UNIVERSITY OF CAPE COAST

EFFECTIVENESS OF ROAD TRAFFIC CONGESTION MEASURES IN THE SEKONDI -TAKORADI METROPOLIS, GHANA

ASARE-PELLE FOSTER

2020

UNIVERSITY OF CAPE COAST

EFFECTIVENESS OF ROAD TRAFFIC CONGESTION MEASURES IN THE SEKONDI -TAKORADI METROPOLIS, GHANA

BY

FOSTER ASARE-PELLE

Thesis Submitted to the Department of Geography and Regional Planning, Faculty of Social Sciences, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy degree in Geography and Regional Planning

MARCH 2020

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:……..…….. Date…….....……

Name: Foster Asare-Pelle

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature……..…Date……..……

Name: Dr. Mrs. Regina Obilie Amoako-Sakyi

Co-Supervisor's Signature……..… Date……..……

Name: Prof. Kwabena Barima Antwi

ABSTRACT

An effective transportation system is significantly important in sustaining economic growth in modern-day economies as it provides connections between different parts of the country and the global world. Good road network links to work, deliver products to market, underpins logistics and supply chain, and also support local and international trade. However, it has been observed that road traffic congestion has been a major transport challenge faced by cities in Ghana. It is against these premise that this study is been conducted to investigate the causes and effects of traffic congestion in the Sekondi-Takoradi Metropolis. The target population of the study were drivers, motor-cycle riders and stakeholders involved in road traffic management. A total of 198 respondents were sampled for the study. Questionnaire and interview guides were employed for data collection. Interviews were transcribed and then categorised under specific themes. Data from questionnaire were analysed using frequencies, percentages, means and standard deviations. Results indicated that the major causes of road traffic congestion included picking and dropping of passengers on the road, inadequate parking space, inadequate routes, illegal parking, as well as bad attitudes of drivers in the metropolis. Economically traffic congestion increased drivers expenditure on fuel and also passengers complained of delays to work and other social activities. Current road traffic congestion measures instituted to check the traffic situation were not effective in reducing the menace. The study recommends that, rules governing road traffic acts in the metropolis should be enforced by the Motor and Traffic Directorate of the Ghana Police Service and Sekondi-Takoradi Metropolitan Assembly.

ACKNOWLEDGEMENTS

I would like to express my profound gratitude to my supervisor Dr. Mrs Regina Obilie Amoako-Sakyi and Prof. Kwabena Barima Antwi for their advice, comments, suggestions and encouragements which made it possible for me to complete this work. I would also like to register my deepest appreciation to Prof. M.A Abane, Prof. Kumi Kyeremeh, Prof. Simon Mariwa, Dr. Collins Mensah, Dr. Thomas Ojo and Mr. Adams Osman of the Department of Geography and Regional Planning, University of Cape Coast for their advice and encouragement throughout my period of study.

I also wish to thank the drivers and officials of road management institutions in Sekondi-Takoradi metropolis for taking time off their busy schedule to respond to my questionnaires and thus contributing effectively the ideas needed to make this study a success. I am again indebted to friends, colleague workers and well-wishers who assisted me in diverse ways and contributed immensely towards the completion of this study.

More importantly, I wish to acknowledge the support given to me by Mr. Emmanuel Ewoo, Mr. Francis Agbalenyo, Mr. Simon Ntumi and my colleague students at the Department of Geography and Regional Planning, University of Cape Coast whose contributions and criticisms helped to shape this work.

DEDICATION

To my lovely daughter, Abena Nhyira Asare-Pelle

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ACRONYMS

BRTA	Bangladesh Road Transport Authority
BRTS	Bus Rapid Transit System
STMA	Sekondi-Takoradi Metropolitan Assembly
DVLA	Driver Vehicle and Licensing Authority
ECMT	European Conference of Transport Ministers
FHWA	Federal Highway Administration
GHA	Ghana Highway Authority
GPRTU	Ghana Private Road Transport Union
MMT	Metro Mass Transit Limited
MRH	Ministry of Roads and Highways
MTTD	Motor Traffic and Transport Department
CBD	Central Business District
SPSS	Statistical Package for Service Solution
SFMTA	San Francisco Municipal Transportation Agency

CHAPTER ONE

INTRODUCTION

Background to the Study

The economic development of a country depends largely on an efficient and adequate system of transport (Rodrigue, Comtois & Slack, 2009). Efficient transportation system plays an important role in catering for the daily necessities in the lives of people in a community or city (Intikhab, Huapu & Shi, 2008). These daily activities include access to goods and services such as education, employment, health, leisure among others. Wane (2001) opined that transportation is a crucial vector for urban insertion since it gives access to economic activity, facilitates family life and helps in spinning social networks.

The emergence of banking, trade and commerce, high population growth and an increase in income have brought about increasing vehicle population and congestion which impedes the benefits of transportation systems (Dargay & Gately, 1999). Federal Highway Administration (FHWA) of the United States of America (2016) defines road traffic congestion as a situation that occurs as the demand of space by vehicles exceeds road capacity. Such situation is characterized by slower vehicular movement, longer trip times, and increased queuing. Turton and Knowles (1998) noted that on any trip generating activity, when vehicular traffic demand is greater than the available space on a stretch of road network, the speed of the traffic stream slow down than the required speed to travel, congestion is incurred.

Rodrigue, Comtois, and Slack (2009) opined that, rapid urban development across the globe indicates a tremendous growth of passengers and freight moving within and across cities and countries which calls for the demand for transport. The trend of urbanization in high, medium, and low income countries poses great challenges in infrastructural development in most cities. Anin, Annan and Otchere (2013) observed that since there is a direct relationship between increase in urban population and the demand for transport, any significant increase in urban population as a result of urbanization without any increase in road transportation network can result in a transportation problem. Limanond, Prabjabok and Tippayawong, (2010) found that the average speed of vehicles on Bangkok streets (9.7 million automobiles) was 15 km/h, while that in Manila (2.5 million registered vehicles), Jakarta (14 million automobiles) and Singapore (6 thousand vehicles) were 18 km/h, 19 km/h and 20 km/h respectively.

Effect of traffic congestion consist of incremental delay, driver stress, high vehicle operating costs, crash risk and pollution resulting from interference between vehicles in the traffic stream, particularly as a roadway system approaches its capacity (Farel,Yannou, Ghaffari & Leroy , 2013). In the United States, congestion costs were estimated at $63.1 billion annually in 2000 and $87.2 billion annually in 2007, with approximately 28 million tons of carbon dioxide (CO2) emitted per year due to fuel wasted from inefficient vehicle operation due to congestion (Schrank & Lomax, 2005).

Across Africa, high rate of urbanization coupled with unplanned systems of building structures and narrow roads, has impeded smooth transportation of goods and services. For instance, in Uganda, traffic

congestion has resulted in high cost of doing business in Kampala which is a disincentive to investors (Wangai & Ngigi, 2014). In South Africa, Johannesburg ranks top in road traffic congestion among its cities. Commuters are therefore stacked in traffic jams during the peak periods: there is a delay of 37 minutes for every hour (Downs, 2003). Similarly, in Nigeria, virtually every state capital faces the problem of road traffic congestion as Lagos is notable for its congestion problems of delays and pollution (Fadairo, 2013). In Ghana, traffic congestion has been one of the major problems of most of the cities and towns in all the regional capitals. Annan (2014) discovered that Ghana loses billions of cedis estimated at 10.5% of the country's Gross Domestic Product. Annan (2014) further added that, traffic congestion has negative impact on social activities such as shopping and social gatherings. This socio-economic effect of traffic possesses a challenge to the growth of the country.

Several works on traffic congestion has been conducted in the country by Abane (1993), Mahama (2012), Andoh (2014). These works have always looked at the causes of traffic congestion and proposed several measures to curb it. Most of these measures have been implemented by government and transport engineers and managers, however, traffic congestion still persist in cities where these measures are implemented across the globe. It is important to understand the issues of implementation of traffic decongestion measures and their effectiveness.

Statement of the Problem

Sekondi–Takoradi is currently becoming one of the growing cities in Ghana (Mahama, 2012). This has been attributed to the presence of the

Takoradi Harbour, and timber firms amidst the discovery of the oil fields in Cape Three Points near Sekondi–Takoradi. As a growing city, a lot of economic and social activities are carried out in this city. Economic and social activities of human kind revolve around transportation. Similarly, business activities depend on urban transportation systems to ensure the mobility of its customers, employees and suppliers. It has been observed in recent times that traffic congestion has become an unbearable situation in the oil city. This phenomenon prevails almost throughout the day and it is severe during peak hours.

It takes more hours for people, goods and services to be transported over a 5 kilometre distance, a trip that took less than 20 minutes to cover prior to the discovery of oil (Mahama, 2012). This situation has raised a lot of concern among several road users with regard to the causes of such severe traffic congestion since the transportation constraints in this regard seriously affect the economic potential of the oil city, especially in the context of rendering goods and services. Even though several measures such as on-street parking, provision of parking lot, introduction of mass transit system and traffic police visibility have been put in place to check traffic congestion in the metropolis, the situation still persists. One cannot tell whether those measures are effective or not. One way to assess the true cause and effect of this traffic congestion is to conduct a study to examine the traffic situation in the city and also assess the effectiveness of implemented traffic congestion measures.

Objectives of the Study

The main objective of this research was to explore the effectiveness of vehicular traffic congestion measures within Sekondi-Takoradi. Specifically, the study sought to:

1 Explore the causes of road traffic congestion in the Sekondi-Takoradi Metropolis.

2 Assess the socio-economic effects of traffic congestion in the metropolis.

3 Explore the effectiveness of the measures put in place by stakeholders to manage congestion in the metropolis.

Research Questions

Based on the objectives set for the study, the following research questions were formulated to guide the study:

1 What are the causes of traffic congestion in the Sekondi-Takoradi Metropolis?

2 What are the socio-economic effects of traffic congestion in the metropolis?

3 How effective are the measures put in place by stakeholders to manage traffic congestion in the metropolis?

Significance of the Study

The main thrust of this research was to study the effectiveness of vehicular traffic congestion measures in Sekondi-Takoradi. Traffic congestion affects the time spent in travelling or carrying out other activities and will also be critical when an individual is choosing a residence and place of work. Traffic flow also affects individuals or communities access to public as well as

the operations of the housing market and the value of land. The quality of the travel way greatly affects the volume of vehicle flow. The outcome of this study would bring to light the major causes of traffic congestion in the Sekondi-Takoradi Metropolis. The result of the study can provide a clear insight into the effectiveness of the measures put in place by stakeholders to manage congestion in the metropolis.

Delimitations

In terms of content, the study covered traffic congestion causes, effects and effectiveness of the measures put in place to control traffic congestion. With regard to scope, the study was delimited to the Secondi-Takoradi metropolis specifically major roads linking the Central Business District (CBD). The main reason for delimiting this study to Secondi-Takoradi was to give the researcher an in-depth analysis of the issue under consideration. Moreover, few earlier studies have been done in Accra and Kumasi which are also big cities in Ghana. In that regard, it has become necessary to consider the Secondi-Takoradi Metro. With respect to population, the study was delineated to motor operators (drivers and motor-cycle riders), STMA officers and MTTD officers of the Ghana Police Service in the metropolis.

Limitations

As much as this study has it strengths methodologically in certain areas, it is also plagued by a number of limitations. In the first place, given the fact that the study was undertaken in the Sekondi Takoradi metropolis with drivers and motor-cycle riders as respondents, getting the drivers and motor-cycle riders to answer the questionnaires was a major challenge and this has affected the data collection time. Another basic issue that confronted the study

was how to sample from the population. There was no record on the number of drivers and motor cycle riders in the metropolis. It was therefore difficult to get a representative sample as the population is not known with certainty. However, the choice of sampling methods used did not invalidate the findings of the study.

Organization of the Study

The study was divided into five chapters which discussed all the aspect of the research study. The first chapter, Chapter One covered the background to the study, statement of the problem, purpose of the study, research questions, significance of the study, delimitations, limitations, operational definition of terms and ended with the organization of the study. Chapter Two presents a review of literature relevant to the study. It looks at the theoretical, conceptual and the empirical studies related to the study. Chapter Three considers the methods used in collecting and analyzing the data. In this chapter, research design, population, sample and sampling technique are described together with instruments used as well as data collection and data analysis procedures. Chapter Four focuses on the results and discussion of the findings. Finally, Chapter Five gives the summary and draws conclusions on the major findings of the study. Chapter Five also outlines recommendations from the study and also gives suggestions for further research

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter presents a review of existing literature related to the study. The chapter is divided into three main sections: theoretical, conceptual and empirical review. The theoretical review exams the Burges Model of Land use. The conceptual review dealt with the concept of traffic congestion whiles the empirical review was carried out along the research objectives formulated for the study.

Theoretical Review

This study was underpinned by Burgess Model of Land Use as shown in Figure 1

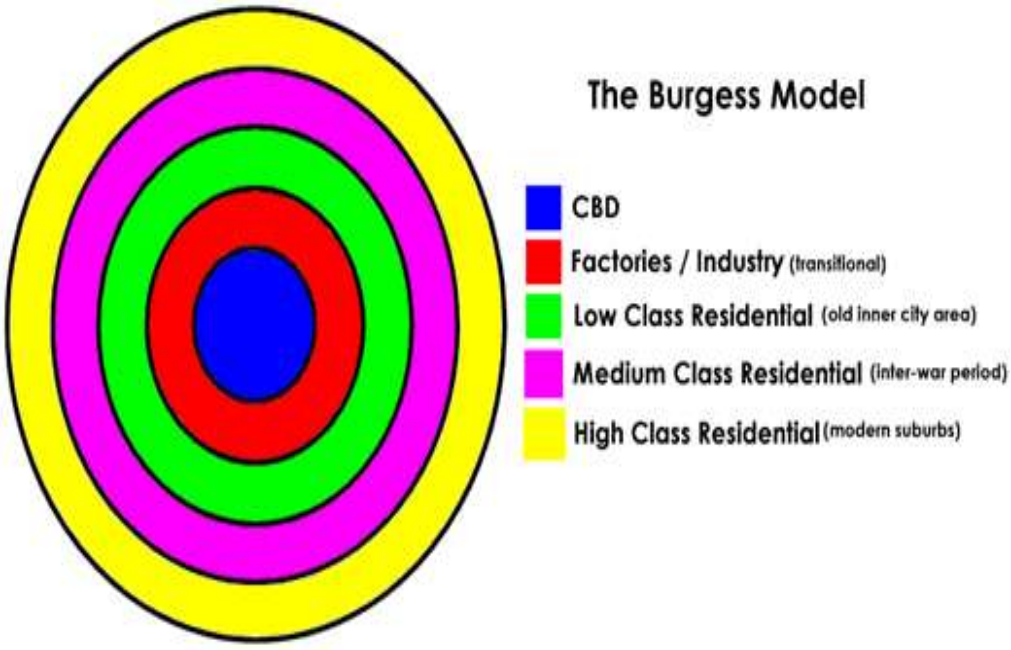

Figure 1: Burgess Model of Land Use

Source: Park & Burgess, 1925

Burgess model of land use was developed by Ernest Burgess in 1925. The model presents a descriptive urban land use, which divided cities in a set of concentric circles expanding from the downtown to the suburbs. That is to say that the scholar gave a clear view of how land is utilized for various purposes. This representation was built from Burgess' observations of a number of American cities, notably Chicago. The model assumes a relationship between the movements of people from their residence to their respective working places situated in the Central Business District (CBD) to undertake socio-economic activities. The model portrays that all the economic activities of the urban area take place in the city centre, which is surrounded by the concentric bands of residential areas. The concentric bands tend to extend to the rural periphery as far as it needed to support the economic base of the city centre. The residential rings around the CBD spread outwards with new agricultural land being converted into urban land use and the length of the CBD extends. The extension of the CBD comes with the construction of road networks to the newly converted agricultural land which facilitates movement of goods and services. This theoretical situation assumes that the transport system is supplied in all directions within the urban area and there is no location advantage in any choice of direction from the residential area to the central business district.

It is also conceptualised that most of the trips made to the CBD are for services since most of the businesses are concentrated in the central regions of the city. Therefore, all business owners and traders who reside in the periphery move to the CBD to transact business especially in the rush hours of the mornings and all of them move back to their destinations in the evening at the

same time. This situation tends to build up traffic congestion, which is eventually disintegrated on radial and concentric roads around the CBD.

Concepts of Traffic Congestion

European Conference of Transport Ministers (ECMT, 2007) defines congestion as the impedance vehicles impose on each other, due to the speed-flow relationship, in conditions where the use of a transport system approaches capacity. Put differently, traffic congestion is a situation in which demand for road space exceeds supply. Since most cities around the world deliver access to a wide range of activities, people, services, goods, markets, opportunities, ideas and networks, these should be achieved either through speed or through greater proximity (Aliyu, Abubakar & Adamu, 2015).

Definition of traffic congestion by the National Research Council (2001), takes it from the time perspectives as they define it as a condition of traffic delay (when the flow of traffic is slowed below reasonable speeds) because the number of vehicles trying to use the road exceeds the traffic network capacity to handle them. Turton and Knowles (1998) used the concept of volume to define congestion as the situation that arises when road and rail networks are no longer capable of accommodating the volume of movements that occur on them. Per the volume concept, Afukaar (2003), indicated that the intensity of traffic congestion on the road vary during a particular period of the day usually during morning and evening rush hours.

Andoh (2014) defined traffic congestion as a situation of having more vehicles on the road than it was designed to accommodate in a given time. He added that, if, a section of road was designed to carry 2000 vehicles per hour

but that section is now carrying 3000 vehicles per hour, then it can be said that the road has exceeded its capacity and therefore congested.

Fadairo (2013) definition of congestion was geared towards road condition by defining traffic congestion as a condition on road networks that occur as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing.

According to the engineering theory of traffic congestion, the ordinary explanation of congestion is a lack of road capacity, that is, a shortage of supply (Thomson, 1998). So, traffic congestion can be defined in two ways: vehicle concentration/low flow speed, and approaching the maximum capacity of the road. Congestion is an imbalance of travel demand and transport system supply (Hon, 2005). Engineering theory of traffic congestion concentrated on increasing the traffic capacity of road links, junctions, and whole urban networks by restrictions on parking, pedestrians, access, and even public transport, as well as new road construction (Thomson, 1998). Traffic congestion is a subjective term with no universally accepted definition and often simply defined as occurring when traffic is not able to flow freely with speed only subject to speed limit (Ademola, 2010). To a typical traveller, congestion will likely be quantified in relation to the travel time required for an essential trip, most likely, the trip to or from work place.

Types of Congestion

Congestion within a geographical location varies from one area to the other depending on the causative condition. Thus, the way or manner the congestion happens defines its type. The European Conference of Transport Ministers (ECMT, 2007) identifies congestion of two types: structural

congestion (recurrent congestion) and incidental congestion (non-recurrent congestion). Structural congestion occurs when traffic demand is higher than capacity, while incidental congestion is the result of occasional conditions such as a crash, bad weather or road works which alter the traffic flow. Drivers are able to anticipate the occurrence of structural congestion more easily because it takes place at about the same locations at about the same time of the day. Incidental congestion, on the other hand, might surprise drivers and lead to more unexpected behaviour. The extent to which congestion surprises drivers also depends on other factors, such as the distance from which the queue is visible. Drivers therefore violate road traffic laws during this type of congestion.

Conceptual Framework

The conceptual framework in Figure 1 portrays a graphical model of road transportation situation in Sekondi–Takoradi Metropolis. This framework seeks to explain the factors that are responsible for traffic congestion, its possible effects as well as the measures put in place to control the traffic situation in the Sekondi –Takoradi Metropolis. The conceptual frame indicates that traffic congestion in the metropolis is as a result of several factors. For instance, it can be seen from the conceptual framework that a general rise in income of an individual leads to an increase in automobile ownership. Thus, as more and more people begin to own cars in the metropolis, the volume of cars plying the road will increase till it exceeds the capacity of the road network available since the supply of road is fixed thereby leading to traffic congestion. It is again noted that illegal parking, police check points, on-street parking, inadequate traffic police coupled with drivers behaviour and trade

obstruction all results in traffic congestion in the Sekondi –Takoradi Metropolis. This situation will therefore result in high energy demand; environmental pollution from car exhausts especially diesel vehicles, loss in productivity and fatigue on both drivers and passengers as well as pressure on road networks across the metropolis. In addressing the issue, certain measures have been put in place by transport policy makers such as MTTD, STMA, GPRTU and DVLA. Among the measures are traffic lights, police visibility, street parking pricing, expanding roadway capacity, investing in public transportation among others. The frame work reveals that these measures can either be effective or non-effective in curbing the traffic situation. The non-effective measures would result in traffic congestion. Traffic congestion situation will cause pollution which would affect the health of people. In addition, congestion may lead to loss in productivity and consequently have an adverse effect on national socio-economic development. Also, since vehicles are delayed in traffic, more fuel is consumed which may have repercussions on the drivers sales. High fuel consumption resulting from traffic congestion, may affect doing business in the metropolis. On the other hand, if the measures to control traffic congestion in the metropolis are effective would bring about free flow of traffic.

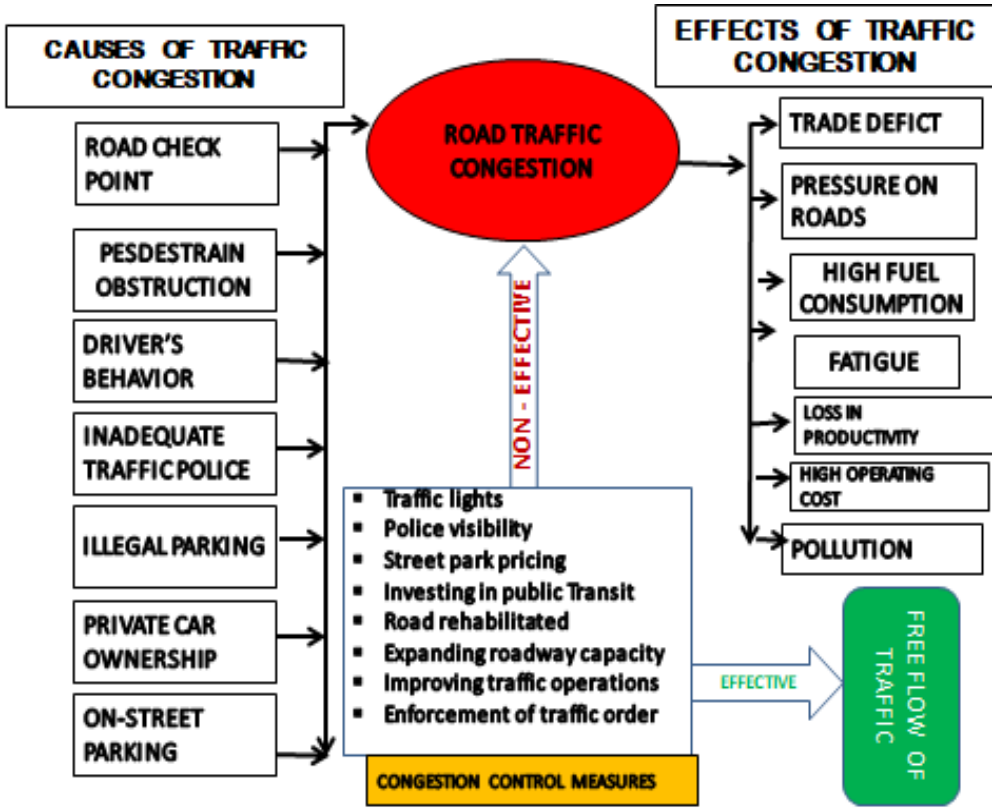

Figure 2: Conceptual Framework Depicting the Causes and Effects of Traffic Congestion

Source: Asare-Pelle, 2016

Empirical Review

This section examines previous studies that have been done in the area of traffic. The review was done in line with the research objectives formulated for the study.

Causes of Traffic Congestion

Traffic flow on many urban roads are expected to be smooth without any interference but due to factors such as violations in traffic rules, wrong parking, picking and dropping of passengers in traffic flow, among others causes traffic congestion. Congestion in most urban areas across the globe occurs as a result of several generic conditions.

Drivers' Behaviour

Attitude has often been defined to mean tendencies to evaluate an object with some degree of favour or disfavour, expressed in affective, cognitive or behavioural responses (Eagly & Chaiken, 1993). Stanton and Salmon (2009) added that violations consist of a complex category of errors and are categorized as behaviours (either deliberate or unintentional) that deviate from accepted procedures, standards, and rules. The various attitudes of some drivers on the road slow the movement of traffic flow at any point on the road especially at intersections and points close to bus stops. Some of these behaviours are loading and discharging of passengers and goods at unapproved areas, on-street parking and the use of road shoulders during traffic jams by some drivers, and then attempting to join the traffic (Ian & Bull, 2002).

Also a delay in taking off from bus stops for other vehicles to use the facility (bus stop) is another cause of congestion on the road. This occurs as a result of a driver loosing attention behind the wheel or subservient vehicle that fails to catch the flow of traffic. This creates sluggish take-off of vehicles when the traffic lights turn green at major intersections resulting in less number of vehicles crossing than the designed capacity.

It is believed that drivers of the public buses and trucks do not observe certain road traffic regulations given the nature of their vehicles. The drivers' attitudes discussed above ultimately lead to traffic-rule violations. A survey by Khaled, Gop and Chowdhur (2012) show that, congestion in the Central Business District (CBD) of a city is usually caused by drivers violating road traffic Acts and cited that traffic rule violation contributes about 25% of traffic

congestion. They also stated the presence of rickshaw, reckless driving among others.

Poor discipline and lack of law implementation, drivers and other road users often are not trained sufficiently to follow lane discipline. The effects of poor lane discipline, especially at traffic junctions, deteriorate the already overcrowded junction situation. According to Agyapong and Ojo (2018), drivers often are not trained enough to follow lane markings in most developing countries across the globe. They added that, the impacts of poor lane discipline on the part of drivers at traffic intersections causes traffic congestions.

Illegal Parking

Illegal parking is one of the major causes of road traffic congestion in most urban areas in the world. Drivers in most developing countries park at unlawful and unaccepted areas in most urban areas. Also in some areas, vehicles are illegally parked on the roadside by shop owners and customers due to the absence of designated parking lots in the city (Chidambaram & Zikos, 2012). For instance, illegal parking on the road has been creating congestion every day from petrol pump to Indrayani College, a distance of around one kilometre. On-street parking of vehicles is one of the main reasons behind serious traffic congestion on different parts of the Talegaon city (Shamsher & Abdullah, 2015).

Lack of Parking Facility

Parking facilities are essentially provided in relation to satisfying vehicle population demand in most urban areas (Afriyie-Dankwa, 2017). Specifically, in the central business districts, a lot of activities occur, however,

the available parking spaces are mostly not adequate to contain the volume of vehicles that travel to the city centres on daily basis. Moreover, the inadequate parking space could also be due to lack of proper assessment of the entire parking needs before implementation. Congestion in most urban areas happen when drivers compete for few parking lots available (Afriyie-Dankwa, 2017). The unavailability of parking facilities influences drivers to spend longer periods cruising through town in the bid to find parking spot these compound the existing traffic problems thereby leading to more congestion or parking on unapproved spaces.

Road Check Points

The several checkpoints erected by Police Officers and the DVLA at various traffic lights, round-about and intersections and check points on many major roads in the country also account for serious traffic congestion which further restrict the flow of traffic on our roads. The security challenges facing many countries presently have necessitated the need to tighten security network. This has called for security check points on the major roads in the country including the cities. One of such measures is the stationing of police and military check points on major corridors and at the entrances and exits of most major cities in the country. These check points have caused the roads to be blocked for vehicles to be inspected and have greatly slowed down traffic flow to a bottle neck situation. Some roads have been closed while traffic on other roads have been re-routed for security reasons.

Road Constructional Works

Congestion can happen due to various conditions such as road work and accidents (Chin, 2004). Road construction activities which could lead to

blockage of the carriage way or part of it or diversion of traffic will result in forcing the traffic to slow down, hence, traffic congestion. A pot hole caused by environmental forces such as rainfall, wind and temperature slows the movement of traffic. This situation calls for patching of these holes on most major road corridors. The attempt to rehabilitate the road renders sections of the roads blocked. Drivers are forced to divert their routes to use alternative routes. This attempt causes congestion on the few routes since more vehicles will use that corridor of road hence causing congestion.

Pedestrians' Obstructions

In most cities of developing countries, pavements of major roads designed as walkways and overhead foot bridges are occupied by hawkers, traders and events. For instance, hawkers and traders occupy about 80% of the Kaneshie and Circle Market foot bridges each day and this activity compels pedestrians to divert to the main road as a walkway which obstruct the flow of traffic (Abane, 1993; Agyapong & Ojo, 2018), In cases where there are no footpaths, cycle-lane and walkways along the road, pedestrians and cyclists tend to share the roads with vehicles. Agyapong and Ojo (2018) noted that, the missing crosswalk sometimes causes pedestrians to cross the road at many different parts obstructing traffic flow as drivers take extra caution to save pedestrians; traffic flow slows down thereby causing traffic congestion.

Bad Weather

Bad weather conditions decrease traffic demand while they also decrease the freeway capacity (Goodwin, 2002). Transport is negatively affected by bad weather (heavy rain, snowfall, strong winds, extreme heat and cold), and reduced visibility, which can cause injury, damage and economic

loss (Jaroszweski, Chapman & Petts, 2010; Vajda, Tuomenvirta, Juga, Nurmi, Jokinen, & Rauhala, 2011). It is postulated that, if the decrease rate of the freeway capacity is faster than the decrease of the traffic demand, traffic congestion is bound to occur (Stopher, 2004). Systematic Cambridge (2005) opines that, 15% of the congestion occurs due to bad weather conditions. Hooper (2013) also found that reduced visibility and friction are the most common impacts and are known to cause reductions in traffic speed. For example, Maze, Agarwal and Burchett (2006), discovered that when visibility was less than 0.25 miles, a 12 per cent reduction in speed occurred in the Minneapolis / St. Paul area in the United States over a four year study period. During heavy precipitation events, visibility on the roads is severely restricted both as a result of the view through the windscreen being obscured and due to increased spray and splash from other vehicles on the road (Edwards, 2002).

Precipitation has several impacts on the road network, including reduced visibility and friction, as well as increasing flooding where drainage is an issue (Walsh, Hall, Street, Blanksby, Cassar, Ekins & Watson, 2007).

On-Road Loading/Unloading

Due to inadequate cargo discharge facilities in most developing cities across Africa, loading and unloading tends to be carried out on roads. Cars and goods loading trucks of some supermarkets and shops park along the road to discharge their goods and sometimes load their goods. In the CBDs where on-street parking is common and where loading/unloading facilities exist, they are used by other vehicle drivers as parking facility, resulting in loading and unloading often being carried out from vehicles that are double parked. This

leads to traffic congestion, and vehicles changing lanes to avoid double-parked vehicles increases the risk of accidents.

Vehicles are illegally parked on the roadside by shop-owners and customers due to the absence of designated parking lots in the city. Lack of pull-outs from designated stopping points of these shopping malls and churches after service results in numerous interruptions to the flow of vehicles.

Private Car Ownership and Increased Vehicle Population

Car ownership is, and will remain, a vital form of transport; and car ownership will extend yet further through society as the economy grows (Whelan, 2007). The increase in car ownership means also an increase in the number of trips per person per day. Vuchic (2005) says the huge increase in car ownership also results in increase in traffic problems affecting both the developed and the developing countries as the traffic infrastructure is failing to cope up with the ever-increasing demand. In Bangladesh, population and traffic growth rate is approximately 1.5 and 7 per cent respectively. But road expansion rate is not at all unmentionable with respect to higher traffic growth. As per BRTA (Shamsher & Abdullah, 2015) at present the total number of approved vehicle in Chittagong city is 84391. Among these are, Bus -2816, Autoricksha (Taxi)-20847, Tempo-4666, Motorcycle-13470, Jeep-1951, Car-15961, Pickup-3656, Tank lorry-386, Tractor trailer-503, Truck-14065 and Micro-5998. So city roads are not capable to carry the traffic especially in the peak hours. In Nigeria, for example, poor planning of transportation system has led to over dependence on motor vehicles resulting in too many vehicles with its accompanied problems including traffic congestion on the roads (Momoh, 2011).

The massive use of cars does not only have an impact on traffic congestion but also leads to decline in public transit efficiency, thereby creating commuting difficulties in cities (Fungai & Virginia, 2013).

Mono Centric City Structure

Central Business Districts in most developed and developing economies have most of their business activities concentrated in few areas within the nation's capital with the arterial roads migrating to the centre in the mornings and originating from it in the evenings. This means that a lot of city services and institutions are located at one major point. This has led to traffic flow predominantly from residential areas to the CBD in the mornings and vice versa in the evenings. According to Kiunsi (2013) and Lupala (2011), the one directional flow of traffic contributes to congestion in the mornings and evenings along the main roads and intersections. He added that since most of the ministries and government agencies, shops and schools are concentrated in the central business district of the city, individuals and school children who are supposed to go to work and school in the morning and return home in the evening create congestion. This causes traffic congestion and high fuel usage.

Poor Traffic Lights Signalling

Timing of traffic lights and faulty traffic signalling systems at traffic intersections also induce high rate of congestion in most developing countries across the globe. This calls for the on-duty traffic policemen who resort to the manual control of vehicular movement on the plea that the system is ineffective during rush hours. This could be mainly due to the absence of a synchronized operation of the entire electronic traffic signalling system (Khaled, Gop & Chowdhur, 2012). The basic problem of the city's traffic

system is that the existing road network is incapable of holding the ever-increasing number of motor vehicles coupled with malfunctioning traffic lights which is due to unstable power supply in the country is one of the major causes of traffic congestion. Thus, poor installation of electronic signals at the major intersections and few number of traffic police on the road are not able to control the traffic situation. Andoh (2014) added that, insufficient timing at pedestrian crossings on double lane roads gets pedestrians caught midway on the road. He further stated that the volume of pedestrians ready to cross to the other side of a road is more than the signal capacity and all of pedestrians want to cross the road at that instance. The effective use of this system of traffic management might provide some temporary relief but not a permanent solution.

Inadequate Mass Transit

Efficient public transport is considered the major potential solution to the problem of urban road traffic congestion (Rwakarehe & Zhong, 2012). Thus, public transportation system is an essential factor that ensures effective transportation system especially in the urban areas (Shapiro, Hassett, & Anold, 2002). They contend that public transportation system (mass transit) offers one of the best strategies to reducing traffic congestion and improving energy efficiency due to their high passenger occupancy rate and fuel saving potentials. To ensure effective public transportation system, buses which are the commonest form of public transportation in developing countries should be available and adequate, improved transport infrastructure, mass transit and traffic management system together contribute to effective transportation system. According to Shapiro, Hassett, and Anold (2002), these result in

speedier travels, improve freight and logistics system, lowers inventory and distribution and ultimately improves the socio-economic activities and Gross Domestic Products (GDP). With all the benefits of public transport, Kitamura (1989) argues that, improving public transport is not enough to combat traffic congestion since the buses are not enough and reliable. The problem is more common in developing countries that are characterized by inadequate public transport infrastructure financing capacity (Briceño-Garmendia, 2004). This condition encourages the use of too many private cars on the road which induce congestion.

Effects of Traffic Congestion

The effects of traffic congestion appear to have no limit. The impact springs from socio-economic to health. Newman and Kenworthy (1999) outlined accidents, noise and air pollution as some of the negative effects of urban traffic. However, traffic congestion has a global impact on climate change, for instance, global warming through the gases which are emitted. If traffic exists in a country, it does not matter the level of economic development, the effects could be felt in various ways. For example, in 2003, traffic congestion steadily increased across the United States, causing 3.7 billion hours of delay and wasting 2.3 billion gallons of motor fuel (Schrank & Lomax, 2005). In the following paragraphs, a few of such effects have been discussed.

Losses in Productivity

Weisbrod, Vary and Treyz (2003) opine that, increasing traffic congestion which is a major transportation challenge imposes cost upon travels and business operations, thus posing wide range of negative impact on

people and on business economy. Advancing their argument, they affirm that the impact of traffic congestion affects quality of life due to delays in personal travels and, especially business activities, as a result of additional cost arising from delays in deliveries of logistics within cities. Thus transportation inefficiencies bring negative bearing on the commercial activities by way of slow and more variable journey times which affect economic efficiency (Anin, Annan & Otchere, 2013). They argue further that congestion impairs moving freely and that it disrupts business activities in cities and reduce productivity.

Congestion affects speed and smooth traffic flow. This affects wide range of activities, services, goods, markets opportunities in the cities which can best be delivered through transport mobility. The report continues that congestion also reduces productivity through increased inventory holding by manufacturers and retailers as a result of unreliable travel conditions within cities. Business activities depend on timely delivery of logistics. However, freight movement in cities is impaired by traffic congestion, thus making productivity suffer. Anderson, Allen and Browne (2005) underscored the increasing congestion and decreasing city accessibility as negative effects which make it quite difficult to achieve high levels of efficiency in urban freight transportation.

The potential impact of road traffic congestion on the economy has been frequently cited as a challenge associated with transportation in urban areas. As trucks, cars and vans inefficiently spend time in slow moving traffic, delivery deadlines are not met as a result. The increasing use of just-in-time delivery means that a larger share of trucks movement are time sensitive, and even though shippers plan their schedules to account for recurring congestion,

they cannot always allow enough slack to account for traffic incidents or unusual delays. With delays, and the need to accommodate them, transportation cost may rise and productivity across the supply chain falls. These challenges are characterized as increased transport costs and productivity loss (Ewing, Pendall & Chen, 2003).

Increasing Pollution and Deteriorating Health

Motor vehicles are a major source of air pollution. Vehicles emit mostly Volatile Organic Compounds (VOCs) and nitrous oxides (NOx), as a major source of air pollution. In urban areas of the United States of America, vehicles account for over 50% of carbon monoxide (CO), 34% of nitrogen oxide (NO2) and over 29% of hydrocarbon emissions in addition to as much as 10 % of fine particulate matter emissions (Huang, Brook, Zhang, Li, Graham, Ernst & Lu, 2006). The emissions from motorized vehicles not only affect our environment but also our health. The consequence of carbon monoxide on human and animals is devastating. Choking as a result of air pollution and high blood pressure due to road rage are all after effects of prolonged stay in road traffic congestion.

Al-Mogin (2005) asserted that lead poisoning occurred more frequently due to traffic. He further identified the symptoms of lead poisoning to include vomiting, constipation or bloody diarrhoea with central-nervous system effects such as insomnia, irritability, convulsion and even death. Olagunju (2015) indicated that other symptoms of lead poisoning include headache, weakness and constipation. The cumulative effects of thousands of vehicles releasing emissions have serious regional air quality impacts on living organisms within that particular region.

Also, numerous studies have confirmed that higher concentrations of ground level ozone exacerbate respiratory illnesses such as asthma and can lead to permanent lung damage as a result of long-term exposure (Environmental Protection Agency, 2012; Health Effects Institute & Panel on the Health Effects of Traffic-Related Air Pollution, 2010). Other studies have shown that, between 2005 and 2007, smog-related pollution cost the state of California in the United States of America $193 million on medical expenses (Romley Hackbarth & Goldman, 2010). Even though vehicle emissions are not the only contributors to smog, it accounts for over 33% of all NOx and 26% of all VOCs attributed to vehicle emissions (Abrams, 2010). Most of the vehicles used in Ghana are old (over age that is above 10-20 years) which have the capacity to produce a lot of fumes which causes pollution.

Globally, over 600 million people are exposed to hazardous level of traffic-generated pollutants in the environment. According to the World Bank (2011), 16 out of the 20 most polluted cities in the world are in China. Only about one-third of 340 monitored Chinese cities meet national air quality standards, which are more lenient than the standards set by the World Health Organization (WHO, 2002). According to Aderamo (2012), the major pollutants by automobiles including carbon monoxide, lead, nitrogen and hydro-carbons are significant sources of eye and respiratory diseases. A report by the US Department of Health and Human Services (2006) indicated that in china, air pollution contributed to nearly 358,000 premature deaths and about 640,000 hospitalizations for respiratory and circulatory diseases in 2004 and also recorded 256,000 new cases of chronic bronchitis. In addition, coal was identified as the main source of air pollution, fumes from automobile exhaust

being the next major pollutant in most Chinese cities. For instance, in 2003, carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO), and fine particulates from vehicles accounted for 80 %, 75 %, 68 %, and 50 %, respectively, of the air pollution in major cities such as Beijing, Shanghai, and Guangzhou. Poor emissions control in Chinese vehicles also contributes to the problem.

Another major concern of urban traffic is noise pollution. Mirrilees Pretorius, Mare, Naude and de Haan (1996) explain noise pollution as unwanted or excessive sound in the wrong place and at the wrong time. Noise produced by vehicles can be annoying and interfere with lots of activities including studying, recreation, and work and sleeping which has psychological effects on both drivers and pedestrians. Traffic noise is mainly generated from moving vehicles (heavy duty trucks, mini vans and cars) in transporting freight, goods and services. Also, much of the noise is mainly caused by vehicles having direct link with the roads to the commercial areas, industrial areas and offices concentrated in a given area and result in an increase in traffic congestion (Fungai & Virginia, 2013). The increase in congestion also account for the increase in the amount of noise generated. In addition, noise is produced by vehicles in bad operation state due to low maintenance levels in most African countries. This is normally experienced during the peak periods of the day and has great effects on man and the environment.

Pressure on Road Infrastructure

Road traffic congestion puts a lot of pressure on existing road networks. Since articulated trucks loaded with goods, bus with passengers and cars spend longer period of time at a particular point on the road, pressure is

put on the infrastructure. According to Olagunju (2015), road infrastructures such as bridges and interchange bears undue burden from traffic congestion. Bridges on such roads carry rest weights of vehicles that have to queue on them. The rest weights of these vehicles take a toll on the bridges with time and decay sets in earlier than expected. The roads also, develop cracks and pot holes due to the weights of over-loaded articulated vehicles. Olagunju (2015) further explained that the widening and deepening of the cracks and potholes are worsened by the exposure to the atmospheric conditions such as run-off from rainfall to develop into large pot holes. Drivers in their attempt to manoeuvre through the pot holes slow down reducing the traffic flow.

High Operating Costs

Traffic congestion in many parts of the world can impose additional costs to businesses and organisations associated with freight and service deliveries. A survey conducted by the confederation of Tanzania showed that traffic congestion eats up 20 per cent of business profit (Elinaza, 2010). For instance, delays in delivering of goods and services are time-sensitive. Goods and services delivery drivers charge more on transport of commodities, goods and items heading to a congested area within the Central Business District. In addition, taxis picked to any congested point within the city carries extra charge since extra fuel is used.

Advancing the argument, the confederation of Tanzania affirms that, the impact of traffic congestion affects quality of life due to delays in personal travels and, especially business activities, as a result of additional cost arising from delays in deliveries of logistics within cities. This assertion is supported by the argument that the economic cost of ineffective transportation system

takes the form of time wasting and unreliable delivery of goods and services, extra fuel and other related cost.

Effectiveness of the Measures Put in Place to Curb Traffic Congestion

This section of the review examines whether the measures that were put in place to control traffic congestion were effective or not. It carefully considers what earlier scholars have found. According to the Oxfordshire Local Transport Plan (2000) traffic congestion can be tackled by either increasing the capacity of the network or reducing the demand. This implies that substantial investment must be made in transport infrastructure such as roads, railway, bridges, tunnels, ports, airports, urban transport infrastructure and inland container depot (intermodal infrastructure) as well as public transport services, road network, signage and traffic management systems, parking lots, bus stops, vehicles and transport terminals (ESCAP, 2005; Arasan, 2012; Rodrique, Comtois, & Slack, 2009). These substantial investments are employed in order to ensure efficient logistics system and effective traffic flows on roads (Eddington, 2006; Muñuzuri, Larrañeta, Onieva & Cortés, 2005).

The remaining section of this review examined the various measures that were put in place to curb traffic congestion. Emphasis was also placed on finding out whether those measures were effective or not. Some of the measures discussed were, expanding roadway capacities, availability of parking facility among others.

Expanding Roadway Capacity

Expanding roadway capacity is often the default action for dealing with traffic congestion by transportation agencies, politicians, and other

decision makers. Advocates of this strategy hold the view that, increasing the capacity of roadways is the only effective solution for mitigating traffic congestion (Staley & Balaker, 2006; Hartgen & Fields, 2006). Similarly, Shamsher and Abdullah (2015) indicate that, road widening provides reductions in urban traffic congestion. Additional road capacity gained by expanding infrastructure can meet the growing travel demand and can dissolve traffic loads. Indeed, increasing road capacity leads to a short-term reduction in the severity of traffic congestion. For instance, Sahni and Ahuja (2016) and Cabanatuan (2011) reported that average annual travel delay for San Francisco Bay Area commuters fell 32% between 2006 and 2009 as freeway capacity in the region increased during this period. Cervero (2001) explained that the relative ineffectiveness of reducing traffic congestion through roadway expansion is a consequence of induced demand. He added that, increasing roadway capacity in a congested road corridor in cities decreases travel times and increases travel speeds along that roadway during peak periods. Hence, expanding roadway capacity is the landmark in the field of transportation studies. There are many approaches that can squeeze additional capacity out of existing infrastructure. These include adding lanes, re-allocating road space, modifying intersections, modifying the geometric design of roads or creating one-way streets. This approach would be beneficial to car users and also public transport (ECMT, 2007). Though, the cost involved in road expansion is very high, it has invited much criticism that it is not a long term solution (Hon, 2005).

When cities are trying to reduce urban traffic congestion, the first idea is often building more roads, to allow increasing traffic volumes. The more

capacity of road networks, the more traffic flows in each period. Supplying more roads capacity or improving the old road networks seems feasible and necessary in the areas of rapid growing of population or vehicles. However, if the increasing of road capacity does not catch up with the growing rate of population and vehicles, traffic flow would even go worse than before. This is because rapid growing population and number of vehicles could easily increase traffic loads, particularly in cities of developing countries. Also triple convergence could put much more pressure on expanded road networks. When most drivers realize new roads can save much time, they will switch their travelling time, travelling routes, and even travelling modes to this improved road, thus the intensity of traffic congestion will come back to the level as before in the near future.

Moreover, expanded roads induce more people to settle near those new roads in the long term. It is difficult therefore to measure the benefits of expanding road networks vis-á-vis the added demands it induces in the long run (Downs, 2003). As mentioned before, when the whole capacity of the traffic system is enlarged, more travellers could travel during the peak hours. The total traffic flows in this area improve, since more vehicles can drive on the enlarged roads per time. So enlarging the capacity will bring benefits to urban transport since it will reduce traffic congestion. Thus, construction of additional road capacity was generally accepted as the most effective solution to movement problems (Danquah, 2008). Expanding transit capacities in most cities tends to reduce road traffic congestion.

Availability of Parking Facility

Parking controls and pricing are tools commonly applied in traffic demand management in both industrialized and developing countries (Gwilliam, 2002). The availability and cost of parking are among the most significant factors influencing a person's decision to drive to a given destination. Providing generous amounts of free or low-cost parking encourages people to choose driving over mass transit or other more socially and environmentally beneficial modes of travel. Furthermore, requiring new development to provide large amounts of parking pushes new growth out to the edges of the city. Managing parking for smart growth represents a paradigm shift in which motorists' interests are no longer the highest priority.

Parking should be properly priced for more efficient use, and where land resources are scarce, the availability of parking spaces should be limited so as to encourage walking, bicycling, and using public transit. For instance, in the work of Yang, Xue and Bai (2004), it was indicated that some Chinese cities, such as Guangzhou and Beijing, are using parking fees to manage car use. Beijing plans to restrict the availability of parking spaces and charge higher parking fees. This discouraged most drivers from driving to some areas of the cities. Furthermore, Beijing has also constructed large parking facilities in key areas where drivers can transfer easily to public transportation. The cost involved in joining the public transit bus is relatively lower than driving a private car to the region. This strategy reduces the amount of traffic flow on a mode to a given flow level. Similar strategies could be adopted in the country to reduce a tremendous amount of traffic on our major roads especially in the Central Business District. There are various types of parking policies, which

focus on different factors such as parking location, parking supply, and parking price. Thus the results of those policies usually vary between each other.

Parking policy control and management can also influence on trip generation, trip distribution, travel modes and travel time. Thus parking could play an "active" role in the transportation system. Litman (2006) has the notion that more focus on parking management could increase the utilization of land and transport in urban areas. It can be used as a price instrument to influence transportation. Many parking policies are designed to control and reduce parking space in city's downtown areas. In general, employers supply a large share of the parking space to employees. With free parking space, employees are encouraged by companies to go to work by private vehicles, especially when the price for parking spaces is high in downtown area.

There are some differences between charging on roads and charging on parking. With the help of electronic smart cards, implement technique of roads pricing has improved a lot and is easier than that of parking pricing. Furthermore, parking pricing cannot charge long-distance lorry and vehicles driving through cordon area. There are many advantages with market-based instruments. The most important one is that it offers different choice to drivers. Drivers can choose one route or a means of travelling that they prefer, which could save money or save travelling time. There will be equilibrium between marginal prices of behaviours and their marginal social costs. Travellers may feel some kind of freedom when compared with regulatory instruments, which usually give no choice to travellers. They will have much

less resent when they drive on HOT lane or other choice, since it is their own' decision to choose which lane to use.

Parking is an important aspect of any transport system as a vehicle at the end of an auto based travel requires a space to park. Parking plays a significant role in reducing traffic congestion in any transport system. Therefore, providing adequate parking space to meet the demand for parking has become a huge challenge in most urban centres. Parking can be grouped into two main types; on-street and off-street parking. On street parking facility is the type of parking which uses road way space and are found in both residential and business centres because of the convenience it provides to commuters (Guo, 2013). On street parking areas include useful resources in business district or an adjacent street in residential areas where we have an adequate amount of parking space present (Sharma, Pithora, Gupta, Goel, & Sinha, 2013). According to them, on- street parking are of different types and each of them has its effects on congestion. Their assertions on their modes of parking are based on the positioning of the vehicle in the space – Parallel Parking, Perpendicular Parking and Angular Parking.

Parallel parking is a method of parking a vehicle parallel to the road in line with other parked vehicles. Parallel Parking is very difficult to access space in parallel mode of parking. In this, vehicles are arranged in a line with the front of one vehicle facing the rear side of the other vehicle. Dimensions of parallel parking are 2.4 x 6.1m. Total area in square metres is 14.85 metres square. This space quoted is required only for one car.

Perpendicular Parking: In this kind of parking, vehicles are parked alongside each other which are perpendicular to the curb or a wall. Generally,

vehicles are parked in this way that they are facing towards the shops and buildings that provide enough space for it. Dimensions of perpendicular parking are 5.5 x 2.7m. Total area in square meters is 15.125 meters square which is the require space for a single car.

Angular parking is a type of parking which is generally used in a common parking lot. The reason behind using this mode of parking is that it takes up low space than the other modes and it is easier to access. In this, cars are parked alongside as in perpendicular parking but at an angle-normally of 60 to the curb. It is used in hotels, stadiums etc. It can also be used on streets where space is adequate. Dimensions of angular parking are 4.9 x 2.4m. Total area in square meters is 11.76 metres square.

From their study they concluded that, angular parking is the best suitable mode for parking because it requires least space and it can be used at most of the places where there is not enough space for parking. Furthermore, they suggested angular parking management because it compresses less space for parking a vehicle or it can increase the overall supply of on-street parking if street is wide enough. In view of all these, it can be concluded that on-street parking of vehicles is one of the main reasons behind serious traffic congestion in different parts of the port city including GEC, Muradpur, CDA Avenue, OR Nizam Road, Zakir Hossain Road, Station Road, Dhaka Trunk Road, Madarbari, Shuvapur Bus Stand, EPZ intersection and Olankar (Shamsher & Abdullah, 2015). On-street parking according to Garrick, Ivan and Hanson, (2009) plays crucial role in benefitting activity centres.

Off-street parking on the other hand is the type of parking which are not provided on the street or road. This type of parking can be located in both

residential and business centres. It normally uses large land space compared to on-street parking. This system of parking includes private parking lots, garages and driveways, basement parking and multi-storey parking. In Ghana, off street parking is owned by the municipal authority, the highways department or completely owned by the private commercial establishment. A good city design should relate compact building areas to open parking areas, so that the end result does not resemble a war. Parking problems and traffic congestion are obvious in commercial areas (Osoba, 2012). In most cases, the parking space attracts a charge, and the vehicle owner is required to pay for the parking space. The rates for these charges are highly varied to discourage all-day parking in commercial areas where the facility and space is limited. Therefore, the availability of a parking lot in commercial and business centres influences congestion in a given locality. Aderamo & Salau (2013) discovered in their research in Ilorin city, Nigeria to examine the pattern and problem of on-street and off-street parking, realised that, the absence of designated parking lots led to congestion and delay problems. This attests to the fact that lack of adequate space for parking is essentially a contributing factor to congestion in the urban district. Contrary, the availability of parking facilities in most urban cities in the world reduces traffic congestion drastically.

Increasing and Developing the Manpower (Traffic Police)

The presence of police personnel at a given intersection could account for traffic congestion on the road in a given area. As the city is running with inadequacy of traffic police than required, so it requires the authority to increase the number of traffic police on the road. This step will create some scope for employment as well. The only problem is that recruitment is not

enough. Police personnel's who are recruited should be trained for the betterment of the traffic management especially with the MTTD of the Ghana Police Service. In Ghana traffic congestion at most intersections are as a result of malfunctioning traffic lights and absence of traffic police to manually direct the flow of traffic. This condition on the road builds up traffic at that given period because of the impatience of most drivers. Increasing more traffic police personnel at the major intersections and roundabout to direct traffic flow will help reduce congestion in most urban district of most cities in the country. The findings concord with the work of Agyekum (2008) who asserted that in order to manage traffic congestion, deployment of the police on the roads is an effective means of reducing congestions in cities and other urban settlements.

Car Pooling

Carpooling is a strategy now being implemented across various countries to reduce congestion. It is the grouping of travellers sharing a single car, so that more than one person travels in a car. The common trips are ensured either by car or van. This could be arranged in two ways. The first one is mostly carried out by strangers where the announcement of carpooling is made by a driver through public websites or closed website schemes and passengers respond to his/her announcement by confirming it. This is arranged such that the one person drives all the time, while the others join him/her by paying travel cost. The second one is commonly performed by office colleagues or friends who have common destinations. This is arranged such that everyone involves in alternate driving and so they do not exchange money. Dewan and Ahmad (2007) conducted a survey for car-pooling in Delhi

and willingness of commuters for car pooling and they observed that car-pooling is one of the solutions to reduce the traffic congestion in Delhi.

Table 1: Strategies for Curbing Road Congestion

Supply Strategies	Measure adopted
Preferential treatment	Bus lanes
	Carpool lanes
	Bicycle and pedestrian facilities
	Traffic signal pre-emption
Public transport operations	Express bus services
	Park-and-ride facilities
	Service improvements
	Public transport images
	High-capacity public transport vehicles
Freight transport operations	Urban goods movement
	Intercity goods movement

Source: Dougherty, Kirby & Boyle, 1994

Demand Strategies

The demand strategies focus on influencing demand for capacity such as increasing residential densities, using toll ways, and using ramp metering, traffic lights. These strategies address traveller demand on the transportation system. More specifically, these strategies are designed to reduce vehicle demand on the road network by increasing vehicle occupancy, increasing the use of public transport, reducing the need to travel during a specified peak-time period, and reducing the need to travel to a specified location of the city. Notable among the demand strategies are: Land use and zoning,

communications substitutes, traveller information services, economic and administrative measures. Table 2 provides a summary on the demand strategies for curbing road congestion.

Table 2: Demand Strategies for Curbing Road Congestion

Demand side	Strategic Measure adopted
Land use and zoning	Land use and zoning policy
	Site amenities and design
Communication substitute	Telecommuting
	Teleconferencing
	Tele shopping
Travellers information service	Pre-trip travel information
	Regional rideshare matching
Economic measure	Congestion pricing
	Parking pricing
	Transportation allowances
	Transit and rideshare financial incentives
	Public transport pass programs
Administrative measures	Transportation partnerships
	Trip reduction ordinances and regulation

Source: Dougherty, 1994

Other Measures to Mitigate Traffic Congestion

In addition to the earlier discussed measures, this aspect considered some additional measures employed to curb traffic congestion.

Mobility Management

Mobility management appears more feasible in West Africa and for that matter, Ghana since funding for road improvements and construction is difficult in our part of the world. It is therefore the concern of the government, planners and stakeholders to design roads such that alteration could be made. There are instances where increasing road space through new roads or road widening schemes can be limited by physical or environmental constraints. It is therefore rational to make the most efficient use of current road space through ensuring that roads and junctions are operating at their maximum design capacities. The capacity of the road network can often be increased without major new construction through localized minor changes such as flaring, lining changes or the use of intelligent equipment at signalized junctions. This action would help alleviate congestion to a degree.

Financial Penalty to the Traffic Law Breakers

Government can take such strict steps like imposing financial penalty on law disobeying drivers. When this trend was introduced in Dhaka in Bangladesh it really reduced congestion drastically (Remi, Adegoke & Oyerinde, 2009). According to Remi, at el., (2009) policies should be made to dissuade the drivers from certain congestion-causing habit such as wrong overtaking, one way driving, disobey of traffic signals. Mobile court should be introduced to fine drivers for disobeying traffic law and driving vehicles that are not road worthy or insured. This strategy of enforcing the law can mitigate traffic congestion in the short run, but in the long run all the stakeholders should be involved to create awareness on the repercussions of traffic congestion on the society as a whole. The introduction of financial penalty to

the traffic law breakers will prevent most drivers who violate the road traffic acts to be on the alert since high penalty will be charged on those disobeying these acts. This system of checking on driver's attitudes will reduce traffic congestion in most urban areas.

Smart Parking

Smart parking is a facility and a strategy employed on road networks to regulate congestion in a given area. In the city, traffic flow can be impacted by a wide number of variables from signal alignment, to lane design, to overall volume of traffic. While perhaps understated, parking, too, can significantly impede the progress of drivers. Smart parking is a dynamic and systematic way of pricing so that drivers were able to find parking more easily on both city streets and public garages managed by the San Francisco Municipal Transportation Agency (Latinopoulos, Sivakumar, & Polak, 2016). This strategy is to deter drivers from parking at some parts of the city centre. For instance, the San Francisco Municipal Transportation Agency (SFMTA) raised the cost of parking in areas with few parking spots and higher traffic, and lowered the cost in areas where parking is more available. As per the San Francisco (SF) Park website, rates varied by block, time of day, and day of week, and the rates themselves were adjusted by no more than 50 cents per hour down to 25 cents per hour up, and no more often than once per month. Through the use of the SF Park app via smartphones, drivers were able to identify the availability and cost of certain parking spaces within the SF Park network.

In connection with the sensors and meters, users were able to consult this data using their smartphones and the SF Park app. In practice, drivers

were therefore able to identify which areas were available to them, and for what cost, when planning their trips. This in turn allowed them to limit the time that they circled city blocks while looking for parking spaces that were available and those that met their willingness to pay. A survey conducted by the San Francisco Municipal Transportation Agency (SFMTA) indicated that close to a third of city traffic congestion is caused by drivers circling while looking for a space. Also drivers who look for a parking space often circle city blocks until they come across one suitable for them. When there is sufficient supply for parking spaces and enough demand from those looking for parking, there are very few delays or inefficiencies. In reality, however, parking is very unevenly distributed. Different areas have higher demand than others, and within those areas, certain streets are more desirable to park on than others. In addition to increasing traffic congestion, parking inefficiencies can cause delays, increased traffic volume, increased risk of accidents with pedestrians and cyclists, and cause an unnecessary amount of excess fuel use and pollution.

Investing in Public Transit

Rapid transit can be defined as a type of high-capacity public transport system generally found in a metropolitan area. For expanding cities such as London, Paris, New York and Istanbul, a rapid transit system is increasingly seen as integral instrument in minimizing traffic congestion, air and noise pollution (Wright, 2010). Prioritization of public transport is another useful strategy in traffic management and this system has been adopted in the developed countries (Detr, 1998). According to Shoup (2006), public transport is the major transport system in the major cities and towns of developing

countries that can accommodate more passengers. The increase in population means an increase in the demand of transport hence the introduction of public transport which is inadequate in the third world cities to cater for the huge volume of travellers. Many cities across the globe such as in Germany, the United States of America and China have been investing heavily in public transit. The situation in most African countries is different (Ian & Bull, 2002). There is the need to improve the efficiency of movement of people through a shift from low capacity public transport vehicles to large and double-decker or articulated buses with the potential to carry over 100 passengers. The overall quality of public transport is poor, most vehicles are old, and maintenance standards are extremely low.

According to Laporte and Mesa (2015), the most important feature of the rapid transit system is that it does not interfere with other road lanes or pedestrian traffic. Rapid transit system is seen as the best public transport option for cities facing the challenge of traffic congestion. Studies indicate that the quality of public transit service affects travel speeds and congestion delays on parallel highways (Vuchic, 1999). The system that will provide convenient, safe, regular and reliable public transport is an essential requirement for any urban area (Hoogendoorn & Bovy, 2001). This statement is supported by Zhang, Xumei, Zhang, Guohua, Yanzhao and Lei, (2009) who said that a system of bus service which is convenient, accessible, comfortable, reliable and operating within acceptable levels of noise, vibration and pollution would be such welcoming news to the majority of the people. In view of this, public transportation which is fast and reliable and of standards will absorb commuters from the other modes of transport.

Moreover, there are different priorities of public transportation in different cities around the globe. Public transportation has a great effect on reducing urban traffic congestion when compared with other modes of transports. Theoretically its huge capacity and high rate of using road resources make it the most efficient way to cut down traffic problems. Also, low ticket fares will make it more affordable for almost everyone especially in developing countries' cities. If people choose public buses for commuting, traffic congestion will reduce drastically. Thus, a world without a public transportation would be a disaster. For example, if the American present mobility status was replicated in any part of the world, it will expand the world fleet of vehicle to 4.52 billion (Bunting, 2004). Public transport has been a panacea in many cities across the globe reducing the use of private cars to considerable low levels. Therefore, building more or improving existing public transits and facilities could be a useful way to reduce traffic congestion. But the development of public transport does not run smoothly in most cities. One important reason is that most people prefer private cars to public transits, because of the flexibility and the accessibility of private cars. For example, drivers of private cars have the advantage of saving time compared to people in public buses on the same route. People who choose to travel with public buses have to go to the bus station, wait for the bus, and the trip takes comparatively longer time because the bus would stop at many stops before the destinations is reached, while drivers of private cars could save such time.

Bus Rapid Transit (BRT) system may remove these disadvantages of private and commercial vehicles, since buses are given the right of way from the demarcated lanes. Through the designated bus lanes, buses could not be

blocked on the normal routes since private cars, pedestrians and other forms of motor-cycle do not use same lanes. This situation will encourage more people to choose BRT instead of private cars. In this case, the design of bus only right-of-ways is more closely related to regulatory instruments rather than physical instrument. In concluding, with the many positive benefits of the Rapid Bus Transport System such as the use of high occupancy vehicles (large buses) to move people en masse, a lot of vehicles would have been taken from the roads than if all of these passengers had driven their own cars, and therefore, the Rapid Bus Transport System indeed tackle traffic congestion in a very significant manner (Agyemang, 2009).

Enforcement of Traffic Orders

The purpose of traffic law enforcement is to encourage road users to comply with establishment of traffic laws. Traffic enforcement team (The Ghana Police Service in collaboration with city and town guards) could be in the position to reduce traffic congestions in the country. High visibility enforcement is very effective in reducing congestion. The effective management of parking arrangements and other traffic regulation orders ensure that the highway network is not abused and that traffic continues to flow in the right channels. Also the team identifies the key diversions and communication strategies to deal with incidents that block or severely affect a lane of the highway. Therefore, effective management of traffic requires the planning of a quick response necessary following incidents on the highway. This strategy should be applied to all main roads in the three mega cities in the country.

In Ghana, the police bear the main responsibilities for traffic control, although in some large urban areas civilians are employed by the stakeholders and local council to control traffic and supervise metered and unmetered parking zones (Atuguba, 2007). The presence of police personnel at post at various intersection and traffic spots induce driver behaviour and make them comply with traffic rules and regulations. This situation ensures the flow of traffic within towns and cities across the globe.

Improving Traffic Operations

This is one of the proactive traffic operations management and has much potential on road traffic congestion. These include road traffic information systems, pre-trip guidance, coordinated traffic signal systems and the implementation of dynamic speed and incident management policies. These measures have often proven to be cost-effective ways to deliver better travel conditions, allowing users to reschedule their trips away from the usual traffic peaks and/or select other travel modes (ECMT, 2007). Singapore, for example, successfully implemented various demand management strategies to control traffic demands and even the level of congestion to some extent (Tanaboriboon, 1992). These strategies all allow road managers to get more out of roads. Traffic management system in most cities in Ghana is not well automated and well-equipped. Most of the intersections are not facilitated with signal lights to reduce congestion. Where there are signal lights, most often they are out of order. Moreover, uneven flow of vehicles from different directions reduces the effectiveness of traffic signals. Modern signalling system should be introduced. Shuichi and Hironao (2003) have shown in their study that improving traffic signalling strategies can improve the traffic

situation of the street cars. According to them, their proposed signalling strategy improves the traffic situation of street cars.

Congestion Pricing

Traffic congestion is a negative externality created in urban areas especially during rush hours. Congestion pricing is basically applied in two forms: road pricing and parking pricing. Road pricing involves cordoning off a section of the city centre and imposing a fee on all vehicles that enter it and parking pricing includes the costs of on-street and perhaps off-street parking of vehicles (Larson & Sasanuma, 2010). Larson and Sasanuma (2010) further asserted that road pricing was adopted in countries like United Kingdom, Singapore and Sweden and parking pricing was adopted in Tokyo. They suggested that congestion will be noticeably reduced by charging the people for creating the problem. Similarly, Ye (2012) in his research identified that congestion pricing in Singapore helped reduce congestion on most roads in the country.

Chapter Summary

This chapter dealt with the review of literature relevant to the study. It was organized into three main sections – the theoretical, conceptual and empirical review. The theoretical review captured the Burgess model of Land use. The main concept that underpins the study is that of traffic Congestion. From the review, it came to light that the concept of Traffic Congestion defies a single definition. Many researchers have expressed their view about the definition. The definition that guides this study is that of Andoh (2014) who defined traffic congestion as having more vehicles on the road than it was designed to accommodate in a given time**.** The empirical review examined

three major issues. These issues are causes, effects and effectiveness of measures put in place to control congestion. Major causes of road traffic include breakdown of vehicles, road construction activities, accident, on-road loading/unloading and most of all drivers' negative attitude. Moreover, high rate of urbanisation, industrialisation and increase in car ownership have increased the demand for transportation in urban areas and low supply and inadequate road infrastructure to match the increasing demand has resulted in traffic congestion which, from the literature, is one of the major urban challenges globally. Traffic congestion in most urban cities across the world has resulted in delays in transporting goods and freights from one geographic region to another. In addition, congestion does not only cause problems to urban transportation activities but also causes degradation to natural environment by increasing the magnitude and intensity of air pollution. All these were reviewed to provide an insight into what already existed concerning the specific issues of interest to this study and identified gaps that will be filled by the current study.

CHAPTER THREE

RESEARCH METHODS

Introduction

This chapter discusses the various methods and techniques that the study employed in the collection and the analysis of data. This is grouped into research design, data and sources, target population, sample size, sampling technique, research instruments and data analysis. Lastly, ethical consideration concerning the work is explained under the header ethical issues.

Research Design

The study used a descriptive research design. Descriptive research design is a scientific method which involves observing and describing the situation without influencing it in any way. This technique is concerned with representing a picture of the specific details of a situation of the study area that is the social setting or relationship (Neuman, 2003). The technique also gives researchers more information about a particular characteristic within a particular field of study. It simply involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data collected. Krathwohl (2009) supports the use of descriptive design because it helps to describe, explain, and validate findings. This is achieved through merging creative exploration and organising the findings in order to fit them with explanations, and then test or validate those explanations.

Contrary, the descriptive design has been criticised for being narrow in scope and limiting analysis of events, concepts and theories to only what they

are without exploring their in-depth components (Creswell, 2010). Notwithstanding the criticism labelled against descriptive design, the method was found to be most appropriate for the study. This can be attributed to the design being considered to be relatively easy to use because data is fairly easy to obtain and interpret by the use of simple descriptive statistics (Sarantakos, 2006). In addition, this method has the advantage of producing a good amount of responses from a wide range of respondents including in this study, motorists, pedestrians and road management experts.

The study adopted a mixed method approach by triangulating both quantitative and qualitative techniques of data collection and data analysis. Creswell (2010) indicated that, triangulation focuses on collecting and analysing both qualitative and quantitative data in a single study. This enables the researcher to have a more critical attitude towards the mechanistic use of quantitative methods and a more relaxed attitude to the use of qualitative methods. It also allows for flexibility and improvisations in choice of practical methods, that is iteration between data and partial results (Mikkelsen, 2005). This method is employed to overcome challenges associated with researches that rely solely on one theory, which is single method and single data set. It is in view of this that Bowen (2009) argued that both qualitative and quantitative approaches have their strengths and weaknesses, which means neither is markedly superior to the other.

A further argument is made that research which combines different qualitative methods and exploits the complementarity of qualitative and quantitative findings looks poised to gain a new respectability within the discipline (Johnston, Remington, Ruthruff, Gold & Romera, 2000). Some

criticisms labelled against triangulation include the fact that even if the results from different data sources tally, there is no guarantee that the inferences involved will be accurate. The results may generate two incorrect but similar conclusions (Blaikie, 2009). In addition, it is time consuming in terms of analyzing both text and numeric data (Creswell, 2010).

Profile of the Study Area

The area selected for this study is the Sekondi-Takoradi Metropolis. Sekondi-Takoradi metropolis is a city comprising of twin cities (Sekondi and Takoradi). Sekondi – Takoradi Metropolitan area is the capital city of the Western Region of Ghana. Sekondi-Takoradi is on 04°55′N 01°46′W and 4.917°N 1.767°W. It is one of the largest industrial and commercial centres in Ghana with a population of 445,205 people (Obeng-Odoom, 2012). Sekondi Takoradi's population is overwhelmingly Christians with over 87% of the population, 9% are Muslims, 3.5% identify as non-religious and 0.2% practice traditional African religions (Obeng-Odoom, 2012). The chief industries in Sekondi-Takoradi are timber processing, cocoa processing, plywood, shipbuilding, its harbor and railway repair, and recently, crude oil. Sekondi-Takoradi lies on the main railway lines to Kumasi and Accra. Takoradi is also a port city and has timber, energy, and technology industries. Over the years Sekondi-Takoradi has attracted a good number of investors, including miners, as the city is close to the mining towns in the western part of Ghana.

The target areas within the metropolis that is of interest to the study includes the following congested lanes: Sekondi By-Pass / Ntankoful Road, Sekondi By-Pass / Tanokrom Road, West Tanokrom Road off Tadisco, Kasanwurodo/Apremdo By-Pass / Namibia Road, Boundary Road Junction,

Agona Nkwanta Road / Kwesimintsim Road and the Liberation Road / Market circle, the main commercial and economic hub of the Metropolis.

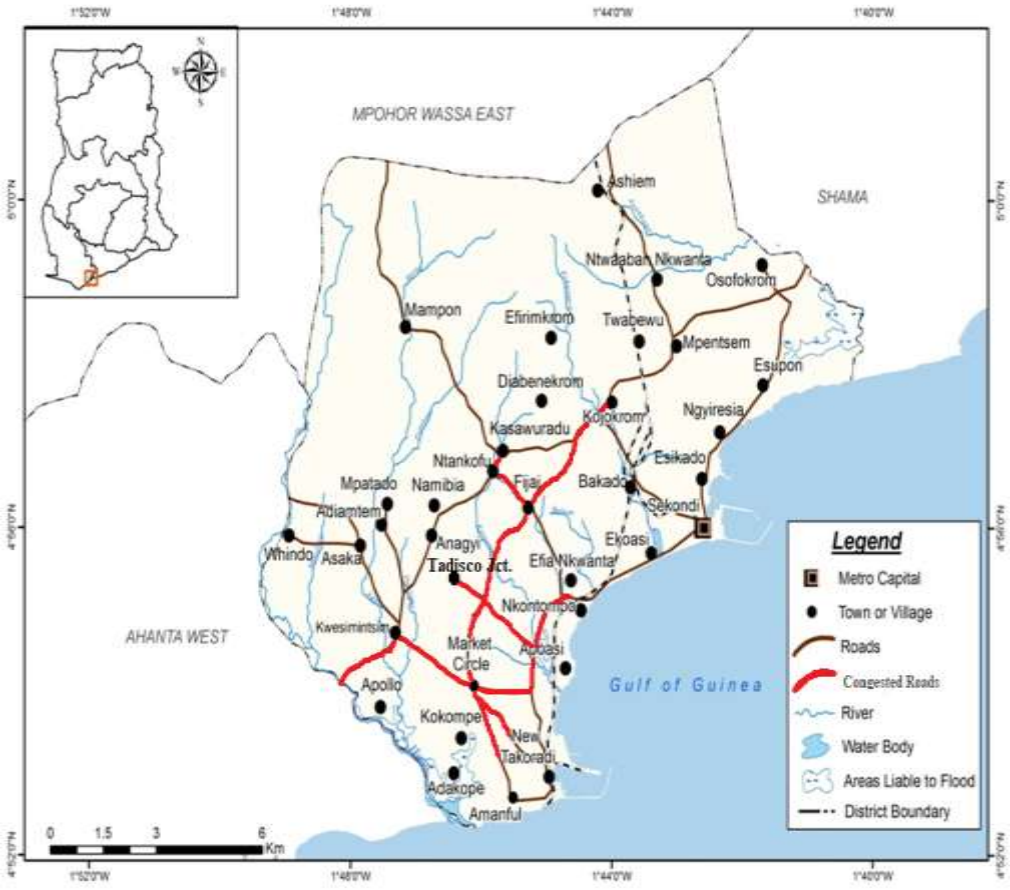

Figure 3: A map of Sekondi-Takoradi Metropolis

Source: Cartographic Unit, University of Cape Coast, Cape Coast (2016).

Population

The target population of the study were drivers (15,109), motor-cycle riders (1,215) and stakeholders involved in road traffic management in the Sekondi-Takoradi Metropolis. Among the drivers were 10,275 commercial drivers and 4,834 private vehicle drivers. The stakeholders involved were officers from the Motor Traffic and Transport Department (MTTD) of the Ghana Police Service, Department of Urban Roads and Ghana Private Road Transport Union (GPRTU).

Sample and Sampling Procedure

In all a total of 198 respondents made up of drivers, motor-cycle riders and officers of STMA, MTTD, Urban Roads and GPRTU were selected for the study. The determination of the sample size was carried out using the Fisher et al, (1998) formula for determining sample size. This is expressed as:

$$n = \frac{z^2 pq}{d^2}$$

$$nf = n/(1+(n/N))$$

Where:

n = the desired sample size (when the population is greater than 10,000)

nf =the desired sample size when the population is less than 10000

z = the standard normal deviation, usually set at 1.96 which corresponds to 95 % confidence level;

p = the proportion in the target population estimated to have particular characteristics (similar views on the effectiveness of road traffic congestion measure put in place by stakeholders);

q = 1.0-p; (with 1.0 as constant) and

d = the degree of accuracy desired, usually set at 0.05

With the (z) statistic being 1.96, degree of accuracy (d) set at 0.05 % and the proportion of the study population with similar characteristics in respect of their views on road traffic congestion in the Sekondi-Takoradi Metropolis (p) at 85% which is equivalent to 0.85, then the sample size generated was:

$$n = \frac{(1.96)^2 (0.85) (0.15)}{0.05^2}$$

$$195.9216$$

$$nf = n/(1+(n/N))$$

nf= the desired sample size when the population is less than 10000

n= the desired sample size when the desired sample is greater than 10000

N = the estimated of the population

To determine (nf) n must first be calculated by determining the sample size of the population greater than 10000 using the formula:

nf=n/(1+(n/N))

nf=196/(1+(196/16324)

nf= by using the total number of drivers and motor cycle riders in the study area which is 16,324 (nf) was estimated at 198

Sampling procedure adopted for this research was the multi-stage sampling. First stage was the proportional allocation of the sample size to the categories of drivers (commercial, private and motor cycle riders) in the metropolis. Per the varied magnitude of the population, disproportional allocation sample size was used to sample the respondents. Sixty-three per cent (63%) was allocated to commercial drivers representing a sample size of 122. A percentage of 30 was also allocated to private drivers representing a sample size of 58 while 7% representing 14 respondents was allocated to motor cycle riders. The rationale behind the use of disproportionate allocation was based on the fact that, the sample differed in terms of numbers. Some of the category of sample had higher numbers than others and as such the researcher employed the

disproportionate allocation to give a balanced representation of targeted sample.

The second stage of sampling was the use of accidental sampling technique. The main reason for the adoption of accidental sampling technique was because drivers are highly mobile. Therefore, commercial drivers and motor cycle riders were accessed at their various stations (market circle, Anaji Trotro station, Kwesimintsim station, New Site Taxi station, Sekondi Taxi station, Harbour, Accra and Tarkwa stations). In this regard, the researcher administered questionnaire to drivers willing to part-take in the research or had free time to spare. On the site, the researcher approached private drivers who have parked their cars at various parking lots (such as malls, filling stations, banks etc.).

Lastly, purposive sampling technique was adopted to select the officers from the Motor Traffic and Transport Department (MTTD) of the Ghana Police Service, Department of Urban Roads and Ghana Private Road Transport Union (GPRTU) because these officials are the managers of traffic and have in-depth knowledge of the subject under study.

Data Collection Instrument

This study collected both primary and secondary data**.** Primary data was solicited from drivers, motor-cycle riders and stakeholders involved in road traffic management in the Sekondi-Takoradi Metropolis. The type of instrument that was used for soliciting primary data from the respondents was the questionnaire and in-depth interviews guide. The questionnaire was self-constructed in light of the empirical review. A questionnaire was selected for this kind of study because it is a self-report measure which guarantees

confidentiality and therefore more likely to elicit more truthfulness in response, with regard to the kind of information required from the respondents. The self-administered questionnaires was adopted as a method of data collection because, it guarantees respondents privacy, which may encourage them to objectively disclose their true feelings and perceptions (Yin, 2014) and because of its associated cost-effectiveness (Bryman & Bell, 2011). The survey questionnaire consisted of both open ended questions as well as closed-ended questions. All items on the closed ended questions was measured on a five-point Likert scale statements, ranging from 1 = strongly disagree to 5 = strongly agree. In addition, other Likert scales such as very effective (VE) = 5, moderately effective (E) = 4, uncertain (U) = 3, less effective (LS) =2, not effective (NE) =1) were also employed.

The questionnaire was structured into four main sections, namely, sections A, B, C, and D. Section A is made of questions that sought the demographic details of respondents. This information would help the research to have vivid picture of the dynamics in the population under study. Section B of the questionnaire contains questions that seek to examine the causes of traffic congestion in the metropolis. Section C of the questionnaire focuses on examining the effects of traffic congestion whiles the last Section D captured the effectiveness of the measures put in place by stakeholders to curb congestion in the Metropolis.

In addition to the questionnaire, interview guides was also designed. The type of interview guide employed was a semi-structured format which was in line with Hockey, Robinson and Meah (2005), assertion that semi-structured interviews are flexible, and they allow for the exploration of

emerging themes and ideas. Interviews were conducted with four key informants. The secondary data emanated from previous published studies such as journal, theses, conference proceedings, and working papers that are relevant to the phenomena under investigation.

Validity of Research Instruments

The instruments were subjected to a validity and reliability test. The validity of a test instrument is the extent to which instrument (i.e., questionnaires in this study) measures the variables under study (Mugenda, & Mugenda, 1999). The instruments for the study were carefully vetted before their final approval by experts in the field of research to establish their validity. Specifically, the instrument was given to my supervisor who meticulously inspected them and ascertained that they met both face and content validity. The suggestions as given by the supervisors with regard to the improper constructions of some items in the questionnaire were used to effect the necessary changes to improve upon the instruments. One benefit of ascertaining content validity is that, if the respondents know what information the researcher is looking for, they can use that "context" to help interpret the questions and provide more useful, accurate answers (Saldana, 2016).

Reliability of Research Instruments

According to Johnson (2017), reliability refers to the consistency and stability of measurement from one period to another. The establishment of reliability was accomplished by measuring the internal consistency of the instruments using a reliability coefficient, obtained by means of Cronbach's alpha. In order to obtain the reliability coefficient, a pilot testing of the instrument was carried out in Accra using 20 respondents (thus drivers and

motor-cycle riders). The data gathered were analysed using the Cronbach's alpha correlation technique to check for internal consistency. Yin (2014) described Cronbach's Alpha as a method used to measure the reliability of the questionnaire between each item and the mean of the whole items of the questionnaire. The normal range of Cronbach's coefficient alpha value is between 0 and 1, and the higher value indicates that higher degree of internal consistency. Different authors accept different values of Cronbach´s alpha so as to achieve internal reliability, but the most frequently accepted value is 0.70 and above to reach internal reliability. In this study a reliability coefficient of 0.788 was obtained which Whaley (2014) considered acceptable for determining the appropriateness of the instruments. The Cronbach's coefficient alpha was calculated for each variable of the questionnaire.

Data Collection Procedure

In order to collect data from the respondents, an introductory letter was taken from the Department of Geography and Regional Planning of the University of Cape Coast. The letter was presented to the stakeholders such as the DVLA, MTTD, STMA and the Departments of Urban Roads to prove the authenticity of the study. This enhanced the smooth collection of data from the various respondents. On the appointed day, respondents were briefed with the purpose of the study and questionnaires were self-administered to the respondents with the aid of four trained field assistants. The questionnaires were taken from the respondents who were able to complete them immediately. However, those who were unable to respond to the questionnaire at that moment were given three days to complete the questionnaires. Questionnaires were read to respondents who could not read and write. The

administration and collection of questionnaire took three weeks (between 1st and 22nd August, 2016).

Data Processing and Analysis

When all the questionnaires were received, they were checked to ensure that they were all well answered and that they were eligible for inclusion in the sample. The Statistical Package for Service Solution (SPSS) version 23.0 was used to analyse data for the study. The data which was collected from the respondents was edited, coded, captured and presented on SPSS prior to data analysis. Descriptive statistics were generated from the analysis. Frequencies, percentages, averages and proportions were used to present the results from the questionnaires in the form of tables, charts and pictures. The data from the interview was first recorded and were later transcribed, then categorised under specific themes and used for the analysis. The theming was done manually.

Ethical Considerations

Padgett (2011) define ethics as a system of moral values concerned with the degree to which research procedures adhere to professional, legal and social obligations concerns of the participants. During and throughout the entire research process of this study, several ethical aspects were taken into consideration. In doing that, respondents were approached and were requested to participate in this study voluntarily. Again, the aims and significance of the study was explained to respondents orally and in a written form attached to the questionnaire. They were assured that information obtained would be confidential and their participation would not affect their dealings with the company. Approval of the study was obtained from the University of Cape

Coast. For the sake of confidentiality and anonymity, no respondent was required to disclose his or her identity or disclose any personal information that could make it possible to trace the completed questionnaires to them.

Chapter Summary

This chapter has given a detailed justification for the research methodology used in the study, as well as a step by step explanation of the procedures employed for data collection and analysis. The researcher first took a critical look at mixed method study design which was employed for this study. Other relevant issues that have been given careful consideration include population, sample and sampling techniques, research instruments, validity and reliability of research instruments, ethical considerations, data collection procedure, as well as method of data analysis. Ethical issues were also dealt with.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

This chapter presents the results obtained from fieldwork with regards to road traffic congestion. The results presented were in two folds. The first was on the socio-demographic characteristics of the respondents. The second covered the presentation of results based on the objectives of the research which was discussed in relation to the literature reviewed.

Socio-Demographic Characteristics of Respondents

This section presents the socio-demographic characteristics of the respondents. These include sex, age, and marital status, level of education, driver category and number of years as a driver.

Table 3: Socio-Demographic Characteristics of Respondents

Category	Frequency(198)	Percentage
Sex		
Male	136	68.7
Female	62	31.3
Age		
Below 20 years	2	1.01
20-29 years	70	35.35
30-39 years	62	31.31
40-49 years	32	16.16
50-59 years	27	13.63
Above 60 years	5	2.52

Table 3 continued

Level of Education		
No formal education	75	37.9
Basic/Middle Sch.	78	39.4
Secondary/A' Level	29	14.6
Tertiary	16	8.1
Driver Category		
Private driver	85	42.9
Commercial driver	102	51.9
Motor-cycle riders	11	5.6
Number of years spent as a driver		
1-9 years	103	51.9
10-19 years	66	33.3
20-29 years	22	11.1
30 > years	7	3.53
License Category		
A	12	6.1
B	119	60.1
C	37	18.7
D	19	9.6
E	10	5.1
F	1	0.5

N=198,

Source: Fieldwork, 2016.

It can be observed that out of a total of 198 respondents, 68.7 % were males (Table 3). This clearly shows that the male drivers outnumbered the female drivers confirming World Health Organisation (2002) report that male drivers dominate in Africa. Most of the drivers were within the age range of 20 and 49 years which constitute 83.26% of the respondents signifying a youthful driver population in the metropolis.

With respect to level of education, the results show that 39.4% of the respondents had basic school education while 37.9% had no formal education. The data further showed that only 14.6% and 8.1% of the respondents had attained secondary and tertiary (college, polytechnic and university) education respectively.

The respondents were mainly commercial drivers (51.5%), private car drivers (42.9%) while 5.6% were motor-cycle riders. This implies that a greater percentage of the respondents were commercial drivers.

The low frequency of motor-cycle riders in the metropolis was opposite to what Kudebong, Wurapa, Nonvignon, Norman, Awoonor-Williams & Aikins (2011) found in their study conducted in Northern Ghana where motor bikes were the most common means of transport. The situation in southern Ghana is however different where motor bikes are shunned by most people. In recent times, patronage has increased because of their ease of mobility in urban areas as traffic congestion keeps increasing.

In terms of level of experience, 51.9% of the respondents have been driving for about 9 years, 33.3 % between 10-19 years with 3.53% having higher experience of 30 years and above. According to Lesch, & Hancock (2004), a period of 9 years of driving is usually considered long enough to

gain much experience on the road. It can therefore be concluded from this study that the respondents were experienced enough in driving within the study area.

According to the Road Traffic Acts 683 and Road Traffic Regulation 2180, people without a valid professional, private or learners' drivers licence are not authorised to drive. In this study, about 6.1% of respondents had License A while 60.1% possessed License B. Furthermore, 18.7%, 9.6% and 5.1% possessed the License C, D and E respectively while only 0.5% possessed License F. A greater proportion of the respondents were qualified to be on the road. Judging from the high level of experience of drivers in STMA coupled with their level of driving qualification it is expected to reflect in their behaviour towards the causes of congestion but the opposite rather exists.

Causes of Traffic Congestion in the Sekondi- Takoradi Metropolis

This section focuses on research objective one which sought to identify the causes of traffic congestion in Sekondi -Takoradi Metropolis (STMA). Two types of congestion were identified from the STMA. These were structural and incidental congestion. This finding was based on observation and views of respondents on traffic congestion in the metropolis. The two types of congestion identified were in conformity with the ECMT (2007) classification of traffic congestion which was structural and incidental congestion. The structural congestion in STMA often occurs in the morning (7-10am) and evening (4-7pm) during rush hours.

The pattern of structural congestion could easily be anticipated by respondents since it takes place at the same location and at the exact time of

the day. The finding of this study confirms the Burgess model of Land Use which depicts that of the concentric pattern of the growth of cities, where the central point of the city is accessible from all directions. Thus most economic activities of the urban area take place in the city centre with the periphery being the residential area. Therefore, all business owners and traders who reside in the periphery move to the CBD to transact business especially in the rush hours of the mornings and all of them move back to their respective abodes in the evening.

The increase in the number of persons using vehicles as the major means of transport builds the traffic in the metropolis just as depicted in Burgess Model of land use in which the movement of persons to the city centre occurs almost at the same time in the day. This situational movement happens in the CBD of most cities in some developed and developing countries. ECMT (2007) also claims that structural congestion is because of high demand for road space by vehicles. Table 4 gives a detail account of the views obtained from the respondents.

Table 4: Causes of Traffic Congestion on Years of Experience of Road User

	1-9 yrs N (%)	10-29 yrs N (%)	30-39yrs N (%)	40-49 yrs N (%)
Picking up and dropping of passengers	98(51%)	51(26%)	15(8%)	4(15%)
Inadequate parking lots	103(53%)	47(24%)	10(15%)	4(8%)
Inadequate routes	99(51%)	46(24%)	12(14%)	3(11%)
Illegal parking	97(50%)	40(21%)	15(13%)	3(16%)
Bad attitude of drivers	92(47%)	40(21%)	13(14%)	2(18%)

Table 4 continued

Pedestrian's attitude	87(49%)	42(32%)	12(6%)	1(13%)
Too many vehicles	71(37%)	36(35%)	12(12%)	1(16%)
Road works	69(36%)	34(18%)	13(23%)	2(14%)
Poor road design	71(37%)	32(16%)	8(14%)	2(33%)
Trade obstruction	67(35%)	30(15%)	6(23%)	2(27%)
Car breakdown	65(33%)	29(25%)	8(18%)	2(24%)
Inadequate traffic lights	63(32%)	29(25%)	8(24%)	4(19%)

N=198

*Multiple responses

Source: Fieldwork, 2016.

In order to ascertain a clearer picture on the causes, the researcher cross tabulated the results in terms of years of driving and their perceptions on the causes of congestion.

Per level of experience and causes of traffic congestion, 103(53%) drivers who have had 1-9 years of experience in driving attributed the cause to inadequate parking lots (Table 4). However, only 15(8%) of respondents with long years (30 – 39) of driving experience regards the same inadequate parking lots as a cause of traffic congestion. From Table 4, it's been noticed that picking and dropping of passengers was identified as another major cause of traffic congestion in the metropolis. It was common to find drivers picking passengers on unapproved locations on the road as depicted in plate 1.

To illustrate further, a 28-year-old commercial driver attested to the fact that, the activity of picking and dropping of passengers on any part of the road was one of the main causes of congestion in the metropolis;

"We the commercial transport operators (Taxi and trotro drivers), pick passengers anywhere on the road without considering the dangers and the effects on other road users. We spend considerable length of time at the stop point… the intention is to outsmart other drivers in getting more passengers. This behaviour delays the flow of traffic and causes congestion on the road".

Plate 1: Driver Picking Passengers on the Road Adding up to Traffic Congestion

Source: Fieldwork, 2016.

Still on the causes of traffic congestion, results from Table 4 depicts that too many vehicles on limited roads in the metropolis also accounted for road traffic congestion as attested by 71(37%) of the respondents whose years of driving were within 1-9 years (Table 4). It was worth adding that these many vehicles were mostly individual private and commercial cars. The picture in plate 2 gives a clearer view of the situation in the metropolis.

Plate 2: Too many Private and Commercial small Vehicles on Limited Road

Source: Fieldwork, 2016.

Again, it can be seen that the greater majority 65(33%) of drivers within the range of 1-9 years of driving experience attribute the cause of traffic congestion to cars breakdown in traffic (Table 4). Similar views were also shared by drivers who had 10-29 years of driving experience. Respondents added that this type of congestion cannot be anticipated. They only become noticeable as you approach the scene hence drivers are usually not aware of its development. Moving further, it could also be deduced from Table 4 that a little above half 98 (51%) of the drivers with 1-9 years of driving experience considered picking and dropping of passengers as another cause of traffic congestion on the road (Table 4).

Furthermore, results from Table 4 reveal that inadequate parking lots in the metropolis were among the causes of traffic congestion. This was pin pointed by more than half 103 (53%) of the drivers with 1-9 years of driving experience. Other respondents also attributed the cause to inadequate routes and attitude of drivers. The least cause of traffic congestion was assigned to

inadequate traffic lights in the metropolis. From the results gathered, it can be concluded from the perception of respondents that drivers who are more experienced are least to cause traffic congestion.

It is important to note that this situation was not limited to only STMA. Abane (1993) identified similar behaviour among drivers in Accra, especially within the CBD. Abane (1993) further noted that, this behaviour of commercial drivers is to earn more money as possible from a day's trip. Also, in Cape Coast, Andoh (2014) attributed traffic congestion in the metropolis to this same commercial drivers behaviour in traffic flow in the Cape Coast metropolis. Similar results were identified by researchers in other parts of Africa. A study conducted by Onyelowe and Ogwo (2015) in Umuahia Metropolis in Nigeria identified picking and dropping of passengers as the major cause of traffic congestion. Rukunga (2002) claimed that Kencom bus stop and Latema road terminus were some of the most congested areas in Nairobi as a result of picking and dropping of passengers at unauthorized points of traffic flow. The situation was also persistent in India, as Rao and Rao (2012) labelled picking and dropping passengers on any part of the road as the cause of traffic in most Indian cities.

Another cause of traffic congestion in the STMA was attributed to inadequate parking space. This challenge can be attributed to the growing economic importance of the metropolis since the discovery of offshore oil and gas in the region. This has resulted in increase in the numbers of residential apartments, commercial activities, education structures, entertainment centres, government offices, financial institutions and medical centres and offices. Growth of the metropolis has also attracted migrants from both far and near

and this has resulted in the increase of private cars and high demand of commercial cars all fuelling traffic congestion. The road network in the metropolis is also limited and of bad state which contributes to the traffic congestion as drivers try to manoeuvre around potholes as displayed in plate 3. A Ghana Highways Authority (GHA) official threw more light on the types and conditions of the road network in the metropolis: `

> *The road network in the metropolis is 688.43 kilometres and it is fairly inadequate with larger proportions full of surface dressing". The proportion of the road that is made of asphalt is 68.45km, surface dressing constituted 312km, and gravel consisted of 266.86km. The rest of the road network in the metropolis is made up of earth 40.27km and 0.47km constructed with concrete. About 50 per cent of the road network in the metropolis is in good condition and the rest are fair and poor. Therefore drivers have no option than to compete for the 50 per cent of the good roods in the metropolis causing congestion. - Official (GHA).*

Plate 3: Bad roads in the Secondi-Takoradi Metropolis
Source: Fieldwork, 2016.

Downs (2003) attribution of traffic congestion to limited parking spaces for cars was true for STMA. This is because drivers are left with no option than to park on the shoulders of the road which reduces the road space for free flow of traffic. It also delays drivers time as they have to be cautious not to damage parked cars which can generate huge conflict and fights on the road between car owners. An MTTD official in STMA supported the limited parking spaces in the metropolis by explaining;

> *The expansion of businesses and the emergence of new banks in the metropolis call for larger parking facilities especially in the central business district. As at now, there is limited parking lot for drivers in the metropolis for both private and commercial vehicles. Private drivers who visit the bank and other shops have to rely on parking on the streets since the car park for them is limited. Commercial vehicle terminals/stations are also very limited as drivers in various stations have had to run a shift system which is even based on merit- Official (MTTD).*

Also some of the drivers attested to the fact that parking space in the metropolis is very difficult to come by especially in the business areas and around the major transport station since there is no place demarcated for parking as displayed in plate 4. A 43-year-old private driver remarked;

> *"Hmmm, we do not have parking facility in this city. We are left to park on the shoulders of the narrow road which is even dangerous but we have no option. Cases of cars being scratched by others whilst parked along the road are commonly reported. In some extremes, the side mirrors of the*

car are broken due to the lack of parking spaces since vehicles are not properly parked. Wrong parking on the shoulders of the road causes congestion and sometimes accidents".

Plate 4: Inadequate Parking Space

Source: Fieldwork, 2016.

Still on the causes of road traffic congestion in the metropolis, only 47% of the respondents' established that traffic congestion is caused by bad attitude of drivers. From observation, attitude of drivers such as fighting on the road, jumping of red traffic lights, and gross disregard for road traffic regulations were cited. This was in conformity with Ian and Bull (2002) studies which indicated that congestion is as a result of drivers' behaviours such as jumping traffic signals. This is also in congruence with the survey conducted by Khaled et al (2012) which claimed that violating road traffic light was one of the causes of traffic congestion in Dhaka, Bangladesh.

Moreover, break down vehicles in traffic further increases the traffic congestion in STMA. According to respondents, breakdown of vehicles on the road could contribute to high traffic congestion for hours especially during

peak periods of traffic. Rukunga (2002) and Olagunju (2015) all attested to this problem in their studies in Niarobi, Kenya and Nigeria respectively.

Plate 5: Broken down Vehicle causing Congestion during Peak Hours

Source: Fieldwork, 2016.

Furthermore, by observation, hawking has also contributed to the traffic situation in the metropolis. Traders and hawkers in their attempt to make better sales, display their merchandise on the pedestrian walkway and some portions of the road. This situation buttresses Singh (2005)'s claim that encroachments on the side of the roads such as street vendors and pavement dwellers additionally narrow down the available road space and affect the smooth flow of traffic. Most of these trade activities are found almost on every major road in the metropolis especially at the Market Circle. Trading on sidewalks and on the street disrupts the normal flow of traffic which is usually by physical impedance in the travel lanes on a road network as suggested by Agyapong and Ojo (2018). It was also noted that, the on-going construction of

the new market and a lorry station at Kojokrom also contributed to the cause of traffic congestion in the metropolis.

From the results, few respondents identified uncontrolled multi-modal use of roads as a contributor to the problem of traffic congestion. In the Sekondi Takoradi metropolis as in many cities in the country, both motorised vehicles and motor-cycle riders are intermixed as there is no lane segregation. The use of motor-cycles popularly called "aboboya" which is an alternative to transporting goods within the market areas and business centres induces congestion. This is further supported by Turton and Knowles (1998), and Springael, Kunsch and Brans (2002) who noted that these tri-cycles often drive at a slow pace when they carry heavy loads and as a result creates slow movement of traffic causing congestion for cars that are behind them when those cars behind them cannot overtake them. Additionally, the absence of pedestrian's walkways in some areas of the metropolis forces pedestrians to share the roads with motorised vehicles and this brings about competition for available space on the road by both vehicles and pedestrians thereby leading to traffic congestion.

Some respondents also indicated that congestion in the metropolis could be attributed to social activities. Social activities such as picnics, demonstrations, route march, rallies, funerals and church services were identified by respondents as being direct causes of traffic congestion in the metropolis.

The metropolis functions as a port city and therefore heavy duty machines used by some mining companies like Bogoso and Tarkwa mines among others are cleared from the Takoradi Harbour. Some of these machines

are oversized cargo which is difficult to be transported by road since most of the roads in the metropolis are narrow. They often occupy the entire road and tend to move slowly. As a result, vehicles behind them must be cautious and move at a slower pace thereby causing traffic congestion.

Through personal observation, it was revealed that many traders who sell in traffic jams slow down the flow of traffic. This is due to the fact that drivers have to slow down for passengers to buy from the traders while traders in some instances will have to find change for the passengers. This exchange between the passengers and the traders further compounds the situation.

Effects of Traffic Congestion in the Sekondi-Takoradi Metropolis

This section of the result presentation discusses the effects of traffic congestion in the Sekondi- Takoradi Metropolis as displayed in Table 5.

Table 5: Effects of Traffic Congestion in the Sekondi-Takoradi Metropolis

Effects of Traffic Congestion	Agree N (%)	Uncertain N (%)	Disagree N (%)
Loss in productivity	132(67%)	14(7%)	52(26%)
Pollution	120(50%)	11(6%)	67(33%)
Pressure on road infrastructure	76(38%)	19(10%)	103(52%)
Operating costs	166(84%)	5(3%)	27(13%)
Global warming	17(8%)	152(77%)	29 (15%)
Cause of accidents	50(25%)	16(8%)	132(67%)
Loss of jobs	62(31%)	54(27%)	82(41%)
Increase stress	173(87%)	4(2%)	21(11%)

Source: Fieldwork, 2016.

The major effect indicated by respondents was increase in stress (87%). Respondents agreed that traffic congestion causes stress to both drivers and passengers. As drivers and passengers get stuck in traffic over a long period of time, heat in the vehicle causes drivers and passengers to loss body water. From an interview, some of the respondents said that the rate of dehydration causes fatigue to both drivers and passengers as displayed in the conceptual framework where traffic congestion results in fatigue (Figure 1). The result of this study confirms the flow of the conceptual framework and is also in line with the work of Anokye, Abdul-Aziz, Annin, and Oduro (2013). Also, Amoah (2014) found out that, traffic congestion has health effect on the lives of the drivers and passengers which sometimes result in depression, dizziness, cardiac arrest among others due to the inhaled smoke and stress. From the results in Table 5, it can be seen that traffic congestion causes pollution which may have health implications on both the driver and passengers in the vehicle as portrayed in the conceptual framework (Figure 1). Pollution can take the form of chemical substances or energy, such as noise, heat or light.

This effect was followed by increase in operating cost (84%). On the contrary, road traffic accident caused as a result of traffic congestion in the metropolis was debunked by more about two-thirds of the respondents. Also about 41% of the respondents disagreed that traffic congestion lead to loss of jobs but (67%) attested to the fact that it rather led to loss of productivity (Table 5). Most of the respondents were also uncertain about some of the effects of traffic congestion. About 77% of the respondents were uncertain if

traffic congestion causes global warming. This could be that respondents did not have much information on global warming.

Moreover, another major concern of urban traffic congestion is noise pollution. Noise produced by moving vehicles can affect studying, recreation, work and sleeping which has psychological effects on drivers, pedestrians and residents in the Sekondi-Takoradi metropolis

In terms of the highest effects thus, loss of productivity, most respondents linked it with time spent in traffic. About 52.5% of the respondent's claimed they spend about 15-30 minutes to drive through a stretch of one kilometer during peak hours as depicted in Table 6

Table 6: Time Taken to Drive 1km During Peak and Off-Peak Periods

A kilometre journey	Responses		
	Less than 15 mins.	15-30 mins	31-45 mins
	N (%)	N (%)	N (%)
During peak	2(1.0%)	104 (52.5%)	70 (35.4%)
Off-peak periods	100 (50.5%)	92 (46.5%)	1(0.5%)

Source: Fieldwork, 2016

Some other respondents, 35.4%, also claimed they spend between 31-45 minutes to cover one kilometre distance of journey during peak hours of the day (Table 6). This is because of slow movement of vehicles during peak hours as the number of cars on the road is high.

This assertion is in line with the findings of Hao, Kang & Wörtche, (2016) who noted that the average Canadian commuter spent 79 total hours in traffic in 2014, representing a two-per cent increase from the year before. The finding is therefore in direct support of Ogunbodede (2004), who posited that

traffic congestion on roads does not occur every day and all day, but during specific periods or times of the day. Andoh (2014) also found out that traffic congestion is very high during the rush hours (morning and evenings) the period where movements of workers and students are in one direction of traffic flow. Since the flow of traffic is one way, the vehicles gather at a given area. However, some of the respondents indicated that, congestion in some areas in the metropolis occur during the mid-day and the late afternoon. This stems from the fact that, many business activities peak in the mid-afternoon. Also, some workers go for lunch across the metropolis. Furthermore, from observation, most schools in the metropolis close in the late afternoon and school children begin their journey back home. This situation increases the volume of traffic on most roads in the metropolis since some drivers have to stop for school children to cross the road. The break in traffic flow results in traffic congestion.

Traffic congestion in STMA imposes additional cost to businesses and organisations associated with cargo and service deliveries. This situation is similar to what was experienced in Tanzania (Elinaza, 2010) where traffic congestion was believed to eat up 20 % of business profit. In the Sekondi-Takoradi metropolis, drivers who deliver goods and services charge more on transportation of goods to any congested area within the Central Business District.

Also, an interview with a respondent indicated that taxi cars that are picked to any congested point within the city carries extra charge since additional fuel is consumed. These results provide confirmatory evidence to conclude that traffic congestion has economic impact on a country and lives of

the people which is manifested in the form of time wasting, unreliable delivery of goods and services, as well as extra fuel consumption. In other words, business activities depend on timely delivery of logistics; however, freight movement in cities is impaired by traffic congestion, thus making productivity suffer. One can argue that traffic congestion results in loss of output per man hour. This finding lends direct support to the study of Anin, Annan and Otchere (2013), Anderson et al. (2005), Weisbrod, Vary and Treyz (2003) as well as Ewing et al. (2003). To illustrate further, Anin, Annan and Otchere (2013) on their part found that traffic congestion reduces productivity through increased inventory holding by manufacturers and retailers as a result of unreliable travel conditions within cities. This is crucial for STMA as the metropolis has a large number of industries whose inventories are likely to get stuck in traffic for hours. Also because the metropolis is used as a major route to most areas in Western Region, companies in the region are also likely to experience delays in their inventories from the port and other parts of the country.

Effectiveness of Measures to Control Traffic in the Metropolis

The third research objective is an attempt to find out the effectiveness of measures put in place by stakeholders to control traffic congestion in the metropolis. In doing that, respondents were presented with a set of items presented on five point Likert scale (very effective (VE) = 5, moderately effective (E) = 4, uncertain (U) = 3, less effective (LS) =2, not effective (NE) =1). For the sake of this discussion, responses which are between the mean of 0-2.9 is not effective, whiles 3.0-5.0 is concluded as very effective. Again, a standard deviation which is below 1 indicates homogeneous responses

whereas a standard deviation which is above 1 implies a heterogeneous response. The results from the responses are presented in Table 7.

Table 7: Effectiveness of Measures to Control Traffic in the Metropolis

Measures	Criterion Value= 3.0						
	VE (%)	ME (%)	U (%)	LE (%)	NE (%)	Mean	SD
Police visibility	39.5	28.8	10.4	14.6	7.7	3.53	1.36
Enforcement of traffic orders	39.4	30.2	11.6	10.6	8.2	3.46	1.25
Improving traffic operations	37.4	22.8	10.1	18.9	10.8	3.42	1.34
Providing parking facility	27.8	27.3	13.4	23.7	7.7	3.08	1.20
Expanding roadway capacity	21.6	19.6	11.3	38.7	8.8	3.05	1.17
Street park pricing	20.6	15.5	11.3	29.4	23.2	2.42	1.35
Mobility management	19.1	17.0	18.0	21.6	24.2	2.41	1.32
Investing in public Transit	14.9	10.3	23.2	30.4	21.1	2.32	1.31
Car pooling	13.4	11.9	22.7	21.1	30.9	2.20	0.52
Smart parking	8.2	8.6	16.5	41.2	27.8	2.18	0.66

Source: Fieldwork, 2016.

In the quest of accomplishing the purpose of the study, the researcher examined the effectiveness of the measures put in place to control traffic in the metropolis. The results from the study gave a strong indication that generally, some measures are effective to control traffic in the metropolis whilst others are not effective. The computed mean which is greater than the criterion value of 3.0 give evidence to that effect (M=3.05, SD=1.17, M>2.90, n=198) (Table 7).

The results however, indicated that some of the measures were more effective than others. It is seen from (Table 7) that police visibility ranks first in reducing traffic congestion on the roads in the metropolis. For instance, the respondents confirmed that the presence of police on the road has reduced congestion in the metropolis (M=3.53, SD=1.362, M>3.00, n=198) as indicated by the percentage value of 39.5% and 28.8% representing very effective and effective respectively (Table 7). This could be that when police personnel are deployed at various intersections in the metropolis, traffic laws are enforced and drivers operate according to traffic laws. Therefore, police visibility has been an effective approach since it has aided in controlling road user behaviour.

This was also confirmed during an interview with one of the respondents when he said:

> *The presence of the police on the road contributes a lot to ensuring conformity to road traffic regulations in the metropolis. A lot of drivers use the shoulder of the road which is illegal. The shoulders of the road are not to be used but commercial drivers in their bid to beat traffic often resort to the use of the shoulders of the road. The situation is attributed to the absence of police personnel at these hotspot areas. Any time the police are on the road drivers comport themselves by following the flow of traffic (28- year old driver).*

From observation during the study, it was noted that every intersection where there was police presence, traffic congestion was minimal and flows accordingly. This finding agrees with the work of Agyekum (2008) who averred that in order to manage traffic congestion, deployment of the police on

the roads is an effective means of reducing congestions in cities and other urban settlements.

Plate 6: Police Visibility

Source: Fieldwork, 2016.

Enforcement of traffic order was recounted by the respondents as the second significant measure which has controlled traffic congestion in the metropolis (M=3.46, SD=1.25, M>3.00, n=198) representing more than half of the respondents (69.2%) as presented in Table 7. In other words, respondents have regarded enforcement of traffic orders as an effective measure to control traffic in the metropolis. This outcome is in direct support of the findings from Watling, Milne and Clark (2012) who indicated that the presence of police personnel at post at various intersection and traffic spots induce driver behaviour and made them comply with traffic rules and regulations (Watling et al., 2012). That notwithstanding, the result from this study provides a contradictory outcome to the study conducted by Shamsher and Abdullah (2017) in Bangladesh. The Bangladeshi study showed that, although the traffic rules and traffic police are assigned to control the traffic system, rickshaws

and auto rickshaws mainly disregard red lights. Moreover, signal lights at most of the busy intersections remained out of order for a long time.

Improving traffic operations was also an effective measure to dealing with traffic congestion. Traffic lights mounted at some major intersections in the metropolis has brought about some degree of congestion control. The respondents strongly have the conviction that traffic lights introduced has reduced traffic congestion in the metropolis (M=3.42, SD=1.35, M>3.00, n=198) and with a percentage of 37.4% for very effective and 22.8% for effective in improving traffic operations. However, it was observed that quite a number of the traffic lights had been broken down and were therefore not functioning as seen in plate 7. It was again noted that there was traffic congestions in the areas such as Apollo and Airport Ridge junctions where traffic lights are broken and malfunctioning. Other areas where traffic lights are not functioning included: pipe Ano, Poly-Sekondi road intersection. This probably means that in the pursuit of combating traffic in the metropolis, more efficient and programmed traffic lights need to be introduced at intersections.

Plate 7: Broken down Traffic Lights in the Metropolis

Source: Fieldwork, 2016.

Also, the result on provision of parking was not different. It could be inferred from the results that adequate provision of parking lots has mitigated traffic in the metropolis (M=3.08, S.D=1.202, M>3.00, n=198). This result confirms the outcome of Shuichi and Hironao (2003) who have shown in their study that improving traffic signalling strategies can improve the traffic situation on the street.

Still examining the effectiveness of measures to control traffic in the metropolis, it was seen from Table 7 that respondents have rated investing in public transit as the eight measure to control traffic in the metropolis (M=2.32, SD=1.111, M<3.00, n=198). This gives practical evidence that when public buses were introduced it did not bring much improvement in traffic control in the metropolis. This is as a result of narrow roads in the area which did not enhance the smooth operation of these buses.

Expanding roadway capacity was also identified by respondents as an effective measure which has curbed traffic congestion in the metropolis (M=3.05, S.D=1.353, M>3.00, n=198). The respondents suggested that when some of the roads in the metropolis were rehabilitated, it reduced traffic congestion. This finding from the current study supports the idea maintained by Zanjirani-Farahani, Miandoabchi, Szeto and Rashidi, (2013) when they observed that when cities are trying to reduce urban traffic congestion, the first idea is often building more roads, to allow increasing traffic volumes. Zanjirani-Farahani et al. (2013) remarked that the more capacity of road networks, the more traffic flows in each period. In other words, supplying more roads capacity or improving the old road networks seems feasible and necessary in the areas of rapid growing of population or vehicles.

In a different line of thought, Hardjono (2011) noted that if the increasing of roads capacity does not catch up with the growing rate of population and vehicles, traffic flow would even go worse than before. This is because rapid growing population and number of vehicles could easily increase traffic loads, particularly in cities of developing countries. Also triple convergence could put much more pressure on expanded road network. When most drivers realize new roads can save much time, they will switch their travelling time, travelling routes, and even travelling modes to this improved road, thus the intensity of traffic congestion will come back to the level as before in the near future.

In addition to the measures discussed, investing in public transit was however found to be an ineffective measure of dealing with road traffic congestion. This finding is inconsistent with findings from other studies such as Vuchic (1999) and Zhang et al. (2009). Vuchic (1999) for instance opined that the rapid transit system is seen as the best public transport option for cities facing the challenge of traffic congestion since the quality of public transit service affects travel speeds and congestion delays on parallel highways. In a similar line of thought, Hoogendoorn and Bovy (2001) noted that, the system that will provide convenient, safe, regular and reliable public transport is an essential requirement for any urban area. This statement is further supported by Zhang et al., (2009) who maintain that a system of bus service which is convenient, accessible, comfortable, reliable and operating within acceptable levels of noise, vibration and pollution would be such welcoming news to the majority of the people. In view of these, public transportation which is fast and

reliable and of standards will absorb commuters from the other modes of transport.

Charges against on smart parking was the least indicated by the respondents as being effective (M=2.18, S.D=1.317, M<3.00, n=198). This could be that, parking fees for on- street parking is not high enough to serve as a disincentive to drivers. Drivers therefore spend so much time parked on the street. An STMA officer in charge of collecting parking fees had this to say:

The STMA charge fees for parking on the streets within the metropolis with the sole purpose of generating revenue. The levy was later increased by the Assembly to increase revenue. The Assembly however realized a short fall in its revenue as drivers were deterred from using the parking spaces due to the increased charges. They were therefore forced to rescind the earlier decision by reducing the charges which also aggravated the congestion problem as drivers could now afford the new charges. -STMA official.

Plate 8: On-Street Parking

Source: Fieldwork, 2016.

The idea for charges on street parking is to reduce the length of time drivers' park on the street, consequently leading to increase in roads space which will lead to a reduction in road traffic congestion. This is because, most drivers shy away from paying more fees for parking on the street. This creates some space for other vehicles to park and also increases the road space on the street. The findings of this study is contrary to the work of Yang et al (2004), which found that some Chinese cities, such as Guangzhou and Beijing, are using parking fees to manage car use by charging higher parking fees. He added that, this strategy discouraged most drivers from driving to some areas of the cities.

Chapter Summary

This chapter discussed both the socio-demographic characteristics of respondents and attempted to answer the study's research questions. Generally, most respondents were commercial vehicle drivers with about one-third of them having no formal education but were classified by the study as very experienced in their vocation due to the number of years they have been engaged in driving. In identifying the causes of road traffic congestion, respondents pointed out that the major causes of road traffic congestion in the Sekondi-Takoradi metropolis included picking and dropping of passengers on the road, inadequate parking space, inadequate routes and illegal parking, bad attitudes of drivers in the metropolis, pedestrian attitudes and too many vehicles on the road. Majority of the respondents indicated that traffic congestion has a negative effect on socioeconomic activities in the Sekondi-Takoradi metropolis. The study discovered that, some of the measures put in place to control traffic congestion have not been effective (Police visibility,

improving traffic operations, enforcement of traffic orders) in curbing traffic congestion in the metropolis. Some measures in controlling traffic congestion on the other hand have not been effective (smart parking, carpooling, investing in public Transit) in dealing with traffic congestion in the metropolis. This could be the reason why traffic congestion still persists in the metropolis.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the key findings that arose from the study. The chapter also contains the conclusions and recommendations that were made based on the findings of the study. It again suggested areas for further research.

Summary of the Research

The main objective of this research was to explore the effectiveness of measures instituted to control vehicular traffic congestion in Sekondi-Takoradi. Specifically, the study sought to identify the causes of traffic congestion in the Sekondi-Takoradi Metropolis, evaluate the socio-economic effects of traffic congestion in the metropolis and finally explore the effectiveness of the measures put in place by stakeholders to manage traffic congestion. This study adopted the descriptive survey design involving both qualitative and quantitative approaches. The target population of the study was drivers, motor-cycle riders and stakeholders involved in road traffic management in the Sekondi-Takoradi Metropolis. A total of 198 respondents participated in the study. The main instruments used were the questionnaire, interview guide and observation. The data from the interview were transcribed, then categorised under specific themes and used for the analysis. Frequencies, percentages, means and standard deviations were used to present the results from the questionnaires in the form of tables.

Summary of Findings

Research question one sought to find out the causes of road traffic congestion within the metropolis. Respondents indicated that the causes included picking and dropping of passengers on the road, inadequate parking space, inadequate routes and illegal parking. Others included bad attitudes of drivers in the metropolis, pedestrian attitudes and too many vehicles on the road. Moreover, the researcher observed that most of the roads in the metropolis are narrow in nature especially in the Central Business District around the market circle. Further to this, vehicles were parked on the shoulders of the road due to lack of designated parking spaces in the CBD.

On the issue of traffic congestion and its effect on socio-economic activities in the metropolis, majority of the respondents indicated that, traffic congestion has a negative effect on socio-economic activities. According to respondents they spend more time before reaching their various destinations and increased transportation cost among others. Businesses in the metropolis become unstable since trips are delayed and leads to low productivity as a result of congestion. Again on social issues, road traffic congestion retards church, funerals and wedding activities.

With respect to how effective the measures put in place by stakeholders to manage traffic congestion in the metropolis had turned out, it was discovered that traffic police visibility, rehabilitation of roads, and education on road traffic Acts are some mitigation measures put in place to curb road traffic congestion. This research found out that, although some of these measures have had their strength in dealing with the traffic situation, there is still more to be done indicating that some have not been very effective

in curbing traffic congestion in the metropolis. Other measures have not been effective in dealing with traffic congestion in the metropolis. This may be the reason why traffic congestion still persists. Hence stakeholders in the transport sector need to improve on measures to bring down traffic congestion in the metropolis.

Conclusions

Based on the findings from the study, it can be concluded that there are several causes of road traffic congestion within the Sekondi–Takoradi metropolis. Notable among the causes included illegal parking on the road, inadequate parking spaces, and bad driver attitudes, malfunctioning traffic lights, increasing number of vehicles plying the roads, poor road designs and bad pedestrian attitudes and narrow roads among other causes.

Moreover, drivers and road management institutions and other stakeholders in the Sekondi-Takoradi metropolis have negative perceptions about traffic congestion. As a result, many respondents largely attribute congestion in the metropolis as human induced and a major challenge that needs to be addressed promptly since it has adverse effect on businesses and social activities.

From the forgoing discussion, there is a compelling reason to conclude that some of the measures instituted to curb traffic congestion in the metropolis have not been effective whiles others are effective in reducing traffic congestion. Those that are effective in managing traffic congestion in the STMA were: police visibility, rehabilitation of roads, and education on road traffic, enforcement of traffic orders, providing parking facility and improving traffic operations. Among the factors that were not effective

included: Street park pricing, traffic lights, investing in public Transit, car-pooling and smart parking Drivers and other stakeholders in the metropolis are not satisfied with the measures implemented by road management institutions on road regulation.

Recommendations

Based on the findings and conclusions of the study, the following recommendations were made:

1. The study recommends that, rules governing road traffic Acts in the country should be enforced by the MTTD of the Ghana Police Service, and the Sekondi-Takoradi Metropolitan Assembly to ensure discipline on our roads. This can materialize when the joint forces of the Ghana Police Service and the Sekondi-Takoradi Metropolitan Assembly ensure that road traffic regulations are enforced and drivers who are found guilty are punished or fined to serve as a deterrent to other road users. Most significantly, narrow roads should be widened by the Departments of Urban Roads to enhance the flow of traffic. Also, the management of the Sekondi-Takoradi Metropolitan Assembly should ban all forms of trade activities on the roads, pavements and shoulders of the roads to reduce congestion especially in the major trading areas since congestion in the metropolis is human induced and often caused by pedestrians, drivers, hawkers and traders who sell on the roads and road sides. It would be essential for authorities to remove all forms of floating shops, mobile hawkers, artisans and temporary traders from roads and roadsides who cause traffic congestion.

2. To minimise the health impact of traffic congestion on the lives of the individuals, vehicles that produce a lot of fumes thereby polluting the environment which in turn affect people's health negatively should not be allowed to ply the road by the DVLA and the Ghana Police Service.
3. Regarding the effectiveness of the measures put in place by stakeholders to manage traffic congestion in the metropolis, police visibility which was very effective measure should be ensured in the core areas of Sekondi Takoradi specifically the major intersections so as to ensure good driver behaviour. Also, broken down and malfunctioning traffic lights should be fixed and equipped with solar units at major intersections within the metropolis so that the system runs in times of power outages. In addition, the highways department in consultation with urban roads should rehabilitate damaged road networks in the metropolis. Finally, public education on road traffic congestion should be intensified by the collaboration of the MTTD of the Ghana police service and the officers of STMA and the leaders of the GPRTU on issues relating to parking in the metropolis to reduce traffic congestion. Lastly, ultra-modern car packing facility should be constructed around the Central Business District (CBD) to accommodate high number of vehicles that visit the area.

Suggestions for Further Studies

The current study concentrated solely on examining causes, effects and effectiveness of traffic congestion measures put in place by stakeholders. Other researchers can research on fuel consumption levels of commercial drivers during traffic congestion and its effects on their livelihood.

REFERENCES

Abane, A. M. (1993). Tackling traffic congestion in Accra, Ghana: A road user's perspective. *Journal of Advanced Transportation, 27*(2), 193-206.

Abane, A. M. (2011). Travel behaviour in Ghana: Empirical observations from four metropolitan areas. *Journal of Transport Geography*, *19* (1), 313-322.

Abrams, J. (2010). On the road again: consumptives traveling for health in the American West, 1840—1925. *Great Plains Quarterly*, *30*(4), 271-285.

Ademola, O. (2010). Tackling road traffic congestion in a developing country – A contemporary. *Approach Journal of Applied Science, 5*(8), 12-27

Aderamo, A. J. (2012). Urban transportation problems and challenges in Nigeria: A planner's view. *Prime Research on Education, 2*(3) 198-203.

Aderamo, A. J., & Salau, K. A. (2013). Parking patterns and problems in developing countries: A case from Ilorin, Nigeria. *African Journal of Engineering Research*, *1*(2), 40-48.

Afriyie-Darkwa, V. (2017). *Performance evaluation of the management and performance of on-street parking within the central business district of Sunyani*. Unpublished Doctoral dissertation, University dissertation, University of Science and Technology, Kumasi.

Afukaar, S. K. (2003). Speed control in low and middle income countries issues, challenges and opportunities in reducing road traffic injuries. *Injury Control and Safety Promotion, 10*, 77-81.

Agyapong, F., & Ojo, T. K. (2018). *Managing Traffic Congestion in the Accra Central Market, Ghana*. Unpublished master's thesis. University of Cape Coast: Cape Coast.

Agyekum, P. (2008). *Socio-economic impact of traffic congestion*. Paper presented at a conference on traffic congestion in major urban cities in Ghana, Engineers Centre, Accra, February 21, 2008.

Agyemang, E. (2009). *Traffic Congestion: The bane of a bus rapid transit system in Accra, Ghana.* Unpublished M.Phil. Thesis (Monograph), Department of Geography, Norwegian University of Science and Technology, Trondheim.

Aliyu, A. A., Abubakar, S. I., & Adamu, H. (2015). Impact of traffic congestion on commercial property rental values in Bauchi Metropolis. *African Journal of Engineering Research*, *3*(3), 10-23.

Al-Mogin, S. (2005). *The impact of adverse effects and environmental effects of mobility on the sustainability of transportation. Sustainable transport in developing countries.* Proceedings Environment 2005 International Conference. Abu Dhabi, UAE: Environmental Agency (ERWDA), pp 177.

Amoah, N. R. (2014). *The causes and effects of traffic jam on commercial transport operations. A case study of trotro drivers at Awutu Senya East Municipality* (Doctoral dissertation, University of Ghana).

Anderson, S., Allen, J., & Browne, M. (2005). Urban logistics—how can it meet policy makers' sustainability objectives? *Journal of Transport Geography*, *13*(1), 71-81.

Andoh, K. A. (2014). *Managing road traffic congestion in the Cape Coast Metropolis, Ghana.* Unpublished Master's dissertation submitted to the Department of Geography and Regional Planning, Faculty of Social Sciences, University of Cape Coast.

Anin, E. K., Annan, J. Otchere, F. A. (2013). Assessing the causes of urban transportation challenges in the Kumasi metropolis of Ghana. *American Based Research Journal, 2*(6), 44-56.

Annan, J. (2014). *Urban road transportation systems: Energy demand, congestion and productivity in an emerging economy.* Unpublished PhD Thesis submitted to Kwame Nkrumah University of Science and Technology, Business School.

Anokye, M., Abdul-Aziz, A. R., Annin, K., & Oduro, F. T. (2013). Application of queuing theory to vehicular traffic at signalized intersection in Kumasi-Ashanti region, Ghana. *American International Journal of Contemporary Research*, *3*(7), 23-29.

Arasan, T.V (2012). *Urban Transportation Systems Planning*. Unpublished Hand Book presented at Short Term Course organized by Kwame Nkrumah University of Science and Technology and Indian Institute of Technology Madras, Accra.

Atuguba, R. (2007). Ghana's inherited police institutions. Africa's Challenge: using law for good governance and development. *Journal of Contemporary Research, 3*, 53-78.

Blaikie, N. (2009). *Designing social research*. Francisco: Oakland Press.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative research journal*, *9*(2), 27-40.

Briceño-Garmendia, C., & Estache, A. (2004). *Infrastructure services in developing countries: access, quality, costs, and policy reform* (Vol. 3468). World Bank Publications. 3468, Washington, DC.

Bryman, A., & Bell, E. (2011). *Ethics in business research*. New York: Kotter Associates.

Bunting, P. M. (2004). *Making public transport work*. McGill-Queen's University Press (MQUP).

Cabanatuan, M. (2011). Congestion Pricing Study of San Francisco–Oakland Bay Bridge in California. *Transportation Research Record*, *2221*(1), 83-95.

Centre for International Economics, (2011). *Subsidies and the social costs and* benefits *of public transport.* Sydney, Australia Transport Infrastructure Network.

Cervero, R. (2001). Walk-and-ride: Factors influencing pedestrian access to transit. *Journal of Public Transportation*, *3*(4), 12-24.

Chidambaram, B., & Zikos, D. (2012). Congestion mitigation measure in Hyderabad – A midnight summer dream? *Südasien-Chronik - South Asia Chronicle 2*, 58-92.

Chin, S. M. (2004). *Temporary losses of highway capacity and impacts on performance: Phase 2* (No. ORNL/TM-2004/209). Oak Ridge National Lab. (ORNL), Oak Ridge, TN (United States).

Creswell, J. W. (2010). Mapping the developing landscape of mixed methods research. *SAGE handbook of mixed methods in social & behavioral research*, *2*, 45-68.

Danquah, S. B. (2008). *Economic and social cost of traffic congestion in major cities in Techiman- Ghana-*. Paper presented on congestion in major urban cities in Ghana, Engineers Centre, Accra, February 21, 2008.

Dargay, J., & Gately, D. (1999). Income's effect on car and vehicle ownership, worldwide: 1960–2015. *Transportation Research Part A: Policy and Practice*, *33*(2), 101-138.

Detr, A. (1998). *New deal for transport: Better for everyone*. Department of the Environment, Transport and the Regions Stationary Office, London.

Dewan, K. K. & Ahmad, I. (2007). Carpooling: A step to reduce congestion (A Case Study of Delhi). Journal of *Engineering 14*(1), 61-66.

Dougherty, M. S., Kirby, H. R., & Boyle, R. D. (1994). Using neural networks to recognise, predict and model traffic. *Artificial intelligence Applications to Traffic Engineering*, *4*(6), 235-250.

Downs, A. (2003). *Stuck in traffic: Coping with peak hour traffic congestion*. The Brookings Institution; the Lincoln Institute of Land Policy. Washington, D.C.; Cambridge, Massachusetts.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Harcourt Brace Jovanovich College Publishers.

Economic and Social Commission for Asia and the Pacific, (2005). Review of developments in transport in Asia and the Pacific 2005.

Eddington, R. (2006). *The Edington transport study*. Main Report: Transport's Role in Sustaining the UK's Productivity and Competitiveness.

Edwards, J. B. (2002). Motorway speeds in wet weather: the comparative influence of porous and conventional asphalt surfacings. *Journal of Transport Geography*, *10*(4), 303-311.

Elinaza, A. (2010). *Car imports soar by 70 per cent, increase oil bill*. Retrieved from http://tzexchange.blogspot.com/2012/02/car-imports-soar-by-70-per-cent.htlm.

Elinaza, A. (2010). Dar es Salaam traffic congestion begs solutions. *Retrieved June*, *20*, 2016.

Environmental Protection Agency (EPA) & National Center for Environmental Assessment (NCEA) (2012). *Biofuels and the Environment: First Triennial Report to Congress*. Government Printing Office.

European Conference of Transport Ministers (ECMT, 2007). *Managing urban traffic congestion.* Joint OECD /ECMT Transport Research Centre

Ewing, R., Pendall, R., & Chen, D. (2003). Measuring sprawl and its transportation impacts. *Transportation Research Record: Journal of the Transportation Research Board*, (1831), 175-183.

Fadairo, G. (2013). Traffic congestion in Akure, Ondo State, Nigeria: using Federal University of Technology Akure Road as a case study. *International Journal of Arts Commence* , *2*, 67-76.

Farahani, R. Z., Miandoabchi, E., Szeto, W. Y., & Rashidi, H. (2013). A review of urban transportation network design problems. *European Journal of Operational Research*, *229*(2), 281-302.

Farel, R., Yannou, B., Ghaffari, A., & Leroy, Y. (2013). A cost and benefit analysis of future end-of-life vehicle glazing recycling in France: a systematic approach. *Resources, Conservation and Recycling*, *74*, 54-65.

Federal Highway Administration (2016), *Monitoring urban roadways in 2002: Using archived operations data for reliability and mobility measurement*: United States Federal Highway Administration: Washington, D.C.

Fungai, H. M. & Virginia, M. (2013). Sustainable urban traffic management in third world cities: the case of Bulawayo city in Zimbabwe. *Journal of Sustainable Development in Africa, 15* (2), 185-200.

Garrick, N., Ivan, J. N. & Hanson, G. (2009). Designing roads that guide drivers to choose safer speeds. *International Journal of Transport, 11(2), 117-130*

Ghana Statistical Service (2012). *2010 Population and Housing Census report.* Accra, Ghana Statistical Service.

Goodwin, L. C. (2002). Weather impacts on arterial traffic flow. *Transportation Research Record*, *21*(2), 12-23.

Guo, Z. (2013). Residential street parking and car ownership: a study of households with off-street parking in the New York City region. *Journal of the American Planning Association*, *79*(1), 32-48.

Gwilliam, K., (2002). *Cities on the move, a World Bank urban transport strategy review.* Washington D.C: Longrove, Waveland Press

Hao, Y., Kang, J., & Wörtche, H. (2016). Assessment of the masking effects of birdsong on the road traffic noise environment. *The Journal of the Acoustical Society of America*, *140*(2), 978-987.

Hardjono, B. (2011). A review of existing traffic jam reduction and avoidance technologies. *Internetworking Indonesia Journal*, *3*(1), 19-23.

Hartgen, D. T., Fields, M. G. (2006). *Building roads to reduce traffic congestion in America's cities: How much and at what cost?* Los Angeles, CA: Reason Foundation.

Health Effects Institute & Panel on the Health Effects of Traffic-Related Air Pollution. (2010). *Traffic-related air pollution: a critical review of the literature on emissions, exposure, and health effects* (No. 17). Health Effects Institute.

Hockey, J., Robinson, V., & Meah, A. (2005). What's sex got to do with it? A family-based investigation of growing up heterosexual during the twentieth century. *The Sociological Review*, *56*(3), 454-473.

Hon, M. L. (2005). *Evaluation of traffic congestion relieving options with using cost benefit analysis: Case study of Central Wan Chai*, Unpublished MSc. Thesis, The University of Hong Kong.

Hoogendoorn S. P., & Bovy, P. H. (2001). State-of-the-art of vehicular traffic flow modelling. *Proceedings of the Institution of Mechanical Engineers, Part I:Journal of Systems and Control Engineering*, *215*(4), 283-303.

Hooper, J. E. (2013). *Future Resilient transport networks – current and future impacts of precipitation on a UK motorway corridor*. Unpublished thesis submitted to the University of Birmingham, Birmingham.

Huang, L., Brook, J. R., Zhang, W., Li, S. M., Graham, L., Ernst, D., & Lu, G. (2006). Stable isotope measurements of carbon fractions (OC/EC) in airborne particulate: A new dimension for source characterization and apportionment. *Atmospheric Environment*, *40*(15), 2690-2705.

Ian, T., & Bull, A. (2002). Urban traffic congestion: Its economic and social causes and consequences. *Cepal Review, 7(6), 23-31*.

Intikhab, Q. A., Huapu L., & Shi, Y. (2008). Urban transportation and equity: A case study of Beijing and Karachi. *Transportation Research Part A: Policy and Practice*, *42*(1), 23-29.

Jaroszweski D., Chapman L. & Petts J. (2010) Assessing the potential impact of climate change on transportation: The need for an interdisciplinary approach. *Journal of Transport Geography*, *18*(2), 331 – 335.

Johnson, L. R. (2017). *Community-based qualitative research: Approaches for education and the social sciences.* Thousand Oaks, CA: Sage.

Johnston, J., Remington, R. W. C., Ruthruff, E., Gold, M., & Romera, M. (2000). Visual search in complex displays: Factors affecting conflict detection by air traffic controllers. *Human Factors*, *42*(3), 349-366.

Khaled, M., Gop, K., & Chowdhur, M. R. S. (2012). Possible Causes & Solutions of Traffic Jam and Their Impact on the Economy of Dhaka City. *Journal of Management and Sustainability, 2(*2), 112-135.

Kitamura R. (1989). A causal analysis of car ownership and transit use. *Transportation Journal*, *16*(2) ,155-173.

Kiunsi, R. B. (2013). A review of traffic congestion in Dar es Salaam city from the physical planning perspective. *Journal of Sustainable Development*, *6*(2), 94-123.

Krathwohl, D. R. (2009). *Methods of educational and social science research: The logic of methods*. Longrove, Waveland Press.

Kudebong, M., Wurapa, F., Nonvignon, J., Norman, I., Awoonor-Williams, J. K., & Aikins, M. (2011). Economic burden of motorcycle accidents in Northern Ghana. *Ghana Medical Journal*, *45*(4), 89-97.

Laporte, G., & Mesa, J. A. (2015). *The design of rapid transit networks in Location science*. Springer: Cham Publications.

Larson, R. C., & Sasanuma, K. (2010). Urban vehicle congestion pricing: A review. *International Journal for Traffic & Transport Engineering*, *2*(6). 156-172.

Latinopoulos, C., Sivakumar, A., & Polak, J. W. (2017). Response of electric vehicle drivers to dynamic pricing of parking and charging services: Risky choice in early reservations. *Transportation Research Part C: Emerging Technologies*, *80*, 175-189.

Latinopoulos, D., Mallios, Z., & Latinopoulos, P. (2016). Valuing the benefits of an urban park project: A contingent valuation study in Thessaloniki, Greece. *Land Use Policy*, *55*, 130-141.

Lesch, M. F., & Hancock, P. A. (2004). Driving performance during concurrent cell-phone use: are drivers aware of their performance decrements?. *Accident Analysis & Prevention*, *36*(3), 471-480.

Limanond, T., Prabjabok, P., & Tippayawong, K. (2010). Exploring impacts of countdown timers on traffic operations and driver behavior at a signalized intersection in Bangkok. *Transport policy*, *17*(6), 420-427.

Litman, T. (2006). Lessons from Katrina and Rita: What major disasters can teach transportation planners. *Journal of Transportation Engineering*, *132*(1), 11-18.

Local Transport Plan, (2000). *Cycling strategy, environmental services,* Oxfordshire County Council.

Lupala, J. (2011). Sustainable urbanization and spatial growth of the cities in the least industrialized countries; the case of Dar es Salaam City. *Journal of Building and Land Development*, *1*(7), 55-62..

Mahama, F. (2012). *Study of vehicular traffic congestion in the Sekondi-Takoradi Metropolis.* Unpublished Dissertation, Department of Mathematics, Kwame Nkrumah University of Science and Technology, Kumasi.

Martin, E. W., & Shaheen, S. A. (2011). Greenhouse gas emission impacts of carsharing in North America. *IEEE Transactions on Intelligent Transportation Systems*, *12*(4), 1074-1086.

Maze, T. H., Agarwal, M., & Burchett, G. (2006). Whether weather matters to traffic demand, traffic safety, and traffic operations and flow. *Transportation Research Record*, *1988*(1), 170-176.

Mikkelsen, B. (2005). *Methods for development work and research: A guide for practitioners.* New Delhi: Sage Publication

Mirrilees, R. I., Pretorius, J., Mare, H. A., Naude, C. M., & de Haan, M. (1996). *South Africa's expanding motor vehicle usage: Its implications for the environment and possible options for restraining it.* Department of Transport Contract Report (CR-96/022).

Momoh, O. A. (2011). *Transportation planning and management for economic development: Global best practices.* Proceedings of the National Conference of Nigerian Society of Engineers in Calabar.

Mugenda, O.M., & Mugenda, A.G. (1999). Research methods: Quantitative and qualitative approaches. Thousand Oaks, CA: Sage

Muñuzuri, J., Larrañeta, J., Onieva, L., & Cortés, P. (2005). Solutions applicable by local administrations for urban logistics improvement. *Cities*, *22*(1), 15-28.

National Research Council & Committee for Evaluating Double Hull Tanker Design Alternatives, & National Research Council (US). Marine Board. (2001). *Environmental performance of tanker designs in collision and grounding: method for comparison* (Vol. 259). Transportation Research Board.

Neuman, W. L. (2003). *Social research method* (5th ed.). Boston, Pearson Education.

Newman, P., & Kenworthy, J. (1999). *Sustainability and cities: Overcoming automobile dependence*. NY: Island Press.

Obeng-Odoom, F. (2014). *Oiling the Urban Economy: land, labour, capital, and the state in Sekondi-Takoradi, Ghana*. Routledge.

Ogunbodede, E. F. (2004). *Application of GIS to the management of traffic congestions in Akure, Ondo state, Nigeria*. Project submitted to RECTAS, Obafemi Awolowo University, Ile- Ife, Nigeria

Olagunju, K. (2015). *Evaluating traffic congestion in developing countries – a case study of Nigeria*. Paper presented at the 2015 chartered institute

of logistics and transport (CILT) Africa Forum held at Mount Meru, Tanzania, 4th March, 2015.

Onyelowe, K. C. & Ogwo, V. (2015). T-test hypothetical analysis of the causes of traffic congestion in Umuahia metropolis. *International Journal of Latest Engineering and Management Research, 1*(1), 32-42.

Osoba, S. B. (2012). Appraisal of parking problems and traffic management measures in central business district in Lagos, Nigeria. *Journal of Sustainable Development*, *5*(8), 105-118.

Padgett, D. K. (2011). *Qualitative and mixed methods in public health*. Thousand Oaks, CA: Sage

Park, R. E., & Burgess, E. W. (1924). *Introduction to the Science of Sociology* (Vol. 574). Chicago: University of Chicago Press.

Rao, A. M., & Rao, K. R. (2012). Measuring urban traffic congestion-a review. *International Journal for Traffic & Transport Engineering*, *2*(4). 141-156

Remi, A.J., Adegoke, A.A.I., Oyerinde, A.J. (2009) A Study of the causes, effects and ameliorative measures of road traffic congestion in Lagos Metropolis. *European Journal of Social Sciences, 11*(1), 119-128.

Rodrique, J. P., Comtois, C., & Slack, B. (2009). *The geography of transport systems*, New York City. Rowman & Littlefield Publishers

Romley, J. A., Hackbarth, A., & Goldman, D. P. (2010). Costs and health consequences of air pollution in California. *European Journal of Social Sciences, 1*(4), 11-28.

Rukunga D. N, (2002). The viability of the bicycle as an alternative mode of transporting Nairobi. Unpublished MA thesis, University of Nairobi

Rwakarehe, E. E., & Zhong, M. (2012). Spatial Correlation Analysis of Truck Traffic Patterns along Road Network Using Arc-GIS: A Case Study of the Province of Saskatchewan (Poster).

Sahni, P., & Ahuja, M. V. (2016). *Experimental analysis and recommendations for traffic congestion approach in Haryana*. The Texas A & M University System

Saldana, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Thousand Oaks, CA: Sage.

Sarantakos, S. (2006). *Social research* (4th ed.). London, Macmillan Press Ltd

Schrank, D. L., & Lomax, T. J. (2009). *Urban mobility report*. Texas Transportation Institute, The Texas A&M University System.

Schrank, D., & Lomax, T. (2005). *The 2005 Urban Mobility Report Texas Transportation Institute*, The Texas A & M University System.

Shamsher, R., & Abdullah, M. N. (2015). Traffic congestion in Bangladesh-causes and solutions: A study of Chittagong Metropolitan City. *Asian Business Review*, *2*(1), 13-18.

Shamsher, R., & Abdullah, M. N. (2017). Traffic congestion in Bangladesh-causes and solutions: A study of Chittagong Metropolitan City. *Asian Business Review*, *3*(3), 13-28.

Shapiro, R. J., Hassett, K. A., & Arnold, F. S. (2002). Conserving energy and preserving the environment: The role of public transportation. *American Public Transportation Association*, *9*, 1-39.

Sharma, S., Pithora, A., Gupta, G., Goel, M., & Sinha, M. (2013). Traffic light priority control for emergency vehicle using Radio Frequency Identification (RFID). *International Journal Innovation and Development*, *2*(2), 363-366.

Shoup, D. C. (2006). Cruising for parking. *Transport Policy*, *13*(6), 479-486.

Shuichi, M., & Hironao, K. (2003). A study on the traffic impacts in city traffic consideration of the value of time about streetcar. *Journal of Nippon Kikai Gakkai Kotsu, Butsuryu Bumon Taikai Koen Ronbunshu (Japan)*, *12*(21), 403-406.

Singh, G. (2005). Traffic congestion detection and management using vehicular ad-Hoc networks (VANETs) in India. *International Journal of Advanced Computer Technology (IJACT)*, *3*(6), 19-26.

Singh, S. K. (2005). Review of urban transportation in India. *Journal of Public Transportation*, *8*(1), 5-12.

Springael, J., Kunsch, P. L. & Brans, J. P. (2002). A multicriteria-based system dynamics modelling of traffic congestion caused by urban commuters *Cejors*, *10*(1), 81-97.

Staley, S., & Balaker, T. (2006). *The Road More Traveled: Why the congestion crisis matters more than you think, and what we can do about it*. Rowman & Littlefield Publishers.

Stanton, N. A., & Salmon, P. M. (2009). Human error taxonomies applied to driving: A generic driver error taxonomy and its implications for intelligent transport systems. *Safety Science*, *47*(2), 227-237.

Stopher, P. R. (2004). Reducing road congestion: A reality check. *Transport Policy*, *11*(2), 117-131.

Tanaboriboon, Y. (1992). An overview and future direction of transport demand management in Asian metropolises. *Regional Development Dialogue*, *13*(3), 46-70.

Thomson, J. M. (1998). Reflections on the economics of traffic congestion. *Journal of Transport Economics and Policy*, *4(*3) 93-112.

Turton, E. & Knowles, C. (1998). Urban transport for a vital and sustainable future. *Road and Transport Research*, *2*(2), 78-89.

US Department of Health and Human Services. (2006). *The health consequences of involuntary exposure to tobacco smoke: A report of the Surgeon General.* Transportation Research Board

Vajda, A., Tuomenvirta, H., Juga, I., Nurmi, P., Jokinen, P., & Rauhala, J. (2011). Severe weather affecting European transport systems: the identification, classification and frequencies of events. *Natural Hazards*, *72*(1), 169-188.

Vuchic, V. R. (1999). *Urban transportation policies: United States and peer countries.* Transportation for livable cities. New Brunswick: Center for Urban Policy Research.

Vuchic, V. R. (2005). Light Rail and BRT: Competitive or Complementary?. *Public Transport International*, *5*, 10.

Walsh C. L., Hall J. W., Street R. B., Blanksby J., Cassar M., Ekins P. &Watson S. J. (2007). *Building knowledge for a changing climate - collaborative research to understand and adapt to the impacts of climate change on infrastructure, the built environment and utilities.*

Wane, H.R. (2001). *Urban mobility and emissions: Towards accurate standards* for *Sub-Saharan Africa*. A Research Program and Results on a Sahelian Case: The District of Bamako. International Alliance for Independent Publishers.

Wangai, L. M., & Ngigi, M. M. (2014*). Applications of GIS to Logistics and transportation in efficient collection and delivery of milk for Githunguri.* Johannesburg: Dairy Cooperative Society Ltd.

Watling, D., Milne, D., & Clark, S. (2012). Network impacts of a road capacity reduction: Empirical analysis and model predictions. *Transportation Research Part A: Policy and Practice*, *46*(1), 167-189.

Weisbrod, G., D. Vary, et al. (2003). Measuring economic costs of urban traffic congestion to business. *Journal of the Transportation Research Board, 9*(4), 98-106.

Whaley, B. B. (2014). *Research methods in health communication: Principles and application*. Routledge: Merril Books Inc.

Whelan, G. (2007). Modelling car ownership in Great Britain. *Transportation Research Part A: Policy and Practice*, *41*(3), 205-219.

World Bank (2011). *Cities on the move. A World Bank transport strategy review.* Washington DC: United Front Publishers

World Health Organization. (2002). Gender and road traffic injuries.

Wright, L. (2010). *Bus rapid transit, sustainable transport: A Sourcebook for* policy-*maker in developing cities.* Eschborn: Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH

Yang, X. G., Xue, K., & Bai, Y. (2004). A study of the structure of parking guidance information system. *Communication and Transportation Systems Engineering and Information*, *1(2)*, 13-19.

Ye, S. (2012). Research on urban road traffic congestion charging based on sustainable development. *Physics Procedia*, *24*, 1567-1572.

Yin, R. K. (2014). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.

Zhang, Y., Xumei, C. H. E. N., Zhang, X., Guohua, S. O. N. G., Yanzhao, H. A. O., & Lei, Y. U. (2009). Assessing effect of traffic signal control strategies on vehicle emissions. *Journal of Transportation Systems*, *6*(5), 30-42.

APPENDICES

APPENDIX A

QUESTIONNAIRE FOR RESPONDENTS

UNIVERSITY OF CAPE COAST

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

The main objective of the study was to explore strategies intended to manage road traffic congestion in the Sekondi-Takoradi Metropolis. This questionnaire is designed to elicit information regarding this research work. There are no "correct" or "wrong" answers. Information given will solely be used for this research. You are also assured of full confidentiality, privacy and anonymity of all the information that will be given by you. You should therefore feel free to give the right information to ensure the success of this work.

Please make a tick [√] in the box against your response and provide answers to the blank spaces. Thanks for your cooperation.

Section A: ***Socio-demographic characteristics***

1. Sex
   a. Male [ ]
   b. Female [ ]
2. Age.....
3. Marital status
   a. Never married [ ]
   b. Married [ ]
   c. Divorced [ ]
   d. Separated [ ]
   e. Widowed [ ]

4. Level of education

   a. No formal education [ ]

   b. Basic/Middle [ ]

   c. Secondary/A' Level [ ]

   d. Tertiary [ ]

   e. Other [ ]

      Specify.....

5. Driver category

   a. Commercial Driver [ ]

   b. Private Driver [ ]

   c. Non-motorised driver [ ]

6. Number of years spent as a driver……

7. License category……

Section B: ***Causes of traffic congestion in Sekondi-Takoradi Metropolis.***

8. In your opinion, what do you think causes traffic congestion in the Metropolis?

   [Tick as many as possible]

   a. Too many vehicles on the road [ ]

   b. Inadequate road routes [ ]

   c. Inadequate parking spaces [ ]

   d. Road works [ ]

   e. Breakdowns or accidents [ ]

   f. Bad attitude of drivers [ ]

   g. Inadequate timing of traffic lights [ ]

h. Bad attitude of pedestrian attitude [ ]

i. Poor road designs [ ]

j. Trade obstruction [ ]

k. illegal parking which blocks the traffic [ ]

l. picking-up / dropping-off passengers [ ]

Others

(specify).....

9. Which time of the day do you experience intense traffic congestion?

……

10. How often do you get trapped in traffic?

a. Very often [ ]

b. Often [ ]

c. Seldom [ ]

d. Not often [ ]

11. With traffic, how long does it take you to drive within one kilometre stretch in the Metropolis?

a. Less than 15 minutes [ ]

b. 15-30 minutes [ ]

c. 31-45 minutes [ ]

d. 46-60 minutes [ ]

e. More than 60 minutes [ ]

12. Without traffic, how long does it take you to drive within one kilometre stretch in the Metropolis?

a. Less than 15 minutes [ ]

b. 15-30 minutes [ ]

c. 31-45 minutes [ ]

d. 46-60 minutes [ ]

e. More than 60 minutes [ ]

13. In your estimation, which type of vehicles is responsible for traffic congestion in Sekondi-Takoradi Metropolis?

a. Commercial vehicles [ ]

b. Private vehicles [ ]

c. Non-motorized transport [ ]

Section B: ***Effects of traffic congestion in Sekondi-Takoradi Metropolis.***

This section examines the possible effects of t*raffic congestion in Sekondi-Takoradi Metropolis.*

Please, indicate by ticking (√) the statements in **section B and C,** the extent of your agreement or disagreement on 1 – 5 scale representing the rank of the responses.

Disagree (D) = 1,

Strongly Disagree (SD) = 2,

Uncertain (U) = 3

Agree (A) = 4,

Strongly Agree (SA) = 5,

Effects of traffic congestion	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
14. Traffic congestion brings about Loss in productivity					
15. Traffic congestion increases pollution and deteriorate health					
16. Traffic congestion can puts Pressure on road infrastructure					
17. Traffic congestion results in high Operating Costs					
18. Traffic congestion causes global warming					
19. Traffic congestion can cause accidents					
20. Traffic congestion make people lose their work					
21. Traffic congestion cause pollution					
22. Traffic congestion causes stress					

SECTION C:

EFFECTIVENESS OF MEASURES PUT IN PLACE TO REDUCE TRAFFIC CONGESTION.

Evaluate [by ticking (√)] whether the under listed measures of controlling traffic congestion in the Sekondi-Takoradi Metropolis has been very effective, effective, somehow effective, uncertain or not effective. Please make a tick [√] in the box against your response.

Measures put in Place to Control Congestion	**Very effective**	**Moderately Effective**	**Uncertain effective**	**Less Effective**	**Not Effective**
23. Expanding roadway capacity					
24. Availability of parking facility					
25. Increasing and developing the manpower (Traffic police)					
26. Car Pooling					
27. Mobility management					
28. Smart Parking					
29. Investing in Public Transit					
30. Enforcement of Traffic Orders					
31. Improving traffic operations					
32. Street park pricing					

THANK YOU

APPENDIX B

INDEPTH INTERVIEW GUIDE FOR KEY INFORMANTS

UNIVERSITY OF CAPE COAST

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

The main objective of the study was to explore strategies designed to manage road traffic congestion in Sekondi-Takoradi Metropolis. This interview guide is designed to elicit information regarding this research work. There are no "correct" or "wrong" answers. Information given will solely be used for this research. You are also assured of full confidentiality, privacy and anonymity of all the information that will be given by you. You should therefore feel free to give the right information to ensure the success of this work.

SECTION A: ***Background information***

a. Date of interview:

b. Place interview was conducted:

c. Duration: From..... To.....

d. Name of institution:

e. Position/ Status:

f. Sex of respondent (Just observe)

g. Level of education

Section B: ***Issues of traffic congestion***

1. Could you share with us your views on road traffic congestion in Sekondi-Takoradi metropolis?
2. Which areas (road networks) within the metropolis is traffic congestion more serious? Please explain.
3. In your opinion, what factors account for road traffic congestion?
4. Could you explain some of the negative effects traffic congestion has on people and businesses?
5. What is the mandate of your institution in traffic management?
6. What policies and programmes have you put in place to minimise traffic congestion in the Metropolis?
7. In your opinion, have the measure put in place to manage congestion been effective? Explain.
8. Could you explain some practical measures your institution have put in place to manage traffic congestion in the Metropolis?
9. Outline some of the challenges your institution face in managing traffic congestion?
10. What is the extent of collaboration between your institution and stakeholders in the road sector in managing traffic congestion in Sekondi-Takoradi Metropolis?

THANK YOU

APPENDIX C

UNIVERSITY OF CAPE COAST

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

OBSERVATION GUIDE

Thesis title:

ITEMS TO BE OBSERVED	YES [√]	NO [√]
1. Are there police men at major intersections?		
2. Are vehicles parked on the side of the road?		
3. Do drivers pick passengers in traffic?		
4. Are there broken traffic lights?		
5. Are there pot holes on the road?		
6. Is there expansion work on the road?		
7. Do STMA officials assist in directing traffic flow?		
8. Do vehicles break down in traffic?		
9. Are there traffic lights at major intersections?		
10. Are there spaces for on-street parking?		

APPENDIX D

INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
COLLEGE OF HUMANITIES AND LEGAL STUDIES
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY & REGIONAL PLANNING

UNIVERSITY POST OFFICE
CAPE COAST, GHANA
WEST AFRICA

Our Ref: GRP/G.4A/Vol.2/16/22

Your Ref:

18th October, 2016.

.....

.....

.....

.....

Dear Sir/Madam,

LETTER OF INTRODUCTION
TO WHOM IT MAY CONCERN

The bearer of this letter, **Mr. Foster Asare-Pelle,** is an M.Phil student at the Department of Geography and Regional Planning, University of Cape Coast. He is conducting a research on the topic: ***Tackling Traffic Congestion in Sekendi Takoradi Metropolis.***

An aspect of the research requires that he collects data from your Organization to enhance his work.

We shall therefore be very grateful if your institution could assist him with any information that would be useful for his work.

Thank you.

Yours faithfully,

Dr. Simon Mariwah
HEAD

Telephone: (Head) 03321-30681, (General Office) 03321-30680
Fax: 03321-34072 E-mail: geography@ucc.edu.gh