ADOPTION OF INFORMATION COMMUNICATION TECHNOLOGY FOR TRAFFIC MANAGEMENT IN ADDIS ABABA, ETHIOPIA

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DECLARATION

Getenet Abera hereby declare that the thesis entitled **"Adoption of Information Communication Technology for Traffic Management in Addis Ababa, Ethiopia."** is original and has not been submitted for other degrees or the like in this University College or any other institutes. It does not contain any material, partly or wholly, published or written by others, except those references quoted in the text.

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CERTIFICATION

This to certify that **Getenet Abera** has carried out his thesis work on the topic entitled **"Adoption of Information Communication Technology for Traffic Management in Addis Ababa, Ethiopia."** under my guidance and supervision. Accordingly, I hereby assure that his work is appropriate and standard enough to be submitted for the award of Master of Arts degree in Logistics and Supply Chain Management.

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ADDIS ABABA UNIVERSITY
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Adoption of Information Communication Technology for Traffic Management in Addis Ababa, Ethiopia

Getenet Abera

This is to certify that the thesis prepared by Getenet Abera, titled: "Adoption of Information Communication Technology for Traffic Management in Addis Ababa, Ethiopia" and submitted in partial fulfillment of the requirements for The Master of Arts Degree in Logistics and Supply Chain Management complies with the regulations of the Addis Ababa University College of Commerce and meets the accepted standards with respect to originality and quality.

Name of Advisor:	Date	Signature
Name of Internal Examiner	Date	Signature
Name of External Examiner	Date	Signature
Name of Department head	Date	Signature

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Acronyms and Abbreviations

AACPC	Addis Ababa Police Commission
AATA	Addis Ababa Transport Authority
AATMA	Addis Ababa Traffic Management Agency
CCTV	Closed Circuit Television
GIS	Geographic Information Systems
GPS	Geographical Positioning Systems
ICT	Information Communication Technology
RTA	Road Transport Accident
TAM	Technology Acceptance Model
TFF	Task Technology Fit Model
WHO	World Health Organization

ABSTRACT

Road traffic accidents are major preventable cause of death and disability in Addis Ababa, among the victim of traffic accident; two-third was men in their prime productive and reproductive age between15 and 44 years. Death and disability in this age group have profound social and economic impact on families and also for the country. Traffic congestions have also been another serious problem in Addis Ababa it increases travel time, air pollution, and fuel consumption among other challenges. Thus the main objective of the study is to examine the utilization and adoption of Information communication technology for traffic management in Addis Ababa. Both primary and secondary source were used to collect data. The descriptive explanatory research design was adopted. Purposive sampling for responsible organization staffs was used. Descriptive statistics were used to analyze the data which was then presented in tables and figures. The main findings of the study were: The major cause of road traffic accidents and road traffic congestion are over speed, failure to give the right of way for pedestrian, drunken driving, wrong driving habits and aggressive driving, ignorance of the rules and violation of the rules. But the research shows that the responsible organizations do not utilize and adopt information technology effectively to mitigate these problems. Based on these findings, the researcher recommended that traffic management agency and other stakeholders have to utilize and adopt information communication technology to empower traffic police in performing their daily tasks by quickly identifying the traffic jam points, shortest route for accessing accident locations, defining alternatives and providing help, the solution enables accurate monitoring and analysis of vehicles daily movement and quick response to breakdowns and accidents, useful traffic information should be provided to road users via mobile messages and digital road signs to avoid congestions and take alternative routes in case of emergencies. Traffic surveillance solution empowers decision making by enabling jam source identification, quick resolutions for traffic jams, timely response to accidents and emergencies, flow pattern analysis, enhance good governance and finally result in improved passengers' safety.

***Key words**: traffic, management, police, GPS, CCTV, Road, accident, congestions, drivers, Pedestrian*

CHAPTER ONE

INTRODUCTION

This chapter shows a general introduction and background of the study area. Further, the statement of research problem, objectives, research questions, significance, and limitations are addressed. Finally, organization of the paper is incorporated.

1.1 Background of the Study

Technology like coin it has two sides, on one hand it helps to solve human problem we can communicate and form relationship with anyone in the world by means of transportation, internet and mobile communication and it also helps to gather, record and exchange information .On the other side of the coin or the main drawback of technology are if we are not utilizing properly it may cause loss of life, injuries and property damage just like car accident (Ivana PESIC, Radivoje KOJIC, 2012).

According to the World Health Organization global status report, 2018 on road safety; Road traffic accident and traffic congestions are persistent problems on our planet earth, especially in developing countries like Ethiopia, Addis Ababa. Being so, it is much a burning problem that it is claiming the lives of many people, causing critical and simple injury and dismemberment on human body, causing a great deal of damage or destruction in physical material property and in efficiency. As a result it has been an explicit or implicit adverse impact on socio-economic and political activities of many countries throughout the world. According to the World Health Organization (WHO) fact sheet report of 2016; every year about 1.35 million peoples are pass away as a result of road traffic accidents. And between 20 to 50 million people suffer non-fatal injury with many incurring disability. From this, over 90% of the world's fatality on the roads occurs in low-income and middle-income countries, which have only 48% of the world's registered vehicle. In Africa also 234,700 peoples are die annually as a result of road traffic accident which is 20% recorded worldwide. In Addis Ababa, the number and severity of accident has been increasing at an alarming rate. The major problem of road traffic flow that has been occurring is due to population growth, lack of awareness, Poor design and condition of the road, increased vehicle density and increased number of vehicles , over speeding, rash and negligence in driving, bad crossing behavior of pedestrians, incompetent drivers and driving under the

influence of alcohol or drugs, violation of the rules and regulations, unfitting condition of the vehicles, changes in climate etc. are some of the major reasons for the accidents resulting in the high mortality rate, serious injuries and simple injuries of human body and destroying properties.

The pervasive nature of this problem has a negative impact on the whole economy, spheres of socio-economic and political engagements of people (Asha Murali & Ajaya Kumar K, 2014).

The number of registered vehicles in Ethiopia is about 831,000. From the entire number of cars, 62 percent of them are found in Addis Ababa. (Federal Transport Authority, 2017).Relatively, the number of car is not too much but the accident rate is higher than that of developed countries.

Traffic accident and congestion is serious problem and so, requires effective and efficient monitoring. For this reason, traffic record management systems have been developed to minimize traffic accident. However, the Addis Ababa crime and traffic accident investigation department employed is mainly manual that is, the use of pen and paper. This record is therefore susceptible to destruction from pests and uncensored manipulation by both authorized and unauthorized personnel. This crude method has resulted in problems in the areas of authenticity, security, retrieval, storage, and exchange of information within transport sectors

The Addis Ababa Police Commission crime and traffic accident investigation playing a great role for collecting accident data on-site but they are also collecting and filling a forms by hand, which are presented to concerned bodies. A manual form is used by the police department to record accident information as they occur and is occasionally summarized and presented in excel charts. The statistics obtained from the manual forms are often inaccurate because of lack of follow-up and examination of accident scenes and hospitals on accident casualties are not updated on the already compiled accident data.

The technique used to oversee accident cases being manual make the registered cases vulnerable to misfortune and often prone to simple access by unauthorized individuals and this practice leads to wrong decision making by higher officials and policy makers and also it may not be reliable in solving this kind of problem adoption information communication technologies that can assist the traffic police department to record, store and retrieve accurate data on traffic policing cases for enhanced traffic law enforcement (Mubaraka, 2013).

The over-all problem of traffic accident and congestion that take place in the city set-ups all over the world cannot be effectively solved without information communication technology (Yongfeng, zhitao, Liu& Min, 2012). Several studies have focused on different aspects of road traffic accidents and congestion in Addis Ababa rather than the applicability of ICT on traffic accident prevention and congestion. The aim of the present study an assessing the level of utilization and adoption of information and communications technology in traffic management in Addis Ababa, and it helps to provide possible solution, to empower the traffic police, traffic management agency, road transport authority and other involved governmental authorities to act proactively and respond swiftly to emergencies thus protecting.

1.2 Statement of the Problem

Everybody travels from one place to another place either to work or to do business or to school or to recreation by using vehicle. Unless proper and relevant operations these vehicles are the major source of road traffic accident. Due to road traffic accidents many drivers, pedestrians and passengers could not return to home: pass away, spent long days, weeks, months, and even years in hospitals, and never be able to work or play as they used before (Greg Chen, 2009).

Figure 1: Rod traffic accident in Addis Ababa

Source: Addis Ababa police commission

According to Global Health Ethiopia CDC (2016) report Road traffic accident has negative impact on Economic, social and political aspect in a country. Road traffic accident in Addis Ababa incurs a lot of property damages, losses a productive man power, and a lot of monetary cost expenses on the medical facilities for medical treatment and medicines. Road injuries were the country's 10thleading cause of death. Every year on average 461 people pass away in addition to this serious injuries and slight injures that accounts to 2581 and property damage of birr

242, 435,281.00 spent for property damaged by road traffic accident. Pedestrians are the most vulnerable road users. (Addis Ababa Police Commission report, 2012-2017). According to the Addis Ababa traffic police statistic in 2017, 82% of road traffic deaths were pedestrians of which 10% four-wheeled vehicle drivers, and 10% motorcyclists. This continues to be the pattern of the last six years, in all of which pedestrian deaths occurred while crossing a road. Among the victim of traffic accident, two-third was men in their prime productive and reproductive age between15 and 44 years of age. The cost of these road traffic accidents have economic crisis, and also Road traffic Accident (RTA) has a social impact in families of the victim face a problem and sometimes they are exposed to separate and eventually disband the family becoming reasons for separation and top disband bring of family members. Because of RTA peoples become disabled or lost their property and become dependent on others. Because of RTA people lost their beloved family members, these all are a social disaster after sustaining of RTA. Unless it's controlled, it leads to political crisis.

Like Car accidents, traffic congestions is also another serious problem as it increases travel time, aggravates air pollution, and fuel consumption, increased accident risk, stress and frustration on travelers and greater transportation cost, are among other challenges (Gladys, 2010& Maitra, 1999).

Fgure:2. Traffic congestion in Addis Ababa

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Source: Own Survey, 2019

Every vehicle in Addis Ababa is subjected to annual vehicle safety inspection each and every year. These annual check- ups are designed to make sure that every vehicle on the roads in Addis Ababa is properly maintained, to make successful traffic flow and safety. Even if all vehicles pass through the yearly safety inspection for renewal of annual registration but practically even some of the inspected vehicles brake pedal do not work well, one or all of its light (headlights, tail, brake, plate lights, and turn signals) may not be working, their horn do not be properly working, their tires are not in good condition, their wind shield do not function as well but their annual vehicle registration is renewed. In order to prevent these kinds of problems efficient and effective traffic enforcement is necessary. Addis Ababa has modern rules of the road, but if these rule is not enforced effectively by adopting and utilizing ICT. In addition to these kinds of problems lack of good governance related to traffic management service.

If any driver offends the traffic rules then automatically his/her driving license is taken by traffic police until he/she shall be pays fine for that specific offence. Even if the driver has planned to travel to some where she /he obliged to cancel. The payment system is weak as it may take one or two days because of this reason the drivers, most of the times are complaining on the payment systems of the government and sometimes they try to solve these kinds of problem and may decide to give bribe to traffic police officers encouraging corruption.

A manual form is used by the Addis Ababa police commission to record accident information as they occur and this is occasionally summarized and presented in excel charts. The statistics obtained from the manual forms are often inaccurate because of lack of follow-up and examination of accident scenes and on top of these hospitals on accident casualties are not updated on the already compiled accident data. Due to this reason, it is difficult to get reliable information and data .This problem may affect policy makers to proper direction, there by effecting judgments of policy makers is setting.

Another gap in traffic management system is still there is reflected as there is no speed control system recording mechanism on repeated traffic rules offenders because of this many drivers violate traffic rules and regulation which is turn leads to increased traffic accident and congestion .

These critical traffic related problems require radical solution to facilitate the traffic movement and resolve daily jams; usually caused by regularly increasing number of vehicles, competing for space that doesn't easily expand to cater for increased number of daily travelers, other conditions as observed on road parking, emergencies and construction works, that do not help much in reducing the size and frequency of the problem.

The Government and Non-government 0rganizations in Addis Ababa have also undertaken various measures towards promoting road safety awareness, but these have not been effective and neither do they emphasize the application of RCTs. Therefore, it is likely from the reviewed literature that RCTs if appropriately implemented in Addis Ababa could significantly improve the level of safety awareness.

While the providing of regular road safety education and sensitization programs through holding workshops, using the mass media and including the road safety awareness campaigns have raised awareness on road accidents, there has been less emphasis on optimizing the application of Road Communication Technologies (RCTs) like Database Management Systems (DMS), Geographic Information Systems (GIS), Genetic Algorithm (GA), Internet Technologies, Chunlu and Yoshito, (2001), Electronic Data Interchange (EDI), Radio Frequency Identification (RFID) Sambasivan, (2009), etc, in promoting road safety awareness (Derek e, 2012)

To solve the above traffic related problems, information communication technology plays a greet role but it is pity that there is very limited use of ICTs in Addis Ababa, Ethiopia.

1.3 Research Questions

In light of the above statement, of the problem, the study tries to answer the following basic research questions

1. How ICT is being practiced for road traffic management?
2. What kinds of ICTs are being used in the transportation sector in Addis Ababa, Ethiopia?
3. What are the major cause of car accident and congestion in Addis Ababa, Ethiopia?
4. How ICT can enhance good governance in road traffic management (during issuing driving license, imported vehicle inspection, annual safety inspection and traffic law enforcement)?
5. What are the major challenges in the adoption of ICT infrastructure in the transportation sector in Addis Ababa?

1.4 Research Objectives

1.4.1 General Objective

The general objective of the study is to examine utilization and adoption of Information communication technology to prevent traffic accident and reduce congestion in Addis Ababa, Ethiopia.

1.4.2 Specific Objective

1. To assess the practices of Addis Ababa road transport management in ICT adoption to reduce road transport accident and congestion;
2. To find out various ICTs that have been adopted by various departments to ensure road safety;
3. To identify the causes for road transport accident and congestion;
4. To determine the role of ICT in enhancing good governance in road transport management;
5. To identify the major challenges in the adoption and utilization of ICT in the transport sectors in Addis Ababa, Ethiopia.

1.5 Significance of the Study

The significance of the study is unquestionable, traffic accident and congestion now a day a burning issue in Ethiopia, especially in Addis Ababa. It is claiming the lives of many young productive people, causing critical and simple injury of and dismemberment on human body and causing a great deal of damage or destruction in physical/material property. Addis Ababa city is relatively a place that has the high rate of traffic flow and traffic accident as compared to other remaining part of the country. This research is going to have the following significance:

First ad above all the study helps identify the major cause of traffic accident, congestion and its severity that will be an input for Addis Ababa Police commission, Addis Ababa Transport authority and Addis Ababa City Management Road Traffic Agency leaders and Stakeholders enabling them in making more informed decision on the adoption and utilization ICTs. Secondly this research enables to integrate and improve their service, for the above mentioned organizations. Thirdly the study will also help to stimulate further investigation on this area. Last but not the least of significance of the study may serve as an input in road safety policy planning and implementation in addition to helping to promote road safety awareness activities leading to encourage growth and development of the city as well as the country at large.

1.6 Scope of the Study

Even if traffic management has operations all over Ethiopia, the applicability of the outcome of the study is limited to Addis Ababa city. The study examines and focuses on adoption and utilization of information communication technologies in traffic management in Addis Ababa.

Conceptually, prevention road traffic accident and reduce road traffic congestion may be determined by many forces. However, this study is delimited to the utilization and adoption of Information communication technology mentioned in the specific objectives.

1.7 Limitations of the Study

It is obvious that adequate and reliable information is important to undertake any kind of study. However, the unwillingness and carelessness of some respondents while filling in the questionnaires during data collection, and under reporting especially of vulnerable road users, poor or absent links between reporting agencies, exemptions from reporting, In making the

research manageable. in addition the study is limited in space, time and scope of area coverage. There are limitations on the thesis, mainly on time restriction to collect actual data like traffic density, traffic flow (volume) and format available of data required for the research work.

1.8 Operational Definition

Communication technology (CT): is a term, used to describe telecommunication equipment through which, we can send, receive, search and access to them. All together it is called the information and communication technology. (Ivana Pešić & Radivoje Kojić,2012)

Driver: means any person who drives, stress a motor vehicle (Road Safe, 2014)

Information: is data that has been processed so that it has meaning and value for the recipient (Turban, 1999)

Information Technology: is common term for the study of resources, procedures and methods for managing, saving, processing, transmission and presentation of data and information (Storovic, 2004)

Offenders: Any person(s) who has acted contrary to the provision of any part or section(s) of the traffic laws, or any person (s) who commit traffic infractions (Abdul-Rahman ,Taiwo ajala,2016)

Road user: is defined as different people who make use of the road, with any known mode of transportation at a particular point in time such as pedestrians, drivers, riders, pillion riders, and/or travellers (Abdul-RahmanTaiwoajala,2016)

Road traffic Accident (RTA): refers to an incident having led to personal injury or killed or damage to property that has taken place in an area intended for public transport or generally used for transport and in which at least one of the involved parties has been a moving vehicle(Abdul-Rahman Taiwo ajala,2016)

Road traffic injury: an injury occurred on the road with an involvement of at least one motor vehicle or bicycle (Road Safe, 2014)

Road accident death: means the death of any person who dies within 30 days or such time period as may be specified by the National Authority, as a result of injuries sustained due to an accident in a public place (Road Safe, 2014)

Traffic Congestion: is travel time or delay in excess of that normally incurred under light or free flow of travel condition (T. Thianniwet and S. Phosaard, 2009).

Traffic on roads includes motor vehicles, pedestrians, on-motorized transport and other vehicles, either singly or together (Goodall, 1987; Mayhew, 1997)

1.9 Organization of the Study

This thesis attempted to explore adoption and utilization of ICT in traffic management in Addis Ababa. Accordingly, the paper is organized in a way that current chapter, chapter one deals with the introduction of the study, the subsequent chapter two presents the review of the related literature, chapter three presents the methodology, chapter four deals with the data analysis and results of the findings and the last chapter five, deals with the summary, conclusion and recommendation parts of the study in reference.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

The purpose of this chapter, relevant literature that is related to the study and consistent with the objectives of the study was reviewed. It is to give a general theoretical framework about the topic; it also aims to examine and to determine the present general facts related to ICT adoption in road traffic issues globally that will be researched.

2.1. Practices of Road+ Traffic Management

The movement of human beings for different reasons whether it is by road, rail, air, on foot, animal or vehicles and movement of different items and goods from one geographic area to the other by these means of transportation is defined as traffic (Goodall, 1987; Mayhew, 1997).

Now a days road transport has become the major type of transportation in moving different items and people from place to place. There is a wide road network over distant places so as to facilitate the movement of human beings and huge amount of items (Bishai, 2003). According to Robertson (2012) the reliance of human beings on the road services made the users subject to various challenges including safety.

Asiyanbola, .S,B, Osoba, S.S. Adewale,(2012). States the role of traffic management in reducing traffic related problems through wise use of the road networks and resources. Traffic management is the systematic, well planned and elaborated activity which is implemented to control, direct the flow of traffic and protect road accident, manage accidents if they occurred and ensuring the transportation system and users safety. Bskar (2009) also mentioned the benefits of traffic management such as reduction of traffic congestions, accidents and traffic jams.

There are four main goals in traffic management and these are reducing accidents, congestion and delay, increasing road performing capacity and facilitating free traffic flow (Abdul-Rahman & Taiwo Ajala, 2016) .

Traffic management has basic goals which are focused on ensuring the free flow of traffic so as to fulfill road users. Users are also expected to comply with traffic rules and regulations, interest and reduce road accidents and congestion which in turn increases road capacity .Traffic policy should indicate the goals of traffic management which is efficient utilization of road capacity, comfortable and safe city transportation system, in a coordinated and properly managed manners. Reducing pollution is also one of the major goals of traffic management. Different concerned bodies are responsible to help users benefit from the traffic system through implementations of the required traffic flow systems. (Ajala, 2010).

Traffic management is plays a great role to control and reduce the traffic accidents and loss of human life and destruction of property. Poorly designed roads and inefficient use of road networks, lack of enforcement capacity has been causing traffic congestion in Addis Ababa city and the major goal of traffic management policy and strategic issue is towards reducing these problems. Furthermore, meager traffic management with ill coordinated activity, disorganized agency arrangements which are implementing policies in a disorganized way, lack of awareness of road users are the main rationales to formulation of traffic management policy. There was no coordinated and combined effort to make traffic management policy until 2018/19. This indicated that traffic management policy and procedures were underestimated by the City Administration. (HagereYilma, 2014).

Addis Ababa is the capital city of the Federal Democratic Republic of Ethiopia. Addis Ababa is the seat of Head Office of African Union and United Nations Economic Commission for Africa because of this reason it is often preferred to be the political capital of Africa, due to its historical, diplomatic and political significance for the continent. The area of Addis Ababa is 540squaresa kilometer that is divided in to 10 subs –cities and116woredas.The road network of Addis Ababa is limited to 121,171km in extent and right of way. Its current population is about 2,738,248 (Central Statistics Agency, 2010) .Addis Ababa is exhibiting high social, economic, structural transformation and change is found to be a fast growing city. The major challenges in transport infrastructure and services are lack of clearly defined transport policy for the city of Addis Ababa, Sevier car accident and high congestion due to poor coordination among city's urban development and road transport ,shortages of road network with respect to the size of the city, lack of sufficient access roads, lack of parking facilities and over utilization of road space

by parked vehicles, poorly designed road junctions, in-sufficient public transport service provision and limited coverage to main roads only(FDRE Ministry of Trnsport,2011).

2.2. Road Traffic related problem

2.2.1. Road Traffic Accident

A road traffic accident is defined as a fatal or non-fatal injury occurred as a result of a collision on a public road involving at least one moving vehicle. Road traffic accident can also be defined as an accident that occurs on a way or street open to public traffic which results in one or more persons being killed or injured and at least one moving vehicle is involved (Persson, 2008).

According to the World Health Organization (WHO) Global status report on road safety 2018, every year about 1.35 million people dying each year. Because of road traffic accidents, nearly 20 to 50 million peoples suffer non-fatal injury. This incident leaves many people with disability. More over 90 % of the fatality on the roads occurs in low-income and middle-income countries, which possess only 48% of the globally registered vehicle. In Africa alone 234,700 people die every year due to road traffic accident and this accounts 20% traffic fatality that of the occurred globally.

Road traffic accident affects the national economic, social and political situations negatively. Like any other country road traffic accident in Addis Ababa causes a tremendous property damage, and loss of productive age group. According to Global Health Ethiopia CDC 2016 report road accident injuries were the nation's 10th leading cause of death. Every year on average 461 people die because of road accidents related problems with serious injuries and slight injures; 2581 property damage that can be estimated to be 242,435,281.00 Birr. Pedestrians are the most vulnerable road users (Addis Ababa Police Commission report, 2012-2017).

Population growth and lack of awareness of road utilization, poor design and condition of the road, increased vehicle density and vehicle population, over speeding, rash and negligence in driving, incompetent drivers and driving under the influence of alcohol or drugs, violation of the rules and regulations, unfitting condition of the vehicles, changes in climate are the fundamental problem of road traffic accidents currently. These accidents resulted in the increasing the death

in death rate, even though the basic engineering design of the road and improving some of the conditions of the road are addressed, the increase in the number vehicles and simple injuries of human body and destroying properties has not been declining (Addis Ababa Police Commission repot, 2017).It is factual that traffic accident is happening all over the world but the extent is different in developed and developing countries. The problem is affecting the countries socio-economic and political activities negatively (Asha Murali, & Ajaya Kumar, 2014).

According to Muhlrad and Lassarre (2005), system theory is based on man-environment adjustments and maladjustments. According to this approach, road traffic accidents are usually caused by flaws in three major components of road safety such as the behavior of man, the environment such as landscape and climate and the vehicle or the means of transport. The human component includes characteristic of road users such as age, sex, socio-economic status, education level, attitudes and general traffic behavior such as driving behavior, experience, style, risk compensation and risk driving or use of alcohol and drugs. The environmental factor incorporates the natural and the man-made environments as well as transport systems. The means of transport component comprises of the volume, composition, age, and quality of vehicles technical condition and safety equipment on the modes of transport. Deviations among any of these elements cause road accidents. The systems approach is supported by a system of traffic laws to control and regulations are designed to ensure road users obey and follow the laws and regulations of traffic flow for sustaining road traffic safety.

2.2.2. Road Traffic Congestion

The traffic congestion is a condition of traffic delay that is when the flow of traffic is slowed below reasonable speeds because of the number of vehicles which are trying to use the road that exceeds the traffic network capacity to handle (Weisbrod, 2001). Traffic congestion is a delay in excess of the normally acquired under a free-flow travel condition Traffic speed has significance effect on the quality of traffic. (Lomax, 1997).

Traffic congestion is a serious problem in big cities. It is spread to the medium cities and even small cities and it is a problem that is not easy to manage. Some cities have implemented solutions for congestion problems. Even though there is no concrete agreement on what the definition of congestion is it is related to the effects of motor vehicle traffic and the increase in

amount in the number of vehicles on a roadway which takes to a point that results in decreased speeds, longer travel times and vehicle queues. Alternatively, in an urban setting with an increasing number of traffic signals, pedestrians and those crossing the street as well as additional turning and parking maneuvers, vehicle volume and speed are much less linked to congestion (Aleks Dzintars & Tyler Sutton, 2016)

Nowadays many cities faced the persistent problem of high traffic congestion on their roadway systems especially during peak periods in central business districts, major traffic generators, etc. The increasing number of automobile travel in big cities increased travel time, air pollution, and fuel consumption, and congestion of the city and intercity travel connections requires prompt action. (Dr. Tapan K. Datta, 1998). In 2014, urban commuters in the USA collectively lost 6.9 billion hours, and 3.1 billoion gallons of fuel to traffic delay and the excess fuel resulting in loss of productivity of $160 billion. Similarly, China a third of the world 50 most congested cities in the world the traffic problem is worse than USA. [Liu, J, Wan, J, Jia, DY (4 more authors) (2017)]

Traffic congestion is one of major issues most cities are facing. Identification of congestion is the primary step for selecting appropriate reduction measures. Congestion impacts the movement of people, wastes time, energy and causes pollution. There are two factors, which affect the congestion; micro-level factors and macro-level factors that relate to overall demand for road use. Congestion is triggered at the micro level, and increases to the macro level. The micro level factors are, when many people want to move at the same time, large amount of vehicles in limited road space. Numerous trips may be delayed because of that, irregular but frequent accidents, vehicle breakdowns, poorly timed traffic signals, special events, political rallies, bad weather conditions. On the other side, macro level factors are e.g. infrastructure investment, employment patterns, income levels, land-use patterns, regional economic dynamics, etc. Traffic accidents are the leading cause of reduction of road traffic capability and create a traffic bottlenecks that result in traffic congestion, the vehicle could be up to the upper section of the line after the queue if the problem is not cleared in time. Timely evacuation, should be given unless traffic congestion may quickly spread on the network, this in turn increase the delay time of the traveler (Mohan Rao, 2012).

Demand or capacity related measure of congestion is one obstacle of smooth traffic flow from moving freely (OECD, 2006). When an increase in volume on a transportation facility exceeds the capacity of the accessible infrastructure, the result is a state of congestion (Vuchic and Kikuchi, 1994). Traffic congestion arises when travel demand surpasses the existing road system capacity (Rosenbloom, 1978).

Cost related measure of congestion has adverse effect on convenience and increases transport fees, fuel cost and also spare parts cost particularly with break system and clutch that are also related with travel. The level of admission is determined by various aspects including travel time and reliability. As congestion affects travel time and reliability, it reduces accessibility. Traffic congestion refers to the incremental costs resulting from interference among road users (VTPI, 2005).

2.2.3. Other Road Traffic Related Problems

Road traffic is the highest source of air pollution in cities. Air pollution is one of the main impacts of traffic to the environment. Motor vehicle discharges are not regulated, yet they add immensely to the pollution of the environment. Exhaust gasses affects the composition of the air and they add to the damage of the ozone layer leading to global warming (Vivanco and Andrade, 2006)

There should be surely added global concern about the safety of the environment as various kinds of contaminations counting noise and vibration produced by today's level of motorization. The impossibility of infinite construction of transport infrastructure and growing awareness of the concerns about threatening of the life surrounding that triggers the question about fresh intelligent results for transportation tools (ITS) (Ghosh & Lee, 2000)

2.3. Information Communication Technology Adoption

Information technology is mutual term for the study of resources, procedures and ways for managing, saving, processing, transmission and demonstration of data and information (Storović,2004) ICT Emerged from the electronics, and using electrical engineering, using the achievements of mathematics and physics, information technologies are parted in particular area. Information technology (IT) is a term that defines the components (hardware equipment) and

programs (software) which allows us to access, retrieve, shape, manipulate and present information electronically. (IvanaPešić & Radivoje Kojić, 2012).

Knowledge and practice of ICT in the modern world is one of the fundamental elements of the knowledge and the values of man. ICT offers a wide choice of specific benefits: increased productivity and efficiency, sharing and keeping of information, communication, faster gathering, dissemination and solicitation of knowledge. ICT is one of the most essential factors that can speed up the transition in the area. They are the main way to grow a network economy and information society, through which we can stretch to western European criteria. The fact is that ICT technologies are not yet properly used. It's not enough, just to present new technologies in the traffic as a way of organizing and dispensing of traffic information but solve traffic glitches. (IvanaPešić & Radivoje Kojić, 2012).

According to Gladys, (2010) and Fourie (2009), various RCTs have been installed to promote road safety awareness in advanced countries. For instance Intelligent Transport Systems (ITS) in Europe help to add people, roads and vehicles (Young & Reagan, 2007). Information gained helps to direct suitable awareness per need basis. ICTs like internet, have contributed meaningfully towards sharing information on road safety from various countries and also websites dedicated to road safety awareness movements established (Butagira, T. 2010).

ICT plays a great part on providing information to the society to defend them from traffic accident and assists to create awareness through mobile devices, social media networks like Face book, tweeter etc. (Chanyagorn & Kungwannarongkun, 2011). Road Communication Technologies can be define as a variety of systems or tools that can be applied to detect incidents, upkeep traffic control and manage or offer real time information to road users and shippers (European Union, 2012).

2.4. Role of an ICT on Traffic Management

ICT plays a great role in different areas. It makes life easy by providing information or inverted in any device that can make work easier. ICT adoption helps to prevent road traffic accident and reduce congestion through addressing education, enforcement and vehicle engineering (SN yamawe. A, & E.C Mbosso, 2014)

2.5. Information Communication Technology in the traffic

Every day road users are confronted with Road traffic accident and congestion. Many road users are faced with the problem of road traffic related problems. ICT plays a great part to lessen traffic accident and congestion. Application of information technologies with purpose to reduce the concentration of traffic, save time, money and expand life condition. (Ivana Pasic & Radivoje Kojic, 2012)

Develop an integrated wireless scrutiny solution for monitoring traffic movement on main roads and high ways; the solution allows traffic police in performing their daily errands by quickly identifying the traffic congestion points, shortest route for get into accident locations, defining alternatives and given that help, the solution enables precise monitoring and analysis of cars daily movement and quick retort to break downs and accidents by fixing multiple cameras capturing the traffic movement key places overlooking the main roads, connecting them in access of a wireless network and streaming videos to central control rooms where capturing data shared with special data is presented over live situational digital maps, further geospatial examination is applied and solution alternatives delivered, it helps to give effective and effective traffic related service, Information technologies are embodied in all fields of society and science, plus the traffic and transport. They are base of intelligent systems. Traffic and transport are zones that are directly related to the spatial associations, in terms of which they are no longer capable to manage efficiently or keep the system without satisfactory infrastructure and database GIS (Geographical Information System) character. (Duraković, 2011).

Traffic demand is growing gradually in the whole world and nowadays the authorities are faced with daily challenges, such as the road and the time consumed traveling. (Williams, 2008:72)

According Jacob Thomas (2009) offer Road safety actions can be classified as user related measures, preparation and education, traffic law, incentive, enforcement and vehicle associated measures. The application of ICT measures will be fit in to the areas like training and education, traffic rule enforcement, vehicle related measures and infrastructure linked measures.

According to David Wallington (2014) specified that Road safety is acknowledged to be subjective by aspects such as weather changes, enlarged police and camera -based enforcement, hot spot remediation plans as suggested by Enforcement of the speed control guidelines and

effective checking of speed limits of vehicles at several stretches by ICT helps of the road is important in this feature. While many aspects of society were upgraded by implementing of advanced technology, we were fulfilled with transport system whose basic control technology, traffic sign remained unchanged since his formation 1923. Fronting the question about upgrading of transport system the consideration must be focused on three key themes (Woodrow & Barfield, 1998)

2.5.1. Computers and Traffic Signal Systems

The growth of computer technology has unlocked doors to the traffic engineers for effective timing pattern design for signal systems in urban locations. A computer can assist two basic functions in the arena of traffic signal systems: design of best timing patterns and control of traffic signal controllers in real-time systems. In sight of the current energy problem, it is vital that our emphasis be on upgrading in traffic control tactic rather than street widening plans to increase the efficiency of our existing services. This does not preclude the point that there will always be a necessity for street widening, alternate route construction, intersection expansions, etc., at specific locations. However, more thorough study and testing may be required to justify a widening project now than ever before. This juncture of time requests, more so than ever, emphasis on use of our know-how in the design and operation of ideal signal control tactic (AshaMurali & Ajaya Kumar K, 2014)..

Breath analyzers

One of the major cause and Sevier cause of traffic accident is intoxicated driving, the number of offenders now days significantly increase.to prevent traffic accident traffic police monitoring the drivers whether they are drinking alcohol more than 30mg/100ml or not. If the in driver body detected the presence of alcohol more than the threshold traffic fine/penalty will be imposed from the offenders. The breath analyzer or alcometer by police is based on electrochemical fuel cell technology. (AshaMurali & Ajaya Kumar K, 2014).

Portal facilities, Networking and Online Payment

According AshaMurali & Ajaya Kumar K, (2014) states that now a day Kerala police is aiding online payment system for traffic lawbreakers. The person can make the payment over the web site [www.payment.keralapolice.gov.in] after regaining the relevant data as per condition. It is

made very user approachable. Customer can simply access the list of unpaid charge memos and select the specific charge memo which they have to make the fee. Payment can be made over net banking or by credit card or debit card through a middle collection service provider Bill Desk. After payment an invoice will be created for future situation. This is a well-accepted initiative from the Kerala police in allowing IT services for the advancement of the services to the community. Kerala motor vehicles department is using an exclusive web portal for providing all IT grounded services [http://www.keralamvd.gov.in]. The vehicle registration, vehicle tax fee, etc. can be made over the portal. The amenities of the department in the entire state are networked and the administrators can retrieve any real time data. The ownership specifics, payment status, registration specifics, financial status, hypothecation status etc. can be simply retrieved. The problem of licenses and permits are similarly computerized. Online transaction services are also provided.

2.5.2. Intelligent Transportation system (ITs)

Actual intelligent Transportation system (ITs) are envisioned to relief the broad spectrum of contests that affect our current traffic infrastructures suggested that to adjust the traffic and passenger movements and to improve system management, unified real-time information on the traffic condition in the urban area use one or combination of various ICTs that have been used in traffic regulating around the world (Young, 2014).

According CIVITASII (2005-2009) states that to optimize traffic flow, reduce traffic accident and congestion to improve system management, integrated real time information on the traffic situation in the city traffic data should be collect by:

CCTV (Closed Circuit Television), which means the application of video cameras transmitting data to a set of video display unit (ICT control room). CCTV utilized for observation that aids to identification of wrong deed or security linked indecencies in general public as it happens. CCTV cameras are used to screen and capture pictures of what occurs in particular zones progressively. The pictures are collected are sent to screen and documented on tape or computerized data. Screen can be seen by controllers or left unmonitored (Ogunleye, Adewale, Alese&Ogunde,2011).

GNSS (Global Navigation Satellite Systems), such as GPS (Global Positioning System) from the USA or GALILEO (in operation 2013) in Europe, which are global navigation satellite systems for the worldwide determination of spatial position. EGNOS (European Geostationary Navigation Overlay Service), which is a satellite, based augmentation system to supplement the Global Navigation Satellite Systems (GNSS).

GSM (Global System for Mobile communications) is a cell-based network actually used for mobile phones. Currently, it is often also used for data transmissions, e.g. by using GPRS (General Packet Radio Service).

GPS (Geographical Positioning systems) can be used for tracing vehicles' over speeding ,goods delivery and public transport vehicles to display the exact location, and are useful to automatically yield authorized electronic freight documents and reports, status messages, etc.(Ogunleye,2011). The growing necessity of the driving public for exact traffic information has urged the development of huge scale dedicated effective infrastructure methods, as they usually provide a cost effective method to collect traffic data, leveraging existing communication infrastructure such as the cellular phone network. A traffic monitoring system founded on GPS-enabled smartphone exploits the existing infrastructure of the communication network (Juan C Herrera, 2010).

In-Car Systems: Koper, Tylor and kubu(2009) said that the high impact technologies in traffic implementation include integrated files; geographic information systems(GIS);

Computer –aided notice with global positioning systems and remote access from patrol cars.

Automatic Number Plate Recognition: Patel, Shah and Patel (2013) agreed that traffic control and vehicle owner identification helps to traffic monitoring activity. Beside these lines, it is unrealistic to repulse errant separate drivers on the grounds that the traffic workers won't have the capacity to recover vehicle amount from the moving vehicle in light of the velocity of the vehicle.

Social media :(Cobb, 2014; Palen & Vieweg, 2008; Semaan & Mark, 2012) states that effectives, and challenges of using Online Social Networks (OSN) by police in advanced world.

Nonetheless, requirement for OSN intervened correspondence, joint effort, and connectedness among nationals and police in developing countries is generally uncharted. (Quarshie, 2014)

WLAN (Wireless Local Area Network) systems: Wi-Fi System is a good example of WLAN. Automated systems, such as programmed traffic count sites (e.g. automatic number plate recognition systems, congestion monitoring loop detectors in the surface of the roads)

The database can (partially) be ready for the public (e.g. in the internet), which lets people to plan journeys, casing all transport means and, therewith, adopting inter modality (Gladys, 2010) **Telematics Road communication technologies over Global Information Systems** can assist during the growth of road infrastructure determining bridge locations, doing an interactive analysis of bridges and roads, scheduling for maintenance, show information on road billboards, among other functions. Other than that, telematics offer an avenue for integrating of digitized spatial data, road infrastructure images through the World Wide Web, to indorse awareness towards planning for road safety (Chunlu and Yoshito, 2001).

According to Mike, (2013) states that utmost developed country specially in America and countries of Western Europe, telematics systems (an integrated practice of telecommunication and informatics) have been estimate to increase awareness of road safety given their wireless connectivity with driver& pedestrian mobile devices to indorse road safety awareness. However, mobile device telematics do drop short when it comes to safety associated applications lacking a consistent connectivity to the gathering of diagnosis data.

Busagala and Ringo, (2013) concluded that limits to the full use of ICT include lack of essential skills, lack of ICT gear, less created ICT base. Spending strategy imperatives, absence of Internet accessibility, and low power and untrusted worthiness of electricity supply. Other ICT related obstacles included inadequate computer expertise among police officers, insufficient resources to facilitate various activities counting training, inappropriate choice of police staff for training on ICT use, insufficient training curriculums, low Internet penetration and consistency and less developed ICT infrastructure. The amount of accidents is considerably condensed in the stretches were cameras are installed. But repairs of the camera functioning is a actual challenge

Now a days Mobile devise and applications especially android mobiles helping to users to identify location, exchange information to the right place at the right moment and possibility to

access the internet at any time. Mobile application is to enable information about the road conditions for all participants in the traffic at the proper time with intention to reduce costs loss of valuable time as well as reduction of congestion in urban and suburban areas. There is also intention to reduce pollution by harmful gases and reduce noise level enabling pleasant and healthy environment for ale citizens. (IvanaPešić & Radivoje Kojić, 2012)

2.6. Factors Hinder on Adoption ICT

Since the early 1990s, Information and Communication Technology (ICT) has been perceived as a reagent for development. The Internet is one of the technologies essential to support information processing in order to implement applications and bring services (Mofleh, 2008; Raji, 2006). However, the UNICEF State of the World's Children Report 2011 acknowledges that the poor in numerous developing countries continue largely excluded from ICT and its aids. Research has revealed the existence of such barring in terms of Internet access Internet World Statistics Website 2011 and ITU 2011 which is the driving force of today's ICT domain. For example, the Internet penetration proportions in Africa and Asia are just 11.4% and 23.8%, respectively (Internet World Statistics Website 2011); they are both not as much of than the world average of 30.2%. Besides, only 1.2% of the population in the least developed countries has access to Internet.

Actual intelligent Transportation system (ITs) are envisioned to relief the broad spectrum of challenges that have an impact on our modern traffic infrastructures, however the utilization of these technologies is not affordable for all city because of the heavy infrastructure required and the assessed cost. In this research tried to evaluate a lighter implementation and reasonably priced cost for cities where its technologies are limited or absent such as cities in developing countries.

Political & Leadership (PL): most developing countries don't have ICT policies especially with traffic related issues to guide the provision and usage of ICTs. The main obstacles grouped into this Critical Achievement Factors are absence of political will , political instability, corruption, redundant bureaucracy, high taxes, absence of regional initiatives, lack of appropriate planning or coordination, monopoly, foreign government/stockholders who fund development plans in developing countries and finally force them to give agreements to their home companies

irrespective of the cost(Invisible hands) (The Electronic Journal of Information Systems in Developing Countries,2013), It is, however, problematic to record progress in the lack of clear policies and the resolute implementation of such policies. The role of government and good leadership is authoritative in this process.

Socio-Cultural (SC): this mostly encompasses language blocks, resistance to alteration, fear of technology, absence of maintenance culture, societal attitudes towards ICTs and the lack of local ICT content, particularly in developing countries. These factors enormously hinder access to ICT services in these areas.

Infrastructural (IF): the success of ICT significantly depends on good infrastructure that permits the availability and accessibility of ICTs. Availability refers to the occurrence of infrastructure that delivers ICT services while accessibility signifies the freedom to use such amenities with minimum or without limitations. lack of or insufficient fixed telephone lines , lack of software and hardware, insufficient or lack of electricity supply, absence of Internet exchange points,(Rangaswamy & Nair ,2010) underline that the success of ICT requires huge infrastructural investment.

Technical (TN): this signifies the types of barriers that obstruct smooth delivery or implementation of ICTs. It basically refers to the technological confines associated with ICTs which contain poor network reception, slow Internet connection, system integration problems, etc. Technical limitations differ from infrastructural in the intellect that the latter do not entail technological limitations of ICTs. Instead the concentration on the availability and accessibility of ICTs. Technical blocks essentially comprises of technology linked barriers.

Educational & Skills (ES): this mostly refers to the human ability to understand, use and manage ICTs. It contains topics like illiteracy, absence of ICT skills, absence of research and development, absence scarcity of technical staffs and poor educational systems in developing countries.

Economical (EC): this refers to the economic aspects involved in ICTs. It contains the ability of ICT users, services benefactors and investors to accommodate ICTs in terms of per capita income, absence of investment, low returns on investment, low income ,high costs, inadequate use or non-existing general service fund, incomplete sustainability of networks, absence of

incentives, high threat on investment. It essentially signifies the cost factors of ICTs which include prices of ICT equipment, facilities and networks.

Security & Safety (SS): this refers to the uncertainty related with the use of ICTs. The main obstacles grouped into this Critical Achievement Factors are Perceived absence of privacy and insecurity. It includes the circumstances of safely being capable to use ICT and the freedom from threat that ICTs pose to individuals and societies at big.

Legal & Regulatory (LR): ICT, particularly in the developing world, is often impeded by laws and regulations. The legal and controlling framework governing ICT in these nations is often not proactive. It essentially delays individuals in using ICTs and deters potential ICT service providers. Regulators in emerging countries are generally weak, reliant on and often part of a system in which the legacy operator captures the controlling and political process (Proenza, 2006).

2.7. Models

2.7.1. Technology Adoption Models

According to (Davis, Bagozzi&Warshaw1989) the technology acceptance model (TAM) is an information systems model that model indicate users derive to accept and use a technology.

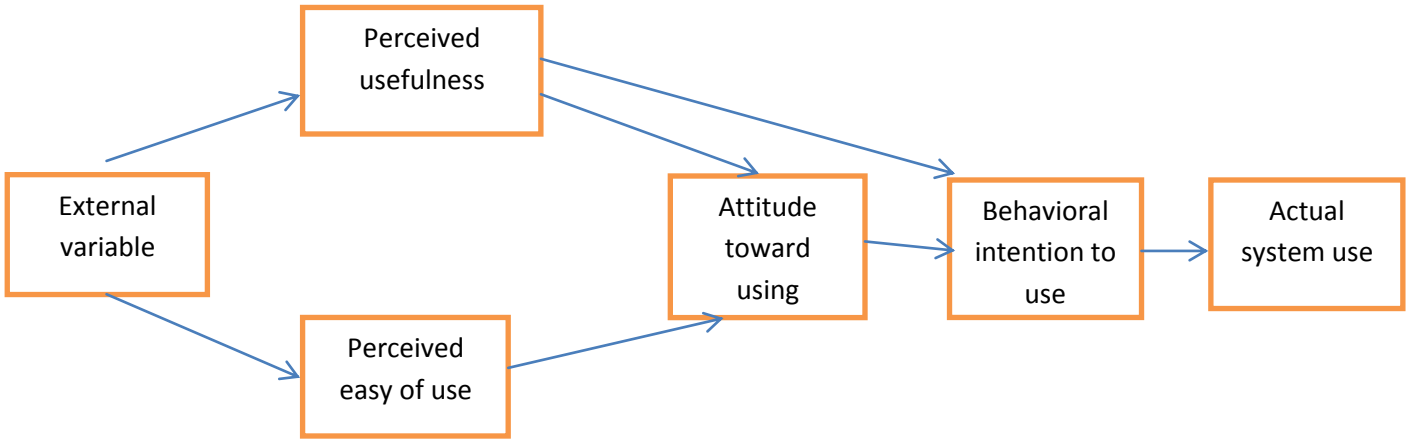


Figure 3:The Technology Acceptance Model (Davis, 1989)

The model proposes that mostly users earlier decide to use new technology consider a number of features such as how and when they will use it, markedly:

Perceived Usefulness-This was demarcated by Fred Davis as “the grade to which a person believes that using a specific system would enhance his or her job performance”.

Perceived ease-of-use (PEOU)-Davis defined this as “the degree to which a person believes that using a particular system would be free from effort” (Davis, 1989)

Behavioral intention is determined by the person’s insolence towards the use of the scheme and also by his insight of its utility. According to Davis, the boldness of an individual is not the only factors that regulates his use of a system, but is also founded on the effect which it may have on his act .Therefore, even if the employee does not welcome an information system, the likelihood that he/she will use it is high if she/he observes that the system will advance her/his performance at work. Besides, the Technology Recognition Model hypothesizes a direct link among perceived usefulness and supposed ease of use. With two systems present the same features, a user will find more suitable the one that she/he finds easier to use (Dillon and Morris, 1996)

Venkatesh and Davis, (2000) proposed the TAM2 .InTAM2 showed that social influence processes (subjective norm, voluntarily, image) and cognitive instrumental processes (job relevance, output quality, result demonstrability) affected perceived usefulness and intention to use. This provided more detailed explanations for the reasons users found a given system useful at three (3) points in time: pre-implementation, one month post implementation and three month post implementation. The TAM2 theorizes that users’ mental assessment of the match between important goals at work and the consequence of performing job tasks using the system serves as a basis for forming perceptions regarding the usefulness of the system (Venkatesh and Davis, 2000).The result revealed that TAM2 performed well in both voluntary and mandatory environment.

Venkatesh and Bala,(2008) combined TAM2(Venatesh&Davis,200) and the model of the determinants of perceived ease of use(Venkatatesh,2000),and developed an integrated model of technology acceptance known asTAM3. The TAM3 using the four different types including the individual differences, system characteristics, social influence, and facilitating conditions which are determinants of perceived usefulness and perceived ease of use. In TAM3 research model, the perceived ease of use to behavioral intention was moderated by experiences. The TAM3 research model was tested in real-world setting of IT implementations.

2.7.2. Unified Theory of Acceptance and use of Technology (UTAUT)

Unified Theory of Acceptance and use of Technology (UTAUT) exemplary is helps to know the user feeling about using ICT and succeeding user behavior. The model reflects four pillars as direct determinants of user acceptance and usage behavior, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. There are four key moderating variables; gender, age, experience, and voluntariness of use. The authors state that UTAUT provides a tool for managers to assess the likelihood of success of technology introductions and to understand the drivers of acceptance in order to design interventions. The basic idea from TRA, that behavioral intention controls user behavior (and adoption) is intact, although alarer battery of factors is seen as important predictors of intentions.

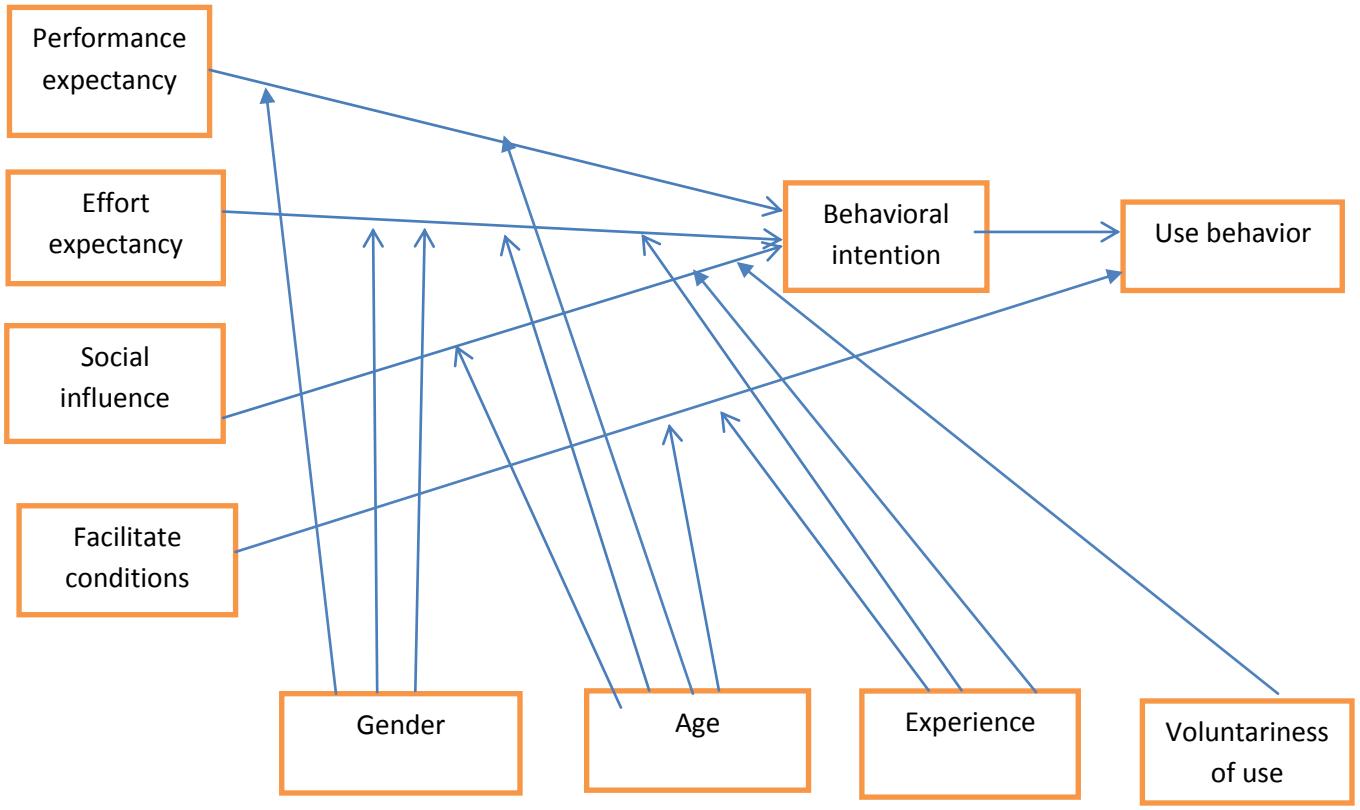


Figure 4: Unified Theory of Acceptance and Use of Technology (Venkatesh., 2003)

2.7.3. Evaluation of A Dynamic Signal Optimization Control Model Using Traffic Simulation

S. Nigarnjnagool, H. Dia (2004) specified about the dynamic cycle time regulator presented in this paper is based on existing well established fixed cycle time optimization techniques. This model helps to identify the performance of the algorithm and it helps to improve traffic conditions based on dynamic demand data provided by loop detectors. The dynamic control strategy was evaluated using the Aimsun traffic simulator. The optimization logic of the control strategy was based on the calculation of optimal signal timing and green time allocation for each movement at the end of every cycle by using predicted demands calculated based on average volumes from previous cycles. The application was evaluated in two different setups. In the first scenario, an isolated intersection which operated without influences from downstream intersections was explored. In the second scenario, the algorithm was tested on signalized intersections along the Corridor. The results for both scenarios showed that the performance of the dynamic control system was superior to fixed time control and provided better throughput across the intersections. The performance of the dynamic control strategy started to decrease under very heavy traffic conditions but remained superior to fixed time control. This finding is almost the same as with results for most adaptive traffic management systems which show that their performance under saturated conditions is limited and similar to what can be achieved by fixed time control strategies.

2.8. Basic Traffic Management Strategies

According to Abdul-Rahman Taiwo Ajala (2016), the basic principles that underlie the strategies in traffic management rests on the “3E”.Evaluation makes the fourth “E”. Some authors like Sangofadeji (2013) identified “6Es or Es”, these basic ingredients are Education, Engineering, Enforcement, Evaluation, Environment, Enlightenment, Enactment Establishment of Road Traffic Management Agency, and Execution.

Education is very important strategy for effective traffic management. It helps to create and increase awareness about the rules and regulations guiding the habit of the road users with the view to safeguarding users from road traffic accident through different road traffic education programs. Training and licensing of drivers and riders, mass deployment for safety measures, enlightenment and reorientation of road users implementing traffic information system and

public participation in policy making processes and implementation are part of road traffic education. Khan (2018) states that educating the public and increasing the awareness of the public at large as a proper way to prevention of road traffic accident and reduces traffic congestion. Legislation and enforcement alone cannot prevent road traffic accident and reduce traffic congestion unless education is part of it.

Engineering: Traffic management agency has to think about and focus on assessment of safety measures in the design, construction and operation of roads such as the use of land effectively and efficiently for development of road infrastructures and to guarantee the free and safe flow of traffic. It include road pavement marking, installation of road signs and signals, intersection design, road landscaping, railing, barrier and other calming devices. These can used to decease the negative effects improve the environment for non-motorized street users and alert the drive to adjust the behavior .Well educated traffic engineers should be part of this aspect of traffic management because it needs more attention and the assigned person should have knowledge on the area of traffic and town planning to coordinate road traffic system effectively. (Lockwood, 1997).

Harlbandh and RS (2002) in their study of stressed the importance of good construction and preventive maintenance facilitates for better traffic management. This is focused on the role timely repair of the road; putting sign boards wherever required, removing billboards that disturb and cutting trees along the highway are the major constituents of this part.

Enforcement of traffic rules and regulations is a basic strategy to ensure free flow of traffic, minimize road traffic accident and reduce congestion. But the major problems in road traffic management is political interference and others agitation to neutralize the effectiveness of law enforcement. Revenue generated from fines and penalties are used as a base line in measuring the performance of most of the traffic management agencies as opposed to the improvement in safety of road users on the highway.

Evaluation is central to all strategies it is a process of reviewing and revising the policy, plans and programs which are made to achieve traffic management goals. Collecting information and managing well recorded data with relevant information is important for planning, decision

making and evaluation. The participation of the public in the evaluation process is vital for effective traffic management strategy.

2.9. Traffic Management Indicators

According to Eden, N, Tsakars to S,A., Kaparls and other four research (2012) tried to explain the following traffic management indicators:

The enforcement of traffic rules and procedures which are simple and clear may help to ensure prevention of traffic accident and road congestion; Effective institutions regarding the implementation of traffic policy, procedures, manage and monitor traffic flow using appropriate electronic tools, skilled human resources that can plan and carry out traffic related issues are quiet important.

Road safety measures are categorized in to two they are user related measures which are training and education, traffic law, and enforcement and vehicle related measures. The Implementing information technology measures are related to the areas such as training and education.

Only building more roads cannot solve the problem even it makes it worse. The fact is that at the beginning extra lanes and new highway can reduce congestion and shorten travel times. But this way can only stimulates more demand and more people join to making more trips and travelling further which in turn leads again to congested roads.

Pricing of roads and transit can make users pay less to travel on less busy routes and the drivers and riders who have more flexibility of time can change their route when they decide to travel and it makes roads free valuable space for those who have does not have flexibility to travel at that time or route. Congestion charging is also one of the effective control mechanisms of congestion that charges road users.

The system adopted information technology system s in London, Singapore and Stockholm .In Stockholm the total amount of traffic flow was to reduce by over 20 percent and travel time for journey in the city was also reduced by 30-35 percent.

2.10. Empirical Review of Related Literature

This section presented the valuation of research papers inscribed in the area of adoption of Information communication technology to solve road traffic linked issues. All the three papers w selected as of their likeness with the study in the adoption of Information communication technology to insure road safety. All the researchers tried to find out the holes which exist in the adoption of ICT that delays the prevention of road traffic accident and decrease traffic congestion and also other traffic related matters to make feasible recommendations and advance the adoption of ICT in traffic linked problems.

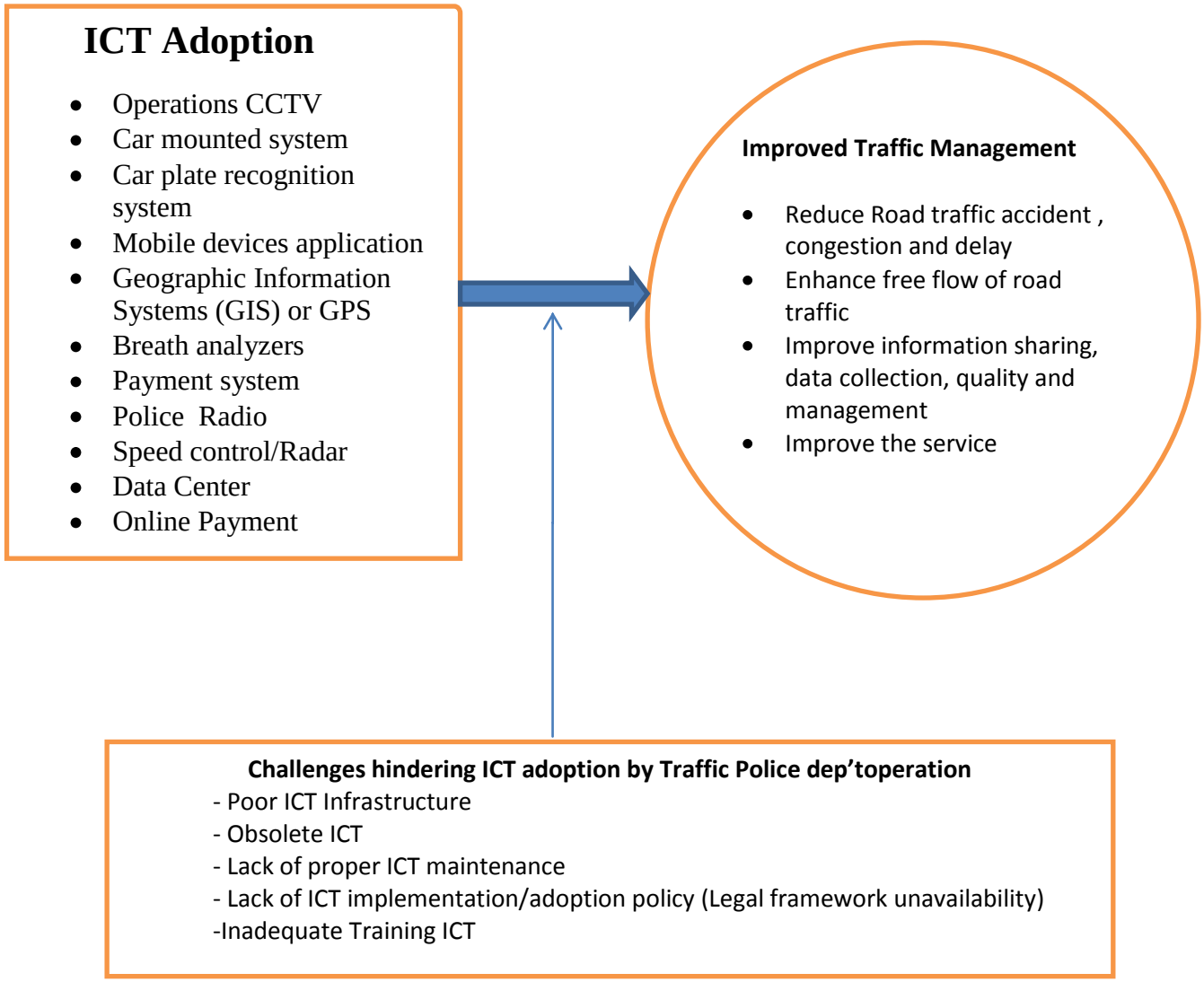
Adoption of Information and Communication Technology in Road Accident Reduction Based on the valuation International Journal of Computer Science and Network (Asha Murali and Ajaya Kumar K ,2014) ,the level of information and communications technology practice in reducing the road accidents in Kerala. The study discovered that agencies or organizations responsible for plummeting the road accidents are by means of one or other form of ICTs. According to the finding of Kerala Police (2013) growing deaths in road accidents are due to the reasons linked to the driver of the vehicle with erroneous driving habits and violent driving, over-speeding and drunken driving. In addition, Ignorance of the rules and defilement of the rules and poor road circumstances play other vital role. Based on the study, it is understood that there is a great scope for incorporating ICT aids at various levels in dropping the road accidents in Kerala. Available literature does not clarify the status or extent of the impact of ICT aids in the monitoring or control of road accidents in Kerala. The main problems delaying in Kerala were, absence of trained personnel, lack of finance, frequent power outages that disturbs the flow, contributing the congestion in many automated traffic signals in cities. Low bandwidth, complexities of the limits to be monitored as well as lack of collaboration among various departments in the coordination were known. This study reviews the effectiveness of the ICT in reducing road accidents in Kerala. It was recommended that an integrated ICT policy for the transportation sector is to be developed, incorporating the roles and responsibilities of the various stakeholders, all these automated intersections are to be equipped with alternative power sources locally to support ICT usage in times of power failure or outage to ensure an uninterrupted power supply, employees of various government departments should be trained in various technological applications and trends in information service and delivery to enhance the services they provide, the political

leadership and administrative leadership are responsible on allocation of adequate budget, acquisition and use of ICTs in various zones of the different agencies across the state. The initial investment will be a concern, and later, these resources will be rewarding in terms of the penalties levied from the violators. More than the investment will be returned within a short run if the law enforcement team is eager in collecting the penalties also. This fund can be used for other enhancement of the services and development in the same sector. To summarize through the analysis on the related literatures and comparison made with the theoretical discussion, we can understand the following. I) The researches show the prevalent gap between theoretical discussions in road traffic management and the practical aspect about the basic principle underlying the strategies The basic strategies of traffic management i.e. the FOUR "4E" and adoption of ICT are not given much attention in practice. II) The existence of common problems in adoption ICT area includes: Lack of finance, absence of trained personal, frequent power outages that interrupts the flow, contributing the congestion, in many automated traffic signals in cities, low bandwidth, complexities of the parameters to be monitored as well as lack of cooperation among various departments in the coordination were identified.

Scholars like Derek, (2012), Gifford, (2010), J arašūniene, & Jakubauskas, (2007), Lu (2005) and Giannopoulos, (2004), have highlighted the importance of communication technologies in increasing road safety through enabling road safety regulation enforcement and driver compliance in Uganda. However, there is little evidence relating to studies highlighting the influence of RCTs on road safety awareness to further improve road safety in the country (Derek , 2012). The Government of Uganda has also undertaken various measures towards promoting road safety awareness, but these have not been effective and neither do they emphasize the application of RCTs. Therefore, it is conceivable from the reviewed literature that RCTs if appropriately implemented in developing countries could significantly improve the level of safety awareness.

Through the analysis on the related literatures and comparison made with the theoretical discussion we can understand that the researches show the prevalent gap between theoretical discussions in leadership and employee performance. Thus the result obtained in many empirical studies does not show perfect consistency with respect to relationship between leadership styles and employee performance due to this gap the researcher encourages to carry out further research.

Conceptual framework of ICT adoption



Sources: This model is adopted and Semi modified from Thang C,T.(2016)

KEY

This double arrow indicated that ICTs tools help to ensure road safety

This single arrow indicated that the major challenges for utilization and adoption ICT for road safety

CHAPTER THREE

METHODOLOGY OF THE RESEARCH

Introduction

This chapter explains the methodology used in the study .A descriptive research design chosen to achieve the objective of the study. Questionnaires and observation are adopted as the primary data collection instruments. Descriptive statistics (frequencies, percentages, mean and standard deviation) were used to summarize trends and observation.

3.1. Research Approach

The research is made based on mixed method research approach. Because, mixed research is useful to capture the best of both qualitative and quantitative research data and using these, the researcher also intended to examine detail features of adoption information technology in traffic management. The advantage of using mixed methods is that it enables to triangulate and support the data and result collected by questionnaire (Greener, 2008 and Sunders, 2007). In addition to these it helps to minimize limitations attached to each of the approaches because each approach has limitations which are possible to be minimized using the combined research approach. Hence, the combined methods are aimed to complement one another and gather reliable information to draw representative outcome and conclusion.

Quantitative method is a means for testing objective theories by examining the relationship among variables. Data collected is number and statistics. On the other hand, qualitative method is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The processes of the research involve emerging questions and procedures. The data typically were collected in the participants setting and the researcher making interpretations of the meaning of the data. The final report was narratively reported with contextual descriptions and direct quotations from research participants. The mixed method focuses on collecting, analyzing and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise was that the use of quantitative and qualitative approach in combination provides a better understanding of research problems than either approach alone (Kothari, 2004).

In this research qualitative research was used to assess respondents' attitudes, feelings and motivations whose findings are not obtained from quantifiable analysis while quantitative research involves mathematical analysis.

3.2. Research Design

The objective of the study was to examine adoption and utilization of information communication technology for traffic management. In the research carried out; descriptive and explanatory survey method is employed.

According to Kothari (2004), descriptive research includes different kinds of surveys and fact-finding enquiries. The major purpose of descriptive research is description of the state of affairs as it exists at present. Adams. (2007) states that explanatory research describes the phenomena as well as explains why behavior is the way it is.

The study employed the descriptive research design by using a sample survey. The descriptive design is ideal as the study sought to describe the use of ICTs in Addis Ababa traffic police, Addis Ababa Transport office and Addis Ababa City Management Road Traffic Agency. The research is adopted the cross sectional survey design which involves the collection of data at one point in time. The cross sectional survey design is appropriate as the researcher collect information from respondents within a specific period of time.

3.3. Population and Sampling

Population of the Study: Population also known as Universe refers to any collection of specified group, according to this definition the population of this research was all employees for Addis Ababa Traffic Management agency employee, Addis Ababa Transport Authority employees, Addis Ababa traffic police officers.

Sampling Method: the research has employed Non- probability purposive or judgmental and convenience sampling techniques is applied for the purpose of this research.

The study area has include the whole Addis Ababa but more focused on a sub-city in Addis Ababa where frequent traffic accident occurs. It identifies through the data collected from Addis Ababa City Police Commission report. During selection informants'; convenience, systematic

and purposive sampling was employed. Sample Size: by using fewer heterogeneity of the population it is possible to gather data from some reasonable sample sizes. i.e. 384 respondents accordingly, traffic police men, Addis Ababa Transport Authority, and Addis Ababa Road Traffic Management Agency.

Cochran (1977) sample size determination formula was used to determine the sample size of the study population:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where,

n_0 **=**the sample size,

z= the critical value of desired confidence level (which is 95% in this research)

p= the estimated proportion of an attribute that is present in the population (which is 0.5 in this research)

q* = 1- *p and

***e*=** the desired level of precision (which is 5%)

$$n_0 = \frac{(1.96)^2 * 0.5 * (1-0.5)}{(0.05)^2} = 384$$

The total sample size determined by the formula was 384. The responded questionnaire was 364 which made the response rate94.8 %.

3.4. Source of Data and Method of Collection.

In this research both primary and secondary data were used. The primary data was collected through observation and questioner from Addis Ababa Traffic Police, Traffic management Agency.

Questionnaire: In addition this research utilized five likert scale open ended questionnaire for the sake of obtaining, giving the opportunity for respondents to vent and explain their thoughts towards the subject of inquiry. The questionnaire was constructed in English language and Amharic language. The first draft was issued arbitrarily in three sub cities traffic police stations and Traffic Management Agency for twenty respondents for pilot testing: in order to ensure that the wording, format, and sequencing of questions was appropriate. During pilot study,

respondents were provided with sufficient space to make any further comments on the study area and additional factors that they might find relevant to study. Feedback from the pilot study was used to improve questions which was ambiguous, difficult to understand, or irrelevant for traffic accident and congestion. While Secondary data source include checking the validity of the questionnaire a pilot test was conducted.

The secondary data books, articles related to information technology and traffic management activities was used and also secondary data collected from the statistical report of Addis Ababa police commission investigation Six years police report between2012-2017/18, Journal articles, books, both published and unpublished research papers. These secondary sources were integrated with the primary source so that the researcher becomes more accurate and reliable.

3.5. Data collection Procedure

The researcher assigned one field assistant for the entire respective sub city who is familiar to traffic related issues. The assistant and researcher gave briefing about the purpose of the study and discuss on each issues by reading the questionnaire. Before the distribution of the questionnaire, higher officials of all concerned organization were contacted to get permission. The data was collected by using different data collection instruments organize, tabulate and analysis in view of the descriptive realm. The data analysis has been using percentage frequency and the finding was presented using data presentation tool with narrative discussions.

3.6. Data Analysis Approach

Data analysis Techniques: Successful data collection led to the data analysis process. Data analysis tool is dependent on the type of data to be analyzed depending on the data nature, quantitatively. The data were presented by using statistical tools like tables, figures, bar charts and others.

Descriptive statistical analysis was used with the help of statistical package for Social Sciences (SPSS).Descriptive statistics incorporate the application of absolute and relative proportions and frequencies, measures of central tendency and dispersion mean and standard deviation respectively. For the purpose of facilitation, Likert Scale was used to present the data for easy comparison. On the other hand, completeness of qualitative data collected was coded according

to emerging themes and included in the qualitative data. Qualitative data from the open –ended questionnaire were present verbalism.

3.7 Ethical Consideration

Ethics in research refers to the appropriateness of one's conduct in connection to the privileges of the individuals who turn to the subject of one's work, or are affected by it. Cooper and Schindler (2011) contended that research ethics is the right behavior in research where the researcher was expected to conduct research in a moral and responsible way. The behavior of the researcher is not only moral but also relate to the use of the correct methodology. Researchers are therefore, required to maintain high levels of ethics when conducting the study and in their general relationship with the sponsor, respondents as well as the organizations they visit to interview.

The researcher upheld ethical consideration in the process of the study and assured the respondents that confidentiality is observed. The researcher obtained informed consent from every respondent in the study and ensures that they responded voluntarily. Thus, the ethical consideration for the study was in anonymity, confidentiality, informed consent and voluntary participation in the data collection process of the study.

3.8 Validity and Reliability Test

The researcher compiled and adapted the research instrument after reviewing literature and consulting experts in the field. Moreover the subject area experts have evaluated and ensured the addresses of the study questions.

3.8.1 Validity of Tests

Validity is the strength of the research conclusions, inferences or propositions. More formally, Patton (2002) defined it as the best available approximation to the truth or falsity of a given inference, proposition or conclusion. Content validity which was employed by this study was measured of the extent to which information gather utilizing a specific instrument speaks to a specific domain or content of a particular concept. The researcher conducted pilot test on survey instrument (questionnaire) to check the reliability of the questionnaire. To establish the content of validity of the research instrument the researcher sought guidance from the university

supervisor and to ensure that the questionnaire was measuring what it intend to measure. This help to improve the content validity of the data collected and facilitate the fundamental amendment and adjustment of the exploration instrument subsequently upgrading legitimacy.

3.8.2 Reliability of Research Instrument

The reliability of a research instrument is established by including numerous comparative things on a measure, by testing various instance of people and by utilizing uniform testing methods .The researcher selects a pilot group of 30 respondents from the target population to test the reliability of the research instruments as recommended by Simon (2010) and r = 0.78 was obtained.

The Cronbach alpha was used to measure the reliability of the Likert scale questions. The alpha value ranges between 0and1 with reliability increasing with the increase in value. The coefficient of 0.7 is a commonly accepted rule of thumb that indicates acceptable reliability (Mugenda & Mugenda, 2003).

The reliability of Major causes of road traffic accident was 0.89, Major causes of road traffic congestion 0.88, Types of ICT adopted for enhancing traffic monitoring 0.71, The role of ICT in enhancing good governance in road traffic management is 0.70, The availability of traffic management system in response to road safety towards minimizing traffic injuries and congestion 0.7 and challenges of adoption of ICT in road traffic management is 0.84. This is deemed acceptable for research. The data from the pilot study was not incorporated to the study.

Table 1 Results of Reliability Test

Variables	Over all Mean	No of items	Cronbach's Alpha score
Major causes of road traffic accident	4.27	15	0.89
Major causes of road traffic congestion	4.23	16	0.88
Types of ICT adopted for enhancing traffic monitoring	2.16	13	0.71
The role of ICT in enhancing good governance in road traffic management	1.73	6	0.70
The availability of traffic management system in response to road safety towards minimizing traffic injuries and congestion	2.3	12	0.74
challenges of adoption of ICT in road traffic management	3.97	19	0.84

CHAPTER FOUR

DISCUSSION, INTERPRETATION AND RESULT

4.1. Introduction

This chapter presents the results and findings of the study as collected from the sample population. The data was gathered exclusively from questionnaire as the research instrument. The questionnaire was designed in line with the objectives of the study. To enhance quality of data obtained, likert type questions were included whereby respondents indicated the level of agreement to which the variables were practiced in a five point liker scale and open ended questionnaire. Coded responses were entered into Statistical Package for the Social Sciences (SPSS) version 20, for data analysis. The data have been presented by tabulation, and some figures. The chapter covers respondents general information based on demographic information, information Challenges, ICT technologies adopted and used in traffic management, examine ICT adoption and utilization in traffic management and constraints facing adoption and use of ICT in traffic management agency and traffic police. Findings based on how the research questions/objectives affect the adoption ICT in Traffic Management and the results are presented and interpreted as follows:

Table 4.1: Socio-demographic characteristics of the participants(n=364)

Variables	Frequency	Percent
Gender		
Female	195	53.6
Male	169	46.4
Educational level		
9-12 grade	26	7.1
Degree holder	52	14.3
Diploma holder	195	53.6
Master's degree and above	91	25.0
Have you received ICT training in traffic management?		
No	260	71.4
Yes	104	28.6
Road Traffic Management Director	1	.3
Road Traffic Management expert	12	3.3
Road traffic rule & regulation	1	.3
Road traffic education and training expert	5	1.4
Road traffic rules and regulation expert	19	5.2
Parking expansion and license officer	10	2.7
AATMA ICT expert	7	1.9
Traffic accident investigator	8	2.2
Traffic police officer	259	71.2
Traffic office control director	1	.3
AAPC Traffic police division heads	13	3.6
AAPC ICT officers	7	1.9
AAPC traffic data and system analyst	6	1.6
Public freight monitor officers	15	4.1

The level of education of the respondents show that 7.1% were secondary school(9-12 grade), 53.6%while who were the majority, were diploma holders,while14.3% were first degree holders and 25% were second degree and above holders .

As it is shown in table 4.1 above, from the total valid respondents, 71.2% of them traffic police officers, 4% of them of them were head of/department/division/directorate, and the remaining of 24.8% of them were senior experts and experts.

This shows that the respondents have good know-how and experience could understand the problem in traffic management related activities and give sufficient and correct information that could contribute through the validity of the study of this study ,so that, they could have the

desired capacity to understand those questions that were included in the questionnaire easily and give the pertinent information accordingly.

ICT TRAINING

As it shown in table 4.1 above, from the total responants,71.4% (260 respondents)of them have not get ICT training in traffic management but the remaining 28.6% (104) took training.This implies that the majority have not received ICT training

Table 4.2 Major causes of road traffic accident Based on questionnaire (n=364)

Major causes of road traffic accident	**Frequency**					**Stat**		**Rank**
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	S.D	
Driving under the influence of alcohol/drunken driving/	0	0	0	143	221	4.60	0.48	4
Driving while talking on mobile phones	0	0	39	91	234	4.54	0.68	5
Drivers exceeding speed limits/over-speeding/	0	0	13	26	325	4.86	0.44	1
Lack of driving knowledge	0	26	52	208	78	3.93	0.80	11
Wrong driving habits and aggressive driving habits,	0	4	68	137	155	4.22	0.70	9
Ignorance of the rules and violation of the rules and regulation	0	13	13	39	299	4.71	0.70	3
Failure to give the right of way for pedestrian	0	0	13	52	299	4.79	0.49	2
Excess loading	0	13	65	234	52	3.89	0.67	12
Not moving at right distance	0	0	13	195	156	4.39	0.56	7
Unsafe behavior of pedestrians	0	26	26	52	260	4.5	0.91	6
Animal and carts using the road	0	52	65	221	26	3.61	0.82	15
Low level awareness of user	0	0	52	234	78	4.07	0.59	10
Inadequate pedestrian walk way	0	13	0	208	143	4.32	0.66	8
Climate condition such as rainy season, foggy	0	13	65	260	26	3.82	0.60	14
Poor road conditions	0	0	78	260	26	3.86	0.52	13
					GRAND MEAN	4.27		

From table 4.2 above, out of the total respondents(n=364), the participants revealed that the major causes of road traffic accident in Addis Ababa city have drivers that are with over-speeding 325 (89.3%, ***M= 4.86***) followed by failure to give the right of way for pedestrian 299 (82.1%, ***M= 4.79***) and ignorance of the and violation of traffic rules and regulation 299 (82.1%, ***M= 4.71***) and Driving while talking on mobile phones234 (M=4.54)The crash impact due to higher speeding is more destructive and increases the severity of the damage.

In the present study the major causes of road traffic accident was the problems related with over-speeding of drivers, ignorance and violation of traffic rules and regulation by the drivers and failure to give the right of way for pedestrian. Where the major causes of traffic accident was drivers' faulty habit. This is consistent with the study done (Ally S. Nyamawe & and Emmanuel C. Mbosso, 2014;Kerala, 2013; Derek, 2012, Hager yilma,2014) This indicates that the drivers' personal behavior contributes more to causes of accident which implies that behavioral education and controlling mechanisms should be applied to ICT devices in order to reduce the accident.

4.1.1. Results found from secondary

Table 4.3 Trend of causes of traffic accident in Addis Ababa (2005-2010 E,C)

causes of traffic accident in Addis Ababa	2005	2006	2007	2008	2009	2010
Ignorance of the rules and violation of the rules and regulation	8836	8645	12348	10351	13178	13239
Failure to give the right of way for pedestrian	2,514	3,484	1,896	2,301	3,502	2472
Wrong driving habits and aggressive driving	1,369	1,392	1,786	4197	3240	2737
Drivers exceeding speed limits/over-speeding	499	759	679	1,881	1922	2737
Total accidents recorded in Addis Ababa caused by the above factors	13,218 (83%)	14,280 (79%)	16,709 (81%)	18,730 (91%)	21,842 (81%)	21,185/ (74%)
Total no of accident recorded in Addis Ababa	/15,815	/17,904	/20,434	/20,434	/26,937	28,364

From 2005-2010 E.C the traffic accidents causes were summarized in to four major areas namely ignorance of the rules and violation of the rules and regulation, failure to give the right of way for pedestrian, wrong driving habits and aggressive driving and drivers exceeding speed limits or over-speeding. For instance in 2005 E.C ignorance of the rules and violation of the rules and regulation was the major cause of traffic accident which comprises 55.9% of the total accident encountered. The second major cause of road traffic accident was failure to give the right of way for pedestrian 15.89%.

The result obtained from the above report shows that the results are similar with outcomes of the questionnaire which states that the cause of accidents has been mostly due to human error accounting for about 80-90% of the road fatalities and include; Ignorance of the rules and violation of the rules and regulation(careless driving), over speeding, failure to give the right of way for pedestrian, driving while talking on mobile phones and driving under the influence of alcohol or drugs among others .

Table 4.4.Major causes of road traffic congestion (n=364)

Major causes of road traffic congestion	Frequency					Stat		RANK
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	S.d	
Inflexible office Working hours and school include fixed the opening hours of certain can increase traffic congestion in peak periods significantly	13	0	52	195	104	4.04	0.87	12
Increases in personal vehicles, lack of ride sharing and small number of public transport	0	26	26	78	234	4.43	0.63	6
Special vehicles like trucks travel through the city during day time (6:00AM-10:PM)	0	0	52	130	182	4.36	0.72	8
Reduction of road space due to road construction and maintenance	0	0	26	299	39	4.44	0.42	3
On street vendors/street vendors	0	0	26	130	208	4.43	0.63	5
Inefficient use of road networks and poor design of roads.	0	0	39	247	78	4.11	0.56	11
Weak enforcement capability	0	0	0	273	91	4.25	0.43	9
Population growth	0	13	0	273	78	4.44	0.58	4
Vehicle break downs and/or abandoned crashed vehicle	0	13	91	247	13	3.71	0.59	16
Drivers' lack of sense of traffic rule [such as running red lights, driving on the wrong side of a street, in wrong lanes or on sidewalks, in the middle of a street in rush hours to buy something from street vendor or to give ride or drop someone without caring about those behind them]	0	0	39	117	208	4.46	0.68	2
Lack of traffic discipline in pedestrians crossed the streets in the middle of flowing traffic without using priority light systems or overpasses built for them	0	0	65	78	221	4.43	0.78	7
Unplanned stoppage/On street parking	0	26	13	52	273	4.57	0.87	1
Lack of bus terminal	0	13	65	221	65	3.93	0.70	15
Availability of road traffic accidents	0	0	52	260	52	4.00	0.54	14
Poor design and condition of the road	0	0	26	260	78	4.14	0.52	10
Increased vehicle density and vehicle population	13	26	39	143	143	4.04	1.05	13
RAND MEAN					G	4.23		

Source: own survey 2019

From the above table 4.4, it can be revealed that the study respondents replied that the major causes of road traffic congestion at Addis Ababa city were problem created due to the parking of vehicles on the road which is improper or unplanned parking takes the first cause of traffic congestion is 273 (75%, M= 4.57) ,Drivers' lack of sense of traffic rule [such as running red lights, driving on the wrong side of a street, in wrong lanes or on sidewalks, in the middle of a street in rush hours to buy something from street vendor or to give ride or drop someone without caring about those behind them] was the second cause (M=4.46), reduction of road space because of road construction and maintenance is 299 (82.1%, ***M= 4.44***) was the third cause of traffic congestions as reported by the participants in addition to these, On street vendors/street vendors , the increasing number of the population, increased vehicle density and vehicle population, Increases in personal vehicles, lack of ride sharing and small number of public transport also the major causes of road traffic congestion in Addis Ababa city.

Table 4.5.Types of ICT adopted for enhancing traffic monitoring (n=364)

Variables	Frequency					Stat	
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	S.d
Addis Ababa TM Uses modern mobile devices and applications and internet technologies for traffic monitoring and exchange information(social media, Twitter)	156	117	39	26	26	2.04	1.21
Addis Ababa TM has Speed control system (like speed camera) that takes pictures of cars that are going faster than is leg ally allowe	117	169	26	26	26	2.11	1.15
Close Circuit Television (CCTV) is often placed on top of traffic signal and along busy road as well as at busy intersections of the high way for recording traffic patterns for future study and observation or monitoring traffic and issuing tickets for moving violation in Addis Ababa .	247	52	39	13	13	1.61	1.05
The Addis Ababa TM uses car navigation; traffic signal control systems; variable message signs; automatic rush hour navigation system in Addis Ababa.	234	78	13	26	13	1.64	1.08
There is Car plate recognition system or speed cameras CCTV (Close Circuit Television) system in Addis Ababa to monitor the security of the traffic system.	247	78	0	26	13	2.57	1.05
There is Variable Message Signs (VMS) is used to give travelers information about warns, journey time, guide the motorists on high ways and expressways depending on the traffic situation.	260	65	39	0	0	1.39	0.67
There is Insurance status information system used for detecting the insurance status of traffic.	247	52	52	13	0	1.54	0.87
Geographic Information Systems (GIS)or GPS for road navigation is being used for tracking vehicles' over speeding.	247	39	39	26	13	1.68	1.14
There is frequent traffic audit with Breath analyzers(Intoxicated condition)	39	182	65	52	26	2.57	1.08
There is making the payment through the website Offenders of various traffic laws.	247	65	13	13	26	1.64	1.17
There is Database Management Systems (DMS) for traffic monitoring.	91	208	52	0	13	2.00	0.85
Radio Frequency Identification (RFID)	26	39	117	156	26	3.32	1.00
We use walkie-talkies for traffic monitoring	13	13	52	143	143	4.07	1.00
					Grand mean	2.29	

Source: own Source 2019

Table 4.5, revealed that the types of ICT adopted for enhancing traffic monitoring such as Variable Message Signs (VMS) which is used to give travelers information about warns, journey time, guide the motorists on high ways and expressways depending on the traffic situation where 260 (71.4% ***M= 4.07***) respondents urged the need to be adopted where 247 (67.9%, ***M= 3.32***) respondents replied Radio Frequency Identification (RFID) which is often placed on top of traffic signal and along busy road as well as at busy intersections of the high way for recording

traffic patterns for future study and observation or monitoring traffic and issuing tickets for moving violation in Addis Ababa is not available. Other technologies such as a car plate recognition system or speed cameras CCTV (Close Circuit Television) system are used to control traffic accidents and congestion as 247 (67.9%, ***M= 2.57***) of the respondents gave responses reported.

The findings of the study showed that the types of information communication technologies adopted for enhancing traffic monitoring such as Variable Message Signs (VMS) are not available as reported by 71.4% of respondents, 67.9% said that Close Circuit Television (CCTV) is not available and also Other technologies such as a car plate recognition system or speed cameras CCTV (Close Circuit Television) system are not used to control traffic accidents and congestion as revealed by 67.9% of the respondents. Traffic police only uses partially electronic equipment/gadgets such as speed guns, walkie-talkies and breathalyzers to enforce road safety regulations. This indicates that the need to adopt and utilize the technology which leads to reduce traffic accident and congestion.

In general, there has been less emphasis on utilization and adoption of Road Communication Technologies (RCTs) especially Database Management Systems (DMS), Geographic Information Systems (GIS), Internet Technologies, Electronic Data Interchange (EDI), Radio Frequency Identification (RFID) and in promoting road safety awareness.

However, according to Storovic (2004), Glady (2010), Fourie (2009) Young &Reagan (2007) different information communication technologies were implemented to control traffic problems and increase safety. The contradiction in the studies may attribute to the presence of the awareness of the importance of the information technology and the capacity to own the necessary equipment.

Table 4.6. Question to assess the role of ICT in enhancing good governance in road traffic management (n=364)

Variables	Frequency					Stat	
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	S.D
Now a days ICT is properly utilized to empower concerned party to act proactively and respond swiftly to emergencies thus protecting lives, properties and infrastructure, maintaining the nation's overall wellbeing and resilience, resulted from road traffic accident.	143	169	13	13	26	1.93	1.10
Adoption of ICT to provide real time information to the society created awareness through mobile devices, social media networks (like Facebook, tweeter etc.) highly reduced traffic accident and congestion and also helps to improve mobility.	137	189	35	3	0	1.74	0.66
Road Communication Technologies (as a range of systems or gadgets that can be applied to detect incidents).	208	78	39	13	26	1.82	1.20
In Addis Ababa implemented adaptive traffic control systems on a city corridor that automatically and continuously adjusts signal timing based on real-time demand	208	117	13	0	26	1.68	1.07
There is fixing multiple cameras capturing the traffic movement key locations overlooking the main roads, connecting them over a wireless network and streaming videos to central control rooms where capturing data combined with special data combined with is presented over live situational digital maps.	260	52	26	0	26	1.57	1.12
There is the database of TM can (partially) be made available for the public (e.g. in the internet), which allows people to plan journeys	234	78	26	0	26	1.64	1.11
GRAND MEAN						1.73	

Source: own Source 2019

Table 4.6 has revealed 260 (71.4%, *M= 1.93*) of the respondent's reported that the absence of fixed multiple cameras to capture the traffic movement at key locations to overlook the main roads, connecting them over a wireless network and streaming videos to central control rooms and capturing data combined with special data for further use and locate situational digital maps is quiet detrimental to the traffic system management and 234 (64.3%, *M= 1.82*) of the respondents indicated that There is no road communication technologies, the database of traffic

management that can (partially) be made available for the public (e.g. in the internet), which allows people to plan journeys.

According to the study, the role of information communication technologies in good governance is quiet important, as 71.4% of the respondent's reported that the need to have fixed multiple cameras systems and data transfer between key locations to overlook the main roads, store data combined with special data for further use and locate situational digital maps is essential to the traffic system. Likewise 64.3% of the respondents indicated that the importance of the database of traffic management that can (partially) be made available for the public. Consistent to the study was done Ivana & Kojic (2010), Glady (2010), Fourie (2009) Young &Reagan (2007) which revealed that information communication technology systems help sharing of data regarding road safety, integrate road and vehicles and by then helped people protect from traffic accident, reduce the intensity of traffic, support traffic control.

Table 4.7. Question to assess the availability of traffic management system in response to road safety towards minimizing traffic injuries and congestion (n=364)

Variables	Frequency					Stat	
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	S.D
There is a Motorist Advisory, Alert and Warning Systems adopted for road safety	260	65	13	13	13	2.9	0.98
There is a Driver license and offender payee system adopted to save time of customer	221	52	26	65	0	1.82	1.67
There is a Speed Management Strategies Systems adopted to reduce traffic accident and congestion	143	130	39	39	13	2.04	1.12
There is a Vehicle Restrictions Strategies Systems	234	65	39	13	13	2.64	1.04
There is a Route restrictions Strategies Systems	169	104	52	26	13	1.93	1.10
There is a Traffic Signal Control Strategies Systems	117	143	39	52	13	2.18	1.14
There is a Traffic Incident registrations soft Management Systems	39	221	65	13	26	2.36	0.97
There is a Personnel/Asset Management	52	195	104	13	0	2.21	0.73
There is an Agency Coordination between Addis Ababa Traffic police, Transport management road construction agency, Hospitals and other concerned body.	39	195	39	65	26	2.57	1.12
There is an Active warning system for road users approaches the rail way crossing	65	52	130	91	26	2.89	1.18
There is a Pre-Trip Road condition information and forecast systems	195	52	78	13	26	1.96	1.24
There is an En-Route weather alerts and pavement condition information	169	52	52	78	13	2.21	1.32
MEAN				GRAND		2.30	

Source: own Source 2019

Table 4.7, regarding the practice of ICT at Addis Ababa road traffic management office the report of the current study participant revealed that the availability of traffic management system in response to road safety towards minimizing traffic injuries and congestion at Addis Ababa city administration was poor. The road traffic management agency practice of ICT in order to manage road traffic system was at very low level where 260 (71.4%, ***M=2.9***)of the participants reported that there is no motorist advisory, alert and warning systems adopted for road safety, followed by 234 (64.3%, ***M=2.64***) the absence of a vehicle restrictions strategies systems.

According to this study, the practice of information communication technologies used in road traffic management was poor. From respondents as much as 71.4% replied that there is no motorist advisory, alert and warning systems adopted for road safety. Similarly 64.3% reported the absence of vehicle restrictions strategies systems. This indicates that the absence of technological supports in the sector which implies the importance of information communication technology in reducing road accidents. Contrary to this finding was the study done at Kerala (2013) which practiced information technology system at various levels to reduce the road accident. The study found that agencies or organizations responsible for reducing road accidents implemented different forms of ICT and reduced road accidents. The difference in the results may be due to the information technologies adopted to reduce the road traffic accidents and the availability of trained personnel who can handle the technologies.

Table 4.8.challenges of adoption of ICT in road traffic management (n=364)

challenges of adoption of ICT in road traffic management	Frequency					Stat		
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	S.D	Rank
Inefficient traffic policy	26	0	78	182	78	3.79	1.01	16
Lack of integrated ICT policy for the transportation sector	0	13	13	234	104	4.18	0.66	4
Lack of political leadership ,commitment focusing on prioritizing the acquisition and usage of ICT	0	26	39	182	117	4.07	0.84	8
Low bandwidth for TM	0	39	39	195	91	3.93	1.80	12
Poor ICT infrastructure, Outdated ICT technology	13	26	26	143	156	4.11	1.05	6
Lack of poor maintenances of ICT technology for TM	13	13	65	78	195	4.17	1.07	5
Population and economic growth is becoming a challenge for TM	13	13	52	91	195	4.21	1.05	2
Resistance to change to adopt ICT for TM	26	13	13	182	130	4.03	1.09	9
Language barriers in adopting ICT for TM	26	26	0	104	208	4.21	1.21	3
Lack of employee satisfaction with their job	26	13	65	247	13	3.57	0.90	17
Lack of awareness about the role of ICT for TM	26	0	52	182	104	3.93	1.03	10
High cost of ICT installation for TM	13	26	26	234	65	3.86	0.92	14
Rain and foggy environment	0	0	156	169	39	3.68	0.66	18
Lack of trained personnel(use and manage ICT)	0	143	26	0	195	3.67	0.65	17
Lack of ICT software and hardware,	26	13	26	247	52	3.79	0.72	13
Technical such as poor network reception, slow internet connection and system integration problem	26	13	26	195	104	3.93	1.07	11
Management and leadership related factor	13	0	26	273	52	4.96	0.73	1
Lack of transparency for adoption of ICT for TM	26	13	26	130	169	4.11	1.15	7
Grand MEAN						3.97		

Source: own Source 2019

Out of the total participants, 273 (75%, *M=4.96*) agreed that management and leadership related factors are hindering the adoption of information technology followed by 247(67.9% *M=4.21*) lack of information technology equipment, 247(67.9%, *M=3.57*) employees less job satisfaction, 234 (64.3%) high cost of information communication technology installation for traffic management, 234 (64.3%) lack of integrated information communication technology policy for the transportation sector were the major challenges reported by the respondents respectively.

The study also found that there are challenges to adopt information communication technologies in traffic management. The study revealed that 75% of the respondents said that management and leadership related factors, 67.9% lack of information technology equipment, 67.9% employees less job satisfaction, 64.3% high cost of information communication technology

installation for traffic management, 64.3% lack of integrated information communication technology policy for the transportation sector were the major challenges reported by the respondents respectively. Consistent with this study were found in Kenya (Thanga, 2016), Busagala (2013) which revealed factors influencing the adoption and utilization of information technology in traffic management are lack of essential skills, poor information communication technology infrastructure, absence of electricity, under developed infrastructure, outdated information communication technology. The similarity of the studies may be due to the factors related to lack of trained personnel that can operate the technology, financial capacity and policy issues.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Introduction

In this chapter the summary of the findings are provided, and conclusions are drawn in light of the objectives of the study. The researcher then presents recommendations for both the research and for improvement by the institutions under study. Finally, it highlights suggestion for further study by other researchers in the future.

5.2. Summary of Major Findings

The research aims at examining the level of utilization and adoption information communication technology in Addis Ababa, Ethiopia. Accordingly to meet this objective, the researcher has developed a questionnaire from the relevant literature to collect and analyze the opinions of the study sample. The respondents of the study were working at different road traffic control sectors with different knowledge of ICT and related systems .The following findings are obtained;

Trend of causes of traffic accident

In the present study the cause of car accidents has been mostly due to human error accounting for about 80-90% of the road fatalities and include; over-speeding of drivers, ignorance and violation of traffic rules and regulation by the drivers and failure to give the right of way for pedestrian, Driving while talking on mobile phone and driving under the influence of alcohols. The analysis and the observation of researcher showed that most sub city police stations did not have solution to control the major cause of car accidents. They have very small number of a radar gun and breathe analyzer. However, even with enough supply of speed radar guns, it is still challenging to have promising number of traffic inspection points all over the trunk roads across regions in the city. The used speed radar guns are only for reading a speed of one vehicle at a time and it is difficult to carry full days.

In this aspect there is a need for technological intervention that will ensure constant tracking of vehicles' speed in transit. According to the above analysis indicates that the drivers' personal behavior contributes more to causes of accident which implies that behavioral education and ICT controlling mechanisms should be advised and recommended in order to reduce the accident.

Scholars like Derek, (2012), Giannopoulos, (2004), Gifford, (2010), Jarašūniene, & Jakubauskas, (2007) and Lu, (2005) have underlined the importance of communication technologies in increasing road safety through enabling road safety regulation enforcement and driver compliance.

Trend of causes of traffic congestion

It can be revealed that the study respondents replied that the major causes of road traffic congestion at Addis Ababa city were problem created due to reduction of road space because of road construction and maintenance accounting for 299 (82.1%, M= 4.44) was the first as reported by the participants and the parking of vehicles on the main road which takes the second cause of traffic congestion that is 273 (75%, M= 4.43) , and the increasing number of the population in the city counts 273 (75%, M= 4.43) of the responses, and others like on street vendor, lack of sense of traffic rule, Special vehicles like trucks travel through the city during the day (6:00AM-10:PM), increases in personal vehicles, lack of ride sharing and small number of public transport have great impact contributing to increase in road congestion.

ICT adopted for enhancing traffic monitoring

The study showed that the types of information communication technologies adopted for enhancing traffic monitoring such as Variable Message Signs (VMS) are not available as reported by 71.4% of respondents,, car plate recognition system, Database Management Systems (DMS), Geographic Information Systems (GIS), Electronic Data Interchange (EDI), Radio Frequency Identification (RFID) and in promoting road safety awareness are not available. There is weak internet technology , modern mobile application are not efficiently utilized in traffic monitoring and also other technologies such as 67.9% said that a speed cameras CCTV (Close Circuit Television) system are not used to control traffic accidents and congestion. Traffic police only uses partially; speed guns, walkie-talkies and breathalyzers to enforce road safety regulations. And as inadequate as these RCTs may be, they have had little significance in collecting electronic data that would be important for the road safety awareness promotions. This indicates that the need to adopt the technology which leads to reduced traffic accident and congestion. Mobile application enables to get information about the road conditions for all participants in the traffic at the proper time with intention to reduce costs, loss of valuable time

as well as reduction of congestion in the city. In general, there has been less emphasis on utilization and adoption of Road Communication.

The role of information communication technologies

According to this study, ICT is not properly utilized to empower traffic police, protecting human life and their property, there is lack of information exchange by using social media like Facebook and tweeter, lack of GPS, the absence of vehicle restrictions strategies systems, there is no motorist advisory, there is no alert and warning systems adopted for road safety, low level of internet access and information system. There are no fixed cameras on the specific road integrated with Addis Ababa police Commission central control room. Due to these and other related problem Addis Ababa Police commission could not be utilizing their ICT control room effectively to facilitate road congestion and monitor road traffic. Likewise 64.3% of the respondents indicated that the importance of the database of traffic management that can (partially) be made available for the public and which revealed that information communication technology systems help sharing of data regarding road safety, integrate road and vehicles and by then helped people protect from traffic accident, reduce the intensity of traffic, support traffic control and the citizen can get reliable information to plan their journey.

There is Poor traffic fine paying system, absence of Online Payment system due to this reason traffic rule offenders lose their precious time, they are obliged to spend more than one day.

In general the practice of information communication technologies used in road traffic management was poor.

Challenges to adoption of ICT in road traffic management

The study also reveals that there are challenges to adopt information communication technologies in traffic management. The management and leadership related factors, lack of information technology equipment, employees less job satisfaction, lack of essential skills, high cost of information communication technology installation for traffic management, lack of integrated information communication technology policy, inadequate training on ICT for the transportation sector were the major challenges reported by the respondents respectively**.**

5.3. Conclusions

In general the study concludes that every day road users are faced with the problems in traffic. The major causes of road fatalities have been mostly due to human error accounting for about 80-90% of the fatalities. The data for the study has revealed that the practice of information communication technologies used in road traffic management has been found to be too poor and under developed. Traffic police only uses electronic equipment such as speed guns, walkie-talkies and breathalyzers to enforce road safety regulations. Based on these findings, the researcher recommended that traffic police, traffic management agency and other stakeholders have to utilize and adopt information communication technology to empower traffic police in performing their daily tasks by quickly identifying the traffic jam points, shortest route for accessing accident locations, defining alternatives and providing help, the solution enables accurate monitoring and analysis of vehicles daily movement and quick response to breakdowns and accidents by fixing multiple cameras capturing the traffic movement key locations overlooking the main roads connecting them over wireless network and streaming videos to Addis Ababa police Commission central control rooms where captured data combined with special data is presented over live situational digital maps, useful traffic information should be provided to road users via mobile messages and digital road signs to avoid congestions and take alternative routes in case of emergencies finally improved road users' safety.

5.4. Recommendations

The researcher recommends that to minimize car accidents and traffic congestion problems that require radical solutions to facilitate the traffic movement and resolve daily jams, usually caused by regularly increasing number of vehicles comparing for space that doesn't easily expand to cater for increased number of daily travellers.

- The political leadership must prioritize the acquisition and use of ICTs in various zones of the different agencies across the state and make budgetary allocation that could support that drive.
- Traffic management agency and other stakeholders have to utilize and adopt information communication technology to empower traffic police in performing their daily tasks by quickly identifying the traffic jam points, shortest route for accessing accident locations,

defining alternatives and providing help, the solution enables accurate monitoring and analysis of vehicles daily movement and quick response to breakdowns and accidents,

- Useful traffic information should be provided to road users via mobile messages and digital road signs to avoid congestions and take alternative routes in case of emergencies. Traffic surveillance solution empowers decision making by enabling jam source identification, quick resolutions for traffic jams, timely response to accidents and emergencies, flow pattern analysis, enhance good governance and finally result in improved passengers' safety.

- Employees of various government departments who are working with related in traffic safety should be trained in various technological applications and trends in information service and delivery to enhance the services they provide

- The leaders should give chance to their employee to make a part of solution, they should be motivating them.

- Addis Ababa police Commission and Traffic Management and other concerned departments and agencies should work together to manage traffic flow and prevent road accident by implement an integrated wireless surveillance solution by fixing multiple cameras to capture the traffic movement key locations overlooking the main roads, traffic signal light, connecting them over a wireless network and streaming videos to central control rooms where capturing data combined with special data have to be presented over live situational digital maps to give quick resolutions for traffic jams, timely response to accidents and emergencies, flow pattern analysis and finally improved passengers' safety.
- Special vehicles like trucks that travel through the city should not be allowed during day time and should operate only afer10:00pm night to morning 6:00pm and also they should be adopt systems of vehicle restrictions strategies.
- Addis Ababa regulatory body has to take action on street vendors
- One of the innovations that applications can provide the user is that application possesses (GPS) combined with geographical information system (GIS) what offers possibility for reducing of the time on the network. Assuming that a user inserts his starting point and the destination in system, the shortest route will be suggested.

- Ethio telecom has a big role and responsibility on traffic management so it should provide application possesses (GPS) combined with geographical information system (GIS) what offers possibility for reducing of the time on the network. Assuming that a user inserts his starting point and the destination in system, the shortest route will be suggested. to reduce accident, costs loss of valuable time and money as well as reduction of congestion in Addis Ababa city .

- To solve the good governance related to traffic fine payment problems the traffic management agency should facilitate online payment system for traffic rules offenders so that offenders can make the payment through the web site efficiently example [www.payment.Traffic Management agency.gov.in] or Payment can be made through net banking or ATM card or it should increase the number of intermediary collection service provider Bill Desk.
- Traffic management agency should initiate to use mobile and web application to increase awareness of road safety given their wireless connectivity with driver& pedestrian mobile devices to endorse road safety awareness.
- Web application should give possibility to inform other users – citizens through news about the most important events, useful information about changes in the traffic as well as suggestions by the users that the state decided to make.
- Database Management Systems (DMS) should apply in Addis Ababa police Commission to provide real information for their customer and for the decision makers.
- To minimize Driving while talking on mobile phones related problems Government should promote awareness of safe user interfaces and hands-free devices in vehicles and promote quality standards for in car communications and also the government should encourage importation of cars with in-car communications and focusing on quality parameters to mitigate use of handheld devices
- To mitigate lack of driving knowledge is due to inadequacies in driver training, testing and annual vehicle inspection and related problems need to fixing multiple cameras capturing the traffic movement key places overlooking the main roads, connecting them in access of a wireless network and streaming videos to central control rooms where capturing data shared with special data is presented over live situational digital maps use ICT. enforced effectively by adopting and utilizing ICT.

5.5. Suggestion for Further Study

This research is conducted only on Addis Ababa. Therefore, the researcher recommends that other researchers include regional Adoption Information Communication Technology in traffic management of Ethiopia.

This study focused only on adoption ICT in traffic management but there is another solution for traffic management such as data management, creating awareness, and unethical practice, behavioral change of drivers and pedestrians as well as engineering (construction).

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Appendix I

Addis Ababa University Collage of Commerce

Department of supply chain and logistics management

Dear respondent,

My name is Getenet Abera and I am carrying out an academic research on examine **"The adoption of Information communication technology for Traffic Management in Addis Ababa, Ethiopia:"**

The validation of the research objectives depends on your genuine and timely response by completing the attached questionnaires. I would like to assure you that the information acquired shall be used purely for academic purpose only and will be kept strictly confidential. Please indicate your level of agreement or disagreement by using **(√ or x)** mark on the appropriate box given corresponding to each statement, Please state your opinion on the space provided for open question and no need of writing your name.

Your co-operation and assistance will be highly appreciated. If you need any clarification or information use my contact address: Mob.0911434045 E-mail. getasebw@gmail.com

Dear respondents I am having study on evaluating /examining/ the adoption of Information communication technology to prevent traffic accident and reduce congestion in Addis Ababa, Ethiopia: please show your level of agreement on the following questions.

Part one: Demographic information of respondent

1. Gender

a) Male ☐ b) Female ☐

2. Educational level

a) Uneducated ☐ c) 1-8grade ☐

b) Read and write only ☐ d) 9-12grade ☐

e) Degree holder ☐ f) Diploma Holder ☐

g) Master's Degree and above ☐

3. Occupations ----------

4. Qualifications of ICT

1. Learner ☐ 2. Advance ☐

3. Sufficient ☐ 4. Proficient ☐

5. Does traffic management office gives you ICT training?

1. YES ☐

2. NO ☐

Part two: Please answer the following traffic management system work on road safety related issues!

1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly agree

1	**The major Causes of road traffic accident in Addis Ababa**	1	2	3	4	5
	Driving under the influence of alcohol/drunken driving/					
	Driving while talking on mobile phones					
	Drivers exceeding speed limits/over-speeding/					
	Lack of driving knowledge					
	Wrong driving habits and aggressive driving,					
	Ignorance of the rules and violation of the rules and regulation					
	Failure to give the right of way for pedestrian					
	Excess loading					
	Not moving at right distance					
	Unsafe behavior of pedestrians					
	Animal and carts using the road					
	low level awareness of user					
	Inadequate pedestrian walk way					
	Climate condition such as rainy season, foggy					
	Poor road conditions					
2	**The major Causes of road traffic Congestion**	1	2	3	4	5
	Inflexible Working hours office and school include fixed the opening hours of certain can increase traffic congestion in peak periods significantly					
	Increases in personal vehicles, lack of ride sharing and small number of public transport					
	Special vehicles like trucks travel through the city in day time (6:00AM-10:PM)					
	Reduction of road space due to road construction and maintenance					
	On street vendors					
	Inefficient use of road networks and poor design of roads.					
	Weak enforcement capability					
	Population growth					
	Vehicle break downs and/or abandoned crashed vehicle					
	Drivers' lack of sense of traffic rule such as running red lights, driving on the wrong side of a street, in wrong lanes or on sidewalks, in the middle of a street in rush hours to buy something from street vendor or to give ride or drop someone without caring about those behind them					
	Lack of traffic discipline in pedestrians crossed the streets in the middle of flowing traffic without using priority light systems or overpasses built for them					
	Unplanned stoppage/On street parking					
	Lack of bus terminal					
	Availability of road traffic accidents					
	Poor design and condition of the road					
	Increased vehicle density and vehicle population					
Organizational internal factor Management and leadership related factor						
Lack of transparency for adoption of ICT for TM						

3. Types of ICT adopted for enhancing road traffic monitoring (traffic accident prevention and reduce congestion for traffic monitoring	1	2	3	4	5
Addis Ababa TM Uses modern mobile devices and applications and internet technologies for traffic monitoring and exchange information(social media, Twitter)					
Addis Ababa TM has Speed control system (like speed camera) that takes pictures of cars that are going faster than is legally allowed					
Close Circuit Television(CCTV) is often placed on top of traffic signal and along busy road as well as at busy intersections of the high way for recording traffic patterns and issuing tickets for moving violation in Addis Ababa .					
The Addis Ababa TM uses car navigation; traffic signal control systems; variable message signs; automatic rush hour navigation system in Addis Ababa..					
There is Car plate recognition system or speed cameras CCTV (Close Circuit Television)system in Addis Ababa to monitor the security of the traffic system.					
There is Variable Message Signs (VMS) is used to give travelers information about warns, journey time, guide the motorists on high ways and expressways depending on the traffic situation.					
There is Insurance status information system used for detecting the insurance status of traffic.					
Geographic Information Systems (GIS)or GPS for road navigation is being used for tracking vehicles' over speeding.					
There is frequent traffic audit with Breath analyzers(Intoxicated condition)					
There is making the payment through the website Offenders of various traffic laws.					
There is Database Management Systems (DMS) for traffic monitoring.					
Radio Frequency Identification (RFID)					
We use walkie-talkies for traffic monitoring					
4. Role of ICT in enhancing good governance in road transport management	1	2	3	4	5
• ICT helps empower Addis Ababa traffic police, traffic management agency, transport authority and other involved governmental authorities to act proactively and respond swiftly to emergencies thus protecting lives, properties and infrastructure, maintaining the nation's overall wellbeing and resilience, resulted from road traffic accident.					
• Adoption of ICT to provide real time information to the society created awareness through mobile devices, social media networks (like Facebook, tweeter etc.,) highly reduced traffic accident and congestion and also helps to improve mobility .					
• Road Communication Technologies (as a range of systems or gadgets that can be applied to detect incidents).					
• In Addis Ababa implemented adaptive traffic control systems on a city corridor that automatically and continuously adjusts signal timing based on real-time demand					
• There is fixing multiple cameras capturing the traffic movement key locations overlooking the main roads, connecting them over a wireless network and streaming videos to central control rooms where capturing data combined with special data combined with is presented over live situational digital maps.					
• There is the database of TM can (partially) be made available for the public (e.g. in the internet), which allows people to plan journeys					

5.Availability of traffic management systems in response to road safety towards minimizing traffic injuries and traffic conjugations	1	2	3	4	5
A)Motorist Advisory, Alert and Warning Systems adopted for road safety					
B)Driver license and offender payee system adopted to save time of customer					
C)Speed Management Strategies Systems adopted to reduce traffic accident and congestion					
D)Vehicle Restrictions Strategies Systems					
E)Route restrictions Strategies Systems					
F)Traffic Signal Control Strategies Systems					
G)Traffic Incident registrations soft Management Systems					
H)Personnel/Asset Management					
I)Agency Coordination between Addis Ababa Traffic police, Transport management ,Road construction agency, Hospitals and other concerned body.					
WR-TMS are based on several technologies such as:					
-There is Active warning system for road users approaches the rail way crossing					
-Pre-Trip Road condition information and forecast systems					
-En-Route weather alerts and pavement condition information					
6.Challenges to adoption of ICT in road traffic management	1	2	3	4	5
Legal and political factor • Inefficient traffic policy					
• Lack of integrated ICT policy for the transportation sector					
• Lack of political leadership ,commitment focusing on prioritizing the acquisition and usage of ICT					
Technological factor • Low bandwidth for TM					
• Poor ICT infrastructure, Outdated ICT technology					
• Lack of poor maintenances of ICT technology for TM					
Socio cultural factor • Population and economic growth is becoming a challenge for TM					
• Resistance to change to adopt ICT for TM					
• Language barriers in adopting ICT for TM					
• Lack of employee satisfaction with their job					
• Lack of awareness about the role of ICT for TM					
Economic factor • High cost of ICT installation for TM					
Natural environment factor such as rain and foggy					
• Lack of trained personnel(use and manage ICT)					
Infrastructure: that enables the availability and accessibility of ICT • Lack of software and hardware,					
• Technical such as poor network reception, slow internet connection and system integration problem					

If others please specify: ……..

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Thank you!