faith organisations and a peer –to –peer (service learning) approach.

The factors that influence the driving behaviours of drivers and how characteristics of both the motor vehicle and the environment affect them and subsequent outcomes are incorporated into the framework. This suggests that there are synergies from multiple interventions. The proposals developed in this conceptual framework focusing on changing drivers' behaviours are applicable in this study. This study adopts the views in this conceptual framework.

2.8 Research and transport policy gaps identified in the Literature review.

One of the main road transport policy gap that greatly affects road safety in Kenya is the lack of a comprehensive regulatory framework for PSVs and more specifically the Para-transit Matau mode of passenger transport . The unregulated operations of Mataus and other PSV operators provides a fertile ground for the operators to engage in chaotic and hazardous driving behaviour and practices which are prone to numerous RTAs.

The other road transport policy gap that affects road safety in Kenya is the lack of a computerized central drivers and motor vehicles licensing depository arrangements where the traffic laws enforcement agencies can trace all road accident culprits and be taking action on habitual traffic law breakers collectively and decisively. The current systems cannot detect habitual traffic law breakers at the shortest time possible for remedial actions.

Another road transport policy gap that affects road safety management in Kenya is the lack of a central body that can coordinate road and traffic safety programmes. Previously

and even currently there are scattered Government, quasi Government and independent stake holder bodies that deal with road and traffic safety issues in Kenya. The uncoordinated nature of such activities for one common problem of road safety becomes wasteful and in most cases actions become digressed and cannot achieve the intended results.

In the year 2012, the Ministry of Transport has facilitated the legislation for a National Transport and Safety Authority (NT&SA) whose functions is to coordinate all road transport agencies and functions in Kenya. The formation of this authority will go a long way to deal with road and traffic issues from a centralized point of operations. This researcher appreciates this GOK initiative and this research will build on the successful formation of this authority on the way forward on road and traffic safety issues in Kenya

Accidents on our roads are still common despite some drop in the past following the “Michuki rules” of 2004. It seems that the enforcement of the rules died with the death of the former, no-nonsense minister. Some people blame law enforcement for such incidents. My take: laws alone do not create orderly societies. There is a need for discipline and an understanding that when accidents happen, we all lose as a society. We should ask ourselves this question: why should a society of presumably reasonable people (mainly adults) required continued policing to assure their own benefit? The culture of not respecting the law is deeply ingrained in Kenyans’ daily conduct. Perhaps the genesis of this may be in our colonial past. It seems that it was right to disobey the laws in an illegitimate state that the colonial government was. It is clear that we never underwent (following independence) a psychological transition to say that the state was now ours and any disregard for the law hurt us collectively; and that it was our collective responsibility to participate in orderly society for our common good (Matunda ,2013).

From Matunda’s views, it seems that one can (perhaps mistakenly) conclude that everyone in Kenya is bent on breaking the law, especially if one knows that one can get away with it. He argues that the idea in the minds of many people is not to get caught; it is as if getting caught is the crime. There is more that, even if one gets caught one can find a way out of it through bribing the traffic laws enforcement officers instead of being fined for the traffic crimes committed. Consequently, those enforcing traffic laws will drive a bargain based on expected fines associated with the offense committed. And

indeed, the steeper the fine associated with a traffic transgression, the higher their demands as kickbacks to let the offender off hook. There seems to be a legislation gap and a policy problem in this area and this research will address the governance factors that affect effective enforcement of traffic laws.

The reviewed literatures also do not critically address the physical road conditions at the road accident black spots and the impact of these operating environments on drivers as a contributor to RTAs. The reviewed literature does not critically address the road traffic infrastructure for pedestrian road facilities and the encroachment of road side activities onto the roads as contributors to RTAs. These physical environmental factors on road accident black spots are addressed in this study.

The relevant literature reviewed in this study show that the many research studies on road traffic accidents and road safety broadly addresses the issues of road traffic patterns, the drivers and driving experiences, vehicles types and conditions and other road users as the main causes of RTAs and the resultant impact road safety. The question of ‘why is there rampant non-compliance by drivers with the traffic laws despite the existence of traffic police enforcements and court fines for offenders’ is not adequately addressed in the literatures reviewed. This non-compliance to the traffic rules and regulations is a governance issue addressed in this study.

In summary, the research gaps identified in the literature reviewed is study are;

- a) The physical environmental conditions of road accident black spots are addressed well on how they contribute to RTAs. The effects of the lack of traffic infrastructure for example pedestrian road crossings and roads side facilities are not adequately addressed on road safety as pedestrian road traffic accidents continues to increase. This study recommends other road safety measures which will be road traffic infrastructure oriented to mitigate the environmental factors which contribute to RTAs.
- b) The perceived effectiveness and ineffectiveness of traffic police officers and traffic court fines in the control of RTAs to improve road safety are not adequately addressed in the literature reviewed on why RTAs continue to increase despite the enforcements

of traffic rules and regulations. This study recommends more robust road safety measures to mitigate the low key governance factors which makes the traffic law enforcement lax.

- c) The begging question all through is why are there road accident black spots on our roads and why are they not mitigated in our road safety traffic engineering and traffic controls systems?.

This study attempts to fill the above research gaps by adding how and to what extent environmental factors on our roads contributes to road safety bottlenecks which leads to road traffic accidents. Then also give a contribution on how governance failures and lax enforcement of traffic rules and regulations contributes to the continuous increase in road traffic accidents in Kenya.

CHAPTER THREE: THE STUDY AREA

3.0 Introduction

This chapter discusses a description of the background, geographical and climatic conditions of the study area. The chapter also gives an overview of the economic activities, the transport patterns and the road networks of the study area. This chapter explains the environmental conditions of the area of study in order to understand how they can affect and influence the research programme and the study itself. The understanding of the study area guides the researcher in field data collection and recording of observations in the research.

3.1 Background to the Study area

This study was carried out in Nairobi City the capital city of Kenya which is within the jurisdiction of the City Council of Nairobi (CCN) and its adjacent environs. Nairobi is the capital city of Kenya and currently second has the highest population in East Africa, with an estimated population of about 3.4 million while Dar Es Salaam has a population of slightly over 4.4 million people. Nairobi was founded in 1899 as a supply depot for the Uganda Railway which was being constructed between Mombasa and Uganda. It was named after a water hole known in Maasai as *Ewaso Nyirobi*, meaning "cool waters". Since its foundation as a railway camp the railway brought wealth into the city, which made it grow dramatically and it then became Kenya's second largest town after Mombasa and has grown to become the largest city in Kenya, and one of the largest cities in Africa. Nairobi continued to grow and many people have settled within the city's suburbs and built several grand hotels.

Nairobi was granted a city status in 1954 and has remained the capital and largest city of the Republic of Kenya. The capital has grown rapidly, and this puts pressure on the city's infrastructure. Between 500,000 to a million people in Nairobi live in Kibera, the largest and poorest slum in Africa, this date from the 1920 settlement for Nubian world war soldiers. The slums cover two square kilometers. The large population increase in Nairobi continues to pose serious problems for the Nairobi City Council; problems compounded by the rapid parallel increase in population in the outskirts of the City, in both the designated urban / trading centres and in surrounding areas (Wikipedia, 2006). The pedestrian flow from this area to and from work at the industrial area is very high and it

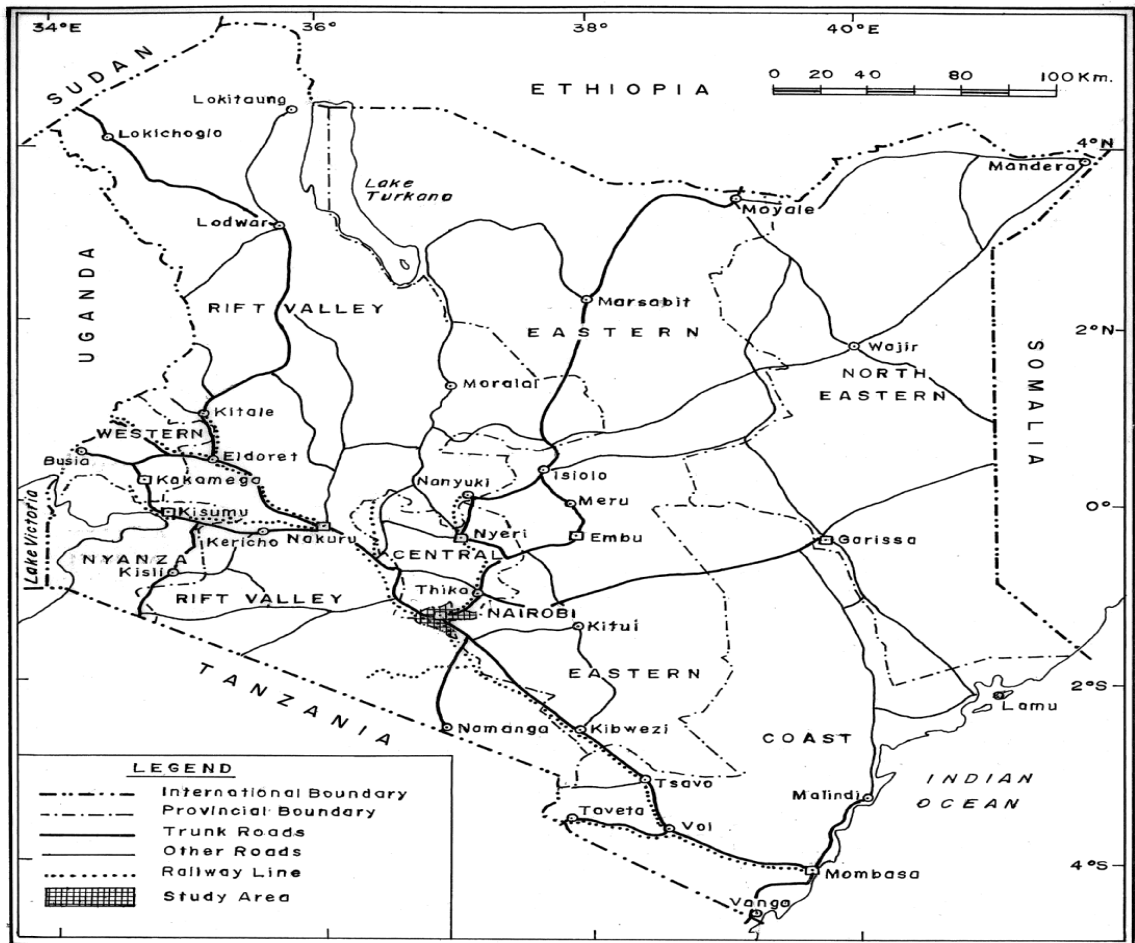
might be the cause for high pedestrian RTAs. This aspect was covered in this study.

3.2 Geographical and Climatic conditions of the study Area

Nairobi city is located at 1°17'S 36°49'E and occupies around 150 km² about 1660 metres (5450 feet) above sea level. It is situated between the cities of Kampala in Uganda and Mombasa port of Kenya beside the Rift valley. Mount Kenya is towards the North and Mount Kilimanjaro of Tanzania is towards the south-east as indicated on figure 3.1. Nairobi enjoys a fairly moderate climate. The sunniest and warmest part of the year is from December to March temperatures average 20- 30°C. There are two rainy seasons but rainfall is only moderate. The cloudiest part of the year is just after the first rainy season, when, until September, conditions are usually overcast with drizzle. There is need to classify RTAs during those periods in order to gauge how weather patterns influence RTAs.

Nairobi City has two physiographic regions. The western side is on a higher ground with slightly rugged topography having some river tributary channels, and the eastern side which is generally low-lying with some areas being flat. The western side has sloppy characteristics which roads and buildings constructors must take into consideration in order to avoid landslides or creep in the event of earth tremor or earthquakes. This is why some road sections in the western side of the city have very sloppy sections and sharp bends that can affect the traffic flow and road safety. This is an area of interest in this study

The eastern side has an expansive thick black cotton soil cover with shrinkage properties due to some clay minerals which makes roads and buildings constructors take into consideration to avoid construction cracks due to differentials in exerted pressure because of expansions and shrinkages of the clay materials in the soil (Wikipedia, 2006). This situation in the eastern side of the city makes some road sections have depressions on the tarmac and occasional potholes which can have some effects on traffic safety on the roads. This aspect was examined in this study.



The Location of Nairobi in Kenya and Road and Railway Network.
 Source: Kenya National Atlas, 1991.

Figure 3.1: Location of Nairobi City

3.3 An Overview of Environmental Problems of Nairobi city

During the period immediately after independence in Kenya, Nairobi city was characterized by rapid growth, creating pressures in housing, community services and physical infrastructure. In Economic Geography we learn that man exploits natural resources to improve the quality of his life, but sometimes this leads to the degradation and sometimes destruction of the environment. Such human and industrial activities have some impact on the environment. Some of the environmental aspects in this case include; disposal of wastes, frequent flooding, water and air pollution. The destruction of the environment by man has some effects on the roads where road users have problems in maneuvering on some road sections which can cause RTAs. This is one of the areas to be covered in this study.

The disposal of solid wastes on the road and the road sides affects the road users who are mainly motorists, cyclists and pedestrians. The encroachment of road space by solid wastes reduces the road space available to road users which can increase road user conflicts which in effect increases the tendencies to RTAs. The disposal of liquid wastes on the roads or road sides might make the roads wet and slippery and this has some impact to the road users.

The release of gaseous wastes into the air provides the atmosphere with extra carbon, phosphorous and nitrogen into the air. These gases undergo geo-chemical cycles in the atmosphere causing environmental problems such as acid rain, poisonous fumes and pollution of ground water resources. In Nairobi city visibility is greatly reduced along major Highways and Avenues (Uhuru, Jogoo, and Moi, Kenyatta, and Mombasa roads). The reduction in visibility is caused by gaseous and particulate emissions from vehicles and when it is raining it affects traffic and driving which affects road safety on the roads. The effects of waste disposal on road safety will be part of this study in order to gauge their environmental impact.

The city of Nairobi also experiences some flooding due to developments without corresponding provision of drainage systems. Flooding occurs when precipitation exceeds drainage and the city population has more than doubled in the last 10 years leading to a high increase in housing projects, construction of offices, factories, roads, landscapes and pavements. These developments decrease infiltration area and increases surface runoff and flooding affecting road conditions which to a large extent can increase road accident risks and road safety in the city (Nyambok, 1992). This is also one of the areas to be covered in this study.

3.4 Land use Planning and Infrastructural Patterns of Nairobi City

Land use planning refers to the utilization of land resources in a given area as per the determined physical development plans. Land use plans deal with distribution patterns and development activities linked up by various modes of communication. Planning is the process through which the accomplishment of these plans is achieved, the influence on location of services and the layout of the physical communication channels. The planning layouts and their environmental effects have some influence on the road network patterns. During planning, the competition for available resources can lead to RTAs.

The then City Council Nairobi (CCN) was the body charged with the responsibility of regulating urban planning and development in the City in terms of urban space, land and the built environment. Now the City County Government carries out these functions. The general guidelines regarding land use in the city of Nairobi are enacted in the then CCN policy, the building code, the building By-laws 1948 (planning) revised 1978, the Local Government Regulations 1963, the Local Government Act, the Land planning Act, the Land control Act and the Public health Act.

However studies carried out on the efficacy of these instruments reveal that land use planning has not been strictly adhered to in the city. This has been attributed to lack of a professional agency within CCN framework (Wangondu, 1986) leading to uncoordinated and haphazard developments that do not comply with planning regulations and guidelines. This has affected the road networks in Nairobi city which leads to road user competitions for the available road space which might be causing RTAs.

In an Examination report of the Systems, Policies, Procedures and Practices of the CCN; it was observed that CCN roads section has not verified and updated the existence and extent of road reserves. The records and maps of the roads in the city are therefore incomplete. This failure might have encouraged building of permanent structures on road reserves and encroachment of pedestrian ways which greatly affects road safety in the city (KACC, 2007). This study will identify the effects of the CCN policies on the road environments and their contribution to RTAs.

3.5 Economic activities and Transportation Patterns of the study area

Nairobi City business hub grew around the central business district within the city square and it is the headquarters of several international companies and organizations making it one of the most influential cities in Africa. Goods manufactured include clothing, textiles, building materials, processed foods, beverages and cigarettes. This high magnitude of economic activities in Nairobi city attracts high motoring tendencies to and from both upcountry and the city environs. The high motoring tendencies can increase road user conflicts which may contribute to RTAs. This is one of the concerns of this study.

Nairobi has a large tourist industry; it is both a tourist destination, a transport hub and has many tourist attractions. The most famous is the Nairobi National Park, the only national

park to border a capital city of this size. The park has many animals including lions and giraffes. Nairobi also has more species of birds than any other capital city in the world. The city has several museums; the Nairobi Railway Museum and the National Museum of Kenya which houses many artefacts including the full remains of a homo erectus (see figure 3.1).

Nairobi is served by Jomo Kenyatta International Airport, the largest airport in the region and is usually the first port of call for most tourists visiting Kenya and Mount Kilimanjaro areas in Tanzania. In 2004 it handled 4 million passengers in 2004(Wikipedia, 2006). It is also served by Wilson Airport a small busy airport to the west of Nairobi which handles small aircraft that generally operate within Kenya, Sudan, Somalia and DRC. The Eastleigh Air force base was the original landing airstrip in the pre- jet airline era used as a landing point in the 1930s and 1940s for the British passenger and mail route from Southampton to Cape Town.

The proximity of the two airports within the City of Nairobi increases travelling to the City centre and its environs thereby increasing the rush to the airports to catch flights. This rush to the airport can increase the risk of RTAs. This study will study some of the “black spots” on the road sections to and from the airports on RTAs occurrences.

Nairobi city was founded as a railway town, and the Kenya Railways (KR) main headquarters are still situated there, near the city centre. The line runs through Nairobi, from Mombasa to Kampala and its main use is freight traffic. Some few morning and evening commuter trains connect the centre with the suburbs, but the city has no proper light rail, tramway or subway lines. A JKI airport shuttle rail service is being contemplated. Due to lack of safe and reliable mode of travel, most people travel by matatu/minibuses, cars, and bicycles/motor cycles or by foot which are susceptible to road traffic accidents (Wikipedia, 2006). This commuters’ susceptibility to RTAs is one of the areas to be covered in this study.

The Nairobi City has a road network of approximately 1,500 kilometers of which the Council is responsible for the administration of a total of 750 kilometers (KACC, March 2007).Nairobi city is linked to the other administrative provincial centres through major trunk roads. From the northern side there is the Thika road dual highway and Kiambu road, from the east there is the Mombasa road highway and Jogoo road, from the west there is the Waiyaki way and Ngong road, from the south there is Langata dual road

linkage (see figure 3.2). These roads lead to Nairobi city CBD and have high tendencies of traffic rush which can cause RTAs. Peri-urban areas have also developed into major population centers on the city environs which depend largely on the City of Nairobi for services and employment making people rush for work and other services to and from the City (Wasike, 2000).

The major trunk roads which connect Nairobi city to the very peri-urban and other towns are designed with large roundabouts whose drainage gets clogged during the rainy seasons and in themselves they become other rainy season black spots. Some of the roads run off drainages are blocked during the rainy seasons and they become accident black spots. Some road sections on Thika road dual highway, Kiambu road, Mombasa road highway, Jogoo road, Langata dual road linkage, Waiyaki way and Ngong road are such roads with poor drainage systems (see figure 3.2).

The city of Nairobi is growing very fast and its consequential growth problems are felt in the environs and on resource constraints. This growth and increase in commuter motor requirements can lead the tendencies of road user conflicts and hence RTAs. This study examine if this has any contribution to road safety problems.

3.6 Road Accident Black Spots in Nairobi City

The Kenya Police Traffic department occasionally releases a list of black spots in the country which are considered risky for motorists and pedestrians due to the number of accidents that occurs in the respective areas in the recent past. In a report published in 2008, the police released a list of 70 black spots in Kenya. And in another report published in 2011, police website lists 78 points in Kenya's roads considered being black spots. This shows an increase of eight (8) black spots on our roads in a span of three (3) years (Kenya Police, 2008).

The Kenya police website (December 2011) lists road accident black spots in Nairobi province as Kasarani GSU stretch, Westlands Museum hill roundabout, Westlands kabete road, Mombasa road between Kencell Headquarters and Cabanas hotel, Jogoo road near Maziwa stage and Waiyaki way near Kangemi fly over shown on Figure 3.2;

Figure 3.2: Map of Nairobi City; Roads, Accident black spots and Railway network

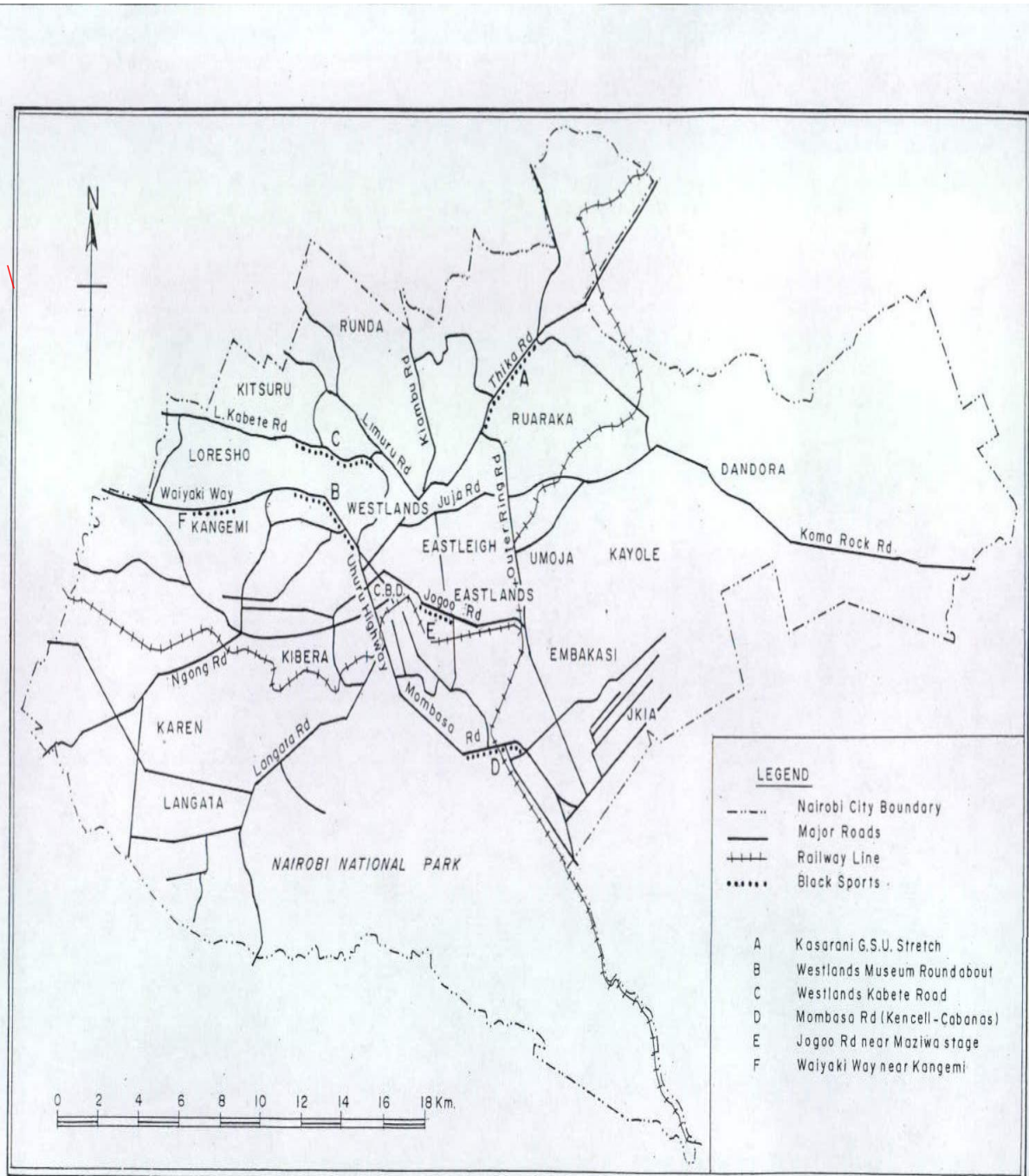


Figure 3. Map of Nairobi City, showing Road Accident Black Spots. Source: Modified from Nairobi Parliamentary Constituencies Map, 2002.

These road accident black spots will form the area of research in this study as tabulated on table 3.1. The sample for this study was obtained from this list of road accident black spots.

Table 3.1: Road Accident Black spots in Nairobi city

No.	Road Accident Black spots	Location – Road	Traffic control - police station
1	Kasarani GSU stretch	Thika Road	Kasarani Police station
2	Westlands Museum hill roundabout	Waiyaki Way	Parklands Police station
3	Westlands kabete road	Kabete Road	Kasarani Police station
4	Mombasa road between Airtel Headquarters and Cabanas hotel	Mombasa Road	Industrial Area Police station
5	Jogoo road near Maziwa stage	Jogoo Road	Jogoo/Buruburu Police station
6	Waiyaki way near Kangemi fly over	Waiyaki Way	Parklands Police station

Source: Abstracted from Kenya police website and tabulated by the Author; 2011

3.7 An overview of Legal and Regulatory framework of Road Transport Licensing and Enforcement in Kenya

For a long time in Kenya the key public institutions which have been involved in road transport management in Kenya includes; Government Ministries and departments, the Kenya Police , the Transport Licensing Board (TLB), the Road transport department of the Kenya Revenue Authority (KRA). The Ministry of Transport (MoT) has been responsible for policy regulations and governance; the Ministry of Roads, Public works and Local Government for provision and maintenance of transport infrastructure. The TLB ensured harmony in the provision of road transport services though a licensing and regulatory framework while KRA undertakes registration and licensing of motor vehicles. There are legal and regulatory frameworks which are enacted to directly and indirectly to manage road safety issues in Kenya. The Kenya Police traffic department is then responsible for enforcing compliance with traffics laws and regulations.

The provisions of section 5 of the Kenya Police Act, of the laws of Kenya issues Administrative orders called “Force standing orders” including the ones of the traffic police. It has been observed that the Force standing orders of the traffic police are some of the most abused in the history of the Police force in Kenya and the key among them is the standing orders on road blocks.

The long standing Traffic Act cap 403 of the laws of Kenya was observed to have had imminent enforcement problems and it experienced low compliance thus leading to abuse and corrupt acts. Bribery and abuse of office allegations in Kenya are more against the police compared to the other public institutions. Reports made to KACC indicate that the police was leading (32%) followed by Local authorities (13.7%) and provincial; Administration (9.4%). Bribery allegations against the Police stood out to be most prevalent (80.99%) with the traffic department being worst affected (41.3%).The traffic police alone accounted for (10.7%) of the total bribery and abuse of office allegations against public officers in the entire public service (KACC, April 2009).

The Kenya Police traffic department has undergone numerous reforms since its establishment in 1954. The Kenya Police website indicates that the Traffic police department has continuously been reformed to improve its operations and performance in order to reduce road safety problems through reduction of RTAs. Whether these reforms have led to improved operations and performance is not clear if you take into consideration the continuous increase in RTAs.

3.8 A history of Road safety Action plans in Kenya

It is noted that after Kenya attained independence in 1963, road safety was the concern of Kenya police. Between 1969 and 1988 a National road safety programme which was supported by Finnish Government facilitated the formation of a Road safety council under the then Ministry of Transport & Communications that established a Road Safety Unit (RSU) secretariat. This unit was later transferred to the then Ministry of Roads & Public works after the split of the Ministries. The council then ceased to operate and the legislative responsibilities for road safety continued to be shared between different arms of Government, a moribund national co-coordinating body with little provision for private sector partnership. This scenario made the efforts to tackle road safety disjointed and in effect safety on the roads deteriorated.

The GOK then published legal notices no. 161 of 2003 and no. 65 of 2005 amending the traffic Act Cap 403 with the aim of bringing discipline in the public service transport sector (PSVs) which was chaotic and prone to numerous RTAs. The regulations in these legal notices included reducing bus passengers overloading, introduction of seat belts, speed governors and identification for drivers and conductors. These measures had some effect on the improvement of road safety due to widespread public support during that time.

With the support of Swedish Government a road safety review study was carried out in 2004 under the Ministry of Roads & Public works Roads 2000 project. This review recommended the need for a National Road Safety Action Plan (NRSAP) for Kenya. The recommendations were endorsed by road safety stakeholders and were then taken over by the Ministry of Transport working closely with key road safety stakeholders including Ministry of Roads & Public works (MRPW), the Ministry of Health (MOH), the Ministry of Local Government, the Kenya Roads Board (KRB), Kenya Police, the private sector, civil society and academic institutions. This Road Safety Action plan initiative developed the GOK National Integrated Transport Policy (NITP). The action plan included an overview section on Kenya's road safety situation with the overall aim of reducing road fatalities on our roads (GOK 2009).

The road safety action plan was to cover a range of road safety aspects which included road safety coordination, child safety, driving standards, emergency medical services, non-motorized transport and road safety research as a necessary process of making a substantial improvement in Kenya's road safety situation. The National Road Safety Action Plan (NRSAP) was to be implemented from 2006 to 2010 but it was not done due to lack of funds and other logistical problems. The National Road Safety Action Plan (NRSAP) was reviewed and commenced from 2009 to 2014 with the aim of improving road safety in order to reduce the needless deaths and injuries on Kenya's roads.

With the great concern on the high road accidents and observed impunity on the roads, Kenya government launched a road safety authority to curb the rising road accidents. The National Transport and Safety Authority Bill, 2012 was enacted as an act of Parliament to provide for the establishment of the National Transport and Safety Authority (NTSA) tasked with the mandate of managing road transport and minimizing loss of lives through

road accidents and the Traffic (Amendment) Act, 2012 was also enacted to facilitate institutional and operational reforms in the PSV sector. The two laws were operationalized and are addressing bottlenecks within the road transport sector to make it responsive to the needs of the industry in licencing , regulations and road safety management in Kenya. This is a positive initiative in the struggle to reduce RTAs in Kenya, however time will tell if it is effective. But the initiatives can be improved for better.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.0 Introduction

This study examined the occurrences of RTAs on road accident black spots, the environmental factors that might have contributory effects to those RTAs and how traffic law enforcements or lack of it contributes to the continuous occurrences of RTAs. The study also examined how legal and regulatory governance factors contribute to occurrences of RTAs as the major causes of road safety problems. Then the chapter finally lays out the methodology of the study.

4.1 The Research Philosophical Paradigm and Research Design

The research paradigm is the broad framework which comprises perceptions, beliefs and understanding of several theories and practices that are used to conduct a research. The research paradigm can also be characterised as a precise procedure which involves various steps through which a researcher creates the research questions, objectives and objectives. It is with this view that research hypotheses should be aligned to the research objectives in order to adequately attempt to answer the research questions. This concept influences the beliefs and values of the researcher so that he/she can provide valid arguments and terminology to give reliable results (Cohen, Manion and Morrison, 2000).

According to Gliner and Morgan (2000), paradigm is a way of thinking about and conducting a research. It is not strictly a methodology, but more of a philosophy that guides how the research is to be conducted. Research paradigm and philosophy comprises various factors such as individual mental model, the ways of seeing things, different perceptions, and variety of beliefs towards reality amongst others.

Easterby-Smith et al (2006) discusses three (3) components of research paradigm in three (3) ways to think about research philosophy. The Epistemology component way looks at common parameters those associated with the excellent way to investigate the nature of the real world. The Ontology component way looks at the most common assumptions that are created to understand the real nature of the society. The Methodology component way looks at the combination of different techniques that are used by the researcher to investigate different situations.

In research studies there are three (3) main types of paradigms to understand reality, these are positivism, interpretivism and realism. The Positivism philosophical approach is associated with the idea of objectivism with a philosophical approach of evaluating the social world with the help of objectivity and not subjectivity. The positivism philosophical approach is mainly related to observations and experiments to collect data. (Easterby –Smith et al, 2006).

Interpretivism philosophical approach is associated with and concentrates on reality and beliefs that already exists in the environment. This philosophical approach research gives importance to the beliefs and values to give adequate justification for a research problem (Easterby –Smith et al, 2006). With the help of this philosophical approach , researchers focus to highlight the real facts and figures according to the research problem. In this approach researchers use small samples and evaluate them in detail to understand the views of large people/populations (Kasi, 2009).

The realism philosophical approach concentrates in the reality and beliefs that already exist in the environment. This philosophical approach has two (2) main approaches; direct and critical realism (Mcmurry, Pace and Scott, 2004). Direct reality means what an individual feels , sees and hears; in critical realism individuals argue about their experiences for a particular situation (Sekaran and Bougie, 2010). This is associated with the situation of social constructivism because individuals try to prove his/her beliefs and values.

From these philosophical paradigm studies , the philosophical paradigm of this study is based on the positivism and interpretivism philosophical paradigm approaches as narrated by Easterby-Smith et al , 2006. The contribution of positivism philosophical paradigm approach to this study is based on the methodology component way of research paradigms that looks at the combination of different techniques that are used by the researcher to investigate different situations. The contribution of the interpretivism philosophical paradigm approaches is based on the epistemology component way of research paradigm that looks at common parameters associated with the excellent way to investigate the nature of the real world . This approach assists the researchers to focus and highlight the real facts and figures according to the research problem. In this

approach researchers use small samples and evaluate them in detail to understand the views of large people/populations. These are the philosophical paradigms of this research study as it involves a combination of different techniques; using questionnaires and field observations, and small ample samples from a questionnaires survey drivers and police officers together.

Deciding upon the most appropriate methodology approach to adopt when designing a research study and carrying out the research is an important consideration for a researcher. In the initial stages of reviewing published materials, it may appear that methodological selection is arbitrarily determined rather than being based upon a sound set of principles. However, in research methods it is argued that methodological choices should be guided by a set of principles and beliefs about the purpose of the inquiry. And this in this study, some of the guide was the road safety principles that RTAs do not just happen but they are caused; and the belief that road traffic accidents are preventable.

The study used both qualitative and quantitative research design. The study is exploratory in nature. The study utilised both primary and secondary data. In the research study, primary data was obtained from surveys carried out on matatu and bus drivers at bus stations/stops. Also more data was obtained from surveys carried out on private vehicle drivers at supermarket and road car parks in Nairobi city on routes to and from the road accident black spot areas.

Questionnaires were administered both to PSV and private car drivers. Also other primary data was obtained from a questionnaires survey carried from available traffic officers in the police traffic stations that cover the sampled road accident black spots in Nairobi city. Physical observations of the road accident black spots were also carried out and analysed and tested to gauge their contribution to RTAs. Secondary data was mainly obtained from police traffic department records, GOK documents and other scholarly publications.

This study analysed the prevailing environmental conditions on the RTAs black spots, the governance regulations in place and how successful they are. The key here was to identify the enforcement gaps in combating the causes of RTAs. Since the core road accidents database is held by Accidents investigation units; and in this case Kenya Police traffic

department, there was very close co-operation with the department in obtaining up-to-date road accidents data. A study of road accident data from sampled black spots after verification of accident locations being studied was carried out in comparison with the existing traffic accident reports, road side observations, site features and traffic conditions for additional information on RTAs. The documented general causes of accidents were verified and tested in this study from the driver road user and the environmental factors which have direct or indirect contribution to the causes of RTAs in Nairobi city.

This exploratory research design also applied secondary data collection techniques in order to understand the extent and magnitude of RTAs as the causes of road traffic problems. The study assembled and analyzed five (5) years road traffic accidents data from the police traffic records from 2007-2011. This intended to show the existent and magnitude of road safety problems and why they merit serious attention.

In Kenya the Traffic Police collect all accident data for the purpose of legal prosecution and insurance claims. The accident data P41 form filled at the Police Stations are collated and forwarded to the Roads Department, Ministry of Roads and Public Works for further processing and analysis. The Roads Department analyses the information in order to determine: Number and type of injuries, Cause of accident and Classification of black spots (determined based on number of fatalities). Based on the road accident information, the Roads Department prepares work plans for enhancement of road safety at identified black spots and other dangerous locations on public roads.

4.2 Sources of Data

4.2.1 Primary Data

This data was collected with the assistance of research assistants under the guidance of the researcher in field surveys and field observations of road accident black spots. The methods of data collection in this study included road side observations and study of accident scenes and environmental features of road accident black spot sites in order to make an assessment of similar accident contributory factors for comparisons.

The study randomly selected from the road networks of some road accident black spots as stipulated in the Kenya police records and their website (see figure 3.2). These road accident black spots are the areas of high accident occurrences with an identifiable pattern of RTAs. These were randomly selected in this study for observations using the following techniques;

- (a) Location sampling of road accident black spots and accident sites for analysis and assessment of contributory factors to RTAs.
- (b) On site observations of traffic features at the scene of road accidents black spots and the observations of the road environmental conditions.
- (c) Observations of pedestrian road crossing points and road crossing facilities and pedestrian movements.
- (d) On site observations of traffic features, speed limit controls and roads signages on the roads assess the frequency of pedestrian-motor conflicts.

The instruments used in collecting primary data were questionnaires administered to the PSV and private vehicle drivers by research assistants at the bus stops, bus stations, parking bays and supermarket parking yards on the sampled study areas.

4.2.2 Secondary Data

This is the RTAs data collected and recorded by other agencies in this field. The data used in this study is from the road traffic accidents data collected and recorded by the traffic enforcement agencies (Kenya Police traffic department and Road transport department - Transport Licensing Board). A variety of road accident data was required to test the formulated hypothesis in probing the identified research problems.

Interviews were also conducted on members of the Kenya Police Traffic Department, specifically the available Traffic Police Officers in Nairobi Area Traffic Branches as they are the most knowledgeable officers within the traffic department on the area of Road Traffic Accidents.

4.3 Sampling Procedures

In this study, adequate data was sourced in order to gauge how environmental and governance factors contribute to road traffic accidents and road safety in general. The selection of road sites for the study was done from the randomly sampled RTAs black spots in order to determine the real causes of accidents on such sections of the roads. The study aimed to establish whether environmental factors play any role on the causes of accidents on the sections of the roads perceived to be “black spots”. The study also set to verify whether road traffic rules and regulations are enforced and how lack of this enforcement if any contributed to RTAs leading to road safety problems.

Also this study analysed through a questionnaire the effects of traffic court fines as a deterrent for habitual traffic offences in order to gauge the effectiveness of the enforcement of traffic rules and regulations. The road traffic accidents data records survey in this study was carried out in collaboration with the police traffic officers as the traffic laws enforcers. This involved abstraction of accident records from the individual traffic police stations in the sampled areas of study.

The primary data collected from the observations and questionnaires; and the secondary data abstracted from other records was analysed and empirically tested as indicated in the formulated research hypothesis of this study.

4.4 The study Sampling Frame

The Kenya police traffic department keeps records of traffic accidents in Nairobi city. It is from the analysis of this data that the road accident black spots were classified and determined in the city. These accident black spots formed the areas of this study. The sample from the area of study was taken from the listed road accident black spots as indicated on figure 3.2 and tabulated on table 4.1.

Table 4.1: Road Accident Black spots Sample points in Nairobi city

No.	Sampled Road Accident Black spot	Location – Road	Traffic control -Police Base	Sampled
1	Kasarani GSU stretch	Thika Road	Kasarani	No
2	Westlands Museum hill roundabout	Waiyaki Way	Parklands	Yes
3	Westlands kabete road	Kabete Road	Parklands	No
4	Mombasa road between Kencell Headquarters and Cabanas hotel	Mombasa Road	Industrial Area	Yes
5	Jogoo road near Maziwa stage	Jogoo Road	Buruburu	No
6	Waiyaki way near Kangemi fly over	Waiyaki Way	Parklands	Yes

Source: Researcher, 2013

From the listed black spots above and in consideration of the traffic police bases that controls traffic flows in the respective black spot areas, the sample for the study was randomly selected using the systematic method of sampling by picking every each second one in the listed road accident black spots. The areas of study for physical environmental observations and administering traffic police officers questionnaires were sampled and tabulated in table 4.2 below. This is a 50% sample frame from the population.

Table 4..2: Study area Sampled Road Accident Black spots

No.	Sampled Road Accident Black spot	Location – Road	Traffic control - Police Base
1	Westlands Museum hill roundabout	Waiyaki Way	Parklands
2	Mombasa road between Kencell Headquarters and Cabanas hotel	Mombasa Road	Industrial
3	Waiyaki way near Kangemi fly over	Waiyaki Way	Parklands

Source: Researcher, 2013

From the above study area sample frame, it is noted that the three (3) sampled location areas (Westlands museum hill and Waiyaki way near Kangemi flyover) of study have two (2) black spots having one traffic base (Parklands) under their traffic operations control. The sample is 50% representative of the listed road accident black spots population. But in order to beef up the data and eliminate degrees of any data bias, there was a need to add some other road sections and traffic polices bases for comparison purposes and for the adequacy of the data to be used in classifying and analyzing the sampled road accident black spots.

From the researchers previous knowledge of traffic operations in the city of Nairobi and oral interviews and discussions were arranged with key informants within Nairobi area with senior traffic officers, police accidents records officers on other pre-determined road accident black spots in Nairobi. With the key informants assistance , purposive sampling was carried out and the following three (3) road sections were classified as other road accident black spots; namely Valley road NPC Flyover area, Mbagathi Road stretch and langata road between carnivore and Mbagathi road junctions. The researcher added these road sections in the area of study for observations and for administering traffic police officers questionnaires as tabulated on table 4.3;

Table 4.3: Extra Study area Sample of possible Road Accident Black spots

No.	Extra Sample of Road Accident Black spot	Location – Road	Traffic control -Police Base
1	Valley road NPC Flyover	Valley Road	Kilimani
2	Mbagathi Road stretch	Mbagathi Road	Langata and Kilimani
3	langata road between carnival and Mbagathi road junctions	Langata Road	Langata

Source: Researcher, 2013

This extra study area increased the study coverage and brought in two (2) more traffic police bases for the study, namely Kilimani and Langata which when added to the earlier two(2) (Parklands and Industrial area) to make four (4) study areas. The traffic police bases to carry out the study were Kilimani, Langata, Parklands and Industrial area. This is a 67% sample of the listed number of road accident black spots in the study area. This is

statistically a representative sample for this study. This addition of extra study area beefed up the study adequately and increased the research data for analysis.

In high level road traffic accident forums in Kenya , there is a notable quote of reflection by no other but the then President of the republic of Kenya Hon Mwai Kibaki on 19th October, 2010; Quote – ‘’ Black spots should be identified and reliable data on road safety integrated in road infrastructure development..’’. The advice by the president showed the concern on road accident black spots as one of the major causes of RTAs in Kenya and the same should be addressed in road policy , planning and during constructions. This quote increased the researcher’s morale in this study.

4.5 Techniques of Data collection

The data collection in this study was based on stakeholders involved in road transport. Some of the Focused Groups (FGs) covered in this study are; PSVs/Matatus drivers, PSV SACCOs, Private vehicle drivers and Traffic police officers.. The research interviews of public transport were done at the routes terminus to avoid rushing the respondents. This was done mostly for PSV drivers. The private car drivers were interviewed at road side parking bays and supermarkets parking yards.

In order to get adequate data from PSV drivers questionnaires, the PSVs CBD Bus tops where driver Interviews were to be done were randomly chosen. These were chosen from the sampled Road Accident Black spots and road locations as tabulated on table 4.4;

Table 4.4 : Study area Road Accident Black spots and Sampled driver interview points

No.	Sampled Road Accident Black spot	Location Road	PSVs CBD Bus tops where Driver Interviews were done	Parking areas where Private car drivers Interviews were done
1	Westlands Museum hill roundabout	Waiyaki Way	Old Nation House ,	CBD Moi Avenue and Westlands car parks
2	Mombasa road between Kencell Headquarters and Cabanas hotel	Mombasa Road	Bus Station	CBD Harambee Avenue and Miombasa Road Car Parks
3	Waiyaki way near Kangemi fly over	Waiyaki Way	Commercial Bus stop	CBD Koinange Street and Westlands Car Parks
4	Valley road NPC Flyover	Valley Road	Kencom Bus stop	CBD Kenyatta Avenue and Loita street car parks
5	Mbagathi Road stretch	Mbagathi Road	General Post Office – GPO Bus stop	CBD City hall way and KICC car parks
6	langata road between carnival and Mbagathi road junctions	Langata Road	Railway Station	CBD Parliament road and Haille sellasie Avenue Car Parks

Source: Researcher, 2013

The above list is based on the road accident black spots which were earmarked for this study. From this listing on table 4.4 a sample of three PSVs CBD Bus tops was randomly selected using systematic method os sampling by picking each second one from the list. Then a list of where PSVs driver Interviews through questionnaires were done.as tabulated below on table 4.5;.

Table 4.5: Study area Road Accident Black spots Sampled PSV driver interview points

No.	Sampled Road Accident Black spot	Location Road	PSVs CBD Bus tops where PSV Driver Interviews were done	Parking areas where Private car drivers Interviews were done
1	Mombasa road between Kencell Headquarters and Cabanas hotel	Mombasa Road	Bus Station	CBD Harambee Avenue and Miombasa Road Car Parks
2	Valley road NPC Flyover	Valley Road	Kencom Bus stop	CBD Kenyatta Avenue and Loita street car parks
3	langata road between carnival and Mbagathi road junctions	Langata Road	Railway Station	CBD Parliament road and Haille sellasie Avenue Car Parks

Source: Researcher, 2013

The sampled areas of study where PSV Driver Interviews were done are the Bus Station near Ronald Ngala Street ; the CBD Kencom Bus stop and the Railway Station matatu and buses park.

Again from the listing on table 4.4 a sample of three CBD roads and car parks were randomly selected as in the previous method where private vehicles drivers.

Interviews through questionnaires were done.as tabulated below on table 4.6;

Table 4.6: Study area Road Accident Black spots and Sampled Private driver interview points

No.	Sampled Road Accident Black spot	Location Road	PSVs CBD Bus tops where PSV Driver Interviews were done	Parking areas where Private car drivers Interviews were done
1	Westlands Museum hill roundabout	Waiyaki Way	Old Nation House ,	CBD Moi Avenue and Westlands car parks
2	Waiyaki way near Kangemi fly over	Waiyaki Way	Commercial Bus stop	CBD Koinange Street and Westlands Car Parks
3	Mbagathi Road stretch	Mbagathi Road	General Post Office – GPO Bus stop	CBD City hall way and KICC car parks

Source: Researcher, 2013

The sampled areas of study are CBD Moi Avenue and Westlands car parks ; CBD Koinange Street and Westlands Car Parks ; CBD City hall way and KICC car parks

This study sought to establish the causal relationship between environmental factors and traffic laws enforcement governance factors influences and cause road traffic accidents. The research design employed the questionnaire survey method. Questionnaires were administered to PSV matatu/Bus drivers and private vehicle drivers picked randomly from the three sampled matatus/bus stops as indicated on table 4.5 and the three roads and parking areas as indicated on table 4.6.

In this field survey of road accidents, questionnaires with a list of questions to be used by RTAs researchers when carrying out accident black spots observations were compiled as per the samples in the appendices indicated as questionnaires A, B, and C. Questionnaire ‘‘A’’ was for road traffic accident environmental factors observations carried out by research assistants under the guidance of the author (Appendix 9.1). Questionnaire ‘‘B’’ was for road traffic accidents law enforcement factors and road side accident spot observations by the Police traffic officers in liaison with the author(Appendix 9.2). And questionnaire ‘‘C’’ was for road traffic accidents governance law enforcement factors

drivers questionnaire administered by research assistants under the guidance of the author (Appendix 9.3). In the accident investigation at ‘black spots’, the commonly occurring accident types were classified for analysis as explained in the methodology of this study. On the spot observations of various environmental features that affect road safety were also done and appropriate recordings kept for analysis in order to depict the real causes of RTAs.

The RTAs data collected from the field study and from road accident reports by the traffic laws enforcement agencies (Kenya traffic police) were analysed to isolate and group the various factors that influence the occurrence of road traffic accidents (RTAs) on the roads. This study also critically analysed the current Road Traffic Act in Kenya for clarity and applicability in line with the existing enforcement patterns of traffic rules and regulations as a road safety measure.

4.5.1 Traffic Laws enforcement Data collection: Traffic Police Officers' Questionnaire

The traffic police officers questionnaire by the researcher on the road accident black spots, recorded data for analysis from the police traffic accident records kept at police stations was obtained. This involved recorded reports on the particulars of the parties involved in the accidents, the time the accident occurred and the type of weather when the accident occurred.

To obtain data on the law enforcement governance factors, the questionnaire obtained data on the drivers' requirements to drive on the roads. The data was on whether during the accidents the driver was holding a valid driving license and if the driver was not holding a valid driving license, was he/she booked/charged with the relevant traffic offences.

The traffic police officers questionnaire further obtained data on the accidents reported to the police. The data from this questionnaire was on whether the accidents were all reported to the traffic police and the respective Insurance Companies or to both. More data was obtained from the accident report/observations and recorded on who was to blame for the accident and if the party to blame for the accident was booked/charged with

the relevant traffic offences.

In order to gauge further the effectiveness of traffic laws enforcement on the roads, the police traffic officers' questionnaire obtained more data on whether during the accident period there were any traffic officers on that stretch of the RTA black spot. This was to countercheck the drivers' questionnaire on whether the presence of traffic police officers on the road makes the drivers drive more carefully.

To check further the environmental factors of road traffic accidents, the traffic police officers' questionnaire obtained observation recorded on the road accident black spots. This involved obtaining and recording observations on whether there are any speed limits marks/signs at the RTA black spot and whether those speed limits were being observed by the drivers on the road.

The questionnaires to the traffic police officers was filled from the traffic road accident data records at the police stations by the available police officers in the four (4) stations covered. Depending on the availability of traffic officers the numbers interviewed ranged between 60-65 in numbers, i.e 15-17 officers per station. Since the study involved the abstraction of road accident reports in a census manner and summarizing the data, this was an adequate sample for this study.

4.5.2 Traffic Laws enforcement Data collection: Drivers' Questionnaire

From the drivers' questionnaire done by research assistants, data was obtained on each interviewed drivers on age, driving experience, number of RTAs they have been involved in and in how many cases did they report to the accidents to the Traffic police and the reasons for reporting or not reporting.

Further the questionnaire implored on the drivers to indicate in how many of the accidents they were to blame for those accidents and why they felt they were blamed for the accidents. In how many of the traffic accidents they were charged in court for the traffic offence, the nature of the charges and whether they reported or involve their Insurance Company on the traffic accidents and the reasons for the same.

In order to gauge the drivers driving consciousness of road traffic controls, the questionnaire was framed to check if the presence of traffic police officers on the roads makes them drive more carefully and whether they felt that traffic police officers are effective in traffic controls to avoid road traffic accidents.

To obtain some research inputs on the traffic laws enforcement governance factors , the questionnaire also had a question to the drivers on whether they feel that the court traffic fines or traffic bonds put to them after road accidents are effective in safe driving, deterring more road accidents and the overall reduction of RTAs.

The method used to administer questionnaires to the PSV drivers was a census method where researcher interviewed as they arrive to the bus stops and stations without rushing them. This was done with the assistance of the Matatus SACCO station supervisors at the respective PSVs terminus places at the CBD. Where many arrive at one time the research assistants were detailed to interview those who were taking a rest and to be consistent with the previous adopted sampling method, interview each second arriving matatu or bus as appropriate. Again the methods adopted is purposive sampling

4.5.3. Environmental Conditions Observations/recordings on Road Accident Black spots

From the observations on the road accident black spots environmental conditions observations questionnaire by the research assistants, data was obtained for analysis on the road side activities that encroach onto the road and foot ways that might be forcing motor vehicle onto the pedestrian ways and the pedestrians onto the road thus causing RTAs.

More data from the accident black spots was also obtained on whether there are sufficient pedestrian crossing facilities provided and are they located where the greatest numbers of pedestrians wish to cross the roads, and if there are pedestrian fences erected / installed to channel pedestrians to safe crossing points.

Road accident black spot observations was done and data was obtained of if there are visible and adequate advance warning of the RTA black spot to warn drivers, if there are speed limiting bumps on the RTA black spot and if they are erected at a reasonable safe driving braking distance before the RTA black spots, if the RTA black spots are obstructed from clear visibility for drivers/ pedestrians and if the pedestrian traffic ways are utilised always to avoid pedestrian accidents.

The road side observations and recordings were carried out by the researcher in liaison and one traffic officer each from the four (4) police stations a long the sampled areas of study as tabulated on tables 5.13- 5.17

4.5.4 Road Traffic Accidents Data Collection - Nairobi Area Traffic Police Records.

From the daily traffic police accident records, data was compiled for a five (5) years period from 2007- 2011. The raw data was abstracted from the traffic police records and compiled by the author. The data compiled was on the Road Accident victims and nature of injuries, Classes of persons killed and injured in Road Accidents, time of the day and number of Road Accidents and a summary of the physical environmental observations on some road accident black spots in Nairobi city.

The compiled data from the traffic police records was used to enhance conclusive results of the tested hypothesis on the environmental and governance law enforcement factors which directly or indirectly have some contribution to the occurrences of RTAs and in effect road safety problems in Nairobi city-Kenya.

4.6 The Data Summary

Primary data was utilised for this study. A cross section of data was compiled from questionnaires administered by the traffic police officers on accident occurrences and observations of road accident black stops sampled from four police traffic bases in Nairobi namely Langata, Industrial area, Kilimani and parklands. Also more primary data was obtained from questionnaires administered in a city census drivers at the bus stations and public car parks across the city which were analysed and used in testing the hypothesis.

The questionnaires were very specific on the questions administered to both PSV drivers private drivers and traffic police officers at large. The reliability of the questionnaire as an instrument of data collection in this study was determined in so far as it addressed the major research study questions and objectives, and the responses obtained were adequate in testing the hypotheses formulated. It worth to note that this study was undertaken in 2012-2013 before the currently observed Nairobi city roads transformation, re-design and traffic calming was done from late 2014.

Data was collected by administering three questionnaires Appendix 9.1; Appendix 9.2 and Appendix 9.3.. Appendix 9.1 on environmental conditions of road accident black spots had 60 respondents. Appendix 9.2 on occurrences of road accidents, driving observations, driver licensing and traffic laws enforcement had 65 respondents. Appendix 9.3 on the nature and occurrences of road accidents, the frequency of road accidents, the effectiveness of traffic law/ fines and the individual perceptions of road accidents had 332 respondents selected from drivers across the city bus stops, bus stations and car parks.

After the data was collected, it was compiled in data sheets and analysed in excel computer packages for easier analysis. The data was grouped based on the similarity of questions during the administration of the questionnaires to the sampled population. The data presentation included figures, tables, plates, graphs, pie-charts, percentages and averages. Chi-square test data analysis method was used to examine the differences and relationship between samples and parameters in testing the hypothesis.

4.6.1 Research Data Cross tabulation-Case Processing Summaries.

The data compiled from questionnaires administered was cross tabulated in the case processing summaries based on the similarity of the questions in the questionnaires. Before subjecting all the data to testing, some case processing summaries were analysed to authenticate data validity and samples representativeness as tabulated on tables 4.7-4.9.

In the first instance it is noted that the sample statistics for the questionnaires administration in the field was gender sensitive. In the sample frame for drivers' questionnaires, gender balancing was attained at 57.9% for males and 42.1% for females as shown on the sample statistics on table 4.7;

**Table 4.7: Gender sample Statistics
Driver's Gender**

Samples	Frequency	Percentage
Male	77	57.9
Female	56	42.1
Total	133	100

Source: Researcher, 2013

From a sample frame of 64 participants on the question to the parties involved in the RTA and who was to blame for the accident, there were 59 valid cases for analysis which is 92.2% of the population. This is an adequate representative sample for analysis as tabulated on table 4.8 .

Table 4.8: Road accidents parties population sample Statistics

Parameter	Sample Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
The parties involved in the RTA * Who was to blame for the accident?	59	92.2%	5	7.8%	64	100.0%

Source: Researcher, 2013

The sample statistics of the questions of road conditions on the accident black spots, the location of traffic infrastructures the visibility of motorists and pedestrians; its noted that all the sample cases attained over 70% for the valid data used in the analysis of this study as tabulated on table 4.9.

Table 4.9: Road conditions questionnaires and field observations samples- Cases Processing Summary

Parameters	Sample Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Are sufficient pedestrian crossing facilities provided and are they properly located? * Are there speed limiting bumps erected at reasonable distance before the RTA black spot?	44	72.1%	17	27.9%	61	100.0%
Are sufficient pedestrian crossing facilities provided and are they properly located? * Is the RTA black spot obstructed from clear visibility by drivers and pedestrians?	54	88.5%	7	11.5%	61	100.0%
Are the pedestrian fence erected to channel pedestrians to safe crossing points? * Are the speed limiting bumps erected at reasonable distance before the RTA black spot?	46	75.4%	15	24.6%	61	100.0%
Are the pedestrian fence erected to channel pedestrians to safe crossing points? * Is the RTA black spot obstructed from clear visibility by drivers and pedestrians?	56	91.8%	5	8.2%	61	100.0%

Source: Researcher, 2013

From the analysis of the above sample questionnaires , it is evident that the samples obtained were statistically representative, ample data was collected and it was adequate in testing the hypothesis formulated.

4.7 Ethical considerations

One of the major problems of road accident secondary data is under-reporting, errors and omissions of crucial details. In some cases Police accident reports includes subjective assessments in terms of finding out the guilty party for prosecution purposes thereby putting more emphasis on “road user behaviour” as the cause of accidents more than other

possible causes such as “road environmental features” and lack of adequate enforcement of the traffic laws. This shortcoming was mitigated by expanding the area of study and testing other parameters relevant to the for comparisons.

From the researcher’s point of view some of the questions and responses in the administered questionnaires might have been a matter of opinion from the motorists’ views and might not have reflected the actual situation on the ground. This shortcoming was addressed in the questionnaires where certain questions for one group had another similar question for the other group to countercheck on the responses in order to reduce the bias in the responses. However the parameters tested in most of the other questionnaires had adequate data to test the entire hypothesis formulated.

There is also a research ethical issue where research assistants can be tempted to induce the questionnaire respondents to hasten the process of filling the questionnaires. This aspect was discussed with the research assistants and their supervisor and they were thoroughly briefed to avoid such tendencies in this research. The research assistants were also detailed on how to handle research fatigue to avoid guess work in filling the questionnaires.

It is also well known that drivers have a phobia fear of traffic police officers. The researcher was well aware that to involve police officers in the interview of drivers would lead to getting very distorted responses. With this view, the research assistants were detailed on how to interview drivers at their confidence level and not to involve police officers or even try to rush them in the interviews.

4.8 Data Analysis

In this study analysis of the environmental observations was carried out done and tabulated to analyse the physical environmental conditions that prevailed during the occurrences of the RTAs on the road accident black spots. The recorded observations were used to gauge and determine the extent which physical environmental factors contribute to road traffic accidents and road safety problems in general. Also ample data was collected from the questionnaires administered to drivers and to the traffic police officers in the sampled areas of study.

This study is on the differences between environmental conditions and road traffic accidents, how lack of pedestrian facilities on our roads contribute to road traffic accidents, the differences between governance and the increase or decrease of road traffic accidents and how lax enforcement of traffic laws influences the occurrences of road traffic accidents. In such studies and in view of the types of data collected, there are two (2) methods to test such differences. The most commonly used are correlation analysis and Chi-squared test data analysis methods.

4.8.1 Correlation and Multiple regression analysis

In data analysis the relationship between variables or factors are determined through observations and recording of happenings. The interrelationships or an association of variables is termed as a correlation. When the value of one variable is related to the value of another variable, they are said to be correlated (Lucey, 1996).

There are two measures of the degree of correlation between two variables denoted by (r) and (rs); where (r) is the product moment coefficient of correlation and rs is the rank correlation coefficient. The product moment coefficient of correlation (r) ranges from (+1) i.e. perfect positive correlation (where Y increases linearly as X increases) or (-1) i.e. perfect negative correlation (where Y decreases linearly as X increases). The rank correlation coefficient denoted by (rs) can also range from (+1) to (-1) on the same principle.

The product moment coefficient of correlation (r) gives an indication of the strength of the linear relationship between variables. There are several possible formulae for calculating the coefficient of correlation (r), but a more practical one is as follows;

Where; X- Summation of x observations/variables.

Y-Summation of Y observations/variables.

A coefficient correlation of zero (0) or near zero indicates generally no correlation. A strong correlation between two variables would produce an r value in excess of (+ 0.9) or (-0.9). An r value of less than (0.5) shows a very weak relationship between the variables. It is possible to test whether a value is sufficiently different from zero for the analyst to

decide whether the X and Y values are correlated. The test may be stated in summary as in the following example;

Ho: $P = 0$ (i.e. the value of P is equal to zero)

Hi: $P \neq 0$ (i.e. the value of P is not equal to zero)

Then the t test for the test statistic is given as follows;

Where; r- calculated coefficient of correlation.

n-number of observations / variables.

The value of P is calculated based on the tabulated value for n-2 degrees of freedom using a 5% level of significance. When the (t) value is greater than the tabulated value for n -2 with a 5% level of significance, then the numerical evidence would be strong enough to reject the null hypothesis (Ho: $P = 0$) and conclude that the value of P is not zero as hypothesised in the example above.

Multiple regression is a flexible method of data analysis that may be appropriate whenever a quantitative variable (the dependent or criterion variable) is to be examined in relationship to any other factors (expressed as independent or predictor variables). Relationships may be nonlinear, independent variables may be quantitative or qualitative, and one can examine the effects of a single variable or multiple variables with or without the effects of other variables taken into account (Cohen, Cohen, West, & Aiken, 2003).

Multiple Regression Models and Significance Tests Many practical questions involve the relationship between a dependent or criterion variable of interest (call it Y) and a set of k independent variables or potential predictor variables (call them X1, X2, X3,..., Xk), where the scores on all variables are measured for N cases. For example, you might be interested in predicting performance on a job (Y) using information on years of experience (X1), performance in a training program (X2), and performance on an aptitude test (X3).

A multiple regression equation for predicting Y can be expressed as follows:

- (1) To apply the equation, each X_j score for an individual case is multiplied by the corresponding B_j value, the products are added together, and the constant A is added to the sum. The result is \hat{Y} , the predicted Y value for the case. For a given set of data, the values for A and the B_j s are determined mathematically to minimize the sum of squared deviations between predicted \hat{Y} and the actual Y scores. Calculations are quite complex, and best performed with the help of a computer, although simple cases with only one or two predictors can be solved by hand with special formulas. The correlation between \hat{Y} and the actual Y value is also called the multiple correlation coefficient, $R_{y.12\dots k}$, or simply R. Thus, R provides a measure of how well Y can be predicted from the set of X scores. The following formula can be used to test the null hypothesis that in the population there is no linear relationship between Y and prediction based on the set of k X variables from N cases:
 - (2) For the statistical test to be accurate, a set of assumptions must be satisfied. The key assumptions are that cases are sampled randomly and independently from the population, and that the deviations of Y values from the predicted Y values are normally distributed with equal variance for all predicted values of Y.

Alternatively, the independent variables can be expressed in terms of standardized scores where Z_1 is the z score of variable X_1 , etc. The regression equation then simplifies to:

$$\hat{Z}_Y = \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 .$$

The value of the multiple correlation R and the test for statistical significance of R are the same for standardized and raw score formulations.

In data analysis, correlation analysis tests and shows linear relationships between variables either positive or negative correlations, for example in the correlations of driving behaviour and speeding. Also in data analysis, chi-square tests measure differences between samples like the differences between traffic accidents and weather conditions. On the other hand correlation analysis shows linear relationships between variables either positive or negative correlations as in the correlation of driving behaviour and speeding.

In this study the available RTAs data was compared with the observed and recorded data from the sampled RTAs black spot road sections. It is worth to note that in using the correlation analysis it is assumed that the relationship between dependent and independent variables is linear but the relationship in RTAs and traffic flows analysis may not be linear always, hence the emphasis on the use of Chi square method of data analysis.

From the available primary data collected during the research, the study used Chi-squared test data analysis method. Since the data collected was not adequate for correlation analysis and more so the relationships on the study was normally non-linear. Chi-square test analysis is a stronger method and the most ideal in nonlinear smaller data analysis. Chi-square method of data analysis was used instead of correlation analysis in analysing the data in this study.

4.8.2 Chi-square test data analysis

In this study the observed frequencies were those collected from the field observations and through the questionnaires administered to the various sampled groups. Before establishing the level of significance in the hypothesis testing, there was a determination of the degrees of freedom (df) that might constrain the statistic in the test.

The data collected from observations and the questionnaires was compiled to test the formulated hypothesis using the Chi-square test data analysis method. The data was tested by use of the Chi-square test (giving the χ^2 -statistic χ^2) to find the significance of the difference between the frequency distributions and the hypothesis.

The Chi-square test data analysis formula

The formula for the test was given as;

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where;

O = Observed (actual) frequencies

E= Expected frequencies

The observed frequencies were those found by the field observations and through the questionnaires administered to the various sampled groups.

The expected frequencies were calculated by;

$$E = \frac{\text{Row totals} \cdot \text{Column totals}}{\text{Grand totals}}$$

Before establishing the level of significance of the χ^2 result there was a determination of the degrees of freedom (**df**) that might constrain the statistic. The degree of freedom was given some meaning to the test statistic χ^2 by relating it to the number of items in the samples upon which the test is based on.

The degrees of freedom (**df**) was given by;

$$df = (r - 1) \cdot (c - 1)$$

Where the matrix holds more than one row and more than one column,
and,

$$df = (n - 1)$$

Where the data involved only one independent sample i.e., there was only one row or only one column in the matrix.

Where;

r = the number of rows in the matrix

c = the number of columns in the matrix

Then the value of χ^2 and the value of the degrees of freedom (df) were referred to the Chi-squared significance graph. Where the values of χ^2 falls above the 0.1% line it means that there was less than 0.1% probability that the null hypothesis (Ho) was true. So there was greater than 99.9% probability that the alternative hypothesis (Hi) was true, Ho was therefore rejected.

Then statistical inferences were made based on the results of the hypothesis to be tested on the causes of road accidents in terms of the environmental and governance / enforcement factors that contribute to road safety problems. For the purpose of this study and the testing of the formulated hypothesis, the term road safety problems were taken to represent road traffic accidents (RTAs). Then statistical inferences were made from the results of the hypothesis tested on the causes of road traffic accidents in terms of the environmental factors and traffic laws enforcement factors.

Chi-square is an important statistic for the analysis of categorical data, but it can sometimes fall short of what we need. If you apply chi-square to a contingency table, and then rearrange one or more rows or columns and calculate chi-square again, you will arrive at exactly the same answer. That is as it should be, because chi-square does not take the ordering of the rows or columns into account (Howell D.C, 2014)

Pearson's chi-square test is a statistical test applied to sets of categorical data to evaluate how likely it is that any observed differences or variations between the sets arose by chance. This test is suitable for unpaired data from large samples. It is used to assess two types of comparison tests of goodness of fit or tests of independence. The test of independence which assesses whether unpaired observations on two variables expressed in a contingency table are independent of each other is applicable in this study and will be used to determine if there are significant or no significant differences in parameters tested in the hypothesis formulated,

Agrestic (1996) presents the Pearson's chi-square test approach and shows that

$M^2 = (N - 1)r^2$, where M^2 is a chi-square statistic on 1 degree of freedom, r is the difference, and N is the sample size.. For the Pearson's chi-square example this becomes

$$M^2 = c^2(1) = 125*(-.215)^2 = 5.757$$

which has an associated probability under the null of .016.

We can go one step further before leaving this approach. We know that the overall Pearson chi-square on 4 $df = 9.459$. We also know that we have just calculated a chi-square = 5.757 on 1 df associated with the linear relationship between the two variables. That linear relationship is part of the total chi-square, and if we subtract the linear

component from the overall chi-square we obtain

	<u>df</u>	<u>Chi-square</u>
Pearson	4	9.459
Linear	<u>1</u>	<u>5.757</u>
Deviation from linear	3	3.702

From this example, the departure for linearity is itself a chi-square = 3.702 on 3 *df*, which has a probability under the null of .295. Thus we do not have any evidence that there is anything other than a linear trend underlying these data.

Agresti (1996) has an excellent discussion of the approach taken here, and he makes the interesting point that for small to medium sample sizes, the standard Pearson chi-square is more sensitive to small sample size than is the ordinal chi-square that we calculated. In other words, although some of the cells in the contingency table are small, Agresti was more confident of the ordinal (linear) chi-square = 5.757 than of the Pearson chi-square of 9.459.

The principles of the Pearson's Chi-square test model will be applied in testing the hypotheses formulated in this study. The analysis will consider the linear by linear associations and the determined deviations from the linear in the Pearson's Chi-square calculations as in the examples cited.

CHAPTER FIVE: ENVIRONMENTAL FACTORS CAUSING ROAD TRAFFIC ACCIDENTS

5.0 Introduction

In this study, four hypotheses were formulated to test their validity using the data obtained from the questionnaires administered as set out in the research design. From the four Hypothesis formulated, two hypothesis were relevant to the environmental factors that may be contributing to Road Traffic Accidents (RTAs). These are Hypothesis (1) and Hypotheses (2).

There were three questionnaires used namely; Appendix 9.1 , Appendix 9.2 and Appendix 9.3. Appendix 9.1 was filled under the guidance of the researcher on the road accident black spot observations to compile data on the observed physical environmental conditions of those sampled road accident black spots for testing. Data from the observations of road accident on-lookers and witnesses was also recorded and compiled for testing. This questionnaire Appendix 9.1 had 60 respondents.

Appendix 9.2 was filled by traffic police officers from the road traffic accident records in their respective traffic base stations within the sampled study area and along the sampled road accident black spots The data obtained was on the occurrences of road accidents on the sampled road accident black spots, the physical environmental conditions, the driver driving observations, the driver licensing conditions and the traffic laws enforcement factors. This questionnaire Appendix 9.2 had 65 respondents.

Appendix 9.3. was filled for drivers of both private and public service vehicles. Each questionnaire covered different aspects of the nature and occurrences of road accidents, the frequency of road accidents, the effectiveness of traffic law/ fines and the individual perceptions of road accidents. This questionnaire Appendix 9.3 had 332 respondents.

5.1 (i) Hypothesis (1)

H₀: There is no significant difference in road traffic accidents between wet and dry road surfaces

H₁: There is a significant difference in road traffic accidents between wet and dry road surfaces.

This aspect is covered in the questions administered Appendix 9.2 to address this hypothesis. Since we are dealing with categorical variables, we tabulated the frequency of RTA occurrences in testing these hypotheses. We examined the number of total number of accidents involving different parties and the condition of the weather, whether wet or dry when those accidents occurred.

5.1 (ii) Hypothesis (1) Test

Using Appendix 9.2, we isolated the number of accidents and checked them against the weather conditions as tabulated on table 5.1 below;

The tabulation of the road accidents occurrences on the parties involved on table 5.1 indicates the number of accidents which occurred during the wet and dry conditions during the research period from the sample of 65 questionnaires administered.

Table 5.1: Number of RTAs Occurrences Based on Weather conditions

Parties involved	Wet	Dry
Saloon +Pedestrian	0	11
Saloon+ saloon	0	15
Saloon + Psv	0	4
Saloon + lorry	0	2
Saloon + cycle	0	5
Psv + Psv	0	10
Psv + lorry	0	2
Psv + cycle	0	1
Psv + pedestrian	0	4
Lorry + lorry	0	3
Lorry + pedestrian	0	4
Pedestrian + unknown party	0	4
Total	0	65

Field Data, 2013

From the analyzed number of accidents and the frequency of road accident occurrences during the wet and dry weather conditions as tabulated on table 5.2 , it is clear that 100 percent of the accidents reported occurred during dry weather conditions.

Table 5.2: Reported Frequency of RTAs based on weather conditions

Weather condition	Number of accidents	Frequency	Percentages
Wet	0	0	0
Dry	65	65	100
Total	65	65	100

Field Data, 2013

We therefore accept the null hypothesis; there is no significant relationship between wetness of road sections and the increase in road traffic accidents.

This was infact a very interesting initial result from this study because it is assumed that we expect more road traffic accidents to increase during the wet seasons and less accidents during the dry seasons. But on farther inerogations with the key informants in this study, some views were expressed that drivers during the period were probably more carefull during the wet weather coditions. More salient studies would give better explanations on this situation, otherwise that was the finding of this study.

Conclusion

There is no significant difference between wetness of road sections and the increase in road traffic accidents.

5.2 (i) Hypothesis (2)

H₀: There is a significant difference between pedestrian accidents and lack of pedestrian road crossing points and road sidewalks.

H₁: There is no significant difference between pedestrian accidents and lack of pedestrian road crossing points and road sidewalks.

In the research design Appendix 9.1 adequately addresses this hypothesis in particular with questions 1, 2, 4, and 9. These questions dealt with observations and recording of road side activities that increase pedestrians-motor conflicts on the road, available pedestrian crossing facilities, pedestrian fences and alternative pedestrian traffic ways.

From the observations of pedestrian road accident black spots there are various factors that contribute to pedestrian motor conflicts on the roads and more so along the road accident black spots. To gauge the effects of those factors, the above questionnaires were randomly administered to researchers to fill the observed physical environmental pedestrian motor conflicts along the sampled road accident black spots. Preliminary observations were done and recorded on each of the questionnaires analyzed as shown from tables 5.1- .5.4.

But due to the multiplicity of the data, this called for a mathematical technique dealing with categorical variables by combining the variables in the analyzed questionnaires for testing. The use of categorical variables allows us to use the chi-square model for the analysis using the Pearson chi-square analysis model as shown on table 5.5.

5.2 (ii) Hypothesis (2)Test

The observations of the occurrences of road side activities interference on motor flow which in effect encroaches on the pedestrian sidewalks data was compiled for analysis as tabulated from tables 5.3 – 5.4 and combined in table 5.5 for testing;

Table 5.3: Road side activity interference with motor vehicle Flow

Effects of Road side activities on motor traffic	Number of occurrences	Percentages %
Interference	34	56.66
Non-interference	26	43.33
Total responses	60	100

Field Data, 2013

The above analysis show that in over 56% of the observed occurrences , various road side activities were interfering with motor vehicle flow and in effect interfering with pedestrian walk ways and in 43% of the occurrences there were no interferences..

Observations of the availability of pedestrian road crossing facilities along the road accident black spots were compiled for analysis as tabulated from table 5.4;

Table 5.4 : Available pedestrian crossing facilities situations

Available pedestrian crossing facilities	Numbers/situations	Percentages %
Sufficient	17	28.33
Insufficient	43	71.66
Total responses	60	100

Field Data, 2013

The above analysis show that in over 71% of the situations observed there were insufficient pedestrian road crossing facilities and in only 28% of the observations there were pedestrian road crossing facilities. This might be one of the causes of the high pedestrian motor road accidents.

The observations of the existence of pedestrian fences to channel pedestrians to safe crossing points along the road accident black spots were compiled for analysis as tabulated from table 5.5;

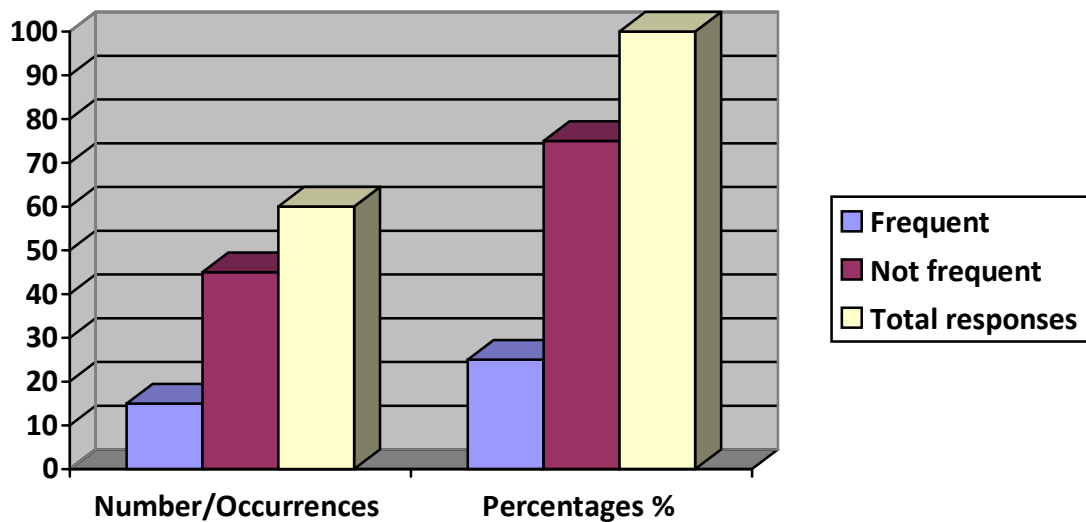
Table 5.5: Existence of pedestrian fences to channel pedestrians to safe crossing points

Pedestrian fences in place	Numbers/situations	Percentages %
Present	14	23.33
Absent	46	71.66
Total responses	60	100

Field Data, 2013

The above analysis show that in over 71% of the observed situations there were no pedestrian fences to channel pedestrians to safe crossing points along the road accident black spots and in only 23% of the situations there were pedestrian fences to channel pedestrians respondents . Again this might be one of the causes of the pedestrian RTAs.

Observations of the using of designated pedestrian sidewalks, traffic ways and safe road crossing points to avoid traffic accidents were compiled for analysis as tabulated on figure 5.1;



Field Data, 2013

Figure 5.1 : Usage of alternative pedestrian traffic ways to avoid traffic accidents

The above analysis show that out of 60 responses in 45 of them (75%) of the observed occurrences , pedestrians frequently do not use designated pedestrian sidewalks, traffic ways and safe road crossing points and in only 15 occassions (25%) of the situations pedestrians were observed to frequently use those designated facilities. Again this might be a contributor to the high pedestrian road traffic accidents.

The above findings and observations indicates to a large extent how pedestrian accidents and lack of pedestrian road sidewalks have an observed connection. But there was a need of combining the variables in the above analyzed questionnaires to empirically test the data using a mathematical technique that deals with categorical variables. In farther analyzing these categorical variables, the Pearson chi-square analysis model was used as tabulated on table 5.6;

Table 5.6: Combining the variables in a chi-square model

	Value	df	Assymp.sig (2 sided)	Difference.
Pearson Chi-Square	.549	2	.760	.211
Likelihood ratio	.956	2	.620	.311
Linear by linear association	.210	1	.647	.437
Deviation from linear	.339	1	.133	.206

It is noted that in 3 cells (50.0%) the Pearson's chi-square and Assymp.sig (2 sided) figures have counts of less than 5 i.e. .459 and .760 respectively. The minimum expected count is .437 (i.e. the difference between the Assymp.sig (2 sided) figure of .647 and the linear by linear association value .210). The Chi-Square test carried out on the data was significant at the 0.01 level (2-tailed $p < 0.0005$) of significance. It is also noted that the difference between Assymp.sig (2 sided) figure of .760 and Pearson Chi-Square .549 is .211 which is almost the same as the linear by linear figure of .210. This shows a negligible variation and confirms no significant differences.

Therefore, we reject the H_0 : that there is a significant difference between pedestrian accidents and lack of pedestrian road sidewalks and accept the alternative H_1 : that there is no significant difference between pedestrian accidents and lack of pedestrian road sidewalks.

Conclusion:

There is a significant relationship between pedestrian accidents and the lack of pedestrian road crossing points and sidewalks.

5.3 Findings on Environmental Factors

5.3.1 Introduction

This section narrates the research findings after the testing of the hypothesis in this study together with the implicit observations of the road accident black spots in the area of study. The formulated hypothesis were tested on the data obtained from the research

through questionnaires administered to the motor drivers as the road users and the traffic police officers who deal with RTAs in the respective road accident black spot areas in Nairobi City.

5.3.2 Road Traffic Accidents occurrences and Weather conditions

The research compared the relationship between road accident occurrences and weather conditions by tabulating the number of accidents which occurred during the wet and dry conditions during the research period from the sample of 65 questionnaires administered. From the analyzed number of accidents and the frequency of road accident occurrences during the wet and dry weather conditions, it was clear that 100 percent of the accidents reported occurred during dry weather conditions. It was therefore noted that there was no significant relationship between wetness of road sections and the increase in road traffic accidents.

This research finding implies that for all the road traffic accidents which occurred during the research period, there was insignificant influence of weather conditions. Therefore there were other contributory factors of these road traffic accidents. Also from the research observation it was noted that 54% of the accidents analysed occurred during the day time and 46% occurred during the night time as tabulated on table 5.7.

Table 5.7: Time of the day number. of Road Accidents; 2007-2011

Day Time 6.30am-6.45pm Accidents	2007	2008	2009	2010	2011
Night Time 6.45pm-6.30am Accidents					
Day Time	1,863 (56%)	1,350 (55%)	1,568 (54%)	1,378 (52%)	1,291 (54%)
Night Time	1,471 (44%)	1,118 (45%)	1,351 (46%)	1,286 (48%)	1,103 (46%)
Total	3,334	2,468	2,919	2,664	2,394*

Source: Researcher, 2013

The research study observation in this study show that time period either day or night had minimal effects on the accident occurrences but severity of accident impacts may differ during the day and night occurrences. Other research studies reviewed by W. Odero et al (1997) on road traffic injuries in developing countries: a comprehensive review of epidemiological studies showed that road accident crash incidences and time of the day have some relationship similar to the observations made in this study. The reviewed epidemiological studies showed that between 60 and 80% of casualties were injured during the day and about one-third of traffic injuries occurred during the night with the highest incidence being between 1800 and 2400h. Only 6 studies (Kaye 1971; 1973; Ferguson 1974; Fosseus 1983; Obembe & Fagbayi 1988; Holder 1989) indicated proportions greater than 50% for night-time crashes (range 51–69%). Although there is less traffic at night, the risk and probability of injury is likely to be much higher than during the day. These reviews show similar trends of the results of this study.

5.3.3 Pedestrian road accidents, Pedestrian way facilities and usage

The research analysed whether there were road side activities interfering with motor vehicle flow and in effect interfering with pedestrian walk ways; whether there were sufficient pedestrian road crossing points/facilities; whether there were pedestrian fences to channel pedestrians to safe road crossing points and whether pedestrians frequently use designated pedestrian sidewalks, traffic ways and safe road crossing points. There are interesting research observations and findings as indicated in tables 5.8 – 5.11;

Table 5.8: Pedestrian road crossing facilities and speed limit bumps data ; Cross tabulation Count

		Are the speed limiting bumps erected at reasonable distance before the RTA black spot?		Total
		No	Yes	
Are sufficient pedestrian crossing facilities provided and are they properly located?	No	27	7	34
	Yes	8	2	10
Total		35	9	44

Source: Researcher, 2013

On pedestrian road crossing facilities and speed limit bumps, the highest observation was that speed limiting bumps are not erected at reasonable distance before the RTA black spot in (27) observations out of a count of (34) and that there are no sufficient pedestrian road crossing facilities provided in (27) observations out of a count of (35).

The fact that there are no sufficient road crossing points and pedestrian facilities on the roads, pedestrians are tempted to take a gamble and cross the roads at any vantage points on the roads despite the risks. If this is accompanied road view obstructions to the pedestrians and motorists, there is a high probability of accidents occurring on such road sections.

Table 5.9: Pedestrian channelling to safe road crossing points and black spots data

Are the pedestrian fence erected to channel pedestrians to safe crossing points? * Are the speed limiting bumps erected at reasonable distance before the RTA black spot?

Cross tabulation Count

		Is the speed limiting bumps erected at reasonable distance before the RTA black spot?		Total
		No	Yes	
Are the pedestrian fences erected to channel pedestrians to safe crossing points?	No	24	8	32
	Yes	12	2	14
Total		36	10	46

Source: Researcher, 2013

From the aspect of pedestrian channelling to safe road crossing points, it is observed in (24) situations out of a count of (36) that pedestrian fences erected to channel pedestrians to safe crossing points and in (2) situations out of a count of (14) that speed limiting bumps are erected at reasonable distance before the RTA black spots

Table 5.10: Pedestrian road crossing facilities and RTAs black spot obstructions.

Are sufficient pedestrian crossing facilities provided and are they properly located? * Is the RTA black spot obstructed from clear visibility by drivers and pedestrians?

Cross tabulation Count

		Do drivers and pedestrians obstruct the RTA black spot from clear visibility?		Total
		No	Yes	
Are sufficient pedestrian crossing facilities provided and are they properly located?	No	28	12	40
	Yes	8	6	14
Total		36	18	54

Source: Researcher, 2013

On the availability of pedestrian road crossing facilities, the highest observation was that there are no sufficient pedestrian crossing facilities in (28) out of a count of (36) and that drivers/pedestrians block the visibility of black spots in (28) out of a count of (40).

Table 5.11: Pedestrian fence erected and black spots visibility data

Are the pedestrian fence well erected to channel pedestrians to safe crossing points? * Are the RTAs black spots obstructed from clear visibility for drivers and pedestrians?

Cross tabulation Count

Parameters	Are RTAs black spots obstructed from clear visibility for drivers and pedestrians?		Total
	No	Yes	
Are the pedestrian fence erected to channel pedestrians to safe crossing points?			
No	30	13	43
Yes	7	6	13
Total	37	19	56

Source: Researcher, 2013

On the aspects of Pedestrian fence erected and black spots obstructions, the highest observation was that pedestrian fences are not well erected to channel pedestrians to safe crossing points in (30) observations out of a count of (37) and that RTAs black spots are obstructed from clear visibility for drivers and pedestrians in (13) observations out of a count of (43). In most such situations the pedestrian safe road crossing points can be very far away from the connecting feeder roads or are located in other physically unsafe road points.

The observations and analysis of these test parameters clearly show that in most cases there were no pedestrian fences to channel pedestrians to safe crossing points along the road accident black spots, pedestrians frequently do not use designated pedestrian

sidewalks, traffic ways and safe road crossing points. These are the main causes of the high pedestrian motor road accidents. Therefore, there is a significant relationship between pedestrian accidents and the lack of pedestrian road sidewalks.

In a similar research study on the form of traffic distribution and environmental factors of roads that affect traffic accidents was done in Dusit District – Thailand on Samsen road. The analysis of the position in traffic accidents were done on the environmental factors of the road that can cause traffic accidents in Dusit District in only areas under the responsibility of a specific police station(Samsen police station).

The test results of this research study indicated that Samsen road had the highest rate of accidents followed by the connecting road at intersect with Samsen road. In this study it was noted that the traffic that occurs variously such as on foot paths; bicycles, cars, motor cycles and also big trucks disturbs the tempo of the traffic making it too slow or rapid and this increases the risk of accidents on the foot paths as the vehicles and pedestrians compete on the road sections (Musthaya Patchanee,2012). This study has similarities in the researcher's study on the roads physical environmental factors which affect pedestrian road crossings and walk ways leading to high pedestrian road traffic accidents.

5.4 Discussion of Results: Environmental Factors and RTAs

5.4.1 Introduction

This section discusses the results of the research findings and the observations done in the area of study. The section also expounds on the road traffic accidents data collected and recorded from the study area. Reference is also made to the other research findings relevant to this study.

Many professional groups argue that the cure for road accidents is to create new regulations, new rules and more control at the road side measures which can make people behave in a better way. Traffic psychologists see people behaving in a different way, any new signs and new regulations are there for people to test whether they can be ignored. If a change in traffic control is not supported by an information campaign and strict Police enforcement there will be no results and as observed in many countries, stop signs are very willingly ignored (Norman, 1989).

Motor vehicle insurance policies also contribute to under-reporting thereby giving the wrong road accidents data. The “no-claims bonus” scheme/incentive whereby, an insured gets a reduction in the premium if in any one year he/she does not lodge an insurance claim to the insurance company for settlement of costs of repair of a vehicle involved in an accident, encourages people not to report accidents. When using RTAs secondary data the possible errors and omissions will be noted in analysing the data abstracted for this study.

5.4.2 Environmental effects on Pedestrian and Cyclists Road Traffic Accidents

The Institute of Highways and Transportation (IHT), 1997 observed that cyclists were the third largest cause of road crashes in Kenya after drivers and pedestrians respectively on similar reasons as for pedestrians but they were observed also to be victims of poor road infrastructure designs which ignores their presence on the road and they have to struggle with motor vehicle drivers for road space because there are no cyclist lanes or parking bays.

Although there are research findings showing that pedestrians and cyclists cause road crashes due to ignorance of road traffic signs and signals, influence of alcohol and other toxic substances, wrong judgements and general lack of anticipation; there are also environmental and governance factors which contribute to pedestrians and cyclists road accidents.

In this research study findings it was observed that in over 56% of the observed occurrences, various road side activities were interfering with motor vehicle flow and in effect interfering with pedestrian walk ways and in over 71% of the situations observed there were insufficient pedestrian road crossing facilities on the road accident black spots. In the study it was also observed that in over 71% of the observed situations there were no pedestrian fences to channel pedestrians to safe crossing points along the road accident black spots; and in 75% of the observed occurrences pedestrians frequently do not use designated pedestrian sidewalks, traffic ways and safe road crossing points to avoid pedestrian motor conflicts. Therefore the research conclusion was that there is a significant relationship between pedestrian accidents and lack of pedestrian road sidewalks.

From the Nairobi area traffic police road accidents records, the research findings observed that pedestrian fatal road accidents increased from 434 in 2007 to 515 in 2011 in Nairobi city as indicated in table 5.12. These are very high road accident figures for only one town in Kenya. This reaffirms the research findings in the tested hypothesis that lack of pedestrian facilities in Nairobi city contributes to RTAs. Although there might be some minor errors in the police road traffic accident records, the magnitude of the pedestrian road traffic accidents in Nairobi city is clearly manifested in the research findings. This calls for both County and National Governments to re-look at pedestrian and cyclists problems on our road systems.

Table 5.12: Classes of persons killed and injured in RTAs; 2007-2011-Nairobi

Year	Pedestrians		Passengers		Drivers		motor cyclists		Totals
	Fatal	Injured	Fatal	Injured	Fatal	Injured	Fatal	Injured	Total
2007	434	1,928	74	2,076	59	216	23	94	4,904
2008	437	1,470	98	1,180	57	296	8	70	3,616
2009	559	1,454	150	1,632	84	349	77	145	4,450
2010	516	1,313	126	1,750	56	343	24	191	4,319
2011	515	1,096	102	1,403	45	224	45	195	3,625

Source: Kenya Police - Nairobi Area traffic records , 2012

5.4.3 Environmental Conditions and Road Traffic Accidents

Asingo P and Mitullah W, 2007 (IDS working paper No. 545) observes that although there are no conclusive studies appears to have been done on the extent to which the sorry state of road infrastructure leads to road crashes, conventional wisdom indicates that the poor state of most Kenyan roads is a major contributing factor to road crashes in the country.

Many road accidents occur when driver/motorists try to avoid pot -holed road sections and when trying to overtake other vehicles along the narrow sections of the roads. In most cases the narrowness of the roads leads to risky overtaking which can cause road traffic accidents. It is also noteworthy that road infrastructure designs sometimes tend to ignore other road users like pedestrians and cyclists who have to struggle with motorists for road space at the risk of causing road accident crashes.

The research findings in this study re-confirm those observations on how the road conditions and the road infrastructural facilities contribute to RTAs. The research study observed that speed limit signs erected on the roads can have some impact in the reduction of RTAs where it is noted that of the sampled RTA occurrences 80% of them occurred where there are no speed limits signs while only 20% of the RTAs occurred where there are traffic speed limit signs at the road accident black spots.

On the impact of speed limiting bumps against number of accidents occurred, it was observed that over 73% of the RTAs occurred where there are no speed limit traffic bumps while only about 27% of RTAs occurred where speed limit bumps are erected on road accident black spots. And the research findings on the blame factors against number of accidents occurred show that 36% of the respondents views are that the RTAs are blamed on the drivers, 31% are due to other factors while 32% of the respondents did not categorize the blame on the accidents.

It is the researcher's point of view that the respondents in this case may have expressed matters of opinion and might not have reflected the actual situation on the ground. However the other research findings supported the view that some physical environmental factors like speed limiting bumps and road speed limit signs can have some impact in reducing RTAs.

As noted earlier road side activity interference with motor vehicle flow, lack of pedestrian crossing facilities on highways and lack of pedestrian fences to channel pedestrians to safe crossing points on urban roads increases the risk of road traffic accidents. Thus the research finding that there is a significant relationship between pedestrian accidents and lack of pedestrian road facilities.

There are many road accident black spot areas observed in this study to have no speed limit signs, no speed control road bumps, lack of convenient pedestrian road crossing facilities, obstructed road views for motorists and passengers, illegal PSV bus stops, unutilized pedestrian flyovers, road side activities encroachment of motor roads and pedestrian walk ways and where motorists do not give way to other motorists and pedestrians even when they have a right of way. Some of those accident black spots areas

are; Mombasa road, Waiyaki way, valley road. Langata road and Mbagathi road. Those research study observations and reports are tabulated from tables 5.13-5.17.

Table 5.13: Environmental observations in Nairobi-Langata and Mbagathi road accident black spots

No	Identified Road accident black spots in the area	What is the nature/condition of the road surface?	What are the common types of accidents?	Are there any pedestrian crossing/ways?	Are there any driver/driving view obstructions?	Are there any speed limits signs/bumps?
1	KNH / IDH flyover – Mbagathi road	Rough concrete tarmac road	Fatal /injury	Yes / A flyover rarely used	Yes, illegal PSV turn to Mbagathi road from IDH	No
2	Nyayo High rise/ Riara University Flyover Mbagathi Road	Rough concrete tarmac road	Serious injury	Yes / A flyover used but sometimes not used	Yes, a dangerous turn off after rail flyover	No
3	Langata road / Mbagathi road round about junction	Smooth tarmac	Fatal/ injury	Yes not marked	Yes , Motorists on Langata road do not give way	No

Source: Researcher, 2013

The salient research observations are; lack of speed limiting facilities, flyovers rarely used , dangerous and illegal PSV bus stops and turning points and motorists not giving way to the motorists who have rights of way on Mbagathi and Lanhgata roads. These factors contribute to RTAs in those areas, hence their inclusion as having road accident black spots.

Table 5.14: Physical Environmental Observations on Mombasa Road Black spot Observations:

No	Identified Road accident black spots in the area	What is the nature/condition of the road surface?	What are the common types of accidents?	Are there any pedestrian crossing/ways?	Are there any driver/ driving view obstructions?	Are there any speed limits signs?
1	General Motors area on Mombasa Road	Smooth tarmac	Fatal	No	Yes, Traffic from GM side joining Mombasa road obstructed	No
2	Bellevue Cinema on Mombasa Road	Smooth tarmac	Serious	No	Yes, Traffic from south B and Bellevue side obstructed	Not clear
3	South ‘‘C’’ Flyover on Mombasa Road	Smooth tarmac	Slight	Flyover rarely used	No	No

Source: Researcher, 2013

The physical environmental observations in this area which would affect motor and pedestrian flow and cause RTAs are; lack of speed limiting facilities, flyovers rarely used , obstructed motorists and pedestrians view, not giving way to the motorists who have rights of way on some sections of Mombasa road. These factors contribute to RTAs in those areas.

Table 5.15: Physical Environmental Observations on Valley Road accident Black spot

No	Identified Road accident black spots in the area	What is the nature/condition of the road surface?	What are the common types of accidents?	Are there any pedestrian crossing/ways?	Are there any driver/ driving view obstructions?	Are there any speed limits signs?
1	Silver Springs Hotel / Kenya Army Hqrs/DOD section-Valley road	Smooth tarmac	Fatal /Injury	No	Yes-Illegal PSV passenger bus stop	No
2	Nairobi Pentecostal Church (NPC) Flyover –Valley road	Smooth tarmac	Fatal/ Serious injury	Yes- A flyover sometimes not used	No	No
3	Milimani/ Valley road junction –Valley Road	Smooth tarmac	Slight Injury, car to car accidents	No signs	Yes obstruction of traffic entering valley road to and from Milimani rd	No

Source: Researcher , 2013

The observations done in this area are; lack of speed limiting facilities, flyovers rarely used, obstructed motorists and pedestrians road view, dangerous and illegal PSV bus stops and turning points on valley road. These factors contribute to RTAs in those areas, hence the need for the valley road area to be included in the class of road accident black spots in Nairobi city.

Table 5.16: Physical Environmental Observations on Waiyaki way accident Black spot

	Identified Road accident black spots in the area	What is the nature/condition of the road surface?	What are the common types of accidents?	Are there any pedestrian crossing/ways?	Are there any driver/driving view obstructions?	Are there any speed limits signs/bumps?
1	Kangemi Fly over-Waiyaki way	Smooth tarmac	Fatal Serious injury	Yes , flyover sometimes not used	Hawkers encroach on the road	No
2	Nairobi school-KARI Muthangari junction, Waiyaki way	Smooth tarmac	Fatal Serious injury	Yes , exit from Nairobi school and KARI on blind corners No	Traffic entry to Waiyaki way from Muthangari is obstructed	No
3	Westlands –Chitromo Junction , Waiyaki way	Smooth tarmac	Fatal Serious injury	No, illegal PSV bus stops	The exit crossing from waiyaki way to riverside is obstructed	No

Source: Researcher , 2013

The observations in this area which increases road accident risks are; lack of speed limiting facilities, flyovers rarely used , dangerous and illegal PSV bus stops, not giving way to the motorists who have rights of way, obstructed exit and entry blinded corners and side roads on Waiyaki way. Some of those observed factors contributes to RTAs in those areas, hence the inclusion the highway as having road accident black spots.

One of the research environmental observations was that where there is no road traffic separation of motor ways and pedestrian road side walks, there will always be pedestrian motor conflicts leading to RTAs. Separation motor ways and pedestrian walk ways as observed along UN Avenue Gigiri on limuru road minimizes pedestrian motor conflicts and this reduces RTAs. Plate: 5.1 shows an example of a well-planned road where pedestrian sidewalks are clearly separated from the road ways. If this is replicated along all the road accident black spot areas, it can greatly reduce pedestrian deaths on our roads.



Researcher: Field observations, 2012

Plate 5.1: Physical Environmental Observations in Nairobi - Limuru Road, Gigiri

Table 5.17: Physical Environmental Observations in Nairobi on High pedestrian Industrial area Road accident Black spots

No.	Identified Road accident black spots in the area	What is the nature/condition of the road surface?	What are the common types of accidents?	Are there any pedestrian crossing/ways?	Are there any driver/driving view obstructions?	Are there any speed limits signs bumps?
1	Masai Road - Industrial area	Smooth tarmac	Non Injury	No	No	No
2	Lunga Lunga Road - Sinai Industrial area	Smooth tarmac	Non Injury	No	Yes	No
3	Enterprise Road Industrial area	Smooth tarmac	Serious	No	No	No

Source: Researcher ; 2013

The salient observations in this area are; lack of speed limiting facilities for speeding vehicles, lack of adequate convenient pedestrian road crossing facilities , no road flyovers for dangerous road sections, dangerous and illegal PSV bus stops and motorists not giving way to pedestrians even when they have a right of road crossing. These factors contributes to pedestrian RTAs and these road sections at Industrial area should be classified as pedestrian road accident black spots. However thia study was carried ou in 2012-2013 and other changes might have happened in 2014-2015 on road re-designs and traffic calming measures.

It was unfortunate that the research finding found no significant relationship between wetness of road sections and the increase in road traffic accidents. The tabulation of the road accidents occurrences on the parties involved indicated the number of accidents which occurred during the wet and dry conditions during the research period. From the analyzed number of accidents and the frequency of road accident occurrences during the wet and dry weather conditions it was noted that 100 percent of the accidents reported occurred during the dry weather conditions. However the results of the other research findings adequately and positively tested the relationship between the other physical environmental factors and the increase in RTAs.

In almost all countries, road networks are designed from the perspective of the motor vehicle user. But developing countries can take lessons from safety conscious road design in countries such as the Netherlands and Denmark, where roads are built to suit their function (high speed, rural, transitional between high speed and rural, and residential) and account for the safety of pedestrians and cyclists. Studies in Denmark showed that providing segregated bicycle lanes alongside urban roads reduced deaths among cyclists by 35 percent.(WHO,2012)

CHAPTER SIX: GOVERNANCE FACTORS INFLUENCING ROAD TRAFFIC ACCIDENTS

6.0 Introduction

In this study, four hypotheses were formulated to test their validity using the data obtained from the questionnaires administered as set out in the research design. From the four Hypothesis formulated, two hypothesis were relevant to the Governance factors that may be contributing to Road Traffic Accidents (RTAs). These are Hypothesis (b) and Hypotheses (d).

There were three questionnaires used namely; Appendix 9.1, Appendix 9.2, and Appendix 9.3. Appendix 9.1 was filled under the guidance of the researcher on the road accident black spot observations to compile data on the observed traffic law enforcement parameters along the sampled road accident black spots for testing. Data from the traffic police officers was also recorded and compiled for testing. This questionnaire Appendix 9.1 had 60 respondents.

Appendix 9.2 was filled by traffic police officers along various stretches of the sampled road accident black spots in their respective traffic base stations. The data obtained was on the occurrences of road accidents on the sampled road accident black spots, the physical environment al conditions, the driver driving observations, the driver licensing conditions and the traffic laws enforcement factors. This questionnaire Appendix 9.2 had 65 respondents.

Appendix 9.3 was filled by drivers of both private and public service vehicles. Each questionnaire covered different aspects of the nature and occurrences of road accidents, the frequency of road accidents, the effectiveness of traffic law/ fines and the individual perceptions of road accidents. This questionnaire Appendix 9.3 had 332 respondents.

6.1 (i) Hypothesis (3)

H0: There is no significant difference between driver behaviour in speeding and road traffic accidents.

H1: There is a significant difference between driver behaviour in speeding and road traffic accidents.

In the research design there are specific questions in the administered questionnaires that address the categorical variables in order to adequately test this hypothesis. These included question 9 in Appendix 9.2, question 6 in Appendix 9.1; questions 4, 7 and 9 in Appendix 9.3. There are various factors that can influence driver speeding knowingly or unknowingly on the roads and more so along the road accident black spots. To gauge the effects of those factors, the above questionnaires were randomly administered to motorists and traffic police officers. Preliminary observations were done and recorded on each of the questionnaire analysed as shown from tables 6.1.1 – 6.1.6. But due to the multiplicity of the data, this called for a mathematical technique dealing with categorical variables by using the Pearson chi-square analysis model as shown on table 6.1.7.

6.1 (ii) Hypothesis (3) Test

- (a) From question 9 (a) in Appendix 9.2, the total number of RTAs from the road accident black spots in comparison to the absence or presence of Traffic officer on the Roads was compiled as tabulated on tables 6.1- 6.6 and combined for testing in 6.1;

Table 6.1 : Table of presence or absence of officers against number of accidents occurred

Police Officers	Number of accidents	Percentages%
Present	18	27.69
Absent	47	72.30
Total	65	100

Field Data, 2013

It is noted that from the sampled number of accidents over 72% of them occurred when the traffic police officers were not present at or near the road accident black spots.

- (b) From question 9 (b) in Appendix 9.2, the total number of RTAs from the road accident black spots in comparison to the absence or presence of speed limit signs on the roads was compiled as tabulated on table 6.2 ;

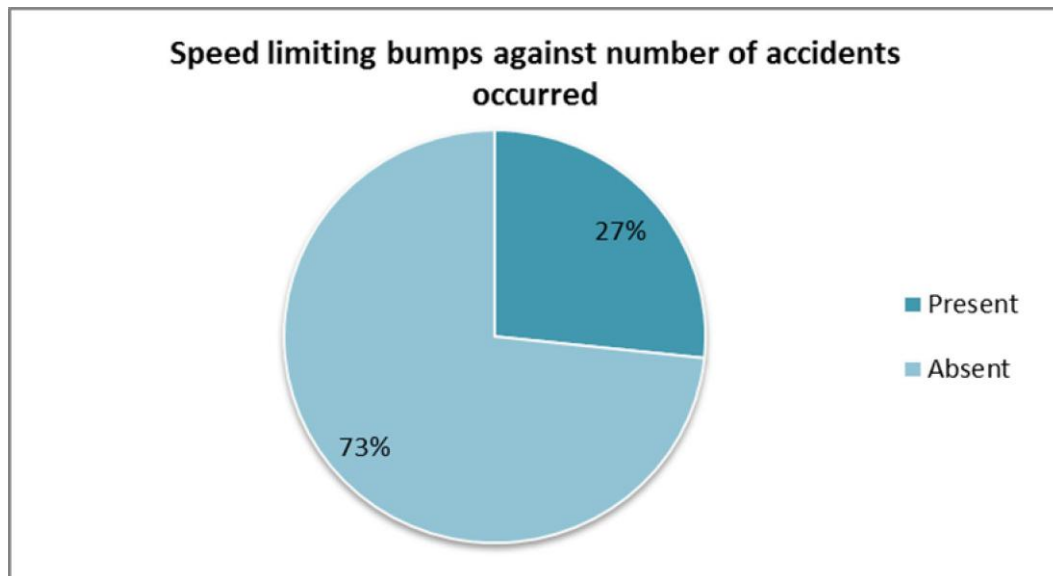
Table 6.2 : Table of presence of speed limits against number of accidents occurred

Speed limit signs	Number of accidents	Percentages %
Present	13	20
Absent	52	80
Total	65	100

Field Data, 2013

It is noted that of the sampled RTA occurrences 80% of them occurred where there are no speed limits signs while only 20% of the RTAs occurred where there are traffic speed limit signs at the road accident black spots.

(c) From question 6 in Appendix 9.1 , the total number of RTAs from the road accident black spots in comparison to the absence or presence of speed limit bumps on the Roads was compiled as tabulated on figure 6.1;

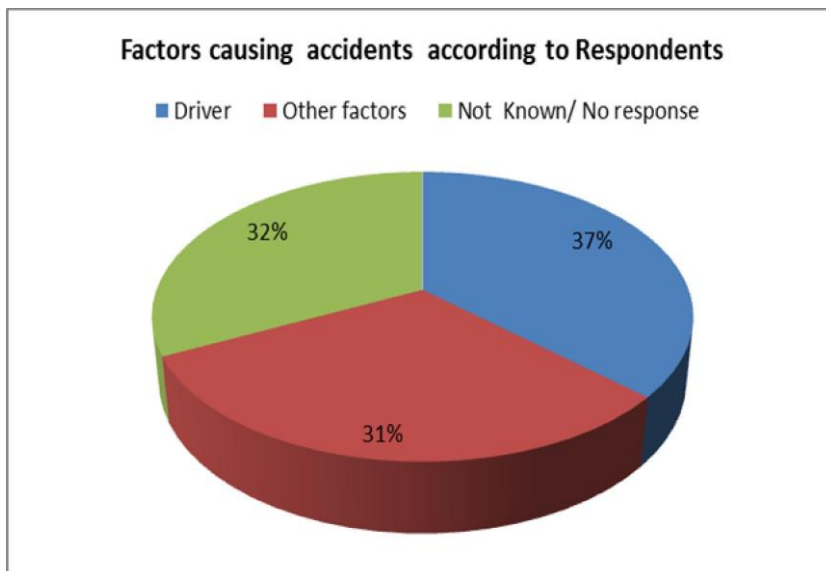


Field Data, 2013

Figure 6.1: Speed limiting bumps against number of accidents occurred

In the analysis of 60 accidents reported , it is noted that 44 of these accidents (about 73%) occurred where there are no speed limit traffic bumps while 16 accidents (about 27%) of them occurred where speed limit bumps are elected at the road accident black spots.

(d) From question 4 in Appendix 9.3 , the total number of RTAs from the road accident black spots in consideration of the factor who was to blame for accident on the Roads was compiled as tabulated on figure 6.2;

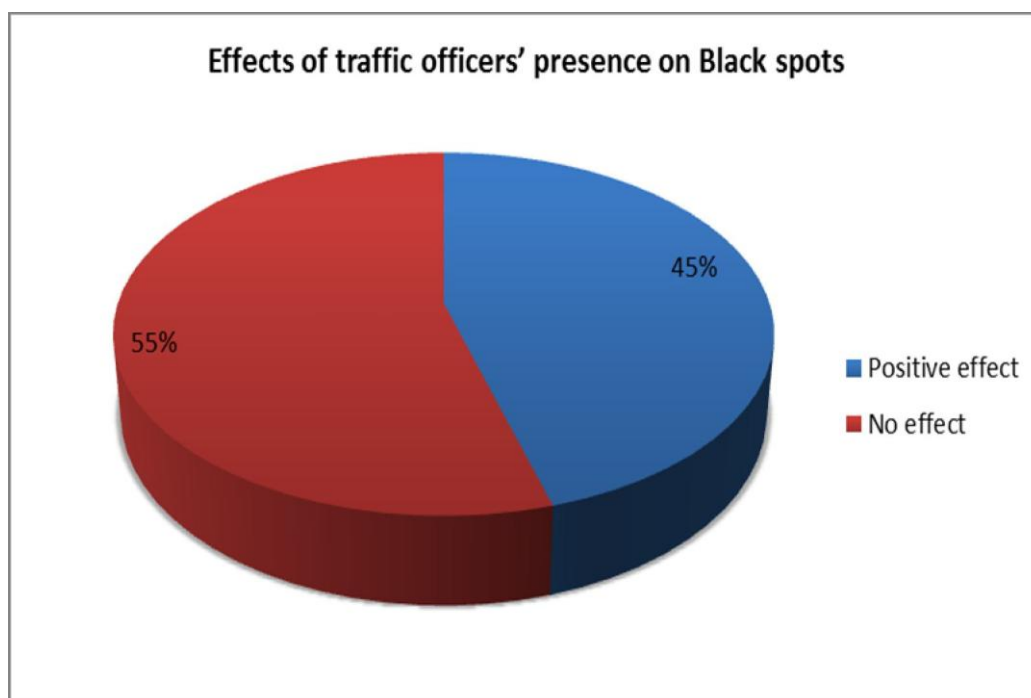


Field Data, 2013

Figure 6.2 : Factors causing accidents according to Respondents

The above analysis shows that 37% (122 respondents) of the 332 respondents in the questionnaire had the views that RTAs are blamed on the drivers, 31% (103 respondents) had the views that RTAs are due to other factors while 32% (107 respondents) of the respondents did not categorize the blame on the accidents. From the researcher’s point of view respondents of question 4 in Appendix 9.3 expressed matters of opinion and might not have reflected the actual situation on the ground. However the blame on the drivers was higher.

(e) From question 7 in Appendix 9.3, the total number of positive and negative effects of the presence of traffic officers on the road accident black spots before RTAs was compiled as tabulated on figure 6.3;



Field Data, 2013

Figure 6.3: Effects of traffic officers' presence on Black spots- Motorists views

The above analysis shows that in over 55% situations (181 out of the sample of 332 respondents) on the effectiveness of traffic officers presence at the road accidents black spots, the responses were that there was no positive effect on the presence of traffic officers on the black spots in deterring RTAs and in 45% of the situations (151 respondents) there were positive effects on the presence of traffic officers in deterring RTAs.

(f) From question 9 in Appendix 9.3, the effects of traffic fines and bonds meted for traffic offences as a deterrent measure were compiled as tabulated on table 6.3;

Table 6.3: Responses on the effects of traffic court fines or bonds on RTAs

Effects of Traffic Fines /Bonds	Number	Percentages %
Positive effect	153	46.08
No effect	179	53.91
Total	332	100

Field Data, 2012

The above analysis show that over 53% of the respondents views are that traffic court fines and bonds fines have no positive effects to drivers in reducing RTAs and slightly over 46% of the respondents indicated that fines and bonds have positive effects in reducing RTAs.

In order to empirically test the data the use a mathematical technique that deals with categorical variables was utilized in combining the variables in the analysed questionnaires for testing. The use of categorical variables allows us to use the chi-square model for the analysis using the Pearson chi-square analysis model as tabulated on table 6.4;

Table 6.4: Chi-square tests Analysis

Combining relevant categorical variables in chi-square model;

	Value	df	Asymp. Sig. (2 sided)	Difference
Pearson Chi-square	7.363	8	.487	6.876
Likelihood ratio	7.823	8	.467	7.356
Linear by linear association	1.076	1	.322	.754
Deviation from linear	6.287	7	.165	

It is noted that in 8 cells (53.3%) the Pearson's Chi-square figure has an expected count of more than 5 i.e 7.363 and the Pearson's Chi-square deviation from linear is also more than 5 i.e 6.282. The minimum expected count is .27. Therefore, we accept the null hypothesis and reject the alternative hypothesis at the 0.01 level of significance.

From the chi-square test carried out above, it is clear that there is no significant difference between driver behaviour in speeding and road traffic accidents.

Conclusion:

There is therefore no significant difference between driver behaviour in speeding and occurrences of road traffic accidents.

6.2 (i) Hypothesis (4)

H₀: There is no significant difference between between lax enforcement of traffic rules and regulations and the increase in road traffic accidents.

H₁: There is a significant difference between between lax enforcement of traffic rules and regulations and the increase in road traffic accidents.

In the research design questionnaires Appendix 9. 1, 9.2 and 9.3 addresses the categorical variables in order to test this hypothesis. These are questions 4, 8 and 9 in Appendix 9.2; also questions 5, 7 and 9 in Appendix 9. 3 addresses this hypothesis. These questionnaires dealt with observations and recording of the ‘on the accident spot’ validity of drivers’ driving licenses, the fate of the party to blame for the accidents, the presence of traffic police officers on the stretch of the road during the accidents, the number of motorists charged in court for the traffic accidents, public view on the effects of the presence of traffic police on the road to motor drivers, the public view of the effects of traffic police officers in reducing road traffic accidents and the overall public view on the effects of court traffic fines or bonds to drivers in reducing road traffic accidents.

The general observations of road traffic accident scenarios, it is observed that there are various factors that contribute to accident situations along the road accident black spots. To gauge the effects of those factors, the above questionnaires were randomly administered to the public, motor drivers’ and traffic police officers to record the various accident situations. Then preliminary observations were done and recorded on each of the questionnaires analyzed as shown from tables 6.2.1 -6.3.7 and combined for testing on table 6.2.8 below;

6.2. (ii) Hypothesis (4) Test

The observations of the validity of the drivers’ driving licenses were recorded either valid or not valid situations for analysis as tabulated from table 6.5;

Table 6.5: Drivers' driving license Validity

On spot Position of drivers license	Numbers situations	Percentages %
Valid	61	93.84
Not valid	4	6.15
Total responses	65	100

Field Data, 2013

The above analysis show that in over 93% of the accident situations the drivers had valid driving licenses and in only 6% of the situations where the drivers were found to be having invalid driving licenses. Observations of the police actions on the fate of party to blame for the accident either charged or not charged for the accident were compiled for analysis as tabulated from table 6.6 below;

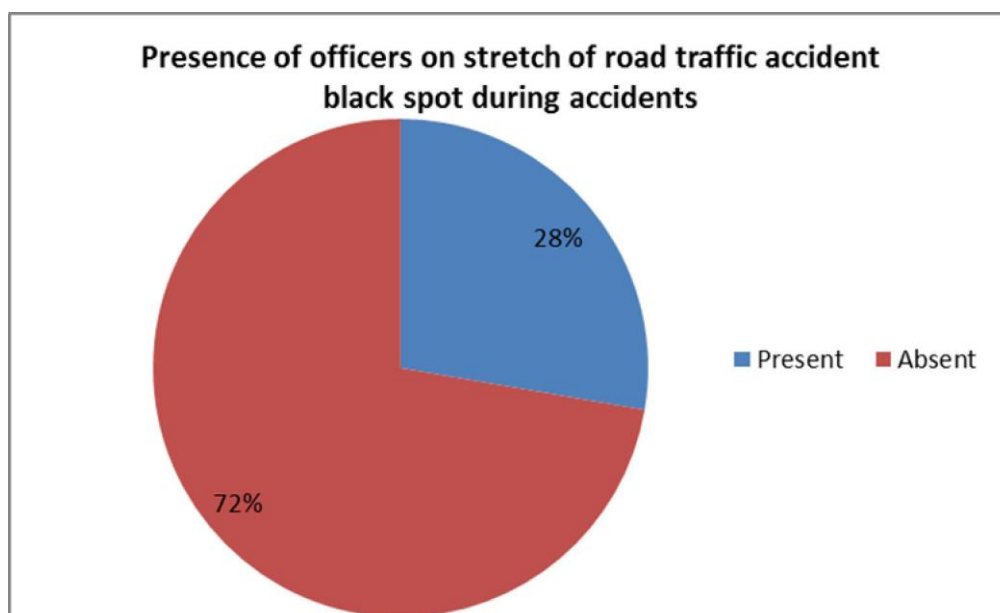
Table 6.6 : Fate of party to blame for accident

After accident Traffic police actions	Numbers / situations	Percentages %
Charged	40	61.53
Not charged	25	38.46
Total responses	65	100

Field Data, 2013

The above analysis show that over 61% of the drivers who were to blame for the accidents were charged for the offences, while over 38% of them were not charged. The main concern of the researcher in this case was why the 38% were not charged. This was addressed in the other RTAs observations and records.

Observations of the occurrences and situations where road traffic accidents occur even when traffic police officers are on the stretches of the same road accident black spots were compiled for analysis as tabulated from figure 6.4;



Field Data, 2013

Figure 6.4: Presence of traffic police officers on stretch of road traffic accident black spot during accidents

The above analysis show that out of 65 of the accident situations in 47 of them i.e over 72% of the situations RTAs occurred when traffic police officers were not on the road accident black spots and in 18 of the accident situations almost 28% of the situations RTAs happened when they were on those road accident black spots. This was an area of concern for the researcher to carry out more observations on this scenario.

The individual motor driver responses on either they were ever charged, not charged or not involved in accidents to warrant being charged were compiled for analysis as tabulated from table 6.7;

Table 6.7: Number of motorists charged in court for offences

Traffic offence actions	Number	Percentages %
Charged	70	21.08
Not charged	155	46.68
N/A (No accidents)	107	32.22
Total responses	332	100

Field Data, 2013

The above analysis show that only slightly over 21% of the respondents voluntarily responded that they were ever charged for traffic offences, slightly over 46% indicated that they were not charged and another 32% implied that they were never involved in a traffic accident. This was another area of concern for the researcher taking note of the many RTAs in Kenya. Were the responses really genuine? This was to be addressed from more observations and research records.

Driver motorists views on the effects of traffic police officers presence on the roads on the motorists were compiled for analysis as tabulated from table 6.8;

Table 6.8: Effects of traffic police officer presence on motor drivers driving behavior

Motorists Public views	Numbers	Percentages %
Positive effect	151	45.48
No effect	181	54.51
Total responses	332	100

Field Data, 2013

The above analysis show that about 55% of the respondents views are that the presence of traffic police officers on the road has no effect on motor drivers driving behaviour and about 46% indicated that the presence of traffic police officers on the road has a positive effect on motorists and can have some effects to motorists in reducing road traffic accidents. The general views of motorists on the effectiveness of traffic police in reducing RTAs were compiled for analysis as tabulated from table 6.9;

Table 6.9 : General effects of traffic police officers in reducing road traffic accidents

Motorists Public views	Numbers	Percentages %
Positive effect	124	37.34
No effect	208	62.65
Total responses	332	100

Field Data, 2013

The above analysis show that out of the 332 respondents , 208 of them about 63% had views that traffic police officers are not effective in reducing RTAs and about 37% , 124 of them are of the view that traffic police officers have a positive effect in reducing road traffic accidents.

The motor drivers public views on the effectiveness of traffic fines or bonds to drivers in reducing road traffic accidents were compiled for analysis as tabulated from table 6.10;

Table 6.10: Effect of court traffic fines or bonds to drivers in reducing road traffic accidents

Motorists - Drivers' views	Numbers	Percentages %
Positive effect	153	46.08
No effect	179	53.91
Total responses	332	100

Field Data, 2013

The above analysis show tat about over 54% of the respondents views are that traffic fines and bonds have no positive effect in reducing RTAs while 46% are of the view that traffic fines and bonds have positive effects to drivers in reducing road traffic accidents. From the above analysis it is implicit that there is some causal relationship between lax enforcement of traffic rules and regulations and the increase in road traffic accidents.

But due to the multiplicity of the data from the above analyzed questionnaires, this calls for a mathematical technique dealing with categorical variables which combines the variables for testing. The chi-square model will be helpful in analyzing these categorical variables. The use of categorical variables allows us to use the chi-square model for the analysis using the Pearson chi-square analysis model as shown on table 6.11;

Table 6.11: Combining these variables in a chi-square model:

	Value	df	Asympt. Sig. (2 sided)	Difference
Pearson Chi-square	7.413	8	.493	6.92
Likelihood ratio	7.812	8	.452	7.36
Linear by linear association	1.071	1	.301	.770
Deviation from linear	6.342			

It is noted that in 8 cells (53.3%) have expected count of more than 5 in the Pearson's chi-square figure and the likelihood ratio i.e 7.413 and 7.812 respectively. The differences also between the Pearson Chi-square figure and the Asympt. Sig. (2 sided) is also more than 5, i.e 6.92. The minimum expected count is .27. Therefore, we accept the null hypothesis at the 0.01 level of significance.

From the chi-square test carried out above, it is clear that there is no significant difference between lax enforcement of traffic rules and regulations and the increase in the road traffic accidents. Therefore, we accept the null H_0 : that there is no significant difference between between lax enforcement of traffic rules & regulations and the increase in road traffic accidents and reject the alternative H_1 : that there is a significant difference between lax enforcement of traffic rules & regulations and the increase in road traffic accidents.

Conclusion:

There is no significant difference between lax enforcement of traffic rules and regulations and the increase in the road traffic accidents.

6.3 Results/Findings: Governance Traffic laws enforcement Factors

This section narrates the research findings after the testing of the Governance related law enforcement hypothesis in this study and the observations done of the road accident black spots in the area of study. The formulated hypothesis were tested on the data obtained from the research questionnaires administered to the motor drivers as the road users and

the traffic police officers who enforce traffic laws and also deal with RTAs in the respective road accident black spots areas in Nairobi.

6.3.1 Traffic laws enforcement Factors and RTAs

The research observations and findings in this research had various results on the frequency of RTAs to the traffic police, effectiveness of traffic police in reducing road accident frequencies, effects of court traffic fines or traffic bonds to drivers on road accidents, parties to blame for RTAs and the remarks on the blames charge for RTAs as tabulated below on tables 6.12- 6.16

Table 6.12: Frequency Accidents reported to the Police

Valid	Frequency	Percentage %	Valid %
All the cases	19	14.3	23.2
None of the cases	42	31.6	51.2
Some of the cases	21	45.8	25.6
Valid Total	82	61.7	100.0
Missing in system	51	38.3	
Grand Total	133	100	

Source: Researcher, 2013

From the drivers responses on the accidents reported to the police , there was an average number of responses 42 out of 133 that ‘none of the cases’ was reported to police after road accidents (31.6%) and only some of the cases 21 out of 133 (15.8%) were reported.

Table 6.13: Comments on the general effectiveness of traffic police in reducing road accidents frequencies: Do you think Police officers are effective in reducing RTAs?

VALID	FREQUENCY	PERCENTAGES %
Valid ‘NO’ Comments	83	62.4
Valid ‘YES’ Comments	47	35.3
Total Valid Comments	130	97.7
Missing in system	3	2.3
Grand Total	133	100

Source: Researcher, 2013

In this area the dominant general comments were that traffic police officers are not effective in reducing road traffic accidents in 83 out of 133 comments (62.4%) of the respondents and 47 (35.3%) comments were that they are effective . There was a small 2.3% (3 comments missing in the system) which did not significantly affect the validity of this analysis.

Table 6.14: Comments on the effects of court traffic fines or traffic bonds to drivers on road accidents

Cross tabulation Count

	Comments/ reasons on the above feeling					Total
	not all cases reach court	drivers fear being fined	the fines are low	fear of the court process	fines cannot stop accidents	
Do you feel that the court traffic fines or traffic bonds to drivers after road traffic accidents are effective in reducing road traffic accidents						
No	24	1	8	3	29	62
Yes	0	61	0	2	0	63
Total	24	62	8	2	29	125

Source: Researcher, 2013

The dominant Comments/ reasons on the feeling on the effectiveness of court traffic fines or traffic bonds to drivers after road traffic accidents in reducing more road traffic accidents (out of 125 responses) are;

- (a) Drivers fear being fined , 62 cases
- (b) Fines cannot stop accidents, 29 cases
- (c) Not all traffic accident cases reach the court, 24 cases

Table 6.15: General comments on frequency of responses on parties to blame for RTAs

The parties involved in the RTA-who was the blame for the accident?- Cross tabulation
Count

		Who was the blame for the accident?			Total
		driver	pedestrian	rider	
The parties involved in the RTA					
	saloon	12	2	0	14
	PSV	10	1	0	11
	pedestrian	1	4	0	5
	PSV and saloon	2	0	0	2
	saloon and cycle	0	2	2	4
	saloon + lorry	2	2	0	4
	pedestrian + saloon	2	3	0	5
	lorry	2	2	0	4
	pedestrian + PSV	0	3	0	3
	lorry + cycle	2	0	0	2
	lorry and pedestrian	1	2	0	3
	lorry + PSV	1	0	0	1
	PSV + cycle	1	0	0	1
Total		36	21	2	59

Source: Researcher, 2013

From the responses on the parties to blame for accidents , it is noted that out of the 59 response the highest responses on the parties to blame for road accidents was the drivers (36 cases) and and Pedestrians (21 cases).

Table 6.16: General comments on frequency of remarks on the blames charge for RTAs

The parties involved in the RTA - Remarks on the blames charge: Cross tabulation
Count

		Remarks on the blames charge					Total
		careless driving	over speeding	ignorance	they died	never showed up	
The parties involved in the RTA	saloon	11	0	1	0	2	14
	PSV	8	3	0	0	0	11
	pedestrian	1	1	1	2	0	5
	PSV and saloon	1	1	0	0	0	2
	saloon and cycle	1	0	1	0	3	5
	saloon + lorry	2	0	0	2	0	4
	pedestrian + saloon	2	1	0	0	2	5
	lorry	1	0	1	1	1	4
	pedestrian + PSV	0	0	0	3	0	3
	lorry + cycle	2	0	0	0	0	2
	lorry and pedestrian	1	0	0	2	0	3
	lorry + PSV	1	0	0	0	0	1
	PSV + cycle	0	1	0	0	0	1
	Total		31	7	4	10	8

Source: Researcher, 2013

In this case out of the 60 cases analysed on the reasons adduced on the blame charges for the parties involved in RTAs , the dominant remarks on the charges for the blames of road accidents was careless driving (31cases), overspeeding (7 cases) , parties died (10 cases) and parties never showed up (8 cases).

6.3.2 Driver speeding and Road Traffic Accidents

The research tested whether there was a significant difference between driver speeding and RTAs, the effect of the presence of traffic police officers on roads, effects of speed limit bumps, effects of speed limit signs on road traffic accident occurrences.

It is noted from the study that a high number of accidents occurred when the traffic police officers were not present at or near the road accident black spots; where there were no speed limit signs and many more accidents occurred where there were no speed limit traffic bumps elected at the road accident black spots.

From the sampled number of accidents and using the set test parameters, the result of the hypothesis test indicated that there was a significant difference between driver speeding and road traffic accidents. This finding implies that speeding has a direct contribution to the occurrences of road traffic accidents. In some cases, however, motorists may speed because they do not realise the risk they are taking by doing so.

Other literatures on driver speeding indicates that motorists often underestimate the negative consequences of speeding for themselves and others, and this may promote speeding (Aberg et al., 1997; Kanellaidis et al., 1995; Lawton, Parker, Stradling, & Manstead, 1997; Parker et al., 1992). For example, drivers typically underestimate the stopping distance that is possible at a range of speeds. Further, drivers think that they can speed safely (Kanellaidis et al., 1995) without caring that speeding poses higher risks in comparison to other risky driving practices. Parker et al, (1992) found that speeding is perceived to put lives in danger to a lesser extent than drink-driving, close following or dangerous overtaking. Following various campaigns in Australia, speeding is likely to be perceived as one of the riskier driving practices.

Drivers may underestimate the risk that speeding poses to themselves in comparison to other drivers. Illusory invulnerability refers to the typical finding that people estimate their chance of experiencing a range of negative events to be lower than that of their average peer (Weinstein, 1980, 1989). For example, people estimate that they are less likely to have a car crash as a driver than is their average peer (Finn and Bragg, 1986). They also judge that they are less likely to be booked for speeding (Job, Hamer, &

Walker, 1995). Perhaps they also think that they are less likely to crash due to speeding. A similar superiority bias is evident in the findings that young male drivers believe themselves to be more skilled drivers than average (Job et al., 1995), whereas young female drivers perceive themselves to be safer drivers than average (Job et al., 1995).

Several models of health-relevant behaviour (e.g. the Health Beliefs Model, Janz & Becker, 1984; The Theory of Planned Behaviour: Ajzen & Fishbein, 1980) include perceived risk as a determinant, and experimental findings suggest that perceived relative risk (and thus illusory invulnerability) is at least as important as perceived personal risk in determining health relevant behaviours (Klein, 1997). Illusory invulnerability regarding aspects of road use has been found to be negatively associated with self-reported adoption of precautionary behaviours (e.g. seat-belt use: (Job et al., 1995). The research findings in this study corroborates the other research views that speeding causes road traffic accidents and therefore is a contributor to road safety problems

6.3.3 Lax enforcement of traffic rules and regulations and road traffic accidents.

The research tested the relationship between lax enforcement of traffic rules and regulations and the increase in road traffic accidents. The test parameters in this area included; the validity of drivers' driving licenses, the fate of party to blame for accident, number of motorists charged in court for traffic offences, the effect of court traffic fines or bonds to drivers in reducing road traffic accidents and the general views on the effects of traffic police officers in reducing road traffic accidents.

The research findings after the analysis of these parameters indicated that there is a significant difference between lax enforcement of traffic rules and regulations and the increase in the road traffic accidents.

6.4 Discussion of Results: Governance Factors and RTAs

This section discusses the research findings of the traffic laws enforcement and the Governance factors in this study and the observations done during the study . The section also expounds on the road traffic accidents data collected and recorded from the study area. Reference is also made to the other research findings relevant to this study.

Many professional groups argue that the cure for road accidents is to create new regulations, new rules and more control at the road side measures which can make people behave in a better way. Traffic psychologists see people behaving in a different way, any new signs and new regulations are there for people to test whether they can be ignored. If a change in traffic control is not supported by an information campaign and strict Police enforcement there will be no results and as observed in many countries, stop signs are very willingly ignored (Norman, 1989).

Motor vehicle insurance policies also contribute to under-reporting thereby giving the wrong road accidents data. The “no-claims bonus” scheme/incentive whereby, an insured gets a reduction in the premium if in any one year he/she does not lodge an insurance claim to the insurance company for settlement of costs of repair of a vehicle involved in an accident, encourages people not to report accidents. When using RTAs secondary data the possible errors and omissions will be noted in analysing the data abstracted for such a study.

6.4.1 The causation effects of speeding on Road Traffic Accidents

One of the generally known major causes of RTAs is over speeding by motor driver road users. In a study of road crashes in Leeds-UK, it was observed that the main problem among drivers which lead to road accidents was failure to give way, lack of anticipation, loss of vehicle control and improper overtaking. The study noted that the underlying reason for all these problems was basically over speeding, not keeping safe distance , obstruction by parked vehicles, overloading, slippery roads, poor visibility and wrong judgements (Carten et al , 1989; cited in Norman 1989)

The effect of drivers’ speed on the frequency of road accidents is well documented by M C Taylor, D A Lyna and A Buraya: (TRL report no.421, 2000) in their investigations of speed and road accidents for both urban and rural areas. Statistical models relating speed and injury accidents which were developed in the road based studies show that no single measure of speed is fully effective as a predictor of accidents. For urban roads studies of road links between major junctions predicts effects of accidents on traffic speeds, traffic flows, pedestrian activities, the number of minor road junctions and the number of vehicles.

The results these studies have been drawn to reach the conclusions that higher speeds are associated with more accidents and reducing the speeds of the fastest driver relative to the average speed for the road is likely to bring greater accident benefits than reducing the overall average for all drivers particularly on urban roads. The scope for reducing accidents by means of speed management depends on the operational characteristics of the road. Speed reduction in urban roads will reduce both pedestrian and vehicle accidents and will also reduce accidents at minor junctions along the road links. The conclusions in these studies affirm the findings in this study that driver speeding behaviour has a major contribution to the causes of road accidents on the black spot areas of study in Nairobi.

In a research carried out by the Transport Research Laboratory (TRL- UK, 2000) to study the extent and likely causes of bus accidents in Nepal, Zimbabwe, Thailand, Tanzania and the Indian state of Maharashtra between 1992-1997 showed that there are three different types of the effects of speed on crashes and collisions which are relevant to this study. First when exceeding the average speed by 25% a driver is about 6 times as likely to be involved in an incident in comparison with a driver adopting the average speed. Second the number of crashes and collisions increases with increasing average speed and the effect varies on different road types. Third the studies of road safety intervention measures like traffic calming measures (e.g. road humps) in 20mph zones have reduced average speeds by about 10mph and resulted in a 50% reduction in collisions (CIT World issue No. 2,2000). This TRL-UK research shows that speed contributes to RTAs.

The findings in a research carried out at Napier University on safe speed driving show that individual drivers are aware that speeds they normally adopt when alone are actually unsafe. Participants in the research described the situations in which they would not over speed and in fact slow down as, the presence of a speed camera or a child in the car. This suggests that individual road users know that if they see a camera they would need to slow down because they would be exceeding the speed limit (Road Safe report, 2006).

In Kenya road accidents causation factors can be traced to the road users, vehicles and road environment as the causes of RTAs. The main causes of RTAs in 1984 according to the Kenya police traffic reveals that in Kenya 80% proportion of the accidents were

traceable to road users, 6% was attributable to vehicles and 14% to road environmental factors. In Nairobi province the contribution to RTAs by road user factors was as high as 94%. (Agoki, 1992).

It is noted that road users highly contribute to RTAs in Nairobi. The road users include motor drivers, cyclists and pedestrians. The road user causes of road accidents are the major factors which lead to road safety problems and challenges. It is generally accepted that road accidents are due to complex interaction of the road user, the vehicle, the road system and the environment. In most cases the motor drivers as road users tends to over speed causing numerous RTAs.

In this research study it was established that in over 93% of the accident situations the drivers had valid driving licenses and in only 6% of the situations where the drivers were found to be having invalid driving licenses. This conclusion indirectly implies that driver licensing has minimal effects on the causes of road traffic accidents in Nairobi city. This aspect requires more research to be able to confirm these findings farther and generalize the findings to other areas in Kenya.

The research findings also established that over 61% of the drivers who were to blame for the road traffic accidents were charged for the offences, while over 38% of them were not charged. The researcher was concerned to establish why the 38% of the drivers who caused accidents were not charged. The researcher enquired on the matter and the explanations given were that the accident parties were referred to their insurance companies. This could not ascertain the real reasons behind this explanation. Other research findings in this area especially the KACC, 2009 study titled ‘The problem of corruption on Kenyan roads: A case for policy, Legal and Administrative Action on Traffic Management in Kenya’ , established that corruption tendencies by traffic police officers can be a motivator not to charge some drivers who cause road accidents by exploiting the window of referring the matters to insurance companies.

The IDS working paper No. 545 of November 2007 by Asingo P and Mitullah W on policy issues and challenges of implementing road transport safety measures in Kenya, it was established that Kenyan drivers cause road accident crashes largely because of

behavioral and attitude problems. These behavioral problems include failure to give way to fellow drivers and other road users and improper overtaking. The other problems established in this report that cause road crashes due to driver behavior are loss of control while driving, not keeping safe distance, making unwarranted emergency brakes, careless driving, over speeding and violation of speed limits. The report concludes that these behavioral and attitudinal problems are more acute among PSV drivers.

The research findings of this study that there was a significant difference between driver speeding and road traffic accidents re-confirm the findings in this IDS working paper. Observations done on most road accident black spots points to the motor driver road user as the main causers of RTAs. Also research observations on Waiyaki way, Mombasa road, Mbagathi road, valley road and, Langata road study area road accident black spots; it was observed that motorists over speed and do not give way to other road users and pedestrians even when they have a right of way.

An observed area worth highlighting is the Mombasa road south ‘B’, Valley road flyover, Langata road/ Mbagathi road roundabout and Langata road carnivore junction where there are numerous accidents due to motorists over speeding, lack of regard for pedestrian crossings and not giving way to other road users.

During the official opening of the National Road Safety Stakeholders Conferance at the Bomas of Kenya in Nairobi on October 19, 2010 the then President of the republic of Kenya expressed the concern on over speeding as a major cause of RTAs. President Kibaki had ordered an immediate crackdown of motorists who over speed while under the influence of alcohol and other intoxicants. He asked the National Road Safety Council to come up with applicable solutions to recurrent abuse of road rules and regulations by defiant motorists. Noting that some motorists tend to over speed on the improved roads, the Head of State said penalties should be stiffer as a deterrent measure to those abusing traffic rules.

6.4.2 The Pedestrians and Cyclists factor on Road Traffic Accidents

The Institute of Highways and Transportation (IHT), 1997 observed that pedestrians are the most vulnerable road users in the busy road areas of Kenya and are the second

greatest single cause of road crashes in Kenya after driver motorists. The institute further observed that pedestrians cause road crashes due to ignorance of road traffic signs and signals, influence of alcohol and other toxic substances, wrong judgements and general lack of anticipation.

From the Nairobi area traffic police road accidents records, the research findings observed that pedestrian fatal road accidents increased from 434 in 2007 to 515 in 2011 in Nairobi city as indicated in table 6.17. These are very high road accident figures for only one town in Kenya. This reaffirms the research findings in the tested hypothesis that lack of pedestrian facilities in Nairobi city contributes to RTAs. Although there might be some minor errors in the police road traffic accident records, the magnitude of the pedestrian road traffic accidents in Nairobi city is clearly manifested in the research findings.

Table 6.17: Classes of persons killed and injured in Road Accidents; 2007-2011

Year	Pedestrians		Passengers		Drivers		motor cyclists		Totals
	Fatal	Injured	Fatal	Injured	Fatal	Injured	Fatal	Injured	Total
2007	434	1,928	74	2,076	59	216	23	94	4,904
2008	437	1,470	98	1,180	57	296	8	70	3,616
2009	559	1,454	150	1,632	84	349	77	145	4,450
2010	516	1,313	126	1,750	56	343	24	191	4,319
2011	515	1,096	102	1,403	45	224	45	195	3,625

Source: Knyia Police - Nairobi Area and tabulated by the Author, 2012

The research findings in this study re-confirm those observations on how the road conditions and the road infrastructural facilities contribute to RTAs. The research study observed that speed limit signs elected on the roads can have some impact in the reduction of RTAs where it is noted that of the sampled RTA occurrences 80% of them occurred where there are no speed limits signs while only 20% of the RTAs occurred where there are traffic speed limit signs at the road accident black spots.

On the impact of speed limiting bumps against number of accidents occurred, it was observed that over 73% of the RTAs occurred where there are no speed limit traffic bumps while only about 27% of RTAs occurred where speed limit bumps are elected on road accident black spots. And the research findings on the blame factors against number of accidents occurred show that 36% of the respondents views are that the RTAs are blamed on the drivers, 31% are due to other factors while 32% of the respondents did not categorize the blame on the accidents.

In other research studies, it is reported that majority of Kenyans do not take personal responsibility for their own safety on the road leaving that role to the police according to a new poll on road safety. In a poll conducted by Ipsos Synovate it was revealed that 64 percent of Kenyans indicated that the police have the responsibility of ensuring road safety through enforcement of the law, 44 percent mention motorists whilst only 22 percent indicate pedestrians have a role to play. “The fact that only 47 per cent of Kenyans believe that drivers are responsible for road safety is telling. It means that our road safety campaign messages need to be more compelling. Relying on the police to enforce discipline on the roads will not reduce accidents because they are too few to cover the whole country. Road safety should be everyone’s responsibility including drivers, passengers and pedestrians until Kenyans understand that, people will continue to die needlessly on our roads”(Ipsos Synovate, 2012)

The Ipsos Synovate poll report recommended that in order to address the problems of road safety in Kenya, it will require an integrated approach that would cover motorists and pedestrian sensitization, enforcement of traffic rules and improvement of road infrastructure. It further opine that ; “There will be a need to continuously capture traffic statistics in a uniform and timely order to enable the identification of emerging crash/victim trends/issues, or for the development of new or revised motor vehicle safety regulations. Road infrastructure includes initiatives that strengthen the infrastructure element in road safety,” the report explained. The report concluded by advising the state to put in place an effective transparent and corrupt free mechanism that will enable enforcement of traffic rules. This research similar views and recommends the same to be implemented in order to curb RTAs on our roads.

Statistics released by the National Transport and Safety Authority (NTSA) in November 2014, indicated that pedestrians topped the crash victims from RTAs in Kenya. In 2014, out of the 2,393 road accident deaths reported 1,115 were pedestrians which was however a drop from 1,237 who died over the same period in 2013. In 2014, 512 passengers lost their lives in road accidents compared to 691 reported in 2013. During the same comparative period, 213 drivers died through RTAs in 2014 compared to 237 in 2013 as tabulated on table 6.18.

Table 6.18: Summary of deads from fatal accidents 2013-2014 (in Numbers)

Class of victims/ Year	2014	2013	% Variance
Pedestrians	1,115	1,237	-9.86
Drivers	213	237	-10.1
M/V Passengers	512	691	-25.9
Boda boda passengers	131	131	0
Pedal cyclists	90	120	-25
Motor cyclists	332	272	22.06
Total	2,393	2,688	-11

Source: National Transport and Safety Authority (NTSA), 2014

The report by NTSA attributes the rampant accidents to driver overspeeding and careless overtakings on the roads. This assertion by NTSA re-affirms the findings from this study that driver overspeeding contributes to the increase in RTAs. The careless overtaking by drivers more so on the road accident black spots covered in this study, and combined with driver fatigue contributes to the occurrences of RTAs on our roads. The NTSA report also attributes the causes of accidents to poor vision due to fogue, lack of or improper use of zebra crossings and foot bridges, drivers not observing traffic rules and signs, passengers not using safety belts and police failure to implement and enforce traffic rules effectively. The report by NTSA re-confirms the research findings of this study on the environmental and governance factors contribution to the occurrences of RTAs.

From the NTSA report on table 6.18 it is observed that in the year 2014, there was some improvement on road safety as there was a reduction in deaths from all the classes of victims except the motorcyclists whose deaths increased by 22.6% from 272 in 2013 to 332 in 2014. This should be an area of concern to all road safety stakeholders in Kenya for collective actions.

6.4.3 Traffic Laws enforcement and Road Traffic Accidents

In Kenya it is the mandate of Kenya police traffic department to investigate all road accidents, collect road accident data and fill road accident reports. The police also cover and take notes of the accident scenes and use the details so obtained to fill accident report forms which are used by individuals and by other relevant organizations which would have some interest in those road accidents.

As indicated in the research study ethical considerations there are problems associated with secondary data due to under-reporting, errors and omissions of crucial details. In other cases Police accident reports include subjective assessments in terms of finding out the guilty party for prosecution purposes thereby putting more emphasis on “road user behaviour” as the cause of accidents more than other possible causes such as “road environmental features” and lack of adequate enforcement of the traffic laws. This problem was addressed by expanding the data area coverage and in the other RTAs observations and records taken in the research study.

The research study findings observed that there was a significant relationship between lax enforcement of traffic rules and regulations and the increase in road traffic accidents in Nairobi city. In the research findings it was noted that in over 72% of the situations, RTAs occurred when traffic police officers were not on the road accident black spots while in 28% of the situations RTAs occurred when they were on those road accident black spots.

The research went farther to gauge the perceived motorist’s opinion if the presence of traffic police officers on the roads have any impact on road traffic accidents. The research findings in this area show that 55% of the opinions of the respondent indicated that the presence of traffic police officers on the road has no effect on motorists and reduction of RTAs while 46% indicated that the presence has a positive effect on motorists and can have some effects to motorists in reducing road traffic accidents.

On a general view from motorists whether traffic police officers are effective in reducing RTAs, it was observed in the research findings that 63% of the respondents views are that traffic police officers are not effective in reducing RTAs while 37% are of the view that traffic police officers have a positive effect in reducing road traffic accidents. Once again this might be one of the research areas where general personal opinions might have overridden the real issues of road traffic accidents. As indicated earlier we not rule out some biases in the respondents comments due to other reasons outside the scope of this research

It is remembered that in the seventies and eighties, one usually encountered traffic police on patrol and in search of over-speeding, overloaded and/or un-road worth vehicles. Not anymore. We seem to have replaced the essential patrol with road blocks. Road blocks cannot solve the over-speeding problem, especially when their location has become a permanent fixture of a kind. This leaves drivers over-speeding through some unpatrolled sections. They then appropriately slow down as they approach road blocks. It is said that a number of vehicles on our roads are un-road worthy. Yet we have an inspection unit that is supposed to ensure that vehicles do not pose undue risk to the public. It is alleged in some circles that owners routinely pay their way to corrupt inspectors to get the merit certificate. These parties do not seem to appreciate the danger in which they place the public with their short term gain. Since corruption is two-way, the law must also seek to punish those that induce the police to bribery. That would ensure proper justice.

The main area of study was on the perceived “black spots or blind corners” on our roads in Nairobi city. Why do drivers over speed and drive carelessly on those sections of “black spots or blind corners” despite the warning signs and traffic rules enforcements? This is one area of concern on road safety challenges in Nairobi city-Kenya where enforcement of traffic law is faced by a myriad of administrative, operational and capacity problems. The findings in this research that traffic police officers are not effective in the enforcement of traffic rules and regulations is detrimental to road safety schemes as RTAs will continue to increase and escalate road safety problems in our city and Kenya at large. An attempt is made in this study through available empirical data and observations to explain the root cause of poor enforcement of the traffic rules and regulations and recommended the way in Kenya. From a policy point of view, these recommendations have an objectives geared towards the reduction of the overall number and severity of road accidents thereby improving safety on our roads.

During the National Transport and Safety Authority (NTSA, 2015) thanksgiving service on 18th January 2015 held at Kenyatta International Convention Centre (KICC) for the drop in road death rate nationally from 3,218 in 2013 to 2,907 in 2014, it was reported that in 2014 four city roads in Nairobi were the most notorious accident zones. The four roads were classified as claiming nearly 300 lives between them in 2014. NTSA lists these roads as Mombasa road, Waiyaki way, Thika super highway and North airport road in Nairobi. It is noteworthy that three of these roads namely; Mombasa road, Waiyaki way and Thika road has had determined black spots all through. Two of these roads Mombasa road and Waiyaki way were part of this study as road accident black spots. From this report by NTSA, it is worrying if the road accident black spots are increasing in Nairobi city as the other new one mentioned i.e North airport road section becomes a black spot also.

The NTSA indicated that this trend of accidents placed Nairobi city on top of the list of 10 counties with the highest road carnage numbers in 2014. The top 10 counties with the highest deaths through accidents were Nairobi (561), Nakuru (156), Kiambu (113), Kisumu (95), Mombasa (90), Makueni (82), Machakos (82), Kakamega (77), Bungoma (69) and Kilifi (57). This trend of road accidents prompted the then Transport Cabinet Secretary Engineer Michael Kamau to direct the Kenya National Highways Authority (KeNHA) to move with speed to avert more deaths by erecting footbridges and pedestrian fences to make pedestrians use designated road crossing points to reduce RTAs. This reaction by the Transport Cabinet secretary re-affirms the findings in this research that lack of pedestrian road facilities on our contributes to the increasing trends of RTAs in Kenya .

CHAPTER SEVEN: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

7.0 Introduction

Based on the results from this study, there is a dire need to constantly review road traffic laws and regulations to take account of the changing circumstances and improve regulatory framework and enforcement of the same. Therefore strict enforcement of traffic rules and regulations on our roads is vital strategy of reducing RTAs and road safety problems. Road user awareness on the causes of RTAs is important in the aspects of road safety. The magnitude of the risk to RTAs gives an indication of the seriousness of the road safety problems.

7.1 Summary of Findings

After testing the parameters in this research, the research findings show that strict enforcement of traffic laws and regulations governance factors can reduce RTAs on our roads. The control of the physical environmental factors that influences over speeding and setting up speed control mechanisms on our roads can deter tendencies of the over speeding and in effect reduce RTAs on the road accident “black spots” where drivers tend to over speed leading to vehicle crashes. Therefore, if strict traffic rules and regulations governance measures are put in place they would positively control such tendencies of over speeding and in effect reduce RTAs on our roads.

The causes of road traffic accidents are multi-factorial. These factors can be divided broadly into driver factors, vehicle factors and roadway factors. Driver factors in road traffic accidents are all factors related to drivers and other road users. Speeding, travelling too fast for prevailing conditions or above the speed limit, is also a driver factor that contributes to road traffic accidents. The risk of being injured increases exponentially with speed much faster than the average speed. The severity of injury depends on the vehicle speed change at impact and transfer of kinetic energy. Though vehicles travelling slower than average speed are also at increased risk of road traffic accidents, most involve speed too fast for the conditions. Road design and maintenance is also a factor that contributes to road traffic accidents. The causes of road traffic accidents are not just human error or driver negligence but a combination of many factors.

In the research study it was observed that the lax enforcement of traffic laws by traffic police has not changed much from the observations done by Mbugua C W in 2008 and this laxity contributes to the recurrence of RTAs. In the study it was also observed that 63% of the research respondents were of the view that traffic police officers are not effective in reducing RTAs, 55% of the respondents' views are that the presence of traffic police officers on the road has no effect on the attitude of driver motorists and 54% of the research respondents were of the view that traffic fines and bonds have no positive effect in reducing RTAs. These findings talk big on the laxity of traffic police officers in the enforcement of traffic laws in Kenya.

Although the majority of those interviewed were of the traffic police and court fines have no effect in RTAs, there are a number of those who had contrary opinions. In the study 46% respondents were of the view that traffic fines and bonds have positive effects to drivers in reducing road traffic accidents, 37% of the view that traffic police officers have a positive effect in reducing road traffic accidents and 46% indicated that the presence of traffic police officers on the roads has a positive effect on motorists and can have some effects in reducing RTAs on the roads. So all is not lost.

Other earlier research studies had similar observations on the causes of RTAs. The analysis of road traffic accidents by Agoki, 1992 revealed four major groupings of factors that influence the causes of RTAs namely; pedestrian factors, land use factors, vehicular factors and traffic control device factors. This research study took cognisance of the study findings by Agoki. The results of this study collaborates the findings by Agoki that environmental factors and the traffic law enforcement shortcomings contribute to the occurrences of RTAs.

In other studies of perception of traffic laws enforcement, the Australian Transport Safety Bureau (ATSB, 2006) reports that typically, enforcement influences speeding (Aberg et al., 1997; Armour, 1984; Shinar & McKnight, 1985). However, the value of fines or demerit as deterrents is likely to be undermined by motorists judging themselves as unlikely to be detected speeding (Kanellaidis et al., 1995; Parker et al., 1992), and as less likely than their peers to be booked for speeding (Job et al., 1995; DeJoy, 1989). Drivers believe in and use a range of techniques to avoid being booked for speeding.

Compliance with regulations is directly related to their perceived appropriateness. Thus, motorists' opinion as to the appropriateness of speed limits is likely to influence their decision to speed (Parker et al., 1992). Road conditions influence motorists' judgments of the degree to which speeding is acceptable (Lawton et al., 1997), and so presumably also their judgment of the appropriateness of speed limits. The perceived appropriateness of the speed limit is also likely to relate to the acceptability of penalties, and the perception of fines for speeding as mere revenue collection may be associated with lack of compliance.

Mohamed Najeeb P.M. (2012), in a study of the psychological factors that influence the rule of violation behaviour of drivers, attempted to explore the effects of various psychological and demographic factors on violation behaviour towards traffic rules by drivers. In this study, the demographic variables of age, experience and education were investigated. The investigation was done on the basis of self-reported violation behaviour of traffic rules.

The results of this investigation indicated that the effects of demographic variables, relationship and influence of psychological variables had various attributes. With age the results show that the youngest age group (18-25 years) was the highest in violation behaviour towards traffic rules. With experience the results showed significant differences with groups of above 20 years of experience with the group of 10-20 years of experience. The more experienced group showed high violation behaviour towards traffic rules. With education , the group with 12 years of schooling showed significant difference (higher) in violation behaviour when compared with the group with 7-10 years schooling and the level. The results showed that the moderately educated were higher in in violation behaviour.

International literature reported that education level does not ensure positive change in driving behaviour and in some reports the more educated were higher in traffic violations. This study addresses the differing opinions of why there is rampant disregard of road traffic rules and regulations by drivers. The knowledge of this study can go a long way in developing more robust road safety policies and countermeasures of preventing the increase in road traffic accidents; Mohamed Najeeb P.M. (2012).

The World Bank and the World Health Organization (WHO) advocate a "systems approach" to road traffic safety that emphasizes involvement at all levels of the road traffic system—from road providers and enforcers (vehicle manufacturers, road traffic planners, road safety engineers, police, educators, health professionals, and insurers) to road users. In developing countries, exposure to potential road traffic injury has increased largely because of rapid motorization, coupled with poor road conditions, rapid population growth, lack of safety features in cars, crowded roads, poor road maintenance, and lack of police enforcement.

7.2 Conclusions

The factors that affect road safety influence each other and therefore they have some interdependence. In this research study the analysis of the causes of RTAs in Nairobi city have revealed that there are some physical road environmental factors that contribute to road accident risks. Also lack of strict enforcement of traffic rules and regulations by the traffic law enforcement agencies greatly contributes to the high RTAs

Based on the research study findings the main conclusions are that driver speeding increases the occurrences of road traffic accidents on the road, lack of pedestrian road sidewalks, illegal road side activities that encroaches the road leads to high pedestrian road accidents. Also the lax enforcement of traffic rules and regulations makes drivers immune to careless and bad driving habits which increases road traffic accidents.

Road traffic accidents (RTAs) are the major concern and causes of road safety problems in Kenya and Nairobi city at large. Preventing road accidents and saving human lives are important elements of road safety policies. Any country that is serious on road safety will constantly monitor its local trunk roads to identify unsafe (road accident black spots) in locations for rectification and improvements for safe driving, safe pedestrian use and evaluate road traffic rules and regulations for enforcements in order to reduce RTAs and their attendant problems. The conclusions in this research study on road accident black spots enabled the researcher to make some recommendations on possible countermeasures to reduce road traffic accidents.

The interaction of human road users, the motor vehicles and the prevailing physical environmental conditions if not harmoniously managed can lead to road traffic accidents which in effect contribute to road safety problems and challenges. From the results of this research study it is evident that effective enforcement of traffic rules and regulations is a major governance factor which with strict implementation can reduce RTAs on our roads.

In order to reduce the exposure to RTAs for road users, the results of this study show that visible road signs, driver speed controls, removal of motorists' obstructions of road view and erection of road bumps (in other terms called "sleeping policemen") are some of the observed physical environmental control features that can reduce RTAs on the roads. The results of this study have also shown that pedestrian motor conflicts on the roads and roadsides increase pedestrian road traffic accidents. This is mainly due to the encroachment of roads side activities onto the roads and pedestrian road side walks. This pushes pedestrians onto the roads and makes them prone to road accidents.

From the research observations, it is noted that driving discipline in Nairobi city is poor and leaves a lot to be desired. Many motorists still remember about the introduction of road safety regulations by the so-called "Michuki rules" of 2003 which were initially aimed at taming the experiences of the "Matatu" motor vehicles' menace on the roads. These rules were geared to change driver driving behaviour, change passengers' attitudes to vehicle over loadings, installations of PSVs' speed governors and enhancement of vehicle safety by installing safety belts for all passengers. Initially these rules brought some sanity on our roads but later on PSVs' operators raised hue and cries citing cost and payback for their investments, less trips for drivers and passengers became apprehensive of belting up for short city journeys.

The Michuki rules were mainly on governance issues of strict traffic laws enforcement. The rules were implemented and there was a drastic reduction in the number of accidents and as well as the number of fatalities. Discipline in the "Matatu" business became the norm that time and slowly the other driving motorist population started to follow the suit. However this was for a while as the move of the late Michuki to another Ministry resulted in the end of the transformation. This implies that these rules were personal to Mr Michuki and they were not institutionalised for continuity. This calls for

formulation of institutionalised road safety systems and policies in order to reduce RTAs on the roads.

The results of this research study re-confirms the ideals of Michuki rules that strict enforcement of traffic rules and regulations can positively contribute in changing driving attitudes and behaviours on motorists and passengers thereby reducing the risks of road traffic accidents. The research study proposes ways to promote the positive factors that contribute to the decrease of those killed or injured on the roads in order to reduce road safety problems. Road safety becomes an issue when people die and are injured, and there is significant damage to vehicles on the road. With the rapid pace of development in Kenya, the road safety situation will continue to deteriorate. This is why proper planning and coordination of road transport environmental issues and strict enforcement of traffic rules and regulations can go a long way to curtail poor road safety trends that lead to and contribute to road safety problems in Kenya.

Co-ordinated road safety action plans are the key to reduction of RTAs. Road safety responsibilities are often fragmented with little coordination. Where a single agency is supposed to be responsible for improving road safety, it may have little or no contact with the various other agencies that can influence the road safety situation. The problem can only be tackled effectively through a coordinated action aimed at reducing the deficiencies in each of the main areas affecting road safety. Without traffic rules enforcement, many traffic schemes may become unworkable or unsafe but conversely, if those same traffic schemes are not designed to be as “self enforcing” as possible, (e.g. raised channelizing islands at junctions to force drivers along particular paths) the enforcement demands may become too high and impossible to the traffic police.

In many developing countries, there is noticeable absence of strong agency relationships and linkages, which are necessary to avoid road safety problems. In most cases, there are poorly defined and fragmented responsibilities often resulting in inefficient use of road space and transport resources. Professionals in different ministries often work independently of each other, despite the fact that their respective work impinges upon each other's activities. Responsibilities in some areas may overlap or be duplicated while in other instances; there may be no organisation at all responsible for a crucial task that affects road safety greatly.

Promoting efficient patterns of land use and providing shorter, safer routes for vulnerable road users can reduce their exposure. Studies in Brazil, Mexico, and Uganda have found that pedestrians would rather cross a dangerous road than go out of their way to take a pedestrian bridge, even though such preferences increased their exposure to injury risk. Improving public transportation systems can also reduce exposure. People in cars are between 8 and 20 times less likely to be killed in a road accident than walkers, bicyclists, or motorized two-wheeler users (WHO,2012). Land-use planning, transport planning, enforcement and education on traffic rules and regulations can have fundamental effects upon road safety, both in the short and long term. These factors not only create the conditions and environment for today's traffic, but often impose the framework within which future traffic has to operate on.

Enforcement of traffic rules and regulations is critical in road safety. In a sociological study of "Matatu" commuter compliance to traffic regulations in Nairobi, Mbugua C W (2008) established that There was police laxity in the enforcement of traffic laws. In this study 58% of the respondents agreed that police were no longer keen on enforcement of the traffic regulations. Other than police laxity, this study also established that corruption was an impediment to the enforcement of the traffic regulations. In the study 63% of the respondents agreed that there was increased corruption on the roads by traffic police officers.

Road traffic accidents (RTAs) are a major but neglected challenge for economic development of many developing countries. Current and projected trends of motorization in Kenya indicate that the problem of RTAs will get worse and can lead to a national crisis. Road traffic accidents and related injuries are the main problems of road safety. Road safety can be considered in three (3) main categories; the road environment; the vehicles and the road users. Each of these categories requires set rules and regulations for harmonious road operations. The lack of and failure to adhere to and enforce the laid down rules and regulations is the cause of road safety problems emanating from RTAs.

In Kenya road traffic accidents seems to be creeping back to the levels last seen before the implementation of the famous 'Michuki rules' on the back of a weak enforcement of traffic laws and general lawlessness on the roads. Road accidents are a major contributor to the mortality rates in Kenya. Faster driving speeds increase the likelihood of a crash

occurring and the severity of the crash consequences. This calls improvement of road safety in order to reduce the number of people injured or killed on the roads. It is with this view that this study was carried out to study the road accident black spots in Nairobi city and analysed what effects the environmental and governance law enforcement factors have on road safety in Nairobi City-Kenya.

7.3 Recommendations

From the results and finding of this study attempts have been made on some recommendations that can be implemented to reduce road traffic accidents (RTAs). There for recommendations for transport and planning, for traffic laws enforcement/and Governance and for scholars.

7.3.1 Recommendations for Transport Planners and Policy-makers

From this research findings, the researcher recommends that Kenya Government should take action and address roads safety in a holistic manner. This will require involvement of multiple sectors which addresses the safety on roads, vehicles and road users. Effective road safety interventions includes designing safer roads that incorporate road safety features into land-use and transport planning, interventions that target road user behaviour, setting and enforcing strict traffic laws and also raising public awareness on the road crashes key risk factors.

In order to control pedestrian motor conflicts on the roads, the researcher recommends that road infrastructure planners should be giving due consideration to pedestrian walk ways and pedestrian road crossings when planning the roads. This call for participatory involvement and consultations in road planning by all stake holders to take care of all road safety issues in the initial planning period and avoid the effects of future road traffic accidents. An examples of such pedestrian facilities planning is shown on plate 9.3.

The researcher recommends that the road traffic engineers takes stock of all road accident black spots in Nairobi city and – design the area that are prone to and contributes to RTAs. Some of the countermeasures recommended are separation or median separation of incoming traffic with wide central hatching to reduce road collisions, improve road markings and putting up visible road signage in accident prone locations. Although

expensive to implement , roundabouts are an effective way of reducing the speed of traffic at intersections reducing the likelihood of high speed right-angle collisions (Wikipedia)

To make roads safe it is recommended that road safety should be recognised as a national disaster and be included in the national development planning with adequate levels of funding from the national and county governments. It has been proposed that donor funding can also boost road safety programmes. In the ‘Make Roads Safe’ campaign for global roads safety report 2011, a major new international funding initiative is proposed where; car and truck manufacturers, insurance companies, fuel companies, car rental companies, automotive parts and service providers should meet their moral and social responsibility by supporting a new innovative financing initiative for road safety programmes. This initiative would encourage customers to make small donations at point of sale to support road safety injury prevention. If successful this common effort would provide significant funding to catalyse country level implementation of road safety action plans. It is recommended that Kenya can borrow a leaf from this initiative.

Road safety was recognized in global environmental policy deliberations at the recent Rio+20 UN conference on sustainable development. In this conference a clear link was made between road safety and sustainable development; where encouraging sustainable transport policy must include making non-motorized forms of transport accessible and safe. The conference noted that 27% of global road traffic deaths are among pedestrians and cyclists but in most countries these road users have been neglected in transport and planning policy. It was recommended that the world must now increase its focus on making walking and cycling safer, and protecting these road users from high-speed traffic. The results of the research study show similar views as the RIO+20 UN conference and it is recommended that transport planners incorporates road safety plans in the policy planning for transport infrastructure in Kenya.

In the spirit of improving road safety in Kenya it is also recommended that in future we make plans to use new technologies that have been invented for other avenues for road safety. These developments include intelligent speed adaptation, in which the vehicle determines the speed limit for the road; alcohol-ignition interlock systems that detect

alcohol on the breath of drivers, preventing them from starting their engines; or electronic driver improvement monitors that connect individual driver profile assessments and an individual vehicle operator's actual driving performance. This will automatically curtail drink driving, minimize the need for traffic police alcohol blow machines and in effect reduce RTAs

It is noted that many road safety programmes in Kenya over-emphasize on the vehicle ignoring the fact that the quality of the drivers and the condition of the roads are equally critical. General routine observations at traffic police road block on a Kenyan road even at the research study road accident black spots; show that a traffic officer will be checking the vehicle conditions, while next to him there are glaring potholes on the road. And as soon as the vehicle is released from the road block, it zooms to above legal speed limits. This is ineffective enforcement and adds no value to road safety. The researcher recommends on traffic laws enforcement with a view of proposing better traffic laws enforcement techniques.

Some examples of road hazards and improvements to reduce mainly high pedestrian road traffic accidents are well captured on the pictorials appendices; Plate No.s 9.1 , 9.2, 9.3, 9.4, 9.5, 9.6, 9.7 and 9.8. This affirms that the occurrences of very high pedestrian road accidents in Nairobi city can be reduced through concerted efforts of road planners and policy makers.

7.3.2 Recommendations for Law enforcement and Governance

It was observed in this research that there was a significant relationship between driver speeding and occurrences of accidents and therefore, driver speeding contributes to RTAs. Safe speed limits are critical and must be linked to the physical environmental conditions of the road sections. It is with this view that the researcher recommends that that in the short run appropriate speed limits be set for all road accident black spots to control vehicle speeding and reduce road accidents. And in the long run road traffic engineers taking remedial measures and re-design the road accident black spots to reduce their accident risks and reduce RTAs.

The researcher highly recommends that traffic laws enforcement by police officers be strengthened under the watch of a professional road safety authority with a clear legal mandate of enforcing road safety rules and regulations. The majority of road crashes on Kenyan roads are preventable. The poor road safety culture and failure to strictly enforce traffic rules are chiefly to blame for the high accident casualty rates

There have been substantial public debates regarding the likely effectiveness of governing the speed limit of vehicles, and the acceptability of such a measure. It seems rather sensible to govern the speeds of vehicles to the maximum speed allowed on the country's roads. A better proposal would be to adopt operationally tested speed governing systems that respond to local limits. As drivers tamper with speed governing devices, it is recommended that speed governing systems be continuously evaluated so that speeding becomes a recorded behaviour that a driver needs to anticipate and unintentional or spontaneous speeding would be eliminated. Nonetheless, several arguments have been mounted against the proposal to introduce speed governing (such as the need to accelerate to avoid a crash).

In 2010 the governments of the world declared 2011–2020 as the Decade of Action for Road Safety. They invited the World Health Organization to prepare a report as a baseline to assess the state of global road safety at the onset of the Decade, and to be able to monitor progress over the period of the decade. The unanimous support for this Decade of Action from Member States indicates a growing awareness that the devastating scale of road traffic injuries is global public health development concern. This report shows that 1.24 million people were killed on the world's roads in 2010. This is unacceptably high. Road traffic injuries take an enormous toll on individuals and communities as well as on national economies (WHO, 2012). The report indicates that middle-income countries like Kenya, which are motorizing rapidly, are the hardest hit by high rates of RTAs.

According to this WHO report, there is a sound body of scientific evidence behind road safety interventions. Adopting and enforcing legislation relating to important risk factors – speed, drink-driving, motorcycle helmets, seat-belts and child restraints – has been shown to lead to reductions in road traffic injuries. This report illustrates some of the progress made in a number of countries to address these risk factors since publication of the first Global status report on road safety (2009). Since 2008, 35 countries have passed

new laws or amended existing legislation covering one or more of these risk factors. Nevertheless, in many countries these laws are either not comprehensive in scope or are lacking altogether. Governments must do more to ensure that their national road safety laws meet best practice, and do more to enforce these laws.

From the results of the research study in Nairobi city, it is evident that the traffic laws and governance instruments are deficient in enforcing traffic rules and regulations in Kenya. In order to streamline traffic operations and reduce road traffic accidents, it is recommended that adopting and enforcing strict legislations relating to traffic offences is very important. The effectiveness of adopted legislation measures should be evaluated periodically to keep phase with the changing transport patterns.

Road traffic injuries are predictable and preventable, but good data are important to understand the ways in which road safety interventions and technology can be successfully transferred from developed countries where they have proven effective. Awareness of the consequences of road traffic injuries is lagging among policymakers and the general public. What's needed is incorporation of comprehensive road safety programs into national planning in developing countries and this is highly recommended in Kenya.

The task of streamlining our road safety problems in Kenya should include proper traffic laws enforcement. The traffic police must ensure that the drivers observe the traffic code and those that flout it should the force of the law. Perhaps, this is the most challenging element given that it must address human behaviour. While corruption in driver licensing was alluded to above, it is not the only place corruption exists. Often those flouting traffic rules are not brought to law after giving some “*kitu kidogo*”(small tokens in form of bribes) to policemen. It has even been said that some policemen have made this a habit and thus expect to be bribed even when there may be no violation of the law. This creates problems that have extreme ramifications on law enforcement. It calls for appropriate sanction on those that perpetuate this practice be they members of the public, government officers or policemen.

It is argued that proper traffic laws enforcement should include policing the police. On many occasions, the police literary police themselves. It is possible that a number of potential police culprits never face the law, courtesy of their fellow policemen. It is appreciated that the Ethics and Anti-corruption Commission (EACC) takes up the responsibility of investigation corrupt malpractices in the traffic laws enforcement. It is recommended that this EACC endeavour be encouraged and more extensively implemented across the country in order to be effective. It is also recommended that legislators and governance experts expolore and devise other mechanism to be put in place that would ensure proper policing of the police, especially the corrupt ones within the police force itself.

Setting road and safety rules, securing compliance, and improving transport policy. Setting and enforcing speed and blood alcohol concentration limits have proven to be perhaps the most successful interventions contributing to the decrease in injury in developed countries. Speed limiting devices on vehicles, limits on engine power, and non-vehicular traffic-calming measures hold the greatest promise in developing countries. Enforcing blood alcohol limits is another opportunity to improve road safety. While it is commonly understood in developed countries that impaired driving is an important contributor to road traffic fatalities and injuries, little is known in developing countries about the nature and scope of the problem. One survey of studies found that, in developing countries, blood alcohol was present in 33 percent to 69 percent of fatally injured drivers WHO,2012) . It is recommended that Kenya continues to implement this initiative to curb drink driving and reduce RTAs.

In the spirit of improving road safety in Kenya it is also recommended that in future we make plans to use new technologies that have been invented for other avenues for road safety. These developments include intelligent speed adaptation, in which the vehicle determines the speed limit for the road; alcohol-ignition interlock systems that detect alcohol on the breath of drivers, preventing them from starting their engines; or electronic driver improvement monitors that connect individual driver profile assessments and an individual vehicle operator's actual driving performance. This will automatically curtail drink, driving, minimise the need for traffic police alcohol blow machines and in effect reduce RTAs

7.3.3 Recommendations for Scholars

The three elements of road safety identified in this study are the vehicle/driver as road users, the pedestrians/cyclists as road users and the road infrastructure. It is noted that many road safety programmes in Kenya over-emphasise on the vehicle ignoring the fact that the quality of the drivers and the condition of the roads are equally critical. General routine observations at traffic police road block on a Kenyan road even at the research study road accident black spots; show that a traffic officer will be checking the vehicle conditions, while next to him there are glaring potholes on the road. And as soon as the vehicle is released from the road block, it zooms to above legal speed limits. This is ineffective enforcement and adds no value to road safety. It is with this view that the researcher recommends that more scholarly research studies be carried out on the training of traffic police officers and on traffic laws enforcement with a view of proposing better and effective traffic laws enforcement techniques.

In a descriptive analysis of RTAs and injury data in Kenya Odero, W (1995) it was observed that 60% of the reported RTAs occurred on rural roads and had a higher case fatality rate (CFR) of 16% compared to those occurring in urban areas with a CFR rate of 11% and it was noted that human factors were responsible for 85% of all accident causes. Vehicle pedestrian collisions were most severe and had the highest CFR of 24% while only 12% on injuries resulting from vehicle-vehicle accidents were fatal. Utility vehicles, ‘‘Matatus’’ and buses were involved in 62% of the injury producing accidents. And of all traffic accident fatalities, pedestrians comprised 42% , passengers 38%, drivers 12% and cyclists 8%. According to Odero, W; the high pedestrian and passenger deaths imply the need to investigate the underlying risk factors, operational and policy issues in the transport systems for appropriate road safety interventions. It is with these views that the researcher recommends that a study on the working population daily travel and movement patterns would give some indicators on the pedestrian difficulties. Are workers walking very long distances making them fatigued and unable to avoid pedestrian motor conflicts on the roads? Do some pedestrian accidents have suicidal tendencies? Attempts to have some answers to these queries can be done in some scholarly studies.

In 2004, the World Health Organization (WHO) and the World Bank launched the World report on road traffic injury prevention. The World report provides extensive information on leading risk factors for road traffic injuries and evidence on effective interventions, and makes recommendations to countries on how to improve National road safety. Strategies exist that are proven to reduce road traffic injuries and a number of countries have successfully used these strategies to reduce their road traffic deaths. Progress in implementing the recommendations of the World report was first reported in the Global status report on road safety: time for action (2009). It is recommended that scholars study the applicability of these strategies to Kenya and make appropriate proposals on the same to enhance our National road safety action plans.

7.4 Areas for further research

This study contends that to a large extent lack of strict enforcement of traffic laws by traffic police in Kenya has contributed to the rampant widespread increase in Road traffic accidents in Nairobi city. It was observed that there was a lot of laxity in enforcement of traffic rules and regulations. It was also observed that some physical environmental features on the roads contributed to the occurrences of RTAs. However there is need to explore through research other factors that might have not been addressed by the study and they also contribute to the occurrence of road traffic accidents. The areas of further research recommended by the researcher are:

- a. The driver behaviour and road traffic crashes
- b. The effects of drunk-driving and drug abuse on road traffic accidents
- c. An analysis of the contribution of social factors on road traffic accidents in Kenya.
- d. The operations of regionalised Public Service Vehicle (PSV) passenger transport in Kenya and its impact on road traffic accidents.
- e. The shortcomings of driver training in Kenya and its impact on road traffic accidents.
- f. The effectiveness of traffic police in Kenya to control road traffic accidents
- g. Public participation in combatting the menace of road traffic accidents(RTAs)

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9.0 APPENDICES

APPENDIX 9.1 QUESTIONNAIRE FOR ROAD SAFETY PROBLEMS IN THE CITY OF NAIROBI

1. Do road side activities encroach onto the road and foot ways at the RTA black spot forcing motor vehicle onto the pedestrian ways the pedestrians onto the road?

Yes.....No.....

Observation/Comments.....

2. Are sufficient pedestrian crossing facilities provided and are they located where the greatest numbers of pedestrians wish to cross? Yes...No....

Observation/Comments.....

3. Did the accident occur due to the carelessness of the driver or the pedestrian?

Answer Observation/Remarks.....

4. Are there pedestrian fences erected / installed to channel pedestrians to safe crossing points?

Yes.....No.....Observation comments.....

5. Is there visible and adequate advance warning of the RTA black spot to warn drivers?

Yes.....No.....Observation

Comments.....

6. Are there speed limiting bumps on the RTA black spot?

Yes.....No.....

Remarks/comments.....

7. Are the speed limiting bumps erected at a reasonable distance before the RTA black spot?

Yes.....No.....observation Comments.....

8. Is the RTA black spot obstructed from clear visibility by drivers and pedestrians?

Yes..... No.....

Observation Comments.....

9. From the RTA black spot observations, are the alternative pedestrian traffic ways utilised always to avoid pedestrian accidents?

Yes...No.... Observation Comments.....

**APPENDIX 9.2: QUESTIONNAIRE FOR LAW ENFORCEMENT FACTORS
(TRAFFIC POLICE OFFICERS)**

1. Name the accident place.....

Name the road the accident occurred

2. Name the parties involved in the RTA (tick)

Saloon.....PSV.....Lorry.....Cycle.....Pedestrian.....

3. Indicate the time the RTA occurred.....AM/ PM.

What was the weather; Wet.....or Dry.....

4. Was the driver holding a valid driving license? Yes.....No.....

5. If the driver was not holding a valid driving license, was he/she booked/charged with the offence?

Yes..... No..... Remarks.....

6. Was the accident reported to the police, to the Insurance Company or to both?

Answer.....Remarks/Comments

7. From the accident report/observations, who was to blame for the accident?

Answer.....Reasons/Comments for the blame.....

8. Was the party to blame for the accident booked/charged? Yes.....No.....

Remarks/Comments.....

9. During the accident period, were there any traffic officers on that stretch of the RTA black spot? Yes..... No.....

10. Are there any speed limits marks/signs at the RTA black spot? Yes.....No.....

Remarks.....

11. Are the speed limits above being observed by the drivers on the road?

Yes.....No.....

Observation Comments.....

12. Indicate some of the difficulties police traffic officers experience when enforcing Road traffic rules and regulations

**APPENDIX 9.3: QUESTIONNAIRE FOR GOVERNANCE FACTORS
(DRIVERS' BEHAVIOUR)**

1. M or F(.....); Age.....(Yrs); Driving experience.....Yrs; PSV.....Own vehicle.....(Tick)

2. In the last 3 years, how many accidents have you been involved in.? (Tick)

1---3 4---6 7---9 more than 10-----

3. In the above accidents, in how many cases did you report to the Traffic police?(Tick)

All the cases--- None of the cases---- Some of the cases..... (How many? Number)

What are the reasons of the above answers

4. In how many of the above accidents were you to blame for the accidents? (Tick)

All the cases..... None of the cases.....Some of the cases----- How many? Number.....why do you think you were blamed for the accidents

5. In how many of the above traffic accidents were you charged in court for the traffic

offences? (Tick) All the cases----- None of the cases---- Some of the cases----- How many? Number.....What are the reasons of the above answer.....

6. Did you report/involve your Insurance Company on the above traffic accidents?

Yes..... No..... In how many cases? Number..... Why? Give reasons of your above answer?.....

7. Does the presence of traffic police officers on the roads make you drive more carefully?

Yes.....No.....Why? Give reasons.....

8. Do you feel that traffic police officers are effective in traffic controls to avoid road traffic accidents? Yes.....No.....Why?

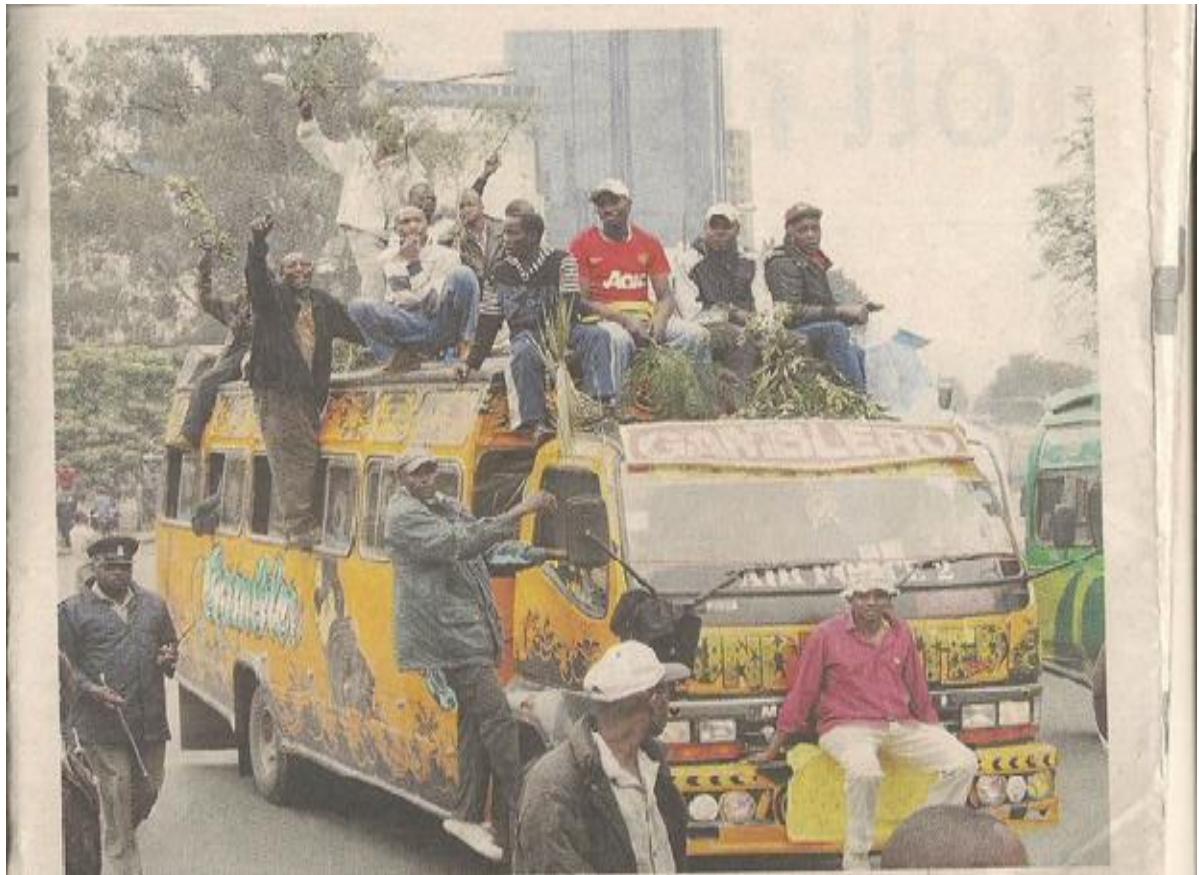
Give reasons.....

9. Do you feel that the court traffic fines or traffic bonds to drivers after road accidents are effective in reducing road traffic accidents?

Yes.....No.....Give reasons/comments.....

10. As a driver, what are your proposals to the Government for implementation as measures to reduce road traffic accidents.....

APPENDIX 9.4: PHOTOGRAPHIC IMPRESSION OF ROAD HAZARDS IN THE CITY OF NAIROBI



Source: Researcher; April , 2013

Plate 9.1: Matatu crews protesting against the introduction of new traffic rules in Nairobi City. This is a serious governance issue in traffic laws legislation and operationalisation in Kenya.



Source: Researcher; April , 2013

Plate 9.2: A pedestrian dangerously and carelessly crossing an un-marked road crossing point along langata road near the Carnivore road junction which can lead to a pedestrian road accident.



Source: Researcher, July, 2015

Plate 9.3:

PSV Matatus making a dangerous careless turning on Mbagathi road with no regard for other motorists increasing the possibility of Road traffic accidents



Source: Researcher; October, 2014

Plate 9.4:

The researcher making road side observations along Valley road section at the junction with Milimani road , which is an accident prone section on this road.



Source: Rsearcher; October, 2014

Plate 9.5:

A marked pedestrian Zebra road crossing point at the junction of Mbagathi road and Langata road roundabout. It is noted that motorists are not according pedestrians the right of crossing safely. The pedestrians are rushing with luggages across the Zebra crossing.



Source: Demotix-The network for freelance photojournalists,2013

Plate 9.6:

Hawkers have taken part of the road and put their wares not considering the danger to themselves , pedestrians and the motorists.



Source: Images by Constant Cap, University of Nairobi-Kenya, January,2014

Plate 9.7:

A Pedestrian carelessly crossing a busy road but can also be a failure by road planners to Protect Pedestrians when road planning

Plate : 9.8



Source: Images by Constant Cap, University of Nairobi-Kenya, January,2014

Plate 9.8:

Road side activities encroaching the roads thereby increasing pedestrian and motor conflicts which can lead to occurrences of road traffic accidents

Appendix 9.5: RESEARCH AUTHORIZATION LETTER

REPUBLIC OF KENYA



NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telegrams: "SCIENCETECH", Nairobi
Telephone: 254-020-241349, 2213102
254-020-310571, 2213123.
Fax: 254-020-2213215, 318245, 318249

When replying, please quote

NCST/RR/12/1/ES-011/28/4

P.O. Box 30623-00100

NAIROBI-KENYA

Website: www.ncst.go.ke

30th June, 2011

Date:

Our Ref:

Jeremy M. Bundi
University of Nairobi
P. O. Box 30197
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "**An analysis of the effects of environmental and governance factors on road safety problems: A case study of road accident black spots in the city of Nairobi, Kenya**" I am pleased to inform you that you have been authorized to undertake research in Nairobi Province for a period ending **31st December, 2011**.

You are advised to report to the **Permanent Secretaries of the selected Ministries, the Chairman, NEMA, the Commandant, Kenya Traffic Police, the Provincial Commissioner & the Provincial Director of Education, Nairobi Province & the Town Clerk, Nairobi City Council** before embarking on the research project.

On completion of the research, you are expected to submit **one hard copy and one soft copy** of the research report/thesis to our office.


DR. M. K. RUGUTT, PhD, HSC
DEPUTY COUNCIL SECRETARY

Copy to:

The Permanent Secretaries
Selected Government Ministries
NAIROBI

Appendix 9.6: RESEARCH CLEARANCE PERMIT



CONDITIONS

- 1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.**
- 2. Government Officers will not be interviewed with-out prior appointment.**
- 3. No questionnaire will be used unless it has been approved.**
- 4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.**
- 5. You are required to submit at least two(2)/four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.**
- 6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.**

REPUBLIC OF KENYA

RESEARCH CLEARANCE PERMIT

GP605563mt10/2011 (CONDITIONS—see back page)