ADDIS ABABA UNIVERSITY
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DESCRIPTIVE ANALYSIS OF ROAD TRAFFIC CRASHES IN ADDIS ABABA

BY

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Addis Ababa, Ethiopia
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List of Abbreviations

AATCID	**Addis Ababa Traffic Control and Investigation Department**
AATBO	**Addis Ababa Transport Branch Office**
AATCID	**Addis Ababa Traffic Control and Investigation Department**
AATPC	**Addis Ababa Traffic Police Commission**
AU	**African Union**
BAC	**Blood Alcohol Concentration**
CAACG	**Council of Addis Ababa City Government,**
CSA	**Central Statistics Agency**
ETSC	**European Transport Safety Council**
IPIFA	**Injury Prevention Initiative For Africa**
NRSCO	**National Road Safety Coordination Office**
NGOs	**Non –Governmental organization**
OECD	**Organization of Economic Co-operation and Development**
UNECA	**United Nations Economic Commission for Africa**
RSC	**Road Safety Campaign**

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Abstract

This paper discusses the growing problem of road traffic crashs, particularly in Addis Ababa with particular reference to the magnitude, risk factors, interventions and research priorities. The Addis Ababa police commission 2012 annual report depicts that of the 369 people die on roads ,and as many as 2010 people are injured.Over 20% of the injuries occur in kirkose sub-city and 17% of injuries occur in Bole Sub-city Adiministration of the total injuries occur in 2011/2012.

The traffic police reports depicts that human error, road environment and vehicle factors as the main causes of road crash. However, little documentation is available on the broader underlying factors such as deficiencies in the breviaries changes, ineffective road safety legislation and enforcement, systems for data collection and management, and inadequate medical infrastructure for post-injury management. Although a variety of road safety interventions have been successfully applied, little attempt has been made to promote and implement them.

Every year, on average more than 300 people are killed and 1500 are light and seriously injured on Addis Ababa's roads[Addis Ababa police commission]. The governments have launched several campaigns, such as “Think!” and Road Safety Campaign (RSC) and slogans,like Alert today-Alive the day after today, Please Drive Safety. To help people become aware of road safety issues and try to reduce road crash.

Stastical analysis is used in this study. Findings of this study have shown that Drivers’ Age, Educational background and Place of crash significantly affect the number of death/ injuries per crash . Drivers who are in the age group of 18-30 are liable for most of the crashs including the sever ones. Drivers with secondary school level of education take the major responsibility for the increased number of injuries per crash. With regards to places of crashs, particularly in central business districts,organizational and residential areas are where the highest mean of injuries per crash is attained in the order given. The major causes of traffic crashs are failure to give -way for vehicle, ,failure to give-way for pedestrians, and following too closely. On average, about 89 % of the road traffic crash fatalities are pedestrians.From the total traffic crashs occurring yearly, on average more than 4% are fatal crashs and over 19 % of the total traffic crash injuries are fatalities.

1 INTRODUCTION

1.1 General

When seen in the global domain, the problem of road safety in Addis Ababa is in an alarming situation calling for an integral effort of all pertinent stakeholders to reverse the trend.

On average approximately 3000 crashs are reported to the police each year. Note that there is still gap between the actual crash and recorded data.

A mixture of ownership structures of which public and private operators are predominantly competitors for business, carries transport in Addis Ababa. The modes of urban transport system in the Addis Ababa are categorized in to motorized and non- motorized traffic. As such the modes of transport include public bus; minibus; taxis and the non-motorized transport.

As modernization and consequently the urbanization moves forward, the use of motorized transport to maintain the socio economic and physical integration of the city increases. The rise in automobile ownership although not yet very significant together with the poor condition of the roads and the poorly functioning traffic system have resulted in high level of congestion particularly at peak hours, whereby the probability of occurrence of crash is very high. Addis Ababa city Transport Authority report depicts,the vehicle fleet in Addis 2011/12 is estimated to be 313,416. Those vehicles are composed of 80,611 private cars, 52,712 station wagon, 62,252 trucks (dry and liquid cargo), 5,171 buses, and 59,869 taxis and 52,801 are others .

1.2 General Background of Addis Ababa

1.2.1 Addis Ababa City Transport

Addis Ababa, the capital city of Ethiopia, is at the heart of one of Africa's most fascinating countries. Once known as Abyssinia, the home of the fabled Queen of Sheba, Ethiopia has a rich history dating back at least 3,000 years and one of the most stunning and diverse land scapes in the world.

Addis Ababa is the ideal gateway to and from most of Africa, the Middle East, Asia and Europe.It is an important administrative center, not only for Ethiopia but also for the whole of

Africa. The headquarters of the UN Economic Commission for Africa was established here in 1958 and it is also the home of the African Union's secretariat.

As it is the seat of the headquarters of the United Nations Economic Commission for Africa UNECA), the African Union (AU) and other regional and international organizations, Addis are the diplomatic capital of Africa. Moreover, the presence of more than 100 embassies and consular missions has enabled it to serve as the venue for international conferences and other gatherings, and stand fourth among the most important centers of international organizations and embassies after Washington DC, New York and London.

For administrational purposes Addis Ababa is divided into 10 'Kefle Ketemas'. Hence, Addis Ababa has a significant contribution in the economic, social and political sector development of the country. Over the past years the city of Addis Ababa has witnessed with an amazing expansion of the city size.

In Addis Ababa has seen a significant face lift in the past few years, it has been in the expansion of roads. The City has opened itself up with road construction which is gradually reaching sub-Saharan levels.Of course, it has yet to invest a lot more to compete with major African cities, such as Johannesburg and Port Louis. But its rate of growth in the last two years has indeed been astonishing. A simple analysis of visitors' comments over the years could accurately show the trend.

Addis Ababa-improved access to emergency medical care and compulsory third-party insurance coverage could help to lower Ethiopia's high road-traffic crash death toll, say officials."At least one person dies out of [every] five car crashs occurring in this country," said Bamlaku Alemayehu, inspector of Ethiopia's National Road Safety Coordination Office. "Most of these victims die due to a lack of proper medical services, such as getting immediate medical assistance on time."

Many of the traffic congestions and road safety problems in Addis Ababa may be attributed to inefficient use of road networks, weak enforcement capability and poor design of roads. As such Road Traffic Safety Regulations have been issued in the 1998 by the Council of Addis Ababa

Administration. Accordingly, who so ever, by omission, contravenes what is laid down depending on the gravity of the offence committed is obliged to be punished.

Table 1-1: Addis Ababa City Administration Road Network

Road Hierarky	Unit	Length	Number of Bridge Constructed	Condition of Road
Arterial	Km	1291	116	Good
Sub –Arterial	Km	267	55	Good
Collectore	Km	114	66	Good
Local	Km	135	40	Good
	Sum	**1807**	**277**	Fair
Cobbel stone	Km	147		
Gravel	Km	1777		
Total Road Length(Km)		**3731**		

Source: Addis Ababa city Roads Authority, January 2012

There has been a lot of progress in road construction in recent years in the country, which improved land transport considerably.Table 1-1 depicts progress in road network and road density up to 2012.

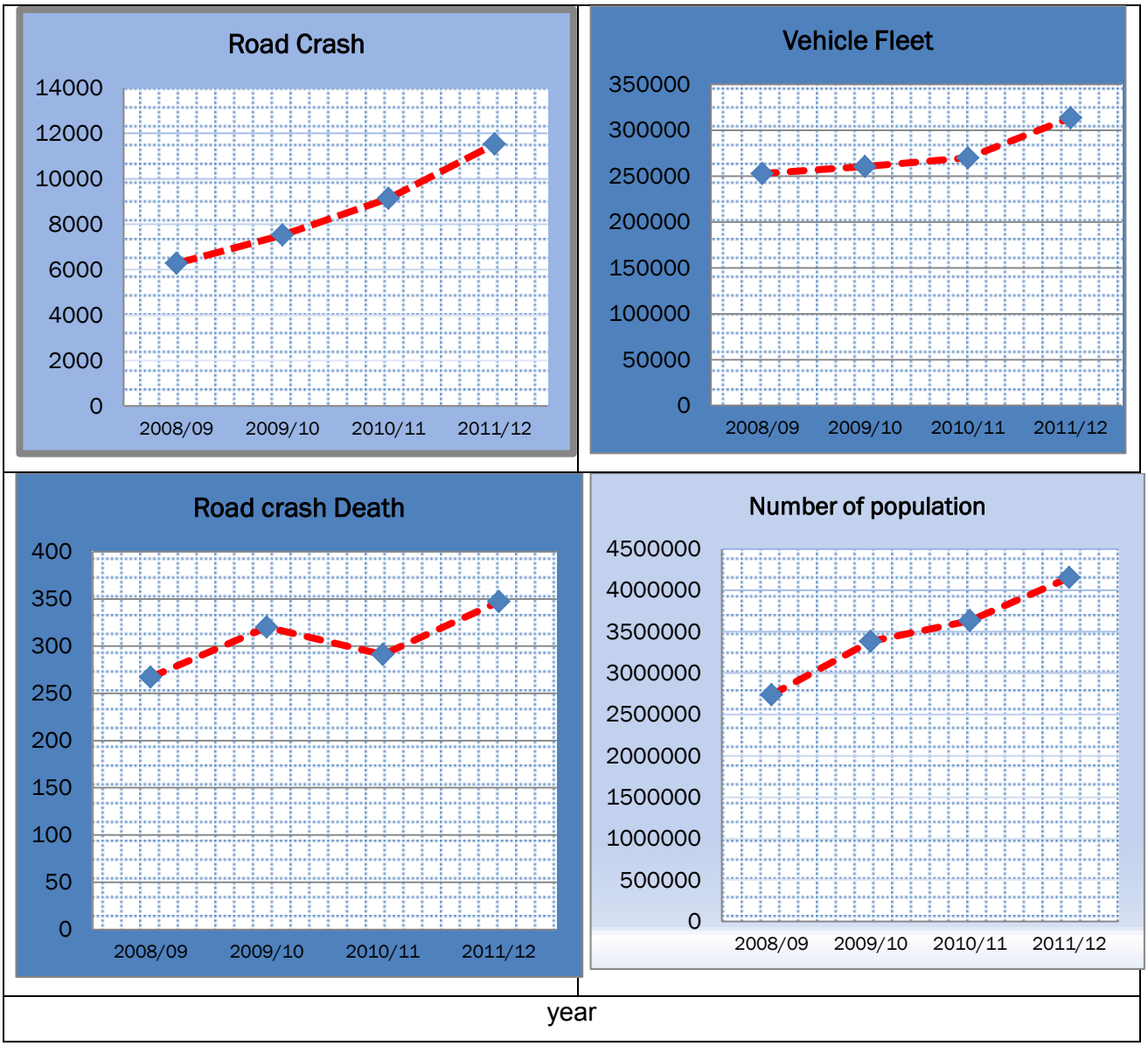
1.2.2 Trends of Traffic Crash

Road traffic crash in Addis Ababa is a cause of significant losses of human and economic resources. In the last Ethiopian fiscal year (2008/09-2011/12), police reported more than 34 thousands of crashes which caused the losses of 2,379 lives and over ETB 157 million equivalents to US$ 7.8 million (cost estimate of property damage by police). It would be impossible to attach a value to each case of human sacrifice and suffering, add up the values and produce a figure that captures the national social cost of road crashes and injuries. However, the economic costs of road traffic crashes are, evidently, a heavy burden for the national economy. According to the World Health Organization report, the economic costs of road crashes and injuries are estimated to be 1% of Gross Domestic Product (GDP) in low-income countries such as Ethiopia.

Table 1-2.Motor Vehicle Crashes In Addis Ababa, 2008/09 - 2011/12

	Year			
	2008/09	***2009/10***	***2010/11***	***2011/12***
Registered Vehicle	252,845	260,336	270,085	313,416
Numbers of population	2,738,248	3,384,569	3,633,154	4,156,251
Total Crashes	6,285	7,523	9,134	11,529
Fatal	318	371	332	369
serious injury	626	731	904	1190
Light injury	652	576	831	820
Property Damage	4,689	5,845	7,067	9,150
Number of Deaths				
Bellow 18 years age	1	1	1	0
18-30 years age	126	138	107	145
31-50 years age	116	132	146	134
Above 50 years	24	49	37	68
Number of people injured				
Bellow 18 years age	11	6	35	71
18-30 years age	487	519	654	882
31-50 years age	439	442	704	691
Above 50 years	160	97	218	265

Table 1-2 depicts reported crash by police in recent years for Addis Ababa. The recent phenomenon of increasing trend of traffic crashes in Addis Ababa can be seen negatively. However, with the increasing exposure which can be measured indirectly by the increase in population, motorization, and road network expansion in the Addis Ababa, and low-level of safety awareness and road safety work, such sudden drop is not normally expected and its reliability should be evaluated over longer period of time. One could rather be suspicious if it is due to random variation, underreporting or both.



Road authority

The Addis Ababa City Roads Authority (AACRA) has a section with main responsibilities of traffic signals, road signs, and pavement markings. The head of the section is also a member of a committee responsible for road signing on existing roads together with members from the Addis Ababa Transport Branch Office (AATBO), and Addis Ababa City Traffic Police (AACTP). The signing and marking of new roads are provided with the design and the contractor furnishes them as part of the contact.

Generally, traffic safety is not an issue primarily considered in the establishment proclamations of roads authorities. These result in the very low commitment of ensuring safety in the planning, design, and operational management of road infrastructures in the country. Consequently, the road authorities do not have strong safety engineering units which take responsibility of undertaking road safety improvement works for safety reasons.

Traffic police

Similar to the government bodies concerned with transport and road infrastructure, police is also organized at the federal and regional levels with hierarchical links. At the federal level, there is a Federal Police Commission accountable to the Ministry of the Federal Affairs.

The traffic police in Ethiopia play a twofold role in traffic safety. They primarily take the responsibility of improving safety by enforcing the traffic regulations. They secondly carry out crash investigation and reporting mainly for own use to document evidences required for court ruling, and as well as to identify priorities and plan enforcement strategies.

Enforcement, crash investigation and reporting are done by local police station. The monthly and yearly aggregated traffic crash data is reported to the next higher police station following the hierarchy to the Police Commission Office. The Police Commission sends the sub-city aggregate traffic crash data to the Federal Police Commission Office which forms the national aggregate traffic crash statistics.

Road traffic crash reporting

As in most countries in the world, police is responsible for traffic crash investigation and reporting in Ethiopia. According to the Ethiopian transport regulation (Negarit Gazeta, 1963, which is still in use with amendments), a driver of a vehicle involved in a road crash shall notify the nearest police station immediately if the crash involves personal injury and within twenty-four hours if it involves property damage only. According to the regulation all crashes are reportable. In practice, however, the police are notified only when the crash involves serious injury, agreement cannot be reached between parties involved or if police crash report is required for insurance. Because of this, the reporting of non-fatal crashes is uncertain. Thus, the under-reporting of road crashes in Addis Ababa is expected to be quite considerable.

Normally, in response to notification of a crash, a traffic police investigator attends the scene of the crash. Based on the information obtained from observations, the parties involved in the crash, and other evidences, police prepares a factual report and makes the sketch of the site on a plain sheet of paper. The police, who are inadequately equipped and trained, understandably, primarily see their role to take action if the law has been broken and give much attention to get evidence for prosecution rather than to investigate the many factors involved in the crash.

On return from the crash site, an account of the crash is recorded in a daily report book at a local police station. The crash recordings in the daily recording book form the basis of the Addis road crash statistics. Periodic summaries of aggregate road crash records are made and sent to the immediate higher police department. They finally reach the Federal Police where the national road crash statistics are compiled.

The content of the road crash reporting, as it exists now, misses relevant details of a crash report required for any road safety improvement works. The reporting form, in the daily report book, is not designed to include details of each vehicle and road user involved in a crash. The report, further, does not contain details of the road section and precise location of an crash. Besides, because a plain paper is used on the spot, the investigating policeman is unlikely to remember the required crash details and as a result the form available at the local traffic police office is never completely filled.

The information recorded could generally be adequate for the police work, but it is of limited use to other bodies requiring information for identifying the causes and appropriate remedial measures. It is primarily inadequate in determining the location of crashes and the factors involved. Moreover, crash reporting lacks a significant level of consistency. Terminology of crash details does not have a uniform definition even among the staff members at a police station.

In addition to the indicated limitations of crash reporting, there is no established system of computerized crash data bank to store detailed information on individual road traffic crashes occurring in the country. This is another handicap for the efficient management of the reported traffic crash data. Moreover, there is less periodic road traffic crash analysis and dissemination

system to give information on road traffic crash trends, specific crash problems so that stakeholders are aware and aim to improve the situation.

Generally,when acident occured there is no daily standared crash report format used currently.But an crash occurs on a specific area, the traffic police mark the crash and registered the name of driver,licence of driver,types of crash by its own way and then registered on daily report book table (contain 25 Catagories) some of them are depicts appendix 1.5. The new propose daily crash format for any individual crash report to be useful, it must be easily retrievable for some time after the occurance of the crash. Daily crash report book format is attached appendix 1.4.

Other institutions

Road safety is multi-sectorial. For example, the Ministry of Health at the federal level and Health Bureaus at regional level are responsible to provide emergency medical treatments for victims of traffic crashes. One of the key issues in road safety in Ethiopia is inadequate post -crash emergency services and medical care. Non-governmental organizations such as the Ethiopian Red Cross Society have significant roles in providing emergency transport services for injuries to reach emergency medical centers. However, emergency pre-hospital care is critically lacking.

The police in Addis indicate that the major cause of traffic crashes is road users' error. This is true virtually in all countries. This indicates that safe road user behavior in children and adults is essential. This directly implies the role of the Ministry of Education at the federal level and Education Bureaus at the regional level in creating traffic safety awareness from the childhood through providing basic safety education for children at schools.

1.3 Statement of the Problem

A road traffic crash is defined as any vehicle crash occurring on a public highway. It includes collisions between vehicles and animals, vehicles and pedestrians, or vehicles and fixed obstacles. Single vehicle crashs, which involve a single vehicle, that means without other road user, are also included[1].

At all levels, whether at national or international level, road traffic crashs continue to be a growing problem. In connection with this, according to a World Health organization/World Bank

Report, deaths from non-communicable diseases are expected to grow from 28.1 million a year in 1990 to 49.7 million by 2020, which is an increase in absolute number of 77%. Traffic crashs are the main cause of this rise. Road traffic injuries are expected to take higher place in the rank order of disease burden in the near future[2].

The tragedy is more or less similar in Addis Ababa, Ethiopia. The rate of traffic crashs in Addis Ababa goes up together with the increase of motor vehicles and population size. The rise in automobile ownership together with the poor condition of the roads has resulted in the high level of traffic safety and congestion problems.

1.4 Research Questions

The research is intended to answer the following questions.

No.	Research Questions	Research objectives
1	Who are the main players in the crash?	To analyze the impact of driver and vehicle related variables on traffic injuries
2	What are the main causes for the increase in the number of road traffic crash in Addis Ababa?	To identify and describe the major variables (factors) that contributes to traffic injuries.

1.5 Objectives of the Thesis

The general objective of the study is:

- To identify the major factors determining the number of traffic injuries.

The specific objectives of the study are:

- To identify and describe the major variables (factors) that contributes to traffic injuries.
- To analyze the impact of driver and vehicle related variables on traffic injuries.

1.6 Significance of the Study

As it is stated earlier, road traffic crashes have been increasing from time to time however; no attention is given to identify the root cause of the problem and its solutions. So, the findings of this study help to:

- Practitioners (traffic police) to be aware of the problems, because as a practitioner,they can contribute on their own part in reducing road traffic crashs.
- The study is believed to enrich the existing literature in road traffic crashs.
- To inform the existing situation so that readers to save their life by showing the severity of the crashs.
- To create or design effective prevention and protection policy, strategy to policymakers, transport authorities, road engineers, and other concerned bodies, to take counter measures and monitor road safety problems.

Thus, this research paper will give a clue to those who are interested in conducting research on traffic crashs.

1.7 Contribution of the Study

Road traffic crash (RTA) is the global nature of the problem and one of the key concerns of our Government list includes the issue of RTA. There are some literatures and documents on the subject based on Addis Ababa Context, and the whole of Ethiopia. Students from different Institutes are also focusing on the issue of road transport related problems, thus there is a multidisciplinary grouping to tackle the problem.

1.8 Expected Benefit of the Thesis

The primary benefit of this research is to provide enable someone who uses or employs something to make better decision while planning to make any movement so that either the risk of being victimized with road crash.Furthermore, the research helps for the responsible authorities to see the effect of how severe the issue is, such that great attention and participations on any research based on road crash related problems will be supported efficiently.

1.9 Thesis Organization

Following this chapter,

chapter 2: provides a summary of the available literature in the area of safety and more specifically in the crash injuries, crash rates and a brief summary of the existing crash databases.

Chapter 3: This chapter will cover different aspects of methodology used during the research. It will present the different options available to carry out the study and gives reasons why a particular method was selected at different stages of the project. As a lot of data collection is involved in the project, the way the collection was made can affect the outcome of the project. For this reason, the data collection method selected on the course of the project will also be discussed here.

Chapter 4: This chapter focuses on the analysis and result of the database and the development of the crash rates that are used in chapter 5. The analysis part includes the various crash trends for the year 2008/9 – 2011/12, because these will be used as a benchmark in order to validate the results that will be presented in chapters 5. Chapter 4 provides information for the database, the extraction process and the reliability of the estimates. Also in this chapter is a description of the database variables and crash rates produced.

Finally,**chapter 5:** conclusions from this study as well recommendations and further research hints are stated.

2 REVIEW OF THE LITERATURE

2.1 Introduction

Road transportation provides benefits both to nations and to individual by facilitating the movement of goods and people. Everybody travels whether it is to be work, play shop or do business. All raw materials must be conveyed from the land to the place of manufacturing or usage, and all goods must be moved from factory to the market place and from the staff to the customer It enable increased access to jobs, economic markets, education,recreation and health care,which in turn have direct and indirect positive impacts on the health of populations. However,the increase in road transportation has also placed a considerable burden on people's health – in the form of road traffic injuries, and the health consequences that ensue from a reduction in physical activitity. There are additional negative economic, social and environmental consequences that arise from the movement of people and goods on the roads- such as air pollution,greenhouse gas emissions,consumption of finite resource, community severance,and noise[4].

Road traffic injuries are a global problem affecting all parts of society. To date, road safety has received insufficient attention at the national and regional levels.
This has resulted in part from:

- a lack of information on the magnitude of the problem and its preventability;
- a fatalistic approach to road crashes; and
- Lack of the political responsibility and multidisciplinary collaboration needed to tackle it effectively.

Traffic crash is the result of multiplicity of factors and it is often the interaction of more than one variable that leads to the occurrence of crash. Crashs occur as a result of the interaction of many different factors among which are road and traffic characteristics.

Most of all traffic crashs are due to human error.The term human error however is often controversial for It doesn't satisfactory describe that large number of injuries and deaths that occurs on the road as the result of driving errors while abilities to do so are mentally or physically unfit by alcohol or drugs, lack of experience, lack at distribution of attention etc .

Car crashs can damage one or more autos, people, or structures. Car crashs also called traffic crashs,auto crashs, road crashs, and motor vehicle crashs cause thousands of deaths and hundreds of thousands of disabilities each year. Worldwide, car crashs kill an estimated over one million people each year.

2.2 Car Crash Types

A traffic crash is defined as any vehicle crash occurring on a public highway (i.e.originating on, terminating on, or involving a vehicle partially on the highway). These crashs therefore include collisions between vehicles and animals, vehicles and pedestrians, or vehicles and fixed obstacles. Single vehicle crashs, in which one vehicle alone (and no other road user) was involved, are included[4].

Car crashs can happen at any time. A car crash can occur due to speeding, traffic gridlock, negligence or recklessness and unsafe driving[5].

Common Car Crash Collisions

- **Rear-end collisions** -Rear-end collisions are very common. These types of traffic crashs are often caused by sudden deceleration (slowing down or braking). In some cases, another driver is following too closely or accelerates to a higher speed than the car in front of it. Whiplash is a common injury that occurs in a rear end collision and usually affects drivers and passengers of the impacted car. Fault is usually attributed to the driver of the car that rear-ends the other vehicle.

- **Side-impact collisions** -Side-impact collisions can cause grave injuries. Often called "T-bone" or "broadside" collisions, side impact crashs occur when the side of a vehicle is impacted. It can be impacted by the front or rear of another vehicle or in some cases a fixed object. Vehicle damage is often severe and drivers or passengers on the impacted side of the vehicle usually sustain far worse injuries than they would in another type of crash.
- **Sideswipe collisions** - Sideswipe collisions occur when two cars that are parallel touch. In many cases, the damage is only severe, as the cars have just "swiped" each other.

Injuries and damages are typically minimal, unless one of the drivers loses control of their vehicle as a result of the collision.

- **Vehicle Rollover** - Vehicle rollover crashs are extremely dangerous and frightening. A rollover occurs when a vehicle literally flips over onto its side or roof. Any vehicle can be involved in rollover crash, but cars with a high center of gravity such as SUVs (Sport Utility Vehicles) are especially prone to this type of crash. Often caused by sharp turns at high speed, rollover crashs can lead to serious injuries including spinal cord injuries and brain trauma.
- **Head-on collisions** - These types of collisions are often fatal. Head-on collisions are exactly what they sound like - they occur when the front ends of two vehicles impact each other.
- **Single car crashs** - Crashs involving only one vehicle are also common. They occur when a vehicle strikes objects such as poles, trees, fire hydrants, and walls. In some cases they may involve pedestrians and other innocent bystanders. Single car collisions can result in driver and passenger injuries, pedestrian injuries, and often extensive property damage.
- **Multi-vehicle collisions** - Multi-vehicle collisions are sometimes referred to as "pile-ups" and often occur on busy roads such as highways and freeways. They can involve many vehicles and be the most dangerous. Vehicles can be impacted multiple times and it may be difficult to escape. It is also difficult to determine fault in these cases[6].

2.3 Causes of Crashes

Many factors result in car crashs, and sometimes multiple causes contribute to a single crash. Factors include the following:

- **Driver distraction**, including fiddling with technical devices, talking with passengers, eating or grooming in the car, dealing with children or pets in the back seat, or attempting to retrieve dropped items;
- **Driver impairment** by tiredness, illness, alcohol or drugs, both legal and illegal. MADD (Mothers Against Drunk Driving) is an organization made up of the families of the dead who were killed in car crashes caused by drunk drivers;

- **Mechanical failure**, including flat tires or tires blowing out, brake failure, axle failure, steering mechanism failure;
- **Road conditions**, including foreign obstacles or substances on the road surface; making the roads slick; road damage including potholes;
- **Speed exceeding safe conditions**, such as the speed for which the road was designed, the road condition, the weather, the speed of surrounding motorists, and so on. Most authorities emphasis speed as a primary cause of crashes, although most experts agree that speed alone rarely causes a crash. Some argue in favor of speed restrictions to mitigate the consequences of crashes.

Road traffic injuries are currently ranked 5th globally among the leading causes of disease burden, in terms of Disability Adjusted Life Years (DALYs) lost. In the year 2020, road traffic injuries are projected to become the 3rd largest cause of disabilities in the world [3].

Developing countries bear the brunt of the fatalities and disabilities from road traffic crashes, accounting for more than 85% of the world's road fatalities, and about 90% of the total DALYs lost due to road traffic injuries. The problem is increasing in these countries at a fast rate, while it is declining in all industrialized nations (Western Europe, North America, Japan, Australia and New Zealand) [3].

The annual cost of road crashes is in excess of US $500 billion, and in the developing world the estimated cost is about US $65 billion each year. Due to the scarcity of costing data for African countries, it is difficult to make a precise cost of road crashes in Sub-Saharan Africa. The current estimate of costs of crashes in the continent is US$ 3.7 billion per year, of which South Africa alone accounts for 2 billion.However, the estimated costs as a percentage of the Gross National Product (GNP) in most African countries range from about 0.8% in Ethiopia and 1% in South Africa to 2.3% in Zambia and 2.7% in Botswana to almost 5% in Kenya[7].

2.4 Road Traffic Crash Report

2.4.1 World Road Traffic Crash

More than 1,200,000 people die in fatal Road Traffic Crashs per year, over 40,000 in America alone. Alcohol is the leading cause. World and regional death rate rankings can be seen below. Some Country rankings are listed below.

Table 2-1: World Death Rate

No.	Country	Road Traffic Crash Death Rate
1	Namibia	53.4
2	Swaziland	48.2
3	Malawi	45.4
4	Iraq	44.7
5	Iran	43.8
6	Thailand	42.9
7	Congo	42.4
8	Central Africa	39.7
9	Sudan	39.2
10	Mozambique	38.2
11	Zambia	37.9
12	Ethiopia	37.8
13	Lesotho	37.4
14	Yemen	37.3
15	Belize	36.9
16	Angola	36.2
17	Venezuela	35.8
18	Dominican Rep	34.8
19	Uganda	34.7
20	Malaysia	34.5
21	Equ. Guinea	34.2

Source: WHO data published April 2011

2.4.2 Africa's Roads Traffic Crash

The African Region remains the least motorized of the six world regions, but suffers the highest rates of road traffic fatalities with 37 of 44 surveyed countries having death rates well above the global average of 18.0 deaths per 100 000 population. While the regional average is 24.1 deaths per 100 000 population, for the 19 countries in the middle-income category, covering 44% of the region's population, the rate is 27.8 deaths per 100 000 population. By comparison, the global average for middle-income countries is 20.1 deaths per 100 000 population[8].While the African region possesses only 2% of the world's vehicles it contributes 16% to the global deaths.

Nigeria and South Africa have the highest fatality rates (33.7 and 31.9 deaths per 100 000 population per year, respectively) in the region. More than one in four deaths in the African region occur on Nigeria's roads, and with six other countries; Democratic Republic of Congo (DRC), Ethiopia, Kenya, South Africa, Tanzania, and Uganda, are responsible for 64% of all road deaths in the region While Ethiopia, Kenya, and Tanzania have relatively low (for the region) road fatality rates, Nigeria, South Africa, and Uganda combine big populations with very high fatality rates, resulting in large numbers of deaths. These seven countries must reduce their road deaths considerably if the region is to realize a significant reduction in deaths[8].
While statistics clearly point to a high economic cost to the respective countries, only nine countries provided an estimate of the cost in terms of the Gross Domestic Product. This ranged from 1% in six of the countries, to 9% in Angola[9].

Magnitude

Africa has one of the highest road traffic death rates in the world, with little difference in rates between those countries categorized as low-income (32.3 deaths per 100 000 population per year) and those categorized as middle-income (32.2 deaths per 100 000 population per year). These rates are twice the death rates of South East Asia, another region with no high-income countries, and far in excess of the global rate of 18.8 traffic deaths per 100 000 population. Whereas the range of fatalities per 100 000 population in the countries of the African Region is not very wide, 70% of all the deaths in the Region occurred in the ten countries that account for 70% of the regional population: Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Madagascar, Mozambique, Nigeria, South Africa, Tanzania[**5**].

Table 2-2: Road Traffic Death rates in Africa

ROAD TRAFFIC ACCIDENTS
AFRICA

Death Rate per 100,000

GOOD POOR

Region Rank	Rate	World Rank	Region Rank	Rate	World Rank
1. Namibia	53.41	1	25. Kenya	28.21	40
2. Swaziland	48.24	2	26. Ghana	28.11	41
3. Malawi	45.39	3	27. Botswana	26.61	42
4. Congo	42.41	7	28. Mauritania	26.06	43
5. Central Africa	39.66	8	29. Benin	25.90	45
6. Sudan	39.25	9	30. Gabon	25.59	46
7. Mozambique	38.24	10	31. Rwanda	24.16	49
8. Zambia	37.94	11	32. Comoros	22.27	55
9. Ethiopia	37.83	12	33. Gambia	21.67	61
10. Lesotho	37.42	13	34. Eritrea	21.66	62
11. Angola	36.19	16	35. Nigeria	21.55	65
12. Uganda	34.71	19	36. Liberia	21.52	66
13. Equ. Guinea	34.16	21	37. Mali	20.51	68
14. Djibouti	33.97	22	38. Cape Verde	20.48	69
15. Cameroon	32.59	24	39. South Africa	20.17	72
16. Guinea-Bissau	31.40	27	40. Togo	19.62	73
17. Guinea	31.39	28	41. Zimbabwe	19.27	74
18. Burkina Faso	31.36	29	42. Senegal	17.84	81
19. Chad	30.88	31	43. Madagascar	17.41	82
20. Sierra Leone	30.21	32	44. Niger	14.94	97
21. Tanzania	29.58	34	45. Mauritius	14.12	105
22. Burundi	29.46	35	46. Sao Tome	12.99	116
23. Cote d Ivoire	28.63	37	47. Somalia	12.14	122
24. Rep Of Congo	28.57	39	48. Seychelles	7.60	157

Source: WHO data published April 2011

Profile of People Affected

All road users are at risk of being involved in a road traffic crash, irrespective of the mode of transport. In countries in the African Region this risk is particularly high for pedestrians, or those travelling on two- or three-wheeled vehicles. Other categories of road users at high risk of injuries and fatalities include those using public transport, and passengers on pick-up trucks who are sometimes perched on top of goods and merchandise[**2**].

A total of 17 countries, comprising 34.2% of the population, provided no data on types of road users killed on the roads. In those countries where road user data are available,48% of the dead were vulnerable road users: pedestrians (35%), motorized two-wheelers (5%), and cyclists (8%).A few countries have only pedestrians dominating the death rates: Democratic Republic of Congo (59%), Ethiopia (54.8%), Kenya (47%), Malawi (45%), Mozambique (68.1%), and Zambia (49.8%). This predominance of vulnerable road users, particularly pedestrians, is evenly spread in the Region.

A significant number of countries have vehicle occupants representing the bulk of the fatalities: Botswana (70%), the Comoros (75%), and Niger (67%). Others include Senegal, Seychelles, Sierra Leone, Swaziland, and Zimbabwe.

Young males (ages 5 to 44 years) tend to be at increased risk of being injured or killed on roads. This includes the most economically active group, making road traffic crashes contributors to increased economic vulnerability at individual and household levels, and entrenched poverty in communities [**2**].

Factors Influencing Exposure to Risk

Risk in road traffic arises out of a need to travel – to have access to work, for instance, or for education or leisure pursuits. A range of factors determines who uses different parts of the transport system, how it is used and why, and at what times[10].

a) Rapid motorization Motor vehicles

One of the main factors contributing to the increase in global road crash injury is the growing number of motor vehicles. Since 1949, when Smeed[11] first demonstrated a relationship

between fatality rates and motorization, several studies have shown a correlation between motor vehicle growth and the number of road crashes and injuries.

While the motor vehicle and subsequent growth in the number of motor vehicles and road infrastructure has brought societal benefit, it has also led to societal cost to which road traffic injury contributes significantly. This explains why a number of studies are drawing attention to the need for careful consideration and planning of transport and mobility in view of the increasing motorization in different parts of the world[12].

Periods of economic prosperity tend to be associated with increasing mobility and demand for transport services. On the other hand, periods of economic decline lead to low generation of movement[13]. In times of economic growth, traffic volumes increase, along with the number of crashes and injuries, and there are generally reductions in walking and cycling. Reductions in alcohol-related crashes have also been observed to coincide with periods of economic recession[14].Motorization rate rises with income[15]. In wealthier countries, there has been dramatic growth in the numbers of cars, but in many poorer countries the increases have been principally in motorcycles and minibuses. Some 80% of all cars are owned by 15% of the world's population, situated in North America, Western Europe and Japan both show that motorization is strongly correlated with income.

b) Demographic factors

Different groups of people have different exposures to risk. As populations change over time, so the overall exposure of that population will change. Fluctuations in the relative sizes of different population groups will have a strong effect on the road traffic toll. For instance, in industrialized countries, young drivers and riders – at increased risk of involvement in road crashes – are currently overrepresented in casualty figures. Demographic changes, though, in these countries over the next 20–30 years will result in road users over 65 years of age becoming the largest group of road users.Their physical vulnerability, though, places them at high risk of fatal and serious injuries[16]. In low-income countries, the expected demographic evolution suggests that younger road users will continue to be the predominant group involved in road crashs.

In some high-income countries, more than 20% of the population will be 65 years or above by 2030[17] . Despite the rising number of older people holding driving licenses in such countries, their declining driving ability as well as possible financial constraints will mean that many of them will have to give up driving. In many low-income countries, older people may never have driven in the first place. Worldwide, a large proportion of older people will still be dependent on public transport or will walk. This illustrates the importance of providing safer and shorter pedestrian routes and safe and convenient public transport.

c) Transport, land use and road network planning

Planning decisions regarding transport, land use and road networks have significant effects on public health – as they affect the amount of air pollution by vehicles, the degree of physical exercise undertaken by individuals, and the volume of road traffic crashes and injuries.

The development of a network of roads – or indeed of other forms of transport, such as railways – has a profound effect on communities and individuals. It influences such things as economic activity, property prices, air and noise pollution, social deprivation and crime – in addition to health. Long commuting times degrade the quality of life and therefore health. Sedentary travel directly and adversely affects health [18].In the absence of proper land-use planning, residential, commercial and industrial activity will evolve in a haphazard pattern, and road traffic will evolve similarly to meet the needs of these various activities.

This is likely to produce heavy flows of traffic through residential areas, vehicles capable of high speed mixing with pedestrians, and heavy, long-distance commercial traffic using routes not designed for such vehicles. The consequent exposure to traffic injury can be high for car occupants, and even more so for vulnerable road users, such as pedestrians, cyclists and motorized two-wheeler users[19].

The mixed nature of road traffic in many low income and middle-income countries – with pedestrians, bicycles, handcarts, mopeds, motorcycles, vans, cars, trucks and buses in different proportions – means that many of the technical aspects of planning, highway design, traffic engineering and traffic management need to be worked out locally, rather than being imported. For example, in many Asian cities, with some notable exceptions, the road network is used by at

least seven categories of motorized and non-motorized vehicles, of varying widths and speeds, all sharing the road space. There is generally no effective channeling or segregation of the different categories, or speed control[20].

d) Increased need for travel

All growing urban areas experience a movement of residents from the inner districts to the suburbs. Socioeconomic changes in many places are leading to a profusion of out-of-town supermarkets and shopping malls, with a consequent loss of local shops. Both of these phenomena generate increased traffic, less opportunity for travel by public transport, and increased exposure to risk. These factors need to be better recognized and evaluated in planning processes. This applies not only to developed countries but also to developing countries, some of which contain rapidly-growing megacities, with their significant but undocumented changes in patterns of wealth and living space

Fatality Rates

There is no single accepted indicator that accurately describes the overall road safety situation in a particular country. The number of fatal crashs per million vehicle kilometres travelled per annum, as a measure of exposure to motor vehicle traffic, is the most common method often used in highly motorized countries. However, because of the absence of accurate data on vehicle usage in most African countries, it is not possible to apply this method. Instead, fatality rates, the number of reported fatalities per 10,000 registered motor vehicles, are normally used.

Fatality risk, calculated as the number of deaths per 100,000 populations per annum,which is also the indicator commonly used by the WHO and the ministries of health sector to report diseases and causes of death. It should be noted that both rates are subject to several errors, including variations in the definition of road deaths; underreporting of crashs, the resulting injuries and deaths; lack of a uniform definition of a vehicle; inaccurate record of the total number of registered vehicles; and lack of accurate population data for the year of reporting. There are wide variations in fatality rates: from 270 in Central African Republic to 8 in Chad. The highest rates, all in excess of 100, are reported in Ethiopia, Malawi, Tanzania, Uganda and Ghana. For most of the countries,the rates lie between 40 and 130.

Profile of Road Fatalities

Vulnerable road users: pedestrians, pedal cyclists and public transport passengers- are the most affected, and pay a heavy toll for their participation in traffic. Pedestrians account for the highest proportion of road fatalities in nearly all African countries,ranging between 31% in Zimbabwe and 51% in Ethiopia. Involvement of pedestrians is much greater in urban environment than in rural areas. Studies in Addis Ababa and Abidjan reported extremely high proportion of pedestrian casualties of 90% and 75%,respectively. Passengers rank second, accounting for 32% to 46%. Pedestrians and passengers altogether represent over 80% of all road deaths. Drivers account for a small share of fatalities, of less than 10 per cent. Among sub-Saharan countries, only South Africa has the largest share of driver fatalities (22%).

Sex and Age

As in other developing countries, males are over-involved in road traffic crashs and account for over 67% of those killed. This can partly be explained by their greater exposure to traffic as drivers and as frequent travellers in motor vehicles for work and leisure activities. Females are involved mainly as passengers and pedestrians. In Botswana, for instance, a recent study showed that females accounted for as high as one third of all pedestrian fatalities and 43 per cent of all pedestrian casualties.

Over 75 per cent of road traffic casualties in Africa are in the economic productive age bracket of between 16 and 65 years. Those aged over 65 years account for a small proportion of road casualties, partly due to their small numbers in the general population.Children often get injured as pedestrians; up to 30% of Botswana's pedestrian casualtieswere aged less than 16 years.

2.4.3 Road Fatalities in Ethiopia

Ethiopia is one of those developing countries with low level of income accompanied by high rate of population growth. As part of the developing world, Ethiopia is predominantly an agrarian country with low level of urbanization. The economic performance of different sectors of the national economy is very low. This low performance is due to a number of constraints such as low level of investment in different sectors of the national economy. Among these the existing transport could be mentioned as one. Transport is an important sector for facilitating different economic activities in the national economy.

Nevertheless, due to low level of urbanization and the poor performance of the economy,transport could be said to be at its infantry stage in Ethiopia .The modalities of transport mobility are limited. The greater percentage is covered by the natural mode of walking and animal transport system leaving only a very negligible share for the motorized.According to The population projection figures in this issue are based on the results of the May 2007 National population and Housing Census of Ethiopia. Therefore, the projected figures for the year 2012 become 84,320,987 of which 42,556,999 are males and 41,763,988 are females Urban areas refer to all capitals of regions, zones and weredas, and it also includes localities with urban kebeles whose inhabitants are primarily engaged in non-agricultural activities. (Central Statistical Authority). Among all the urban centers Addis Ababa is the largest urban centre, accounting one third (around 28 percent) of the total population of all the urban centres[21].

Road Traffic Crash

According to WHO data published in April 2011 Road Traffic Crashes Death in Ethiopia reached 22,786 or 2.77% of total death. The age adjusted Death Rate is 37.83 per 100,000 of population ranks Ethiopia number 12 in the world. Vehicular crashes (VA) have already become one of the ever increasing public health problems, particularly for developing countries. As of 2007-2008, Ethiopia had 95 traffic crash fatalities per 10,000 vehicles, states a 2009 UN Economic Commission For Africa report.

Poor emergency medical services and the absence of compulsory liability insurance laws are among reasons contributing to the high fatality rates, it says, adding that "in the urban areas, although traffic police and hospitals are available, crash victims are usually evacuated by standers who [have] neither the necessary skills nor equipment in pre-hospital care.

"And many of the victims are underprivileged people and they can neither afford out-of-pocket payments nor do they have health insurance to receive healthcare services, [thus many such casualties] are not reported."

Ethiopia is ,therefore ,no exception. Avaliable data show that every year two thousand people are killed while the property damage ranges between four hundered and five hundered millon birr. It gives a shocking wave to hear one hundered thirty six fatality rate per 10,000 vehicles.when compared to two and three per same number in developed countries.If we

calculate only the stated damage in terms of money,it can be carry out varies development activites.

General Conditions of Traffic and Transport Development

A mixture of ownership structures, of which public and private operators are predominantly contenders for business, carries urban transport in Addis Ababa. The modes of urban transport system in the Addis Ababa are categorized in to motorized and non- motorized traffic. As such the modes of transport include public bus; minibus; taxis and the non-motorized transport, while walking and animal carts dominant the periphery.Currently, taxis, city bus and private cars altogether cover 30 percent of the urban mobility, that is, 26% bus, 72% taxis and 4 % private cars. While 70% of urban mobility is covered on foot [12].

Many of the traffic congestions and road safety problems in Addis Ababa may be attributed to inefficient use of road networks, weak enforcement capability and poor design of roads. As such Road Traffic Safety Regulations have been issued in the 1998 by the Council of Addis Ababa Administration. Accordingly, who so ever, by omission,contravenes what is laid down depending on the gravity of the offence committed is obliged to be punished [11].

Transportation

Public transportation is through public buses from Anbessa City Bus Service Enterprise or blue and white share taxis. The taxis are usually minibuses that can seat at most twelve people. Two people are responsible for each taxi, the driver and a weyala who collects fares and calls out the taxi's destination.

The construction of the Addis Ababa Ring Road was initiated in 1998 to implement the city master plan and enhance peripheral development. The Ring Road was divided into three major phases that connect all the five main gates in and out of Addis Ababa with all other Regions (Jimma, Debre Zeit, Asmara, Gojjam and Ambo). For this project, China Road and Bridge Corporation (CRBC) was the partner of Addis Ababa City Roads Authority (AACRA).[8] The Ring Road has greatly helped to decongest and alleviate city car traffic.Intercity bus service is provided by the Selam Bus Line Share Company.

The city is served by Addis Ababa Bole International Airport, where a new terminal opened in 2003. The old Lideta Airport in the western "Old Airport" district is used mostly by small craft and military planes and helicopters. Addis Ababa also has had a railway connection with Djibouti City, with a picturesque French style railway station, but the railway no longer operates pending the construction of a new modern rail line to be built in the near future.

A light rail system is planned; in September 2010, Ethiopian Railway Corp reached a funding agreement with Export and Import Bank of China. Plans include a 30 km network with two lines; an east-west line from Ayat to the Torhailoch ringroad, and from Menelik Square to Mercato Bus Station, Meskel Square and Akaki [10].

Basic Indicators for the Description Of mobility

Addis Ababa transport has special characteristics of its own. The foundation of the city in 1886, the broad physiognomy of a radial road system had evolved focusing around the centre. The radial system, which consists of 5 main arterial roads. Besides their national and regional level functions also ensure connection and accessibility to new expansion areas. A combination of these radials with a set of ring roads has been envisaged so as to minimize travel distance, time and energy consumption to discourage long-distance traffic from passing within the city centre.

Today, the total length of road in the city is 3,731 km, out of which 48 percent or 1,807 km is asphalt road; the remaining 52 percent or 1,924 km is non-asphalt (cobbel stone or gravel).Road gross density is 1.45 percent, which is including asphalt and non-asphalt roads adequate to support the smooth running and development of the socio economic and physical integration of the city.

As modernization and consequently the urbanization moves forward, the use of motorized transport to maintain the socio economic and physical integration of the city increases. Currently, taxis, city bus,station Wagon and private cars altogether cover 60 percent of the mobility, that is, 1.7% bus, 19% taxis,17% station Wagon and 25 % private cars, while 40% of mobility is covered on foot.. The rise in automobile ownership although not yet very significant together with the poor condition of the roads and the poorly functioning traffic system have resulted in high level of congestion particularly at peak hours.

Main Problems of Traffic Development in Addis Ababa

The rate of traffic crashs and pollution in Addis Ababa goes up together with the increase of motor vehicles and population size. The rise in automobile ownership together with the poor condition of the roads has resulted in the high level of traffic safety and congestion problems. Despite it has low level of motorization; the share of the city in the total number of crashs was 60 percent in 1989 and 55 percent on the average from 1986-2002. During this period, annual average traffic crash growth had been 31.4 percent. Besides, the increase in car traffic has resulted in an increase in air and noise pollution of the city. More than 12, 000,000 Ethiopian Birr is being lost every year because of traffic crashs. Thus the rise in automobile ownership together with the poor conditions of the road has resulted in high level of traffic safety and congestion problems.

In general the major transport problems in Addis Ababa include among others:

- Shortage and low quality of transport services and facilities
- Poor quality of roads, pedestrian walkways
- Low affordability level by most urban citizens
- High rate of congestion at peak hours and hence high rate of traffic crashes
- Lack of lane animal transport, bicycle and pedestrian

More over, the high unemployment rate, the rising household size and the low-income level negatively affect the demand for motorized transport. City bus transport is the second cheapest mode of transport next to walking. The fact that the revenue it generates doesn't cover its costs and that even the subsidized fares are unaffordable by the majority of the citizens are the major challenge [12].

The Need for Computerization

Currently, the Addis Ababa City Police commussion maintains a large volume of traffic crashs,drivers,Vehicles and other data on manual files .In order to improve data management there is a need to computerize the system however; there is financial limitations to do so.

Human Resources Development

In order to enhance urban transport sectoral efficiency the requirements of skilled manpower is indispensable one. Particularly we need to develop our staff in traffic police crashs investigation;Traffic management, in Information Science and transport management, and so on,however, there is shortage of financial resources.

Road Safety

Among the many causes, road crash is identified to be the major cause of death for economically productive potion of the population in Addis Ababa. Traffic crash rate in the city is high which covers 60 percent of the total crash occurred in Ethiopia. This is due to:

- ✓ In adequate drivers' training and public awareness on traffic safety
- ✓ Inadequate traffic facilities such as traffic lights, signs, signs crossing marks
- ✓ Ineffective and inefficient traffic regulations there are weak traffic management in the city.

As the issue of road safety is vital by its virtue it needs a special treatment in order to save the lives of citizens. To this effect ample financial resource is required where developing countries like Ethiopia are lacking [12].

Road infrastructure

Roads should be designed, constructed, and maintained to ensure the safety of their users. A lot of conflicts and deaths can be avoided by conducting safety audits on all roads. Safety reviews such as the ones conducted by the International Road Assessment Programme (iRAP) assess how safe the roads are specifically for vulnerable road users. Because rigorous audits or reviews might recommend costly infrastructural interventions, it is best that the reviews be undertaken by an agency independent from the contractor, as this avoids conflict of interest. Thirty one countries conduct road safety audits on new roads while only 17 conduct them on existing roads. Only ten countries have national policies to separate road users as a way of protecting vulnerable road users[11].

2.5 Road Traffic Injury Research

2.5.1 Severity of Crash Injuries

In China, in 1999, speed was the main reported cause of road traffic crashes[22]. Errors – such as loss of control of vehicle, speeding, misjudgment and improper overtaking – contributed to 44% of all police-reported crashes in Kenya[23]. Speed was identified as the main contributory factor in 50% of road crashes in Ghana between 1998 and 2000 [56] .Speed has also been identified as an important factor in crashes involving commercial road transport and public passenger vehicles [10, 24]. In South Africa, for instance, 50% of such crashes is related to speed [11]. While in many high-income countries, there is increasing use of in-built mechanism in trucks and buses to restrict speeds above a certain limit, such devices are frequently resisted in low-income and middle-income countries for commercial reasons, or else, if installed, are disabled by the operators. Commercial operations are often based on timetables that put pressure on drivers to speed.

2.5.2 Research on the Role of Alcohol in Crashes

Apart from in those countries where alcohol is prohibited, impairment by alcohol is likely to be an important factor in causing crashes and in exacerbating the consequences of crashes. Systematic surveillance, though, is not established in many countries[25,26]. In many low-income countries, the police often lack the means, in terms of human resources and equipment, to monitor routinely the level of alcohol in drivers, even where legal limits exist [14]. As Odero and Zwi [15] for low-income and middle-income countries and the European Transport Safety Council (ETSC) for Europe[27] have outlined, variable measurements; testing for different injury severities and different thresholds for BAC (where they exist), preclude a full comparison of excess alcohol levels between countries. Some studies refer to presence of any alcohol, others to alcohol over the legal limit, where such a limit exists. From an investigation of studies conducted in low-income countries, it emerged that alcohol was present in between 33% and 69% of fatally injured drivers, and in between 8% and 29% of drivers involved in crashes who were not fatally injured [15]. Peden et al.[28] [found that alcohol was a factor in around 29% of non-fatally-injured drivers, and in over 47% of fatally-injured drivers in South Africa. A later study found excess alcohol in over 52% of trauma patients involved in road crashes[29].

2.5.3 Inadequate Visibility

To see and be seen is a fundamental prerequisite for the safety of all road users. Detailed studies in Australia, Germany and Japan have shown that visual errors play a very important role in the cause of crashes[30]. In highly-motorized countries, inadequate visibility plays a key role in three types of crashes[31]:

1. a moving vehicle running into the rear or side of a slowly moving or stationary vehicle located ahead on the roadway, at night-time;
2. angled collisions or head-on collisions in daytime;
3. Rear-end collisions in fog, in daytime and at night.

In low-income and middle-income countries, the phenomenon of pedestrians and vehicles not being properly visible is frequently a serious problem. In these places, there are fewer roads with adequate illumination and some may not be lit at all. In addition, it is more common for large numbers of bicycles and other vehicles to have no lights and for road space to be shared by fast-moving and slow-moving road users.

2.5.4 Road-Related Factors

Road crashes tend not to be evenly distributed throughout the network. They occur in clusters at single sites, along particular sections of road, or scattered across whole residential neighborhoods, especially in areas of social deprivation[32]. While road engineering can greatly help in reducing the frequency and severity of road traffic crashes, poor engineering can contribute to crashes. The road network has an effect on crash risk because it determines how road users perceive their environment and provides instructions for road users, through signs and traffic controls, on what they should be doing. Many traffic management and road safety engineering measures work through their influence on human behavior [38].

Negative road engineering factors include those where a road defect directly triggers a crash, where some element of the road environment misleads a road user and thereby creates error, or where some feasible physical alteration to the road that would have made the crash less likely has not been made [40].

In the planning, design and maintenance of the road network, four particular elements affecting road safety have been identified [40]. These elements are:

1. safety-awareness in the planning of new road networks;
2. the incorporation of safety features in the design of new roads;
3. safety improvements to existing roads;
4. Remedial action at high-risk crash sites.

The absence of any of these elements, discussed below, are risk factors for crashes.

I. Inattention to safety in planning new road networks

Crash risks in road networks are frequently increased by the existence of unnecessary motorized travel, by policies encouraging travel by less safe modes, and by the creation of unsafe mixes of travel [33].Specific situations related to road planning that are risk factors for crashes include [*22, 40*]:

a) through-traffic passing through residential areas;
b) Conflicts between pedestrians and vehicles near schools located on busy roads;
c) lack of segregation of pedestrians and high-speed traffic;
d) lack of median barriers to prevent dangerous overtaking on single-carriageway roads;
e) lack of barriers to prevent pedestrian access onto high-speed dual-carriageway roads.

The growth in urbanization and in the number of motorized vehicles in many low-income and middle-income countries has not been accompanied by adequate attention to road design.

II. Inattention to safety in designing roads

Where road layouts are self-explanatory to their users – through the use of markings, signs and physically self-enforcing measures to reduce speed – engineering can have a beneficial influence on behavior. Engineering design, though, can often have negative influences on behavior – when there is incompatibility between the function of the roads, their layout and their use, this creates risk for road users.

Uncertainty among road users about the layout of roads – through the absence of clear and unambiguous markings and signs – is a particular risk factor for crashes. Similarly, the lack of

self-enforcing measures to reduce speed will increase the risk. Straight, unmarked single-carriageway roads encourage drivers to speed. Other risk factors are the poor design and control of junctions and insufficient lighting.

III. Safety defects in existing roads

Defects contributing to crash risk can appear in road designs, especially if they have not been subject to a safety audit by experienced safety personnel. Such defects are frequently caused by the poor design of junctions or by design that allows for large differences in the speed and the mass of vehicles and in the direction of travel. Bad road surface conditions are a particular risk factor for users of motorized two-wheelers. Often, where there is no safety impact study to assess the effects of a new road scheme on the existing network, a new road scheme can have an adverse impact on large areas.

IV. Lack of remedial action at high-risk crash sites

Large numbers of high-risk crash sites exist everywhere located either at isolated spots or grouped along particular stretches of road. Many of them are well-known and documented. Some 145 dangerous locations, for example, have been identified on Kenya's main rural road network[34]. If such sites are not dealt with, promptly and systematically, there will be a great risk of further crashes. A survey of 12 European Union countries found that many of them lacked comprehensive remedial programmers for high-risk sites [*41*]. The survey showed that:

a) only seven countries reported having a formal policy;
b) only six had national guidelines or manuals;
c) only five reported taking specific steps to stimulate remedial schemes;
d) only three reported having a separate national budget;
e) only three reported that evaluations were standard practice in applying remedial schemes.

2.5.5 Vehicle-Related Risk Factors

While vehicle design can have considerable influence on crash injuries, its contribution to crashes, through vehicle defects, is generally around 3% in high-income countries[35], about 5% in Kenya [4] and 3% in South Africa[36].Though periodic vehicle inspections have not been found useful in reducing injury crashes, inspections and checks for overloading and safety

related maintenance for larger commercial vehicles and buses could be important for vehicles more than 12 years old [37].While there is in general no evidence that periodic motor vehicle inspections reduce crash rates, the exception is in the field of commercial vehicles, where defective brakes on large trucks have been shown to be a risk factor [38].

2.6 Risk Factors

Reports for various countries (Kenya, Uganda, Ethiopia, Tanzania, Ghana, South Africa, and Zimbabwe) show that most of the road crashes are largely due to a range of human error, road and vehicle factors that include:

1) Over speeding, perilous overtaking;
2) Alcohol and drug abuse;
3) Driver negligence, poor driving standards;
4) Vehicle overload;
5) Poor maintenance of vehicles;
6) Bad roads and hilly terrain;
7) Negligence of pedestrians;
8) Distraction of drivers (e.g. speaking on cell phones, talking with passengers).

These findings need to be taken with caution as the single causes usually reported by the police oversimplify the reality. Also, traffic police are often more inclined to cite the driver as being at fault than a pedestrian or cyclist because of the rules and guiding principles existing at this moment in time in Ethiopia.

These include:

- Rapid growth in motorization and human population;
- Increased spatial interaction of road traffic, in terms of the volume and direction of movement;
- Deficiencies and problems in road user behavior;
- Conditions and environment of work in the public transport sector, with special reference to buses and minibuses;
- Social and economic conditions prevailing in Ethiopia;

- Serious deficiencies in the road network development and maintenance; and deficiencies in road safety planning, management, enforcement and interventions.

Firm political commitment and resources are needed at the national and international levels to effectively address these social, economic and developmental issues[39].

In road traffic, risk is a function of four elements. The first is the exposure – the 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[40].

Risk arises largely as a result of various factors,that include [10]:

1. human error within the traffic system;
2. the size and nature of the kinetic energy of the impact to which people in the system are exposed as a result of errors;
3. the tolerance of the individual to this impact;
4. The quality and availability of emergency services and acute trauma care.

The human operator often adapts to changing conditions in ways that do not always serve safety. A single error can have life or death consequences. Behind road-user errors, there are natural limitations. These include vision in night traffic c, the detection of targets in the periphery of the eye, the estimation of speed and distance, the processing of information by the brain, and other physiological factors associated with age and sex that have a bearing on crash risk. Also influencing human error are external factors such as the design of the road, the design of the vehicle, traffic rules and the enforcement of traffic rules [*2*]. Sophisticated and quality-assured systems that combine human beings and machines, therefore, need to have an in-built tolerance of human error [41]. The tolerance of the human body to the physical forces released in crashes is limited. Injury is broadly related to the kinetic energy applied to the human frame. The energy involved in a collision varies as the square of the velocity, so that small increases in speed result in major increases in the risk of injury. The relationship between impact forces in crashes and the injuries that are sustained is known for a number of parts of the body and type of injury – for different categories of road user, as well as for different age groups. Biomechanical thresholds

associated with age, sex and speed is reliable predictors of crash injury. For example, impact forces that produce a moderate injury in a robust 25-year-old male will result in a life-threatening injury if applied to a 65-year-old infirm female [*4*].

2.7 Road Safety Initiatives

Like in other developing nations, many African countries have established road safety agencies in form of National Road Safety Council or Road Safety Committee since the early 1980s, mostly within Ministries of Transport and Roads, with the aim of preventing road "crashs". They are intersectorial in composition, with membership derived from both governmental and non-governmental sectors, and operate mainly at the national level. Their roles and capacity to effectively function, however, vary from country to country. Activities includes:

A. Ensuring law enforcement,
B. Collecting road crash statistics,
C. Revising traffic legislation,
D. Promotion of road safety education,
E. Ensuring adequate provision of medical facilities for traffic injury victims,
F. Undertaking research in road safety, and co-ordination of all road safety activities.

In general, in Ethiopia – Addis Ababa, these organizations have largely been ineffective, as they do not have the capacity to function effectively due to inadequate funding, lack of sufficient human and material resources, as well as lack of authority to fully discharge their duties. A more effective central agency for road safety, with adequate resources and trained personnel, is needed in each Region.

There are some emerging initiatives to improve awareness and documentation of road crashes in Africa. The Injury Prevention Initiative For Africa (IPIFA), formed in 1997 by a small team of researchers, is exemplary. IPIFA is a non-profit organization with membership from 12 African countries (Uganda, Kenya, Ghana, Nigeria, Egypt,Ethiopia, Eritrea, Zambia, Zimbabwe, Mozambique, South Africa and Mauritius).

The aims of IPIFA are to conduct research in injury control and promote safety, develop and conduct training programs in injury epidemiology, prevention and acute care;undertake

advocacy for the prevention and control of injury; facilitate the exchange of knowledge in Africa, and act as a liaison between Africa and international and continental stakeholders in injury control. IPIFA has taken on the challenge of injury control on a continent where the problem is largely unrecognized and where the magnitude of the problem has been demonstrated to be huge.

IPIFA works closely with the WHO and Global Forum for Health Research, and has received considerable financial support from these organizations. Other institutions and organizations, which have provided funding for injury research to IPIFA, include the Graduate Institute of Geneva on Small Arms Survey and the Road Traffic Injury Research Network (RTIRN). In addition, individual members of IPIFA have been able to win competitive research awards from various agencies such as the National Institutes of Health, Center of Disease control (CDC), Rockefeller Foundation, and the Volvo Research Foundations.

The key research areas identified through these initiatives encompass the following topics: Pedestrian and cyclist mobility, Policy issues and Emergency medical systems.The Future - According to a World Health Organization/World Bank report "The Global Burden of Disease", deaths from non-communicable diseases are expected to climb from 28.1 million a year in 1990 to 49.7 million by 2020 - an increase in absolute numbers of 77%.

Traffic crashs are the main cause of this rise. Road traffic injuries are expected to take third place in the rank order of disease burden by the year 2020. "The Magnitude of the Problem" - On average in the industrialized countries, and also in many developing countries, one hospital bed in ten is occupied by an crash victim.

Traffic crashs are a major cause of severe injuries in most countries. Developing countries have nearly four times the number of deaths from these causes as the developed world.
According to the WHO, Ethiopia has the highest rate of fatalities per vehicle in the world. Uganda ranks second in road fatality rates in the world behind Ethiopia.Emergency medical systems are often poor and injury prevention programmes are rarely available [14].

Road traffic crashs currently kill 1,800 Ethiopians a year and injure another 7,000.Alarmed by the increasing carnage, Shell Ethiopia, the largest fuel distributor in Ethiopia with a 43 % market share, launched an awareness campaign: “Drive to Live”.The campaign is intended to promote the value of safety rules and the benefit of implementing “defensive driving” for drivers employed by the transport companies.

In Ethiopia, the capital Addis, there were different workshops and presentations had been coordinated and conducted to respective authorities, aimed global initiative in benchmarking road-traffic enforcement through international sharing of good practices and successful implemented enforcement strategies.

The Conference laid special emphasis [13].

- In re-defining the enforcement with current relevance;
- In suggesting the role and coordination of responsible agencies in enforcement;
- Definition and allocation of traffic related fines;
- Crash Investigation and Analysis as a core issue to understanding the complex issues relating to enforcement;
- Legislation for important enforcement issues like: dangerous driving, driving under the influence of alcohol and drugs, over-speeding, school transportation, parking, protection for two wheeler riders etc;
- Tools and systems for effective enforcement;
- Infrastructure for enforcement;
- Expertise and Skills for enforcers;
- Driver Training;
- Vehicle Certification and enforcement;
- Public dealing;
- Crisis Management and handling of collisions;
- Global coordination and dissemination of best practices.

2.8 The Burden and Trends of Road Traffic Injuries in Developing Countries

Why still the road traffic crash increases? Why so many crashs?

The social and economic costs of road traffic injuries are enormous. The annual loss to developing country economies, due to road traffic injuries, is estimated at US$ 100 million. This figure is about twice the total official development aid and loans these countries receive [13]. These cost estimates do not include social and psychological costs associated with death and disability from road traffic injuries, regardless of where they may occur.The fatalities and injuries due to road traffic crashes in developing countries are rising,fueled by rapid growth in motor vehicle numbers. In Ethiopia, for instance, four-wheel motor vehicles increased by 3 per cent per year [13].

2.9 Components of the Traffic System and Their Characteristics

To understand the function and operational aspects of traffic on streets and highways it is important to understand how the various elements of a traffic system interact. Further ,the chracterstics of traffic streams are heavly infuenced by the the characterstics and limitations of each of these elements. There are five critical components that interact in a traffic system:[7]

- Road users- drivers, pedestrians, bicyclists, and passengers
- Vehicles-private and commercial
- Street and highway
- Traffic control device
- Environment

Road users

Human beings are complex and have a wide range of characterstics that can and do influence the driving task. In a system where the driver is in complete control of vehicle operation ,good traffic engineering requires a keen understanding of driver characterstics. Much of the task of traffic engineering is to find ways to provide drivers with information in a clear , effective manner that induces safe and proper responses[7].

The two driver chararctrerstics of utmost importance are visual acuity factores factors and the reaction process.The two overlap, in that reaction requires the use of vision for most driving cues. Undrestanding how infomation is receving and processed is a key element in the design of roadway and controls.

Important characterstics of road users:

- Hearing is an important element in the driving task (i.e., horns emergency vehicle sirens, brakes squealing, etc.). While noting this is important, however, no traffic element can be designed around audio cues, as hearing-impaired and even deaf drivers are licensed. Most important human factors that influence driving are the personality and psychology of the driver. This, however, is not easily quantified and is difficult to consider in design.

It is dealt with primarily through enforcement and licening procedures that attempt to remove or restrict drivers who periodically display inapproperiate tendencies, as indicated by crash and violation experience[7].

Pedestrian characteristics

One of the most critical safety problems in any highway and street system involves the interactions of vehicles and pedestrians. A substantial number of traffic crashs and fatalities invove pedestrians.Virtually all of the interactions between pedestrianns and vehicles occurs as pedestrians cross the street at interactons and mid-block locations.

At signalized intersections, safe accomidation of pedestrian crossing is as critical as vehicle requirements in establishing an approperiate timing pattern. Pedestrians walking speed in crosswalks in the most important factor in the consideration of pedestrians in signal timing.At unsignalized crossing locations,gap-acceptance behavior of pedestrians is another important consideration [7].

2.10 Approaches to Highway Safety

There are three factors that result in crash:

1. Road and environment deficiencies
2. Road user errors (human factors)
3. Vehicle defects

Road and environment deficiencies account on their own only for only 3% of all crashs but in combination with road user error account slightly less than 20%. Human factors on, their own, account for 75% - 80% of crashs. Typical road and environment deficiencies are those, which provide misleading visual information, or insufficient or unclear information to the road users. Only occasionally crashs are caused solely by bad design. Human factors include excessive speed for the conditions, failing to give way, improper turning, improperly overtaking or following too close and general misjudgements by both driver and pedestrian.

There is an intimate relationship between defect of roads and road traffic crashes. The design, lighting, and surfacing of roads can affect injury rate and well-designed roads allow greater margins of safety. Many crashes needlessly occur because the facilities provided do not adequately allow for the range of individual requirements of separate groups of road users particularly the pedestrians [9].

The condition of road surface also contributes to the occurrence of traffic crashes. Road moisture condition is another contributory factor for the incidence of traffic crash. Road surfaces such as dry; wet and muddy have their own contributions to the traffic flow.

The relationships of road width, curvature and straight distance all have particularly marked effects on the occurrence of crashes [9]. It is on straight and plain roads that traffic crashes occur mostly rather than on others. It is due to the low gradient of these roads that drivers want to drive fast on this section of the road.

Environmental/road user factors account for 48.8% followed by environmental/ vehicle road user factors (16.4%), road user factors (12.4%), vehicle/ road user factors (7.2%), environmental factors (5.6%) and environmental/vehicle factors (4.8%). And in a wider ranging on-the-spot study by TRL, human factors are the sole reason in 65% of the cases and a contributory cause in 95%. About 25% of the crashes studied displayed a deficiency in the road, environment linked to a driver error [9].

Road environments have impacts on occurrences of road traffic crashes. In developed countries, there are continuous efforts to meet the safety standards of roads through safety audit during the planning, designing, and operation stage.[42] indicates that, in Africa road network is expanding fast, maintenance standards have started improving lately, and there is potential for

improving the safety standards of the roads. However, [21] reports that, in Ethiopia, the police have limited road and traffic engineering skill in general and thus they underestimate the contribution of roads and environments to traffic crashes and especially they lack trainings on subject area.

2.10.1 Road Alignment

An important factor, which affects the occurrence of road traffic crashs in terms of frequency and severity, is road alignment. Inconsistent horizontal alignments of roads, sharp curves and grades are known for their substantial and adverse safety impacts [13].

1) Horizontal Alignments

A recent study [14] depicts that crashes on horizontal curves are causes for concern in all countries. A study in Denmark has found that about 20 per cent of all personal injury crashes and 13 per cent of all fatal crashes occur on curves in rural areas; and in France, over 20 per cent of fatal crashes occur on dangerous curves in rural areas. Crashes on bends are major problems in many developing countries, although the proportion of such crashes is dependent on both topography and demography of each country.

2) Vertical Curve

There are three main effects of vertical road alignments, which are closely associated with the occurrences of traffic crashes. These are excessive speeds and out-of-control vehicles on down grades, differential speed between vehicles created on both down and upgrades, and low range of visibility that often occurs in the immediate vicinity of steep grades at the crest of vertical curves. [39] Indicates that it may be difficult for driver to appreciate the sight distance available on crust curve and he may overtake when it is insufficient for him to do so safely. This can be extremely expensive to provide safe overtaking sight distances on crust curves. However, a complete ban on overtaking would be difficult to enforce because of the presence of very slow moving vehicles, the lack of driver discipline in selecting places, poor maintenance of road marking and signs. Successive short vertical curves on straight section of road may produce misleading forward visibility.

2.10.2 Sight Distance

This is the ability to see ahead in order to stop safely or overtake vehicle or view approach intersection. Sight obstructions on the road, generally occur due to the presence of deep cuts, embankments, vegetation, walls and the like on the inside of the horizontal curves and intersection quadrants, and sharp crest vertical curves themselves. Types of sight distances are: stopping sight distance, passing sight distance, intersection sight distance, and decision sight distance. [21] Reviews various studies that value and consider uses of the above sight distances. However, there are variations among different design standards. These sight distances vary with design or operational speeds of road section, perception/reaction time, eye, height, object height and pavement friction.

[21] Reviews studies in Sweden that a decrease of crash rates with increasing sight distance was observed, especially single-vehicle crashes at night. In British study, it was reported that on rural roads sight distances shorter that 200m were relatively more likely to be found at crashes sites through their association with horizontal curves.

2.10.3 Vehicle Factors

It is not only the improvement in the standards and design of vehicles that matters, but also adequate maintenance of the vehicle during its working life [14]. Older vehicles with mechanical defects and poor maintenance cause higher fatal injuries and property damage. For instance, studies in Britain show that about 20-30 percent of personal injury crashes involve a vehicle having some deficiency [14]. In most cases, defects associated with the break, tire, light and other mechanical defects are associated with crash. Size difference between colliding vehicles also affects the severity of injury, particularly in cases when heavy vehicles impact light vehicles.

2.10.4 Driver Factors

Most of the time the major contributing factor in the majority of traffic accidents is the behavior of the driver. As it has been discussed worldwide studies such as those of the OECD, show that about 80-90% of the road traffic accidents are attributed to the fault of the driver.

The negligence of drivers is the main feature of traffic accident in Addis Ababa. As calculated using the traffic accident data from the traffic police, (1993/94-1999/00) driver faults account for 98% of the causes. Refusing priority to pedestrians (94%) and to other vehicles (16%), driving too close (18%) and inaccurate by pass (14%) respectively which account for about 73% of all cases are the prominent problems. Among these faults of the driver, refusing priority to pedestrians and driving too fast cause 80, 84 and 89% of the fatal, serious and slight injuries respectively. Drivers in the age group between18-30 are responsible for 39, 36, 27 and 32 percent of the fatal, serious, and slight and damage to property respectively during the specified period. Whereas those in the age group 31-50 had contributed 38,38, 27 and 42 percent of the fatal, serious, slight and damage to property respectively. But the contributors of about 21% of the total traffic accidents are the hit and run cases.

Male drivers were responsible for 84, 79, 60 and 78 percent of the fatal, serious, slight and total traffic accidents respectively. Drivers having driving experience between 2-5, 5-10 and above 10 years are responsible for 22, 20 and 28 percent of the casualties respectively. This condition negates the inverse relationship between driving experience and traffic accident. More than 70% of the traffic accidents in the city are attributed to those drivers having more than 5 years of driving experience. The other possible contributory factor for traffic accidents is the relation of the driver and the vehicle he/she drives. About 62% of damage to property, 58% of fatal, 51% of serious and 40% of slight injury accidents and about 57% of the total casualties are caused by employed drivers. [15]

3 METHODOLOGY

3.1 General

This chapter will cover different aspects of methodology used during the research. It will present the different options available to carry out the study and gives reasons why a particular method was selected at different stages of the project. As a lot of data collection is involved in the project, the way the collection was made can affect the outcome of the project. For this reason, the data collection method selected on the course of the project will also be discussed here.

3.2 The Study Area

Addis Ababa has 10 sub cities, located about 2,440m above sea level at 9.02°00'16.68" N 38°44'49.39" E, and became Ethiopia's capital when Menelik II was Emperor of Ethiopia. The town grew by leaps and bounds[43].

Figure 3-1: Addis Ababa city Administration

Addis Ababa has the status of both a city and a state. It is where the African Union and its predecessor the OAU are based. It also hosts the headquarters of the United Nations Economic Commission for Africa (UNECA) and numerous other continental and international organizations. Addis Ababa is therefore often referred to as "the political capital of Africa", due to its historical, diplomatic and political significance for the continent[44]**.** The city is populated by people from different regions of Ethiopia – the country has as many as 80 nationalities speaking 80 languages and belonging to a wide variety of religious communities. It is home to Addis Ababa University. The Federation of African Societies of Chemistry (FASC) and Horn of Africa Press Institute (HAPI) are also headquartered in Addis Ababa [47].

Public transportation is through public buses or blue and white share taxis, locally known as "blue donkeys". The taxis are usually minibuses that can sit at least twelve people. Two people are responsible for each taxi, the driver and his assistant who collects fares and calls out the taxi's destination [47].

Out of all the crashs registered in Ethiopia, Addis Ababa holds about 60% on average. This is partly because the city has great contact through its all gates with different regions every day. In addition to this, of the registered motor vehicles in Ethiopia, the city takes about 77% of it. All these facts reveal that Addis Ababa, having a great deal of concentration of vehicles and traffic, takes the lion's share in car crashs also. Statistical data from the office depicts that Addis Ababa is experiencing around 700 crashs per month and the costs of such fatalities and injuries due to traffic crashs have a great impact on various aspects of the society[45]**.**

3.3 Research Approach

Research is an active, diligent and systematic process of inquiry in order to discover, interpret or revise facts, events, behaviors, or theories, or to make practical applications with the help of such facts, laws or theories. The scope of the research process is to produce some new knowledge.

This, in principle, can take three main forms:

1. **Explanatory research:** testing hypotheses and theories that explain how and why a phenomenon operates as it does.

2. **Constructive research:** a new solution to a problem can be developed.
3. **Empirical research:** empirical evidence on the feasibility of an existing solution to a problem can be provided.

In this particular study, the purpose is to solve a problem in road traffic crash based on traffic police data. The data collected from the Addis Ababa Police Commission Traffic Control and Investigation Office will be used to justify the proposed solution. Therefore, this study can be categorized partly as an empirical research, since it is tried to show that traffic crash in Addis Ababa.

The first attempt made during the research was to have the overall picture of the research area. It is our daily news that traffic crash is increasing in Addis Ababa. The researcher job demands his to be on the road for more than half of the office hours. This helps him to recognize the actual traffic crashs and associated causes.

There is also a separate section in the researcher's organization, which updates and teaches the employees on defensive driving and road safety. Since safe driving on the road is not the responsibility of a single individual action and the researcher being part of it, the research attention comes in to picture.

3.4 Research Method

The method used when collecting, processing and analyzing the gathered information can be quantitative research method.

The nature of the study requires quantitative information to reach a good understanding of road traffic crash causes and trends and to make good measurements. Quantitative methods (collect numerical data or data in the form of numbers) have also been used to support conclusions made in the thesis.

3.5 Data Source

Crashs are recorded by the traffic police on daily basis. This study is based on a secondary data obtained from Addis Ababa Traffic Police Commission (AATPC).The observations are generally about crashs that occur within 2008/09 to 2011/12.

3.6 Data Collection Techniques

Depending on the research perspective and strategy chosen, the researcher must choose methods for collecting data. The data or information collected by the researcher can be either primary, i.e. the researcher collects the material himself, or secondary, i.e. already documented material are being used as a data source, which can be done in quantitative way. In this thesis, only secondary data is used.

Traffic crash data from Addis Ababa Traffic Police Commission, Addis Ababa Transport Authority and Addis Ababa City Road Authority is collected.

3.7 Data Collection

Road traffic crash data

Crashs are recorded by the traffic police on yearily basis. This study is based on a secondary data obtained from AATCID, Addis Ababa Traffic Police Commission Investigation Division.

The following variables are considered in this study.

i. Independent Categorical Variables

Demographic Variables**:** The demographic variables related to driver involved in the crash are:

- **Age:** it is categorized as:
  - below 18
  - 18-30,
  - 31-50 and
  - 51 and above
- **Educational Background:** The maximum education level attained by the driver is recorded under one of the following categories:

1. Basic Education
2. Elementary School
3. Junior School
4. Secondary School
5. above Secondary School

- **Driving Experience:** This is the number of years since the driver received a driving license.

This information is sometimes recorded by asking the driver since the year the driver received the first license could not be found on the current license if the driver is having higher level driving license. The information obtained from the driver is recorded under one of the following six categories:

1. Less than or equal to 1 year
2. Greater than 1 year and less than or equal to 2 years
3. Greater than 2 years and less than or equal to 5 years
4. Greater than 5 years and less than or equal to 10 years
5. More than 10 years

ii. Other Variables

Vehicle related variables: Vehicle is defined as carriage, bicycle, motor vehicle, semi-trailer and trailer operated on a road (CAACG, 1998). The variables related to the vehicle responsible for the traffic crash are described below.

Vehicle Type: it has the following categories:

I. Bus
II. Taxi
III. Automobile
IV. Trucks
V. Station Wagon
VI. Liquid Cargo

Location related variable: This variable indicates the area where a traffic crashs happened. The categories are given by:

a. Organization
b. Residence
c. Market
d. Religious Place
e. Entertainment
f. School
g. Hospital

Crash at Road Junction:

a) Midblock
b) “Y” junction
c) “T” junction
d) Roundabout
e) Four leg junction
f) Five leg junction

3.8 Methods of Analysis

3.8.1 Statistical Analysis

In order to characterize the populations of crash, statistical analysis will be applied to determine the uniformity of the collected data. Statistics is the science and art of experimenting, collecting, analyzing, and making inferences from data [7]. Road crash were characterised using descriptive analysis to examine the relationships among factors and to identify possible causes and contributing factors. This helps to know which crashs are significantly higher compared to crashs of other locations. Crash rates,severity index will also be used to compare the total crashs.

Crash rates,severity index should also be calculated. Traffic Crash is as catagorized as follows: fatal , property damage, serious injury and slight injury.

Graphical techniques provide an excellent method to visualize the variability and other properties of a set of data. To the powerful interactive system of one’s brain and eyes, graphical

displays provide insight into the form and shape of the data and lead to a preliminary concept of the generating process.There are numerous types of graphs. Line and, histograms are given in this thesis.

3.8.2 Severity Index

A widely used statistics for the description of relative crash severity is the severity index (SI), defined as the number of fatalities per crash or the number of Injuries per crash.

$$SI=\frac{\text{Number of Fatalities}}{\text{Total of Crashs}} \quad \textbf{or} \quad \frac{\text{Number of Injuries}}{\text{Total of Crashs}}$$

The severity index is another statistic that should be compared with previous years and state and national norms, so that conclusions may be drawn with respect to the general severity of crash in the subject jurisdiction.

4 ANALYSIS AND DISCUSSION

4.1 Characteristics of Traffic Crash

4.1.1 Road Crashes in Sub-City Administrations

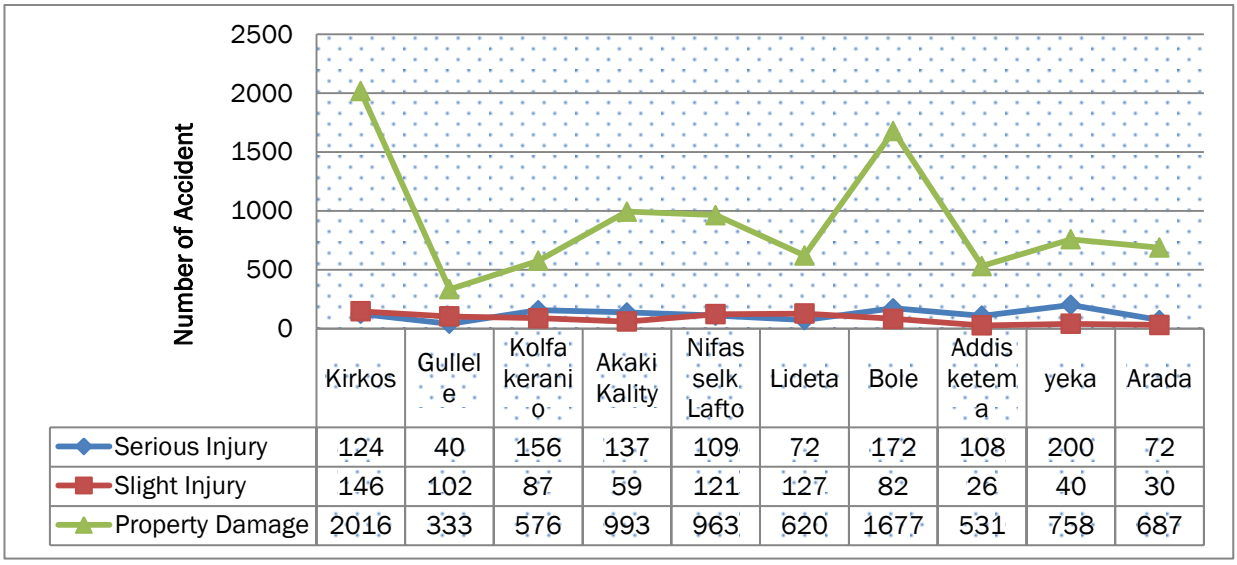
The municipal administration is sub-divided into 10 sub-cities (Amharic: Kifle Ketema) and 116 'woredas' the lowest administrative levels below the sub-city but larger than a village. The 10 sub cities population, traffic crash and location map are shown Table 4-1.

Table 4-1: Addis Ababa Sub-City Administration, Traffic Crash (2008/09-2011/12).

No.	*Sub-city*	*Area (km2)*	*Population*	*Density*	*Road Traffic Crashs**		*Map*
					Number	*Percentage*	
1	Addis Ketema	7.41	271,644	36,659.1	665	6	
2	Akaky Kality	118.08	195,273	1,653.7	1189	10.7	
3	Arada	9.91	225,999	23,000	789	7.1	
4	Bole	122.08	328,900	2,694.1	1931	17.3	
5	Gullele	30.18	284,865	9,438.9	475	4.3	
6	Kirkose	14.62	235,441	16,104	2286	20.5	
7	Kolfe Keranio	61.25	546,219	7,448.5	819	7.3	
8	Lideta	9.18	214,769	23,000	819	7.3	
9	Nifas Silk-Lafto	68.3	335,740	4,915.7	1193	10.7	
10	Yeka	85.99	350,202	4,255	998	8.9	

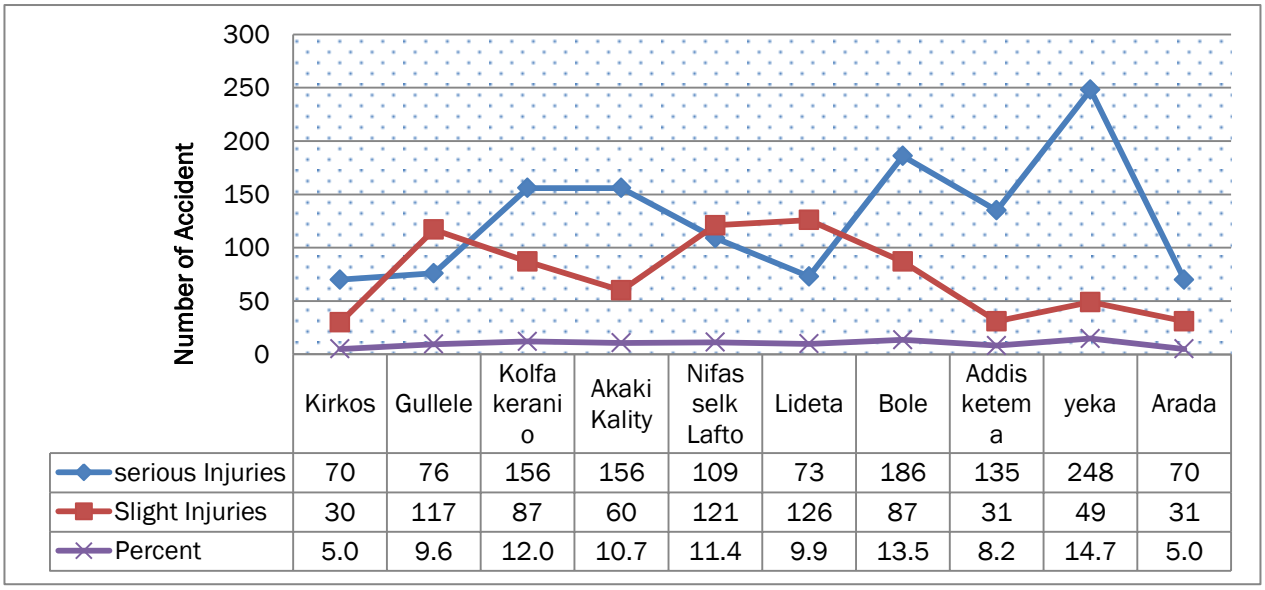
 : indicate Sub-City Administration * crashes that exclude death.

Addis Ababa has an estimated that presently there are no rural parts to the city, so 100% of the inhabitants are considered urban dwellers; 24% of all urban dwellers in Ethiopia are in Addis Ababa. With an estimated area of 527 square kilometers, the city has an estimated density of 5,165.1 people per square kilometer (43).



	Kirkos	Gullele	Kolfa keranio	Akaki Kality	Nifas selk Lafto	Lideta	Bole	Addis ketema	yeka	Arada
Serious Injury	124	40	156	137	109	72	172	108	200	72
Slight Injury	146	102	87	59	121	127	82	26	40	30
Property Damage	2016	333	576	993	963	620	1677	531	758	687

Figure 4-1(a): Road Traffic Crashes in Sub-City Administrations, 2011/12.



	Kirkos	Gullele	Kolfa keranio	Akaki Kality	Nifas selk Lafto	Lideta	Bole	Addis ketema	yeka	Arada
serious Injuries	70	76	156	156	109	73	186	135	248	70
Slight Injuries	30	117	87	60	121	126	87	31	49	31
Percent	5.0	9.6	12.0	10.7	11.4	9.9	13.5	8.2	14.7	5.0

Figure 4-2 (b): Victims of Road Traffic Crash in Sub-City Administrations, 2011/12.

Data Source: Addis Ababa Police Commission

Traffic crash in Table 4-1(a) depicts kirkose sub-city accounting nearly 20.5% of total crashs (excluding fatal crashs) and is quite high compared with that of the Bole sub-city administration, which is the highest area coverage and high traffic movement in Addis Abeba.

The victims of road traffic crash Fig 4-1(b) depicts Yeka sub-city accounte nearly 14.7% of all injuries crashs and in Bole Sub-city account 13.5% of injury is quite high compared with that of the Kirkose sub-city administration.

4.1.2 Causes As Identified By Police

According to the police reports, more than 90 per cent of the traffic crashs are caused by human errors. Of these crashs, drivers are indicated as responsible causes in about 89 per cent. Table 4-2 depicts the causes of traffic crashs as identified during police investigation. Accordingly, the major causes of traffic crashs in the year of the studies are failure to give -way for vehicle, ,failure to give-way for pedestrians, and following too closely. However, the major causes of fatal crashs is failure to give way for pedestrians. The causes of this crash is mainly driver errors. The causes are many of which include inadequate training,a driver failing to yield the right-of-way to a pedestrian at a crosswalk,a driver not making a complete stop, driving under the influence of alcohol, drug or Chaat, and others.

Table 4-2: Causes Of Road Traffic Crashes in Addis Ababa, 2008/09-2011/12

Cause of Traffic Crash	Traffic Crashes		Causes	% age
	Total crash	%		
Influence of alcohol or drug	1243	3.61	Human error	95.4
Failure to respect right hand rule	2965	8.6	Human error	
Failure to give -way for Vehicle	6991	20.28	Human error	
Failure to give -way for pedestrians	7135	20.7	Human error	
Following too closely	6899	20.01	Human error	
Improper overtaking	1199	3.48	Human error	
Improper turning	2106	6.11	Human error	
Over speeding	932	2.7	Human error	
Failure to respect traffic Signs	753	2.18	Human error	

Cause of Traffic Crash	Traffic Crashes		Causes	% age
	Total crash	%		
Driving with fatigue	57	0.17	Human error	
Driving without attention	518	1.5	Human error	
Improper parking/Moving from parking	1877	5.44	Human error	
Excess loading	175	0.51	Human error	
Failure in Vehicle	86	0.25	vehicle factor	0.3
Defective road & Environment	36	0.1	road & environment factor	0.1
Pedestrian error	80	0.23	Human error	
others	564	1.64		4.3
unidentified	859	2.49		
Total	34475			

Data Source: Addis Ababa Police Commission

Table 4-2 depicts the cause of traffic crash in the year 2008/09-2011/12, in general the most critical type of traffic crash is failure to give–way for pedestrians.The main factor of traffic crashs speed and speeding has a great impact on pedestrian safety. Clearly, the faster drivers choose to travel, the more likely they are to be involved in a crash, and are more likely to severely injure vulnerable road users. Higher driving speeds reduce predictability and reduce a driver's ability to control the vehicle, negotiate and manoeuvre around obstacles on the roadway. Higher speed also increases the distance a vehicle travels while the driver reacts to a potential collision, reducing the time available to avoid a collision.

Generally report shows that most of the road crashs are largely due to a range of human error, road and vehicle factors that include:

i. Negligence of pedestrians;
ii. Over speeding, perilous overtaking;
iii. Alcohol and drug abuse;
iv. Driver negligence, poor driving standards;
v. Vehicle overload;
vi. Poor maintenance of vehicles;
vii. Bad roads;

viii. Distraction of drivers (e.g. speaking on cell phones, talking with passengers).

These findings need to be taken with caution as the single causes usually reported by the police oversimplify the reality. Also, traffic police are often more inclined to cite the driver as being at fault than a pedestrian or cyclist because of the rules and guiding principles existing at this moment in time in Addis, special investigation teams are needed to assess the contribution of the various risk factors at the time of a crash.

4.1.3 Road Crash Deaths By Road User Types

Traffic crash deaths by road users type Table 4.3 depicts in Addis Ababa from 2008/09 to 2011/12. On average, about 89 % of the road traffic crash fatalities are pedestrians,8.2 % are passengers, and only 2.8 % are drivers.The figure of pedestrian fatalities rises in built -up areas. This figures are indicators of the poor safty behaviour of road users and lack of pedestrians facilities and respect for them.

Table 4-3: Traffic Crash Deaths by Road Users Type

Year	*Total No. of death*	*Drivers*		*Pedestrians*		*Passengers*	
		Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
2008/09	379	15	4.0	337	88.9	27	7.1
2009/10	340	13	3.8	286	84.1	41	12.1
2010/11	368	9	2.4	337	91.6	22	6.0
2011/12	411	4	1.0	376	91.5	31	7.5
Average		10.3	2.8	334	89.0	30.3	8.2

In terms of collision types, pedestrian crash are the dominant types of collision, as motorized traffic and pedestrians share the same facilities. Total number of death by the road users, Table 4-3 shows that the percentage of total death of road users in a year 2011/12 is` increases by more than 5 % from the year 2008/09 of which pedestrain takes more. Failing to observe pedestrian priority and speeding are the likely root causes for the high level of crashs in the Addis.

Among the many causes, road crash is identified to be the major cause of death for economically productive potion of the population in Addis Ababa. Traffic crash rate in the city is high which covers 60 percent of the total crash occurred in Ehthiopia (45).This is due to in adequate drivers' training and public awareness on traffic safety;Inadequate traffic facilities such as traffic lights, signs, signs crossing marks; and Ineffective and inefficient traffic regulations there are weak traffic management in the city.As the issue of road safety is vital by its virtue it needs a special treatment in order to save the lives of citizens.

As suggested, the separation of non-motorized traffic from highways-through both hard-scape and soft-scape measures may represent a viable solutions for protecting pedestrians.

4.1.4 Severity of Crashes

Table 4-4.Severity Of Traffic Crashes in Addis Ababa/12

Ethiopian Fiscal Year	*Severity of Crashs*			*Severity of Injuries*		
	Fatal Crashes	*Total Crashes*	*% Fatal Crashes*	*Total Fatalities*	*Total Injuries*	*Fatalities as % of Injuries*
2008/09	318	6285	5.1	1278	5967	21.4
2009/10	371	7523	4.9	1307	7152	18.3
2010/11	332	9134	3.6	1735	8802	19.7
2011/12	369	11529	3.2	2010	11160	18
Total	1390	34471	16.8	6330	33081	77.4
Ave.	347.5	8617.8	4.2	1582.5	8270.3	19.4

Data Source: Addis Ababa Police Commission Annual Report, 2008/09 - 2011/12

Table 4-4 depicts the total traffic crashs occurring yearly, on average more than 4% are fatal crashs and over 19 % of the total traffic crash injuries are fatalities. The high percentage of fatalities indicates the critical lack of pre-hospital and emergency medical services.Poor emergency medical services and the absence of compulsory liability insurance laws are among reasons contributing to the high fatality rates, although traffic police and hospitals are available, crash victims are usually evacuated by standers who [have] neither the necessary skills nor equipment in pre-hospital care. And many of the victims are underprivileged people and they

can neither afford out-of-pocket payments nor do they have health insurance to receive healthcare services, [thus many such casualties] are not reported.A poor road network and limited enforcement of existing traffic laws and the poor condition of vehicles are other factors.

4.2 Independent Categories Variable

A recent year data is used in order to compare the impact of each variable on the number of injuries per crash, the number of death per crash, the mean number of death per crash and the mean number of injuries per crash with respect to the levels of each variable was calculated. The results are summarized based on the three indicators which can show the impact of the different levels of each variable.

The three indicators are:

- Number of Crashes (by each level of a variable)
- Number of deaths (by each level of a variable)
- Number of Injuries (by each level of a variable)
- The mean number of injuries per crash (by each level of a variable)
- The mean number of death per crash (by each level of a variable)

4.2.1 Driver Related Variables

More than 90 per cent of the traffic crashs are caused by human errors. Of these crashs, drivers are indicated as responsible causes in about 89 per cent.

A) Driver's Age

The age range of drivers involved in crash is shown Table 4-5. Among these categories, drivers with in the age group 18-30 are responsible for the larger number of injuries (57.5%) and for the large number of crashes (48%). And also with regards to the number of injuries per crash, the highest mean (0.267) is also attained. However, drivers with age 18 and below have the smallest share in all the three measurements with regards to the total percent of crash.

Table 4-5: Death, Injuries, total crashes and Mean of Injuries/Death per Crash by Driver's age, 2008/09-2011/12

Variable	Levels	T. Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	T. Number of Crashes	% of Total Crashes	Mean of Injuries per Crash	Mean of Death per Crash
Driving Age	Below 18	3	0.2	123	2	475	1.7	0.259	0.006
	Between 18-30	516	42.1	3551	57.1	13277	48	0.267	0.039
	Between 31-50	528	43.1	2276	36.6	9192	33.2	0.248	0.057
	Above 51	178	14.5	265	4.3	4730	17.1	0.056	0.038
	Total	1225		6215		27674			
	Average.	306.2		1553.7		6918.5			

Among age groups, driver's aged fewer than 18 accounts for only 1.7% of total crash although they make up more than half the population, such that the 18-30 and 31-50 age groups account for more than three-fourth of total crashes. This is consistent with international reports that indicate that road traffic injuries are the second and third leading causes of death for age groups 15-29 and 30-44 (4).

We look at the number of driving licenses by age group of drivers; here are the figures of 2011/12 from the Addis Ababa Transport Authority.

Table 4-6: Licenses by Age Group

Age Group	**Number of Licenses**	**Percent**
18-30	98213	22.3676
31-50	230250	52.43847
51 and above	110623	25.19393
Total	439,086	

The results of the above table show that the number of drivers in the age group 18-30 is lower than those in the other group. However, the young drivers take the main responsibility for the number and magnitude (severity) of crashes.

Driver involvement in crashes disproportionately high for the 18-30 age groups, followed by the 31-50 age groups.

There was a strong and consistent relationship between increasing driver age and decreasing risk of moderate to fatal injury. In multivariate analyses, drivers older than 50 years had more than 50% lower risk than those aged from 18-30 (Mean of Injuries per Crash 0.056 and 0.267, respectively).

In general on the social interaction of victims and family, on the physical safety or the survival of individuals including permanent and temporal health problems. Countermeasures are being carried out young driver's, authorities starting from creating awareness through education campaigns and enforcement of the traffic regulation of the city, though the rate of road traffic crashes are still raising and occurring frequently. The study concludes that, road traffic crashes have multifaceted effects on human in Addis and little attention is given to the problem, despite the increase of road crashes from time to time.

B) Driver's Educational Background

Among the six categories of educational background depicts Table 4-7, those drivers with secondary School level of education are responsible for the largest share of injuries (39.3%) and the largest share of death (47.1%).The number of injuries per crash and the number of death per crash, drivers with Basic Education takes the liability for the largest mean 0.245 and 0.064, respectively. However, the other categories are almost similar to each other.

Table 4-7: Death, Injuries, total crashes and Mean of Injuries/Death per Crash by driver's education, 2011/12.

Variable	Levels	Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	Number or Crashes	% of Total Crashes	Mean of Injuries per Crash	Mean of Death per Crash
Driving Education	Illiterate	1	0.1	23	0.4	103	0.3	0.123	0.010
	Basic Education	17	1.4	65	1.1	265	0.8	0.245	0.064
	Primary School	207	16.9	761	13.4	6001	18.6	0.127	0.034
	Junior School	238	23.9	1449	23.9	8159	23.9	0.178	0.029
	Secondary School	577	47.1	2231	39.3	12121	37.6	0.184	0.048
	Above Secondary school	185	15.1	1152	20.3	5595	17.4	0.206	0.033
	Total	1225		5681		32244			
	Average	204.2		946.8		5374.0			

The total number of crashes depicts that, the severity of crashes is higher for Secondary School level drivers. However, it is difficult to reach conclusions about the significance of the findings without knowing the education levels of drivers in the general population, it can be said that crashes are necessarily occurred due to lack of knowledge or education.

C) Driving Experience

Table 4-9 depicts that drivers whose experiences were more than 10 years represented 31.70% and 17.58% of fatally and injury crashes, respectively. Similarly, finding indicated that drivers whose experiences were greater than 5 year or less than or equal to 10 years indicated 17.29% and 35.45% of fatally and injury crashes, respectively.

Table 4-8: Death, Injuries, total crashes and Mean of Injuries/Death per Crash Driving Experience, 2008/09-2011/12.

Variable	Levels	Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	Total Number or Crashes	% of Total crashes	Mean of Injuries per Crash	Mean of Death per Crash
Driving Experience	No driving license	74	6.2	232	4.1	650	2	0.357	0.114
	Less than or equal to 1 year	60	5	286	5	2695	8.2	0.106	0.022
	Greater than 1 year or less than or equal to 2 year	134	11.3	733	12.9	3358	10.2	0.218	0.04
	Greater than 2 year or less than or equal to 5 year	290	24.4	1444	25.4	7958	24.1	0.181	0.036
	Greater than 5 year or less than or equal to 10 year	264	22.2	1647	29	9647	29.2	0.171	0.027
	More than 10 years	368	30.9	1339	23.6	8676	26.3	0.154	0.042
	Total	1190		5681		32984			
	Average	198.3		946.8		5497.3			

Crashes were analyzed in terms of driver experience, and findings indicated that no driving licenses were involved in 6.2% of fatalities and 4.1% of injuries are recorded.

Mean of Injuries per crash by driver's experience on traffic crashes among motorcyclists in Addis, we demonstrated an inverse monotonic relationship between crash risk and driving experience. As compared to drivers with less than 1 year of driving experience (0.218), Mean of Injuries per crash for those with driving experience of 2-5, 5-10 and 10 year or more were 0.181, 0.171 and 0.154, respectively. We propose that intensive in-circuit training of learner motorcyclists should replace the conventional on-the-road training on the basis that the former serves to increase their driving experience without subjecting the learner motorcyclists to the risk of sustaining road crash.

4.2.2 Vehicle Related Variable

Type of Vehicle

This variable has six categories. Among the six categories, Automobiles and Trucks are responsible for the largest number of crash with values 30.4% and 26 % respectively. However, the mean of injuries per crash, all categories are almost similar to each other takes the liability for the largest mean. The mean of death per crash, taxi takes the liability for the largest mean (0.064).

Table 4-9: Death, Injuries, total crashes and Mean of Injuries/Death per Crash by Vehicle type, 2008/09-2011/12

Variable	Levels	Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	Total Number of Crashes	% of Total Crashes	Mean of Injuries per Crash	Mean of Death per Crash
Type of Vehicle	Bus	265	21.4	2348	32.8	5312	16.3	0.963	0.038
	Taxi	272	21.9	1105	15.4	4470	13.7	0.936	0.064
	Trucks	396	31.9	1302	18.2	8458	26.0	0.883	0.034
	Station Wagon	77	6.2	748	10.5	4309	13.2	0.996	0.004
	Automobile	222	17.9	1636	22.9	9891	30.4	0.976	0.024
	Liquid Cargo	8	0.6	15	0.2	147	0.5	0.943	0.057
	Total	1240		7154		32587			
	Average	206.7		1192.33		5431.17			

Truck, taxis and bus were also involved in 31.9%, 21.9% and 21.4% of fatalities,respectivily. However, automobile, trucks and taxi currently make up only 20.7%, 20.33% , and 19.10%, respectively of the vehicle population in the city. On the other hand, comparativily automobile vehicles had low fatality records; however, there were significantly high numbers of crash during the period. This may be due to the lower annual kilometres travelled by this group of vehicles, however there are no data to confirm this. Vehicle roadworthiness may be a problem, since 36% of imported vehicles and 65% of the vehicle population have been found to have an age of over 15 years (48). Given these figures, it is not surprising that vehicles aged over 5 years were involved in the majority of crashs in Addis Ababa.

In Addis are more likely to make use of commercial vehicles, minibuses and buses to support mobility needs. Commercial vehicles, minibuses, and buses have a high involvement in crashs, although again there is a need for exposure data to determine whether they are over-represented. It is also highly likely that these vehicles travel more kilometers per annum which contributes to both a high number of crashs and a high rate. Countermeasures might include higher training and licensing standards for professional drivers, adherence to vehicle capacity limits, and other improvements to infrastructure identified.

4.2.3 Location Related Variable

Place of Crash

Among the eight categories of places, organization and market takes the highest crashs place (38.4% and 22.1%) respectively. But when it comes to the number of injuries per crash, Table 4-10 depicts schools are the places with highest mean (0.265) followed by residence with mean 0.239. The lowest mean of injuries per crash is for organization with mean 0.130.

Table 4-10: Death, Injuries, total crashes and Mean of Injuries/Death per Crash by crash place, 2008/09-2011/12

Variable	Levels	Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	Total Number or Crashes	% of Total Crashes	Mean of Injuries per Crash	Mean of Death per Crash
Crash Place	School	68	5.0	426	7.4	1609	4.7	0.265	0.042
	Industrial area	14	1.0	158	2.8	908	2.7	0.174	0.015
	Religious place	92	6.8	387	6.8	2123	6.2	0.182	0.043
	Market	133	9.8	1190	20.8	7541	22.1	0.158	0.018
	Entertainment	118	8.7	662	11.6	3527	10.4	0.188	0.033
	Hospital	29	2.1	328	5.7	1649	4.8	0.199	0.018
	Organization	681	50.1	1700	29.7	13066	38.4	0.130	0.052
	Residence	224	16.5	868	15.2	3629	10.7	0.239	0.062
	Total	1359		5719		34052			
	Avg.	169.9		714.9		4256.5			

There are also links between different land use types and the occurrence of crashs. The analysis indicates that most fatal and injury crashs occurred in and around cities, particularly in central business districts, Residence and organizational areas. Table 4-10 depicts that 50.1% fatalities and 29.7% of serious injuries occurred in organaization areas. More than one fouth of total crashs occurred in central business districts. The high occurrence of crashs in these areas may be explained by the complexity of the road environment, mixed traffic and built-up property along these roads that attracts mixed road users with variation across time and location. Around residential area are also crashs prone areas, second to organanizational for fatalities. The speed limit in residents sections in Addis is 30kph; however, most drivers operate on these road environments at a higher speed as they approach to this areas, and then do not reduce their speed sufficiently (50). A probable contributor to this behaviour is the lack of provision of transitional speed zones. As a result of the lack of transition, geometric parameters and roadside features can change abruptly and motorists may encounter heavy workload (e.g. pedestrian and animal traffic) which creates safety risks.

Most crashs occurred on paved roads particularly in central business districts; Organizational and residential areas. In Addis, the transportation systems cater to mixed traffic including high

speed vehicles, pedestrians, animals, and animal drawn carts. The speed can vary from 5km/hr. to 80km/hr. and these speed differentials have been recognized as risk factors for road traffic crashs. Moreover, the complexity of land use, lack of comprehensive transportation planning, and many social activities along or on the roads may have contributed to the rise in road traffic crash. The road environment is not conducive to the safety of road users and could be addressed by implementing sound transport planning which in turn minimizes activities in and along roads. The separation of non-motorized traffic from roadways could assist in the reduction of road traffic crashs. Inconsistencies of speed zoning could be addressed through the implementation of a road safety audit process during the planning, construction and operation stages of roads.

4.2.4Junction Related Variable

Road Junction Type

Among the six categories of places, mid-block takes the highest crashes place which is 63% of total crashes. Road junction type categories list below mid-block road junction, the number of death and number of injuries are the highest (82.1% and 61.2%). But when it comes to the number of injuries per crash, four legs junction is the highest mean (0.5010) followed by "Y" junction and roundabout with mean (0.4784) and (0.4402) respectively. And also the number of death per crash, four legs junction is the highest mean (0.0476) and the lowest mean of death per crash is for roundabout with mean 0.0014.

Table 4-11: Death, Injuries, total crashes and Mean of Injuries/Death per Crash Road junction type, 2008/09-2011/12

Variable	Levels	Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	Total Number of Crashes	% of Total Crashes	Mean of Injuries per Crash	Mean of Death per Crash
Road junction type	Mid-block/no junction	1143	82.1	4234	61.2	21660	63.0	0.314	0.014
	"Y" junction	17	1.9	302	6.8	1572	4.6	0.478	0.005
	"T" junction	113	4.9	676	6.9	3800	11.1	0.201	0.005
	Roundabout	34	1.1	464	11.3	2917	8.3	0.440	0.001
	Four leg junction	57	3.8	564	11.4	4005	11.7	0.318	0.004
	Five leg junction	26	6.23	62	2.18	483	1.4	0.501	0.048
	Total	1390		6302		34437			

Mid-block road sections had a considerable share of fatal and non-fatal crashes in the 2008/09 - 2011/12 year, probably because much pedestrian crossing takes place in these sections. Overall, 82.1% of fatalities and 61.2% of non-fatal injury crashes occurred on midblock road sections, as shown in table 4-11. Marked and other crossing facilities are rare in midblock areas, which might result in increased fatal and non-fatal crashes. Where an unsignalized crossing exists at a transit stop, enhanced crossing treatments or actuated signals should be added.

In addition, tangent alignment of road sections, and midblock areas were the most common locations of crashes. There is a need for good exposure data (such as traffic volumes) to determine whether these factors are over-represented among crashes. However, factors like speeding may be mitigated by provision of low cost engineering measures.

In the case of midblock crossings, advance warning signs and markings for vehicles and pedestrians, and road safety education may be viable solutions.

There are no road markings or signs to inform motorists that they must give way or to warn of the crossroad junction ahead. Typically found in quiet residential areas. Although unmarked crossroads appear quiet and stress-free, the often offer motorists some of the most hazardous conditions. Due to the lack of warning signs for the impending crossroads, no road markings to provide drivers with a clue that they must give way.

4.3 The Main Risk Factors for Road Traffic Crash

Factors influencing exposure to risk

- Economic factors such as level of economic development and social deprivation;
- Demographic factors such as age and sex;
- land-use planning practices which influence length of trip and mode of travel;
- Mixture of high-speed motorized traffic with vulnerable road users;
- Insufficient attention to integration of road function with decisions about speed limits, road layout and design.

Risk factors influencing traffic crash involvement

- inappropriate and excessive speed, perilous overtaking;
- being a young male;

- being a vulnerable road user in commercial center and residential areas;
- travelling in darkness;
- Distraction of drivers (e.g. speaking on cell phones, talking with passengers);
- vehicle factors – such as braking, handling and maintenance;
- defects in road design, layout and maintenance, which can also lead to unsafe behavior by road users;
- inadequate visibility because of environmental factors (making it hard to detect vehicles and other road users);
- Poor eyesight of road users.

Risk factors influencing traffic crash severity

- human tolerance factors;
- inappropriate or excessive speed;
- seat-belts and child restraints not used;
- crash-helmets not worn by users of two-wheeled vehicles;
- roadside objects not crash-protective;
- Presence of alcohol and other drugs.

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The results in this study show that the number of injuries per crash is mainly determined by the variables related to drivers. Drivers' Age, Educational background and Place of crash significantly affect the number of injuries per crash.

- On average about 89 % of the road traffic crash fatalities are pedestrians, 8 % are passengers, and only 3 % are drivers.
- Drivers who are in the age group of 18-30 are liable for most of crashes including the sever ones.
- Drivers with secondary school level of education take the major responsibility for the increased number of injuries per crash.
- With regards to places of crashes, market (in central business districts), organizational and residential areas are where the highest mean of injuries per crash is attained in the order given.
- The highest mean number of injuries per crash (0.35) is obtained in residential areas and industrial area by drivers in the age group of 18-30 who have above secondary school level of education.

5.2 Recommendations

The recommendations listed below pertain to the perceived priority areas where needs are greatest and opportunities are being missed.

❖ Crash Data

Crashs location details should be standardised and monitored. Road authorities should provide traffic police with road maps, including strip maps from rehabilitation projects, to help document locations. The coding of locations and subsequent identification of hazardous locations should be one of the first objectives of a crash data system.

Joint training of police and engineers should improve the understanding of their roles and the development of crash data transferral procedures (from police to road authorities) should be included in any crash data system upgrading. The road authorities should be involved in the improvement of crash data reporting as they are expected to be the main users. The end objective is the application of crash data and not just its computerisation.

In case of a major crash involving many deaths and injuries, the Road Authority conducts in-depth analysis of the crash in order to determine the exact cause and circumstances leading up to the crash. This allows for improvements in traffic policy, regulations and equipment to be implemented by related government agencies such that similar crashs will not happen again.

❖ Vulnerable Road User Safety

As it can a general observation be said that pedestrians are the neglected road users. Relatively few pedestrian crossing facilities exist in most major cities such as foot bridges, under passes, signal controlled crossings etc. Features that assist pedestrian safety, for example, guard rails or central reservations are also infrequently used. Vulnerable road user safety should be a priority area, and pedestrian safety in particular.

❖ Community Participation

Experience from both higher income countries as well as Africa has shown 'top-down' approaches to have limited effect and lack sustainability. Local participation is required to maintain political support as well as ensure the approach adopted, both in terms of problem

analysis as well as remedial measure identification, is appropriate and compatible with local priorities.

Community participation should be a basic component of any road safety programme, with involvement of both service organisations, NGOs, and the business community a priority. Local road safety initiatives should be incorporated in national road safety programmes with bottom-up efforts co-inciding instead of following national level action.

Road rehabilitation projects should include publicity campaigns in villages adversely affected by road improvements with the local community involved in both the identification of the problem and the development of the remedial measures.

- **Professional Drivers**

Driver training and testing improvements and initiatives should target professional drivers. These should include extended on road tests with hazard perception checks, and defensive driver training. Refresher training should also be promoted along with close monitoring of drivers working conditions and crash involvement.

- **Children's Traffic Education**

Teaching safety skills to children can provide lifelong benefits to society, but should be seen as a long term intervention strategy. Experience in many countries has shown that reliance on individuals or organisations visiting schools to give talks on road safety are not effective on their own. Children may remember the messages in the short term, but effective and sustainable development of positive attitudes towards road safety are best achieved by inclusion in the core curriculum, either as a compulsory subject in its own right or as a cross-curricular theme.

It is also essential that education inputs are incremental (building on previous skills) and linked to the child's physical and psychological abilities.

Training is best done in schools by professional teachers who have themselves been trained in the safety issues relevant to children.

❖ **Emergency Medical Services**

Timely and proper treatment of road casualties is essential for reducing the severity of injury to crash victims. Driver education on first aid procedures and correct transportation of crash victims is important. A single emergency telephone number (for example, "911" is used in USA) can facilitate the simultaneous alerting of police, ambulance and other rescue services and help to reduce response times (depending on the availability of road-side telephones).

❖ **Road Safety Engineering**

At present, road safety is assumed to be addressed through adherence to geometric design standards and few road safety audits are being conducted. Safety audits are needed as they consider the safety of all road users (including roadside dwellers).

Road safety engineering unit guidelines (suggested organisational structure, work programme, job descriptions, training progammes) should be developed as a key reference for the Institutional Strengthening projects which have often neglected safety in the past.

In general, in addition to human problems, the major transport problems in Addis Ababa include among others:

a) Shortage and low quality of transport services and facilities,
b) Poor quality of roads, pedestrian walkways,
c) High rate of congestion at peak hours and hence high rate of traffic crashes.

It can be learnt from this study that in addition to the efforts being made to reduce the frequency of traffic crashs in general, special attention should be given to reduce the severity of crashs by taking the following into consideration:

i. Strict control and management of vehicle movement is necessary especially in residential areas and industrial area. The same would be required for areas around schools and religious institutions.

ii. Further studies can be made on the area of traffic crashes by considering detail and accurate information on various variables. For example if the causes and consequences

of crash are recorded in detail instead of broad categories results could be more accurate and efficient.

The observed trends in Addis road traffic crash provide guidance on their current road safety problems and challenges, and point to possible areas of countermeasure development and implementation. In many cases countermeasures, policies, and programs will need to represent low-cost solutions, given economic constraints within the country. In order to conduct a more refined analysis of crashs exposure data will be needed; thus, in general the collection of exposure data in Addis should become a priority moving forward.

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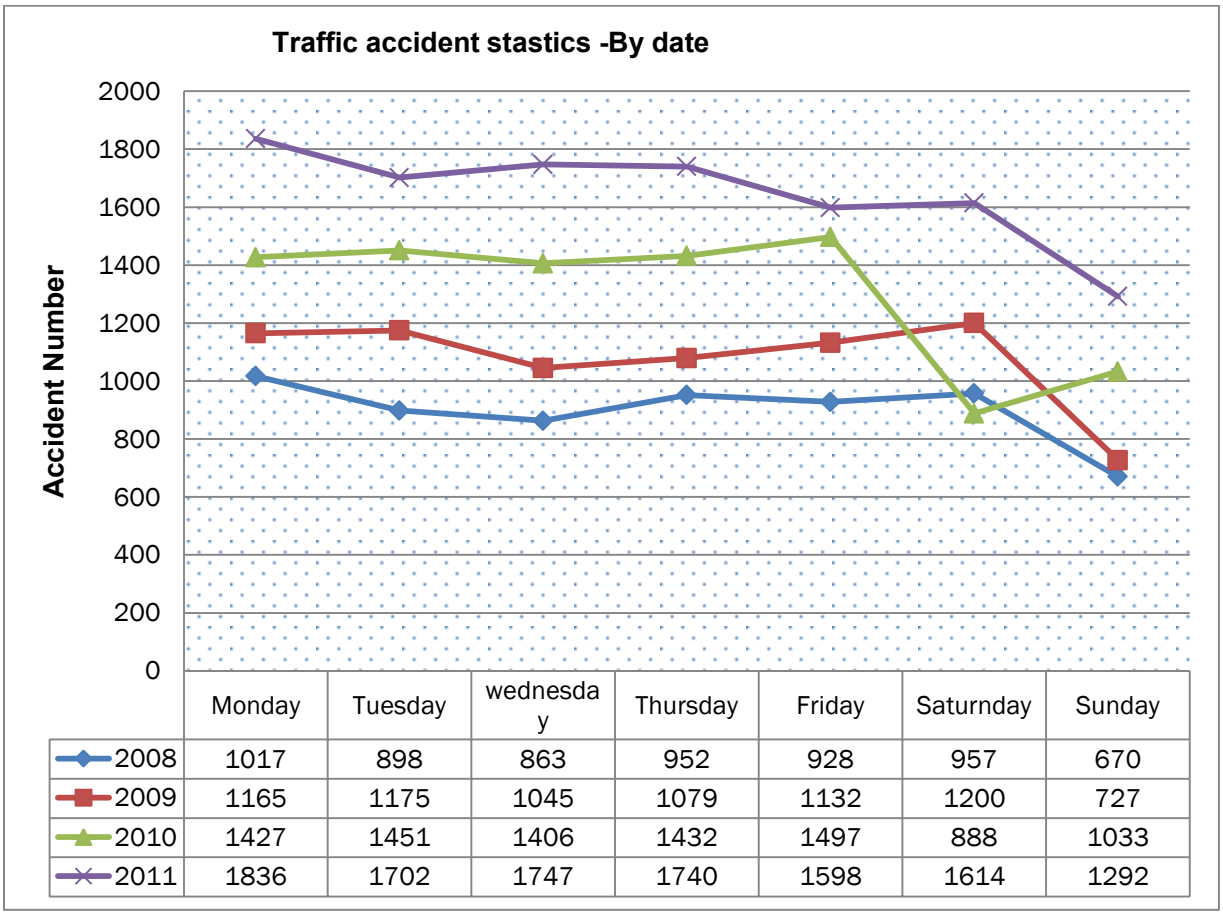
APPENDICS I
ADDIS ABABA CITY CRASH STATISTICS

Appendics :EXCEL OUTPUT DESCRIPTIVE STATISTICS

Appendics 1.1: Traffic crash statics -By date

	Traffic crash statics -By date			
Date	**year**			
	2008/09	**2009/10**	**2010/11**	**2011/12**
Monday	1017	1165	1427	1836
Tuesday	898	1175	1451	1702
Wednesday	863	1045	1406	1747
Thursday	952	1079	1432	1740
Friday	928	1132	1497	1598
Saturday	957	1200	888	1614
Sunday	670	727	1033	1292



Appendics 1.2: Traffic crash statics -By Time

	Traffic crash statics -By Time			
TIME	**year**			
	2008/09	**2009/10**	**2010/11**	**2011/12**
01:00-02:00	104	96	120	220
02:00-03:00	112	67	174	245
03:00-04:00	89	81	165	226
04:00-05:00	84	64	159	247
05:00-06:00	127	94	167	279
06:00-07:00	198	195	268	408
07:00-08:00	368	494	489	655
08:00-09:00	321	508	528	466
09:00-10:00	386	440	534	704
10:00-11:00	389	539	608	741
11:00-12:00	400	554	336	717
12:00-13:00	337	449	538	633
13:00-14:00	343	387	430	600
14:00-15:00	371	431	545	626
15:00-16:00	366	534	533	708
16:00-17:00	397	475	552	729
17:00-18:00	361	472	529	661
18:00-19:00	271	337	464	591
19:00-20:00	374	335	465	525
20:00-21:00	265	291	390	476
21:00-22:00	181	205	337	403
22:00-23:00	167	173	532	199
23:00-24:00	126	163	167	260
24:00-01:00	98	139	112	214

Appendics 1.3: Summary Contrast of Driver's age ,Educational Background of the driver and place of crash for year 2011/12

Driver's Age	Educational Background of the Driver	place of Crash							
		School	Industrial area	Religious place	Market	Entertainment	Hospital	Organization	Residence
Below 18	illiterate	0.18	0.18	0.16	0.14	0.17	0.17	0.17	0.18
	Basic Education	0.25	0.25	0.23	0.21	0.24	0.24	0.24	0.25
	Primary School	0.18	0.18	0.16	0.14	0.17	0.17	0.17	0.17
	Junior School	0.19	0.19	0.17	0.16	0.19	0.18	0.18	0.19
	Secondary School	0.21	0.30	0.28	0.27	0.29	0.29	0.29	0.30
	Above Secondary school	0.33	0.34	0.32	0.30	0.33	0.32	0.33	0.33
	MAX	**0.33**	**0.34**	**0.32**	**0.30**	**0.33**	**0.32**	**0.33**	**0.33**
	MIN	**0.18**	**0.18**	**0.16**	**0.14**	**0.17**	**0.17**	**0.17**	**0.17**
Between 18-30	illiterate	0.17	0.20	0.18	0.16	0.19	0.19	0.19	0.20
	Basic Education	0.24	0.27	0.25	0.23	0.26	0.26	0.26	0.26
	Primary School	0.17	0.16	0.17	0.16	0.19	0.18	0.18	0.19
	Junior School	0.18	0.16	0.19	0.18	0.20	0.20	0.20	0.21
	Secondary School	0.20	0.32	0.30	0.28	0.31	0.31	0.27	0.32
	Above Secondary school	0.33	0.35	0.33	0.32	0.34	0.34	0.30	0.35
	MAX	**0.33**	**0.35**	**0.33**	**0.32**	**0.34**	**0.34**	**0.30**	**0.35**
	MIN	**0.17**	**0.16**	**0.17**	**0.16**	**0.19**	**0.18**	**0.18**	**0.19**
Between 31-50	illiterate	0.16	0.16	0.14	0.12	0.15	0.15	0.16	0.16

Driver's Age	Educational Background of the Driver	place of Crash							
		School	Industrial area	Religious place	Market	Entertainment	Hospital	Organization	Residence
	Basic Education	0.23	0.23	0.21	0.19	0.22	0.22	0.23	0.22
	Primary School	0.15	0.15	0.13	0.12	0.15	0.14	0.15	0.15
	Junior School	0.17	0.17	0.15	0.14	0.16	0.16	0.17	0.17
	Secondary School	0.19	0.28	0.26	0.24	0.27	0.27	0.28	0.28
	Above Secondary school	0.31	0.31	0.29	0.28	0.30	0.30	0.31	0.31
	MAX	**0.31**	**0.31**	**0.29**	**0.28**	**0.30**	**0.30**	**0.31**	**0.31**
	MIN	**0.15**	**0.15**	**0.13**	**0.12**	**0.15**	**0.14**	**0.15**	**0.15**
Above 51	illiterate	0.17	0.17	0.15	0.13	0.16	0.16	0.16	0.16
	Basic Education	0.23	0.24	0.22	0.20	0.23	0.22	0.23	0.23
	Primary School	0.16	0.16	0.14	0.13	0.15	0.15	0.15	0.23
	Junior School	0.18	0.18	0.16	0.14	0.17	0.17	0.17	0.18
	Secondary School	0.20	0.29	0.27	0.25	0.28	0.28	0.28	0.29
	Above Secondary school	0.32	0.32	0.30	0.29	0.31	0.31	0.31	0.32
	MAX	**0.32**	**0.32**	**0.30**	**0.29**	**0.31**	**0.31**	**0.31**	**0.32**
	MIN	**0.16**	**0.16**	**0.14**	**0.13**	**0.15**	**0.15**	**0.15**	**0.16**

Appendics 1.4:Proposed Crash Report Format

Day-to-day Traffic Crash Report

Sub-city (Kifle Ketema):_____

Location:_____

woreda/ Village:_____

Description:_____

Year:_____

Number	*Month*	*Date*	*Time*	*Drivers'*				*Taxi Less Than 5 Seats*	*Taxi 5-12 Seat*	*station Wagon*	*Bus Less Than 30 Seats*	*Bus Above 30 Seats*	*Truck (Up To 120 QUNTL)*	*Truck (121-250 QUNTL)*	*Above 250 QUNTAL*	*Truck Tractor*	*Trailer*	*Semi- Trailer*	*Other*	*Crash Type*	*weather*	*Road Condition*	*Road Surface*	*fatal*	*Injured*		*Property Damage(PD)*
				Age	*sex*	*Experience*	*Edu. Background*																		*Serious*	*Slight*	

Crash type

Code :

A-right side collision

B-rear end collusion

C-head -on collusion

D-mv sideswiped(opposite direction)

E-mv sideswiped(same direction)

F-mv leaving curb

G-mv collided with parked mv

H-mv collided with fixed object

I-mv executing U-turn

J-PD

K-mv executing improper left- turn

L-mv executing improper right- turn

M-left -turn ,head-on collision

N-right -turn ,head-on collision

O-pedestrian struck by mv

P-unknown

Q-hole in road way

R-mv backing against traffic

S-operator or occupant fell out of mv

T-person injured while hitchhiking ride on mv

U-mv collided with separated part or object of another mv

V-mv and train collusion

W-mv struck by thrown or fallen object

X-parked mv (unattended) rolled into another mv or object

Y-towed mv or trailer broke free of towing vehicle

Z-mv and bicycle in collision

Appendics 1.5:Table of traffic statistics

Sub-city_____
Year _____ Month: _____ Day_____ Time_____

Age of Drivers

No	Age(Year)	Type of Traffic Crash			
		Death	Heavy crash	Light Crash	Property Damage
1	Below 18				
2	Between 18-30				
3	Between 31-50				
4	Above 51				
5	Unkown				

Sex of Drivers

No	Sex	Type of Traffic Crash			
		Death	Heavy crash	Light Crash	Property Damage
1	Male				
2	Female				
5	Unkown				

Educational Background of Drivers

No	Level of education	Type of Traffic Crash			
		Death	Heavy crash	Light Crash	Property Damage
1	illiterate				
2	Basic Education				
3	Primary School				
4	Junior School				
5	Secondary School				
6	Above Secondary school				

Experience of Drivers

No	Level of Experience	Type of Traffic Crash			
		Death	Heavy crash	Light Crash	Property Damage
1	No driving licence				
2	Less than or equal to 1 year				
3	Greater than 1 year or less than or equal to 2 year				
4	Greater than 2 year or less than or equal to 5 year				

5	Greater than 5 year or less than or equal to 10 year				
6	More than 10 years				

Type of Pavement Surface

No	Type of surface	Type of Traffic Crash			
		Death	Heavy crash	Light Crash	Property Damage
1	Asphalt concrete				
2	Deteriorated Asphalt				
3	Gravel road				
4	Unpaved Road				

Road condition

No	Road	Type of Traffic Crash			
		Death	Heavy crash	Light Crash	Property Damage
1	Dry				
2	wet				
3	Muddy				

The Area where traffic crash happened

No	The Area	Type of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	school				
2	Organizational				
3	Religious place				
4	Market				
5	Entertainment				
6	Hospital				
7	Residence				

Type of Pavement Surface

No	Type of surface	Type of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	Asphalt concrete				
2	Detorerated Asphalt				
3	Gravel road				
4	Unpaved Road				

crash Type that happened

No	crash Type	Type Of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	Front -Front crash 				
2	Front -Back crash 				
3	Front -side crash 				
4	Side -Side crash 				
5	crest 				
6	Pedestrial crash				

Road condition

No	Road	Type Of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	Dry				
2	wet				
3	Mudy				

Road Light condition

No	Road	Type Of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	Day Light				
2	sun rise Time				
3	sun set Time				
4	Night time well Road light condition				
5	Night time Not well Road light condition				
6	Night time No Road light condition				

Road junction

No	Road	Type Of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	No junction				
1	 Junction				
2	 Junction				
3	 Roundabout				
4	 Junction				
5	 Junction				

Vehicle year of service

No.	Service year	Type Of Traffic crash			
		Death	Heavy crash	Light crash	Property Damage
1	Less than or equal to 1 year				
2	Greater than 1 year or less than or equal to 2 year				
3	Greater than 2 year or less than or equal to 5 year				
4	Greater than 5 year or less than or equal to 10 year				
5	More than 10 years				