THE ECONOMIC COST AND POLICY IMPLICATIONS OF HEAVY GOODS VEHICLES ROAD TRAFFIC ACCIDENTS IN NIGERIA

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Copyright Statement

Abstract

This study of the Cost of heavy goods vehicles accidents was conceived following the growing rate of road traffic accidents involving heavy goods vehicles in Nigeria. The study was designed to analyse the place of heavy goods vehicles road traffic in Nigeria and the cost of traffic accidents involving these types of vehicles. Nigerian transportation system was reviewed among other literature on costs of accidents to base the analysis. The study was anchored on the positivist research philosophy and both primary and secondary data were collected and analysed. Secondary data were collected from the Federal Road Safety Commission and from four different hospitals. Primary data were obtained from a field survey conducted at Shagamu and Mararraban Jos rest areas for truck drivers; and in Kaduna, Kano, Lagos and Port Harcourt for truck operators.

Analysis of the data was achieved using; descriptive statistics, Whitney u-test and human capital analytical methods. The results show that the major causes of heavy goods vehicles traffic accidents in Nigeria are bad roads, drivers over speeding, wrong overtaking by drivers and obstructions placed on highways.

The total cost of heavy goods vehicles road traffic accidents in 2011 was estimated to be $0.602 billion, this was estimated to be equivalent to 5.9 % of the overall cost of road accidents to the GDP of Nigeria per annum. The amount is also equivalent to 2.64 % of the contribution of the transport sector to the economy, and 2.94% of that of the road transport sector. The major cost components were property damage costs (vehicles, goods in transit, third party property), lost output, pain, grief and suffering, administration and medical costs. In the same manner, the cost associated with fatal accidents is higher than the cost of serious injury accidents, minor injury accidents and property damage only accidents.

Policy recommendations of the study include restriction of the importation of used vehicles in to the country, review of the road construction policy to accommodate heavier vehicles, development of a robust road traffic accident data collection and

management system and development of an effective driver-training program to improve drivers' skills.

The major contribution of this study to knowledge is the estimation of the cost of heavy goods vehicles road traffic accidents, which has not been done before in Nigeria as well as in other developing countries. It is also a contribution to knowledge that, multiple sources of data were utilized to calculate the cost of the accidents based on the requirements of the human capital model.

The objectives of the study were fully achieved and the outcomes are similar with results of other studies obtained elsewhere using other models. Further research is recommended in the areas of the cost of traffic congestions and delays that are caused by HGV accidents, the cost of environmental damage due to HGV accidents and funeral cost of accident victims. Additional research is also required in the area of accident under-reporting in Nigeria.

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List of Abbreviations

ADB	African Development Bank
A&E	Accident and Emergency
AGO	Automated Gas Oil
AIS	Abbreviated Injury Scale
ASEAN	Association of South East Asian Nations
BAC	Blood Alcohol Concentration
BPE	Bureau for Public Enterprise
CBN	Central Bank of Nigeria
CIA	Central Intelligence Agency
CVM	Contingency Valuation Method
DOT	Department of Transportation
ECOWAS	Economic Commission for West African State
ETSC	European Transport Safety Council
FCT	Federal Capital Territory
FERMA	Federal Road Maintenance Agency
FMWH	Federal Ministry of Works and Housing
FRSC	Federal Road Safety Commission
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNP	Gross National Product
HGV	Heavy Goods Vehicles
HCM	Human Capital Method
KAROTA	Kano Road Traffic Agency
KASTELIA	Kaduna State Traffic and Environmental Agency
LASTMA	Lagos State Traffic Management Agency
LGV	Large Goods Vehicles
MITI	Master plan for Integrated Transport Infrastructure
NARTO	National Association of Road Transport Owners
NITT	Nigerian Institute of Transport Technology
NTSP	National Transport survey and projections
NTM	National Transport Master Plan
NURTW	National Union of Road Transport Workers
NRSS	National Road Safety Strategy
NRTR	National Transport survey and projections
PDO	Property Damage Only Accident
US	United States
UK	United Kingdom
VMT	Vehicle Mile Travel
PMS	Premium Motor Spirit
RTMC	Road Traffic Management Corporation
TRB	Transportation Research Board
TRRL	Transport and Road Research Laboratory
RTA	Road Traffic Accidents
WHO	World Health Organisation
WTP	Willingness to Pay Method
UNICEF	United Nations Children Education Fund
PMS	Premium Motor Spirit
UNECA	United Nations Economic Commission on Africa
RTA	Road Traffic Accident
RTC	Road Traffic Crash
RTSS	Road Transport Safety Standardisation

CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

Transport is a basic and essential requirement for daily human activities. It is needed for the purpose of achieving the socio-economic and political goals of mankind. As a measure of the interaction between areas, transport enables a division of labour to occur (Hoyle and Knowles, 1992). Furthermore, transport not only facilitates the distribution of goods and services by ensuring that producers are linked with the area of consumption, but it also serves as a catalyst in the process of change and development. Movement is therefore necessary and compulsory for all human activities from womb to tomb (Oyesiku, 2002). In fact, no human activity takes place without one form of transport or the other, and most countries attach a lot of importance to the transportation sector, as transport is synonymous with innovation and technology. Countries now are as developed as their transport system; the country with the best transport system always has an edge over others in the areas of trade, investment, tourism, security, intelligence and war. In fact, any country that does not develop transportation does so at its peril (Oyesiku, 2002).

Despite the undisputed role and importance of transportation on the effective functioning of modern societies, it is beset with myriads of negative externalities which if not well managed could wipe out the benefits associated with it (Ogunsanya,1984).The commonest externalities associated with transportation are noise, environmental degradation, congestion, pollution, accidents and vibration. These externalities vary from mode to mode and from country to country and a lot of research and policy on transportation development are directed towards the mitigation of these externalities.

Since transportation provides the medium within which all sorts of movements take place, human activities require more than one form of transport to be accomplished. Thus, transport is comprised of many modes, namely; road, rail, air, water and pipeline. However, in most countries of the world, road transport is the major mode of

transportation. In Nigeria, it is responsible for about 90% of all transportation services (Akphoghomeh, 2012), indicating a heavy reliance on the road system for the movement and distribution of goods and services in the country.

Nigeria's population is over 162 million people in 2011 and 182 million in 2015 evenly distributed across the country. The major population centres are Lagos, Kano, Kaduna, Ibadan, Port Harcourt, Enugu, Onitsha, Benin and Maiduguri. The country covers a total land area of 923,768sq km, and is classified by the World Bank as a middle income country with an annual per capita income of $2,600 and a GDP of $414 billion per annum in 2011, and a GDP of $481 billion in 2015 with per capita income of 2,655 dollars (World bank 2012, 2016). The country is divided into 6 Geo-Political zones comprising of 36 states and Abuja, the Federal Capital Territory (FCT), as shown in Figure 1.1.

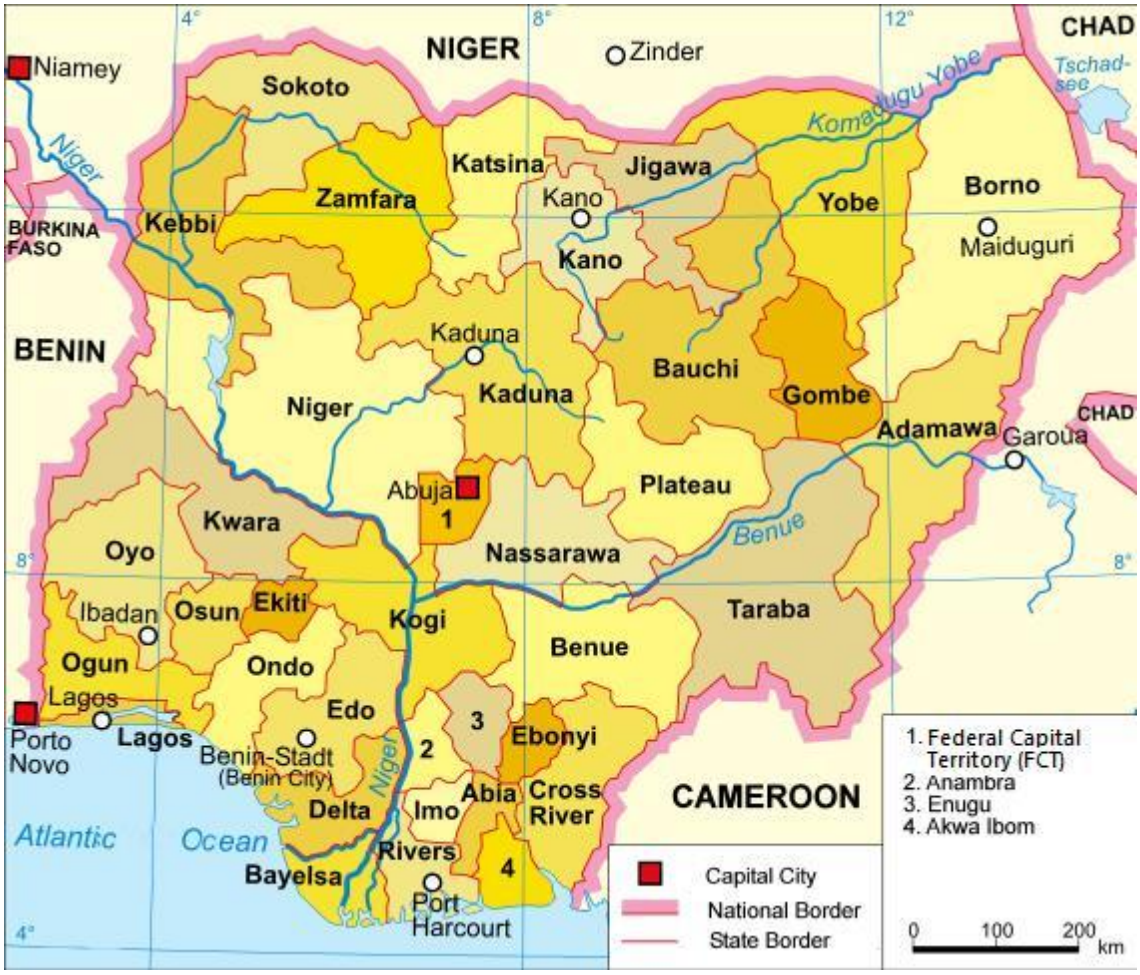


Figure 1.1: Map of Nigeria Showing the 36 States and FCT Abuja

Agriculture and primary production is the main stay of the Nigerian economy accounting for over 40 percent of the GDP, but employing about 70% of the population. The country is also a major oil producer and exporter and a member of the oil producing and exporting countries (OPEC) (CIA World Fact Book, 2012).

The structure of the Nigerian economy is largely North-South interdependent. The Northern region produces the greater portion of the agricultural produce, while the south is the industrial base of the country. Major arterial roads in the country run from North to South, reflecting the nature of population distribution and economic activities.

Nigeria as a developing country is seriously concerned about its transportation system. The Nigerian road network system is 193,200 km in length and over 7,600,000 vehicles are registered to use the roads in 2008, 60% of these were motorized 4 wheelers, 30% were motorized 2 wheelers and about 10% were trucks (FRSC, 2010). The road system is supported by 4332 km of rail track; part of a rail network that performs badly and a total of 53 airports covering major cities out of which five located at Lagos, Kano, Abuja, Port Harcourt and Enugu are International Airports.. The country also has seaports in Lagos, Port Harcourt, Onne, Calabar and Warri. The pipeline networks constitute 2,042 km for crude oil, 3,000km for petroleum and 500km for natural gas, even though they do not function for most of the time due to their frequent destruction by criminals (MITI, 2002).

The road transport sub-sector is very important for industrial development and social integration, which Nigeria dearly needs. Road transport in Nigeria is particularly important because of its flexibility and capillary characteristics. It is suitably in line with the geographical realities of the country in terms of space and time and its historical facts. For Nigeria, a safe and reliable road transport system is therefore of major importance for the administration of its diverse communities, and it is at the centre of the county's socio-economic and political integration.

Furthermore, the prevalence of the use of road as the primary mode of transport in Nigeria for all purposes of movement has been further necessitated by the near collapse of the railway system. The system was laid mostly during the country's colonial period

when there was the need to move large quantities of agricultural produce and minerals from the hinterland to the sea. In the past few decades however, the system has suffered from a long period of neglect, making it moribund.

On the part of air transport, its cost has made it restrictive, leaving it affordable only to a small section of the Nigerian population. The inland waterways system is also by its nature physically restrictive, thus not accessible to the majority of communities in the country. The pipeline network has not been fully put to use due to the activities of criminals who are fun of destroying the pipeline infrastructure. This has forced the country to rely on trucks to transport petroleum products by road, contributing to the deterioration of the road infrastructure and an increased number of road traffic accidents.

Despite its advantages, the nation's road transport sector is not living up to expectations; it is beset with serious problems ranging from an inadequate road network, poor maintenance of the infrastructure, un-roadworthy vehicles, high traffic accident rates, delays and congestion, high operational cost and fleet management problems (Olagunju, 2011).

In particular, Road traffic accidents in Nigeria are a serious problem. Between 2002 and 2008, a total 40,007 persons were killed from accidents on the roads, while 136,068 suffered different degrees of injuries (Olagunju, 2010). In 2008 alone, the number of people killed in road traffic accidents totaled 6,661 that is an average of 18 persons daily. During that same year, another 27,980 people sustained injuries of varying degrees in road traffic accidents. When considered against the backdrop of the likely under-reporting of accidents in Nigeria, these statistics become source of great concern to not only the government and road safety agencies, but also to the public.

1.2 Statement of the Problem

According to the World Health Organization (WHO, 2008), globally more than 1.3 million people are killed every year and 50 million sustain injuries as result of road traffic accidents, 90% of these take place in low income countries (70% in Africa),

even though only about 50% of the world's vehicles are actually located in the low income countries. It is further reported by WHO (2008), that the world economy loses the sum of $1.4 billion daily as a result of road traffic accidents and individual national economies lose in average, between 1-3% of their Goss Domestic Products to road traffic accidents every year.

A report by the Road Safety in WHO African region (2013) highlights the magnitude of the road safety problem in the region. The report shows that, the African region has the highest fatalities from road traffic accidents ahead of other regions in the world, despite the fact that the African region is the least motorized of the six world regions. In fact, Africa possesses 2% of world's vehicles but contributes 16% of global road traffic deaths. Accident statistics in some African countries have shown that, the road traffic death rate is 100 deaths per 10,000 vehicles (while in Sweden the rate is just 1.3 deaths per 10,000 vehicles). Nigeria and South Africa have the highest fatality rates of 33.7 and 31.9 deaths per 100,000 populations per year respectively. This is not surprising since these two countries have very high population concentration and are the largest economies in Africa. The report therefore highlighted the need for urgent actions, warning that, if no urgent steps are taken, the fatality rate may increase to about 80 percent of this in Africa by 2020.

In Nigeria over 90% of goods are imported by sea and thereafter distributed to their various destinations via road haulage. This includes the distribution of goods to all the commercial centres of the country including Lagos, Port Harcourt, Abuja, Kano, Kaduna, Maiduguri, Enugu, Onitsha, Benin, Yola, Ibadan, Aba and Zaria. In the same way, agricultural and other goods produced at various points' hinterland are transported to where they are needed for industrial and consumer usage. In most cases these types of goods are produced in the northern parts of the country and then transported to the south, where they are needed for consumption and Industrial use, and to the ports of Lagos, Warri, Port Harcourt and Calabar for export.

However, the road haulage industry in Nigeria is bedeviled with very serious problems and challenges that are threatening the performance of the industry (Ogunsanya, 2004). These problems include poorly maintained roads, safety and security concerns, high

accident rates and increasing operational cost. The results of these problems are enormous and include; Loss of life and property, increase insurance cost, waste of time and man-hour, colossal loss that can lead to the collapse of the haulage company, increase in freight rates, destruction of the road infrastructure and increase in cost of road and vehicle maintenance. Accidents are particularly of great concern, in this regard, the National Transport Policy Retreat of 1993 expressed concern over the growing trend of accidents involving heavy goods freight vehicles traffic especially on the nation's regional roads. The forum observed that, one out of every five accidents along Kaduna-Lagos road involved goods vehicles.

According to the Federal Road Safety Commission (FRSC) report in 2010, the problem of accidents involving road haulage vehicles in Nigeria is costing the nation a lot of resources. Statistics have shown for example that, from January 2007 to June 2010, not less than 4,107 trucks were involved in road traffic accidents in Nigeria causing the death of 4,076 people and 12,994 sustaining injuries of varying degrees, with accompanying loss of property (Olagunju, 2011). For a developing country requiring to utilise its resources effectively, this is an unbearable loss that requires investigation through research and consequent intervention and innovations.

1.3 Aim of the Study

The aim of this study is to estimate the cost of heavy goods road traffic accidents in Nigeria and analyse its implications on road transport policies of the country.

1.4 Objectives

The objectives of the study are as follows;

- To analyse the Nigerian road transportation system and appraise the level of HGV accidents
- To review the literature relating to the estimation of the cost of road traffic accidents in both developed and developing countries and to appraise the place of HGV accidents research
- To evaluate the causes of HGV traffic accidents and their prevention strategies in Nigeria

- To estimate the economic cost of heavy goods vehicles road traffic accidents in Nigeria and its impact on the GDP of the country.
- To appraise ways in which transport policy may be reviewed in order to reduce the cost of HGV accidents in Nigeria.

1.5 Significance of the Study

1.5.1 Benefits of the research

Reduction in road traffic accidents is a global concern, from the United Nations and its agencies to individual countries. Thus, no contribution is too little in this direction. The results of this research may therefore contribute towards reducing HGV road traffic accidents in Nigeria, thereby improving logistics efficiency and economic performance of Nigerian enterprises. The findings of the research may also assist the road freight companies to understand the causes and nature of HGV accidents, appreciate the cost of such accidents and evaluate the implications of the accidents on the performance of their operations thereby affording them the ability to manage the problems for improved productivity.

Road transport is the dominant means of movement in Nigeria and is always yearning for improvement, thus; the outcome of this research may bring out new ideas that may lead government in to new thinking and improvement in road transportation policies in Nigeria.

1.5.2 Justification of the Research

As the world economy continues to grow and the demand for transportation keeps on rising, more vehicles are produced all over the world. With increasing affluence among the world population coming from prosperity associated with increase in production, more vehicles are on the highways of many nations and the risk of road crashes keep rising. This means that more research is needed on the problem of road traffic accidents to catch up with emerging technologies in the area and ensure that lives and properties are safe.

This study is therefore justified from the above perspectives and from the fact that freight business in Nigeria is dominated by road traffic and thus the need to research the problems of the industry and particularly the effects and cost of accidents on its performance. The research will attempt to determine the magnitude of the problem of heavy goods vehicles road traffic accidents in Nigeria and its effects on the Nigerian economy and then advice Government and industry players on implications and possible solutions.

1.6 Originality

The originality in this research is in the investigation of the cost of accidents that involved heavy goods vehicles (HGV) only. Many studies have been done on road traffic accidents in many countries, but the majority of previous studies were on total accidents involving all categories of vehicles. This is particularly true in Nigeria and most African countries, and apart from the economic benefits of the study, it will also contribute to the existing literature on the causes, cost and remedies to road traffic accidents. The study will also open up new research challenges for future academic activities in the field of road traffic accidents and road transportation in general.

1.7 Scope and limitations

The study is designed to utilise data from all the 36 states of Nigeria and Abuja, the capital territory. Thus, secondary data was collected and analysed for the whole country, while primary data was collected at survey points selected at key road corridors connecting the North from the South. The study covers accident records for 2011 only, being the year with the latest HGV accident records before the commencement of the study.

According to the report of National Transport Survey and Projections, compiled by the Nigerian Institute of Transport Technology (NITT) for the Federal Ministry of Transportation, several types of vehicles are involved in the road freight business in Nigeria, the commonest being, trailers, tanker trailers, trucks, Lorries and smaller carriers like canter and pickups. This research will however be limited to Heavy Goods Vehicles (HGV) only. For the purpose of this study, Heavy Goods Vehicles include articulated trailer, open trailer, tanker trailer and Lorries that can carry goods of 15

tonnes and above. These types of trucks are referred to as Large Goods Vehicles **(LGV)** in some countries including the United Kingdom.

1.8 Organisation of the Thesis

This thesis is structured in to seven chapters as follows:

Chapter 1: General Introduction

Chapter 1 is a general introduction to the study. It gives a background to the study, stating the problem of investigation and the aim and objectives of the study. Also discussed in this chapter are the scope and limitations of the study, its significance and the originality in the research. The outline of the research is given at the end of the chapter along with a brief summary of the methodological approach in figure 1.2.

Chapter 2: The Nigerian Transportation system

The Nigerian transportation system is discussed in this chapter with emphasis on the development of road transportation. The chapter discussed the Nigerian road network, its length and spread, and traffic characteristics. The chapter also discussed the operations and management of the road transport system, highlighting laws and legislations governing the system. There were also discussions on traffic accidents in Nigeria involving all types of vehicles, but with a section that covers accidents involving heavy goods vehicles.

Chapter 3: Literature review

Literature relevant to this study has been reviewed in this chapter. The review covered definitions and accident causation theories. In addition, the cost of accidents and the different models of costing accidents were identified and discussed, specifically the willingness to pay and the human capital methods. Different accident cost studies were reviewed including studies on HGV operations and accidents in Developing countries. Causes of accidents and their prevention strategies were also reviewed in this chapter. From the different studies reviewed, the gap in road traffic accident studies was identified and highlighted.

Chapter 4: Methodology

Chapter Four is on the methodological approach and methods used to carry out the research. The research was based on the positivist philosophical arguments. Data were collected from secondary and primary sources, using field survey methods. Similarly, data collected were validated to know their reliability level. In addition, the processes involved in the human capital analysis methods were identified and discussed.

Chapter 5: Truck drivers and operators data analysis

During the field survey, data were collected using questionnaires from truck drivers and operators. The data collected were analysed in this chapter using, frequency distribution tables, pie and bar charts, line graphs and Man Whitney U-test statistical methods. Various characteristics of truck drivers and operators were identified and discussed. Causes of HGV accidents and their prevention strategies were derived from the primary data and analysed in this chapter.

Chapter 6: Cost of heavy goods vehicles road traffic accidents.

Chapter 6 is on the costing of heavy goods vehicles road traffic accidents in Nigeria for the year 2011. The human capital method was used to calculate the cost of lost output, property damage (vehicle damage, third party property damage, and goods in transit damage) cost, medical cost and the cost of pain, grief and suffering. The chapter discusses the application of the human capital method on different data sets to arrive at results. Issues of under-reporting were treated as well as the cost and impact of the HGV road traffic accidents cost on the GDP of Nigeria in the year 2011.

Chapter 7: Summary, Conclusion and Recommendation

This chapter provides the summary of the findings of this study on the cost of heavy goods vehicles traffic accidents. The Chapter also, reported the key findings of the study, and reviewed the extent to which the research objectives were achieved. Recommendations were made on research and policy implications to the transportation system as well. In this chapter also, the contributions of the research to knowledge was identified, the research limitations were stated and further research areas have been recommended.

1.9 Summary and conclusion of this Chapter

This chapter provides a general introduction to the study on the cost of Heavy Goods Vehicles Traffic accidents in Nigeria. The chapter gave a brief background about Nigeria, its economy, population and the transportation system. Furthermore, this chapter explains the motivation of this study, which was a reflection on the growing concerns over the catastrophic incidents of heavy goods vehicles traffic accidents on the Nigerian road network.

Thus, the problem of the research was identified and stated, including the aims and objectives of the research. The key research objectives are to analyse HGV accidents in Nigeria and estimate the cost of the accidents. The study also evaluated the causes of accidents and their remedies, and also the impact of HGV accidents on the Nigerian economy, and its implications on transport policy. The study w
heavy goods vehicles accidents of 15 tonnes, above, and for the year 2011 only

This leads to chapter two, where the Transportation system in Nigeria is presented and analysed. The chapter will provide information about the road transport system in Nigeria including analyses on accident rates.

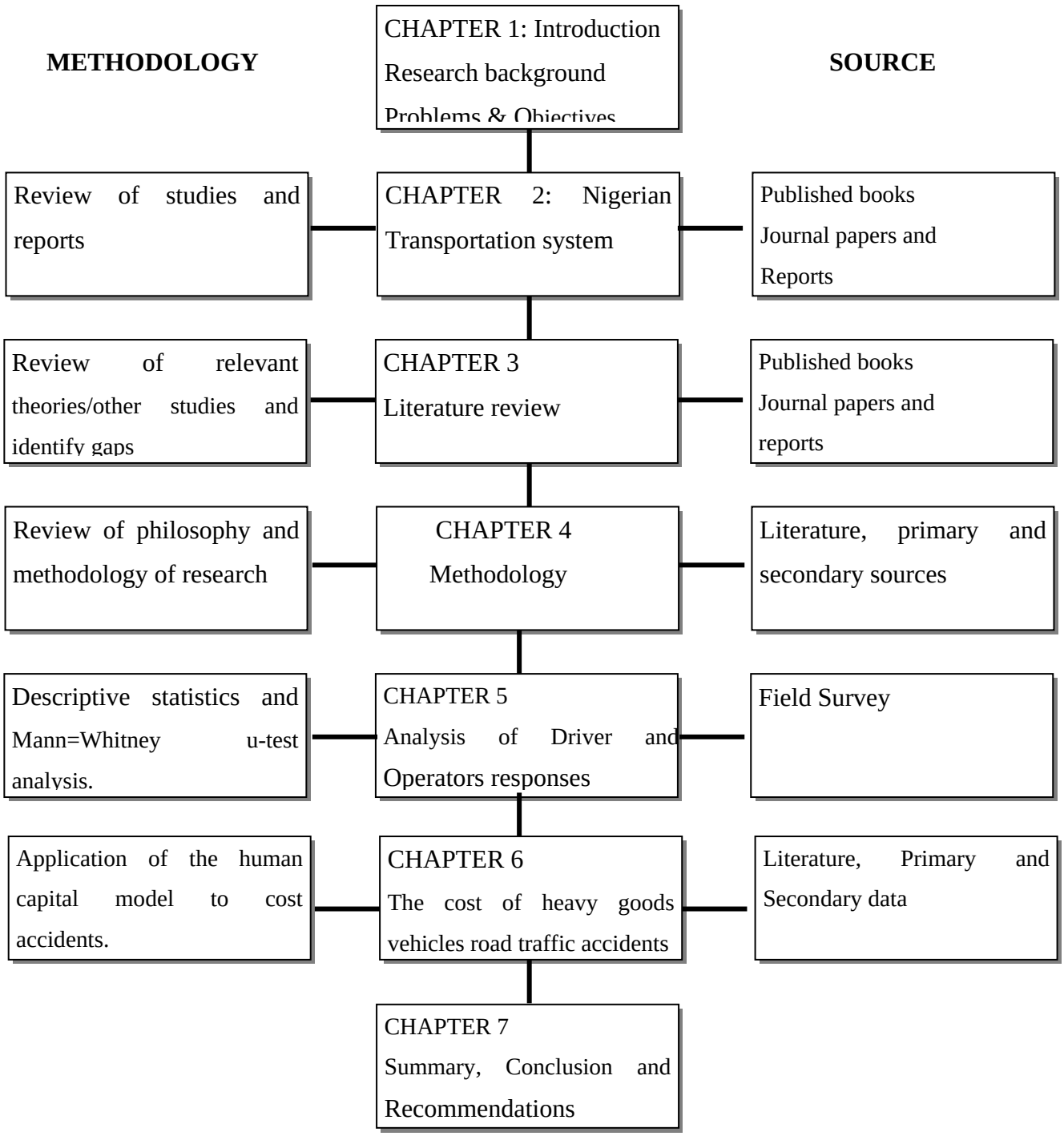


Figure 1.2: Thesis structure flow chart

CHAPTER TWO

THE NIGERIAN TRANSPORTATION SYSTEM

2.1 Introduction

The Federal Republic of Nigeria is a country occupying a land area of 923,768 square kilometres. The country is located at the gulf of Guinea, between Benin and Cameroon. Nigeria has a 4,447km long international boundary and is neighbouring Cameroon (1,690 km) to the east, Niger (1,497 km) to the North, Benin (773 km) to the west and Chad (87 km) to the North east. Nigeria also has a coastline of 853 km long (NTM 2006).

Nigeria operates a federal system of administration comprising of one central government, 36 State Governments and a Federal Capital Territory in Abuja. There are also 774 Local Government Areas in the country. Nigeria is a member of the Economic Community of West African States (ECOWAS), and the African Union (AU).

The last population census was held in Nigeria in 2006. The census results showed that there were 140 million People in Nigeria in that year. This was made up of 71 million males and 69 million females. The states with the highest population figures in the country are Kano (6.7%), Lagos (6.4%), Kaduna (4.3%), Katsina (4.1) and Oyo (4.0%) and those with least population are Bayelsa (1.2%), Nasarawa (1.3%), Ebonyi (1.6%), Taraba (1.6%) and the federal capital territory, Abuja with a total of 1.4 million people, representing 1.0% of the total population in 2006. The country's population increased to 162 million in 2011 and 182 million in 2015. Life expectancy in Nigeria is 54.5 years, with a median age of 17.9 (NPC 2012, 2016).

2.2 The Nigerian economy

Nigeria is a middle income, mixed economy (emerging market) with expanding financial, service, entertainment, communications and technology sectors. It is ranked 21 largest economy in the world in terms of GDP. Nigerian GDP has grown from $170 billion in 2000 to $414 billion in 2011 and $451 billion in 2012. The GDP for 2015 is $481 billion. Correspondingly, the GDP per capita doubled from $1400 per person in 2000 to an estimated

rate of $2,400 in 2011 and $2,600 per person in 2012, and $2,655 in 2015. The contribution to the GDP was composed of the following sectors: agriculture: 40%; services: 30%; manufacturing: 15%; oil: 14% (NBS, 2013) (World Bank, 2016).

2.3 Transportation system

At the beginning of the 20th century, movements of goods and services were carried out along footpaths and bush tracks in the territory now called Nigeria and in most parts of the African continent. In the forest region of the southern part of the country, people used human porterage to move their wares across villages especially on market days, in addition to the use of dug out boats across the creeks of the riverine areas. In the savannah region however horses and donkeys were commonly used (Mabogunje, 1968).

During the colonial era (1900-1960), transportation problems were a very serious handicap to the effective administration of the territory, thus the decision by the colonial authorities to embark upon rail and road constructions to link the various regions of the country especially where exports were being transported to the sea. Oluwasanmi (1966) explained this, when he stated that two reasons were responsible for the trend in the development of the Nigerian transport system. First, the establishment of effective territorial machinery in Nigeria was inconceivable without an effective transportation system. Secondly, the vast interior of the country could not be opened up to trade in industrial goods nor could its agricultural and mineral resources be fully exploited without efficient means of transportation of goods to and from the ports.

The Nigerian Transportation system comprised of air, water, land (road and rail) and pipeline transportation modes. The size of the Nigeria air transport industry can be described as fairly modest, with 53 airports, five of which handle international flights. The International airports are; Aminu Kano International Airport (Kano), Murtala Mohammed International Airport (Lagos), Nnamdi Azikwe International Airport (Abuja), Port Harcourt International Airport (Port Harcourt) and Akanu Ibiam International Airport, Enugu. The air transport sector is substantially deregulated, with domestic airlines competing in the domestic market, and international flights are provided for mostly by foreign airlines.

The importance of road transportation to the Nigerian economy may be predicated on the nature and pattern of Nigerian physical and human geographical settings. The road system seems very flexible as it provides easy access to all parts of the country as it connects major industrial and commercial centres. In 1914, when the Southern and Northern Protectorates were amalgamated, the total road network in Nigeria was 3,200 kilometres. But by 1960 when Nigeria got its independence, its total road network had increased to 66,000 km (NTM, 2006), and by 2012 the total length of the road network was 193,200 km (FMW 2013).

Pipeline transportation in Nigeria is servicing the oil industry. The pipeline networks constitute of 105 km of condensate, 2,042 km for crude oil, 3,000km for petroleum and 500km for natural gas, even though they do not function for most of the time due to the activities of criminals destroying the pipeline infrastructure (MITI, 2006). Because criminals are constantly damaging these pipelines, about 26,000 trucks are used to deliver oil products across the country. These trucks have caused damage to the nation's major highways in addition to causing accidents, which bring about death and loss of properties, causing the nation serious economic loss.

The use of inland waterways for transportation in Nigeria is more pronounced in the coastal areas and along the two major rivers of Benue and Niger. According to Filani (2006), the master plan for integrated transport infrastructure (MITI) has revealed that between 1960 and 2002, a range of 100,000 to 200,000 tonnes of cargo was transported through river transport annually. Although no reliable statistics are available, MITI estimated that not less than 100,000 tonnes of goods are still being moved along the Bight of Benin where river transport has perennially been the only available means of transportation.

Rail transport is known worldwide to play a significant role in the transportation of people and goods. In fact, rail transport is prominent for the provision of cheap and efficient transport services. The imbalance in modal share between rail and road transportation emerged after Nigeria's independence in 1960. In the last 20 years, the highest number of passengers carried by the rail system was 15.5 million in 1984 and the highest volume of freight was 2.4 million tonnes in 1977. As at 2000/2001, traffic had declined to 2 million passengers and less than 300,000 tonnes of freight, because of neglect and infrastructural

decay of the rail transport system (MITI, 2002). The rail system is still struggling to pick up full operations due to massive decay in infrastructure.

Meanwhile, the contribution of transportation to the GDP in Nigeria is still very low, hovering around 5%. Road transportation alone accounted for 60% of the contribution of the transport sector to the GDP in the 1960s, over 80% in the 80s and over 90% in the 90s and beyond (FMW, 2013). In 2015, Transportation and logistics contributed only 2.1% of the GDP of Nigeria, and Nigeria's ranking in the world logistics index has fallen from 77 in 2014 to 90 in 2016.

2.4 Road network

The Nigerian road network comprises of Federal, State and Local Government roads (NTM 2006).However, the major road transport infrastructure consist of 32,100 km of Federal highways, 30,500 km of state roads and 130,600 km of rural roads, under the control of the local governments. Thus, giving a total road length of 193, 200 km (FMW, 2013). In average, there are 35 cars per kilometer of road in Nigeria, and the population, road ratio is 861 persons per kilometer of road. This clearly shows that, the road network is in adequate, Akphoghomeh (2012).

It is worth noting that major investment in the road transport sector in the past decade was directed at improvement and maintenance of the existing infrastructure rather than expansion despite the growing demands. This explains the reason why the network has not increased in size over the last ten years. The structure of the road transport system in Nigeria is illustrated in Table 2.1.

Table 2.1: Structure of road ownership in Nigeria

	Federal	State	Local Govt.	Total	Percentage
Paved Main Roads	26,500	10,400		36,900	19%
Unpaved Main Roads	5,600	20,100		25,700	13%
Urban Roads			21,900	21,900	11%
Main Rural Roads			72,800	72,800	38%
Village Access Roads			35,900	35,900	19%
Total	32,100	30,500	130,600	193,200	100%
Per cent	17%	16%	67%	100%	

Source: FMW, 2013

The federal roads, which are all in the category of highways, are classified as trunk A roads, trunk B represent state roads and trunk C local Government roads. However, some roads formerly under state ownership but taken-over by federal government for upgrading and control are classified as trunk F roads. Despite the position of road transport as the major means of transportation in Nigeria, the current road infrastructure as shown in 2.1 above is grossly inadequate, compared to other developing countries like Malaysia, which has over 100,000 km of paved roads serving about 12 million registered vehicles, in addition to other functional modal transport systems.

The predominance of truck transportation accounts for the excessive damage of the road infrastructure and the attendant cost imposition on the economy. This cost is estimated in the order of USD 156 million at 2008 prices, by the Bureau for Public Enterprises in its report on axle load study of Nigeria for 2008. Furthermore, the Federal Ministry of Works and Housing estimates the economic losses to the Nigerian economy arising from poor road maintenance at USD 0.5billion yearly and USD 0.33 billion in vehicle operational cost (FMW 2012). In identifying reasons for the poor state of roads infrastructure in Nigeria, Oni (2013) attributes this to the following reasons;

- Excessive use of the road network (road stress);
- Faulty designs;
- Absence of an articulated road programme;
- Inadequate funding for road maintenance;
- Absence of road safety audit;
- Absence of integrated / coordinated multi modern transport system in the country;
- Tremendous increase in motor vehicle transportation; and
- Road infrastructure assessment that is below benchmark

The Nation's federal roads shown in Table 2.1 largely flow from North to South and East to West. This reflects the geographical setting of the country and the location of economic activities. These roads constitute the nation’s major highways, and according to the federal highways department (2006) all major highways are classified as ‘A’ highways and are grouped thus:

1. The North-South highways include:
    I. Highway A1, from Lagos to Sokoto in the West.
    II. Highway A2, linking Warri and Kano.
    III. Highway A3, connecting Port Harcourt and the area around Jos in Plateau state.
    IV. Highway A4, connecting Calabar in the far South-east and Maiduguri in the far North- east.
2. The West-East highways, include:
    I. Highways A121 and A232, linking Lagos to Enugu
    II. Highways A122 and A233, linking Ibadan and Katsina-Ala.
    III. Highways A124 and A234, connecting Jebba and the area to the South of Jos.
    IV. Highways A126 (Sokoto-Zaria),A2(Zaria to Kano),A237(Kano –Potiskum).
    V. Highways A3 (Potiskum-Maiduguri), connecting Sokoto to Maiduguri via Kano.

Figure 2.1 illustrates the different connectivity of the above road network, among other components of the nation's transport system.

Figure 2.1: Map of Nigeria showing the transportation system
Source: NTM, 2006

However, the road network connecting the sea ports to the hinterland are of particular importance. The section of highway A1 from Lagos to Jebba and the highways from A121 and A232 from Lagos to Enugu are vital connections between the Lagos area and the collection centres at the North and the South Eastern parts of the country (NTM, 2006).

The conditions of the roads are still not very good in terms of asphalting, bridge structures, signage marking and so on. A study commissioned by the Central Bank of Nigeria in 2002 has categorized most of the nation's federal roads as being in poor condition. The study described the roads lying along South Eastern and North Western part of the country as most critical. In particular, some of the roads constructed over 30 years ago, had not been rehabilitated even once, resulting in major cracks, depressions, broken down bridges and numerous potholes that make the hitherto pleasant road transport services boring, slow and hazardous (CBN, 2002).

This situation has not changed significantly up till now due to paucity of maintenance funds and increasing pressure on the roads. The establishment of the Federal Road Maintenance Agency (FERMA) in 2004 is however the first major step towards improving the condition of the road infrastructure in Nigeria. The NTM (2006) report and Oni (2013), observed that the practice of overloading of trucks is responsible for damage to roads infrastructure in Nigeria. The practice of carrying excessively high axle loads on paved and unpaved gravel roads especially during the rainy season substantially reduces the life expectancy of roads. In Nigeria, axle loads are not checked, even though they are meant to be, as such drivers are normally free to load their vehicles to the highest possible level. Axle loads are usually expected not to exceed 9 tonnes, but in reality, axle load often amounts to 15 tonnes on the major highways in the country. Other factors that contribute to the poor state of the Nigerian roads are faulty designs, inadequate drainage system and very thin coatings that are easily washed away and excessive use of the network, given the underdevelopment of the railway and inland waterways systems.

2.5 Pattern of Road Traffic operation

Notwithstanding the relatively poor condition of the roads, traffic volumes are growing. Traffic data on federal roads show that about 5% of the roads carry over 10,000 vehicles per day; 19% carry between 6000-10000 vehicles per day, while 26% and 51% of the road carry

between 4,500-6000 vehicles per day and less than 4,500 vehicles per day respectively (FMW, 2013).

Road transport mode is widely used for regional and interregional transfer of goods and passengers. Vehicle registration, for instance, increased from 2,781 in 1937 to 1.1 million in 1997, and 1.3 million in 2000. The total vehicle fleet has risen to 7.6 million in 2007 and by 2011 the total vehicle fleet has risen to 8 million. From the total fleet size of 8 million in 2011, 2 million vehicles are registered under commercial category and 6 million are registered under private category (Bolade, 1991; Filani, 2011). As at 1991, over 6 million of the 6.2 million passengers in Lagos area rely on road transport for movement Bolade, (1991).

Currently, there are three major regions of heavy traffic volume in Nigeria. These regions include;

1. The North.The Northern traffic region has heavy traffic volumes in Kano and Sokoto, Sokoto-Gusau, Sokoto- Argungu, Zaria-Kano, and Abuja-Kaduna. Similarly, the traffic volume along Kaduna-Jos-Bauchi and Maiduguri axis is considerably high.
2. The West Central part covering Kwara, Niger and Kogi states. The pressure is largely through traffic from the south to the north, especially the Kaduna-Tegina-Jebba-Ilorin road being fed by Minna-Zungeru-Tegina roads, Bida-Mokwa road. As of today, the Abuja- Lokoja roads are one of the most important links in the country linking the North to the East through Ajaokuta-Enugu roads. It also links the south south through Benin and the South West, through Kabba-Ekiti road.
3. The Western and Eastern zone centred on Lagos to the west, Onitsha, Port Harcourt and Calabar to the east. The routes with very heavy traffic volume in this region include the Lagos-Ibadan road, Lagos—Benin road, Ibadan- Ife, Ibadan- Oyo-Ilorin, Sapele- Benin, Agbor- Onitsha- Enugu and Port Harcourt-Ikot Ekpene- Calabar roads. Bolade (1991) further explained that the heavy traffic volume recorded for this region is attributable to the industrial development of Lagos and Port Harcourt, which are the two most important ports in Nigeria with heavy industrial concentration.

These roads, in addition to the heavy freight traffic, also handle large volumes of passenger traffic throughout the year. In addition, most vehicular movements in Nigeria are associated with commercial activity. Long distance inter-state movements are predominantly carried out

with tractor-trailer combinations. Buses and private cars are increasingly used for passenger transport. Taxis also make up a very high percentage of passengers movements (NTM, 2006).

Meanwhile, Nigeria's public transport services are substantially controlled by the private sector. In the road transport sector, the types of vehicles used for passenger movement are taxis, mini buses, midi buses and conventional single decker buses. Sumaila (2004) explains that though the Government regulates public transport operations, the regulation is generally minimal and consists mainly of issuing of licenses, charging required fees, and regular vehicle fitness inspections. Sumaila (2004) further explained that, private operators generally have freedom to select routes and fixed fares arbitrarily. He further noted that the vehicles are largely imported as second hand since only Government and its agencies are able to buy new vehicles. The vehicles are further adapted by the operators to increase their carrying capacity, and suit the cultural realities of the citizens. Similarly, Oyesiku (2002) and FMW (2013) explained that 95% of public transport vehicles in use in Nigeria are imported as second hand. Some of the vehicles are to say the least rickety with smoking engines, emitting poisonous gases such as carbon monoxide, nitrogen oxide, volatile compounds, lead etc. into the environment and these are a health risk to the motorists and commuters and also the ecosystem

2.6 Road traffic Legislations in Nigeria

Efforts at regulating the road transport sub-sector in Nigeria towards ensuring safe operations started in 1913 with the enactment of the first transport law referred to as the Highway (Motor Traffic) Ordinance. The objective of this law was to ensure road traffic safety in the southern protectorate. The scope of the ordinance was later broadened in 1916 for nationwide application following the amalgamation of the Northern and Southern protectorates in 1914. This law was subsequently revised in 1940 and 1945 to reflect the fundamentals of the United Kingdom Traffic Act, 1930

To further improve road traffic safety in Nigeria, the Nigerian Government enacted the Road Traffic Act 1974 and the declared 1974 as the National Road Safety year. This declaration was followed with the establishment of a Road Safety Advisory Commission, under the Federal Ministry of Works and Housing. Some states of the federation also decided to pick

up the challenge of improving road safety within their domain. For instance due to the spate of increasing RTC along Ife – Ibadan route, the then Oyo State Government established the Oyo State Road Safety Corps via Edict 18 of 1977. Similar action was taken in Lagos during the same period, which coincided with the festival of Arts and Culture (FESTAC) that was hosted in Lagos in 1977. This effort was replicated at the federal government level with the creation of the National Road Safety Commission under the Federal Ministry of Works and Housing in 1980.

Following the continuous rise in the number of road traffic accidents, the federal Government established the Federal Road Safety Commission; via decree 45 of 13 December 1988 with its mandate limited to federal highways only. This decree was amended with decree 35 of August 1992 to function on all types of roads in the entire country, now FRSC ACT, 2007. The main functions of the commission as contained in the law are;

1. Prevention of accidents on highways
2. Clearance of obstructions on highways
3. Education of drivers, motorists and other stakeholders on proper use of roads
4. Rescue and care for accident victims
5. Research on causes of accidents and prevention strategies
6. Fixing and enforcement of speed limits for all categories road users

Other notable efforts by government include; Establishment of the Lagos State Traffic Management Authority in 1999, Establishment of the Lagos State Government Motor Vehicle Administration Agency (MVAA) in 2007. However, all these efforts have not fully addressed the increasing spate of RTC especially those associated with HGV (Gana and Emmanuel 2014).

In furtherance of the above, the National Road Traffic Regulation Act (NRTR 2004) was also established by Government to provide necessary guidance for motorists. The law retained the State's right to issue a driver's license, which was contained in the 1974 road traffic act. The act however, established minimum National Standards, which States must meet when licensing all commercial motor vehicles including HGV. This Regulation corrects the situation that existed prior to 2004 by making it illegal to hold more than one license and by requiring states to adopt testing and licensing standards for HGV and bus drivers to check the ability of drivers to operate the type of vehicle he/she wants to be licensed for. The

National Road Traffic Regulation act (NRTR 2004) also made it mandatory for all HGV drivers to have a Commercial driver's License (CDL) category to be legally certified to drive any HGV. In this regard, the Federal Road Safety commission (FRSC) was empowered to develop the requirements for testing and licensing of HGV drivers under commercial driver licensing scheme. The Act (NRTR, 2004), also established 0.05% as the maximum acceptable Blood Alcohol Concentration (BAC) level above which a HGV and other CMV driver is deemed to be driving under the influence of alcohol and is subject to disqualification upon confirmation.

There are also various laws and regulations that deal with traffic matters in Nigeria. These are the constitution of the Federal Republic of Nigeria 1999, Nigerian police ACT CAP 359 LFN 1990 and the Federal Highways ACT CAP 135 LFN 1990. The 36 states of Nigeria and the federal capital territory (FCT) have also created road traffic laws, with the establishment of states traffic management agencies that cater for registration, licensing and regulation of vehicles. There are also regulations stating the guidelines on the administration of traffic laws in the states and the federal capital territory. It is necessary however to properly articulate the relationship between the Federal Highway Act, the road traffic act and the traffic laws in the states to avoid conflict between the two tiers of Government (Olagunju, 2011).

However, the most recent legislation covering vehicle operations in Nigeria is contained in the revised National Road Traffic Regulation Act, 2012. The regulations contained in this act covers the rules guiding the operations of all categories of motor vehicles and use of roads. Section 200 of the document provides that all vehicles must be registered before they are put on the road for operations. It also specifically states that, a vehicle owner shall not operate a commercial vehicle without being a registered member of a licenced commercial transport union in Nigeria.

Section 170 of the act provides the guidelines on hours of driving. According to the regulations, drivers are legally permitted to drive vehicles for five hours without rest and also allowed to drive for 10 or 10 ½ hours for a consecutive period of 24 hours. In addition to these, drivers are required to rest for 30 minutes for a journey of more than five hours after completing the five hours. Section 187 of road traffic regulations act made provisions on permissible dimensions and weight of vehicles permitted to be driven on Nigerian roads.

According to the regulations, vehicles dimensions are not permitted to go beyond the following;
Length-18.288 meters
Weight=2.591 meters
Height=3.25 meters

Section 192 of the act provides necessary provisions on accident reporting. According to this section, accidents are to be reported according to the following categories.
Minor crash= a minor crash is when a damage is caused to the public road and the vehicle and there is no injury to any person.
Serious crash= this is a crash where there is substantial damage to a public road and there are injuries to persons on public road.
Fatal crash=in this category of crash, a death occurs of a person irrespective of the level of damage to properties.

In addition, section 45 of this act discusses what is required to obtain drivers' licences. While the age of 18 is the minimum requirement for private licence, a minimum of 26 years is the minimum requirement for commercial or professional drivers licences. In addition to other requirements that include training and testing, applicants for commercial drivers' licence are also required to belong to the National Union of Road Transport Workers (NURTW) or the National Association of Road Transport Owners (NARTO). Furthermore, section 201 requires drivers to attend periodic training, seminars and courses in key areas like defensive driving, speed limit, use of the road. Etc.

Section 139 of the act covers vehicle insurance, according to this section, no person is allowed to drive any un-insured vehicle, trailer, stage carriage and omnibus without insurance Any person who does so on a public road commits an offence and is liable on conviction to six months imprisonment or a fine of two thousand naira.

Sections 149 cover operations of heavy goods vehicles. According to this section a licence is required to operate heavy goods vehicles in Nigeria. These include agricultural machines, articulated vehicles, trailers and tankers. These licences are issued for three years upon the completion of a driving test. Section 188 requires fleet operators to create a safety unit in

their organization and appoint the qualified safety officer for maintaining required operational standard and, section 95 prohibits HGV operators from carrying passengers on goods vehicles. Only driver and two persons are permitted to be so carried.

The enforcement of these regulations is bestowed on law enforcement agencies like the police, federal road safety corps, law traffic agencies of various state governments like LASTMA in Lagos, KAROTA in Kano, KASTELIA in Kaduna etc. Each of these agencies is empowered to perform these roles by the laws that individually established them.

2.7 Road freight traffic operations and use of Heavy Goods Vehicles in Nigeria

Heavy Goods Vehicles have become a very important component of the Road Transport landscape in Nigeria. Olagunju (2011) reported that there was an average of about 5000 tanker-trailers involved in wet cargo (petroleum) haulage in Nigeria moving over 150 million litres of petroleum. There are also 2500 trailers in dry cargo plying the roads daily, even though officials of the National Union of Road Transport Workers believe that the number is higher than this, with Dangote Transport alone having over 4000 trucks moving cement and other products across the country.

According to Eke (2006), there are about 15 identifiable brands of trucks in Nigeria; however, the most noticeable are Mercedez, MAN Diesel, DAF, Iveco, Mack, Asia truck and freightliner. These heavy vehicles ply inter-urban roads which involve the movement between urban centres within the country, servicing shopping areas, warehouses and factories, transporting also food items and other agricultural products from rural areas. They also serve ports with export cargo, and convey import items to the hinterland. They also move petroleum products from refineries, oil depots and tanks from different locations to various destinations in the country. Inter-urban vehicles facilitate transportation of consumer goods to markets, shopping centres, warehouses, raw materials to factories and petroleum products to various filling stations all within an urban area.

The National Transport Survey and Projection survey is aimed at provision of necessary and accurate database for transport planning and forecasting of future demand for transport in Nigeria. According to the report of the (NTSP) (2010), compiled by the Nigerian Institute of Transport Technology for the Federal Ministry of Transportation, the growth of heavy goods

vehicles traffic in Nigeria is not only attributable to the growth in industrialisation, but rather also due to the mundane status of other modes of transportation in the country. The study concludes that private sector operators are in control of both the road freight and road passenger traffic in Nigeria. Many of these operators are small-scale operators who operate 1 to 10 vehicles, though; there are quite a number of medium and large-scale fleet operators in the country. The NTSP Report (2010) shows that, 75.6% of freight vehicles in Nigeria are owned by individual holders, while companies owned the remaining 24.4%. Similarly, organisations with one vehicle ownership controlled 14% of the freight business. While organisations with two vehicles control 7.7% and those with up to 15 vehicles control 6.0%, the rest is controlled by bigger fleet owners.

Going by the above therefore, road freight transport in Nigeria needs many of improvements. For example, the MITI report (2002) observed that the way road freight transport is organised in Nigeria falls short of efficient best practices. Consequent upon these, the transit time of freight containers on Nigerian roads is unsually high compared to the world standard (Oni, 1998; 2000; Ubogu, 2005, Fagbemi, 2006; 2010). There is also the problem of goods not arriving at their destination according to schedule due to road traffic accidents involving freight vehicles plying the highways and poor condition of road infrastructure**.** This is in addition to loss in road infrastructure investment arising from damage to the roads as a result of the high axle load trucks that ply the roads (FMWH, 1999). The severity of this problem is worst in the rainy season especially in the southern part of the country.

The National Transport Survey report (2010) also highlighted the problems of the road freight industry in Nigeria. Based on the report, the problems of bad roads accounted for 26.6% of the overall problems, followed by harassment by security agencies, which accounted for 22.6% of the problems. The problems of armed robbery attacks and fuel problems accounted for 14% each. Other problems listed are road traffic accidents 13.8% and vehicular related problems account for the remainder. This is in addition to loss in road infrastructure investment arising from damage to the roads because of the high axle load trucks that ply the roads (FMWH, 1999).

Another ugly characteristic of road freight traffic in Nigeria is the practice of overloading of vehicles. In this regard, Olagunju (2010) observed that overloaded heavy goods vehicles

present a threat and severe safety risk. Olagunju particularly observed that because these vehicles are designed to carry specific loads and are equipped with engines, tyres, suspension and brakes to specifications in consistent with the axle load. Exceeding these specifications presents risky situations to the operator, the vehicle and other road users, thus, leading to vehicle failure, traffic hazard, and road failure or wearing away and consequently resulting in accidents and loss of lives and properties.

Furthermore, highway bottlenecks and blockages are common resulting in serious operational problems for the trucking industry in Nigeria. These are caused by non-recurring congestion, road construction and maintenance activities, narrow bridges and bridge failures, accidents, vehicle breakdowns or extreme weather conditions (FWHH, 2009). Studies by Oni (2000); Ubogu 2005; Oni and Okanlawon (2006) and the World Bank (2007) have also identified the following as the key bottlenecks confronting the road freight industry in Nigeria.

- Poor roads
- Narrow bridges
- Activities of armed robbers and other criminals on highways
- Harassment by security agencies
- Activities of touts
- Delays as result of traffic congestions
- Shortage of fuel
- Road traffic accidents
- Frequent breakdown of vehicles and
- Congestion and delays in city center

According to the Federal Road Safety Commission (FRSC 2010), many drivers of heavy goods vehicles (HGV) are not qualified to operate such vehicles, as they are not properly licensed to do so. Because of this, there are high rates of road crashes resulting from unprofessional conduct and carelessness by the majority of the drivers. To tackle this, the Federal Government has mandated the Federal Road Safety Commission (FRSC) to establish Minimum Safety Requirements for heavy goods vehicles (HGV) operations in Nigeria. These minimum requirements include having the operator registered with the Road Transport Safety Standardisation scheme (RTSS). The Road Transport Safety Standardization Scheme was created by law under the FRSC establishment act 2007, which provides for the establishment

of safety units by all transport operators to develop professionalism into the industry and promote a rapid, safe, efficient and convenient fleet transportation in the country. This was aimed at improving the safety level of freight transport services in Nigeria, and thus reducing to the minimum, the incidences of heavy goods vehicles accidents on Nigerian roads.

The operators of heavy goods vehicles are also required to conform to the Road Transport Safety standardization scheme requirement of registration of operators with at least five vehicles in their fleet. Operators with less than five vehicles are also required to comply with the minimum safety standards as clearly spelt out in the national traffic laws and regulations. The RTSS registration process also requires operators of all categories of heavy goods vehicles to define the type of freight transport services they are engaged in and then register their operation with the FRSC. Each Operator is assigned a unique Registration Number, which serves as an identity for collation and monitoring of the company's safety compliance records such as safety review, crash investigations and facility inspection activities. The Road Transport Safety Standardization scheme has also specified roles for fleet Operators and Drivers to ensure safer operations.

Similarly, there were other initiatives by the Standard Organization of Nigeria (SON) to put in place standard code of practice for drivers of HGV and operators in Nigeria. This was the Nigerian Industrial Standard (NIS) Code of Practice (NCP 040:2008) for drivers of HGV, which was prepared by the Technical Committee on Automobiles. It covers the safety requirements for road users and it is aimed at abating potential risks on the Highway. This regulation was also an exigency in view of the high rate of road traffic accidents resulting from incompetence, unprofessional conduct or carelessness of heavy-duty vehicle drivers especially the tanker and trailer drivers (NRSS, 2012 - 2016). Furthermore, NIS regulations (NIS 529:2006; NIS 615:2008, for trailers: open body, close body and flat deck) provides that all HGVs must comply with the specification for carriage of bulk goods and the drivers of HGVs must also comply with the code of practice for heavy good drivers as contained in (NCP: 040:2008).

2.8 Road traffic accidents in Nigeria

Road traffic accidents are one of the major problems of the Nigerian road transport sub-sector. In 2011, 4,700 accidents were recorded with an average of about four casualties per crash (Akpoghomeh, 2012). According to the FRSC (2012), Nigeria ranked 127 out of 175 on country ranking based on World Health Organisation's estimated road traffic fatality per 100,000 populations in 2011.

Table 2.2 shows the summary of reported cases of road traffic accidents in Nigeria from 2001- 2011 in the various classifications of fatal, serious, minor cases, person killed and injured. The number of persons killed per minute and number of accident cases per minute are highlighted in the Table.

Table 2.2: Summary Report on Road Traffic Accidents from 2001- 2011

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Average/Yr
Fatal Cases	6,966	4,029	3,910	3,275	2,299	2,600	2,162	3,024	2,460	1,178	1,764	26,701	2,427
Serious Cases	8,185	7,190	7,882	6,948	4,143	5,550	4,812	5,671	6,024	2,819	2,485	53,524	4,866
Minor Cases	5,379	3,325	2,472	4,051	2,620	964	1,503	2,646	2,370	1,333	516	21,900	1,991
Total Cases	20,530	14,544	14,364	14,274	9,062	9,114	8,477	11,341	10,854	5,330	4,765	102,125	9,284
Persons Killed	9,946	7,407	6,452	5,351	4,519	4,944	4,673	6,661	5,693	4,065	4,372	54,137	4,921
Persons Injured	23,249	22,112	18,116	16,897	15,779	17,390	17,794	27,980	27,270	18,095	17,464	198,897	18,082
Total Casualty	33,195	29,519	24,568	22,248	20,298	22,334	22,467	34,641	32,963	22,160	21,836	253,034	23,003
Time Per No Killed (Mins)	53	71	81	98	116	106	112	79	92	129	120		
Time Per Rtc Case (Mins)	26	36	37	37	58	58	62	46	48	99	110		

Source: FRSC, 2012

Table 2.2 and Figure 2.2 shows that the year 2001 had the highest number of fatal cases of 6,966 followed by 2002 with 4,029 cases while year 2011 had the lowest fatal cases of 1,764. Similarly, the year 2001 had the highest figure of serious and minor cases with a value of 8,185 and 5,339 respectively, while the least value of serious and minor cases was also reported for 2011. One general trend for all of the years is that there is gradual and steady reduction in reported cases across the classes from 2001 to 2011. Over the same period, 102,125 accident cases were recorded in Nigeria. This is further illustrated in Figure 2.2.

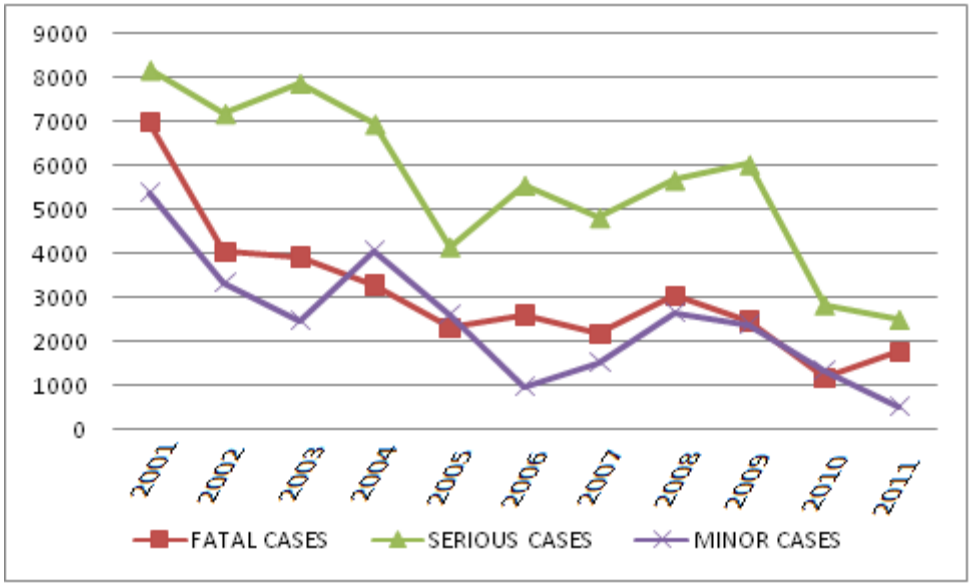


Figure 2.2: Reported RTA (2001- 2011)

The corresponding number of people killed and injured between 2001- 2011 as presented in Table 2.2 shows that 54,137 people were killed as against the 194,897 injured. The highest figure of 9,946 was recorded in 2001 while 2011 has the least figure of 4,065, which represents a gradual yearly decrease until 2010, as shown in Figure 2.3.

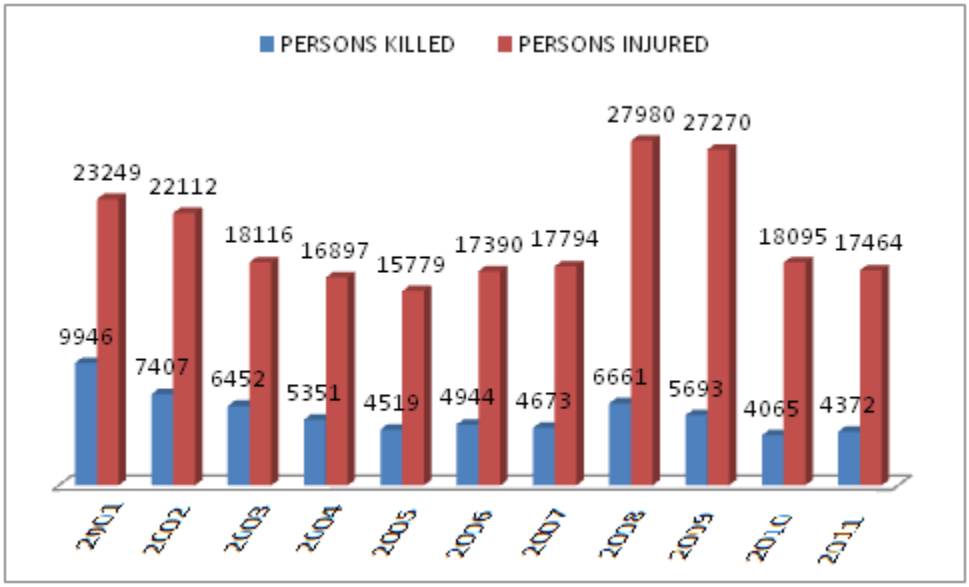


Figure 2.3: RTA death and Injuries (2001-2011)

From Table 2.2 and Figure 2.3, the analysis of the number of persons killed per minute shows that at least 1 person was killed in every 53 minutes in 2001, this decreased to one person in every 71 minutes in 2002 until it reaches the lowest value of 129 minute in 2010. The time per reported cases of accident is one person killed in every 110 minutes in 2011, as further illustrated in Figure 2.4.

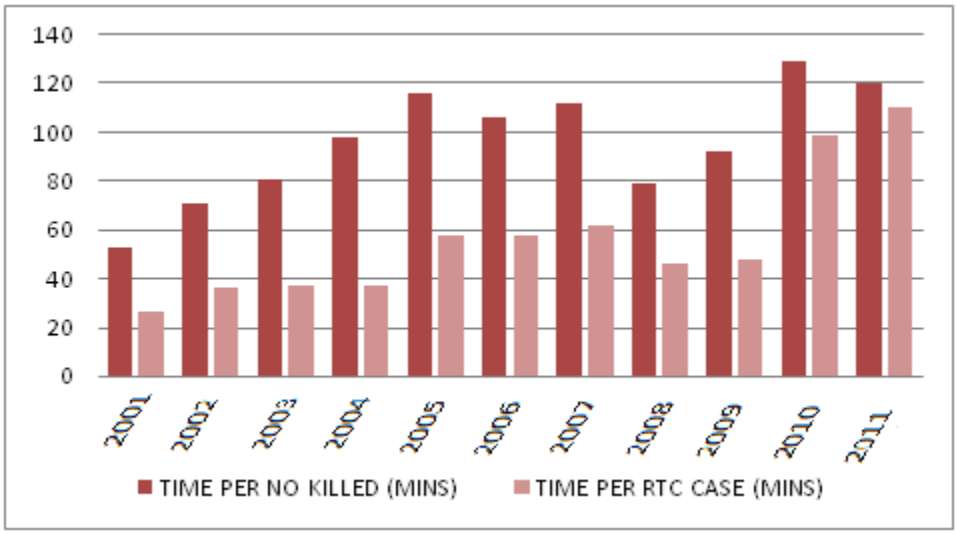


Figure 2.4: Average time per death & cases in RTA

The implications of the above observations is that reported cases (fatal, serious, minor, persons killed and injured) is high in Nigeria and they are all above the national averages for

other countries at the same level of development as Nigeria. These results may not be unconnected to the unsafe operating conditions of road transport in Nigeria, which manifest in the form of poor road conditions, rickety vehicles and poor attitudes of road users as well as the traffic law enforcement agencies.

2.9 Heavy Goods Vehicles accidents in Nigeria

Considering the Nigerian freight traffic situation, available statistics shows that, the number of deaths from passenger vehicles traffic accidents keeps on fluctuating annually, but statistics of casualties from truck accidents have continued to rise (see Table 2.4). Several reasons are responsible for this, among which are the increasing dependence on road freight transport following the dwindling fortune of rail transport in the country. Similarly, there is increasing over-dependence of the country on road transport for the distribution of petroleum products without giving due consideration to the environmental consequences of this policy (Ameyan, 1996).

It was reported by FRSC (2011) that between January 2007 and June 2010 a total of 4,017 truck accidents occurred on Nigerian roads with an annual average of 1,148 cases and monthly average of 96 cases. It can be seen from Table 2.3 that the rate of truck accidents is in the rise with a monthly average of 51 in 2007 accidents, 102 in 2008,101 in 2009 and by June 2010 an average of 161 accidents occurred each month.

Table 2.3: Record of accidents involving trucks January 2007--June 2010

S/N	Year	Total RTA	Total No. killed	Total No. injured	Total No. casualty	Total vehicles` involved
1.	2007	607	805	2169	2974	976
2	2008	1229	1221	3891	5112	1655
3.	2009	1213	1085	3714	4799	1767
4	2010	968	965	3220	4185	1427
Sum	2007-June 2010	4017	4076	12294	17070	5825

Source: FRSC, 2012

Table 2.3 shows that 4076 persons were killed in accidents involving trucks from January 2007-June 2010 with 805 dead persons in 2007; 1,221persons in 2008; 1,085 in 2009 and 965 persons were killed between January and June 2010. On averagely, 97 people were killed every month from road traffic accidents caused by trucks between January 2007 and June 2010

Similarly, Table 2.3 also shows that during the period of January 2007 to June 2010, the total number of people injured due to road traffic accidents involving trucks was 12,994 persons with a monthly average of 309 and daily average of 10 persons. Averagely, about 181 persons were injured monthly in 2007 and 316 in 2008, 310 in 2009 and 537 from January to June, 2010. The number of injuries sustained from truck accidents daily from 2007 are 6 in 2007, 10 in 2008, and 10 in 2009 and an average of 18 persons were injured per day from January to June in 2010. Table 2.3 further reveals that 976 vehicles were involved in accidents in 2007. In 2008, it was 1,655 while in 2009, 1,767 vehicles were involved. An average of 138 vehicles monthly was involved in Road Traffic Accidents (RTA) involving trucks between 2007 and June 2010. This means an average of 5 vehicles were involved in accidents per day. The average daily number of vehicles involved in accident is three in 2007, 5 in 2008, and 5 in 2009 and from January to June 2010 the number of vehicles involved in accident per day on Nigerian roads was 8 trucks.

2.10 Nature and characteristics of road traffic accidents

The nature of road traffic accidents in Nigeria for the year 2011 is presented in Table 2.4. The table shows the relationship between the various types of accident cases recorded on selected road corridors. Overall, it shows that there were more serious injury cases than fatal and the minor injury cases are the lowest. The ratio of accident cases is therefore 3:6:2 for fatal accidents, serious accidents and minor accidents respectively, while the ratio of the relationship between the injuries accidents is 8:2 in favour of serious injuries to minor injuries. For every one fatal accident therefore, there are two cases of serious injury accidents and one minor injury accident, meaning that there are three injury accidents to every fatal accident. The low minor injury accident cases may however be attributed to the problem of accident under-reporting.

Table 2.4: Nature of road traffic accidents by severity along selected corridors, 2011

Route	Fatal Cases	Serious Cases	Minor Cases	Total Cases	Number Killed	Number Injured	Total Casualty
Ojota-Ibadan	99	266	43	408	176	1290	1466
Sagamu-Awka	251	472	154	877	556	3149	3705
Gwagwalada-Zariagi	75	155	112	342	173	1133	1306
Nyanya-Hong	75	341	44	460	133	1276	1409
Abuja-Kano	186	485	167	838	354	2771	3125
Mokola-Kaduna	71	145	39	305	193	788	981
Iwo-Owo	123	174	39	336	288	1597	1885
Benin-Ahoada	61	212	71	344	105	641	746
Enugu-P/Court	27	44	13	84	36	305	341
Lafia-Jos	7	16	0	23	13	87	100
Jos-Kaduna	10	31	7	48	17	139	156
Maid.-Ogoja	34	88	69	191	52	264	316
Bauchi-Maid.	28	94	7	129	64	499	563
Kishi-Oturkpo	60	111	19	190	98	582	680
Katsina-Potiskum	44	77	3	124	146	600	746
Kotangora-Sokoto	13	30	14	57	25	171	196
Katsina-Zaria	7	19	5	31	2	141	143

Onitsha-Arochukwu	18	26	20	64	22	88	110
Abuja-Kano	44	29	25	98	132	474	606
Benin-Ilesha	51	78	4	133	184	522	706
Mokwa-Suleja	41	108	57	206	208	555	763
Total	1325	3001	912	5288	3007	17072	20079
Average	64	143	44	251	143	813	956

Source: FRSC, 2013

On the ratio between fatalities and the injuries, the figures are 2:8 fatalities to injuries. This means that for every one fatality, there are four injury victims.

According to Ipingbemi (2008), 5.5% of accident victims in South Western Nigeria are aged between 0-15 years, 33.6% are between 16-30 years and 40.4% are 31-45 years old. Similarly, 16.4% are within 46-60 years and 4.1% are 60 years and above. Thus, 70% of victims fall within the productive years of 15-45. Males constitute over 80% of all accident victims in the south west of Nigeria. World Health Organisation reported that 73% of these were male (Paden 2004).

In addition, 64% of the victims reported that they are married, 32% are single and 2% are divorced. However, 5.5% had no formal education, while 23.3% have primary education, 51.4% have secondary education and 21.9% have tertiary education. He also found out that on average, accident victims spent about $17 per day in the hospital. In addition, about 85% of the victims had one of their family members around them in hospital at all times. Madubueze et al (2010), reported a mean age of 29 years for accident victims in Nigeria with a modal age of 25, and 74% of victims were between the ages of 15-40 years, with a male to female ratio of 3.4:1.

2.11 Summary and conclusion of this chapter

This chapter introduced Nigeria, its geography, population, its economy, the GDP and the per capita income. It also discussed the Nigerian Transportation system, covering its nature, structure capacity and challenges, stating that the country has about 193,200 km long road network, the road transport network is highly undeveloped, having only about 30% of it asphalted.

Legislations covering the operations of road traffic in Nigeria have been presented in this chapter including the Road Traffic ACT 2012 and the FRSC ACT 2007. Road traffic accidents in Nigeria were also discussed. The number of casualties was analysed, including the number of fatalities, the number of injuries and the total number of vehicles damaged. The chapter also covered issues of road freight traffic in Nigeria and a review of road traffic accidents involving trucks. Accident records of heavy goods vehicles in Nigeria were therefore discussed in this chapter.

The next Chapter is the Literature review. It covered issues of traffic accidents, costs, causes and prevention strategies.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

In every country, safety to lives and properties is regarded as a very important requirement for growth, prosperity and development. This underlies the importance to which road traffic safety has been recognised by governments and institutions the world over. It is in response to this that research activity in the area of road traffic safety has increased in recent years. In this chapter, a review of some of the research done in this field and identification of the areas that require further research activity is provided.

According to Schelp and Svanstrom (1986), an accident is defined as a sudden unexpected series of undesired happenings in interplay between individuals and the environment, which lead to personal injury. According to Nkwonta (2003), a road traffic accident means a mishap, a collision or a crash involving one or more vehicles on the road often resulting in damage, injury or deaths.

The Federal Road Safety Commission (FRSC) of Nigeria, defines a road traffic accident as a collision between one or more vehicles or a moving vehicle and a stationary vehicle/object or pedestrian resulting in death, injury or damage to the vehicle or loss of physical property, (FRSC,2014). According to Akpoghomeh (2012), a road traffic accident is a mishap or a chance event on the road, usually involving catastrophe, suffering or damage.

The World Health Organization (WHO 2013) reports that road traffic accidents (RTAs) have emerged to be another huge global public health and development problem killing over 1.24 million people a year and injuring or disabling between 20-50 million people. It is the number one cause of death among those aged 15-29, with over 90% of the fatalities occurring in low and middle income countries, even though these countries have only about half of the world's vehicle population. The World Health Organization (WHO) has also estimated that nearly 25% of fatal injuries worldwide are because of road traffic crashes. As at 2012, road traffic accidents are the ninth biggest cause of death worldwide and will rise to the third with about 1.9 million deaths in 2020 if active steps are not taken urgently to promote traffic

safety. In fact, accident rates in developing counties are often 10-70 times higher than in developed countries (Krug, 2011).

3.2 Theoretical framework

The most popular theories of accident causation are the Domino theory, the human factors theory, the accident/incident theory, the epidemiological theory, the systems theory, the combination theory and the behavioural theory.

3.2.1 Domino theory of accident causation

Heinrich (1931) pioneered the emergence of what is known as the Domino theory of accident causation after his study of the reports of 75,000 industrial accidents in late 1920s. Heinrich's conclusion and findings are that;

1. Acts that are unsafe by co- workers cause 88% of industrial accidents.
2. unsafe conditions are responsible for 10% of industrial accidents, and
3. Unavoidable circumstances are responsible for 2% of industrial accidents.

From his study, Heinrich came up with the Axioms of industrial safety and his theory of accident causation popularly known as the Domino theory. Heinrich Axioms of industrial safety are summarised as follows:

- Injury is a product of a completed series of factors, one of which is the accident itself,
- An accident can take place only from an unsafe act by a person and/or a physical or mechanical occurrence,
- Unsafe behaviour by people is the cause of most accidents,
- An accident or injury does not occur immediately after an unsafe act by a person or an unsafe condition.
- The reasons why people commit unsafe acts can provide helpful guides in selecting corrective accident actions
- The severity of an accident is largely fortuitous, and the accident that caused it is largely preventable.
- The best accident prevention techniques are analogous with the best quality and productivity methods.
- Management should assume responsibility for safety, because it is in the best position to get results.
- The supervisor is the key person in the prevention of accidents

- In addition to the direct costs of an accident e.g. compensation, liability claims, medical costs etc., there are also hidden and indirect costs.

According to Moliero et al (2008), Heinreich's domino theory lays more emphasis on the human error in the causation of accidents. Other factors are structural factors like production and quality techniques and technological factors like physical and mechanical constraints. Furthermore, there are two central points in the domino theory of accident causation (1) injuries are caused by the action of preceding factors and (2) removal of the central factor negates the action of the preceding factors and thus, prevents accidents and injuries.

3.2.2 Human factors theory of accident causation

The Human factors theory of accident causation is when a worker is distracted by factors that are either internal or external. The distracting factors influences are temporary and not permanent. Therefore, if care is taken to eliminate the distracting factors, there is a possibility of preventing accidents. The human factors theory of accident causation consists of three broad factors that lead to human error:

- Overload
- Inappropriate response
- Inappropriate activities

These are illustrated in figure 3.1.

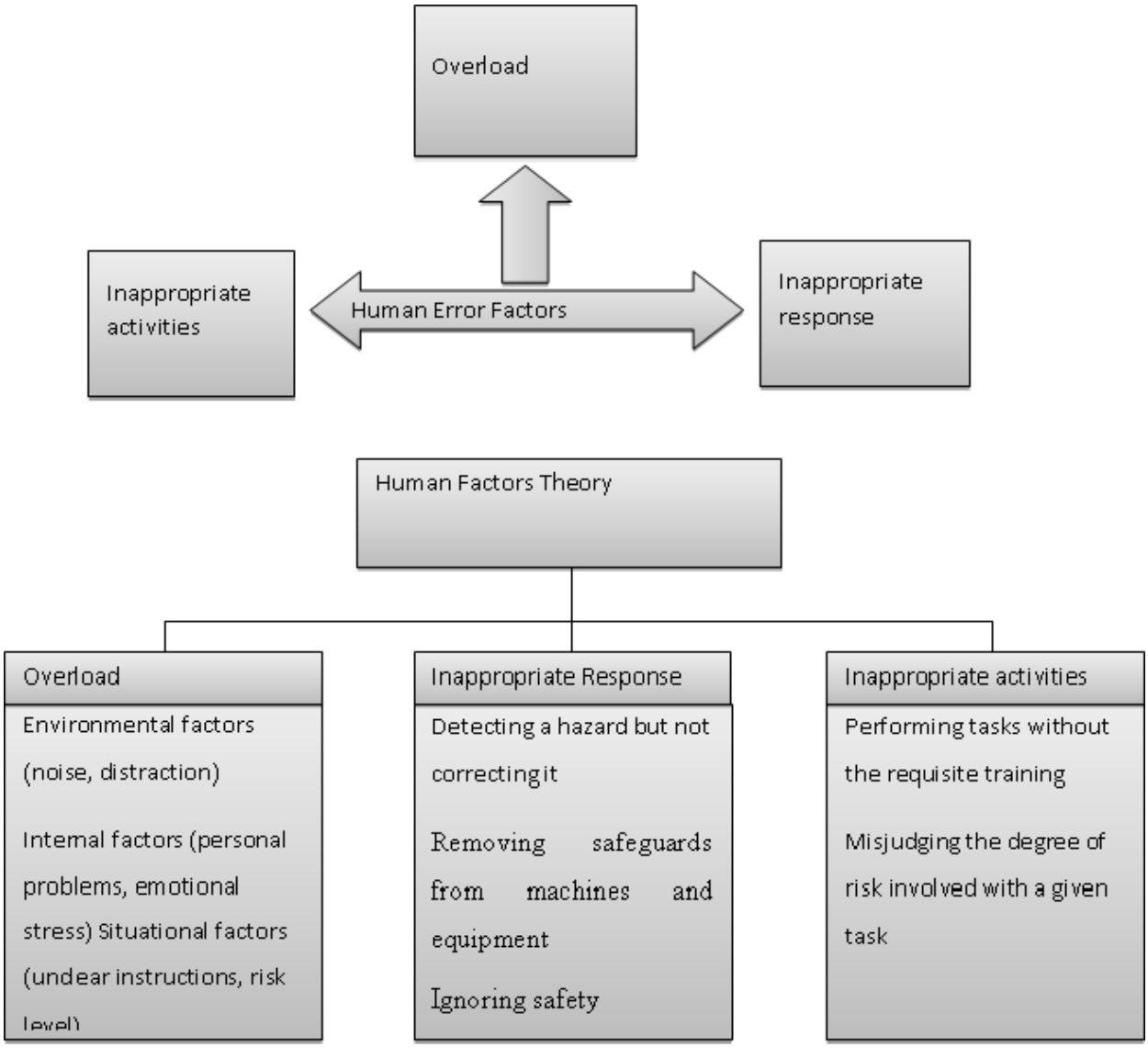


Figure 3.1: Human factors theory of accident causation

Source: Adopted from Moliero, 2008

3.2.3 Accident/Incident theory of accident causation

The accident/incident model of accident causation suggests that human error normally arises from three multidimensional factors of overload, ergonomic traps and a decision to err. These factors lead to an accident under the Accident/incident model as shown in figure 3.2.

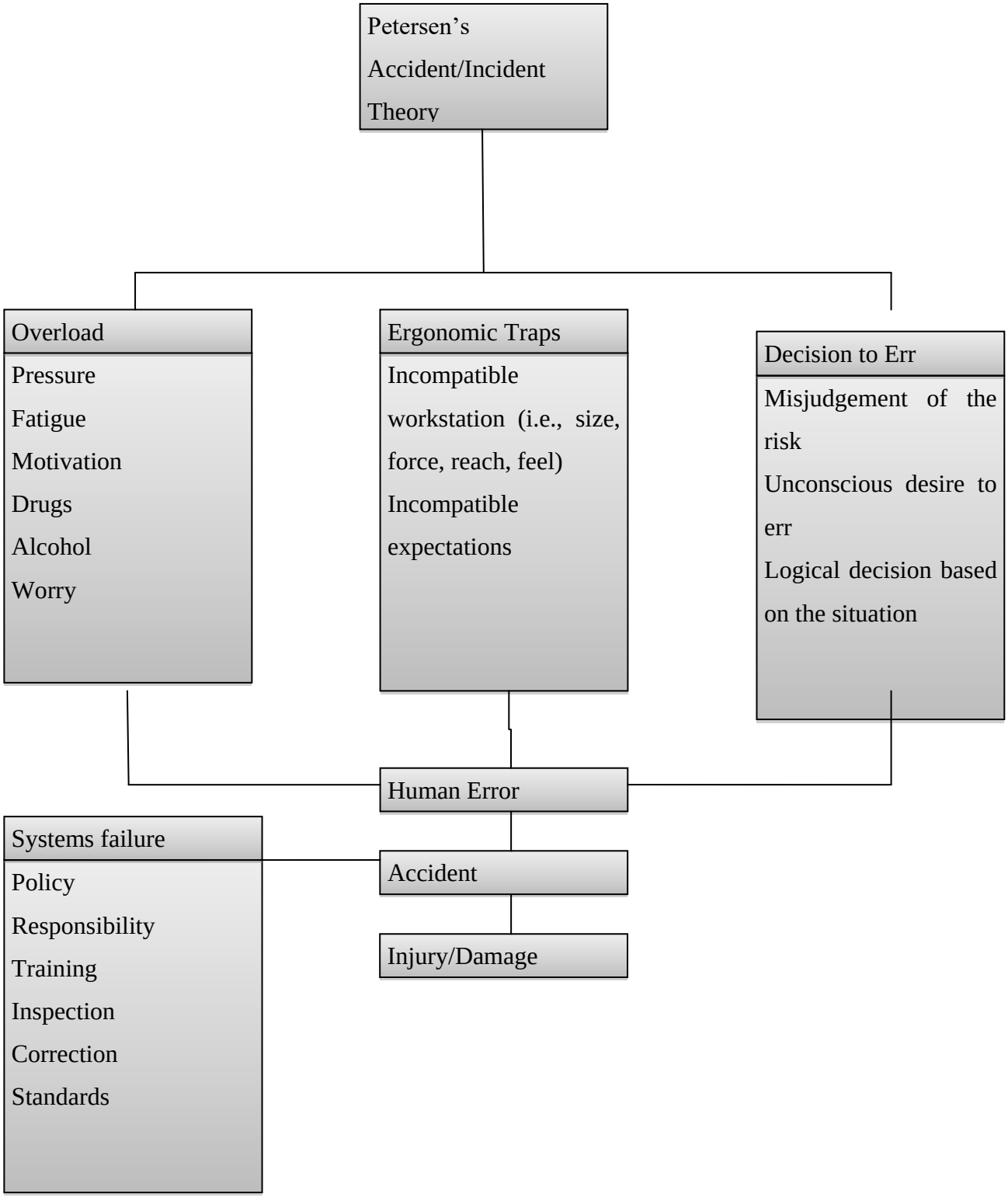


Figure 3.2: Accident model

Source:Adopted from Moliero, 2008

The model postulates that even as a person interacts with a machine within an environment, three activities take place between the system and the tasks to be executed. Each time a task is performed, risk exists that accident may occur. Sometimes the risks are great and at other times the risk are small.

According to Strasser et al. (1981), homeostasis or equilibrium remains one of the basic concepts of system theory of accident causation. A system is stable when it runs according to its design, but when it is exposed to extraneous disturbances, it develops a built in mechanism to restore its balance, as if a pedestrian being pushed by a vehicle or a car and its driver skidding off the road.

3.2.4 Epidemiological model

One of the distinct theoretical areas of research on road traffic accidents is built around the concept of the epidemiological model. According to Dart and Mackenzie (1981) and Badejo (2011), the epidemiological model originated from medical research, where it is a study of causal relationships between environmental factors and disease. This was later widely used in the analysis of non-disease injury and fatality due to road traffic accident. It was premised on three variables of the host, the agent and the environment as illustrated in the Figure 3.3.

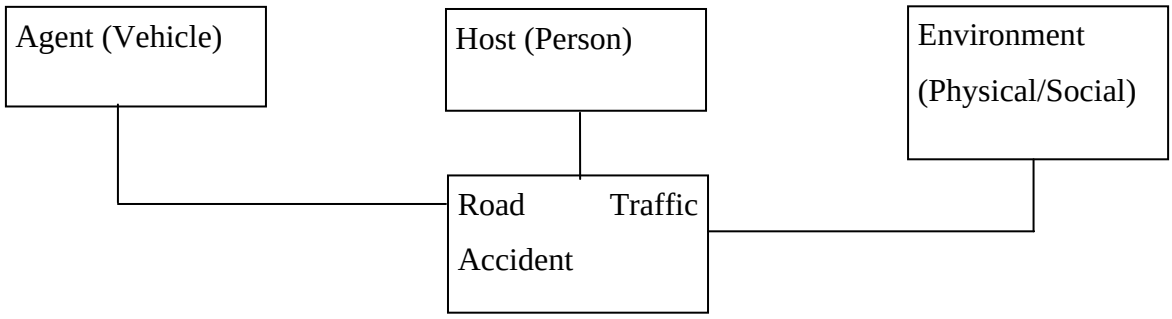


Figure 3.3 Epidemiological model of road traffic accident

Source: Schram, 1970

Under this model, the host is the person, the agent is the vehicle, and the environment is the physical and social factors. It is the interactions that take place between these variables that result in an accident.

Drawing from the work of Badejo (2011), road traffic accident phases are captured at three levels of occurrence, these are;

The pre-crash phase: This is also called the accident avoidance stage, and it is made up of all accident causation factors of the vehicle, environment, road users and all measures taken to prevent the accident from happening.

The crash phase: This is the accident's occurrence stage and is known as the injury prevention stage. The outcome of the accident and the circumstances of its occurrence in terms of time and location are included in this phase.

The post-crash phase: At this phase, accidents consequences are assessed and evaluated to achieve severity reduction. It involves saving lives and reducing the number going to hospital and prevention of disabilities. Nigeria is in this stage in its accident management level, as efforts are largely concentrated in managing accidents rather than actual prevention due to failure to enforce traffic rules and regulations. The Haddon Matrix in Table 3.1, developed by Haddon (1968), illustrates this.

Table 3.1: Haddon Matrix

Phase		Factors		
		Human	Vehicle and Equipment	Environment
Pre-crash	Crash prevention	Information Attitudes Impairment Police enforcement	Roadworthiness Lighting Braking Handling Speed management	Road design and layout Speed limits Pedestrian facilities
Crash	Injury prevention during crash	Use of restraints Impairment	Occupant restraints Other safety devices Crash-Protective design	Crash-protective roadside objects
Post-crash	Life sustaining	First-aid skills Access to medics	Ease of access Fire risk	Rescue facilities Congestion

Source: World report on Road Traffic Injury Prevention, 2004

The Haddon Matrix is an illustration of the interactions of the three factors of human, vehicle/equipment and the environment at the three phases of accident occurrence.
The essence of these interactions is to help reduce exposure to risk, prevent the accident from happening, reduce severity and injury if the accident happens and then reduce its consequences should it happen. This model is generally applied in order to conceptualise etiologic factors for road traffic accident injury and have the capacity to forecast potential preventive strategies for result oriented safety intervention measures (Sadaukas, 2003).

3.2.5 Systems theory of accident causation

A system is a group of constantly interacting and interrelated components that form a unified and complete whole. It is a situation where an accident occurs in a system that comprises three components of host, agency and environment. Thus, the main components of the systems model are the person/machine/environment, information, decisions, risks, and the task to be performed. Each of these components has a certain level of bearing on the probability that an accident will either occur or not.

3.2.6 Combination theory

On combination theory, Moliero (2008) postulated that one given model might not be fully adequate in explaining why accidents occur, because for some accidents, one given model may be adequate while for some others, a combination of models may be required. The combination theory is therefore a postulation that, the explanation for the actual cause of an accident may be achieved through a combination of several different models.

3.2.7 Behavioural theory

This is often referred to as behaviour-based safety (BBS) and it is the application of behavioural theories from the field of psychology to the field of occupational safety. The theories are applied in situations where certain types of human behaviours are desired and others are avoided. Positive measures like incentives and rewards are used to encourage the desired behaviours and to discourage unsafe actions (Moliero, 2008). The prominent proponents of the behaviour theories are Geller (2000) Fern and Alzamora (1999).

Having examined the various theories of accident causation, it is clear that no single theory can adequately explain the causes of road traffic accidents in Nigeria. This is so, because of the nature of the Nigerian road traffic environment, which can be described as chaotic, un-organised, un-regulated and therefore largely unsafe as seen in Chapter 2.

3.3 Classes of road traffic accidents

Based on the work of Dawson & TRRL (1967), accidents are classified as fatal, serious injury or slight injury accidents. A fatal accident is the class of accident in which one or more persons are killed from the impact of the accident, provided the death happens within 30 days. A serious injury accident is the class of accident that does not result to deaths, but results to serious injury of one or more persons. This means the accident victim will be kept in hospital as an inpatient or where the nature of the injuries are the dimension of fractures, concussion, internal injuries, crushing, severe cuts and lacerations, or severe general shock that require medical treatment. A slight injury accident occurs where there are no deaths or serious injuries ut the victim is slightly injured in the dimension of cut, sprain or bruise and is treated and discharged without admission in the hospital. Another class of accident is the damage only accident, which was described by Jacob (1995) as another class of accident in which no one is injured but damage to vehicles and/or properties, is sustained.

From the above explanations, an accident by severity is often grouped according to the most serious casualty severity among the victims of that particular accident. Based on this definition, the cost of an accident is the same as the cost of all casualties resulting from that accident, including fatalities, serious and minor injuries and properties damaged. According to Arokodare (1978), accidents can also be classified according to the proportion of fatal accident cases to the total personal injury accidents in a group of accidents, the number of deaths recorded per fatal accident case and the proportion of deaths to the total casualties. This involves 3 types of severities as follows;

1. An accident is considered fairly severe when the proportion of fatal accident cases to total injury accidents lies between 5% and 10%, it is considered severe when the proportion is greater than 10% but below 15% and very severe if above 15%.
2. An accident is considered severe when death per fatal accident is below 1.25; it is severe if more than 1.25 but not greater than 1.5 and very severe if greater than 1.5.

3. An accident is considered also to be fairly severe if the proportion of death to the total casualties is between 5% and 10%, severe if more than 10% but not greater than 15% and very severe if greater than 15%.

Bankole (1996), described the Abbreviated Injury Scale (AIS) as an internationally recognised clinical classification of severity injury with respect to the part of the body affected. The (AIS) has seven main categories as shown in Table 3.2.

Table 3.2: Abbreviated injury scale (AIS) classification

Category	Description
AIS 0	No injury
AIS 1 Minor	Minor cuts, bruises, or abrasions, un-displaced fractures of fingers and toes
AIS 2 Moderate	Moderate cuts, mild concussion, un-displaced fractures of the long bones of the arms
AIS 3 Severe (not life threatening)	Severe cuts, displaced fractures of the arms, fractures of the long bones of the legs
AIS 4 (life threatening but survival possible)	Ruptured spleen, multiple rib fractures with a unilateral frail chest
AIS 5 (survival uncertain)	Bilateral frail chest, extensive lacerations of liver
AIS6 Maximum(injuries currently untreatable	Decapitation. Massive intra-cerebral haemorrhae leading to death within 60 minutes. Tran section or rupture of aorta with immediate exsanguinations.

Source: Adopted from Bankole, 1996

Death can result from various types of injuries, and as such does not have a separate category within the injury classification. The terminology of fatal is not used under this system, but

will fall under AIS 6 or any of the lower categories that leads to death within 30 days from the day of accident.

3.4 Cost of road traffic accidents.

According to Jacobs (1995), the need for costing in road traffic accident analysis emanated from the necessity to have national resource, planning in order to make sure that road safety is also considered equitably with other sectors in terms of resource allocation and investment in its improvement. Silcock/TRRL (2003) also argued that an accident cost analysis can produce estimates of total annual national costs of accidents which are useful for resource allocation at a national level to favour road safety and make sure it is equitably recognised in terms of investment in the improvement of the quality of life for citizens.

Downing (1997) justified the costing of road traffic accidents with the following arguments

1. That the knowledge of road traffic accident rates only does not necessarily give the full picture of the burden of accident. The real value of damage, pain and suffering caused can only be truly revealed by means of ascribing cost to the problem. In effect, costing brings out all the negative implications to be estimated and compared with other national issues that are competing for national resources in the form of investment.
2. That the benefits of road traffic accident casualty savings can be estimated only after a real value is attached to road traffic accidents and casualties. This means that road safety will not be left behind when considerations are made for investment at the level of national economic planning.
3. That including values for safety will ensure safer designs are made and implemented as lack of accident cost estimates will make such projects to be designed towards increases in speed and capacity for motor vehicles, thus, disregarding vulnerable road users like pedestrians, cyclists and motorcyclists who form significant percentage of casualties of road traffic accidents, especially in developing countries.
4. That only through accident cost analysis will be a cost benefit analysis of alternative road safety improvement projects that will ensure that the budgets on road safety is efficiently utilised.

Zaloshna et al (2004) are of the view that accident cost estimates are useful in many ways ranging from estimating safety benefits for a proposed or planned road safety intervention for a given location or driver groups to identifying priority targets in national or regional road safety programme. Zaloshna and Miller (2004) suggested that heavy vehicle crash costs are useful for the purpose of analysing the effectiveness of a particular roadway enhancement project, measurement of the impact of safety improvement programmes, the measurement of the efficacy of different crash counter-measures and comparison of the effectiveness of proposed safety regulations.

Costing of road traffic accidents is not without its controversies. To many people, putting monetary values to life of human beings and their safety may be seen as immoral and unacceptable (Jacobs, 1995). Nevertheless, McMahon and Dahdah (2010) explained that the value of statistical life is the level of investment adjudged adequate which can be justified for the saving of one life. It is about the value that can be ascribed to a change in risk such that one life will be saved, but not the valuation of the worth of a life of an individual. Furthermore, arguments are still raging on whether it is appropriate to use same values for life in developing and developed countries in view of disparities in level of income. The economic argument in this is the sense that, the worth of a thing is determined by the price that a society is prepared to pay for that thing. From this point of view, some people regard safety as a commodity in that reduction in risk attracts expenditure, meaning that there is a trade-off between wealth and the desired level of safety. In this regard, the value of statistical life is ultimately determined by income the method applied notwithstanding.

According to Fletcher (2014), conservative estimates of the global burden of road traffic accident costs amounts to about 1% of the GDP, though this is most likely to be higher especially for the low and medium income countries, which may be as high as 5%.

3.5 Modelling the cost of road traffic accidents

Over the years, many methods have been developed to estimate the cost of road traffic accidents. Some of these methods have been discussed in this section. It is to emphasize that no single method is suitable for all circumstances, but the choice of a method depends on the intentions and priorities of the agency/body for which the costs and values are compiled.

3.5.1 Rule of Thumb Method

Fouracre and Jacobs (1976) developed the general method of costing road traffic accidents. Their study on the cost of road traffic accidents in selected countries, which include Ivory Coast, Thailand, Southern Rhodesia, South Africa, Ghana and Turkey, indicated that the cost is about one percent of the Gross Domestic Product (GDP) of these countries. This method was used mostly due to the non-availability of data and technical expertise for more technical costing of road traffic accidents.

Furthermore, the International Road Assessment Programme (iRAP) has developed this method further. The method is also called the 'rule of thumb' and is based on the assumption that the level of income determines the value of statistical life (McMahon and Dahdah, 2010). iRAP has used this methodology to estimate that the GDP loss due to road traffic accidents for low and medium income countries is 5% and 2% respectively (Fletcher, 2014).

3.5.2 The net output method

In this method, the discounted value of the victim's future consumption is subtracted from the amount of the gross output. Thus, an individual's gross output less his future consumption is the measure of the society's valuation of his continued survival. The problem with this approach is how to estimate an individual's future consumption. Moreover, the net output method cannot be used to compute the historical cost of road traffic accidents because it is difficult to capture consumption in the past, given that taste and preference and combination of goods do change over time.

3.5.3 The life insurance method

Under the life insurance method, the amount individuals are willing and able to insure their lives determine the value of the prevention of accident. This approach is subjective because it

deals with how an individual values his life. This method is silent on the value of life to the insured person himself. In addition, the level of life insurance cover may not be up to what it ought to be in the event that the motive is to generate sufficient resources for the survival of his dependants. In developing countries, the approach is of little relevance because very few people have insurance policies. The method also has other shortcomings, as it cannot provide the historical cost of road traffic accidents

3.5.4 The court award method

The amount awarded by the courts to the surviving dependants of the accident victims is considered as the indication of the cost society associates to road traffic accidents or the value that it would place on prevention. The amount depends on many factors such as the degree of negligence, the availability of industrial injury benefit, employers' response in terms of wage payment continuity. According to Jacob (1995), the Court award method is the demonstration of what the society associates with the road traffic accident or the value that it would have placed on its prevention. The problem with this method is that, it is difficult to determine the extent of blame to be shared between the defendant and the victims. This emerges from the fact that awards by the judicial system are not normally based on any serious economic evaluation of the damage done by the accident to the victims and to property. Also in many countries, it takes a longer time before judgment is delivered defeating the objective of compensation. Apart from the aforementioned problems associated with this assessment method, there is the problem also of aggregation when the analysis is to assume a national coverage. It is also a problem that, the court award method cannot be used to provide the historical cost of a road traffic accident.

3.5.5 The implicit public sector valuation method

This method attempts to determine the costs and values that are allocated implicitly on accident prevention in National legislations showing public sector policies in favour of or against appropriation of funds for the purpose of road accident preventions. This method looks subjective as it depends on what resources are available to be appropriated. It also depends on the competing demands for such resources. This method has not been widely applied in many countries.

3.5.6 The gross output/ human capital method

This method deals with two clear costs involving a fatality.

First, are the costs of a loss or diversion of current resources and secondly is the cost due to loss of future output of accident victims. Further included in the first costs above are the costs in the following areas;

- Cost as a result of vehicle damage
- Cost as a result of medical treatment
- Cost as a result of police/administration activities

Therefore, to calculate loss of future output of persons involved in a fatal accident is to consider the average wage rates in use in that particular country (tax inclusive) in order to estimate lost output for that year in which life was lost and also for future years. The cost of future years is discounted backward to give present day values.

The above estimate is calculated for an accident victim (killed or injured) in a road traffic accident. Some versions of this assessment method also add a substantial amount to reflect the cost of pain, grief and suffering of accident victims and to relatives caring for them. The nature of this assessment method, makes it less difficult to apply to less developed countries though adjustments are usually made to reflect the nature of the under developed economies of the third world nations. The adjustments include the exclusion of some terms from the ideal model. These include the probability of being alive and classification across sex and age brackets because the data are not available in most developing countries, such as Nigeria.

Jacobs (1995) argued that, the costs arising from road traffic accident may emanate from injuries to casualties, property damage cost and costs due to administrative procedures. These costs can be divided further into, costs arising from diversion of current resources and costs caused by a loss of future output, (De-leon et al, 2005).

1. Estimating lost output

Under the Human capital method, accident costs are classified based on accident severity. Accordingly, costs are calculated for fatal, severe injury, minor injury or damage only

accident. Both accidents involving fatalities and injuries lead to loss of future output. In the case of fatal injuries, the resulting loss of a victim's economic contribution is total, this means that the cost in future years has to be discounted to get present day value (Silcock/TRL 2003).

According to de Haan (1992), lost output was about 23% of the cost of accidents in South Africa, and 80% of the cost of fatal accidents. Similarly, de Beer and van Niekerk (2004) reported that in the US in 1994, lost wages and loss of productive household activity accounted for 85% of the cost of fatal accidents. Household based production loss amounted to 8.2% of the total cost of all crashes and 15.9% of the total cost of fatal crashes only. In the same report, lost wages was responsible for the cost of 28% of the average cost of accidents.

2. Estimation of property damage

Road traffic accidents often come with one form of property damage or the other. These may include vehicles damage, roadside property damage, road furniture damage and damage to goods in transit carried by vehicles. This cost also includes the lost economic productivity of wrecked vehicles.

Silcock/TRRL (2003) observed that damage to vehicles often form the largest portion of damage to property. Most studies have shown that property damage costs are less significant when compared to human cost and lost output, but when consideration is made of the total national cost of accidents, the cumulative cost of property cost outweighs others for the reason that damage only accidents are often higher in number than other severity cases. Insurance data is the most widely used information in calculating the cost of property damage. In Jacobs (1995), Silcock/TRL (2003), Melhuish et al (2003, 2004, 2007), Tanaboriboon and Luathep (2005), Zaloshna and Miller (2003), insurance data was accessible and readily available for the costing of property damage.

3. Medical cost

As part of the total cost of traffic accidents, medical costs are computed for all categories of accidents. According to Silcock/TRRL (2003), medical costs in accidents range from those injured at the scene through to recovery or death. These include first aid, rescue services, hospital cost and rehabilitation cost. Zaloshnja and Miller (2004) listed among the medical

costs of an accident, the cost of an ambulance, emergency medical, physician, hospital, rehabilitation, prescription, as well as the cost of crutches and physical therapy.

Tanaboriboon and Luathep's (2005) assessment of the cost of medical treatment was based on the Abbreviated Injury Scale. As a result, road accident victims were classified to maximum AIS scores such as maximum AIS 5 and 6 are categorised as fatality, while maximum AIS 3 and 4 are serious injury and maximum AIS 1and 2 are represented as minor injury. The funeral cost was also computed and added to the total medical cost.

Silcock/TRRL (2003) noted that even though the cost of medical treatment of accident victims has only contributed a very small percentage of the total accident cost in most developing countries, it is often seen as the first and most visible economic burden suffered by families of victims in those countries.

4. Administration cost

Administration cost consists of police service cost, insurance service cost and the cost of court administration. Most writers believe that these costs are typically low compared to other costs. To calculate administration cost, Silcock/TRRL (2003) are of the opinion that the data obtained from the police and the insurance companies must be made up of the amount of time used by staff in the process which would be multiplied by the staff wages. Alternatively, a reasonable proportion of the total cost of accident would be added as is done in some previous studies to determine the administrative cost. Silcock/TRRL (2003) further argued that since these costs are typically small, much time and effort might not be spent to produce detailed estimates of such costs.

Silcock/TRRL (2003) argued that in the UK in 2000, insurance administration costs accounted for just 2.8% of non-casualty based costs and police costs was 0.6% of all non-casualty based costs. To Zaloshnja and Miller (2004), legal costs include legal fees and court costs from civil litigations that resulted from accidents.

Zaloshna and Miller (2004) further explained that the Insurance cost is estimated from administrative costs derived from processing insurance claims and defence lawyers' fees. Jacobs (1995) reported that in the UK, 17% of all insurance cost is provided to cover

administrative expenses 50% of this is for paying of claims, while the remaining half is for handling of claims. Thus, 8.5% of the entire premium paid can be set aside for insurance administrative cost. Police administration cost accounted for 0.2% of total resource cost of fatal accidents in the UK in 1995, 4.0% of the cost of serious accidents, 14.0% of the cost of minor accidents and 10.0% of the cost of property damage only accidents (Jacobs, 1995).

5. Travel delay cost

There is the need to estimate the monetary value of delays of travel time caused to travellers who were not involved in road traffic accidents, but who were delayed because of gridlock and congestion due to the accident. Blincoe et al (2003) explained that these delays vary based on types of accident, location of accident (urban or rural) and road type/class.

In the US, each hour of delay due to congestion resulting from traffic accident in 2002 was estimated to cost $13.86 for urban roads and $16.49 in rural areas (Blincoe, 2002). Zaloshnja and Miller (2003), surveyed data from five police stations and came up with hours of delay ratio of 49:86:233 for the delays that are due to PDO, injury, and fatal crashes, respectively. Most accident cost studies do not consider congestion/delay cost as worth spending time on in view of its minimal contribution to the total cost of accidents.

6. Human cost

This is an indirect cost, also called social pain (Rodriguez, 2003), cost of pain, grief and suffering (De leon, et al 2005), non-monetary cost or intangible cost (Burtchart et al 2008) and Quality of life lost in some literature. This was reflected under the gross output method to cover the cost that is associated with pain, grief and suffering. According to Jacobs (1995), these costs are usually captured under the Willingness to pay method, thus, no separate calculation is required when that method is in use.

Jacobs (1995) recommended that in the absence of detailed research in developing countries, an additional amount equal to 38%, 100% and 8% of the resource costs obtained in each country are added to represent the cost of pain, relief and suffering respectively. Even though many developing countries have used these figures, in India and Nepal, 20% of lost output cost was applied. Silcock/TRRL (2003) described the values to include to represent pain grief and suffering as a political decision taken for each crash costing undertaken. The decision

would be taken after taking into consideration the effects of accidents on poor societies and or the applications of the amounts that have been added in other countries.

Following the Transport Research Laboratory and Jacobs (1995), a number of developing countries have adopted the recommendation of the TRRL to apply the following sums to reflect pain grief and suffering.

- For a fatal accident 28% of the total cost of accident was added
- For a serious accident 50% of the total cost of accident was added
- For a slight accident 8% of the total cost of accident was added
- For a damage only accident 0% of the total cost of accident was added

Silcock/TRRL (2003) also reported that countries like Bangladesh, Vietnam and the Kerala state of India have been using the amounts suggested from a study of accident costs in India. The figures are;

- For fatal accident it is 20% of total cost of accident
- For serious injury accident it is 60% of total cost of accident
- For minor injury accident it is 30% of total cost of accident
- For property damage only accident it is 1% of a total cost of accident

Masniak (2008) is of the view that the amount to be included to represent pain grief and suffering is regarded as part of the objective of poverty reduction because crashes do have a significant effect on the poor. As such, the greater the amount, the higher the values the country places on accident prevention, considerations are normally made of the wider effects of accidents on poorer households.

Elvik (2000) observed that cost of road traffic accidents are not explicitly captured in national accounts of countries especially with respect to lost quality of life. In 1996, the Department of Transport and Regional Economics of Australia estimated the cost of pain, grief and suffering to be the second highest crash cost component amounting to be about 1.8 billion Australian dollars. This cost estimate was based on an objective medical scale of impairment.

According to Zaloshna and Miller (2004), the loss in good health associated with injuries can be determined by estimating QALYS lost. QALY is defined as a health outcome measure that assigns a value of 1 to a year of perfect health and 0 to death.

7. Calculation of total accident cost

The total accident cost is arrived at after the unit cost of each cost element is computed and aggregated. According to Silcock/TRRL (2003), to calculate the overall component, cost per victim cost is multiplied by the number of victims in the respective component. The incidence related cost is then added to arrive at the total overall cost. This is followed by computing the national annual cost, which is arrived at by adding the values of the average cost components of each accident, and the values of the total number of accidents and casualties happening per year. Comparison is then made with the GDP of a country to determine the percentage of accident costs to the GDP of that country.

The total cost of road crashes in Australia was estimated at $17.85 billion for 2006.This comprised of the sum of $3.87 fatal costs, $9.62 billion injury cost, $4.36 property damage cost. Cost per fatal injury was $2.67, serious injury cost $266,000, minor injury was $16,200 and property damage was approximately $9950 (Tim et al 2006) (All cost in Australian dollars).

According to McMahon and Dahdah (2010), the gross-output method is often criticized for its concentration on the economic effects of the loss of life ignoring the very important value and enjoyment of life forgone. This results in underestimation of the true values of prevention of road accidents. It is to partially correct this shortcoming that a component of pain, grief and suffering is often added to the total cost. Even with this addition, the results from the gross output method are often lower than the willingness to pay values.

3.5.7 The value of risk change or Willingness to pay method

According to Jones-Lee (1976, 1981), Willingness to pay is based on the fundamental assumptions that public sector investment decisions about the appropriation of scarce resources is to reflect the priorities and expectation of the people for whom the decisions are being made. Jacobs (1995) further explained this as the value of a given improvement in road safety in terms of the aggregate amount that people are prepared to pay. Thus, the resources used to prevent an accident involving one fatality is seen as the overall resources that all the affected people would pay for the reduction of small risk, both for themselves and for those they care about. This method is far from being straightforward because of the

various steps involved in its estimation. It ranges from estimates obtained by means of observation to the use of questionnaires that are very complex where people are sampled and asked questions about how much money they would be willing to forgo in order to obtain a small reduction in their own or other people's risk (Jacobs, 1995).

Two methods have been identified and used to estimate willingness to pay. These are;

1. **Revealed preference**

   This is based on actual market transactions. This involves the use information obtained from actual transactions in the market environment. The main disadvantage of this method is the difficulty to find a distinctive traffic safety product in the market.

2. **Stated preference**

   This method is widely used to react to a value of safety. Under this method, a hypothetical situation is created, where people are required to value safety. Most studies would attempt to describe the safety situation on highways and then request people to express their willingness to pay for a particular product/public programme that increases the safety by a certain percentage. According to Jesdapitat (2002), the willingness to pay method can be used to determine prices of a good. This method is mostly used where prices of goods are not known.

Several writers have developed a number of hierarchical classification approaches to organise existing methods of WTP estimation. Marbeau (1987), Balderjan (2003), Nagle and Holden (2004) discussed the different methods of estimating WTP. According to them, these methods may be monadic or competitive tests, or they may elicit price information at the aggregate or individual level and they may be based on experiment or uncontrolled measurement of the different variables.

Similarly, Louviere et al (2000) also discussed the process of data collection under the willingness to pay method as presented in figure 3.4. In this method, data is collected by either stated preference or revealed preference techniques. If it is revealed preference, then we have to aim at market data and conduct experiments. Nevertheless, if the choice is stated preference, there are the options of direct and indirect surveys. Respondents are required to provide information about how much they are willing to pay to obtain certain products by

means of direct surveys, while rating and ranking are normally required if using indirect surveys in order to estimate consumer preference structure from where WTP is derived,

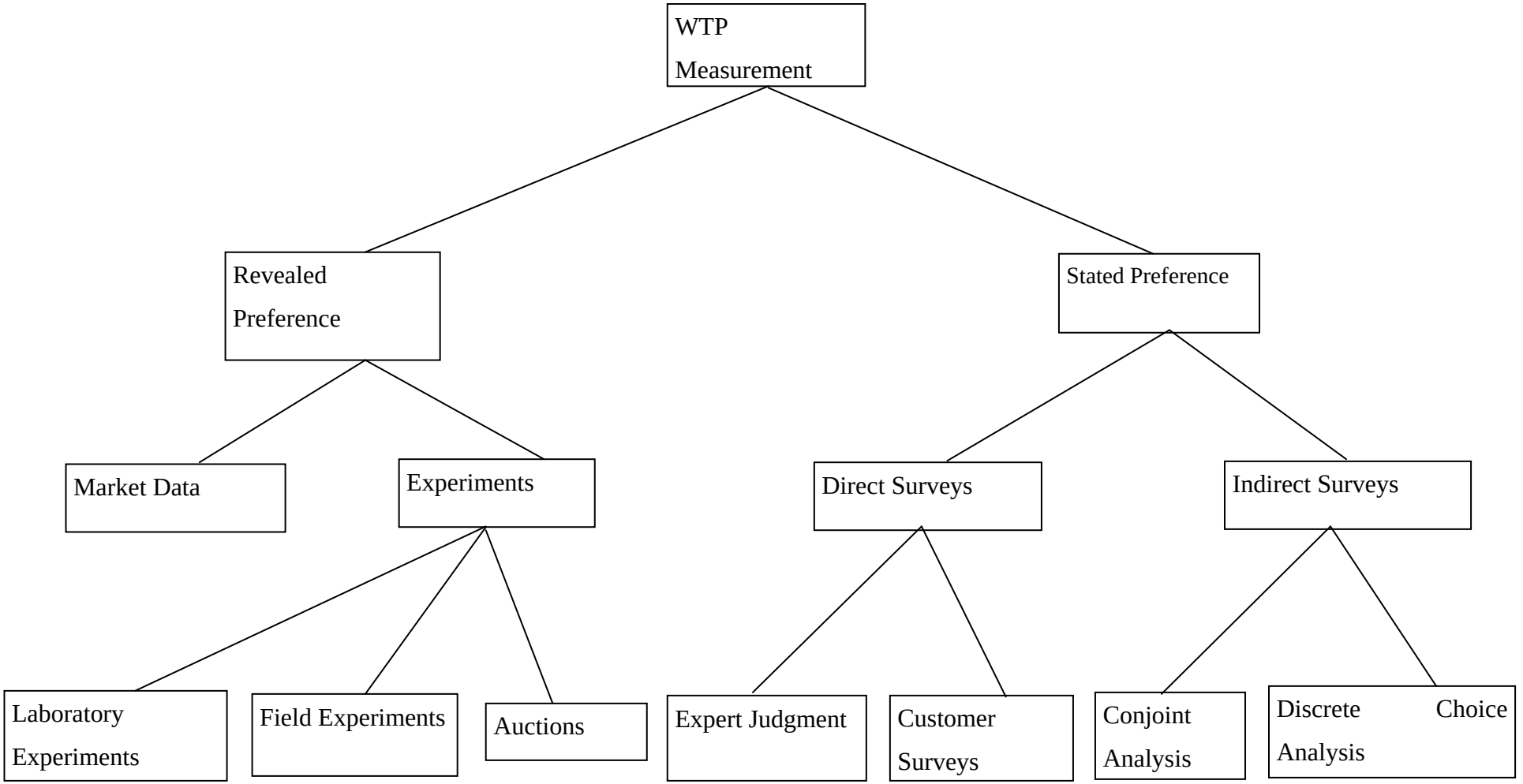


Figure 3.4: Classification framework for methods to measure Willingness-to-Pay (WTP)

Source: Louviere et al, 2000

Practically, the choice of the best procedure to estimate willingness to pay is influenced by factors of time and resource availability. The data collection process is usually very tedious since it requires a lot of time and consumes a lot of money before it is completed.

The WTP assessment method has been used widely in USA, Sweden and New Zealand (Jones-Lee, 1989). But, the use of WTP approach in developing countries is not recommended due to the following reasons (Silcock/TRL, 2003);

1. The use of complex questionnaires for WTP approach in UK produce values obtained directly from adults while children were left out because they could not complete the complex questionnaires. Since children are a large proportion of accident victims in developing countries, this method is not appropriate for use to calculate the cost of accidents in those countries.
2. The literacy level in most developing countries is low which will hinder the response level of the target group.
3. Its application is restricted to driver or passengers, making it inadequate since the proportion of pedestrians and pedal cyclists killed or injured in road traffic accidents in developing countries are significant.
4. The WTP approach cannot be used to ascertain the historical cost of road traffic accidents.
5.

3.5.8 Value of statistical life (VSL).

McMahon and Dahdah (2010) defined the value of statistical life as the amount of investment that can be made and justified for saving of one life. It is the valuations of the change in the risk such that one life is saved, rather than the valuation of the worth of human life. Viscussi (2005) defined two principal values of life concepts; the amount that is optimal in insurance and the value needed for deterrence.

An underlying assumption of VSL is the fact that the worth of something is determined by the amount that people are willing to pay for it. Thus, safety should be seen as a commodity in that reduction in risk is an expenditure that requires a trade-off between money and the level of safety desired (McMahon and Dahdah, 2010). Some studies also estimate the value

of statistical year to represent the value the society places on reducing the risk of premature death.

The statistical value of life varies from country to country. This variation is because of differences in the GDP of those countries. Viscussi (2005) reported a VSL value of $7m for US, Australian Government reported VSL value of 4.3m Australian dollar in Australia in 2014 and Fletcher (2014) put UK VSL value at $6m and Ethiopia has a VSL value of $300,000 for 2010.

3.6 The cost of road traffic accidents in developing countries

Silcock/TRRL (2003) reported two main uses of crash cost in developing countries. These are; resource allocation at a national level to ensure road safety is ranked equitably in terms of investment in the improvement of road safety in the country and ensuring that the best use is made of any investment through economic appraisal and cost benefit analysis. This will assist in deciding which types of measures will be more cost effective, thus making it possible to prioritise programs. It is also an evaluation to determine actual crash savings emanates from the implementation of a safety program. Table 3.3 shows a summary of studies on cost of road traffic accidents in some developing countries.

Table 3.3: Cost of Road Traffic Accidents in some Developing Countries

S/N	Title and Author	Methodology	Main findings	Comment
1	Economic impact assessment of road traffic accident casualties in Nigeria (1980-1995), Arosanyin, G. (2001).	Human capital Method was used to estimate the cost of accidents.	The cost of accident was estimated at N1.9 billion per annum, which is equivalent to 2.46 % of the GDP of Nigeria	All categories of vehicles were included in the study. Cost of HGV accidents was not was separately calculated.
2	Socio-economic Impact of road traffic injuries in west Africa; exploratory data from Nigeria, Julliard M. (2010).	Primary and Secondary data were used to estimate the cost of injuries.	Average cost of treatment for an injury patient was calculated at $25 per person.	Other components of the cost of accidents like property damage were not included.
3	Cost Evaluation of Road Traffic Accidents in Nigeria, Using the Human Capital Approach; A case study of Abuja-Lokoja Road, Abdussalam G. (2014).	Human capital method was used to estimate the cost of accidents from 2000-2010.	The total cost of accidents was N56.6 billion for the period under study.	The cost of HGV traffic accidents was not calculated despite the prevalence of HGV traffic on this road.

4	Cost of road traffic accidents in Egypt, Ismail, M. A. and S. Abdelmageed (2010).	Human capital method was used.	The cost of road traffic accidents in Egypt using 2008 data was $1.8 billion.	All categories of vehicles were included in this study
5	Cost of Crashes in South Africa, Road Traffic Management Corporation (2016).	Human Capital method was used to estimate the cost of accidents.	The total cost of accidents was R142.95, which was equivalent to 3.4% of the GDP.	All categories of vehicles were included in the analysis.
6	The economic impact of road traffic accidents and injuries in developing countries; RAPID DESK STUDY. Fletcher J. (2014).	The VoSL approach was used to estimate cost of accidents for Ethiopia.	The VoSL for Ethiopia was estimated at $30,000 for the year 2010.	Estimate did not include properties damage
7	Estimating the Cost of Road Traffic Accidents in Iran. Razi-Ardakani H. and M. Reza-Ahadi (2015).	Human capital method was used	The cost of accident for Iran was $11.46 b for the year 2009, which was equivalent to 1.41% of the GDP	All vehicles categories were included in this estimation
8	Estimation of Vehicle damaged cost involved jn Road Traffic Accidents in Karachi, Pakistan; Zubair S. and Jamil H.K (2013)	Data was collected from vehicle repair garages	The total cost of vehicle repair from accidents for 2012 was 20 million PKR.	Only the component of vehicle repair cost was estimated in this study.

Source. Authors compilation, 2016

According to Arosanyin (2001), road traffic accidents in Nigeria were found to be a major cause of death among the population between1980-1995. Nigeria also lost about N1.9 billion Naira per annum within the same period, accounting for about 2.46 percent of the GDP of the country. The study by Arosanyin (2001) was based on the Human capital method. The study made use of data obtained from secondary sources across the states of Nigeria. The study also covered all categories of motor vehicles, but did not give a breakdown of the contribution of heavy goods vehicles to the cost of the accidents.

Juillard et al. (2010) reported that the mean cost of treatment for an accident injury patient in Nigeria in 2005 was $25 per person, which was 40% of the mean monthly per capita income in Nigeria for 2005. In addition, in 2006, the Federal Road Safety Commission (FRSC) reported 17,390 road traffic injuries and 4,944 deaths due to accidents. Assuming each victim spends $25 on care, the total annual road traffic injury burden of $435,000 can be estimated

from these records. This study was focused on accident injury and its extent, and did not estimate the total cost of accident for the year and its implications to the GDP of Nigeria.

Abdussalam (2014) undertook an evaluation of of road traffic accidents in Nigeria. The study was aimed at estimating the cost of traffic accidents along Abuja-Lokoja road in central Nigeria from 2000-2010. The human capital approach was the method used to undertake the study. The result shows that the total cost of road traffic accidents on this road for the period under study was N56.6 billion and the cost per km was N318.3 million with the cost per vehicle at N10.8 million. This study covered only 178 km of the 193,200 km road network in Nigeria, and did not provide the costs of accidents on yearly basis. Abuja-Lokoja road is one of the busiest roads in terms of traffic volume in Nigeria with very high concentration of HGV traffic coming to the North from Obajana Cement Company and many trucks coming to the North from the southern economic zones. The study did not reflect these characteristics and the rising frequency of HGV accidents along this road is not emphasized in the study.

Ismail and Abdulmageed (2010) wrote on the cost of road traffic accidents in Egypt. The main objective of their research was to estimate the cost of road traffic accidents in Egypt. The human capital method was used for the estimation which covered accident data for the year 2008.The results indicated that the cost of road traffic accidents in Egypt was 1.8 billion US dollars. The study is not specific on the category of vehicles that were considered for the costing, whether 2 wheelers, passenger vehicles, freight vehicles or articulated vehicles. This lack of specific breakdown will not allow for effective development and implementation of effective counter measures and policies.

In South Africa, the Road Traffic Safety Management Corporation (2016), published a report on the Cost of Crashes in South Africa. The Corporation used the Human Capital Method to estimate the cost of road traffic accidents in South Africa for 2015. The report was based on data compiled by the RTMC with provision for 5% under-reporting, which amounted to 832,560 total accidents and 1,708,414 numbers of casualties for the year. The total cost of accidents for the year was put at R142.95 billion which is equivalent to 3.4% of the GDP of South Africa in 2015. The report however is not mode specific and thus, did not calculate the breakdown of the contribution of each vehicle category to the overall cost.

Fletcher (2014) used the iRAP method to estimate the VoSL and cost of serious injuries accidents for Ethiopia based on data derived from WHO Global road traffic accidents status report for 2010. The result showed that VoSL for Ethiopia is estimated at $30,000 at 2010 prices. Taking into account the value of the VoSL and serious injuries that was estimated at 10 times the number of fatalities, the cost of accidents to the GDP of Ethiopia for 2010 is at 0.8%. This estimate is arrived at excluding values of minor injuries and damaged only accidents. However, when WHO modelled figures were applied, the percentage cost to the GDP was up to 4.3%. The emphasis in this estimate is on lost output resulting from loss of life and cost of injury. Cost associated to properties damage that include vehicles are not estimated and included in this study.

Razi-Ardakhani and Ahadi (2015), estimated the cost of road traffic accidents in Iran using the Human Capital Method. The study was based on road traffic accidents data for the year 2009. The result indicated that, the cost of road traffic accident for Iran in 2009 was 11.458 US Dollars, which is equivalent to 1.41% of Iran's Gross National Product. Lost output and property damaged constituted the highest cost components. The study did not establish the cost per vehicle type, but gave a total cost based on the total number of accidents only.

Zubair and Jamil (2013) study was based on property damaged cost of vehicles involved in accident in Karachi, Pakistan. Data was collected from vehicle repair garages on the cost of repair of vehicles involved in accidents. The total repair cost of vehicles damaged in accidents in Karachi for the year 2012 was 20 million PKR. In this study, other accident cost components like lost output and Administrative cost are not calculated thus, underestimating the seriousness of the problem. In addition, the conception is not on heavy goods vehicles, but on all types of vehicles.

3.7. HGV traffic accidents in developing countires

Generally, the scenes at accident involving trucks are regarded to be serious and devastating both in terms of properties damaged and in terms of injuries to both road users and vehicles occupants. In this section, truck traffic accidents are discussed with emphasis to accidents in developing countries with few examples from advanced countries.

According to Lindberg (2001), there are differences between road traffic accidents involving heavy goods vehicles (HGV) and the accidents involving passenger vehicles. This is largely because of the facts that HGVs' are generally heavier, larger and bigger in size than passenger cars and they generate less effective accelerations and deceleration than passenger cars. Meanwhile, according to Blower and Woodrooffe (2012), there are several types of truck accidents. Some of the commonest types include; rear end, sideswipes, lane departures, crossing-path collisions, pedestrian involved accidents, vehicle rollover, head-on collision, single truck accidents and under-run accidents. Table 3.4 shows a summary of some HGV studies in some developing countries.

Table 3.4: Studies on HGV Traffic accidents in some Developing countries

S/N	Title and Author	Methodology	Main findings	Comment
1	"The potentials of rail-road integration for port-hinterland freight transport in Nigeria, Ubogu, A. E. (2011).	Questionnaires were administered on truck drivers.	Harassment by security agencies, armed robbery and delays were the problems discovered.	Truck accidents analysis was not included in the research.
2	Distribution Pattern from Dangote Cement, Obajana, Nigeria, Jamiu et al (2014).	Questionnaires were administered on truck drivers.	67% of drivers reported that it is safe to transport cement with trucks from Obajana	Truck accidents analysis was not included in the research.
3	Road Haulage Constraints in the Transportation of Petroleum Products in Northern Nigeria, Obasanjo, et al (2014).	Questionnaires were administered on truck drivers.	Delay at checkpoints, mechanical problems of vehicles and bad roads are the main problems of trucking petroleum products.	Truck accidents analysis was not included in the research.
4	Impact of Heavy Goods Vehicles on Safety and Traffic Management in the Tema Metropolis; Anonu P. (2011).	Secondary data sources was used for this study.	The study found out that, there was an increase in the rate of HGV accidents in Tema city	The cost of HGV accidents was not covered in the study
5	Traffic Safety of the Trucking Industry in Saudi Arabia, Issa and Ratrout (2014),	Field surveys was used to collect data for the study	Human errors are responsible for most of the truck accidents	The cost of HGV accidents was not covered in the study

Source. Authors compilation2016

Ubogu et al. (2011) studied the operations of trucks in Nigeria. The study investigated the socio-economic characteristics and areal coverage of truck drivers and the operational difficulties faced by hauliers in Nigeria. Data was collected using systematic sampling of truck drivers at Lagos and Port Harcourt seaports. Kruskal-Wallis method of non-parametric test was used to evaluate the results. In addition, Spearman correlation matrix was the method used to investigate relationship of the pairs of operational constraint. The result shows that harassment by security agencies, traffic delays and activities of armed robbers are the leading constraints to truck services operations in Nigeria. The result shows that accidents accounted for 2.7% only. This looks unrealistic in view of the menace of road traffic accidents caused by HGV in Nigeria. The study did not envisage the reality of truck accidents as often reflected in accidents data of trucks as published by the FRSC and discussed in chapter two of this study.

Jamiu et al (2014) studied the distribution of cement by trucks in Nigeria. The study was aimed at determining the efficiency of using trucks to distribute cement from the Obajana cement company to its users across the country. Field data was collected through systematic sampling of truck drivers and secondary data were collected from the company's records for the study. After analysis, the result shows that 66.7% of the respondents believe that the use of trucks to transport cement from Obajana to other parts of Nigeria is safe. This study is however silent on effects of truck accidents on the distribution system of the company even though the FRSC has always complained about the rate of accidents involving the Dangote trucks on Nigerian highways. In addition, the study is also silent on the loss the company is suffering due to damage to its goods in transit because of accidents on Nigerian roads.

Obasanjo et al (2014), studied roads haulage constraints in the transportation of petroleum products in Nigeria. The study was aimed at assessing the efficiency of road haulage in the distribution of petroleum products in Nigeria. Primary data was collected from truck drivers using a systematic sampling method. Analysis of the data was done using descriptive statistics and kruskal-wallis methods. The result shows that delay at police and military checkpoints is the main constraint of the distribution system; this was followed by mechanical problems of vehicles and bad roads. However, the study fails to address the critical issue of truck accidents and the cost of those accidents to the operators and the Nigerian economy.

A study by Anornu (2011) on the impact of heavy goods vehicles on safety and traffic management in the Tema Metropolis of Ghana was conducted to establish the characteristics of truck traffic accidents in the metropolis. The study covered the period from 2007-2009. The data for the study were derived from secondary sources and field survey conducted on main road corridors in the metropolis to determine travel pattern, travel time and delays in the region. The study found that there was an increase in the number of HGV accidents progressively throughout the study period, with more accidents taking place on the link sections of roads. The study further revealed that the types of accidents are rear-ended; sideswipe and right angle types truck accidents. The study recommended improvement in the city's traffic management measures to curtail the rate of accidents. The study however did not cost the truck traffic accidents to show the magnitude of the increasing accident rates.

In a study of the traffic safety of trucking in Saudi Arabia, Issa and Ratrout (2014), found that truck accidents in Saudi Arabia results in more death than injuries and that most of the accidents are caused by human errors, which account for 75% of all accidents and vehicles deficiencies account for 25%. The research used field surveys and field questionnaires to collect data from truck drivers and road traffic regulators. The data was analysed using descriptive statistical approach. The research however did not cover the cost aspect of the accidents, thus limiting the knowledge of the impact of these accidents to the society.

Blower and Woodrooffe (2012) observed that in Brazil rollover accidents account for 9.0% of truck-involved accidents but 20.5% of fatalities in these accidents. Head-on collision accounts for only 4.0% of truck accidents, but is responsible for 15.5% of deaths in those accidents. Only 1.1% of truck traffic accidents involve pedestrians, but accounting for 26.5% of fatalities among this group of road users. Thus, collision with road users, such as pedestrians, cyclists, and motorcyclist account for the majority of fatalities in truck traffic accidents in Brazil (accounting for about three quarters of the fatalities in accidents involving trucks). Similarly, in China trucks were responsible for about 20% of the road traffic accidents of all severities, and 30% of vehicles in fatal crashes are trucks.

3.8 HGV traffic accidents in Developed countries

Blower and Woodrooffe (2012) reported that truck fatal accidents accounted for 15% of all fatal crashes in Australia in 2010 and that articulated vehicles account for two-thirds of the trucks involved in the fatal accidents, and rigid vehicles account for the other one-third. Similarly, almost 18% of fatalities in articulated truck accidents are occupants, usually including drivers; in rigid trucks, it is lower at 9%. Australian laws also permit very large trucks with up to 4 trailers and with over 175 feet long and of 148 tonnes capacity to operate, though they have permission to ply certain roads only. However, in most Australian territories, trucks are limited to two-trailer combination only, grossing 62.5 tonnes. These types of trucks carried 32% of road freight in Australia in 2007, 30% was carried by single-trailer combinations, road trains carry 17% and rigid trucks carried 20%.

Blower and Woodrooffe (2012) further observed that, unlike in most developing countries, trucks in the United States are operated more on limited access roads or other high-speed express roads where pedestrians and cyclists are legally restricted. In addition to this, more of the travelling population in the US use motor vehicles compared with the travelling populations in other countries where other means of transportation like trains and waterways are used. With this situation, the main truck traffic safety problem is collision with other light motor vehicles and other non-motorists on the highways.

Further analysis of fatal traffic accident statistics (Blower and Woodrooffe 2012), shows that truck accidents that occur on high-speed roads and in rural areas are often fatal and often result from head on collision where another vehicle is involved. Again, tractor-semi trailers are often more involved in serious injury traffic accidents of over 50,000 Australian dollars than two trailer combinations. In the United States, Blower and Woodrooffe's (2012) analysis showed that trucks accounted for 3.5% of vehicle registration but 7.5% of Vehicles miles travel. However, trucks constitute only 3.7% of vehicles involved in road traffic accidents, though trucks account for 8.3% of the vehicles involved in fatal accidents. Because trucks are bigger than other vehicles, and have frames that are stiffer and higher than other vehicles, truck accidents are always more devastating causing other vehicles to sustain damage that is more serious.

According to US DOT (2007), trucks tend to be involved in more fatal traffic accidents per mile travelled than smaller motor vehicles. Blower and Woodrooffe (2012) also observed that while trucks have been found to have higher fatal traffic accidents rates than passenger vehicles in the United States, injury and property damage only accidents rates of trucks are much lower compared to passenger vehicles. They explained further that the higher fatal rate for trucks is likely to be associated to the physical mismatch between trucks and the other vehicles involved in the accidents. It can also be attributed to the fact that many of the truck accidents occur on express roads with high speed resulting in consequences that are more serious. On the other hand, the low injury and property damage only accidents rates can be attributed to the fact that in most circumstances truck drivers are professional drivers and are at work when driving compared to less professional passenger car drivers. In addition, the study observed that between 2004 and 2008 the average number of people killed annually in truck involved accidents in the US were 5,316 people out of which 878 (16.5%) were drivers and passengers travelling in the truck, 3,970 (74.7%) were passengers travelling in another motor vehicle, and pedestrians were (6.8%) while cyclists were(1.6%).

The Transportation Research Board (TRB, 2010) reported that in the United States in 2005, 82% of the people involved in fatal truck accidents are passengers of other vehicles, and more truck drivers often die on the job than do other workers in many other single occupations. As a result, truck drivers accounted for about 15% of all occupational fatalities in the United States, and motor vehicle accidents accounts for two-thirds to three-quarters of these deaths.

Furthermore, according to Blower and Woodrooffe (2012), in the United States, “the hit object in road” accidents which involve collision with pedestrians, bicyclists, and other non-motorists accounts for 10% of fatal accidents. Similarly, 6% of the fatal accidents are run- off road resulting in fatal injury caused by either rollover or collision with a fixed object. Other fatal accident severity types of accidents are rear end (16%), head on collision (13%), opposite direction sideswipes (12%), turning (10%), intersection (11%), and for injury severity types accidents, rear-end was responsible for 28% of accidents, turning (16%) and same direction sideswipes had (14%) of accidents.

The study by Blower and Woodrooffe (2012) is a review of the status of truck safety in some selected countries of Brazil, China, Australia and United States. The study was designed to research the role of freight transportation in each of these countries, its current level of safety and identify safety problems associated with truck operations, using secondary sources of information from participating countries. Even though, the study covered much on truck safety in these countries, no attempt was made to quantify the problem by estimating the cost of truck accidents.

However, Zaloshna and Miller (2004) estimated the Cost of Heavy Goods Vehicles accidents for United States. They observed that factors like the number of vehicles involved in the accident, the severity of each casualty, and the cost of injury treatment, the cost of vehicle damage and the cost caused by traffic delays and congestion must be ascertained before estimating the total cost of accident. To ease analysis, trucks were classified according to the different category of truck configurations. These are straight truck no trailer, straight truck with trailer, straight truck but unknown if with trailer, truck tractor with no trailer, tractor with one trailer, tractor with two or three trailers, tractor with unknown number of trailers, medium/heavy truck unknown if with trailer and all large trucks.

To arrive at the property damage cost, Zaloshna and Miller (2004) utilised insurance data to estimate the number of vehicles involved in a crash from which cost per crash was arrived at. The study revealed that the estimated cost of truck crashes with gross weight of more than 10,000 pounds is an average of $91,112. Other costs are for tractor with two or three trailers which amounted to $289,549, the cost crashes with straight trucks with no trailers is $56,296 and the cost of property damaged only accidents is $15,114. The average cost of fatal crashes was $3,604,518, and cost per non-fatal injury crash was $195,258.

The study also revealed that the average annual cost of large truck-involved crashes in 1997-1999 amounted to about US$19.6 billion, or 5.9% of the total cost of highway crashes in the United States. The cost is made up of $6.6 billion loss of production, $3.4 billion loss of resources and $9.6 billion loss in quality of life. Additionally, the study revealed that multiple combination truck crashes cost more than any other vehicle crash type, even though when seen on a per truck-mile or per ton of freight moved basis, the crash type of these types of trucks is much lower.

The cost elements include cost of medical cost, emergency services cost, and property damaged cost, lost production and the cost of pain grief and suffering. Costs not included are mental health care for victims, roadside furniture damage repair cost, goods and cargo damage cost, earnings lost by family and friends.

Sections 3.6, 3.7 and 3.8 provided a critical review of studies on the cost of accidents in Nigeria, and some developing counties. Also reviewed are studies on HGV accidents in both developed and developing countries. It is clear from presentations in the two sections that, studies on costs of heavy goods vehicles accidents are not very visible in the literature for developing countries. This is a clear gap, which has been established in this literature review and would require further research.

3.9 Causes of road traffic accident

Road traffic accidents occur because of a friction between a road user and a carrier. According to the Vienna convention, a road traffic accident involves the collision of a moving vehicle on a public road after which a road user sustains injuries (IRAD, 1992). Hence, it is asserted that accidents do not just occur but they are caused (Bolade, Ogunsanya 1991).

According to Peden (2004) in the Status report of road traffic injury of the World Health Organisatio, the key factors responsible for road traffic accidents globally are; rapidly growing motorisation, land use and road network planning problems, over speeding by drivers, absence of adequate separation of pedestrian and cyclist facilities. Other causes are, excessive and uncontrolled alcohol consumption, un regulated medicinal and recreational drugs, driver tiredness and fatigue, frequent use of hand-held mobile telephones while driving, poor and inadequate visibility, road-related factors like potholes, narrow bridges and, vehicle-related risk factors like burst tyre and brake failure. Peden (2004) report was based on global account of road traffic accidents and thus did not specify the peculiarities of Heavy Goods Traffic Accidents.

However, Deleon et al (2005) concluded that the main causes of motor vehicle traffic accidents can be attributed to human and environmental factors; defective vehicles, roads that

are characterized by many obstacles and unprofessional driving behaviours such as over-speeding, driving in the wrong lanes, careless overtaking, overloading, carrying wide loads and making turns at inappropriate points without proper turning signals. Deleon et al (2005) study was on the cost of road traffic accidents using the human capital method. The study did not specify the cost of HGV accidents and its impact.

To Ndikom (2008), most accidents often directly or indirectly result from improper driving habits, poor physical and mental condition of drivers, ignorance and abuse of traffic regulations, ignorance and in attention to vehicle performance, non-response to road and traffic signs and lack of consideration to other road users. More over Ndikom (2008) explained that the following factors are responsible for majority of road traffic accidents in Nigeria.

- Wrong overtaking by reckless drivers
- Tail-gating by impatient motorists
- Failing to obey road signs and stop for pedestrians even at zebra crossings
- Failing to obey road signs and traffic wardens especially at busy road intersections
- Shunting queues and double overtaking even at sharp bends
- Racing competition by drivers on public roads
- Inadequate rest time and sleeping while driving
- Making phone calls while driving
- Drinking while driving
- Poor concentration and absent mindedness while driving
- Placement and leaving of obstacles like stones, woods and twigs on roads after they were used as signs to indicate vehicle breakdown
- Speed beyond limit violation
- Violation of vehicle overloading regulation
- Illegal and excessive checkpoints and road blocks by road maintenance and road construction companies, as well as security and traffic enforcement agencies
- Too many potholes and bad curves on highways
- Mechanical failure and vehicle malfunctions due to lack of proper maintenance.

Though Ndikom (2008) has dwelt extensively on traffic accidents in Nigeria in his book, the cost of those accidents was not estimated. In addition, HGV operations and accidents were not covered in the analysis.

Ojo (2014) investigated the predominant causes of road traffic accidents among commercial vehicle drivers in Ekiti state of Nigeria. Structured questionnaires were used to collect data from drivers of commercial vehicles in motor parks for this study. Inferential statistics of linear regression method was used to analyse the data collected, and the result shows that driver distraction was the significant factor responsible for commercial vehicle traffic accidents in Ekiti state of Nigeria. However, this study covered commercial vehicle drivers, but it did not include truck drivers since truck drivers do not parked in motor parks in Nigeria. They often have their own separate parking garages, which are not covered in this study.

In another study, Omidiji (2010) discovered that, 91% of road users interviewed in Nigeria strongly agreed with the view that armed robbers are a serious menace to travellers and this is one of the causes of the high rate of road traffic accidents on the Nigerian roads. In addition, 88% of the road users responded that armed robbers are in the habit of boarding passenger vehicles in order to carry out their criminal activities and consequently cause road traffic accidents on the roads. Similarly, 95% of road users indicated that potholes on the road and artificial road bumps often encourage armed robbery attacks and result in traffic accidents, while 97% indicated that sharp bends and other hazardous locations on the road also contribute to many of the road traffic accidents. In addition, 96% of respondents indicated that alcohol drinking while driving is a major cause of road traffic accidents especially those carrying freight goods, while 94% are with the view that, accidents are caused by mechanical deficiencies in vehicles due to their poor maintenance.

Agbonkhese et al. (2013) analysed the causes of accidents on Nigerian roads from the perspectives of driver factors, vehicle factors, road and environmental factors. Driver factors include, speeding and indiscriminate use of sirens, drink driving and use of drugs, distracted driving and the use of mobile phones, inexperienced and unqualified drivers, non-use of safety devices and negligence of duty by officials. Vehicular factors have to do with vehicle components like; vehicle design, vehicle brake system, vehicle body and tyres, vehicle lights,

vehicle engine. Road pavement condition is an important factor causing accident in Nigeria due to poor design and inadequate maintenance. Similarly, environmentally related factors such as fog, sunrays, mist and rain are found to have caused accidents in Nigeria. Aghbonkhese used secondary data from FRSC to compile his report, which did not investigate the cost of HGV accidents in Nigeria.

Akpoghomeh (2012), reported that from 2008-2011, human causative factors accounted for 73% of traffic accidents in Nigeria, while technical factors accounted for 20% of the causes. Speed violation, dangerous driving and loss of control, contributed 60% of the human causative factors. Akphogomeh (2012) analysis was based on secondary data obtained from the FRSC and did not distinguish the causes according to types of vehicles or traffic characteristics.

IRTAD (2014) annual report for Nigeria indicates that speed violation accounted for 32% of identified probable causes of accidents, followed by loss of control and dangerous driving at 17 and 21 percent respectively. Similarly, 1% of fatal accidents are due to drink driving (authorised alcohol content is 0.5g/l), 1% is due to the consumption of illegal drugs, the use of mobile phones and driver distraction accounts for 0.4% and fatigue contributes 2% of fatal crashes in 2013. The IRTAD (2014) report did not cover any aspect of the cost of road traffic accidents in Nigeria.

3.10 Prevention of road traffic accidents

According to Paden (2004) and Getu (2007) road traffic accident prevention and intervention methods are many and vary just like the causes are also varied and many. The main strategies of preventing road traffic accidents therefore are proper design of transport infrastructure and traffic system, well co-ordinated land use system designed for safe and sustainable transport development, considering safety awareness in planning transport infrastructure, vehicle design that is accident protective, enforcement and monitoring of speed limiters, enforcement of alcohol control laws, emphasising the role of safety education, information and publicity through efficient road user campaigns, driver education and training, development and production of smart vehicles, regulation and streamlining of drivers and vehicle licensing and the banning and monitoring of the use of mobile phone while driving. Other measures are

enforcement of seat belt rule and helmet use, channelisation of traffic by means of ITS, marking of speed breakers and dividers, regulation of road side parking, removal of broken down and damaged vehicles from roads.

ETSC (2007) recommended a road safety audit as the best preventive measure against the occurrence of road traffic accidents. This is very important because it will enable all the new highways being developed to operate very safely since all measures were considered to make sure that safety issues were duly considered throughout the process of preparation and construction of the transport infrastructure schemes.

Summaila (2013) studied the trends of road crashes and safety management in Nigeria. He used secondary sources of data to analyse the trends from 2007 -2011. The result shows that the driver is the most critical factor in road accidents. The study recommended measures like establishment of a robust procedure for processing and issuance of driver licence, improvement in vehicle registration process, full implementation of the RTSS scheme, enforcement of traffic rules and regulations by traffic management agencies, education and training for drivers, improvement in public publicity and awareness and also, effective post-crash management system. This study did not cover the cost of accidents and the role of HGV in Nigeria's accident history.

Badejo (2011) explained that, the solution to the problem of road traffic crashes in Nigeria lies in a collective implementation of some critical measures such as a review of the current traffic laws, which are outdated and need to be revised to address the challenges of the contemporary traffic needs of the nation. Other traffic accident reduction measures identified by Badejo (2011) are:

- improving the welfare and service conditions of the transport operators
- skill development and training for employees responsible for the enforcement of road traffic safety laws at federal and state levels
- Adequate and functional road safety equipment including, communication gadgets, vehicles, motorcycles, tracking devices, surveillance and radar watch facilities.
- Data base development and improvement in information sharing between and among organisations.

- additional investment is needed on research and development from which each organisation is required to benefit from; be it federal, state or local government.
- Involve federal road safety corps, the police, medical and paramedical personnel, vehicle inspection officers etc.
- there should be a well programmed and co-ordinated search and rescue strategy

According to Ipingbemi (2008), road traffic accidents in Nigeria can be prevented through; public enlightenment campaign and enforcement of traffic laws, regulating the use of motorcycles, subsidize motor vehicle tyres, first aid training and building of roadside clinic, subsidise drugs and related medical services for accident victims, strengthening of health institutions. Agbonkhese et al. (2013) are of the view that to prevent road traffic accidents, sale of alcohol in motor parks must be banned in Nigeria, alongside the enactment of BAC laws and constitution of sobriety checkpoints to enforce the laws.

According to the Cleen foundation (2015), the following measures will go a long way to improve road safety in Nigeria:

1. Deployment of breath analysers on strategic points on expressways to check drunk driving
2. A national audit of road availability and quality by state
3. Installation of speed breakers in residential and congested neighborhoods
4. Installation of ICT devices to check speed and traffic rules violation.
5. Installation of pedestrian bridges and zebra crossing at appropriate locations
6. Standardisation of driver instruction process in Nigeria with driving schools registered and regulated by designated authorities.
7. Improve sensitisation of the society to imbibe the message of road traffic safety.

On the way forward, Akpoghomeh (2012) recommended measures that include driver education and training, traffic education in school curricular, motor vehicle road worthiness testing, road infrastructure improvement, effective enforcement of traffic regulations, adequate provision of pedestrians and cyclists right of way and collection, storage and retrieval of comprehensive accident data.

3.11 Problem of under reporting of accidents

Police are the usual source of traffic accident data in many countries but much of these data are not accurate. Silcock/TRRL (2003) has identified three types of problems responsible for under reporting of traffic accident data. These are whether the crashes are not reported, misrecorded or under reported.

The problem of under reporting varies from country to country and is more severe in developing countries, even though it also happens in the most developed societies. In Britain, it was reported that only 61% of those hospitalised for three days or more were found to have been recorded by the police (Broughton et al 2001). In 1999, the record of in-patient in Scotland recorded from 1980 indicates that only about half of that number is found to have been recorded by the police (keigan et al 1999). However, the problem is serious in developing countries, the result of findings on these have been summarised by Silcock/TRL (2003) and are shown in table 3.3.

Table 3.3: Under-reporting of road traffic casualties in developing countries

	Country	Finding
Deaths	China	Road deaths estimated to be 42% greater than that reported by police, according to study by Beijing Research Institute of Traffic Engineering.
	Taiwan	Department of Health Reported road accidents that are 130% greater than the road deaths reported by police (latter limited to those within 24 hours of the crash) (Lu, 1998).
	Karachi, Pakistan	56% road deaths reported by ambulance service were recorded in police statistics (Razak, 1998).
	Bogota, Colombia	46% mortuary reported road deaths were in the police data base (but with 19% listed as injured).
	Bangladesh	A national injury survey in Bangladesh undertaken in the mid 1990s found the rate of road death to be twice that reported by the police (Bangladesh Bureau of statistics, 1996).
	South Africa	For the Pretoria urban area, the police recorded somewhere between 77 and 97% of the fatal casualties recorded in a mortuary surveillance system. For the Cape Town Municipality and Urban Area as a whole the figure was 94 and 81% respectively (2002)
Injuries	Mauritius	2,100 hospital reported serious road traffic injuries, 8 times the 261 recorded by the police (Jones, 1998).
	Reunion	37% of non-fatal injuries estimated recorded by police (Aptel, 1999)
	Kazakhstan	50% more road traffic injuries reported by ambulances than police (Transport Research Laboratory (1997).
	Dhaka, Bangladesh	3-12% of hospital road traffic casualties were recorded by the police (Aeron-Thomas, 2000).
	Hanoi, Vietnam	17-33% of hospital reported road traffic casualties were recorded by the police (Aeron-Thomas, 2000).
	Bangalore, India	24-53% of hospital road traffic casualties were recorded by the police (Aeron-Thomas, 2000).

Source: Silcock/TRRL (2003).

Salifu and Ackaah's (2009) study in Ghana shows that shortfalls between police traffic accident data and other sources of data emanates from non-reporting and under-recording of accident cases. In the report, it was shown that 57% of property damage cases were not reported to the police, 8% for serious injury cases and 0% for fatal cases. The findings also revealed that under recording of cases was 37% -27% of cases.

Sigua and Palmino (2005) reported that in the Philippines, a study conducted by UNICEF shows that though about 9,500 fatalities were attributable to road accidents in 2003, the police reported only 900 fatalities, arguing that the figures were sure to be higher for injuries and damage only vehicles. Mohan (2001) reported that an injury ratio of 20-30 was used for low-income countries, while a ratio of 70 slight injuries and 15 serious injuries for every death was recommended to reflect under reporting for all countries at the first community conference on cost calculation and cost effectiveness. In addition, Jacobs et al (2000), believed that under reporting in injuries is greater than it is in death. A ratio of 100 injuries to one death was therefore applied for that study in high-income countries.

Underreporting may also likely occur when accidents involve minor bicycle or pedestrian road users, or in cases of omission arising from administrative, clerical, or procedural errors. Accordingly, in the US, estimates of unreported injuries shows that nearly one quarter of all minor injuries and almost all PDO crashes (PDO unreported cases was up to 48% in the 2000 report) are unreported. At the same time, it is widely accepted that all fatal and critical injuries are reported (Blincoe et al 2000).

3.12 Summary and conclusion of this chapter

This Chapter has explained the definitions of accidents by different writers. It has also looked at the theoretical foundation of accident causation, reviewing the different concepts of accident causation theories. Most of the theories are founded around the interaction of the person, the road, the vehicle/machine and the environment. Different writers have explained how road traffic accidents happened; but the majority of them attribute many of the causes to the failure of the driver to perform his role.

The cost of road traffic accidents is extensively discussed in this chapter, with the different costing methods analysed. Seven methods have been identified in the literature including

human capita/gross output, net output method, court award method, willingness to pay and the life insurance method. The review of the willingness to pay and the human capital methods brought into context their applications, advantages and disadvantages. From the review of the different accident costing methods, it is clear that that the Human capital method will be more suitable for this study because of its simplicity, clarity and adaptability to the circumstances of Nigeria as a developing country.

Several studies on cost of road traffic accidents in developing countries have been critically reviewed in this chapter. Also reviewed are studies on HGV accidents, in both developing and developed countries. The result of the review showed that, road traffic accident studies have been done on areas like causes of accidents, accident prevention strategies and cost of accidents especially in developed countries. Some studies have also been done on use of HGV to transport and distribute products and their involvement in accidents. However, what are missing are studies concentrating on the cost of HGV traffic accidents especially in developing countries. In view of the importance of this group of vehicles and the growing demand for their services especially in developing countries, it is very important to concentrate research in this area in order to block the gap in research. This is the gap, that this study is designed to fill, by researching the cost of accidents involving HGV in Nigeria.

The Chapter also discussed writers' opinions on the causes of road traffic accidents and their remedies. The main causes are over speeding by drivers, violation of traffic rules and regulations and use of defective vehicles. The main remedies are driver training, speed control, traffic rules enforcement, proper road markings and public enlightenment.

Having reviewed the literature in this chapter, the next chapter will be on research methodology.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

Research in simple terms means search for knowledge. In technical terms however, research is a serious exercise that involves a systematic and scientific search for pertinent information on a specific subject. It is an act of investigation to discover knowledge. The systematic processes involved in the search for knowledge is the methodology of research.

According to Leedy and Ormrod (2005), research is the process of collecting, analysing and interpreting data in order to understand phenomena. The success of research is dependent on the methodological approach adopted. Methodology is the commonly used term to describe the approach used to study research topics (Silverman, 2013). It is a way that needs to be followed to systematically solve the research problem. The methodology adopted in this research will include the process of data collection, collation, analysis and interpretation in order to achieve the research objectives.

In this chapter, the philosophical background of the study is discussed and the selection of methods justified. The research design is outlined and the data identification and collection procedures are discussed with the sampling procedure explained. All of these are discussed with justification ascribed to each choice of methods and procedures. Appropriate data analysis techniques are then presented and costing methods are reviewed and used to estimate the cost of heavy goods vehicles road traffic accidents

4.2 Research Philosophy

Research philosophy is about a writer's assumption about the world. It contains assumptions that support the writer's research strategy and the methods to be selected.

There are three popular philosophies of research. These are ontology, epistemology and axiology (Flowers 2009).

4.2.1 Ontology

According to Blaikie (2007), ontology is the branch of philosophical science of the study of being. Ontology describes the nature of reality, more especially, an objective reality that really exists, or a subjective reality created in peoples' minds. According to Flowers (2009), there are some deeply embedded ontological assumptions that affect every one's views about reality and whether existence is attributable to one set of things over others. These underlying assumptions would need to be identified and considered in order to protect the study from being blinded to certain aspects of the inquiry or certain phenomena. Thus, ontology is about the reality and how its perception will influences the behaviour of people.

4.2.2 Epistemology

Epistemology refers to what constitutes acceptable knowledge in a field of research. It brings out what is acceptable knowledge in the field of research and what information is considered the truth and is regarded as facts after rigorous testing. According to Easterby-Smith, Thorpe and Jackson (2008), epistemology talks about the ways that are most appropriate for enquiring into the nature of the world and what knowledge is, and what are the sources and limits of knowledge.

Flowers (2009), opined that epistemology is a philosophy that is most commonly used in scientific research as outcomes, information and facts require to be proved without doubt rather than changeable situations and opinions. Hatch and Cunliffe (2012) summarise epistemology as knowing how you can know, and how is the knowledge generated, what criteria discriminate good knowledge from bad knowledge, and should reality be represented and described.

4.2.3 Axiology

Axiology gives the researcher the understanding and recognition of the role their opinion and values can play in the conduct of the research as opposed to eliminating or trying to balance the influence in it. Referring to the research onion model based on Saunders et al (2009) as in Figure 4.1, these three philosophies of ontology, epistemology and axiology have been included in this particular diagram as three additional elements.

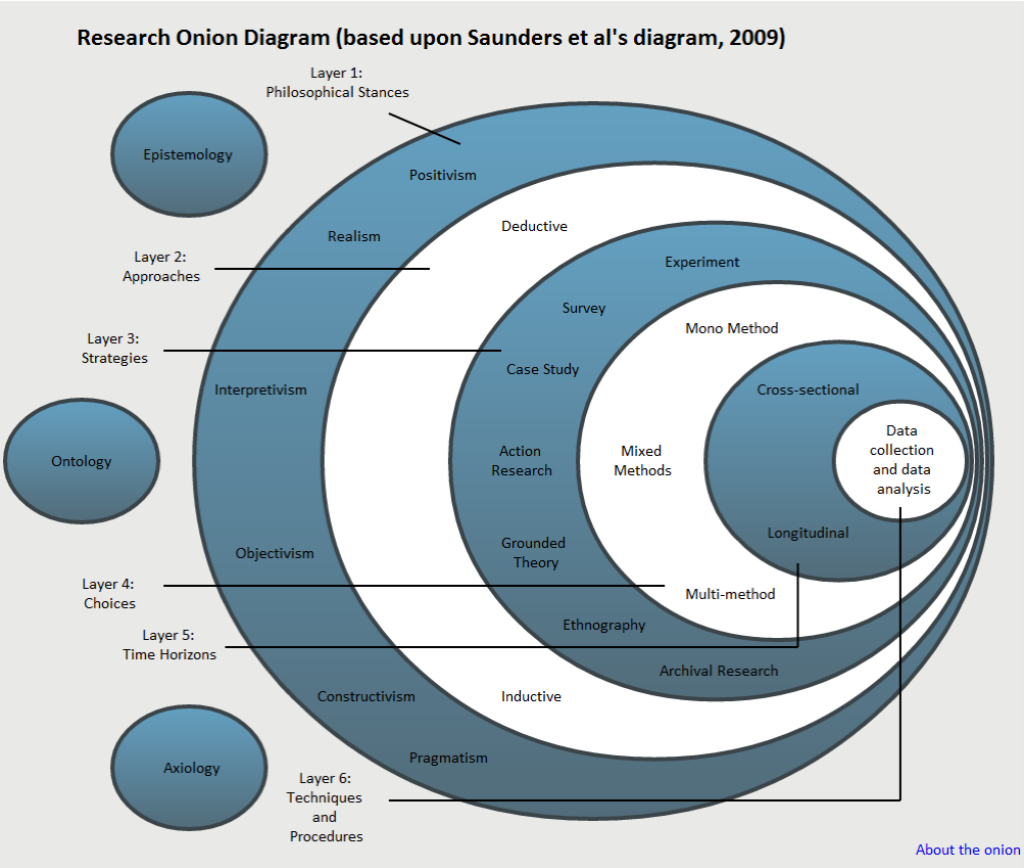


Figure 4.1: Research onion diagram

4.3 Research Paradigms

Denzin and Lincoln (2009) described a research paradigm as an interpretive framework. According to Saunders (2009), a paradigm is a way of examining a social phenomenon from which particular understandings of these phenomena can be gained and explanations attempted. Key research paradigms are contained in layer one of the research onion in Figure 4.1 and are discussed in the subsequent subsections.

4.3.1 Constructivism

Constructivism means the construction of social phenomena by actors in the social arena. This philosophy believes that reality is not objective and exterior, but socially constructed by people. It is founded on what people belief and therefore develops around the experience of people. Constructivism also relies on fundamental laws to explain social phenomena.

4.3.2 Objectivism

Objectivism is the opposite of constructivism and its arguments are that social phenomena and their existence is separate from the influence of social actors. This is one of the aspects of

ontology that supports the position that, social entities exist in reality, external to social actors concerned with their existence.

4.3.3 Positivism

Positivism is derived from the natural sciences and builds hypotheses/research questions, which can be tested to provide explanations that can be measured against known and accepted knowledge in the field. Saunders et al. (2009) explained that the positivist approach includes the various philosophies of natural sciences such as the philosophy of unchanging, universal law and the view of everything that occurs in nature. This position creates a body of research that can be replicated by other researchers to generate the same results. Positivism emphasise quantifiable results that can be subjected to statistical analysis. Studies such as Blaike (2007), Saunders et al. (2009), Erikson and Kovalaine (2000), Easterby-Smith et al. (2012) and Hatch and Cunliffe (2012), observed that positivism is based on values of reason, truth, validity and is focused purely on facts, established by direct observation, experience and measured empirically through quantitative methods (surveys and experiments-and statistical analysis).

4.3.4 Realism

Realism has similarities with positivism in its process and in its belief, that social reality and the researcher are independent of each other and so will not create biased results. Their difference is that realism believes that scientific methods are not perfect. It is also the belief in realism that theory can be revisited and revised and that our ability to know reality is possible with new research approached from new research methods.

4.3.5 Interpretivism

Interpretivism is a philosophical approach that explains the meaningful nature of people's involvement in cultural and social life. Research studies in this area are those that discuss the meaning people ascribe upon their own and others actions and take the view that change and cultural existence can be understood by studying what people think about their ideas and the meanings that are important to them. Interpretivists consider that there are multiple realities (Denzin and Lincoln, 2009) since all knowledge is relative to the knower. The focus of the interpretivist researcher is to understand the meanings and interpretations of actors in the social arena, and to appreciate the world from their point of view, which is contextual and thus may not be widely generalisable (Saunders et al 2009). According to Johnson and Christensen (2010), this philosophy believes that there are many truths and meanings of each

simple fact that are suitable for every situation and for every research problem. Eriksson and Kovalainen (2000) believed that the nature of this paradigm, and the emphasis on language make it more associated with qualitative research.

4.3.6 Pragmatism

Pragmatists are of the opinion that both constructivist and objectivists are valid approaches to research. Pragmatism enables the researcher to approach research from of the two viewpoints either on the influence or on actions of the social actors and utilise these to develop an approach, which is practical to research. According to Saunders et al (2009), the pragmatism argument is that the most important determinant of the research philosophy adopted is the research question, as one research may be more suitable than the other in answering the research questions. Where the research question is not specific on either to use positivist or interpretivist, then the pragmatist view that it is perfectly possible to use both philosophies is acceptable.

Tashakori and Teddlie (2010) are of the opinion that it is more appropriate to think of the philosophy adopted as a continuum rather than opposite positions. They further explained that it is better for the researcher to study what interests him and is of value to him, and to study the subject matter in the different ways he considers appropriate, and also to use the results in the best ways he considers would bring about positive results to the value system (Tshakkori and Teddlie, 2010). Having reviewed the philosophies of research, positivism has been identified as the appropriate research philosophy for this study on the cost of HGV road traffic accidents in Nigeria. This is in line with the objectives of the research to generate data sufficient to answer the research questions.

4.4 Research approaches

From layer two of the research onion in Figure 4.1, the different research approaches are examined in order to determine which approach is applicable to this study. These are the Deductive and Inductive research.

4.4.1 Deductive approach

Deductive means the researcher will start with a statement or question and the research will set out to provide answers to the question or statement.

According to Saunders et al. (2009,) deduction is largely suited to scientific research. It involves the development of a theory that is subjected to rigorous scientific test. The thought process of deduction runs from theory to the research question, to data collection, to findings that will lead to rejection or confirmation of the research question or statement. The deductive research method is the approach, which seeks to develop a theory and hypothesis with a research design to test the hypothesis (Saunders et al, 2009).

4.4.2 Inductive approach

Induction means finding over knowledge that can be used to create a theory. The process moves in the opposite direction to the deductive approach taking its focus from the research title and not from existing theory. This means the research move from research question, to observation and description to analysis and final theory. Saunders et al (2008) have however, suggested that it is advantageous to combine deduction and induction approaches in the same piece of research. But, this study which relies on the collection of quantitative and qualitative data from sufficient sample sizes to make a valid generalisation will follow the inductive research approach.

4.5 Research strategies

Layer 3 of the research onion presents the various research strategies in use. These are choices, which need to be made to collect and analyse the data. Different strategies may be associated with different philosophies. The researcher may choose more than one strategy to design and collect data so long as this is needed and is justifiable.

4.5.1 Experiment

Experimental research attempts to determine if a specific treatment influences an outcome. This impact is assessed by providing a specific treatment to one group and withholding it from another and then determining how much the two groups showed in an outcome. Experimental research design emanated from natural sciences but is now used in social and management science. Experimental design is very rigid and scientific in its structure and largely used to test cause and effect relationships. Experimental strategies generate data suitable for statistical analysis and they have been used in exploratory and explanatory types of research to explain how and why questions (Saunders et al., 2009).

4.5.2 Surveys

Survey research design is popular in business research since it provide the researcher with a highly economical way and simple way of collecting large quantities of data to address the questions of what, where, when, who and how of his research area (Saunders et al., 2009).

Babbie (1990) explained that, the survey research has the ability to provide the researcher with a quantitative explanation of events, trends, attitudes, behaviours or opinions of a certain population by investigating a sample of that population. Survey strategies can be cross-sectional or longitudinal studies using questionnaires or structured interviews for the purpose of data collection, with the goal of making generalisation from a sample to a population.

A survey strategy also makes it easy for the researcher to collect data that are both qualitative and quantitative in nature and which can be analysed using statistical tools like descriptive statistics and inferential techniques. In addition, data collected using a survey strategy can be used to establish and explain relationships between variables and to develop models of these relationships. A survey strategy makes it possible to collect data using sampling and make findings that are representative, which can be used to make generalisation. Surveys strategies are a good way of collecting a large amount of data, providing a broad perspective.

According to Frechtling et al (2002), surveys can be constructed in many ways, but would always contain two components, questions and responses. The researcher may choose to keep responses ‘open ended’ but most often, the “closed ended” approach in which respondents are asked to select from a range of predetermined answers is adopted. Closed ended responses are easier to code and require less time than open-ended responses.

Questionnaire technique, structured observation, structured interviews are some of the common techniques in survey research. Surveys may be electronically administered or by telephone or through an e-mail or by face to face. In this study, a survey strategy is used to collect data from respondents using questionnaire methods. However, there is a possibility that the participant may bias responses particularly if the issues involved are sensitive or require some measure of self-disclosure or trust since surveys are self-reporting by respondents.

4.5.3 Case study

The case study design is an extensive study of one or more individuals, groups or cases in a real life scenario. Stake (1995), explained that case studies' strategy of research is where the researcher explores a programme, event, activity, process or one or more individuals in depth. He explained further that the cases being studied are bounded by time and activity, and the researchers collect over a period of time detailed information using a variety of data collection techniques. However, Saunders et al. (2009) are of the view that a case study strategy has an unscientific feel, though the strategy can be useful when exploring existing theory. In addition, a well-planned case study strategy gives the researcher the room to explore an existing theory and also provide him with options to develop new research questions.

4.5.4 Action research

Action research is about addressing issues to find solutions. To research a solution to a problem, an action research is a strategy that allows the researcher to be part of the organisation, system or case study that requires that particular solution. Specific data to be collected may include watching aspects of the participants' behaviour or their setting, interviews with participants and record searching.

4.5.5 Grounded theory

Grounded theory is a strategy of research that enables the researcher to derive a general, abstract theory of a process, action, or interaction grounded in the views of the participants. It uses inductive methods to make prediction and explanation of behaviour to develop theory. The process begins with data collection by means of observation methods, making theory and prediction from that data and then testing the predictions made. Though grounded theory is a strategy that generates new theory, it is still however grounded by existing theory and literature on the topic.

4.5.6 Ethnography

Ethnography has its roots in anthropology. According to Cresswell (2007) ethnography is a research strategy where the researcher observed a cultural group that is intact in a natural setting over a long period of time by basically collecting data through observation and

interview. The researcher using this strategy will be required to be part of the community or situation he is studying. Saunders et al. (2009) explained that this strategy has disadvantage of time consumption and may take place over an extended time period as the researcher needs to immerse himself in a social world being researched as completely as possible.

4.5.7 Archival research

This strategy is about making use of administrative records and documents as sources of data. According to Saunders et al. (2009), the archival research strategy address research questions focusing upon the past and the changes that happen over time to be, be they descriptive, explanatory or exploratory. However, the accuracy and breadth of the data available may be an issue for a research relying on archival strategy. The nature of the administrative records will however determine whether the use of the strategy will be able to answer the research questions. This research on the cost of heavy goods vehicles accidents and its impact on the Nigerian economy is designed to make use of survey as its research strategy in view of the fact that it needs to collect data from the field and would have to sample the population to obtain a representative result.

4.6 Research choices

The fourth layer of the research onion is about research choice. This is where the researcher defines how to use qualitative and quantitative methods in the research. Methods are the ways to actually design and collect data. Here a decision is made whether to use the two methods or use one, whether to use them equally or with one dominating.

As the name suggest, quantitative research is about numbers. It is concerned with quantity and measurement. Williams (2007) explained that quantitative research can be classified into; experimental, descriptive and causal comparative. Experimental research investigates the treatment of intervention into the study group and then measures the outcome of the treatment. A descriptive research approach is a method that examines the situation, as it exists in its current state. In causal comparative research, the focus is on how the independent variable is affected by the dependent variables and involves cause and effect relationships between the variables.

Furthermore, Saunders et al. (2009) explained that quantitative research is predominantly used as a synonym for any data collection technique such as questionnaire, or data analysis procedure, such as graphs or statistics techniques that generates or uses numerical data.
However, qualitative research is concerned with rich data such as personal accounts and opinions. Saunders et al (2009) also explained that qualitative research is used predominantly as a synonym for any data collection technique (such as interview, data analysis procedure or data categorisation) that generates or uses non-numerical data. They further added that qualitative can refer to data that is not words like pictures and video clips. Methods are the ways to design and collect data with each choice having its framework of methods and tools. Three methods have been identified by Saunders et al. (2009) as shown on the fourth layer of the research onion in Figure 4.1.

4.6.1 Mono-Methods

Mono-method of research choice is referring to the collection of either quantitative or qualitative data rather than a combination of both. A Mono-method combines either a single quantitative data collection technique such as questionnaires with quantitative data analysis procedures or a qualitative data collection technique such as in-depth interviews with qualitative data analysis technique.

4.6.2 Multi-Methods

This is when both qualitative and quantitative are used but the researchers outlook is rooted in one. Tashakkori and Teddlie (2010) described multi-methods as the situation where the techniques used to collect and analyse data are more than one but fall within the confines of either the quantitative or the qualitative worldview of research choice. With multi-method, quantitative and qualitative techniques and procedures would be mixed.

4.6.3 Mixed-Methods

Mixed-methods of research is when the researcher uses quantitative and qualitative research methods in the process of the study. By combining the two methods, the limitation of each individual method can be offset and gaps of data can be filled or predicted. This study on the cost of heavy goods vehicles road traffic accidents is using mixed methods to achieve the stated objectives. Saunders et al. (2009) explained that mixed-methods in research uses

quantitative and qualitative data collection techniques and analysis procedures either at the same time or at one after the other, but does not combine them.

4.7 Time horizons

This is represented in layer five of our research onion. There are only two time horizon choices, cross-sectional and longitudinal. Cross-sectional is a research done within a short time while longitudinal is a research carried out over a longer period.

4.7.1 Longitudinal study

Longitudinal study is an event over a long period, associated with constructionist research (Easterby-Smith et al., 2012). Longitudinal designs can also use qualitative and quantitative research but they study events and behaviours using concentrated samples over a longer period.

4.7.2 Cross-sectional study

According to Saunders et al. (2009), cross-sectional study is an event at a particular period of time. Cross-sectional study can use qualitative and quantitative research choices and is a study that measures an aspect of behaviour of many groups or individuals and at a single point in time. Cross-sectional studies often employ the survey strategy Easterby-Smith et al. (2012). Thus, given that this study focuses on the cost of heavy goods vehicles road traffic accidents in Nigeria and survey methods are used to collect the data for the economic cost of accidents in 2011, this means that the study lies within the realms of cross-sectional research.

4.8 Data collection

Data are usually collected through qualitative and quantitative methods. The collection and analysis phase is illustrated in the sixth layer of the research onion (Figure 4.1). Qualitative approaches address the how and why of a study and tend to use unstructured methods of data collection to fully explore the topic. Qualitative methods include focus groups, group discussions and interviews. Quantitative approaches however address the research question of what? A Quantitative approach uses a systematic standardised approach and employs methods such as surveys.

Having reviewed the different accident costing methods in chapter three, this study on the cost of heavy goods vehicles road traffic accidents will be carried out using the Human Capital Method. This is because of its advantages over others in this type of research (see 3.5.6). For this reason, both quantitative and qualitative data will be collected to estimate the cost of the accidents, their causes, prevention and establish the implications of the accidents on the economy in measurable terms. Details of the information (data) required for this study and their sources are presented in Table 4.1.

However, different approaches have been used to collect these data, which include field survey, literature survey and review of documents and interviews.

Table 4.1: Data requirements and sources of each cost component

S/N	Cost Components	Data Requirements	Data Sources
1.	Hospital and Medical Cost	Average hospital and medical expenditure (in-and out-patients)	Selected Hospitals/ Medical Records
2.	Lost output	Fatal Casualty Average fatal age Average retirement age Average national income statistics Serious and minor Casualty Time loss for rehabilitation	Selected Hospitals/ Medical Records National Bureau Statistics Literature estimate Internet
3.	Funeral cost	Average expenditure to bury accident victim	Literature surveys
4.	Property Damage Cost	Vehicle damage cost Goods damage cost 3rd Party damage cost Road furniture damage cost	Questionnaire Surveys(Operators) Literature estimate
5.	Insurance Administrative Cost	Accident Investigation and claim costs	Literature estimate
6.	Emergency Medical Service (EMS) Cost	EMS costs	FRSC Volunteers Selected Hospitals/Medical records
7.	Police Administrative Cost	Fees and fines	Motor Traffic Division(Police) Literature estimates
8.	Human Cost	Pain, grief, suffering and economic consequences	Literature estimate

Source: Author 2013

4.9 Sampling

Haque (2010) defines sampling as the selection of some part of an aggregate or totality or a whole on the basis of which a judgment or inference about the aggregate, the whole or totality is made. Sampling is the process of examining a part of a population in order to obtain information about the entire population. From the foregoing, a sample is any number of people, projects or units chosen to represent an entire population based on certain rules.

Unlike a census, which is the consideration of the entire population, sampling is the method that selects a fraction of the population in such a way that it represents the whole population. The standard definition is that which includes the ability of the research to select a portion of the population that is truly representative of the said population (Latham, 2007).

Furthermore, Latham (2007), Lynch (2011) and Haque (2010) observed that there are two groups of sampling; probability and non-probability sampling methods. Accordingly, the choice of a sampling method would depend on the goal of the research. To achieve certain level of confidence in the data collection, probability sampling should be adopted (MacNealy, 1999). Non-probability sampling does not provide this advantage, but is useful when researchers want to achieve a particular objective in their research (Henry, 1990).

4.9.1 Probability sampling methods

In probability sampling methods, every item of the population has an equal chance of inclusion in the sample, thus each population element has a known (non-zero) chance of being chosen (Henry, 1990). This equal chance helps to eliminate the danger of researchers being biased in the selection process because of their own desires or opinions. Bias must be eliminated before the results of the research can be generalised from the sample to the whole of the population since the sample represents the population (Frey, et al 2000). There are four common types of probability sampling techniques (Latham 2007). These are simple random sampling, systematic random sampling, stratified random sampling and cluster random sampling. These are illustrated in the Table 4.2 as cited in Henry (1990).

This study on the cost of heavy goods vehicles road traffic accidents uses systematic random sampling to collect data from the field.

Table 4.2: Probability sampling methods.

Types of Sampling	Selection Strategy
Simple	Each member of the study population has an equal probability of being selected
Systematic	Each member of the study population is either assembled or listed, a random start is designated, and then members of the population are selected at equal intervals.
Stratified	Each member of the study population is assigned to a group or stratum, then a simple random sample is selected from each stratum
Cluster	Each member of the study population is assigned to a group or cluster, then clusters are selected at random and all members of a selected are included in the sample

Source: Adopted from Henry (1990)

4.9.2 Non-Probability sampling methods

In non-probability sampling, the sample are selected deliberately by the researcher instead of using the techniques of random sampling that gives equal chance to participants (Haque, 2010). Babbie (1990) explained that non-probability sampling methods have the advantages of providing a convenient way for researchers to assemble a sample with little or no cost and suitable for those researchers that do not aim at generalisation.

Non-probability sampling methods according to Haque (2010) include; quota sampling, purposive sampling, systematic sampling, snowball sampling and double sampling. According to Henry (1990), quota sampling enables the researcher the opportunity to select a sample that produces the same proportions as the population proportions on easily identified variables. Snowball sampling is in use when group members identify additional members to be included in the sample and in purposive sampling; selected cases are those that are judged to represent similar characteristics.

Haque (2010) described systematic non-probability sampling as the method where every nth element is selected from a list of population having serial number. He described it as vague and misleading though suitable in homogenous populations. Haque (2010) further described

double sampling method as a method where sampling is drawn twice. He described this method as time consuming and expensive.

4.10 Field Survey

Survey is the research design used in this study and questionnaire is the survey instrument adopted to collect primary data. To understand how well the questionnaire measures what it sets out to measure, content analysis was done on the questionnaire. Experts in the field were requested to review and judged the questionnaire contents to ensure that it contains relevant questions and that would be able to achieve the stated objectives. The secondary data were also subjected to checking for lack of missing entry and wrong entry when compared with the original data files.

Systematic random sampling is the selection method used in this study for both the operators and the drivers. This is because officials of National Union of Road Transport Workers (NURTW) were used to mobilise the drivers for the enumerators to administer the questionnaires by selecting one in every ten rivers that arrived at the truck parks until the required number was exhausted. In Nigeria, it is mandatory for drivers to belong to labour unions, and NURTW is the main union where drivers of commercial vehicles are members as contained in NRTR (2012).

Similarly, the operators were met at their sites/locations with the assistance of the officials of the National Association of Road Transport Owners (NARTO) where they were requested to answer the questionnaire within a period of two weeks by themselves, after which the enumerators would return and retrieve the filled questionnaire. NARTO is the main trade association of freight vehicles owners in Nigeria.

4.10.1 Truck drivers

Truck drivers are a group of people who are responsible for piloting the heavy goods vehicles across Nigeria. This group of workers are identified and targeted for sampling bearing in mind the fact that they are the potential victims of any accident case involving their vehicles. They are therefore in the best position to provide first hand and reliable information about the accidents they get involved in. Because this group of workers is most often in transit, the researcher decided to trace them to their work environment. These are the parks where they transit for rest as they move from one location to the other. Many of these parks exist along

the main corridors of the Nigerian road network, but the most visited ones are the one at Shagamu in Ogun state and the one in Mararraban Jos in Kaduna State.

In addition to the above reasons, these parks were also selected for the survey due to the following additional reasons.

- Shagamu Park in Ogun State is a major freight vehicle park along Lagos-Ibadan expressway. The express way serves as the major corridor that collects all the traffic which originates or terminates in Lagos. Lagos city attracts or generates over 60% of the freight traffic vehicles in Nigeria being an industrial nerve centre and host to the country's biggest ports (see Figure 4.2)
- The Mararaban Jos Park is located close to Kaduna, a refinery city, where most of its products are transported by road to other locations in Northern Nigeria. The park is also located along the very busy Kaduna-Kano express way. This road corridor collects traffic coming from southern Nigerian states and North central states to the North west and North east (see Figure 4.2)
- Accident records from the FRSC (2011), shows that the two corridors have the highest accident cases in the country.

Sampling drivers along these corridors therefore is representative as the respondents drive into parks from different locations across the country, thus representing the population mix of truck drivers in Nigeria. Cooperation of the respondents was obtained through their labour union, the National Union of Road Transport Workers (NURTW) as contained in the letter to the union (see Appendix 1).

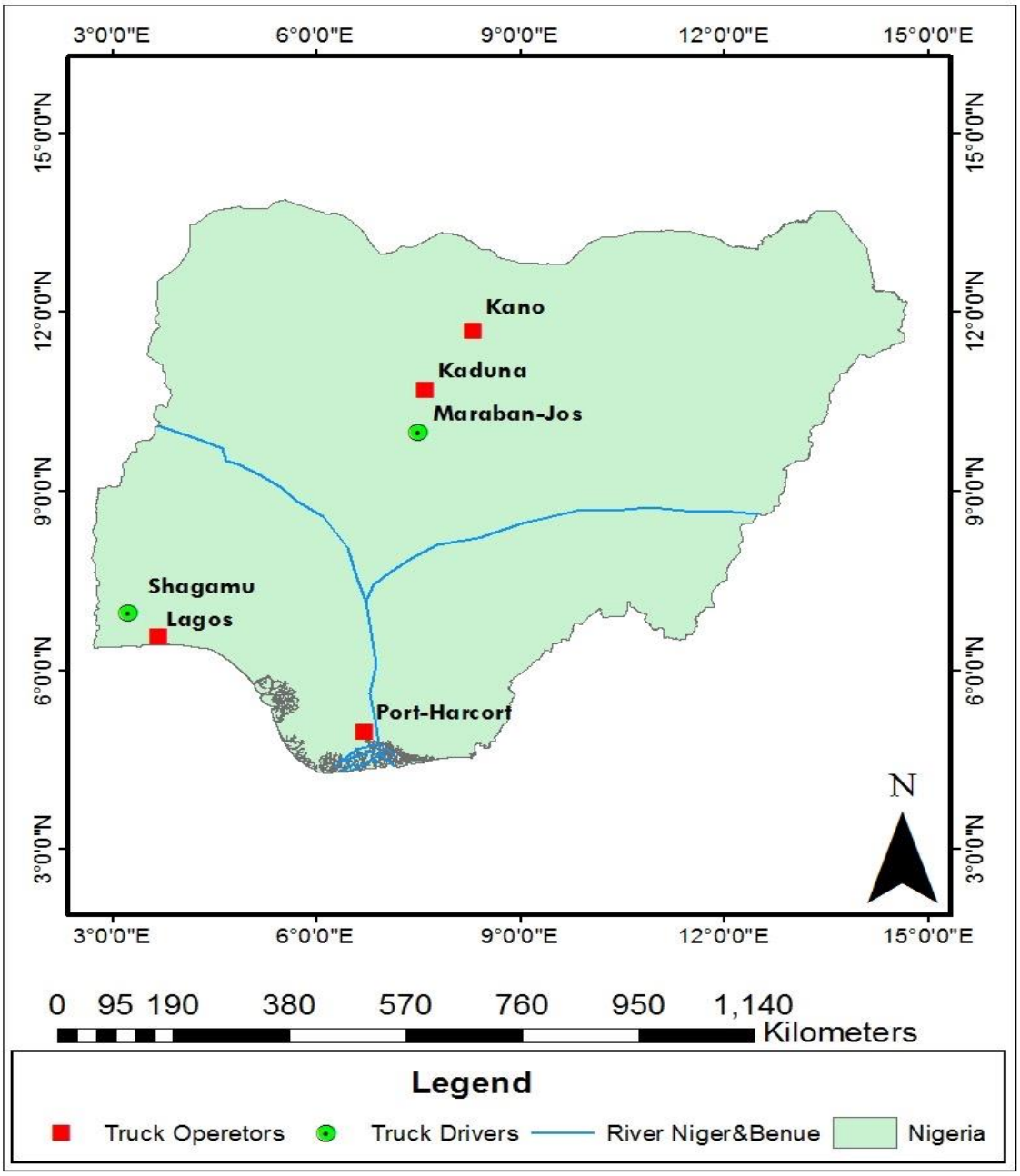


Figure 4.2: Map of Nigeria showing the location of Survey points.

4.10.2 Sampling truck drivers

Using the correct sample size is very crucial for the success of this study. A sample that is too big will cause the waste of resources like time and money. A sample that is too small is also likely to prevent the researcher from gaining reliable insights. The size of a sample therefore depends on how accurate the researcher wants the survey data to be, or how closely the research results are required to match those of the entire population. According to Saunders et al (2009), the choice of a sample size is governed by the confidence level, the margin of error

that can be tolerated, and the types of analysis techniques and the size of the total population from which sample is drawn.

The population of truck drivers on Nigerian roads is estimated to be about 70,000 (FRSC, 2011**).** In determining a representative sample from the estimated total population of trucks drivers in 2011, the adoption of a formula for determining sample size from Yomens (2000) was used. The formula is given as follows.

$$SS = \frac{N}{1 + N(e)^2}$$

(4.1)

Where

SS is the sample size, *N* is the population size and *e* is the tolerable error in investigating the population. This is based on the summation by Saunders et al. (2009), which puts the 95% best margin of error under such circumstance.

Therefore,

$$SS = \frac{70000}{1 + 70000(0.05)^2} = 397.7$$

$$\approx 398$$

Hence, 398 questionnaires were to be administered, but to take care of unreturned, no response and achieve about 80% return, 500 questionnaires were distributed. See (Appendix 2) for the detailed drivers' questionnaire. The 500 questionnaires were distributed to two different parks in the country in a ratio of 3: 2. In other words, 300 questionnaires were administered to truck drivers in Shagamu Park in Ogun State and the remaining 200 questionnaires were administered to truck drivers in Mararraban-Jos Park along Zaria-Kaduna Road, Kaduna State.

4.10.3 Truck driver questionnaire administration

The procedure used to administer the questionnaire to the respondents is presented step by step in the section below.

1. Four research assistants were recruited, trained and deployed to the field to administer the questionnaire
2. Two of the research assistants were sent to Shagamu and the other two to Marraban Jos.

3. Field offices of NURTW in Shagamu and Marraban Jos were used to administer the questionnaires.

4. Respondents were selected for questionnaire administration based on arrival at the park.

5. One in every ten trucks was selected on arrival at the park for questionnaire administration until the required number was achieved.

6. Every driver selected was requested to report at the office of the NURTW to fill the questionnaire with the assistance of the research assistant.

7. The questionnaire completion exercise lasted for 2 days in both locations after which completed questionnaires were compiled and returned to the researcher for analysis.

From the 500 questionnaires, 410, which represent 91%, were filled correctly and retrieved. Data from the returned questionnaires therefore formed the basis of the analysis in this study. Table 4.3 presents the locations and distribution of the returned drivers' questionnaires.

Table 4.3 Returned drivers' questionnaires

Type of Truck	Name of Park		Total
	Shagamu	Maraban Jos	
Tanker	167	81	248
Trailer	80	53	133
Lorries	25	4	29
Total	272	138	410

Source: Author's compilation

4.10.4 Truck operator's survey

Truck operators are a group of business men/women who own and manage heavy goods vehicles businesses in Nigeria. They are located in different parts of the country but are mainly concentrated in large commercial centres. Due to the poor performance of the rail system, truck operators play a very important role in the economic wellbeing of Nigeria.

The freight vehicle operator questionnaire was administered in Lagos, Port Harcourt, Kaduna and Kano. These locations are selected for the following reasons:

- Kano is the largest city in Northern Nigeria and the commercial and the industrial nerve centre of the North. It has a very high concentration of truck owners who service the industries in the city and distribute agricultural and industrial products to other parts of the country.
- Kaduna is the second largest city in Northern Nigeria and the second most industrialised state. It is also home to the only petroleum refinery in the region. There are high concentrations of truck owners in the city who are responsible for the distribution of petroleum and other industrial products to other states in the country.
- Lagos is the commercial nerve centre of Nigeria and home to its biggest port establishment. Many truck companies in Lagos service these economic interests.
- Port Harcourt is the hub of Nigeria's oil industry and home to oil refineries and other industrial establishments. Port Harcourt is also hosting Nigeria's second biggest seaport. There is therefore a high concentration of truck operators in the city.

Sampling truck operators in these locations therefore gives a very good representation of the road trucking industry in Nigeria.

4.10.5 Sampling truck operators

In line with the strategy adopted in sampling truck drivers, systematic random sampling method is also adopted in selecting respondents for the administration of the questionnaires. The questionnaires were delivered at the offices of the trucking companies, and were collected after the operators completed them at an agreed time. The research assistants were introduced to the operators by officials of their trade group association, the National Association of Road Transport Owners (NARTO) as contained in (Appendix 3). The population of HGV operators in Nigeria is estimated to be 917 (FRSC, 2011).

Similarly, using equation 4.1 above the sample size for truck operators was estimated as follows.

$$SS = \frac{917}{1 + 917(0.05)^2}$$

$$= 278.51$$

$$\approx 279$$

Hence, 279 questionnaires were distributed in the four selected locations of Lagos, Kano, Kaduna and Port-Harcourt, out of which 213 were filled and retrieved. Table 4.4 present the analysis of the returned operator's questionnaires. Details of the operator questionnaire are contained in Appendix 4.

4.10.6 Truck operator questionnaire administration

The quesionnaires were distributed by research assistants to the truck companies at Lagos, Kaduna, Port Harcourt and Kano in the following order.

1. Recruitment, training and deployment of research assistants to the field
2. List of truck companies in Lagos, Kaduna, Kano and Port Harcourt were obtained from the field offices of NARTO in the selected locations.
4. The required number of respondents was selected by the research assistants from each of the four lists on the basis of one in every two companies i.e. 1, 3, 5, 7, 9 etc.
5. Questionnaires were then distributed to the selected companies physically at their offices by research assistants
6. Truck operators were then requested to complete the questionnaires within two weeks
7. After two weeks, questionnaire was retrieved from truck operators after cross checking to ensure that entries were correctly made as shown in Table 4.4.
8. Questionnaires not completed as at that date and those damaged were also retrieved.
9. All questionnaires were then compiled and returned to the researcher for analysis.

Table 4.4 Returned questionnaires from truck Operators survey

Location Of The Operator	Frequency
Kaduna	68
Kano	51
Lagos	53 0
Port Harcourt	41
Total	213

Source: Author 2013

4.11 Secondary data

The secondary data, which includes the HGV accident statistics and hospital accident data were collected from the Federal Road Safety Commission (FRSC), and selected regional referral hospitals.

4.11.1 Federal Road Safety Commission (FRSC) data

The Federal Road Safety Commission as the lead agency established by law and responsible for prevention and management of road traffic accidents in Nigeria has devised strategies of road traffic accident data collection, storage and management. Data is collected using crash templates at the scene of accidents by officials of the safety commission on patrol, or when a phone call is received at the FRSC toll-free emergency call center, or through other forms of accident reporting to the commission. Through this method, the commission has established and maintained a database of accident records in Nigeria. The required data for this study is therefore extracted from the database of the commission for the period of the study. An extract of part of the data from the FRSC is contained in Appendix 6.

4.11.2 Data of medical records

The hospitals selected are Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, Dala Orthopedic Hospital, Kano, Orthopedic Hospital Igbobi, and University of Benint Teaching Hospital (UBTH), Benin.

Ahmadu Bello University Teaching Hospital is the main tertiary Hospital located along the busy Kano-Kaduna expressway. This route is the main corridor in Northern Nigeria with heavy traffic volume and is prone to high road traffic accident levels. The University of Benin Teaching Hospital is also a major tertiary Hospital located in Benin City, where the West-East road passes through. Many road traffic accident victims are treated at this Hospital.

Dala Orthopedic Hospital is located in Kano. It is the main Hospital handling orthorpedic cases in Northern Nigeria. It is therefore a popular center for the treatment of accident cases. Similarly, the Orthopedic Hospital located at Igbobi in the heart of Lagos is a specialized center for the treatment of injury patients.

The procedure adopted to collect the cost of medical treatment data was as follows;

1. Permission was obtained from Hospitals management for the research assistants to access accident patient files for the year 2011.
2. Fifteen files in each Hospital were collected by selecting one in every five files until the required number was achieved
3. In each selected file, details of treatments were extracted. The specific information extracted from each file were nature of injury, types of treatment, cost of treatment and duration of stay in Hospital
4 .Information collected in (3) were used to classify accident patients into fatal, serious and minor injuries based on definition in section 192 of NRTR (2012) .
5. On that bases, the average cost of treatment was then calculated for each severity level for each Hospital
6. The total average values for each accident severity were then applied to 2011 accident data to compute medical cost of accidents for each severity

4.12 Data reliability and validity test

According to Tharenou et al. (2007) data reliability can be defined as the ratio of the true score variance to the observed score variance, because each of the observed score is made up of true score and measurement error. If the reliability is too low, it is not used in this research. Reliability must be tested whenever an instrument is used to generate scores for a sample. Tharenou et al. (2007) define validity as the extent to which a measure, measures what it is supposed to measure. They added that validity is the degree of confidence that a researcher can have in the conclusions drawn from scores, and the level of confidence that a researcher can have in the meaning that is derived from the score. It is important to know that a measure is valid only when it is reliable, though a measure can be reliable not valid. Reliability is therefore a necessary but not a sufficient condition for validity.

Several methods have been developed to test reliability as mentioned by Tharenou et al (2007), these include internal consistency reliability, test-retest reliability, inter-rater reliability, split-half reliabilities and parallel forms reliability. In the same vein, Tharenou et al (2007) also identified a number of validity measures, which include; construct validity,

criterion-related validity, and content validity and face validity. In this study, Cronbach's Alpha Reliability Test**,** and Inter-rater Reliability analysis were used to measure the reliability of information and instrument used.

4.12.1 Cronbach's Alpha Reliability Test.

A reliability test was performed to know how reliable was the scaling of the variables in the designed questionnaire for drivers and operators. From Table 4.5, since the Cronbach's alpha reliable test involves splitting data into two in every possible way and computing the correlation for each split, it can be observed that the Cronbach's Alpha for both halves (dimensions) of the driver and operator questionnaires is close to one.

Table 4.5: Cronbach's Alpha reliability test for driver and operator Questionnaires

Dimension	Cronbach's Alpha for Driver Questionnaire	Variance Accounted For Total (Eigenvalue)	Cronbach's Alpha for Operator Questionnaire	Variance Accounted for Total (Eigenvalue)
1	.882	6.643	.911	8.667
2	.797	4.307	.897	7.754
Total	.944[a]	10.950	.967[a]	16.421

a. Total Cronbach's Alpha is based on the total Eigenvalue.

Likewise, their total Cronbach's Alpha values, which are based on the total Eigenvalues, are also close to one. The Eigenvalues for both halves of the driver and operator questionnaires are greater than one. This implies that the variable scaling in both questionnaires is reliable for analysis.

4.12.2 Inter-rater Reliability analysis

This method was also used to test for the reliability of the categorical variables in the questionnaire. The categorical items in the questionnaire were randomly split into two equal halves, where each item from both halves was compared to determine reliability or agreement between the measures. Cohen's Kappa was computed to determine consistency among respondents. The resulting Kappa of items ranges between 0.41 – 0.60, $p \leq 0.05$. The result

shows there is agreement between the measures. Table 4.6 shows a summary of the data validation methods used in this study.

Table 4.6 Summary of validation methods

Data	Validation Method	Applicability
Driver Data	Internal Consistancy reliability (Cronbach alpha) Inter-rater reliability (Cohen's Kappa)	Descriptive analysis, u-test, logistic regression and human capital analysis for cost estimation.
Operator Data	Internal Consistancy reliability (Cronbach alpha) Inter-rater reliability (Cohen's Kappa)	Descriptive analysis and u-test and human capital analysis for cost estimation
Hospital Data	Validation by comparison between four different Hospitals	Human capital analysis for cost estimation.
Road safety Data	Validation by comparison with Police data	Human capital analysis for cost estimation

Source: Author 2013

4.13 Methods of Data Analysis

When data is collected from the field through either primary or secondary sources, be it quantitative or qualitative data, it needs to be analysed to make meaning. According to Tharenou et al (2007) there are several ways of categorising techniques of data analysis in terms of their broad purposes and applicability. In this study, three methods of analysis have been used to reflect the objective of the research and to statistically analyse the sets of data collected. These methods are presented in the following subsections.

4.13.1 Descriptive statistics

In this research, frequency distribution, percentages, line graphs and bar charts are used to describe the responses obtained from the respondents, that is, drivers and operators of heavy goods vehicles. The data obtained from secondary sources were also presented descriptively where needed. These descriptive statistics helped in presenting and interpreting the collated data and results.

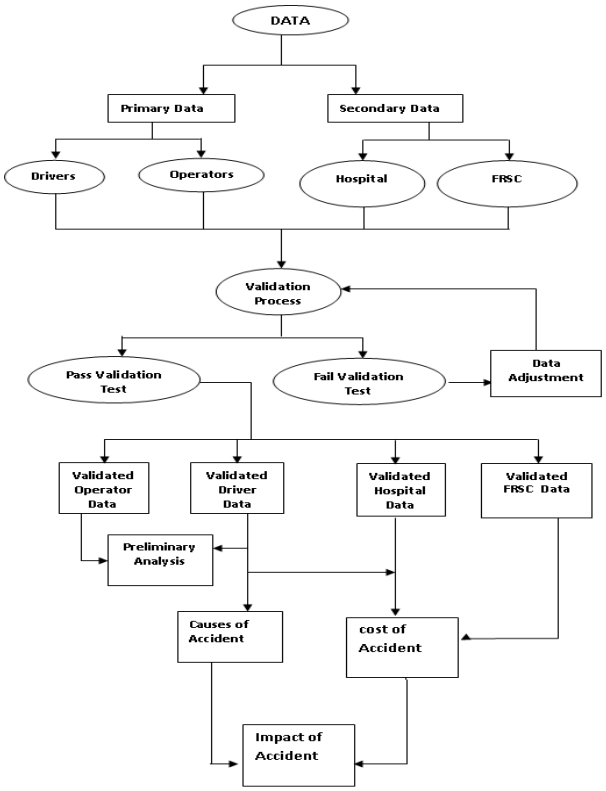
4.13.2 Mann-Whitney U test

The Mann - Whitney u - test is a non-parametric test with the assumption that a randomly selected value from one sample will be less than or greater than a randomly selected value from a second sample. In this study, the Mann-Whitney *U*-test statistic is adopted to compare two independent samples, which are responses from *drivers* and *operators* of road freight companies on the causes of HGV accidents in Nigeria (see Appendix 5).

4.14 Data analysis framework

In this study, data collected from primary and secondary sources were analysed to present an in-depth understanding of the implications HGV traffic accidents in Nigeria. Figure 4.3 shows the data analysis framework.

Figure 4.3: Data analysis framework



The data analysis framework as shown in Figure 4.3 is a process flow of how the data collected was analysed. Two types of data were used: primary and secondary. The primary data consist of data collected from drivers and from operators using separate designed questionnaires for drivers and operators. Secondary data were also sourced from hospitals and Federal Road Safety Commission of Nigeria. The four data set used were passed through a validation process using the split half reliability test on the primary data where the Cronbach's Alpha for both halves was assessed. The secondary data were subject to checking for lack of missing entry and wrong entry when compared with the original data files

If the validation test on the data is "pass", the validated data is then subjected to the required analysis but if validation test on the data is "fail" then the data is subjected to adjustment and then passed through the validation process again. From the data analysis framework in figure 4.3, it can be seen that the operator and driver validated data were used for analysis on driver and operator characteristics and also the causes and cost of accidents. The hospital and FRSC data were used for estimating the cost of heavy goods vehicles road freight traffic accidents and its implication on the Nigerian economy.

4.15 Estimating the cost of heavy goods vehicles road traffic accidents

Several methodologies have been developed in different countries to cost road traffic accidents. According to Hills and Jones (1981;1983), Miller et al. (1991), Jacobs (1995), Silcock/TRL (2003), Thuy ANH et al.(2005), Deleon et al. (2005) and De Silva et al (2010) Zeloshnja and Miller (2004), Risky, De Silva and Tong (2008) and Ismail and Abdulmajid (2010), Macmahon and Dahdah (2010) and Fletcher (2014). the different methods for placing cost on accidents, include; the "Gross output" or Human Capital Method, the "Value of risk change" or "Willingness to pay" Method, the "implicit public sector valuation" method, the "Net output" method, the "Life Insurance" method and the "Court award" method, the rule of thumb and the value of statistical life approach. These methods have been presented and discussed in chapter three of this study.

The choice of an appropriate method is however dependent on the objectives and priorities of the study. Meanwhile, the human capital method is highly recommended for developing countries, (Jacobs, 1995). The method has also greater flexibility in capturing all associated costs component in road traffic accidents (Silcock/TRRL, 2003).In addition, the methodology is more reliable and internally consistent and has a strong theoretical base (Downing, 1994).

The method is about two clear costs in an accident, the cost of a loss or diversion of current resources and the cost due to loss of future output. The human capital method has been successfully used by Trinh and Nguyen (2005), Downing (1994), Melhuish et al. (2003), Mohamed and Abdelmaged (2010) in their studies. Furthermore, the method was recommended by the Asian Development Bank for use in ASEAN countries (Asian Development Bank, 1997). However, Nunez et al. (2011) reported that when willingness to pay is used, costs could be 2 to 3 times higher.

Having reviewed the application of the human capital method and in view of its suitability in developing countries, the method is being applied in this research for costing of HGV traffic accidents in Nigeria. Below are the steps adopted in this study to calculate each of the components that make up the cost of accidents under the Human Capital Method (HCM).

4.15.1 Property damage cost

Information on costing of property damage can be obtained from three basic sources. These are insurance companies, motor repair garages and large fleet vehicle owners, such as bus companies and road freight operators. In this study, the total average cost of own vehicle damage/repairs, total average cost of goods damaged and total average cost of damage to third party property and or vehicle were estimated from the survey of fleet operators during the survey.

There are four steps involved in calculating property damage followed in this study. These steps are as follows (Silcock/TRRL, 2003):

1. **Step I:** identify the average number of vehicles and properties *damaged* in each accident.
2. **Step II:** estimate the average property damage cost per vehicle/property.
3. **Step I11:** calculate the average vehicle/property damage cost per accident severity, where available.
4. **Step 1V:** highlight assumptions and present final results

4.15.2 Medical cost

Medical costs are usually a small portion of the overall costs of accident. However, these types of costs are usually the most visible sign of economic burden experienced by the family of the accident victim. Medical costs comprise of cost of at scene care, ambulance, in-

hospital stay including food and bed, operations, x-rays, medicines, doctor services, out-patient treatment, drug, and prosthetics. According to Silcock/TRRL (2003), all these are categorised as direct costs with some being private and some being public, and can be long term costs, depending upon the severity of injury.

In this study, four hospitals were used to obtain accident victims' medical records to estimate medical expenditures, see (4.12). In calculating medical cost the following three steps are applied as suggested by Silcock/TRL (2003).

1. **Step I:** identify available medical cost and usage data from the sampled data of the hospitals.
2. **Step II:** classify accident victims records according to severity
3. **Step III:** calculate average medical costs by casualty severity.

In this study, the medical cost incurred by accident victims during treatment was based on the medical records collected from identified hospitals, the average costs of all expenses during treatment was estimated and then multiplied by the number of casualties per accident category.

Formula for the different accident severities are given below.

Fatal Medical Cost (FMC) = at scene and ambulance costs + stay in-hospital costs +
Outpatient costs.

Serious Medical Costs (SMC) = at scene and ambulance costs +stay in-hospital costs + outpatient costs + rehabilitation and prosthetic costs.

Minor Medical Costs (MMC) = outpatient costs.

The total medical cost (TMC) is estimated by adding the estimated cost of MMC, SMC and FMC.The total medical cost is therefore; TMC = MMC + SMC + FMC

4.15.3 Lost output

Lost output is described as the loss the economy of a nation suffers as a result of the loss of the economic contribution of those affected by road traffic accidents. In developing countries, lost output is typically the largest casualty based resource cost, and can vary in value from as little as one day for minor injury casualties, to several years of lost contribution from people killed or permanently disabled in an accident (Silcock/TRRL, 2003). The most important data required for calculating lost output are the amount of time (hours, days, months or years) lost by casualties and the average income of the casualties.

For fatal casualties, the amount of working time lost is the difference between the time of death and the time they could have spent working in the future had they not suffered a premature death. This is computed to run from the time of death due to accident to the official age of retirement from work in the country. Thus, to calculate the lost working time for fatal casualties is take the average age at the time of the accident and subtract it from the average age of retirement. While for serious and minor injury victims, the number of working time lost is calculated as the time they would have spent at work had they not been involved in the accident that led to disability that kept them for that period of time in hospital or at home (Silcock/TRRL, 2003).

Data required for estimating average wages of casualties is normally sourced from three places; statistics of national income, surveys of travel time and surveys of accident casualties. In this study, the statistics of national income were used because they are a traditional source for computing the lost output. Likewise, it is easy to obtain and it's the choice for many studies (Silcock/TRRL, 2003). Lost output calculation was achieved in this study along the following steps.

1. **Step I:** compute the average amount of lost output by severity for each accident casualty.
2. **Step II:** compute the average age of victims in fatality accidents and subtract it from the average retirement age in the country to obtain the average years of lost output resulting from a fatal road traffic accident.
3. **Step III:** compute the average income by severity for each accident casualty.

4. **Step IV:** calculate the cost of lost output for fatal casualties. This is the sum of each future year's lost output, estimated as follows:

$$LO_{Fatality} = \sum_{i=1}^{N} \frac{W(1+g)^i}{(1+r)^i} \qquad (4.9)$$

Where;

r is discount rate

g is growth rate

W is average yearly per capita GDP

i is average number of years of lost output per fatal accident casualty

LO is lost output

5. **Step V:** calculate the cost of lost output for serious and minor casualties.

6. **Step VI:** calculate the total lost output for accident by summing the lost output estimate for fatal, serious and minor accidents.

4.15.4 Administrative cost

Administrative costs of accidents include police service costs, insurance administration costs and court administration costs.

The calculation of administration costs, would normally depend upon the type of data made available by the insurance companies, courts or the police authorities. Normally, the *amount of staff time* should be provided and this would be multiplied by the *employees' wages* to pay for that time. This will give results showing the average cost per severity of accident. In this study, the proportion of total crash costs for administration cost used is derived from the outcome of similar studies in the literature.

4.15.5 Cost of pain, grief and suffering

Quality of life is normally affected due to accident which comes with suffering, bereavement, pain and other adverse effects on people and society. As a result of this, a sum or estimate to cater for these human costs, usually called pain, grief and suffering is included in the final cost estimates of accident costs. According to Silcock/ TRRL (2003) the amount to estimate as the cost of pain, grief and suffering using the Human Capital Method is usually considered to be a political decision to be made for each accident costing situation. The decision however will be guided by consideration of the effect of accidents on the poor and the need to consider such amounts within the context of an overall poverty alleviation programme. Therefore, the higher the amount added, the higher the value the society would place upon the prevention of accidents. As such, some degree of judgment is required in order to decide how much will be added to reflect pain, grief and suffering in the estimates.

In this study of the cost of heavy goods vehicles road traffic accidents to the Nigerian economy, percentages of resource costs are used to represent the cost of pain, grief and suffering. These percentages are based on the values used in the literature for developing countries like Nigeria (Silcock/TRRL and Jacobs, 1995). In this case 28% is used for fatal accidents, 50% for serious accidents and 8% for minor accidents.

4.15.6 Total cost of accidents

The total cost of accident is then calculated by adding up the various accident components estimated. In this study, the sub totals of Property damaged cost, Lost output cost, Medical treatment cost, Administration cost and the costs of pain, grief and suffering and put together to arrive at the total cost of HGV accidents. The cost is then computed over the overall cost of accidents in the country to know its magnitude on the transport sector and the GDP of the country.

4.17 Estimating underreporting of accidents

As reported in 2.12-road traffic accident statistics adequacy often suffer from the problem of underreporting, especially in developing countries. In Nigeria, the problem is acute since a comprehensive accident reporting system is not yet fully in place. In this study, 80% is added to the official accident data to cater for underreporting of accidents. This is based on the findings of the Cleen Foundation study (2013).

4.18 Impact of HGV road traffic accidents on the Nigerian economy.

In this study, the impact of road traffic accidents involving heavy goods vehicles was measured in two ways.

a. Impact on the Cost of accidents to the GDP in Nigeria

   In many studies, the cost of accident is often measured against the overall GDP of a country and it usually ranges from 1-5% (see 2.10). However, in this study, the interest is in an aspect of the road traffic accidents, involving heavy goods vehicles only. In this way, this study is set to measure the percent of the total accident cost contributed by heavy goods vehicles.

b. Impact on the contribution of the transport sector to the annual GDP of Nigeria

   The transport sector contributes a certain amount to the GDP of Nigeria every year. Also, every year, part of that contribution is lost to accidents. The amount lost to heavy goods vehicles accident is estimated in this study as the measure of the economic impact of the accidents on the Nigerian economy.

c. Impact on the contribution of road transport sub-sector to the annual GDP of Nigeria

The road transport sub-sector is a very important component of the Nigerian road transport system. In fact, it accounts for 90% of all the transportation needs of the country. This study

therefore attempts to estimate the cost of HGV accidents to the contribution of the road transport sector to the Nigerian economy.

4.19 Summary and conclusion

This chapter on methodology provides the framework upon which this study is carried out. The chapter discussed the methodology of the study. The methodological approach was built around the research onion. The philosophical underpinning is based on positivist thinking, using an inductive approach. A survey research design was adopted to collect data from the field and from secondary sources. Primary data was collected from truck drivers and truck operators using a systematic random sampling approach, while secondary data was collected from FRSC and hospitals. Both primary and secondary data collected were subjected to validity test using the Cronbach's Alpha reliability test before analysis.

The statistical analysis frame work has also been presented in this chapter. Descriptive statistics were used to describe the nature of the industry, Mann-Whitney U-test was the analytical tools applied on the primary data to analyse the causes of accidents. Also, the human capital method was selected for use to estimate the cost of HGV road traffic accidents because of its simplicity and applicability to the data.

The procedure of using the human capital method to calculate the cost of accidents was also discussed in this chapter, step by step. Similarly, discussion was made on how the cost was calculated based on each cost component. The procedure used in assessing the impact of the cost of the accidents on the economy of Nigeria was also shown in this chapter.

Having defined the appropriate methodology for this study in this chapter, the next step is to analyse the data collected from the field survey and from the secondary sources. This task is accomplished in Chapters five and six.

CHAPTER FIVE

ANALYSIS OF DRIVERS AND OPERATORS RESPONSES

5.1 Introduction

This chapter contains the analysis of the results of the data derived from the completed questionnaires. The objectives of the questionnaires are to solicit information from practitioners in the road freight industry, especially the owners and operators of heavy goods vehicles on their operational activities and accident experiences. The questionnaires were administered by trained research assistants to drivers and operators of heavy goods vehicles at different locations in Nigeria in March 2013.

The first questionnaire was distributed to truck drivers at Shagamu in Ogun State and Mararraban- Jos in Kaduna State. The total number of questionnaires administered to drivers at both Shagamu and Mararraban Jos was 500 out of which 90 of the questionnaires were not appropriately filled in and were rejected. From the 410 questionnaires filled appropriately and returned, 272 (66.3%) are from Shagamu Park, Ogun State and the remaining 138 (33.7%) are from Mararraban-Jos, Kaduna State (see 4.10).The second designed questionnaire was distributed to operators of Heavy Goods Vehicles, that is, officials working in road freight companies. The total number of questionnaires administered was 279, out of which 213 were filled and returned. Respondents targeted were from trucking companies at four different locations namely; Kaduna, Kano, Lagos and Port Harcourt (see 4.10).

In analysing the responses from the respondents (Drivers and Truck Operators) in the questionnaires, the following statistical methods have been used (see 4.13).

Frequency distribution of responses

Pie and Bar charts representation

Mann Whitney u-test analysis

The statistical software used for the analysis was SPSS 20.0 (statistical package for social sciences).

In this Chapter, the responses of drivers and operators during the field survey are analysed and some of the information will be used in estimating the cost of HGV accidents in chapter six. Similarly, an analysis of the responses of drivers and operators on the causes of accidents and their prevention strategies will also be made. At the end of the Chapter, **objective three** of this study will be achieved.

5.2 HGV DRIVERS

Heavy goods vehicle drivers are key players in the road freight business in Nigeria. To understand the industry therefore, a survey of their occupational characteristics was performed and the analysis is done in this section**.** This section addresses **objective one** of this study.

5.2.1. Age of vehicles drivers

Table 5.1 and Figure 5.1 shows the age distribution of truck drivers in the study area. A total of 272 and 138 drivers from Shagamu and Mararraban- Jos Parks responded to this section respectively. This shows that all the 410 drivers answered this question as illustrated in Figure 5.1.

Table 5:1 Age structures of drivers in Shagamu/Mararraban -Jos parks

Driver's Age	Name of Park		Total
	Shagamu	M/ Jos	
18-28 years	6	10	16
	2.2%	7.2%	3.9%
29-39 years	98	45	143
	36.0%	32.6%	34.9%
40-50 years	101	51	152
	37.1%	37.0%	37.1%
51 years & above	67	32	99
	24.6%	23.2%	24.1%
Total	272	138	410
	100.0%	100.0 %	100.0%

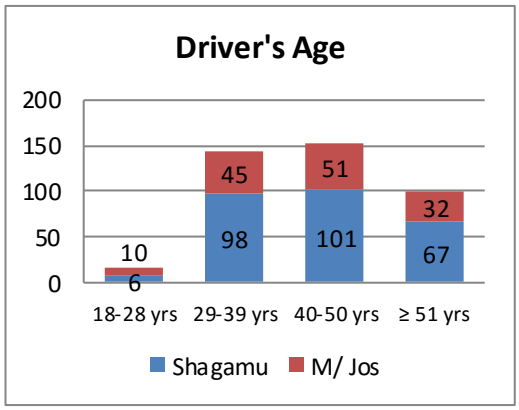


Figure 5.1: Age distribution of drivers

The result revealed that the highest proportion of drivers are between the age group of 40-50 years with 37% in both Shagamu and 37% in

Marraraban-Jos, followed by the age group between 29-39 years with 36% and 32.6% respectively. The results also show that the majority of the drivers in the study area are between the age group of 29 and 50 years amounting to 72 % of the total sampled driver population, while just 3.9% of drivers are between the age group of 18-28 years. Heavy goods vehicles drivers in Nigeria are therefore in their prime years and would be able to withstand the rigours of truck driving, which requires energy, skills and perseverance. This result is expected since heavy goods drivers' are normally expected to have garnered previous years driving experience from driving other vehicles and gradually moving to bigger vehicles. Drivers' licences are legally issued to people who are 18 years of age in Nigeria. For Heavy Goods Vehicles, the National Road Traffic ACT (2012) requires drivers to be 26 years of age before they are licenced to drive that category of vehicles. However, many freight companies do not really comply with this requirement since the result of this survey is showing that some of the drivers are below 26 years. For example, Dangote group has a minimum age requirement of 25 years for employment of heavy goods vehicles drivers. However, in the United Kingdom, learner driver licences are issued to drivers on attainment of 17 years and the age requirement for heavy goods vehicles ranges from 21 to 23 years, depending on the insurance policies in practice in a particular organisation.

5.2.2 Ownership status of heavy goods vehicles

Table 5.2 and Figure 5.2 shows the vehicle ownership status of freight truck drivers in Shagamu and Mararaban Jos Park respectively.

Table 5.2: Vehicle ownership status

Ownership Status	Name of Park		Total
	Shagamu	M/ Jos	
Self	9	1	10
	3.3%	0.7%	2.4%
Transport Company	251	44	295
	92.3%	31.9%	72.0%
Labour Union	11	18	29
	4.0%	13.0%	7.1%
Factory/Industry	0	75	75
	0.0%	54.3%	18.3%
Government Organization	1	0	1
	0.4%	0.0%	0.2%
Total	272	138	410
	100.0%	100.0%	100.0%

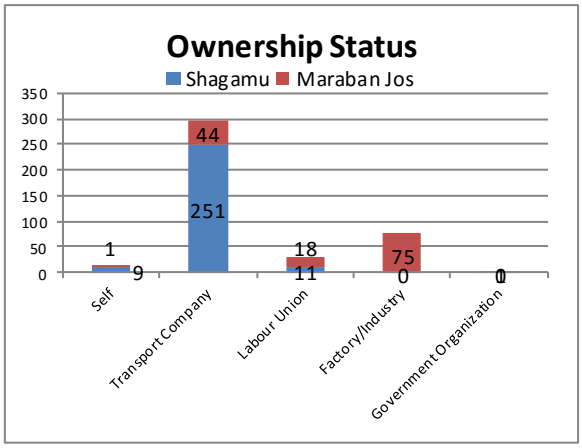


Figure 5.2: Vehicle ownership

The result revealed that most vehicles in Shagamu Park (92.3%) are owned by transport companies and 4% are owned by labour unions while in Mararraban- Jos, 54.3% of the trucks are owned by factories/Industries and 31.9% are owned by transport companies. The high concentration of trucks owned by transport companies in Shagamu against Mararraban-Jos is because of the nature of goods transported in the region which is largely industrial goods and imported goods. While in Mararraban-Jos, the majority carry petroleum products from Kaduna refinery and agricultural products from neighbouring agricultural areas.

The results show that most of the vehicles are owned by transport companies (72%) followed by vehicles owned by factories/Industries (18.3%), while drivers who own vehicles are 2.4% of the total vehicle ownership status.

5.2.3 Drivers dependants in the family

Table 5.4 and Figure 5.3 show the drivers' number of family dependents in the study areas. The result shows that most drivers (62.9%) in Shagamu have 6-10 dependants and 16.9% of the drivers with 11-15 dependants while in Mararraban-Jos, most drivers (53%) have 0-5 dependants and 34.3% of drivers with 6-10 dependants.

Table 5.3: Distribution of driver's number of dependants

Dependants	Name of Park		Total
	Shagamu	M/ Jos	
0-5	42	71	113
	15.4%	53.0%	27.8%
6-10	171	46	217
	62.9%	34.3%	53.4%
11-15	46	13	59
	16.9%	9.7%	14.5%
16-20	4	3	7
	1.5%	2.2%	1.7%
21 & above	9	1	10
	3.3%	0.7%	2.5%
Total	272	134	406
	100.0%	100.0 %	100.0%

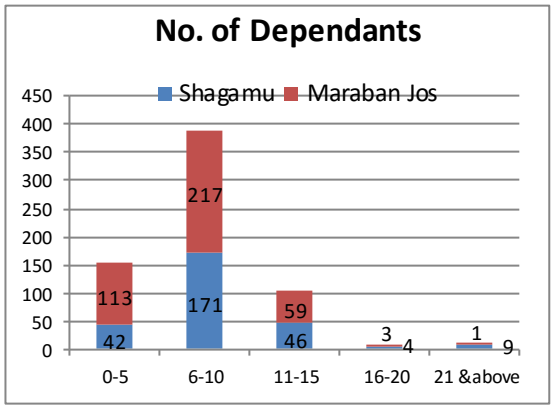


Figure 5.3 Drivers number of dependants

The results from Table 5.3 revealed that most drivers (53.4%) have 6-10 number of family dependants, 27.8% of drivers have 0-5 number of

dependents in their families while only 1.7% has between 16 to 20 numbers of family dependents. This shows that most dri

vers (81.2%) in the study area have between 0-10 of dependants in their families.

5.2.4 Drivers' educational qualification

Table 5.4 and Fig: 5.4 show drivers' educational qualifications. The result reveals that most drivers (46.8%) in Shagamu have secondary school certificate, while 35.6% have primary education. In Mararraban Jos, 33.6% have Primary school education, 32.8% have Quaranic education while 32.1% have Secondary school education

Table 5.4 Drivers educational qualification

Qualification	Name of Park		Total
	Shagamu	M/ Jos	
HND/B.Sc. or Higher Degrees	0	0	0
	0%	0%	0%
NCE/OND	1	2	3
	0.4%	1.5%	0.7%
Secondary School	125	43	168
	46.8%	32.1%	41.9%
Primary Education	95	45	140
	35.6%	33.6%	34.9%
Quranic Education	46	44	90
	17.2%	32.8%	22.4%
Total	267	134	401
	100.0%	100.0 %	100.0 %

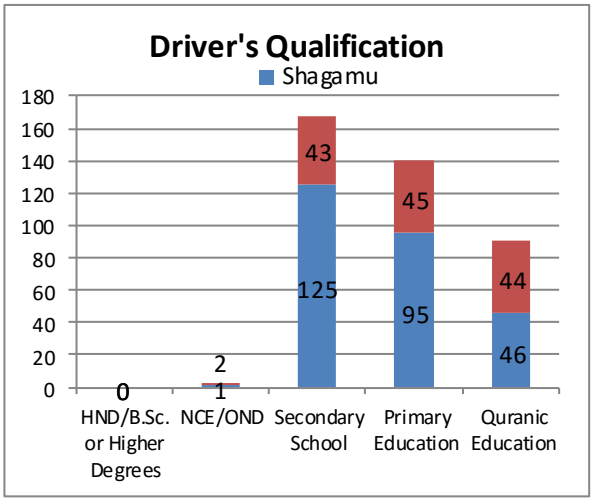


Figure 5.4: Drivers qualification

The result reveals that majority (41.9%) of drivers in the country have secondary school education, 34.9% have only primary school education and 90 (22.2%) have Quranic education, while only 0.7% are NCE/OND holders. This means that none of the drivers have a university degree or higher degree. It is therefore right to conclude

that all drivers of Heavy Goods Vehicles in Nigeria have a certain level of literacy. Problems may arise from those drivers who only have Quranic education (which is based on Arabic alphabets) because they may not be able to read and interpret properly traffic signs, rules and regulations which are normally written English, except when they are translated into Arabic or vernacular using Arabic alphabets.

5.2.5 Drivers' years of experience

Table 5.5and Figure 5.5 show the driving experience of Heavy Goods Vehicles drivers. The result shows that about 64.3% of the drivers in Shagamu Park have driving experience of heavy goods vehicles of between 8 and 21 years, while most (76.1%) drivers in Mararraban-Jos have 0-21 years of driving experience.

Table 5.5: Driver's years of driving experience

Driving Experience	Name of Park		Total
	Shagamu	M/ Jos	
0 - 7years	36	24	60
	13.2%	17.4%	14.6%
8 - 14years	74	29	103
	27.2%	21.0%	25.1%
15 - 21years	65	52	117
	23.9%	37.7%	28.5%
22 - 28years	34	14	48
	12.5%	10.1%	11.7%
29 - 35years	51	12	63
	18.8%	8.7%	15.4%
36years & above	12	7	19
	4.4%	5.1%	4.6%
Total	272	138	410
	100.0%	100.0%	100.0%

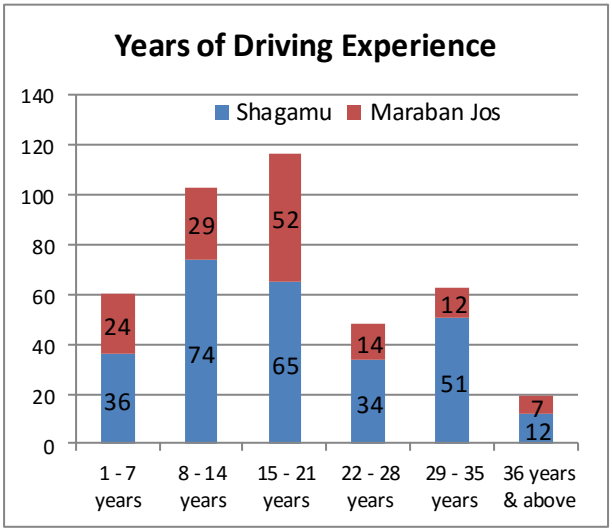


Figure 5.5 Drivers years of experience

Overall, the majority of the drivers (28.5%) have 15-21 years of driving experience, 25.1% have 8-14 years of experience, 15.4% have 25-36 years experience while 7.1% have 1-7

years of driving experience. Looking at the average age of the drivers, which range from 29-50 years, the majority of drivers' years of experience in driving ranging from 8-36 years are justifiable. This means that a driver, who started driving at 18 years, now aging 50 years, would have gathered 32 years driving experience.

Based on the above, it can be concluded that heavy goods vehicles drivers in Nigeria are experienced, having worked for a long period of time. This is expected to contribute to their driving performance.

5.2.6 Types of heavy goods vehicles on Nigerian roads

Table 5.6 and Figure 5.6 show the type of trucks driven by drivers. The result shows that most drivers (61.4%) in Shagamu drive tanker trucks, while 29.4% drive trailer trucks. In Mararraban-Jos most drivers (58.7%) also drive tanker trucks while 38.4% drive trailer trucks, but just 9.2% and 2.9% of drivers drive Lorries respectively. The result revealed more than half (60.5%) of the drivers drive tanker trucks, 32.4% drive trailer trucks and only 7.1% drive Lorries.

Table 5.6: Drivers' type of trucks

Type of Truck	Name of Park		Total
	Shagamu	M/ Jos	
Tanker	167	81	248
	61.4%	58.7%	60.5%
Trailer	80	53	133
	29.4%	38.4%	32.4%
Lorries	25	4	29
	9.2%	2.9%	7.1%
Total	272	138	410
	100.0%	100.0 %	100.0%

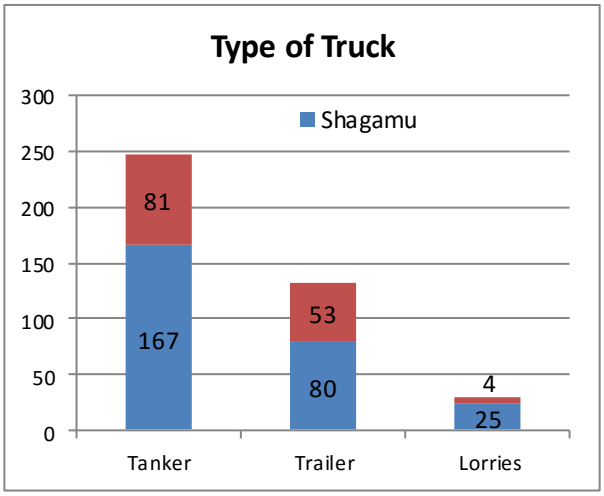


Figure 5.6 Types of Trucks

This is a reflection of the categories of trucks on Nigerian roads. Almost half of the trucks are tanker trucks, reflecting the over dependence of the Nigerian economy on the road transport system in the distribution of petroleum products. This is so because of the failure of the

pipeline system arising from insecurity and insurgency in the Niger Delta region where most of the pipelines originate.

Similarly, lorry populations are very small due to the fact that larger and more versatile trailers have taken over the road freight business from the hitherto popular lorries which cannot withstand the demand of modern freight transport industry. It was also observed during the field survey that the trucks on the Nigerian roads are single trailer trucks, some of which are open body.

5.2.7 Normal routes of heavy goods vehicles

The summary of routes plied by freight vehicles is presented in the Table 5.7

Table 5.7: Route of freight vehicles

Route	Frequency	Percentage	Valid Percentage
Lagos-Shagamu-Ibadan-Jebba-Kaduna-Kano-Maiduguri	191	46.6	53.4
Lagos/shagamu-ore-benin-onitsha-oweri-aba-Ph	30	7.3	8.4
Lagos/shagamu-mokwa- jega-sokoto	25	6.1	7.0
Lagos/shagamu-ilesha- obajana-lokoja-abuja-kaduna-jos	18	4.4	5.0
Lagos/shagamu-ijebuode-ore-benin-warri	18	4.4	5.0
All route	18	4.4	5.0
Lagos/shagamu-abeokuta	15	3.7	4.2
Lagos/shagamu-mokwa-B/gwari-futua-katsina	7	1.7	2.0
Lagos/shagamu-mokwa-bida-suleja-abuja-kaduna	7	1.7	2.0
Lagos/shagamu-ore-benin-onitsha-jalingo-yola-maiduguri	6	1.5	1.7
Lagos/shagamu-ijebuode-ore-benin-onitsha-warri-bayelsa	4	1.0	1.1
Lagos/shagamu-ogbomosho	4	1.0	1.1
Lagos/shagamu-Ibadan-Jebba-Jos-Bauchi-Gombe	3	0.7	0.8
Lagos/shagamu-benin express road	3	0.7	0.8
Lagos/shagamu-ore-benin-enugu-otukpo-makurdi-lafia-jos-bauchi-gombe-yola	3	0.7	0.8

Lagos/shagamu-ore-benin-onitsha-enugu-otukpo-katsinaala	2	0.5	0.6
Lagos/shagamu-ore-benin-onitsha-oweri-aba-Uyo-calabar	1	0.2	0.3
Lagos/shagamu-zuru	1	0.2	0.3
Lagos/shagamu-Niger Republic	1	0.2	0.3
Lagos/shagamu-Ilaro	1	0.2	0.3
TOTAL	**358**	**87.2**	**100**
No response	52	12.7	
TOTAL	**410**	**100.0**	

Source: Field survey 2013

From Table 5.7, the major road corridors with the highest concentration of truck traffic are the Lagos-Shagamu- Ibadan-Jebba-Kaduna-Kano - Maiduguri route. It is the longest route passing through main cities across the country. Other important routes are the Lagos-Shagamu-Ore- Benin-Owerri-Aba- Port Harcourt route. This route is very important because it moves goods from Lagos port and industrial centres to the commercial heart of the Eastern part of the country and the Delta region.

5.3 HGV OPERATORS

A survey was conducted on truck operators to determine their operational characteristics. The survey was conducted using questionnaires in Lagos, Kaduna, Kano and Port Harcourt. The responses of the operators are analysed in the following sections. This section addresses **objective two** of this study

5.3.1 Location of HGV operators

Table 5.8 and Figure 5.7shows the location of the operators of freight vehicles. The result reveals that 31.9% of the operators are located in Kaduna, followed by Lagos and Kano with 24.9% and 23.9% respectively, while those in Port Harcourt are 19.2%.

Table 5.8: Location of the operator

Operators Location	Frequency	Percent
Kaduna	68	31.9
Kano	51	23.9
Lagos	53	24.9
Port Harcourt	41	19.2
Total	213	100.0

Source: Field survey,2013

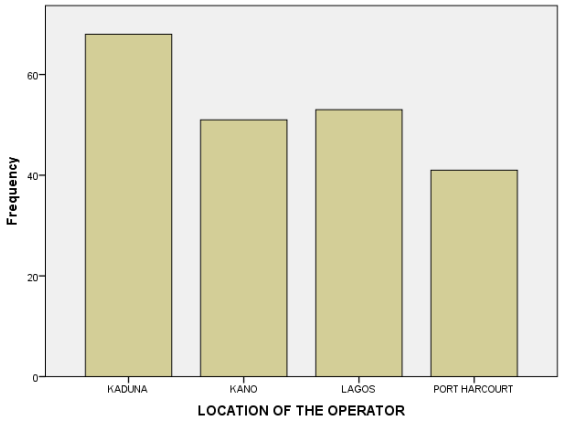


Figure 5.7: Location of operator

The location of operators is a function of the demand for truck services. Kaduna has a high number of operators because of its status as a refinery city where petroleum products are lifted and distributed to many parts of the country. Kano has large population of trailers because of its status as the commercial centre of Northern Nigeria, where industrial products are produced and distributed to many areas. Lagos is the economic capital of Nigeria, being home to the country's largest ports, with major industrial establishments and heavy population concentration.

Similarly, Port Harcourt is home to Nigeria's biggest refinery, petro-chemical Company, fertilizer plant and second largest port establishments. The majority of the truck operators therefore have a substantial portion of their business activities around these key economic centres, because they have to lift these products to northern Nigeria where they are utilised.

5.3.2 Operators' years of operational experience

Following the decline of the railway system in Nigeria, heavy goods vehicles took over as the main means of road freight business in the country. This emerged to be so since the early 1980"s, following the oil boom of the 1970"s that led to expansion in the road network and massive increase in imports.

Table 5.9 and Figure 5.8 show the operators' years of experience. It reveals that majority of operators (67.0%) have 1-10years of experience, followed by 23.9% who have 11-20years, and 7.2% said they have 21-30 years' experience, while those operators with 31years of experience are just 1.9% of the total respondents.

Table 5.9: Operator's years of Experience

Years of experience		
	Frequency	Percent
1-10 years	140	67.0
11-20 years	50	23.9
21-30 years	15	7.2
31 years & above	4	1.9
Total	209	100.0
No Response	4	
Total	213	

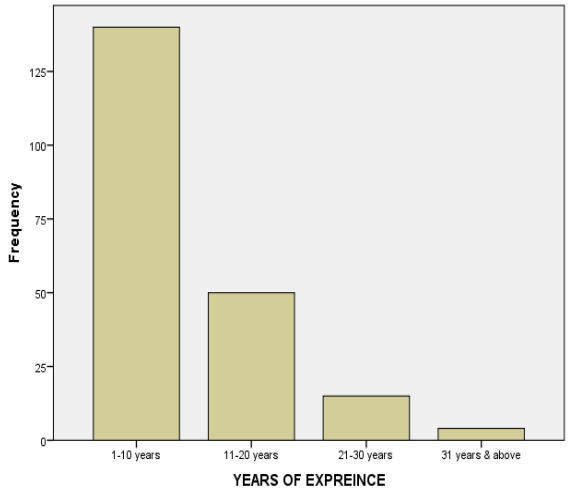


Figure 5.8 Operators Years of Experience

This may not be unconnected with the harsh business environment that makes it difficult for the operators to sustain long years of business. It may also be connected with the fact that in the 1960s and 1970s, the railway system was the dominant means of movement for goods across the country, but it declined in the early eighties.

5.3.3: Operators' fleet size

Table 5.10 and Figure 5.9 show the number of heavy goods vehicles owned by different company levels. It is shown that most companies (79.7%) have between 1-20 vehicles, 8.2% have 21-40 vehicles and those with 41 vehicles and above 12.1%. The result in Table 5.10 show that majority of operators are small. This reflects the situation in Table 5.9 where it was shown that most truck operators do not have many years of operational experience. Apart from short years of operational experience, other factors that can be attributable to the operators' small fleet size could be their poor capital base and absence of large scale investment in the trucking industry occasioned by its high risk.

Table 5.10: The number of HGV in company

Number of HGV owned by companies			
Number of vehicles		Frequency	Percent
	1-20	145	79.7
	21-40	15	8.2
	41 & above	22	12.1
	Total	182	100.0
Missing	No Response	31	
Total		213	

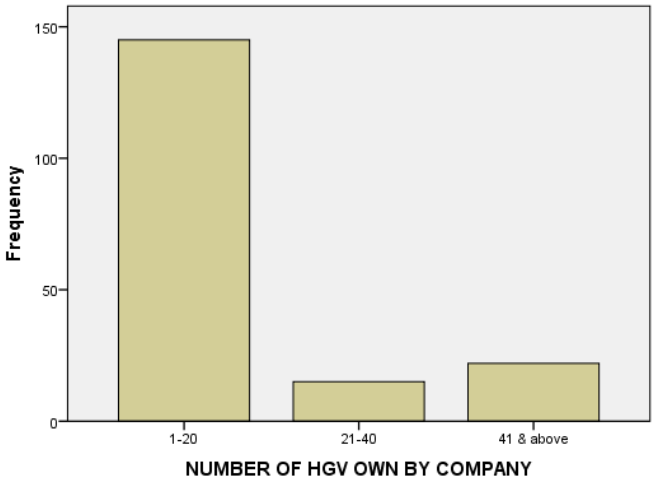


Figure 5.9 Numbers of vehicles in company

This situation notwithstanding, some of the big operators have a significant number of trucks in their fleets. These include the major oil marketing companies and manufacturing companies like the Dangote group, Oando oil, Total oil, Arrahmaniya oil and Gas, Coca-cola, Seven-up, Flour mills and Nigerian breweries.

5.3.4 Scale of truck ownership by companies by types of trucks

The number of trucks owned by truck companies shows that majority of companies surveyed have smaller number of vehicles in their fleet (Table 5.11).

Table 5.11: The Number of trucks owned by the operators by types

Number of Tankers Owned	Frequency	Percent
1-15	52	67.5
16-30	11	14.3
31 & above	14	18.2
Total	77	100.0
Number of trailers owned		
1-15	105	83.3
16-30	7	5.6
31-45	5	4.0
46 & above	9	7.1
Total	126	100.0
Number of lorries owned		
1-3	36	59.0
4-6	21	34.4
7 & above	4	6.6
Total	61	100.0

Table 5.11 confirms that the majority of the operators of the trucks are really small holders. 67.5% of the respondents reported a fleet size of 1-15 tankers in their companies. 83.3% reported that their trailer numbers ranges between 1-15 and 59% reported a small lorry fleet size of 1-3.

5.3.5 Capacity of vehicles by type

The capacities of heavy goods vehicles on Nigerian roads are presented in Table 5.12. According to the survey, the capacities of the trucks are generally low, reflecting the capacity of the infrastructure, the state of the economy and the level of investment in the sector.

Table 5.12: Capacity of vehicles owned by the operators

Capacity of Tanker Owned	Frequency	Percent
15000 - 30000L/T	6	7.6
31000 - 46000L/T	67	84.8
47000L/T & above	6	7.6
Total	79	100.0
Capacity of Trailer Owned		
15-25 tonnes	26	21.5
26-36 tonnes	91	75.2
37 tonnes & above	4	3.3
Total	121	100.0
Capacity of Lorry Owned		
6-12 tones	18	34.6
13-19 tones	13	25.0
20 tones & above	21	40.4
Total	52	100.0

Table 5.12 shows the capacity of tankers, trailers and Lorries operated by operators. The result shows that most tankers have capacities of 31000-46000L. Capacity of trailers is in majority between 26-36 tonnes, while capacity of Lorries is mostly 20 tonnes and above. The road transportation infrastructure is presently not designed to carry heavier vehicles and

double trailers. Its state of disrepair and poor maintenance means that heavier trucks cannot operate successfully in Nigeria at the moment.

5.3.6 Types of goods transported

The types of goods transported on Nigerian roads are a reflection of the nature of the economy. From Table 5.13, 27.5% of the operators disclosed that they transport general goods like consumer items, textiles and other household needs. These kinds of goods are normally transported in trailers and Lorries. Figure 5.10 illustrates the result further.

Table 5.13: Main types of goods transported by the operators

Types of Goods	Frequency	Valid Percent	Percentage
Petroleum products	88	43.6	41.3
General	59	29.2	27.7
Building materials	13	6.4	6.1
Grains and agricultural goods	12	5.9	5.6
Asphalt / bitumen	9	4.5	4.2
Contenerised goods	9	4.5	4.2
Electrical/Electronics	5	2.5	2.3
Heavy iron and metals	3	1.5	1.4
Provision goods	2	1.0	0.9
Bottled drinks	2	1.0	0.9
Total	202	100	-
Missing/No response	11	-	-
Total	213	-	100

Source: Field survey, 2013

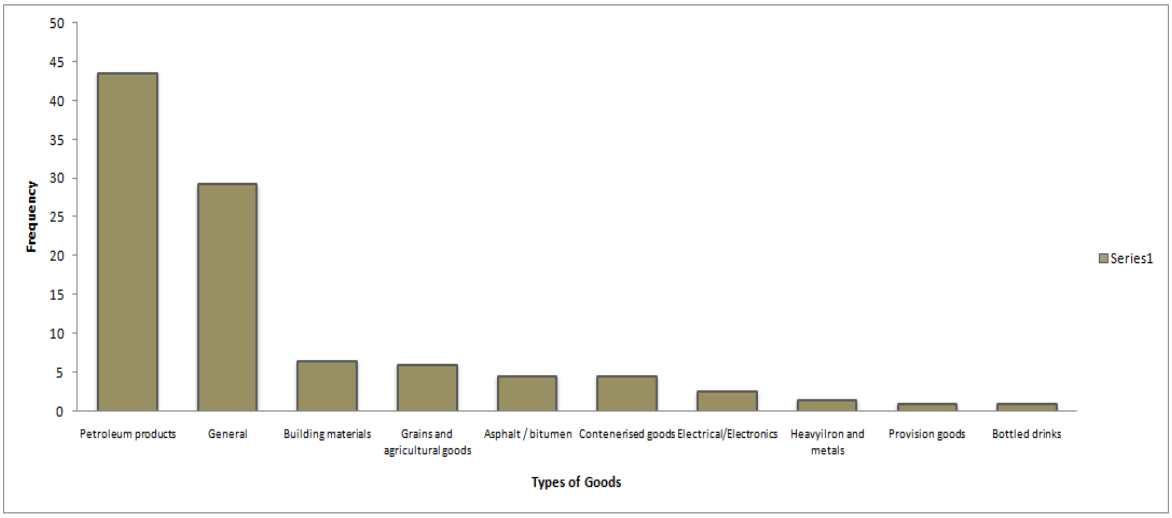


Figure 5.10 Types of goods transported by freight vehicles

Petroleum products accounted for 41.3% of the goods transported. This reflects the strength of the number of tanker trucks on Nigerian roads, and indicates that most of the operators that responded to this question are tanker truck owners.

5.3.7: Value of goods transported by freight vehicles

Table 5.14 shows the value of goods transported per freight vehicle. Several types of goods are transported by HGVs across Nigeria. Table 5.13 provides a group of such goods. However, these goods have significant variation in values. Table 5.14 shows such value ranges across the group of HGVs in use. The table shows that both trailers and Tankers do carry goods wort over $87,000 while, the highest for Lorries is about $31,000. This is so because Lorries have lower tonnage capacity, and cannot very high value goods because of the nature of their configuration.

Table 5.14: Value of goods transported in US dollar

Tanker		Frequency	Percent
Value of Tankers Goods	<$3,125	0	0
	3,125 -$31,250	29	44.6
	$31,250- $59,375	12	18.5
	$59,376-$87,501	10	15.4
	>$87,502	14	21.5
	Total	65	100.0

Value of Trailer Goods	< $3,125	13	13.4
	$3,125-$31,250	27	27.8
	$31,250- $59,375	15	15.5
	$59,376-$87,501	14	14.4
	>$87,502	28	28.9
	Total	97	100.0
Value of Lorries Goods	<$3,125	2	4.8
	$3,125-$31,250	24	57.1
	>$31,250	16	38.1
	Total	42	100.0

Source: Field survey, 2013

5.3.8: Cost of damage to vehicles/goods due to road freight traffic accidents.

Having seen the types and values of goods transported by heavy goods vehicles in Nigeria, this section presents the average cost of damage to goods and vehicles resulting from accidents as reported by the operators. Table 5.15 shows the average amount of losses road freight operators recorded as a result of accidents from 2007-2011.

Table 5.15: Average cost of damage to vehicles and goods 2007-2011

Average cost (in US dollar)	2011 (000)	2010 (000)	2009 (000)	2008 (000)	2007 (000)
Average cost of vehicle repair for 2011	$63	$38	$37	$31	$25
Average cost of goods damage for 2011	$77	$66	$59	$50	$46
Average cost of goods damage to third party	$58	$50	$40	$29	$23

Source: Field survey 2013

The average cost for vehicle replacement ranges from to $25,000 in 2007 to $63,000 in 2011. The amounts cover the repair of accident vehicles and replacement of damaged vehicles or key components like trailer head or the trailer or the tanker itself.

The average cost involving damage to goods in transit ranges from $46,000 in 2007 to $77,000 in 2011. This is justified from Table 5.14 where majority of trailers transport goods of more than $87,000, majority of the goods transported by tanker are valued at $3,125-$31,250 and that of lorry are also valued at $3,125-$31,250.

The average cost of third party goods damaged as a result of truck accidents ranges from $23,000 in 2007 to $58,000 in 2011. Damage to third party properties includes effects on buildings, shops and farmlands. This difference is due to inflation and the continuous decline in the value of the Naira, the Nigerian currency.

5.3.9 Insurance Policies

Further to the above, operators believe that insurance is important in ensuring that they are successful in their business. Table 5.16 shows the number of operators with insurance policies.

Table 5.16: Vehicle insurance practices

INSURANCE		
	Frequency	Percent
Yes	116	54.5
No	1	.5
No Response	96	45
Total	213	100.0

Source: Field survey,2013

The road freight traffic business involves a lot of risk as vehicles transporting goods are subjected to the risk of accidents, pilferages, damage due to weather factors and other unforeseen circumstances. Conscious of these, 54.5% of freight transport operators have insurance policies to cover their operations. 45 % of the respondents have not responded to the insurance question, suggesting most likely that they are not insured and they don't want to disclose this knowing the legal implication of that response. The number of the operators with insurance is very low bearing in mind the nature of the road freight transport industry

and the challenges associated with it. This means that the law on insurance as contained in NRTR (2012 that requires every vehicle to be insured before it is put to use is not being fully enforced. This needs to be fully implemented in the interest of the Nigerian economy.

5.3.10 Road transport Safety standardisation scheme

The Road Transport Safety Standardisation Scheme was introduced by the Federal Road Safety Commission in 2007 to address the problems of safety among commercial vehicle operators in the Nigerian road transport sector. Key features of the scheme include the registration of all commercial transport operators and the establishment of safety departments/units to be headed by a competent road safety officer in the Transport organisation. Table 5.17shows the responses of HGV operators regarding their compliance to the requirement of the scheme.

Table 5.17: Number of vehicles with RTSS certification

RTSS CERTIFICATION		
	Frequency	Percent
Yes	68	31.9
No	7	3.3
No Response	138	64.8
Total	213	100.0

Source: Field survey 2013

The result shows that only 31.9% of the operators are registered with the RTSS scheme and 64.8% of the operators surveyed did not respond to the question about the RTSS. In view of the above, it is worth saying that the response rate and the percentage of compliance does not indicate that the operators are fully into the RTSS scheme. However, it suffices to say that more enlightenment need to be put in place to educate the operators on the importance of the scheme and how it can assist in improving the safety of their operations.

5.3.11 Challenges of road freight haulage in Nigeria

Road freight Haulage in Nigeria is affected by a number of problems. Some of the problems have been identified by the freight vehicle owners and operators during the survey, and are presented in Table 5.18.

Table 5.18: Challenges of road freight operation in Nigeria

Challenges in road freight haulage	%
Lack of good road network	40.0
Lack of enforcement of road traffic regulations	19.3
Poor driver education and training	16.7
Poor use of road signs and signals	10.5
Non enforcement of appropriate punishment to road traffic defaulters	9.5
Non clearance of road obstruction	4.0

Source: Field survey 2013

From Table 5.18, the major problem of the road freight industry in Nigeria according to the operators is the lack of good road infrastructure. Road maintenance is not regular in major road networks and most of the roads are not dual and ashpalted, making it difficult for truck drivers to adequately manoeuvre. About 40% of the road freight operators consider this to be the major challenge facing their business, since the consequences of bad roads are frequent vehicle repairs, delays that may result in higher energy consumption and thus, higher operational costs. Bad roads may also be responsible for accidents. The lack of effective enforcement of traffic rules and regulations is also a very serious problem for the road freight industry in Nigeria. In Table 5.18, 19.3% of the operators who responded to the question believed that traffic enforcement agencies have not been doing their role in enforcement of road traffic signs adequately.

Poor driver education and training is also a serious factor affecting the performance of the road freight industry. The survey shows that 16.7% of the operators see this problem as seriously affecting the success of the industry. In the earlier analysis of driver educational

qualifications, it was seen that the majority of the drivers fall within the secondary education level. This may not be sufficient for the drivers to adequately understand the demand of truck driving and management, unless it is regularly complemented with regular continuous driver training programmes, which are not very common in Nigeria.

A large portion of the Nigerian road network is not properly marked with relevant road signs, while in some other portions the road signs have been eroded or removed. In some other circumstances, the road users are not well trained to read and interpret the road signs. There are also cases where road users deliberately disobey the signs and signals. This constitutes a problem for road traffic operators, and 10.5% of the operators consider it as a serious problem. Non-application of appropriate penalties to road traffic offenders constitutes 9.5% of the road freight traffic problems according the operators. This may not be disassociated with corruption, where government officials collect gratification from offenders in order to set them free.

The preponderance of roadblocks on major highways constitutes a problem to road freight transport operation. The survey shows that 4% of the operators see this as a problem affecting their operations. Road blocks are very common on Nigerian roads, most of which are erected by security agencies including the Nigerian police, the Federal road safety corps marshals, Vehicle inspection officials, and National drug law enforcement officials, the Nigerian Custom services and the Nigerian Army. Construction companies that are responsible for road repair and maintenance also maintain roadblocks at their sites and road diversions, which at times are erected at short notice without prior warning.

5.3.12 Improvement measures of road freight haulage in Nigeria

To have an efficient road freight transport industry in Nigeria, operators have recommended the implementation of measures contained in Table 5.19.

The operators believe that even though the infrastructure may not be adequate and sufficient, if traffic rules would be enforced to the letter, order would be restored in the system and sanity would be established. However, some of the operators (25.7%) have the feeling that stakeholders are not being adequately involved in the design and implementation of road

safety policy. As key players in the industry, stakeholders have a great role to play in ensuring that the operations of the industry are safe and according to standards.

Table 5.19: Measures to improve road freight business in Nigeria

Solution to problem facing road haulage	%
Enforcement of all driving regulations	42.2%
Improve stakeholders collaboration to address road safety	25.7%
Strategically provide more road parking facilities	15.6%
Adopt measures to monitor drivers on the road	13.8%
Use of good tyres and spare parts	2.8%

Source: Field survey 2013

Table 5.19 shows the opinions of truck owners on the measures that need to be put in place to improve the operation of road freight traffic in Nigeria.

Parking facilities are generally a big problem for heavy goods vehicles in Nigeria. Roads have not been constructed with these in mind, thus it is a common sight that trailers and tankers are parked along road shoulders or on the road divides, thus causing obstruction to other road users. Attempts have been made by the Federal Road Safety Commission and the Federal Roads Maintenance Agency to address this problem without success. This problem is common in locations like Mokwa, Tafa, Marraban Jos, Ogere, Shagamu, Apapa, Potiskum and Ore, Jebba, Oballo-Afor, Onitsha. Fifteen point six percent (15.6%) of the operators are of the opinion that addressing this problem will considerably contribute to the improvement of the road freight traffic system.

Driver factors are also a key consideration in the improvement of the road traffic industry. Drivers need to be trained regularly and be informed of best practices on the performance of their functions. For selfish reasons, drivers of Heavy Goods Vehicles are in the habit of sharp practices like pilferage of cargo, careless driving and overloading of vehicles. The survey shows that 13.8% of truck operators believe that improvement of drivers' attitude will improve the road freight transport industry in Nigeria.

Vehicle Maintenance and use of good tyres and genuine spare parts is also a way of improving the road freight industry. The survey shows that 2.8% of the operators have problem in the area of vehicle maintenance. This is so because the majority of the trucks on Nigerian roads are used vehicles imported to the country after the end of their useful life in Europe and America. Spare parts for their maintenance are not readily available, making it necessary for maintenance garages to improvise to enable the vehicle to work. Similarly, tyres are no longer being manufactured in Nigeria, thus making it difficult for operators to afford the tyres imported due to the high cost. As a result of this, drivers and operators use tyres until they are completely worn out and unmanageable.

The Government needs to evolve policies that would address these problems through the provision of rebate on imports related to Heavy Goods Vehicle maintenance, and also encourage the resuscitation of the tyre manufacturing and the establishment of new companies.

Most of these problems centre on regulation and standardisation of the road transport industry in Nigeria. A lot needs to be done by the Government to establish standards and regulations that would serve to guide the operations of the road freight transport industry in view of its critical role to the wellbeing of the Nigerian economy.

5.4 Heavy Goods Vehicles Accidents

In this section, responses on nature and causes of heavy goods vehicles traffic accidents and their prevention strategies are analysed. Both drivers and operators were requested to state their experiences regarding accidents involving HGV in Nigeria. This section addresses **objective three** of this study.

5.4.1 Number of drivers and vehicles involved in road freight traffic accidents

Table 5.20 shows the frequency distribution results on drivers' involvement in accidents from 2007 – 2011. It can be observed that out of the 410 drivers that responded to the question, 56 (13.7%) of them have been involved in road freight traffic accident while 354 (86.3%) of the remaining drivers have not been involved in road freight traffic accidents. Hence, the type of the accidents encountered by these 56 (13.7%) drivers is examined for the 5 years in order to know the impact.

Table 5.20: Drivers involvement in accident between 2007 -2011

Drivers involvement in accident between 2007 -2011	Name of Park		Total
	Shagamu	Maraban Jos	
Yes	30	26	56
	7.3%	6.3%	13.7%
No	242	112	354
	59.0%	27.3%	86.3%
Total	272	138	410
	66.3%	33.7%	100.0%

Source: Field survey, 2013

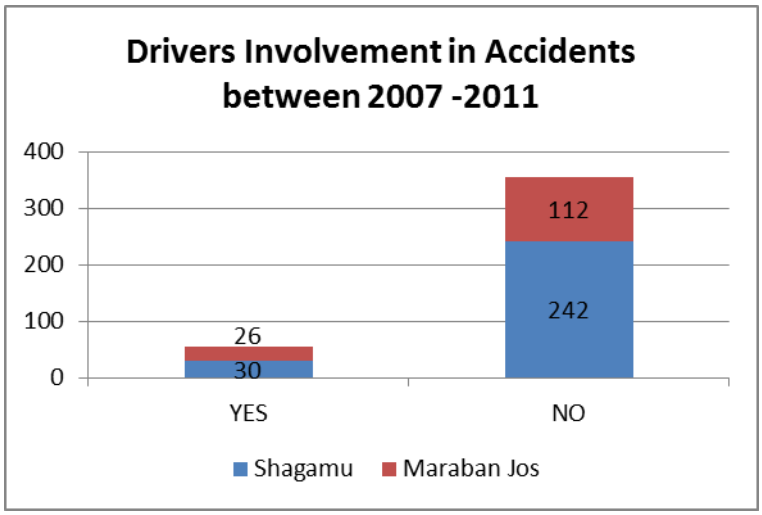


Figure 5.11: Drivers Involvement in Accident between 2007 -2011

Furthermore, Table 5.21 shows the number of accidents involved by drivers between 2007 - 2011. The result shows that all drivers involved in accidents had one accident, except in 2010, where a driver recorded three accidents. This implies that the frequency of same driver repeating accident is very low.

Table 5.21: Number of drivers' involvement in accident between 2007 -2011

Frequency	Years				
	2011	2010	2009	2008	2007
One accident	8	13	11	7	16
Two accidents	0	0	0	0	0
three accidents	0	1	0	0	0
Total	8	14	11	7	16

Source: Field Survey, 2013

The results also show that 2007 recorded the highest number of accidents (16), 2010 recorded 14 number of accidents while 2008 recorded the lowest involvement (7).Similarly, Table 5.22 is a representation of the number of vehicles involved in accident. The table shows that more vehicles were involved in accidents in 2011 than in other years.

Table 5:22: Type and number of trucks involved in accident

Types of Trucks	Number of accident involvement by year				
	2011	2010	2009	2008	2007
Tanker	51	41	41	42	33
Trailer	104	74	65	28	28
Lorry	23	32	22	19	12
Total	178	147	128	89	73

Source: Field survey, 2013

The result also shows that there are more trailers involved in accidents than tankers and lorries. The information was derived from the operators' questionnaire administered at Lagos,

Kaduna, Kano and Port Harcourt. This may be attributable to the physical condition of the trailers or still more to the types of goods they carry. Furthermore, the Table 5.23 and Figure 5.12 show the times of accident occurrence according to drivers' responses. The result revealed that most accidents experienced by drivers occurred at night (45%), followed by afternoon with 34% while 21% of the accidents occurred in the morning.

Table 5.23: Time of accident reported by the drivers

Time	2007	2008	2009	2010	2011	Total
Morning	3	0	2	4	3	12
Afternoon	5	4	2	7	1	19
Night	8	3	7	3	4	25
Total	16	7	11	14	8	56

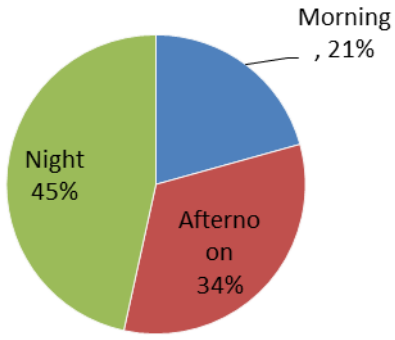


Figure 5.12: Time of accident

The result shows that many of the accidents take place at night because of so many factors including, bad roads, and road obstructions, the activities of criminals and drivers' fatigue. Criminals perform most of their operations at night targeting night travellers for attack and robbery. The criminals normally mount roadblocks by placing heavy objects like tyres and big stones to forcefully stop vehicles. In most cases these objects are not removed even after the operation. Most of the vehicles also have very poor illumination at night, with some travelling with only one headlamp, thus confusing incoming vehicles on which lane to manoevre, and thus causing head on collision. Incidentally, most of the heavy goods vehicles make their trips at night to avoid congestion and delays normally associated with heavy traffic during the daytime.

5.4.2 Location of accidents

Table 5.24 shows the location of traffic accidents involving heavy goods vehicles between 2007 and 2011. The result shows that Lagos, Kano, Ibadan and Kogi are the major locations upon which freight traffic accidents involving Heavy Trucks Vehicles occur across the country. Across location, Kano has the highest record of accident with 11 occurrences,

followed by Ibadan with 6 occurrences. Both Ibadan and Kano lie along the busiest freight traffic route starting from Lagos and ending at Maiduguri.

Details of the location of the accidents involving truck vehicles are shown in Figure 5.13.

Table 5.24: Location of accidents

		Ibadan	Kano	IJebu-Ode	Ikorodu	Kogi	Iwo	Ore	Abia	Lagos	Edo				Total
2007	Feq	3	8	1	1	1	1	1	1	1	1				19
	%	15.8	42.1	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3				100
		Ilorin	Abeokuta	Kogi	Kwanar Dang	Gwaado	Lagos	Ondo							Total
2008	Feq	1	1	1	1	1	1	1							7
	%	14.3	14.3	14.3	14.3	14.3	14.3	14.3							100
		Ibadan	Kano	Zaria	Abuja	B/Gwari	Mokwa	Biyu	Kwanar Dang						Total
2009	Feq	2	1	1	2	1	1	2	1						11
	%	18.2	9.1	9.1	18.2	9.1	9.1	18.2	9.1						100
		Ilorin	Ibadan	Kano	IJebu-Ode	Ikorodu	Kogi	Offa	B/Gwari	Jos	PH	Ogere	Ilesha	Lagos	Total
2010	Feq	1	1	1	1	1	1	1	1	1	2	1	1	1	14
	%	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	14.3	7.1	7.1	7.1	100
		Ibadan	Kano	Kogi	Lagos	Gusua	Ondo	Total							Total
2011	Feq	1	1	1	2	1	1	7							7
	%	14.3	14.3	14.3	28.6	14.3	14.3	100							100

Source: Field Survey, 2013

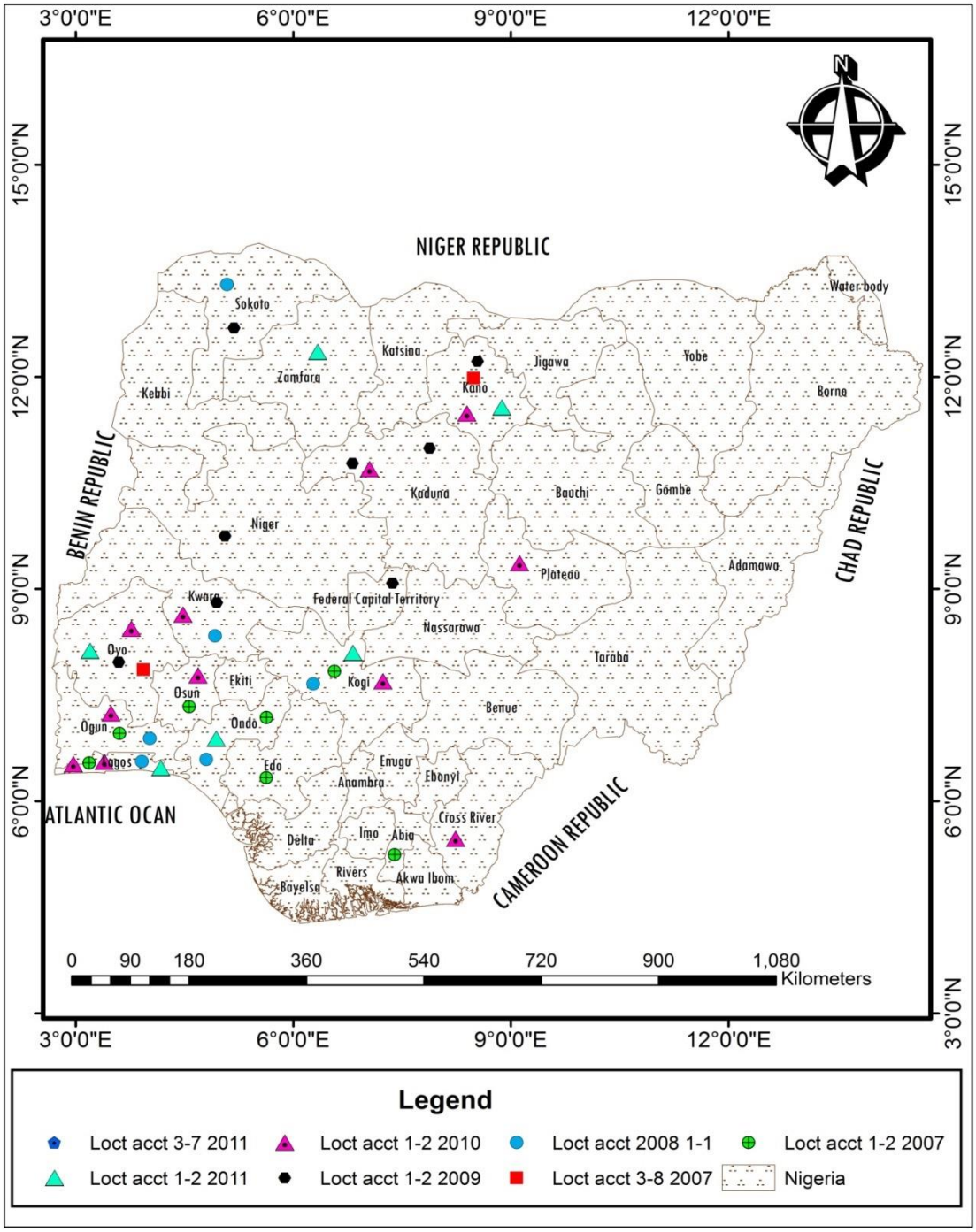


Figure: 5.13: Map of Nigeria Showing Location of Truck Accidents

Source: Modified From Administrative Map of Nigeria

5.4.3 Severity of accidents

Severity of accident represents the outcome of accident occurrences in terms of severity. This is classified in to fatal accident, injury accident or property damaged only accident. Table

5.25 presents results on the nature of accident encountered by heavy goods vehicles drivers from 2007 to 2011.

Table 5.25: Severity of accident from 2007 – 2011

Accident Year	Nature of Accident				Total
	Fatal	Serious	Minor	Vehicle Damage	
2011	1(16.7%)	0	4(66.6%)	1(16.7%)	6(100%)
2010	1(7.7%)	6(46.1%)	5(38.4%)	1(7.7%)	13(100%)
2009	0	8(72.7%)	2(18.2%)	1(9.1%)	11(100%)
2008	1(14.3%)	2(28.6%)	3(42.8%)	1(14.3%)	7(100%)
2007	1(5.3%)	10(52.6%)	7(36.8%)	1(5.3%)	19(100%)
Total	4(7.1%)	26(46.4%)	21(37.5%)	5(8.9%)	56(100%)

Source: Field Survey, 2013

The result shows that overall, in the four years covered by the survey, 4 drivers had fatal accidents, 26 had serious injury accidents, 21 had minor injury accidents and 5 encountered vehicles damaged only accident. It can be observed from the table that from 2007 to 2011, accidents with serious injury are higher in Number, followed by Minor injury, property damage and fatal injury accidents.

To fully appreciate the nature of these accidents, it is important to determine the severity index of the injuries. The severity index of injuries sustained by the truck drivers is calculated as follows,

$$\frac{\sum_{k}^{i} F}{N} \quad \text{……. (5.1)}$$

Where,

F is fatality casualties

N is the total casualties from the accident

From Table 5.23, it can be observed that the total fatality cases for all the years on the truck drivers that had accident is 4 cases, and the total casualty for the four years is 56. Hence, the severity index, which is the proportional measurement of all casualties that are fatal, is 4/56 = 0.07.

It can be seen that the severity index value is less than 1 and this implies that the severity of Heavy Goods Vehicles accidents with fatality casualty is not high. This is attributed to the sample of truck drivers and the low proportion of those that have been involved in an accident in the sample.

5.4.4 Causes of road freight traffic (HGV) accidents

Both operators and drivers were requested to answer questions on the causes of HGV road traffic accidents. Drivers' and operators responses have been analysed to determine the factors that cause HGV road traffic accidents in Nigeria.

A Mann Whitney U-test analysis was made on both truck drivers and truck operators' responses on the causes of road freight traffic accidents in Nigeria. The *Mann Whitney U*-test is performed to test if there is a significant difference between the truck drivers' and operators' rating of the different causes of accidents.

Table 5.26 presents the Mann Whitney U-test results on ratings of the causes of HGV road traffic accidents by truck drivers and operators. It can be observed that both the drivers and operators rated at least one of the factors causing road traffic accident as an important factor. Over speeding was ranked as an important (median rank of 3) factor causing road freight traffic accident by both the drivers and operators, and at 5% significant level their (drivers and operators) response rate (mean rank of 312.55 and 310.94 respectively) are the same. Drivers and Operators rated overloading as less important with (median rank of 2), but at 5% significant level operators' response rate (mean rank of 342.87) is significantly larger than drivers' response rate (mean rank of 295.96). Drivers rating of wrong overtaking was less important (median rank of 2), while operators ranked it as an important factor (median rank of 3) and operators mean rank of 358.92 is significantly larger than drivers' mean rank of 287.62 at 5% significant level.

Table 5.26: Mann Whitney U-test on truck drivers' and operators' ranking of the causes of road freight traffic accidents in Nigeria

Causes of accidents	Group	Median Rank	Mean Rank	U-value	Z value	P-value
Over speeding	Driver	3	312.55	43439	-0.134	0.893
	Operator	3	310.94			
Over loading	Driver	2	295.96	37090	-3.303	0.001*
	Operator	2	342.87			
Wrong overtaking	Driver	2	287.62	33670	-5.182	0.0001*
	Operator	3	358.92			
Drinking alcohol	Driver	2	296.98	37505	-3.090	0.002*
	Operator	2	340.92			
Bad road	Driver	3	330.24	36188	-6.807	0.0001*
	Operator	3	276.90			
Vehicle defect	Driver	1.5	285.02	32604.5	-5.561	0.0001*
	Operator	2	363.93			
Weather	Driver	1	312.19	43588	-0.044	0.965
	Operator	1	311.64			
Driver's stress	Driver	1	313.78	42933.5	-0.379	0.704
	Operator	1	308.57			
Driver's health	Driver	1	307.86	41967	-0.995	0.32
	Operator	1	319.97			
Under age driving	Driver	2	301.77	39470.5	-2.104	0.035*
	Operator	2	331.69			
Road obstruction	Driver	3	331.19	35795.5	-5.004	0.0001*
	Operator	3	275.05			

*significant at 5% significance level

Source: Field survey analysis 2013

Both drivers and operators rated alcohol (median rank of 2) as a less important factor causing road freight traffic accident, however, the majority of the operators (mean rank of 340.92) significantly responded less important compared to drivers with a mean rank of 296.98 at 5% significant level. Bad roads as a factor causing road freight traffic accident were rated as

important factor by both the drivers and operators (median rank of 3) but at 5% significant level, most of the drivers with a mean rank of 330.24 ranked bad road as an important factor compared to operators with a mean rank of 276.90. Majority of the operators ranked vehicles defect (median rank of 2) with a mean rank of 363.93 which is significantly larger at 5% compared to majority of drivers who ranked vehicle defects as not important (median rank of 1.5) with a mean rank of 285.02.

Weather, driver stress and driver's ill-health were all ranked as not important (median rank of 1) by both drivers and operators, and their mean rank for each of the factors are not significantly different. Drivers and operators ranked under age driving (median rank of 2) as less important factor causing road freight traffic accidents. The majority of the operators have a response mean rank of 331.69 which is larger than drivers' response mean rank of 301.77 at 5% significant level. Both drivers and operators ranked road obstruction as an important (median rank of 3) factor for causing road freight traffic accident. However, the majority of the drivers have a response mean rank of 331.19, which is larger than operators' response mean rank of 275.05 at 5% significant level.

5.5: Discussion of the causes of road freight traffic accidents

Many of the factors that cause road traffic accidents fall within four categories of **Human, environmental, vehicular** and **road** (Ndikom 2008; Badejo 2007; Blower and Woodrooffe, 2012; and Blower and Drisco, 2011). In this study, the identification of the factors causing road freight traffic accidents have previously been analysed from responses of the drivers and operators during the field survey, and in Table 5.27, both responses have been analysed further to show if there are significant differences in their ratings.

Table 5.27: Median rank of drivers/operators response on causes of road freight traffic accident in Nigeria

Important causes based on respondent median rank response	**Driver**	**Operator**
Over speeding	3	3
Wrong overtaking	2	3
Bad road	3	3
Road Obstruction	3	3

Not Important & less important causes based on respondent median rank response	**Driver**	**Operator**
Wrong overtaking	2	3
Overloading	2	2
Drunkenness	2	2
Vehicle defect	1.5	2
Weather	1	1
Driver stress	1	1
Driver health	1	1
Under age Drivers'	2	2

*median of 3 = important; 2 = less important; 1 = not important

Source: Field survey analysis, 2013

From table 5.27, it can be observed that the causes of road freight accidents were rated by drivers and operators as important, less important and not important. Table 5.27 shows that over speeding, bad road and road obstruction were rated by *drivers* as important factors causing road freight traffic accidents in Nigeria. While, *operators* rated over speeding, wrong overtaking, bad road and road obstruction as important factors causing road freight traffic accident in Nigeria. From the same Table 5.27, it can be observed that drivers rated vehicle defects, weather, driver stress and driver's health as not important factors causing road freight traffic accident in Nigeria. While *operators* rated weather, driver stress and driver's health as not important factors causing road freight traffic accident in Nigeria.

From Table 5.27, it can be observed also that *drivers* rated wrong overtaking, overloading, alcohol and under age driving as less important causes of road freight traffic accidents in Nigeria, while *operators* rated overloading, alcohol, vehicle defects and under age driving as less important causes of road freight traffic accidents in Nigeria.

For clarity and ease of discussion, these factors have been classified into relevant groupings in the theories of accident causation of human, road, vehicular and environment.

5.5.1: Human factors

Human Factors are the major causes of accidents in most countries. The major human factors responsible for road freight traffic accidents in this study are discussed below.

a. Wrong overtaking of vehicles

This is about drivers' wrong judgment and/or lack of patience. It may also arise from poor vision or due to influence of alcohol/drugs. When drivers are overtaking other vehicles, there is possibility of collision with other incoming vehicles; it may also lead to sideswipes with the overtaking vehicle or even lane departures. Wrong overtaking also involves overtaking on bends and other inappropriate portions of the road. Most Nigerian roads are narrow and windy in many areas, thus the incidences of wrong overtaking often results in accidents. Wrong overtaking therefore, has been rated as an important factor that causes road freight traffic accidents by operators, while drivers think it is not an important factor, as shown in Table 5.29. Akpoghomeh (2012) and IRTAD (2014) reported similar findings.

b. Over speeding.

In Nigeria, the situation is critical as drivers do not observe speed regulations, even though trucks are not allowed to exceed 60 km/hr by law. Similarly, limiters are not yet in use in most Nigerian road freight companies. The only way speed is currently checked is through the erection of speed bumps, which are usually sited in urban areas. This is not very useful since most truck accidents take place on highways. As a result, over speeding is rated by both drivers and operators as one of the most important causes of road freight traffic accidents in Nigeria (Table 5.31).IRTAD (2014) reported 32% contribution by speed violation to road accidents in Nigeria.

According to Driscoll (2013), inappropriate speed is responsible for 25.4% of traffic accidents involving large trucks in 2011 and 31.8% of similar accidents in 2009 in Australia. Blower and Woodrooffe (2012), reported over speeding to be responsible for 32% of accidents in Australia. Speeding in most circumstances reflect tight shipping schedules, hence speed limiters are used to limit drivers speed, and in some Australian regions, cameras are used to identify specific vehicle, calculate average drivers' speed, and violation tickets are issued where trucks traverses the roads faster than is consistent with legal speeds.

c. Underage driving

Underage driving is a very serious problem in Nigeria. This may be attributed to the driver licensing process. The law in Nigeria is not specific on the age limit for licensing drivers to drive on HGV, thus the control in the issuance of driver licences is porous. There are

conflicts of responsibilities between the federal and the state tiers of government on the control of drivers' licences in Nigeria. Driving schools are also inadequate as well as poorly regulated. For instance, their syllabuses are not harmonised, hence standards are never regulated. In this study therefore, underage driving is rated by both operators and drivers among the factors that are important causes of freight traffic accident involving HGV in Nigeria. Agbonkhese (2012) also reported this as a factor causing accidents in Nigeria.

d. Drivers' health (challenge)

Drivers' health conditions are not usually given serious consideration in Nigeria. Neither drivers nor their employers bother seriously about the health status of drivers, especially as it relates to critical elements like hypertension, obesity, diabetes and other conditions that are likely to affect driving performances. That is why, drivers' health condition was rated by drivers as the first among the unimportant factors causing road freight traffic accidents in Nigeria. The implication of this is that much needs to be done to educate both drivers and employers on the need for proper monitoring of individual drivers' status.

Blower and Woodrooffe (2012) reported that in a survey in Australia, three quarters of truck were found to have medical condition that can be called significant, like high blood pressure, diabetes and heart diseases. In the United States, Krueger et al (2007) reported that almost 50% of drivers of trucks are smokers, three-quarters are obese, while sleepapnoea which was severe or moderate was found in 10% of drivers while small sleep apnea was found in an additional 18% of the drivers. Similarly, prescription drugs related to high blood pressure, stress or cholesterol were found with 30% of drivers in serious and fatal truck accidents.

e. Driver Drinking

Drink driving is not a very serious problem among truck drivers in Nigeria. This is link to cultural factors since majority of the drivers of these categories of vehicles come from the Northern part of the country where drinking is less practised due to the fact that majority of the population are Muslims. However, truck drivers have been seriously linked to the consumption of other drugs like cannabis though this would require another study to substantiate. The result of this survey shows that drink driving is placed among the not important factors that contribute to freight traffic accidents. However, Mukoro (1986) and

Ogunjumo (1995) believed that drink driving is an important factor causing accidents in Nigeria.

However, according to Khan and Mokbul (2010), among truck drivers with fatal truck accidents in United States, 2.0% had blood alcohol levels which is higher than the approved legal limit, this is against 23% reported for passenger car drivers involved in fatal accidents. Similarly, about 1.2% of the truck drivers involved in fatal accidents was found to be involved with illegal drugs. Blower and Woodrooffe (2012) also reported that almost half of the 300 drivers studied accepted taking alcohol while driving, and over one third consume other illegal stimulants in Brazil. In Australia, it was found that one-sixth of drivers involved in fatal accidents tested positive for illegal drugs or stimulants.

f. Driver tiredness/fatigue

Responses from the drivers' and operators' survey show that drivers' stress/fatigue is not an important factor causing accidents. The NRTR (2012) has provided guidelines on hours of driving in Nigeria. In addition, drivers are always guided by their employers on when and where to stopover and rest.

However, driver fatigue and distraction are common factors that cause truck accidents in many countries. This is also associated to overloading, since trucks which are overloaded can only move slowly, this contributes to keep the driver longer on the road and thus contribute to fatigue. The current driving standard in Australia is 15 minutes break after every 5.5 hours driving and not exceeding 12 hours driving in every 24 hours driving time. Fatigue is responsible for 10% of truck accidents in Australia. Blower and Woodrooffe (2012) reported that a study of 300 truck drivers in Brazil showed that, almost 70% of drivers work more than 10 hours a day, and 16% of the drivers are hypertensive.

The Transportation Research Board (2010), reported that several factors are responsible for truck accidents, of which fatique was a prominent factor ranking six, with 13% of the truck drivers reported as being fatigued at the time of accident. In addition a report from US Department of Transportation (2006) shows that only 2% of truck drivers are reported as fatigued or asleep, in another study, fatigue was identified to be responsible for 13% of truck accidents. Driver distraction is also a common contributor to accidents. Many organisations try to keep close contact with their drivers, keeping in touch most of the times, about loads,

schedules and traffic delays. Blower and Woodrooffe (2012) noted that these all add to distractions coming from the proliferation of cell phones

5.5.2 Environmental factors

These are also known as weather factors. The commonest environmental factors in Nigeria that cause road traffic accidents are discussed under weather conditions.

Nigeria lies within the African tropical zone with tropical type climate characterised by dry season occasioned by dusty and windy air and tropical rainy season with strong winds and heavy tropical rains. Both weather conditions have effects on the rate of accidents in Nigeria, especially on heavy goods vehicles. Heavy and windy rains that fall during the rainy seasons often create blurred visions that forced drivers to park their vehicles until after the rains stop. Similarly, strong winds often result in falling trees on highways, blocking major roads and causing accidents. Similarly, during the dry seasons, vehicles plying roads in northern Nigeria are confronted with dry, dusty, windy weather conditions. In some cases the weather gets so bad that vehicles are not able to move due to blurred vision. However, weather is rated second among the non-mportant factors that cause road freight traffic accidents in Nigeria. Agbonkhese (2012) also reported weather as a factor causing accidents in Nigeria.

5.5.3 Vehicular factors

a. Vehicle Defects.

The Nigerian situation is more complex, as most vehicles on Nigerian roads are imported into the country as second hand vehicles. This means that many of the vehicles are imported into Nigeria after they have been used in other countries. Section 5.2.2 indicates that 2% of the sampled vehicles belong to individuals, while 72% belong to companies and organisations. Small holders are always responsible for the second hand imported vehicles. The implication of this is that, these vehicles are more likely to have mechanical problems compared to new trucks. This explains the suggestion by operators in section 5.3.3 which emphasises that vehicles must be properly maintained. Similarly, Akpoghomeh (2012) observed that vehicular factors account for 20% of accidents in Nigeria.

Vehicle defects are responsible for truck accidents in a many countries. In Brazil, a mandatory vehicle inspections system is not enforced for all vehicles, about 45% of vehicles inspected in a particular study failed. In fact mechanical failure is responsible for 8.2% of truck crashes and brake defects have been reported in about 20% of inspected trucks, Blower and Woodrooffe (2012). In China, the second largest cause of truck accidents came from problems associated with the mechanical condition of the vehicle especially break failure. This problem is addressed through driver training and supervision, increased inspection and meaningful penalties and through specific actions that include fitting antilock-braking systems, tyre pressure monitoring systems, engine retarders and radial tyres (Blower and Woodrooffe,2012). McCartt et al. (2007) reported that in the US brakes is the system prone to truck defects. Brake inspection by Commercial Vehicle Safety Alliance in 2011 showed more than 16% of trucks inspected has brake problems that can put them out of service.

Blower et al. (2009), also reported that in China 36% of trucks in serious accidents have brake problems, and about 20% does not qualify to be in service if they had been inspected before the accident. About 55% of the trucks had other mechanical problem, with 30% having vehicle defects that was enough to put it off the road.

b. Overloading

Even though overloading is rated as an unimportant factor causing HGV accident by drivers and truck operators in this research, overloading is a very common occurrence on Nigerian roads. Appendix 15 shows a typically overloaded freight vehicle on Nigerian road. This largely happen due to the lack of enforcement of traffic rules by the police and other government agencies responsible for road safety on the roads. This is made worst by the absence of weight bridges on the highways, thus giving room to freight companies to load as much as the vehicle can contain. Similarly, drivers are in the habit of loading additional loads on their way to their destinations, in addition to the loads they have been officially assigned. Meanwhile, Olagunju (2010) observed that overloading is a major cause of accidents among freight vehicles in Nigeria.

Blower and Woodrooffe (2012), reported that, 60% of trucks involved in accidents in Brazil are overloaded, with 20% of the trucks that go through the weigh bridges recording overloading. Mechanically, excessive gross vehicle weight can cause mechanical failures and

loss control. This is why roll over in truck accidents in Brazil is identified as 20% of fatal crashes. The study observed that estimates from China show that 70 to 90 percent of truck accidents have some relationship to overloading and oversized trucks. Overloading makes vehicle control more difficult, contributing to brake failure and an increase in stoppage distance with more risk of rollover accidents.

However, the study by International Road Union for the European Truck Association shows that load factors that include loss of load, overload, unbalance of the load and insufficient safety measures, are the main causes of accident in only 1.4% of all accidents studied, though the study showed that the load factor can contribute to the severity of the accident.

5.5.4 Road factors

a. Road Obstruction

Road obstruction is a major cause of road freight traffic accidents in Nigeria. It is rated as a very important cause of accidents by the truck drivers and operators. Roads are obstructed in the following circumstances. Construction companies responsible for road construction or rehabilitation often place materials like sand, gravels, and iron rods on the roads without prior notice to motorists. In most cases motorists ram into these obstructions without knowing, leading to accidents. Police and other road safety agencies mount road blocks at critical portions of the road to check motorists violating road traffic rules and check the activities of criminals, especially at night. These road blocks are often mounted without illuminating signs at reasonable distances, making unsuspecting motorists ram into them leading to accidents.

Criminals commonly mount road blocks to perpetrate their nefarious activities. In many cases, these road blocks cause accidents since they are normally established at dangerous locations like steep portions, dangerous bends or road portion that is characterised by potholes. Mukoro (1986), Ogunjumo (1995) and Ipingemi (2013) have reported similar discoveries. On the other hand drivers, especially of Heavy Goods Vehicles, are also liable to leave their broken down vehicles on the highway without adequate signs to oncoming vehicles. Many accidents on Nigerian roads are attributable to these practices. Similarly, illegal/improper parking is responsible for truck accidents in many countries. The consequences of parking illegally on the road side and on ramp shoulders leading to and from

truck parking areas often obstructs visibility to oncoming traffic and trucks accelerating to merge into oncoming traffic, (TRB 2010).The study by International Road Union for the European Truck Association discovered that, road obstructions arising from road repairs contribute to truck accidents by 8% in Europe. Similarly, in one-third of these accidents, the engineering work was the main cause of the accident, and in one of three of these cases the accidents happened at an intersection.

b. Bad roads

According to the truck drivers and operators, this is the most important factor causing road freight traffic accidents in Nigeria. Most portions of the Nigerian road network are in a bad condition. A significant portion of the roads are not paved, and those paved are fraught with potholes. Less than 33% of the 193,200km network is paved (CBN, 2010). After every rainy season, the roads get very bad due to erosion and poor construction. Many accidents happen on the roads as a result of drivers attempting to avoid potholes or tyre burst or mechanical failure that often result from vehicles falling into those potholes. NTSP (2010) reported that bad roads are responsible for 26.6% of freight traffic problems in Nigeria.

Bad roads as a cause of accident emanates from road design and signage. Blower and Woodrooffe (2012) observed that road design and signage's in China are mostly lacking or designed for smaller vehicles, not heavy trucks. Many roads are build with steep gradients, sharp bends, poor sight distances, and portions having narrow or no shoulders, making them highly unsuitable for truck traffic.

According to the Transportation Research Board (2010), the lack of truck parking facilities on or near national highways is a major problem for the trucking industry. The lack of adequate truck parking facilities can affect the safety of drivers who require the facilities to avoid situations where drivers are forced to continue driving even when they need to rest or are fatigued due to lack of resting space. It is also a problem where drivers run out of time before reaching their destination under the permitted driving hours regulation. These kind of situations result in fatigue related crashes and fatalities.

The study by International Road Union for the European Truck Association indicates that only in 5% of accidents that road conditions form the main cause of accidents in Europe, with

half of these accidents happening along inter-urban roads. Similarly, findings from the study by International Road Union for the European Truck Association on the factors responsible for truck accidents showed that, the main accident cause is linked to human error (85.2%) of the truck driver, the car driver or the pedestrian/cyclist. Out of the accidents associated with human error, only 25% are caused by the driver of the truck. Other factors include weather conditions 4.4%, infrastructure conditions 5.1%, and technical failure of the vehicle 5.3%.

5.6 Accident prevention strategies

According to the World Health Organization (WHO) (2004), accidents are avoidable and as such preventable. This explains why some authors prefer to use the word road crashes in place of accidents. To prevent an accident from happening, several approaches have been applied in different countries. However, the most effective prevention strategies are those linked to the causes of the accidents. The responses of the truck operators during the field survey on the measures to prevent road freight traffic accidents are presented in Table 5.28.

Table 5.28: Measures to prevent road freight traffic accidents.

Safety improvement measures	Frequency	%
Use of good tyres and spare parts	101	32.4%
Enforcement of traffic laws and regulations	45	14.4%
Driver education and training	40	12.8%
Monitoring of drivers on journey	33	10.6%
Discouragement of night journeys	30	9.6%
Driver employment improvement	24	7.7%
Routine vehicle maintenance	16	5.1%
Spiritual (prayers)	12	3.8%
Use of safety devices	11	3.5%

Source: Field Survey, 2013

a. Use of good tyres and spare parts

Proper vehicle maintenance practices are an important measure of accident prevention. Vehicle maintenance is a major problem of road haulage in Nigeria, since most of the vehicles are often imported second hand after they have been used in other countries. Thus, they often come to Nigeria with high maintenance cost. In most cases, spare parts are not

readily available, and where available are mostly not genuine. Many companies rely on second hand or improvised spare parts. Maintenance garages are also below an appropriate standard since most freight companies do not own their own garages, but rely on road site mechanics that do not have proper training and standard workshops. This has become the major safety problem in freight traffic operations since up to 32.4% of the operators have rated it so high. Bun (2012), Ipingemi (2008), Akpoghomeh (2012) and Agbonkhese et al. (2013) have also made similar conclusions.

b. Enforcement of traffic laws and regulations

It is important to put necessary laws in place in respect of road traffic accidents. The most recent law is the NRTR act promulgated in 2012, which is an update on the 2014 NRTR law. The law is harmonized with the provisions of the FRSC act 2007 to ensure consistency and reduce conflict of operations. However, there is a need to harmonize further, the provisions of the different acts and streamline the functions of agencies as is obtained in the United Kingdom. According to the field survey, 14.4% of road freight operators are of the opinion that enactment and enforcement of traffic laws and regulations are necessary requirements for safe road freight operations in Nigeria. Similar findings are in Ipingemi (2008), Aderemo (2012), and Akpogomeh (2012).

Ditter (2005) reported the effectiveness of the graduated driver licensing (GDL) Scheme. He described the graduated driver licensing scheme as an additional licensing level that gives the learner driver more practical driving experience and at the same time reducing the possibility of road collisions. A review of studies from Canada, the US and Australia reported a reduction in crash rates in the year after licensing of between 26% and 41%.

The police, the federal road safety corps and the vehicle inspection officers are responsible for enforcing traffic rules and regulations in Nigeria. These agencies responsible must be made to function well and wake up to their duties and responsibilities and implement the laws to the letter. It is pertinent to say that the sanctions on traffic offenders are no longer effective to deter violations. For example, asking an offender to pay $5 for exceeding speed limit is not an effective fine, and many would opt to break the law and pay the small fine.

Meanwhile, there are too many agencies with responsibilities in the road transport sector in Nigeria: The Federal Road Safety Commission; the Nigeria police force; the vehicle inspection officers at state level; the National emergency management agency; the civil defence corps and the traffic management agencies being established in many states of the federation like, Lagos state traffic management agency, Kano road traffic management agency. Co-operation, collaboration and synergy are therefore required among these agencies to eliminate duplications, conflicts and ensure efficiency in the deployment of resources and outcomes. These agencies roles and functions need to be streamlined through appropriate legislations at both the federal and state level.

c. Drivers education and training

Driver training and re-training is a very important instrument of ensuring drivers are up to date in their jobs. This is not very pronounced in Nigeria, as the only drivers that get regular training are those that work for companies and organisations. Most drivers that drive their own vehicles or vehicles belonging to individuals are not trained. The NRTR (2012) has emphasized training as a requirement for licensing of drivers in Nigeria, even though this requirement is not being seriously enforced.

Truck operators have realized this and have identified driver training and re-training as a very important strategy of combating road traffic accidents. Twelve point eight percent (12.8%) of the operators rated training as important accident prevention strategy. This is similar to the results in Aderemo (2012), Badejo (2011), Agbonkhese et al (2013) and Akpoghomeh (2012).

According to Wood et al. (2007), driver education programmes are designed to increase the driver's safety behaviours and awareness by reducing driver errors. Education programmes can be in the form of manuals, one-one interaction or group discussion. They can be delivered specifically to groups with special needs like people with identified higher risk of accidents, older people or learner drivers. In the UK, driver offender re- training schemes are often organised for drivers found with road traffic offenses to serve as an alternative to court appearances or license points penalty (Elder et al.,2005). Evidence exists that driver education programmes can improve driving performance and knowledge, especially for older

drivers. Komer et al. (2009) also stated that it improves awareness for driving hazards, especially for new drivers.

In Nigeria, driver education and training is not well developed as so many drivers, especially in the informal sector, are not trained at all. It is necessary therefore to ensure that driver training is made a priority. Drivers' licences should be issued only to drivers who have evidently passed through recognized and accredited driving school, as contained in the NRTR ACT (2012).

Driver training syllabuses should be harmonised and produced among accredited driver training institutions in Nigeria to ensure harmony in instructions and maintain standards. Drivers should be encouraged to see their work as a profession and be made to grow and develop their competences within the profession. They should not see driving as a past-time or a job for those who could not make it in school.

d Monitoring of drivers when they are on journeys.

Driver monitoring and supervision is an important strategy for checking drivers' excesses when they are at work. When drivers know they are being monitored, they are more careful and they ensure that they do not do things that are not allowed. Driver monitoring helps to check fatigue, drinking, over speeding and improper driving behaviour. Driver monitoring has been identified by 10.6% of operators as a measure that can be used to reduce heavy truck accidents in Nigeria. This recommendation is also in the Cleen foundation report (2013) and Agbonkhese et al (2013).

In the United States, new hours of work standard that restricts the number of hours a driver is allowed to work was introduced. It includes mandatory rest hours, and also limits the number of consecutive hours of work. These measures have been enforced since 2003 and have improved overall truck safety, Blower and Woodrooffe (2012)

e. Discouragement of night journeys

Nigerians engage in night travel a lot in pursuit of their daily activities. 9.6% of operators are of the opinion that restriction in night journeys is an important measure that would lead to a reduction in road freight traffic accidents. This is similar to the finding of Ndikom (2011).

Night journeys are more common among drivers of long buses and heavy goods vehicles. Night journeys are normally convenient for long distance travels in respect of the above two categories of travellers. Result of the analysis presented in Figure 5.12 shows the distribution of freight traffic accidents among sampled truck drivers. The analysis shows that 45% of truck accidents happen at night time, 34% at afternoon time and 21% take place during morning hours. Night travels are particularly risky due to the condition of the Nigerian roads which are generally narrow, full of potholes and in many cases slippery.

The nature of the vehicles also calls for a restriction on night travels. The vehicles are generally bad, poorly maintained, old and unreliable. When a vehicle breaks down at night, it can hardly be fixed that night due to absence of garages that function at night in Nigeria. This means that the vehicle would be left, un-cleared from the highway, thus causing hazard and risk to other vehicles. Restriction on night travels will therefore reduce the risk of accident involvement by freight vehicles. Restrictions may come in form of limiting hours drivers can drive at night or restriction on the routes to be used at night or even introducing safety requirements for vehicles before they are allowed to go on night journeys.

f. Driver employment improvement

The driver profession in Nigeria is very porous in terms of entry and exit. The majority of drivers in Nigeria have not passed through a driving school to obtain licences. Despite consistent efforts by the FRSC to streamline the issuance of driver licensing, people still obtain licences without passing through a driver test. Freight vehicle operators have therefore recommended improvements in driver recruitment as strategies to reduce road freight traffic accidents. Seven point seven percent (7.7%) of the operators believe this is a very important measure of traffic accident mitigation.

To improve driver recruitment, the Government need to introduce new requirements for commercial drivers in Nigeria. Every Nigerian aspiring to drive a commercial vehicle needs

to pass through driving school, and must meet other requirements like good health, evidence of not consuming illicit drugs and must graduate from one licence grade to the other. As it is now, people can have grade E licence at the beginning without passing through other grades. Transport operators also need to secure the expertise of consultants in driver recruitment, which is the only way proper screening will be guaranteed in the recruitment process.

g. Routine vehicle maintenance

Proper Vehicle maintenance practices are an important measure of accident prevention. Vehicle maintenance is a major problem. As indicated above, most of the vehicles are often imported second hand after they have been used in other countries. Thus, they often come to Nigeria with high maintenance cost. Spare parts are not readily available, and where available are mostly not in their original form. Operators rate routine vehicle maintenance at 5.1% as a factor that will curtail road freight vehicle accidents. This also features in Bun (2012), Akpoghomeh (2012) and Agbonkhese et al (2013).

Most freight companies do not own their own garages, but rely on road side mechanics that do not have proper training and standard workshops. In this regard, the following approaches would be very helpful:

1. Freight companies be made to establish own garages to ensure routine maintenance of their vehicles. Small holder operators are encouraged to jointly establish repair garages that will guarantee standards in maintenance.
2. Regular training of maintenance staff to guarantee standards and quality service. Effective surveillance by vehicle inspection officers to ensure that only road worthy vehicles are allowed to ply the roads.
3. Strict vehicle licensing policy that will ensure that only vehicles that meet certain safety standards are licensed to operate.

h. Spiritual (prayers)

Nigeria has a large population of Christians and Muslims. Events are therefore substantially interpreted the spiritual way, as many Nigerians commonly believe in the power of prayers. As such, 3.8% of the respondents believe that regular prayers are required to prevent road traffic accidents from happening and improve road traffic safety in Nigeria.

5.7 Summary and conclusion of this chapter

This chapter is the analysis of the questionnaires from the field survey. The result shows that the majority of the drivers are those with secondary school education. Similarly, most of the drivers have family dependents of 1-5 members and majority of them fall within the 29-40 age range. Similarly, most of the drivers drive tanker trucks that belong to freight companies, majority of whom ply the road from Lagos- Shagamu- Ibadan-Mokwa- Kaduna- Kano and ending in Maiduguri.

The truck operator's survey conducted at Lagos, Kaduna, Kano and Port Harcourt showed that majority of the operators have between 1-15 vehicles in their fleet, comprising of trailers with 15-30 tonne capacity, and tankers of 33,000-litre capacity. The values of goods transported range from $3,125-$87,500 per truck.

From the analyses of both the drivers and operators responses, drivers rated over speeding, bad roads and road obstructions as the most important factors that are causing HGV road traffic accidents while operators ranked over speeding, wrong overtaking, bad roads and road obstructions as the main factors responsible for truck accidents in Nigeria.

The Problems of road freight business in Nigeria and their possible solutions have also been discussed in this chapter. Similarly, remedies to heavy goods vehicles road traffic accidents have also been analysed from the questionnaire. Some of the main remedies to HGV accidents according to operators are use of good tyres and original spare parts and enforcement of traffic rules and regulations.

The next chapter is about the cost of heavy goods vehicles road traffic accidents and its implications on the Nigerian economy. Certain findings in this chapter will form the ingredients that will feed into the model for the computation of the cost of accidents.

CHAPTER SIX

THE COST OF HEAVY GOODS VEHICLES TRAFFIC ACCIDENTS

6.1 Introduction

The loss of people's lives and injuries from road traffic accidents is a dominant cause of personal grief and economic hardship for accident victims' families, their relatives, friends and the entire society. Thus, both the society and the victims' families are normally affected in so many ways; for instance, society often has to cope with the need to support and provide for the victims' families and also eventually suffers loss of the victims' foregone contribution to the nation's economy. The family of the victims also, suffers instant economic hardships from lost income of the deceased and the injured.

The objective of this chapter is to determine the cost of HGV road traffic accidents in Nigeria for the year 2011 and its implications on the GDP of Nigeria. The chapter provides the framework of estimating the costs and describes step by step, how each cost component is integrated in to the cost estimation model. At the end of this chapter therefore **objective four** of this study will be achieved. The determination of the cost of road traffic accidents is important for the following reasons;

- To provide information that will assist government officials at all levels to structure distinctive programs for curtailing road traffic accidents.
- For the use of government officials to appraise the impact of road safety counter measures.
- For use in resource allocation so that road safety is ranked equally considered in terms of resource allocation and investment as a priority sector.

The true costs of the lives and human resources that are destroyed in road traffic accidents can never be fully measured just as the pain, suffering and frustration suffered by individual accident casualties cannot be valued purely in monetary terms. In reality however, there are other costs that are direct and tangible in nature that result from these accidents such as vehicle damage costs and other properties, the cost of medical treatment and administration costs of police and courts which can really be quantifiable. This chapter estimates these costs

and other costs resulting from heavy goods vehicles road traffic accidents in Nigeria, for the year 2011.

It is however important to note generally that the estimation of the cost of accidents is done in approximate terms, due to the fact that calculations of values like future output are normally based on a number of averages, including average income of accident casualties, average age of retirement in the society, average age of accident victim etc. In addition to the averages that are largely assumed, the value of production in the future has to be discounted to give present day values (Dawson, 1967).

The different methods for costing road traffic accidents have been discussed in Chapters 3 and 4 of this study. As seen in those discussions, the most suitable method for developing countries is the **Human Capital/gross output method**, which was recommended by the Overseas Unit of the Transport Research Laboratory in TRRL/Jacobs (1995) and Silcock/TRRL (2003). Therefore, this method has been used in this research with improvements to reflect the realities of the road traffic situation in Nigeria and the peculiarities of Heavy Goods Vehicles. Figure 6.1 shows the procedure of calculating the total cost of HGV accidents in Nigeria adopted in this study.

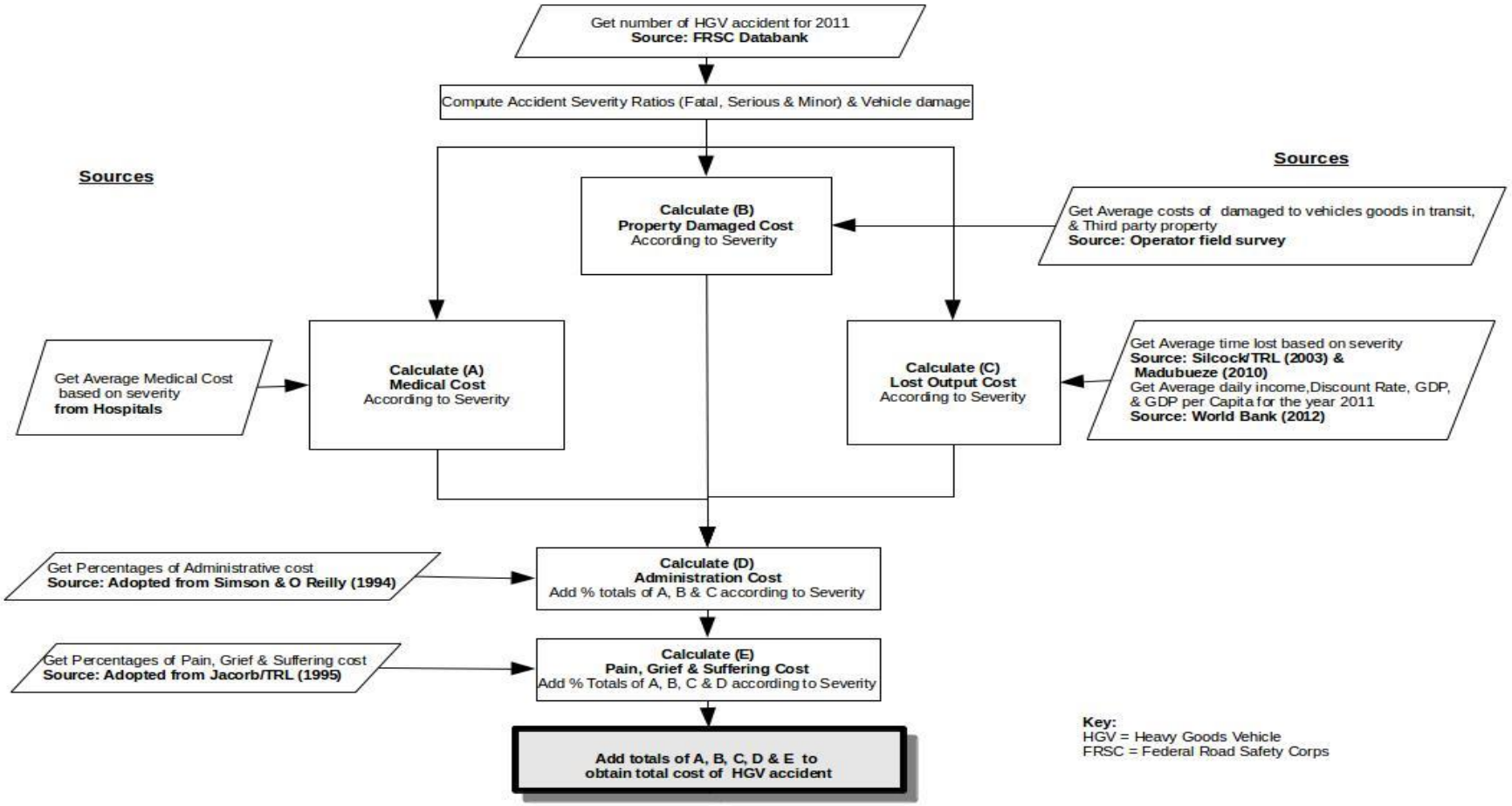


Figure 6.1: Diagram showing the process of Estimating the Cost of HGV traffic Accidents.

6.2 Accident Data

Road traffic accident cost analysis requires a considerable amount of information. The starting point is the collection of data (Silcock/TRRL2003), which is the most challenging part of this study. Details of the data requirements, their sources and methods of their collection have been discussed in Chapter 4 of this study.

6.2.1 Number of accidents

In summary, Nigeria recorded 21,836 road traffic accidents in 2011 that resulted in 47,219 casualties out of which 8,298 of these were victims of road freight traffic accidents. The number of overall freight traffic accidents in 2011 was 2351, representing 10.7% of all traffic accidents in the year (FRSC 2013). This means that there were about 6.4 recorded freight traffic accidents per day, which means that, there were about 4 casualties per recorded accident. Similarly, in 2011, there were 1306 accidents involving Heavy Goods Vehicles with 4020 casualties. With an estimated 70,000-truck vehicle population, there was an estimated 187 truck accidents in every 10,000 trucks in 2011

To successfully calculate the cost of road traffic accidents in Nigeria, it is very important to have a uniform classification of data (Silcock/TRRL, 2003). In this study, as in many studies where human capital method has been used, accidents data are classified according to severity in the form of fatal, serious injury, minor injury and property damage only accidents. These categories have been clearly defined in Chapter 2 and 3 of this study.

Since the official data collected for this study from the Federal Road Safety Commission (Appendix 6) are not fully classified according to the above classifications, a method of converting the data to conform to the above classification is necessary. To address this issue, two approaches have been considered.

i. Review previous studies undertaken in different locations to identify the criteria used. In this regard, Abdelmaged and Ismail (2010) reported higher ratios of serious to minor accidents while Luathep and Tanaboriboon (2005) and BRTE (2009) reported higher minor injuries to serious injuries
ii. Comparison with other similar surveys done in Nigeria. In a survey conducted by the Federal Road Safety Commission (2013) along key Road Corridors in Nigeria, the result of which is shown in Table 2.4, the average ratio of different degrees of

accidents along all the 20 road corridors studied is presented to be 2.5:6.2:3.1 ratios of fatal, serious injury and minor injury accident respectively.

This compares well with the field survey of this study, which came up with a ratio of 6 serious injury to 4 minor injury accidents. In this regard, the ratio of the field survey is used to estimate the number of serious and minor injury accidents for this study. Meanwhile, the records of Heavy Goods Vehicle accidents extracted from the database of FRSC are shown in Table 6.1.

Table 6.1: Road traffic accidents (HGV) statistics in Nigeria in 2011

Type of Accidents	Number of Accidents	Number of Casualties	Casualty / Accident ratio
Fatal	394	905	2.3
Injury	726	3115	4.3
PDO	186	0	0.0
Total	1306	4020	3.1

Source: Authors Compilation, 2013

From Table 6.1, the number of road traffic accidents and casualties data collected from FRSC, are grouped into the various degrees of accidents of fatal, injury and property damaged, but are not classified into the breakdown between major and minor injury accidents and casualties. This explains why the injury ratio is up to 4.3 in Table 6.1, almost two times the magnitude of the other groups. In order to categorise these accidents into serious injuries and minor injuries, the average ratio of accident categories obtained from driver field survey covering the period 2007-2011 as shown in Table 5.25 have been adopted (Naji, 1995).

In the field survey, truck drivers were requested to provide information on the degree of accidents they were involved in from 2007-2011. The results of their responses showed that the majority of the drivers were involved in serious injury accidents by 46.4%, 37.5% of the drivers said they were involved in minor injury accidents, 7.1% had fatal accidents and the remaining 8.9% were involved in property damage only accidents. This translates to a ratio of 6 serious injury accidents to 4 minor injury accidents from the field survey. This was projected on the number of Heavy Goods Vehicles traffic injury accidents data obtained

the Federal Road Safety Commission shown in Appendix 7, in order to obtain the categories of serious and minor injury accidents. The result in Table 6.2 shows the injuries resulting from HGV accidents in 2011 according to severity of injuries recorded.

Table 6.2: Road traffic injury accidents (HGV) in 2011 by degree of injury

Type of Accident	Sample Results		Population
	Number	Ratio	
Serious	26	6	435
Slight	21	4	291
Total Injury Accident	47	-	726

Source: Authors compilation 2013

6.2.2 Number of Casualties

Table 6.3 shows the percentage of road traffic accident casualties of Heavy Goods Vehicles according to severities in 2011. It shows that 22.5% of the accident victims were fatality cases, 77.5% were injury cases, and there were 1.6 casualties per accident vehicle. There were also 3 casualties per accident in the year 2011.

Table 6.3: Road traffic accident casualties of (HGV) in Nigeria, 2011

Group of Casualties	Number of Casualties	% of total casualties
Fatalities	905	22
Injuries	3115	78
Total	4020	100
Number of Vehicles Involved	2472	1.6 casualty per accident vehicle
Total Number of Accident cases	1306	3 casualty per accident

Source: FRSC 2013

The total casualties from road traffic accidents of Heavy Goods Vehicles in Nigeria in 2011 were 905 fatalities and the number of injuries was 3115. To feed into the human capital

model, these injuries were broken down into serious and minor injuries category using the ratio of 2:1, being the ratio of accident victims' by accident severity from the hospital data sample survey used in this study. The result as shown in Table 6.4 indicates that slightly more than half of HGV road traffic accidents in 2011 are classified under serious accident category. Many reasons are attributable to this, one of which may be linked to the causes of Heavy Goods Vehicle accidents in Nigeria. From the analysis of the causes of accidents in chapter five, bad roads, wrong overtaking and over speeding were rated very important. Accidents of this nature naturally translate in to serious impact.

Table 6.4: Estimated casualties of road Freight traffic accidents in Nigeria 2011

Type	Number	%
Fatalities	905	22
Serious Injuries	2077	52
Slight Injuries	1038	26
PDO	0	0
Total	4020	100

Source: Authors Compilation, 2015

Table 6.4 shows the estimated number of injuries and fatalities that resulted from HGV road traffic accidents in Nigeria in 2011.The Table shows that victims with serious injuries were more in number representing 52% of the total casualties. Minor injuries were 26% and a fatality was 22%.

Table 6.5: Ratio of casualties per accident Severity 2011

Type of Accident	Number of Accidents	Number of casualties	Casualty/Accident Ratio
Fatal	394	905	2.3
Serious injury	435	2077	4.8
Minor injury	291	1038	4.5
Property damage	186	-	=
Total	1306	4020	3

Source: Authors Compilation, 2015

Similarly, Table 6.5 shows the accident casualty ratio derived from Table 6.4 data. The ratio of serious injury is highest at 4.8 casualties per serious injury accident. The average number of casualties per accident was three victims.

6.2.3 Property damage Accidents

The type of data on road traffic accidents collected from the Federal Road Safety Commission provides the breakdown of accident vehicles according to severity. The data also gave the total number of vehicles involved in the accidents. Table 6.6 shows that there were 2472 vehicles involved in 1306 HGV road traffic accidents in 2011. From the number, 969 were involved in fatal accidents, 1053 were involved in injury accidents and 450 in property damage only accidents.

Table 6.6: Vehicles damaged in HGV road traffic accidents in Nigeria 2011.

Type of Accidents	Number of Accidents	Number of Vehicles	Vehicle / Accident ratio
Fatal	394	969	2.5
Injury	726	1053	1.5
PDO	186	450	2.4
Total	1306	2472	1.9

Source: Authors Compilation, 2015

6.3 Adjustment to accommodate under reporting

In the majority of countries, there is a potentially serious concern regarding the quality of road accident data. This is manifest in the underreporting of accident cases. If this underreporting is not resolved, then there is the likelihood that the magnitude of the road safety problem is under estimated, thus leading to incorrect prioritization of policy measures to improve road safety, or could lead to in appropriate counter measures.

Very little research has been done on this area in developing countries. But findings from Ghana shows that this problem occurs as a result of delays in compilation of accident reports, non- availability of details, police reluctance to maintain information where court action is pending, the decision of parties involved to settle the case out of court and the lack of a

central data management facility (Salifu and Acckah, 2009). However, Sigua and Palminao (2005) estimated that underreporting in the case of property damage only accidents in the Philippines is 98%, meaning that only 2% of property damage accidents are reported by the police. Kopits and Cropper (2003) also estimated that worldwide, only about 50% of road injuries are reported, and there are about 100 injuries for every road fatality. Many accidents involving smaller vehicles may pass unnoticed and unreported, but Heavy Goods Vehicles generate impacts that are likely to attract the attention of people and the road safety management agencies. The average percentage of unreported accidents in some countries has been shown in Table 3.3 to range from 40-97%. For this reason, and the fact that data on underreporting of these kinds of accidents is not available in Nigeria, adjustment is made to reflect un reported cases of HGV road traffic accidents in this study.

It was discovered that little research has so far been done on this subject in Nigeria, despite the fact that Nigeria does not yet have a reliable road safety data system in place and there is likelihood that many road accident cases go un-noticed and hence unreported. The Research by the Cleen Foundation between 2010 and 2013 on roads and road safety in Nigeria concluded that about 80% of accidents are not reported to the federal road safety commission. In this regard therefore, 80% is taken across accident severities to represent the amount of unreported accident cases in this study.

Table 6.7 shows the 2011 HGV road traffic accidents data by severity, with 80% added to the data in Table 6.5 to cater for un-reported accidents. In each accident severity case, there is more than one casualty outcome. This means that overall, there were 1631 number of fatalities, 3765 cases of serious injuries and 1873 cases of minor injuries. In fatal injury accidents, there were 1631 fatalities, 2071 serious injuries and 482 minor injuries. In serious injury accident, there were 1694 cases of serious injuries and 575 cases of minor injuries. In minor injury accidents there were 816 minor injury victims. It is only in property damage accident cases that you don’t find loss of lives or injuries.

Table 6.7: Road traffic accidents of (HGV) by severity

Type of Accident	Number of Cases	Number of Fatalities	Number of serious injuries	Number of minor Injuries	Total casualties	Number of Vehicles
Fatal	709	1631	2071	482	4184	1773
Serious	783		1694	575	2269	1196
Minor	524			816	816	765
P D O	335				0	804
Total	2351	1631	3765	1873	7269	4537

Source: Authors compilation 2015

Table 6.8 presents the results of the analysis of accident severity ratios for HGV traffic accidents in 2011. The figure of fatalities is 2.3 fatal casualties per fatal accident, and there were 2.9 serious injuries in each fatal accident and 0.6 minor injuries per fatal accident. With a ratio of 5.8 casualties per fatal accidents, the number of casualties in a fatal accident is normally higher compared to the other categories of accidents owing to the severe nature of such accidents. In serious injury accidents, there was an average of 2.9 casualties per accident, in minor injury accidents; there was an average of 1.6 casualties per accident.

Table 6.8: 2011 Accident severity ratios

Type of Accident	Number of fatalities	Number of major injuries	Number of minor Injuries	Total casualties	Number of Vehicles/accident
Fatal	2.3	2.9	0.6	5.8	2.5
Serious injury		2.2	0.7	2.9	1.5
Minor injury			1.6	1.6	1.4
Damage only					2.4

Source: Authors compilation 2015

The ratio of vehicles damaged per accident in Table 6.6 is used to estimate the number of vehicles per accident with under-reporting cases included as shown in the last column of Table 6.7.

The number of vehicles per accident by severity is also computed in Table 6.8. There were an average of 2.5 vehicles damaged in a fatal accident, 1.5 in serious injury accident, 1.4 in minor injury accident and 2.4 in damage only accident.

6.4 Cost of HGV road traffic accidents

Accident costs are usually estimated based on severity where separate values are obtained for fatal, serious injury, minor injury and damage only accidents. The national cost of accidents is then estimated by multiplying the costs by accident severity and by the number of those accidents that happened in the year. Several costs are associated with road traffic accidents. According to Silcock/TRRL (2003) the following costs are recognisable costs associated with road traffic accidents; Property damaged cost, Administration cost, lost output cost, Medical cost and Human costs.

Trinh et al (2005) classified accident cost components into tangible and intangible costs. Tangible costs are the costs of property damaged, administration costs and medical expenses of those involved in the accidents. Intangible costs are lost output and the cost of pain, grief and suffering. Elvik (2000) divides costs of accidents into three major components; direct costs which include any additional expenses that result from accidents, which include costs of hospital treatment, cost of replacement or repair of vehicles that are damaged, and the costs of administration like police and courts involvement. Indirect costs of accidents are lost output caused by premature death of accident victim, premature impairment, or temporary absence from work as a result of traffic accidents. The third component represents the cost of pain, grief and suffering resulting from road accidents.

Luathep and Tanaboriboon (2005) identified seven integrated cost components under the human capital technique. These costs are; hospital and medical costs, lost output, property damage costs, insurance administrative cost, emergency medical service cost, police administrative cost, funeral and human cost. Swarts et al (2012) discussed the external cost

of road freight traffic in South Africa. Among the external costs associated with the costs of road freight traffic accidents are lost output, towing, car hire, insurance administration, assessors, legal fees, accident administration and time delay cost.

According to the Asia Development Bank guidelines on the costing of accidents (1997), key components of accident costs are classified into casualty related costs and accident related costs. Thus, casualty related costs are; lost output, medical costs, and the cost of pain, grief and suffering. The accident related costs are; property damage and administration costs. All these costs are classified as resource costs except the pain, grief and suffering component which is a social cost. The cost of an accident is determined by the sum of casualty related costs, plus the accident related costs, while the total cost of accident is the number of accidents by severity multiplied by their respective accident cost (ADB, 1997).

The analysis of the cost of HGV road traffic accidents in Nigeria in this study will cover casualty related costs and accident related costs. However, since this research is centred on HGV road traffic accidents that involve the movements of large vehicles, the cost of damage to goods in transit and damage to third party property are also estimated as components of the cost of property damage. The process of calculating HGV accident costs in this study and the sources of data for each cost category is shown in Figure 6.1. From that figure, five cost components are estimated in this study. These are Medical, Property damage, Lost output, Administrative and PGS accident costs.

6.5 Medical cost

When road traffic accidents happen, casualties are normally recorded according to severity, ranging from minor injury, serious injury, fatality and property damaged. As such, there are costs attached to these outcomes, and the costs involving the treatment to injured persons are estimated in this study under the cost of medical treatment. Medical costs are casualty related costs and are therefore estimated from the average costs of treatment of an accident victim.

The components of the cost of medical treatment resulting from HGV road traffic accidents are usually hospital treatment (in-patient and out-patient), the use of ambulance and the treatment by general practitioners (Jacobs 1995). This research is however, limited to the

estimation of the cost of medical treatment at the hospital, and this is determined according the level of injury as follows;

- Estimating the average cost of treatment of a minor injury
- Estimating the average cost of treatment of a serious injury
- Estimating the average cost of treatment of a fatal accident case

Ambulances are not frequently used to convey accident victims to Hospitals in Nigeria, and therefore its cost is not available and so is not introduced into the medical cost of accidents in this study.

The information relevant to this sub-section was obtained by extracting accident victim records from patient files in Hospitals. The hospitals are; Ahmadu Bello University Teaching Hospital Zaria, University of Benin Teaching Hospital, Lagos orthopaedic Hospital and Kano orthopaedic Hospital. Accident patient files for the year 2011 were assembled at each of the selected four hospitals as explained in 4.11. Cost of treatment for each patient was calculated from victims' hospital records extracted from their files. The cost of all expenses during treatment was calculated per accident category and the results multiplied by the average number of casualties in that accident category.

It is important to know that in Nigeria, accident victims and their relatives have full responsibility for the payment of the hospital bills emanating from their hospital treatment. Table 6.9 shows the average cost of medical treatment for accident victims across the severity injuries of minor injury, serious injury and fatal injury derived from the Four Hospitals data. Figure 6.2 shows that the cost of treatment for major injury is higher than the rest. This is because accident patients with serious injuries are bound to stay longer in hospital and would therefore incur more cost. It is important to note that the cost in Zaria is lower than the rest because of its location as a semi-urban area with a lower cost of living.

Table 6.9: Average cost of medical treatment of accident Victims 2011 (US DOLLAR)

Hospital	Fatal Accident	Serious Accident	Minor Accident
A B U Zaria	206	411	30
Orthopaedic Dala	No case selected	690	42
Orthopaedic Lagos	389	755	140
University of Benin	641	656	149
Total cost	1735	2549	361
Average Cost/Injury	412	628	90

Source: Authors compilation 2015

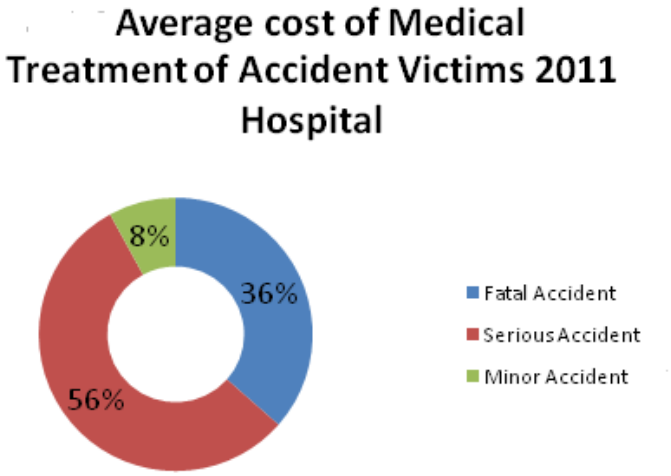


Figure 6.2: Average cost of Medical Treatment

6.5.1 Cost of medical treatment for minor injury for Year 2011

From the hospitals data in Table 6.9, the average cost of minor injury casualty was estimated at 90 US Dollars for the year 2011. These costs include that of card registration as an accident casualty, cost of consultation, cost of dressing of wounds, cost of medication. Taking into account the fact that there were 1.6 casualties per minor injury accident for the year 2011 (Table 6.5), then the cost of medical treatment for minor injury accident (MMC) is \$90 x 1.6= \$145 per accident.

6.5.2 Cost of medical treatment for serious casualty for Year 2011

From the hospital data in Table 6.9, the average cost of serious injury casualty treatment for the year 2011 was estimated at 628 US dollars. These costs include the cost of card registration, cost of consultation, cost of dressing of wounds, cost of medication, cost of bed fee per day, cost of surgery, cost of prosthesis, cost of laboratory investigation, cost of physiotherapy and other incidental costs. Taking into account the fact that there were 2.16 serious casualties per serious injury accident for the year 2011 (Table 6.8), then the cost of medical treatment for serious casualty accidents (SMC) is $628 x 2.16 = $1356. Similarly, there were 0.72 minor injury casualties per serious injury accident for the year 2011 (Table 6.8), thus, the medical cost of treatment for minor injuries in serious injury accident is $90 x 0.72 = $65 only. The cost of serious injury accident including minor and serious injuries is therefore, $65 + $1356 = $1,421.

6.5.3 Cost of medical treatment for fatal casualty for Year 2011

From the hospital data in Table 6.9, the average cost of fatal casualty for the year 2011 was estimated at 412 US dollars. These costs include the cost of registration, the cost of consultation, and cost of dressing wounds, cost of suturing of wounds, cost of medication, cost of bed per day, cost of surgery, and cost of laboratory investigation.

Taking into account the fact that there were 2.3 fatalities per fatal accident for the year 2011 (Table 6.5), then the cost of medical treatment for casualties in fatal accidents (FMC) is $412x 2.3= $948 per fatal accident. Similarly, there were 2.9 serious injury casualties in a fatal accident, thus the cost of treatment for serious injury casualties in fatal accidents is $628 x 2.9 = $1821 only. There were also 0.67 minor injuries per each fatal accident in 2011, giving a cost of $90 x 0.67= $60 only. The cost of a fatal injury accident including fatal casualties, serious and minor injury casualties' medical treatments is $946 + $1821 + $60 = $2,827.

Further analysis is contained in Table 6.10, which reveals that the total medical cost of HGV road traffic accidents for 2011 is $3.18 Million out of which $2.0 Million was the cost for fatal accidents, $1.1 Million was for serious injury accident and $.075 Million was for minor injury accident. These represent 63% for fatal accident, 36% for serious injury accident and 1% for minor injury accident of the total medical cost of HGV road traffic accident.

Table 6.10: Medical cost of traffic accident victim 2011(US dollar)

Type of Accident	Average Cost of Accident ($)	Number of Accidents	Total Cost (million USD)
Fatal	2,829	709	2.0
Serious Injury	1,421	783	1.1
Minor injury	145	524	.075
Total		2016	3.18

Source: Authors compilation, 2015.

It has been stated earlier in this section that the estimates under medical cost does not include cost of ambulances and the cost of rehabilitation after discharge from hospital. These costs are excluded for lack of data. Moreover, Silcock/TRRL (2003) have observed that Medical costs have tended to attract less priority in accident cost analysis as they are generally much lower than property damage cost and loss of output estimates.

6.6 Property Damage

Road freight traffic represents the activities of goods vehicles that move with thousands of tonnes of goods and materials of different dimensions in weight and shape over large distances. However, different dimensions of vehicles are used for road freight traffic in Nigeria, but this study is focusing on Heavy Goods Vehicles only as stated in Chapter one and two. When these types of vehicles are involved in an accident, the impact is not only on the vehicle but its contents and other properties on or around the road way are damaged (see Appendices 8, 9.10, 11,12and 13).

Property damage is an accident related cost and is estimated in this study on the bases of the number of accidents by severity. Several sources are available to obtain data required to calculate the cost of properties damaged in road traffic accidents. These are insurance companies, fleet owners, motor repair garages and owner/operator Surveys, (Silcock/TRRL2003). When estimating the average cost of properties damaged in road traffic accidents, information on the number of vehicles involved per accident according to severity

is required. In this study, the number of the vehicles involved in accidents per accident severity was obtained from the data collected from the Federal Road Safety Commission. In addition, the operators' survey was the source of the data used to estimate the average number of accidents that resulted in damage to vehicles and other properties. Similarly, the cost of vehicles damaged per accident, the cost of third party property damaged per accident and cost of goods in transit damaged as a result of HGV road traffic accidents in 2011 are calculated based on the outcome of the operators' survey (see figure 6.1).

The operators' responses on the number of accidents that result in various forms of damages are presented in Table 6.11. It shows that there were 85 responses who recorded traffic accidents that led to property damage. The result also showed that while all the 85 respondents recorded vehicle damage accidents, 26 accidents caused damage to goods in transit and 12 resulted in damage to third party properties (figure 6.3).

It is worth noting that one accident can result in outcomes that may lead to vehicle damage, goods in transit damage and third party damage at the same time. In this research, each outcome is calculated as a case of its own.

Table 6.11: Distribution of property lost in accident

Types of property	No. of cases	Percentage
Vehicles damaged	85	100
Goods in transit damaged	26	31
Third party property damaged	12	14

Source: Authors compilation, 2013

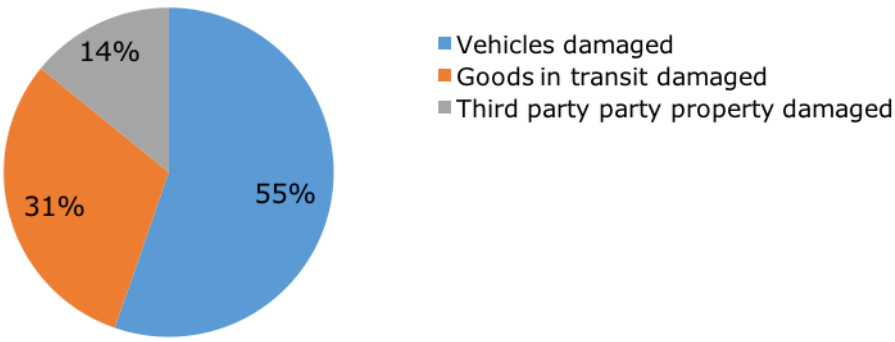


Figure 6.3: Distribution of properties damaged in percentages.

Cost of damage to road infrastructure and furniture arising from these types of accident are not covered in this study due to lack of data.

This study is therefore focused on estimating three key components of property damage associated with HGV road traffic accidents. These are the cost of own/third party vehicle damaged, the cost of third party property damaged and also the cost of goods transported by the vehicles that was involved in accident. In accordance with the human capital model, the average costs of each of these are estimated based on the averages obtained from the operators' questionnaire. Operators were asked to state how much they have lost in the form of damage to vehicles, damage to goods in transit and damage to third party properties, and their responses are shown in Table 6.12.

Table 6.12: Average cost of property damaged 2011 (US dollar)

Vehicle Type	Vehicles damage (000)	Goods in Transit damage (000)	Third party property damage (000)
Tanker	57	72	55
Trailer	77	68	65
Lorry	54	92	55
Average	63	77	58

Source: Authors compilation, 2013

6.6.1 Vehicles damaged

The estimation of the cost of road freight vehicles damaged because of accidents starts with the compilation of the average number of vehicles involved in road freight traffic accidents per accident severity. Table 6.6 shows the breakdown of the number of vehicles involved in various categories of HGV road traffic accidents in Nigeria in 2011. From the table, the average number of vehicles involved in HGV road accident in Nigeria in the year in 2011 was 1.9 vehicles per accident. From Table 6.8 the number of vehicles per fatal accident was

2.5, for serious injury accidents it was 1.53 and 1.46 for minor injury accidents. For PDO accidents, it was 2.4 vehicles.

In this section, the number of vehicles that were damaged because of the accidents is computed. From Table 6.6, the total number of HGV road traffic accidents in 2011 is 2351, leading to 4537 vehicles damaged. This gives an average of 1.9 vehicles per accident. Since there is already the number of vehicles involved in accident by accident severity in Table 6.6, and the cost of vehicle damaged per accident is given in Table 6.12, the total cost of vehicle damaged accident is calculated in Table 6.13.

Table 6.13 Average cost of vehicle damaged/ per accident severity (US dollar)

Type of Accident	Number of Accident	Average Number of damaged vehicles per accident	Average Cost of vehicle damaged per accident (000)	Total Cost of vehicle damaged per accident severity (Million)
Fatal	709	2.50	63	111
Serious Injury	783	1.53	63	75
Minor Injury	524	1.46	63	48
Property damage	335	2.40	63	51
Total	2351			285

Source: Authors compilation 2013

Table 6.13 shows the result of the analysis on average cost of vehicle damaged for 2011 as reported by vehicle operators. Results from Table 6.12 indicate that the average cost of HGV road vehicle damaged is $63,000 per accident. This is calculated to reflect the severity of accident in Table 6.13; by multiplying the number of accidents by severity with the average cost of vehicle repair/replacement per accident and the average number of vehicles damaged per accident. Table 6.13 shows that the cost of vehicle repair/replacement is highest in fatality accident, then serious injury accident. The total cost of vehicle repair/replacement is however $285 Million in 2011 with the highest cost coming from fatal accident, then serious injury accident and then minor injury accident while property damaged accident is the least.

6.6.2 Damage of goods in transit

Over 90% of goods of all types are transported in Nigeria by road (Akhphogomeh, 2012). This means that goods worth millions of Dollars might be lost due to HGV road traffic accidents yearly. The survey of truck drivers has shown the types of goods being transported on Nigerian roads and the values of such goods were recorded by truck operators. Table 6.11

shows that 31% of accidents that involved properties damaged are accidents that also include damages to goods in transit.

The average values of goods in transit damaged as a result of HGV road traffic accidents by truck type is shown in Table 6.14. The table shows that an average of $77,000 goods are lost per accident that results in goods in transit damaged in Nigeria in 2011. The loss in goods due to accidents caused by lorry accident is higher than both tanker and trailer load even though in Table 5.12, the volume of goods carried by trailers is higher in value. The explanation to these arose from the fact that the Lorries being are built from wood, and when they are involved in accident, the damage to both vehicles and goods is total.

Table 6.14 Average cost of Goods in Transit/ per accident severity (US dollar)

Type of Accident	Number of Accident	Number of accident with damaged to goods (31% of total accidents).	Average Cost of damage to goods/ accident (000)	Total Cost of damage to goods/accident severity (Million)
Fatal	709	226	77	17
Serious Injury	783	241	77	19
Minor Injury	524	160	77	12
Property damage	335	102	77	8
Total	2351	729		56

Source: Author's compilation 2013

Since the number of accidents, involving damage to goods in transit is 31% of HGV traffic accidents it follows therefore that some trucks do make their return trips empty after delivering their cargo at designated points. Accidents involving these types of trucks therefore happen without any damage to goods in transit. The total number of accidents that

resulted in damage to goods in transit is thus, 31% of 2351 = 729. This is classified into severities of accidents in Table 6.14 and the cost of each severity computed. The total cost of goods in transit damaged is therefore $56 Million only.

6.6.3: Damage of third party property

In addition to the damage to vehicles and goods in transit, trucks accidents also incur additional cost to the economy. This is in the form of damage that often results to third party properties like buildings, shops and other third party properties. To estimate the cost of this damage, road freight truck operators were requested to provide the cost of damage to third party properties due to accidents in their companies. Table 6.12 shows the computation of the cost of damage to third party's property for 2011. The Table shows that the average of this cost per accident is $58,000 for the year 2011. The value for each type of vehicle accident is $49,000 for tankers, $65,000 for trailers and $61,000 for Lorries. Table 6.12 also shows that, third party loss from accidents resulting from trailers is $65,000, which is higher than tankers and Lorries.

Table 6.15 Cost of damaged to 3rd party property per accident severity (US dollar)

Type of Accident	Number of Accident	Number of accident with damage to 3rd party property (14% of accidents)	Average Cost of damage to 3rd party property (000)	Total Cost of damaged to 3rd party property per accident severity (Million)
Fatal	709	102	58	6
Serious Injury	783	109	58	6
Minor Injury	524	72	58	4
Property damage	335	46	58	3
Total	2351			19

Source: Author's compilation 2013

This is expected since trailers are normally bigger in size and their accidents are bound to make more impacts on other properties. The number of accidents involving damage to third parties' properties is derived from operators' responses and is shown in Table 6.11. The Table shows that up to 14% of the accidents resulted in damage to third party properties. The total number of accidents that resulted in damage to third party properties is therefore 14% of 2351 = 329. These are categorised into severities in Table 6.15.

6.6.4: Total cost of property damage accidents 2011

The total cost of damage to third party properties is computed in Table 6.16 according to severities of accidents.

Table 6.16 Total cost of property damaged 2011 (US dollar)

Type of Accident	Vehicles damaged (Million)	Goods in transit damaged (Million)	3rd party property damaged (Million)	Total
Fatal	111	17	6	134
Serious Injury	75	19	6	100
Minor Injury	48	12	4	64
Property damage	51	8	3	62
Total	285	56	19	360

Source: Author's compilation 2013

The Table shows that the cost of vehicle damage is much higher than other costs, followed by goods in transit damage and then 3rd party property damage. Similarly, cost arising from fatal accidents is $134 Million, followed by $100 Million for serious injury and then minor injury accidents, with the cost of properties damage by the least.

6.6.5: Proportional cost of property damage

After computing the estimated cost of the three components of property damage accidents involving HGVs in 2011, the composition of the costs based on individual costs components is shown in Table 6.17 and Figure 6.4.

Table 6.17: Proportional cost of property damaged cost in 2011 (US dollar)

Cost Component	Estimated Cost (Million)	% of Property Damage Cost
Vehicle Damage	285	62%
Goods in transit damage	56	28%
Third party property damage	19	10%
Total	360	100%

Source: Author's compilation, 2013

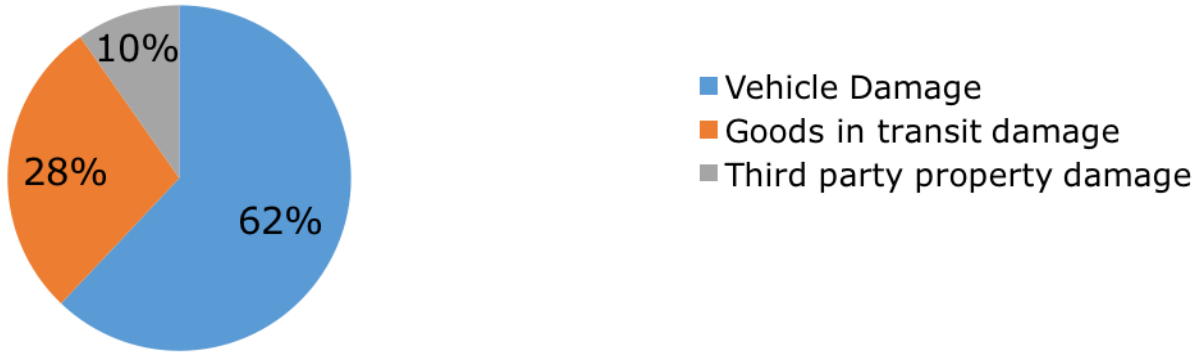


Figure 6.4: Total Property damaged cost 2011.

Figure 6.4 shows the proportional distribution of damage to properties. The total cost of property damage resulting from HGV road traffic accidents in Nigeria in 2011 is **$360 Million.** As shown in Table 6.16 and figure 6.4 above, 62 % of this cost was caused by damage to vehicles, 28% resulted from damage to goods in transit, while 10% cost came from cost of damage to third party properties. According to Silcock/TRRL (2003), the cumulative cost of damage to property can account for the highest proportional percentage of the total cost of road traffic accidents in a country.

6.7 Lost Output

In accident cost analysis, lost output is the amount that represents the forgone earnings of an accident victim who suffers from death or injury. This cost is about a loss in capacity due to time delays of the victims of the accidents and their relatives, time for recovery and rehabilitation. Lost output therefore involves cost estimates of foregone earnings from loss of productive years due to fatality accident, major injury accident and minor injury accident. Some writers also include the cost of time required to look for a new job (ANH Thuy et al. 2005).

The value of a person's lost contribution to the community due to death is still controversial among accident cost researchers. Naji (1994) observed that it was common previously to deduct the consumption of the fatality from his/her future lost output. Many researchers have raised objections against this deduction because they consider consumption as a step in the creation of other products in the society. Moreover, deduction of consumption may be appropriate when estimating the economic consequences of death from the view point of a particular family, but this is not the case from the society's point of view.

To estimate lost output, the average age of fatality, the average income in the country and the average age of accident victims need to be determined. Lost output is therefore a casualty based cost of an accident and is estimated according to the number of casualties involved in the accident. According to Madubueze et al. (2010), the mean age of accident victims in Nigeria is 29 years and the amount of time spent for serious injury and minor injury treatment is 35 days and 5 days respectively as reported in Silcock/TRRL (2003). Table 6.18 shows the average lost time of casualties used in this study. Typical cases of lost output that were covered in this study arose from the types of accidents cited in Appendix 12, 13, 14 and 15.

Table 6.18: Average lost time of casualties and carers

Casualty severity	Average time spent	Explanation
Fatality	36 years	Retirement age of 65 and average road death of 29
Serious Injury	35 days	25 days recovery and 10 days looking for new work.
Minor Injury	5 days	3 days recovery and 2 days looking for new work

Source: Adopted from Silcock/TRL 2003 and Madubueze (2010).

6.7.1: Minor Injury lost output

Lost output from minor injuries was for an average of 5 days. Table 6.18 above shows that the average lost time of casualty for minor injury is 5 days. Since the per capita income is $2,600, the average daily income for 2011 is $8, assuming that Nigerians work for 6 days a week, totalling 313 days in a year. Therefore, the cost of lost output for minor injury victim in road freight traffic accident for 2011 is thus 5 days X $8 = $40.

From Table 6.8, there were 1.56 minor injuries per minor injury accident in 2011. The cost of lost output for minor injury accidents in HGV road traffic accidents in 2011 is therefore, $40 x 1.56 x 524=$.03 Million

6.7.2: Serious Injury lost output

To obtain lost output for serious injury accident, the number of days spent recovering in hospital was used. Table 6.18 above shows that the average lost time of casualty for serious injury is 35 days. Since the per capita income is $2,600 the average daily income for 2011 is $8, assuming that Nigerians work for 6 days a week, totalling 313 days in a year. Therefore, the cost of lost output for serious injury victim in a serious injury accident in HGV road traffic accident for 2011 is thus 35 days X $8 = $280.

From Table 6.8, the average serious injury casualties in a serious injury accident is 2.16 per accident, thus, the cost of lost output for serious injury accident for serious injury victims is $280 X 2.16 x783 = $473,558. The cost of minor injury lost output in serious injury accident will also be $40 X 0.73 X 783 = $22,863. Therefore, the total loss output due to serious injury accidents including serious and minor injury victims in road freight traffic accidents in 2011 is $473,558 + $22,863 =$.50 Million

In addition to this cost is the cost reflecting the loss output for the carer (i.e. the person taking care of the injured). This is well known norm in the developing countries, where a family member stays with the injured beside the nurses in the hospital to provide care and assistance to the victim. Thus, the loss output become 2 x $.50 Million = $1 Million.

6.7.3: Fatality lost output

The average age of accident fatality in Nigeria is 29 years as shown in table 6.18. This is subtracted from the average retirement age in the country in order to know the lost output for a fatal accident victim. The average age of retirement in Nigeria public service is 60 years for some public sector employees, 65 for some other categories and still 70 for yet another category and those in the private sector. This study is therefore based on 65 years, representing the average retirement age in Nigeria and Lost output calculation for fatalities is therefore based on 36 years. The parameters for calculating lost output are the GDP of Nigeria, per capita income, growth rate and discount rate of the year under consideration. The per capita income is used to represent the average wage rate in this study as presented below in table 6.19.

Table 6.19: Parameters for estimating lost output in fatal accidents in Nigeria 2011

Year	r (%)	g (%)	GDP per capita	GDP 2011
2011	9.75	6.8	($2,600 USD)	($414 billon(USD)

Source: World Bank (2012).

According to ANH thuy et al (2005) the total average lost output for fatal road accident is the sum of each future year's lost output, estimated as follows:

$$LO_{Fatality} = \sum_{i=1}^{N} \frac{W(1+g)^i}{(1+r)^i}$$

Where,

LO is the lost output.

r is the discount rate (9.75)

g is the growth rate (6.8)

W is the average yearly per capita income ($2,507.68)

i is the average number of years of lost output per fatality = $56,750

The cost of lost output for fatal accidents is estimated by calculating the cost against each accident severity in fatal accidents. There are 2.3 fatal casualties in each fatal accident (Table

6.8) in 2011. Cost of fatality in HGV road traffic fatal accident for 2011 is therefore $56,750 x 2.3 x 709 = $92.5 Million.

Similarly, the lost output for serious casualties in fatality accidents is $280 per casualty. With 2.9 serious injuries in each fatal accidents (Table 6.8), the lost output for serious injury in fatal accident for HGV road traffic in 2011 is therefore $280 x 2.9 x 709 = $.58 Million The cost of minor injury lost output is $40 only. In a fatal accident, there were 0.68 minor injuries (Table 6.8), these cost $40 x 0.68 x 709 =$.02 Million. Thus, the total cost of lost output in fatal accidents for road freight traffic in 2011 is $92.5 Million+ $.57 Million+ $.02 Million = $93 Million.

From table 6.20 shows that the total cost of lost output for HGV road traffic accidents in 2011 is $94.03 Million**.** The cost associated to lost output due to fatal accidents is 98.4% of the total lost output. The cost of serious injury is just 1.5% of the total cost of lost output,while the cost of minor injury is 0.03%.

Table 6.20: Proportional cost of lost output 2011 (US dollar)

Type of Accident	Cost of Accident (Million)	%
Fatal Injury	93	98.4%
Serious Injury	1.0	1.5%
Minor Injury	.03	0.03%
Total	94.03	100.00%

Source: Author's compilation (2015

From the analysis, the cost of lost output is lower than property damage cost; this is understandable since the research is on HGV road traffic accidents, covering three property damage categories.

6.8 Administration Cost

Administration costs estimation refers to the cost of the time spent by the Police, the Courts and the Insurance companies in the administration of accidents. Silcock/TRRL (2003) stated that administration costs are typically small amounts compared with other costs and it is not

advisable to spend much time and effort in their investigation. However in this research, previous studies have been used to estimate the cost of the administration of accidents.

Anh Thuy et al. (2005) reported that experiences of other countries indicate that insurance and administration cost account for just 2.8% of all non-casualty costs and police costs accounted for only 0.6% of non-casualty costs. In this study, the administration cost is estimated based on the findings of Jacobs (1991) and Simpson O' Reilly (1994). The average percentages of these two reports were computed and applied as the percentage of Administration costs for this study. This is shown in Table 6.21 as the average police and administrative cost, being a percentage of resource cost estimated in this study.

Table 6.21: Average administration cost as % of resource cost

Type of accident	Jacobs, 1991	Simpson and O' Reilly	Average
Fatal	0.2	2	1.1
Serious injury	4	8	6
Minor injury	14	7	10.5
Property damage only	10	5	7.5
Average	5.1	5.5	6.3

Source: Adopted from Nnaji 1994

In this regard, the average costs in Simpson and O' Reilly per accident severity as contained in Table 6.21 are added as administrative cost of accidents. This falls within the range in Silcock/TRRL (2003) for five developing countries; Jordan 8%, Vietnam 3%, South Africa 5%, Argentina 5% and Bangladesh 1%.

Table 6.22: Administrative cost of accident at (US dollar)

Type of accident	Cost of accident (Million)	Administrative cost (%)	Administrative cost (Million)	Total cost (Million)
Fatal	229	1.1	2.52	231.52
Serious injury	102.1	6	6.13	108.23
Minor injury	64.1	10.5	6.73	70.83
Property damage	62	7.5	4.65	66.65
Total	**457.2**		**20.03**	**477.23**

Source: Author's compilation (2013)

Therefore the administrative cost of the road freight accident in 2011 from Table: 6.22 is $20 .03 Million and the total cost of accidents including the cost of Administration is equal to $477.23 Million.

6.9: Cost of Pain, Grief and Suffering

According to Silcock/TRRL (2003), a study on road traffic accidents cost which has the objectives of cost- benefit analysis or assessment of effects on resource allocation efficiency will be done using the Willingness-To-Pay method. But, since this method is not suitable for developing countries, the human capital method is always used with amounts added to reflect pain, grief and suffering.

The cost of pain, grief and suffering are costs that are though difficult to express in monetary terms, but which the community would usually be prepared to meet in order to avoid the misery involved (Jacobs, 1995). The human cost that accounts for pain, grief and suffering and the economic consequences of that is added to the total cost for each severity type of accident (Luathep and Tanaboriboon, 2005). Similarly, Silcock/TRRL (2003) added that the amount to cover the cost of pain, grief and suffering within the human capital method is essentially a political decision. However, many developing countries have used the figures in United Kingdom to estimate the human cost, though countries like Nepal and India have used 20% of lost output cost.

In this study a percentage to represent pain, grief and suffering is calculated according to the values suggested by the Transport Research Laboratory (Jacobs/TRL, 1995) as follows;

- For a fatal accident 28% of total cost
- For a serious injury accident 50% of total costs
- For a minor injury accident 8% of total costs
- For a property damaged only accident 0% of total costs

Silcock/TRRL (2003) observed that these values were used in many other countries and in the United Kingdom in the mid-80s before the application of the willingness to pay approach. In this study, the cost of pain, grief and suffering is calculated in Tables 6.23.

Table 6.23: Cost of pain, grief and suffering (US dollars) 2011

Type of accident	Cost of accident (Million)	PGS cost(%)	PGS Cost (Million)	Total cost (Million)
Fatal	231.52	28%	64.83	296.35
Serious injury	108.23	50%	54.12	162.35
Minor injury	70.83	8%	5.67	76.50
Property damage	66.65	0%	0	66.65
Total	477.23		124.62	601.85

Source: Authors compilation (2013)

The cost of pain, grief and suffering of heavy goods vehicles traffic accidents for 2011 is $124. 62 Million (see details in Table 6.23).

6.10 Total accident cost

The total HGV traffic accident cost including all categories of accidents with the values of pain, grief and suffering added is shown in Table 6.23 to amount to **$601.85 Million.** In Table 6.24, the costs are calculated according to types of accident and also according to accident severities.

Table 6.24: Total cost of Heavy Goods Vehicles accidents in 2011 (US dollars)

Type of cost	Fatal (Million)	Serious Injury (Million)	Minor Injury (Million)	Property damage (Million)	Total (Million)
Medical	2.0	1.1	.075	-	3.18
Property damage	134	100	64	62	360
Lost output	93	1	.032	-	94.03
Administrative	2.52	6.13	6.73	4.65	20.03
Pain, grief and suffering	64.83	54.12	5.67	-	124.62
Total	296.35	162.35	76.50	66.65	601.85

Source: Author's compilation (2013)

The analysis of road traffic accidents of heavy goods vehicles in Table 6.24 shows that property damage cost is the major contributor of cost totaling $360 Million followed by pain, grief and suffering which is $124.62 Million and then loss output is $94.03 Million. Other cost are administrative cost $20.03 Million and last is medical cost, which amounts to $3.18 Million only. Figure 6.5 illustrate the costs distribution further according to percentages.

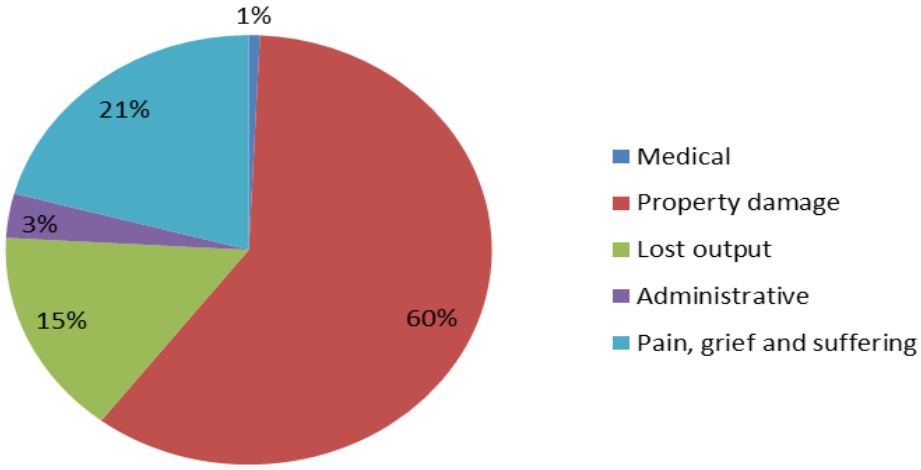


Figure 6.5: Proportional total cost of accident

Table 6.24 shows that the cost of fatal accidents is the highest cost amounting to $296.35 Million followed by the cost of serious injury accidents at $162.35 Million and then the cost of minor injury accident at $76.50 Million. Property damage only accidents cost is the lowest at $66.65 Million as illustrated in figure 6.6.

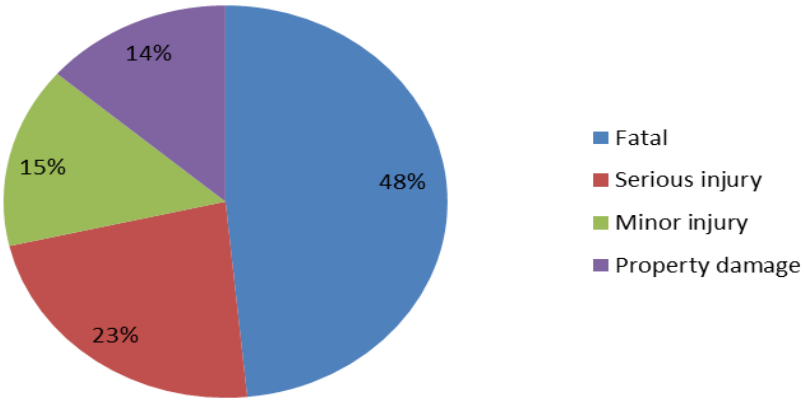


Figure 6.6: Proportional total cost of accident (based on Severity)

From the foregoing, the total cost of heavy goods vehicle road traffic accidents for 2011 is $0.602 billion.

6.11 The economic implications of heavy goods vehicles road traffic accidents in 2011

To fully achieve **objective four** of this study, there is need to assess the implications of the cost of HGV road heavy goods vehicles traffic accidents on the Nigerian economy. In this study, this is measured in two different ways;

6.11.1 Contribution to the cost of traffic accidents

Most research on the cost of road traffic accidents has produced results that placed the costs of accidents within 1-5% of GDP thresholds Elvik (2002). In Nigeria, research by Orosanyin (2003) on the cost road traffic accidents, put road accidents cost in Nigeria at 2.46% of GDP. Paul et al (2003) estimated cost of road traffic accidents in Bangladesh at 2.5% of GDP and Mohan (2000) estimated the cost of accidents in India within 2% of GDP. Luathep and Tanaboriboon (2005) estimates of cost of road traffic accidents in Thailand is also at 2.56% of Gross Domestic Products. BRTE (2010) estimated the cost of road traffic accidents for 2006 in Australia at 1.75% of GDP.

In addition, Elvik (2000) estimated the costs of road traffic accidents, which was measured as a percentage of gross national product for twelve countries, which he derived from previous research. With non-market costs (pain and suffering) included, the costs are in the average of 1.3% of GDP, with range of 0.3-2.8%; and when a non-market costs are excluded, they are in the average of 2.5%, with a range of 0.5-5.7%. The findings of Zaloshnja and Miller (2004) put the cost of large truck crashes of about $19.6 billion amounting to 5.9% of the cost total highway crashes in United States.

The Gross Domestic Product of Nigeria for the year 2011 is $414 billion. Therefore, the percentage of road accidents costs in relation to the country's GDP is obtained by dividing the total accident costs by the GDP. This will come up to 2.46% of $414 billion, which amounts to **$10.18** billion.

To appreciate the magnitude of the cost of the HGV accidents, it is important to compare it with the overall accident cost. To do this, the cost of the HGV traffic accidents is divided by the overall cost of accidents and then multiplied by 100. Thus, giving the percentage of the cost of HGV accidents over the overall cost of accidents for the country in 2011. This is $0.602/$10.18 x 100 **= 5.9%.**

The contribution of road traffic accidents of heavy goods vehicles to the cost of accidents in Nigeria is therefore 5.9% of the total cost of accidents. In the United States, it is also 5.9% of the cost of highway crashes according to Zaloshnja and Miller (2004).

6.11.2 Cost to the GDP of the transport sector in Nigeria

The impact of HGV road traffic accidents is also measured through the determination of the contribution of the transport sector to the GDP of Nigeria. According to the federal Ministry of Works (FMW 2014), the transport sectors' contribution to the GDP in Nigeria is 5.5% of the GDP in 2011, of which the road sector accounts for 90% of that contribution.

The Gross Domestic Product of Nigeria for the year 2011 is $414 billion, and the transport sector contributes 5.5% of this, amounting to $22.77 billion. Out of this, the road transport sub-sector contributes 90% of the amount contributed by the transport sector, meaning $20.49 billion.

The cost of HGV road traffic accidents to the GDP of the transport sector is therefore; $0.602billion/$22.77billion * 100 = **2.64%.** The cost of HGV road traffic accidents to the GDP of the road transport sector is also $0.602billion/**$**20.49 billion* 100 = **2.94%.**

It is very important to say here that estimates derived from the human capital method are a conservative one. Masniak (2010) and Downing (1997) have estimated that where willingness to pay is used, the amounts are higher by between more than twice the values of the human capital method. Even at this, the cost is very significant, and it requires serious efforts to curtail it to the minimum.

6.12 Summary and conclusion of this chapter

Chapter six discusses the cost of HGV road traffic accidents in Nigeria. The cost estimates, based on 2011 road freight traffic accidents data was based on the guidelines of the human capital method.

The cost components estimated are lost output, vehicles damage cost, and third party damaged costs, goods in transit damaged cost, medical cost, the costs of pain grief and suffering and administration costs.

The cost estimates were based on data collected from the Federal Road Safety Commission, the field survey and a provision of under-reporting of 80%. The total cost of heavy goods vehicles road traffic accidents in Nigeria for 2011 is therefore **$0.602 billion**, this amount to 5.9% of the total cost of accidents in 2011.Property damaged cost is the highest component, followed by pain grief and suffering costs, lost output followed by administration costs and the least is medical cost.

Similarly, fatal accidents accumulated the highest cost, followed by serious injury accident, minor injury accident and the least is property damage only accident. Table 6.25 shows the summary of all the cost calculations.

The implications of this to the Nigerian economy is that, 5.9% of the loss to road traffic accidents in Nigeria was contributed by accidents involving heavy goods vehicles. Similarly, 2.64% of the value of the contribution by the transport sector to the GDP in 2011 is lost through accidents involving heavy goods vehicles. In addition, 2.94% of the contribution of the road transport sector to the GDP is lost through heavy goods vehicles accidents.

For a developing country like Nigeria where over 70% of the population live below the poverty line, losing this amount of resources is ill affordable, especially that these resources are being lost through avoidable channels. The saving of these resources through accident counter measures will enable the Government to invest in improving the welfare of the citizens and put more resources in improving education, health care, un- employment and protecting the environment. A lot must have been done in the past few years to curtail the road of road traffic accidents in Nigeria, but the outcome of this study shows that more need to be done especially in tackling heavy goods vehicles road traffic accidents in order to save this waste of resources.

Chapter seven provides the summary, conclusion and recommendation on this study of the cost of heavy goods vehicles traffic accidents to the Nigerian economy.

Table 6.25: Summary of the cost of accidents involving heavy goods vehicles in 2011

Type of cost	Type of accident	Description of calculation	Average cost of accident ($)	No. of accidents	Total cost ($Million)
Medical Cost	Fatal	Cost of medical treatment for casualties in fatal accidents $412 x 2.3= $948 per fatal accident Cost of treatment for serious injury casualties in fatal accidents is $628 x 2.9 = $1821 only Cost of treatment for minor injury casualties in fatal accidents is $90 x 0.67= $60 only The Total cost of a fatal injury accident: $946 + $1821 + $60 =	2827	709	2
	Serious	Cost of medical treatment for serious casualty accidents is $628 x 2.16= $1356 Cost of treatment for minor injuries in serious injury accident is $90 x 0.72=$65 only The Total cost of serious injury accident: $65 + $1356 =	1421	783	1.1
	Minor	Cost of medical treatment for minor injury accident is $90 x 1.6=	145	524	.075
		Total medical cost			3.18
	Note:	*In M x N; M is Average cost while N is the ratio per number of accident*			

Property damage	Vehicle Damage	Multiplying the average number of accident severity(s) with the average cost of vehicle repair/replacement per accident and number of accident per severity. This is multiplied with the average cost of vehicle damage per accident which is $63,000.			285
	Goods in transit damage	Average cost of goods damaged in transit per accident and number of accident per severity. This is multiplied with the average cost of goods damaged per accident which is $77,000 x729			56
	Third party property damage	Average cost of third part property damaged per accident and number of accident per severity. This is multiplied with the average cost of vehicle damage $58,000 x329			19
		Total property damage cost			360
Loss output	Fatal	Fatal injury lost output was calculated by multiplying $56,750 x2.3 x 709 = $92 Million PLUS Lost output for serious casualties in fatality accidents which was calculated by multiplying $280 x 2.9 x 709 = $575,000 PLUS Lost output for minor casualties in fatality accidents which was calculated by multiplying $40 x 0.68 x 709 = $19,000. Total lost output for fatal accidents is therefore:			93

	Serious	Lost output for serious injuries in serious injury accident was calculated by multiplying $280 x 2.2 x 783 = $482,000 PLUS Lost output for minor injuries in serious injury accident was calculated by multiplying $40 x 0.73 x783 = $22,000 PLUS Lost output for one carer which was calculated by adding $482,000 and $22,000 and the multiplying by two.		1	
	Minor	Lost output for minor injury accidents was calculated by multiplying $40 x 1.56 x 524.			.032
	Total	Total cost of lost output			94.03
Sub-Total cost					457.21
			Administration cost (Million)		Total per Severity (Million)
Administration Cost	Fatal	Add 1.1% of total fatal accident Cost (229 Million)	2.52		231.52
	Serious	Add 6.0% of total serious accident cost (102.1 Million)	6.13		108.23
	Minor	Add 10.5% of total minor accident cost (64.1Million)	6.73		70.83
	Property Damage	Add 7.5% of total property damage cost (62 Million)	4.65		66.65
		Total administrative cost	20.03		

		Total cost with % administrative cost included		477.23
Pain, Grief and Suffering	Fatal	Add 28% of total fatal accident cost (231,52 Million)	64.83	296.35
	Serious	Add 50% of total serious accident cost (108.23Million)	54.12	162.35
	Minor	Add 8% of total minor accident cost (70.83 Million)	5.67	76.50
	Property Damage	Add 0% of total property damage cost (66.65 Million)	0	66.65
		Total Pain, Grief and Suffering (PGS) cost	124.62	
		Total overall cost of heavy goods vehicles road traffic accidents for 2011		602

CHAPTER SEVEN

SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 Summary

Road traffic accidents have been identified as a leading cause of death and injury in many countries. This study on the cost of HGV road traffic accidents and its implications on transport policy in Nigeria was carried out to ascertain the magnitude of the loss to Nigeria and the Nigerian economy from these types of accidents in 2011.

The research was motivated by the growing incidences of HGV accidents in Nigeria, which can be attributed to the increasing number of these vehicles in the Nigerian transportation system. The increase emanates from the continuous growth of the Nigerian economy and rising demand for transportation services. It is also associated with the progressive decline of the Railway system. However, the safety performance of these vehicles has been a cause for serious concern in the country. Thus, the need to research this problem and make recommendations that can ameliorate the problem. Table 7.1 shows the research objectives of the study and how they were achieved.

Table 7.1: Research objectives and how they were achieved

Research objective	Methodology	Outcome
To analyse the Nigerian road transportation system and appraise the level of HGV accidents	Review of reports, journal papers and published books	This objective is addressed in Chapter 2. The analyses found that heavy goods vehicles are a very visible component of the Nigerian transport system. They have high accident rates with a monthly average of 96 incidences, causing an average monthly deaths of 97 and 309 monthly average injuries.

To review the literature relating to the estimation of the cost of road traffic accidents in both developed and developing countries and to appraise the place of HGV accidents research	Review of Published books, journal papers and reports.	This objective was achieved in chapter 3.The review analysed a range of costing models used in previous studies of the cost of road traffic accidents in developing and developed countries and identified a gap in the research of RTAs in developing countries.
To evaluate the causes of HGV traffic accidents and their prevention strategies in Nigeria	Descriptive statistics and Man-Whitney u-test analysis of data from the survey of truck drivers and operators	This objective was achieved by analysing the data from the field survey in Chapter 5. The major causes of HGV accidents are bad roads, over speeding by drivers, road obstructions and mechanical problems in vehicles. Prevention measures include proper vehicle maintenance, adequate enforcement of traffic rules and regular driver training and retraining.
To estimate the economic cost of heavy goods vehicles road traffic accidents in Nigeria and its impact on the GDP of the country.	Comparison of the accident cost against the cost of accidents of in Nigeria in 2011and on the contribution of Transport to the GDP	Objective four was achieved in Chapter 6. In this chapter, the total cost of HGV accidents in 2011 was estimated at US $0.602 billion, which is equivalent to 5.9% of the cost of traffic accidents in 2011.
To appraise ways in which transport policy may be reviewed in order to reduce these costs.	Review of research process and findings to bring out policy implications	This objective is addressed in Chapter 7. New policies to improve HGV operations in Nigeria have been recommended in this chapter.

Source: Authors compilation, 2016

The research was anchored on the positivist research philosophy using an inductive approach. Data for the research was obtained from primary and secondary sources. Field surveys were conducted involving truck drivers and truck operators at Shagamu in Ogun State and Mararaban-Jos in Kaduna State for truck drivers and Lagos, Kaduna, Kano and Port Harcourt for truck operators. Total of (410) questionnaires were filled and returned from truck drivers' survey and 213 questionnaires were filled and returned from the truck operators' survey.

Secondary data were collected from the Federal Road Safety Commission and four selected hospitals in Lagos, Kano, Benin and Zaria. Both the primary and the secondary data collected were validated and then analysed using frequency distribution tables, pie and bar charts representation, line graphs and Man-Whitney u-test.

A review of the various models of accident cost analysis was conducted and the human capital method was selected and used to estimate the cost of heavy goods vehicles road traffic accidents in 2011. The human capital method was used in this research instead of the willingness to pay method because of its suitability to the objectives of this research. The method has also been recommended for use in developing countries like Nigeria by the Transport and Road Research Laboratory (TRRL) of the United Kingdom.

7.2 Conclusion

After the analyses, findings were made in respect of the nature, causes and remedies of HGV accidents, the cost of HGV traffic accidents in Nigeria, and its impact for the economy and on Government policies on road transport development.

7.2.1 Level of HGV accidents in Nigeria

The study covered key areas of Heavy Goods Vehicles accidents in Nigeria as reflected in objective one. The analysis of the Nigerian road transport system established the dominance of HGV vehicles in the transportation of freight across the country. From the analysis, it can be concluded that road freight transportation in Nigeria is afflicted by problems such as bad roads, harassment by security agencies, attack by arm robbers, road traffic accidents, poor vehicle

conditions and also overloading of vehicles. The study further concludes that HGV accidents are actually in the rise in Nigeria compared to passenger traffic accidents rate, which appeared to be fluctuating from year to year. This is evident from the records of HGV accidents from 2007 to 2010.

7.2.2 Studies on the cost of HGV accidents

A review of road traffic accident cost studies revealed that the most suitable approach to cost road traffic accidents in developing countries is the Human Capital Method, and this method was used in this study to estimate the cost of HGV accidents in Nigeria. Analyses of the previous studies reviewed in this chapter also revealed that, there is a gap in research in respect of the cost of HGV accidents. This is the gap that this study has addressed by estimating the cost of HGV traffic accidents in Nigeria.

7.2.3 Causes of HGV accidents and their prevention strategies

The outcome of the drivers' and operators' surveys form the basis of the analyses in respect of the causes and prevention strategies of HGV accidents. The following are conclusions drawn from the outcome of the field surveys of both drivers and operators.

1. Drivers

The majority of the truck drivers fall within 40-50 age group, followed by those ranging from 29-39 years. Thus, 72% of the truck drivers in Nigeria fall within 29-50 years bracket. Similarly, most truck drivers (41.9%) have secondary education as their highest educational qualification, and no driver was found to have a qualification higher than a diploma, as well as no driver was found to be completely illiterate. The study concludes therefore that, truck drivers on Nigerian roads have acquired some level of literacy that would enable them to read and interpret road signs.

In addition, the majority of the drivers (53.6%) have between 8-21 years of driving experience. This means that majority of the heavy goods vehicles drivers in Nigeria are experienced

professional drivers. Furthermore, the results revealed that the majority of drivers (53.4%) have between six and ten 6-10 family dependants. In addition.

2. Operators

The study reveals that the majority of operators (67.0%) have 1-10 years of operational experience. From the results therefore, it can be concluded that majority of the operators have less than 11 years operational experience. The survey also found that most operators (79.7%) have between 1-20 vehicles. This means that the majority of the operators have a small fleet size. Meanwhile, only 54% of the operators claimed to possess an insurance policy, this is a factor that also affects the growth and performance of the companies since several losses may not be compensated due to lack of insurance.

3. Heavy Goods Vehicles

The result of the survey revealed that (60.5%) of the drivers, drive tanker trucks, 32.4% drive trailer trucks and only 7.1% drive Lorries. This is as a result of the failure of the pipeline system, where tanker trucks are now the sole distributor of petroleum products in Nigeria. The study also discovered that most tanker trucks are of 31000-46000L capacity, while majority of trailers have between 26-36 tones capacity while capacity of majority of lorries is 20 tonnes and above.

The outcome of study also shows that, the highest concentration of truck traffic is on the Lagos-Shagamu- Ibadan-Jebba-Kaduna-Kano-Maiduguri route. Also important is the Lagos-Shagamu-Ore-Benin-Owerri-Aba-Port Harcourt route. These two routes combined account for 54% of heavy goods vehicles traffic in Nigeria.

4. Goods

The result shows that, petroleum products account for 43.6% of the goods transported by heavy trucks, general goods like consumer items, textiles and other household needs account for 29.2%. These categories of goods combine to account for 72.9% of the goods transported by heavy goods vehicles on Nigerian roads. The value of goods transported by heavy goods vehicles in Nigeria is between $3,125 and $87,502 per truck.

5. Causes of HGV accidents

The result shows that there were more accidents at night (46%), than there were in the afternoon (33%) and in the morning (21%). The most accident frequented areas are Kano which had had more accident cases than other locations. Lagos, Ibadan, Kogi also had many accidents too. Analysis has also shown that 17% of the drivers who had accidents, were involved in fatal accidents, 67% had injury accidents and 16% were involved in damage only accidents. The severity index of injuries was not high, just about 0.07%.

The study discovered that the main causes of accidents are bad roads, wrong overtaking by drivers, road obstructions and over speeding by drivers. The factors rated as not important causes of accidents are health condition of drivers, weather conditions, driver's stress and vehicles' defects. Overloading, drink driving and underage driving are rated by both drivers and operators as less important factors causing heavy goods vehicles accidents in Nigeria. The study concludes that there is little difference between drivers' and operators' opinions on the causes of heavy goods traffic accidents in Nigeria.

6. Prevention of HGV accidents

The survey on truck operators has revealed certain actions that are required to curb the menace of HGV accidents in Nigeria and its implications on the Nation. Key actions that require attention are measures on proper vehicle maintenance that involve the use of good tyres and spare parts, enforcement of traffic laws and regulations as enshrine in NRTR 2012, training and monitoring of drivers on journeys, driver employment regulation and policies and restrictions on night journeys. Implementation of these measures will improve the road safety index in the country and reduce the incidences of HGV accidents.

7.2.4 Cost of HGV road traffic accidents

The data used to estimate the cost of heavy goods vehicles road traffic accidents was based on the 2011 traffic accident records. The result shows that there were 2.3 fatal casualties in each

fatal accident, 2.9 serious injuries in each fatal accident, and 0.67 minor injuries in each fatal accident, making a total of 5.8 casualties per fatal accident in 2011. Similarly, there were 2.2 serious injuries in each injury accident and 0.72 minor injuries in each serious injury accident, making an average of 2.9 casualties in each serious accident. For minor injuries it was 1.57 casualties per accident. Under-reporting of accidents was estimated at 80% of the official data collected from the Federal Road Safety Commission.

From the foregoing the study concludes that the accident fatality and injury ratio are low, of course this is so because the study concentrated on heavy goods vehicles road traffic accidents. The analysis of the cost of accidents covered casualty related cost and accident related cost. The cost components calculated are; Medical cost, property damaged cost (vehicles damage, damage to third party properties, damage to goods in transit), lost output, administration cost and the cost of pain, grief and suffering.

a. Medical cost of accidents

The cost of medical treatment for victims of accidents of heavy goods vehicles was computed based on accident severity. The study reveals that the total medical cost of road freight traffic accidents for 2011 is $3.18 Million out of which $2 Million was the cost for fatal accidents, $1.1 Million was for serious injury accident and $.075 Million was for minor accident. These constitute 45% for fatal accident, 54% for serious injury accident and 1% for minor injury accident. These costs are very small and constitute just 1% of the total cost of heavy goods vehicles traffic accidents in 2011.This is in line with the observations of Silcock/TRL(2003).

b. Cost of property damaged accidents

The cost of property damaged accidents is computed to include cost of vehicle damage, goods in transit damage and third party properties damage. The study reveals that the cost of vehicle damage is higher than other costs, followed by goods in transit damage and then 3rd party properties damage. Thus, total cost of property damage resulting from heavy goods vehicles road traffic accidents in Nigeria in 2011 is $360 Million. The result shows that 61 % of this cost

was caused by damage to vehicles, 28% resulted from damage to goods in transit, while 10% cost came from cost of damage to third party properties.

The cost of property damage is the highest cost component of the total cost of heavy goods vehicle accidents in 2011, accounting for 60% of the total cost. This falls within the prediction of Silcock/TRRL (2003), who stated that, the cumulative cost of property damage accidents can contribute to the highest portion of the total cost of accident in a country.

c. Lost output

Lost output in this study is computed to reflect the cost of accidents according to severity of accidents. It was computed for fatal accidents, serious injury accidents and minor injury accidents, and the total cost of lost output for heavy goods vehicles traffic accidents in 2011 is $94.03 Million, this amount to 15% of the total cost of accidents.

The study reveals that the cost associated to lost output due to fatal accidents is 98.4% of the total lost output. The cost of serious injury is just 0.03% of the total cost of lost output. This cost is lower than property damage cost, because the research is on heavy goods vehicles traffic accidents, covering three property damage categories, with minimal fatalities and injuries, even though Silcock/TRRL(2003), reported that lost output is usually the largest casualty related resource cost incurred in road traffic accidents.

d. Administration cost.

Administration cost in this study is determined by application of the average of the figures used by Jacob (1991) and Simpson and o' Reilly (1995). Therefore, the administrative cost of the heavy goods vehicles road traffic accidents in 2011 is $20.03 Million, this amounts to 3% of the total cost of the accidents. This agrees with observations of Silcock/TRL (2003) that administrative costs are a small ingredient compared to other costs components and it is not worth spending much time and effort in producing detailed administrative costs.

e. Cost of pain, grief and suffering

The cost of pain, grief and suffering is computed in line with the recommendation of the Transport Research Laboratory (1995). In this study, the cost of pain, grief and suffering for heavy goods vehicles accident victims for 2011 amounts to $124.62 Million. This constitutes 21 % of the total cost of the accidents.

f. Total cost of HGV accidents

The total cost of HGV accidents in Nigeria for the year 2011 is $.602 billion. This cost has been estimated according to accident severities of fatal, serious injury, minor injury and property damaged only accidents. The result of the study shows that the cost of fatal injury accidents is $296.35 Million which is 48% of the total cost of accidents. This is in agreement with Silcock/TRRL 2003 that fatal accidents contribute the highest fatality cost. For serious injury accidents, the cost is $162.35 Million which is 23% of the total cost of accidents according to accident severities. Similarly, the cost of minor injury accident and property damage only accidents are $76.50 Million (15%) and 66.65 Million (14%) respectively.

The impact of the cost of heavy goods vehicles road traffic accidents is measured on the GDP of Nigeria. Measured against the GDP of 2011, the cost amounted to 5.9% of the cost of traffic accidents in Nigeria in 2011, which is equivalent to 2.64% of the contribution of the transport sector to the GDP of Nigeria, and also 2.94% of the contributions of road transport sector to the GDP in 2011, signifying a significant impact to the economy.

7.3 Policy Recommendations

The outcome of the research has implications on policy directives of transport development in Nigeria. This section therefore addresses objective five of this study by providing important recommendations of policy direction and improvement.

The costing of heavy goods vehicles road traffic accidents shows that property damaged accidents resulted in damage to vehicles accounting for 47% of the total cost of the accidents.

Related to this is the observation already made by operators on the problems of road freight transport in Nigeria, where vehicle repair and maintenance with genuine parts were prominent suggestions. This therefore calls for a policy decision by the Nigerian Government that will reduce the rate of importation of used vehicles. The policy should strictly be implemented to ensure that only vehicles certified to be road-worthy in the country of importation are imported into Nigeria. Similarly, a policy banning the importation of second hand spare parts and tyres should be introduced and be strictly enforced, such that only vehicle parts and tyres supplied directly from manufacturers are imported into Nigeria.

The road construction policy in Nigeria also requires review and or enforcement. Bad roads are a major cause of accidents according to the findings of this study. Roads therefore should always be constructed to carry heavy vehicles of up to 60 tonnes and above. At the moment, Nigerian roads are constructed only to carry vehicles of about 40 tonnes, though a lot of vehicles now carry load of up to 60 tonnes. This results into damage to the roads and the creation of potholes that may cause road traffic accidents.

Regulation of the driving profession needs to be enforced, since drivers' licences have three and five years duration, renewal of such licences should be given only after the request is backed with evidence of additional training. Compulsory offender training programme should also be introduced and enforced as it is in the UK to serve as a deterrent to traffic offenders.

The current government policy on road safety places too much emphasis on the driver factor, other critical issues that would involve the deployment of intelligent transport systems should be in the forefront of all new initiatives, like it is done in advanced countries. These strategies should form the core of road safety policy of the future. Nigeria already has a lead agency responsible for the prevention of accidents, which is the Federal Road Safety Commission. This agency needs to be empowered with sufficient legislation and adequate funds to enable it achieve its key mandate of preventing road traffic accidents.

In the United States and the United Kingdom, the Department of Transport plays key roles in road traffic regulations, management and co-ordination. This should be replicated in Nigeria to

ensure synergy and avoidance of conflicts and duplication among coordinating ministries. The Federal Ministry of Transport should assume a leading role in the setting of standards and co-ordination in the road transport sector.

The starting point for effective road safety management policies would come from robust and reliable information. This is a problem in many countries as the problem of accident underreporting is manifested in the quantity and quality of data available for analysis, which is needed to guide policy direction in the road safety sector. A robust data collection and management system must therefore be provided in the first place to guide the formulation of intervention policies. Examples of such a system are the STAT 19 system in United Kingdom and NHTS system in United States. Nigeria needs to establish a similar system at the Federal Ministry of Transportation to collect and disseminate information and provide statistics on the performance of road safety from time to time. This is justified from the experience of this research, which shows that Nigeria does not have any reliable sources of data on road traffic accidents.

Insurance must be made to play an important role in the road transport industry. Though vehicle insurance is compulsory under NRTR (2014), this study shows that many vehicles are not ensured even though they operating on daily basis. Similarly, medical insurance need to be introduced for accident victims. For instance, in UK accident victims are not required to pay for treatment due to the provision of the health insurance scheme. This policy is also recommended for implementation in Nigeria.

7.4 Contribution to Knowledge

The contribution of this study to knowledge emanates from its focus on the heavy goods vehicles operations and road traffic accidents. This is the first attempt to estimate the cost of heavy goods vehicles road traffic accidents in Nigeria. It is a major contribution to knowledge.

The use of the human capital method which has been used in many developing countries to cost road traffic accidents, to estimate the cost of heavy goods vehicles road traffic accidents is also a contribution to knowledge. Even though the foundation philosophy of the human capital method

lies in the computation of loss of contribution of accident victims to production due to injury and death, this study shows that the method can also be reliably used to estimate other costs under this method satisfactorily.

Accident cost studies require a lot of data from different sources. In this study data were collected from primary and secondary sources. These include hospitals, FRSC offices and field survey. The approach used in this research to collect the data from different sources, collate and analyse them to produce the required results is a major contribution to knowledge. This is very relevant to studies especially in developing countries where road traffic accidents data collection and storage is still a big problem.

Several studies have estimated the national cost of accidents to fall within 1-5% of GDP in developing countries. In this study, the implications of the cost of heavy goods vehicles accidents on the Nigerian economy is measured against its contribution to the national cost of accidents, its effect on the contribution of the transport sector to the economy and also its effect on the contribution of the road transport sector to the GDP of Nigeria. This is a new approach to estimating the cost of accidents that can be used to determine the contribution of the specific traffic type on the overall cost of accidents in a country and is a major contribution to knowledge.

7.5: Limitation of the study

This study is limited in a number of ways, especially related to data availability. Nigeria now does not have a reliable and sustainable database of road traffic accidents. These have limited the research and have left the researcher with no option than to resort to multiple data sources. Reliable databases like the STAT 19 in the UK must be established and maintained to eliminate this problem.

Although much has been done on the operations and cost of road traffic accidents in developed countries, not much has been done in Africa and especially on the cost of HGV accidents. This

has limited the study in terms of availability of relevant literature for comparisons. All comparisons done in this study have been with studies in Europe, America and Asia.

7.6: Further research

Though the study has successfully established the economic cost of heavy goods vehicles road traffic accidents in Nigeria, certain areas of additional research are recommended.

Road freight traffic accidents involving heavy goods vehicles are likely to cause serious gridlock and congestion that may cause several hours' delays, especially if it happens in urban or semi-urban areas. This congestion could lead to loss in man-hours that would have been utilised to improve productivity in the economy. This aspect was not covered in this research; further research is suggested in this area.

Road freight traffic accidents can also lead to explosions that may result in to environmental pollution. This may cause damage to the ecosystem, carbon monoxide emissions and other hazardous gases. This is more likely to happen since a substantial number of the heavy goods vehicles are conveying liquids and gases like petroleum products. A research is required in this area to ascertain the impact of road traffic accidents in Nigeria on the environment. Funeral costs of accidents have not also been covered in this study, even though the cost of funeral can be very high in some Nigerian communities. Further research is also recommended in this area.

In many countries, sufficient research has been done on the extent of accident under-reporting to establish the gap in accident data. This has not been sufficiently done in Nigeria. A research is therefore required is this area to improve the quality of data and reliability of results as is done in other countries.

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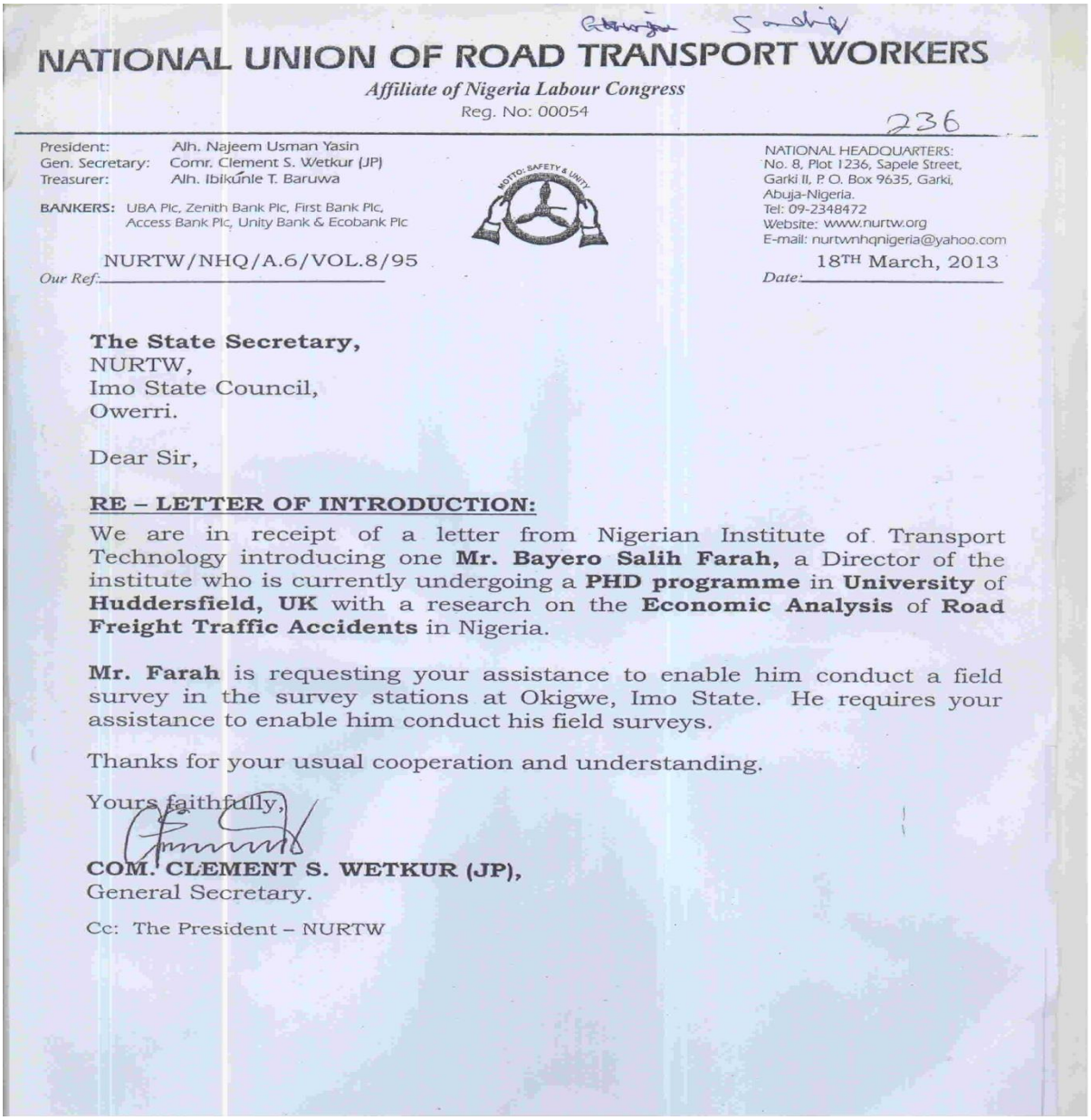
APPENDICES

Appendix 1: Introduction Letter to the National Union of Road Transport Workers



NATIONAL UNION OF ROAD TRANSPORT WORKERS

Affiliate of Nigeria Labour Congress

Reg. No: 00054

236

President: Alh. Najeem Usman Yasin
Gen. Secretary: Comr. Clement S. Wetkur (JP)
Treasurer: Alh. Ibikunle T. Baruwa

BANKERS: UBA Plc, Zenith Bank Plc, First Bank Plc, Access Bank Plc, Unity Bank & Ecobank Plc

NATIONAL HEADQUARTERS:
No. 8, Plot 1236, Sapele Street,
Garki II, P.O. Box 9635, Garki,
Abuja-Nigeria.
Tel: 09-2348472
Website: www.nurtw.org
E-mail: nurtwnhqnigeria@yahoo.com

Our Ref: NURTW/NHQ/A.6/VOL.8/95

Date: 18TH March, 2013

The State Secretary,
NURTW,
Imo State Council,
Owerri.

Dear Sir,

RE – LETTER OF INTRODUCTION:

We are in receipt of a letter from Nigerian Institute of Transport Technology introducing one **Mr. Bayero Salih Farah,** a Director of the institute who is currently undergoing a **PHD programme** in **University** of **Huddersfield, UK** with a research on the **Economic Analysis** of **Road Freight Traffic Accidents** in Nigeria.

Mr. Farah is requesting your assistance to enable him conduct a field survey in the survey stations at Okigwe, Imo State. He requires your assistance to enable him conduct his field surveys.

Thanks for your usual cooperation and understanding.

Yours faithfully,

COM. CLEMENT S. WETKUR (JP),
General Secretary.

Cc: The President – NURTW

Appendix 2: Truck Drivers Questionnaire on Economic Analysis of Road Freight Traffic Accidents in Nigeria.

This questionnaire is designed to collect information on accident characteristics of road freight haulage and their economic impact. All data collected will be treated as strictly confidential and solely used for academic purpose.

1.0 General Information

Name of park ……..……Date of Interview…….....

DRIVER BACK GROUND INFORMATION

2.1 Sex Male ( ) Female ( )

2.2 How old are you----------

2.4 How many dependents do you have----------

2.5 What is your highest Educational Qualification?

1. HND/B.Sc. or Higher Degrees
2. NCE/OND
3. Secondary School
4. Primary Education
5. Quranic Education
6. No formal education

2.6 How many years of experience do you have in truck driving? .....

3.0 TRUCK /GOODS CHARACTERISTICS

3.1 Which type of truck are you presently driving? .....

3.2What is the maximum Capacity of the truck you are driving in Litres or tonnes? .....

3.3 Whose truck are you driving: i. self ( ) ii. Transport Company ( ) iii.Labor Union ( )

iv. Factory/Industry ( ) v. Government Organization ( )

3.4What Type of goods are you carrying? ----------

Volume/Quantity of the goods carried……

4.0 INFORMATION ON ACCIDENT RECORD

What route do you normally operate……

Accident Records from 2007 – 2011:

Year	Number of Accidents	Location of accident	Time of the day accident took place	Cause of accident	Effects of accident			
					Fatal	Serious injury	Minor injury	
2011								
2010								
2009								
2008								
2007								

In your opinion what is the single most important cause of heavy goods vehicles (HGV) accidents along your route……

From the following list, please specify the importance of the causative factors for RTA along your route (5 is the highest weight and the lowest is1).

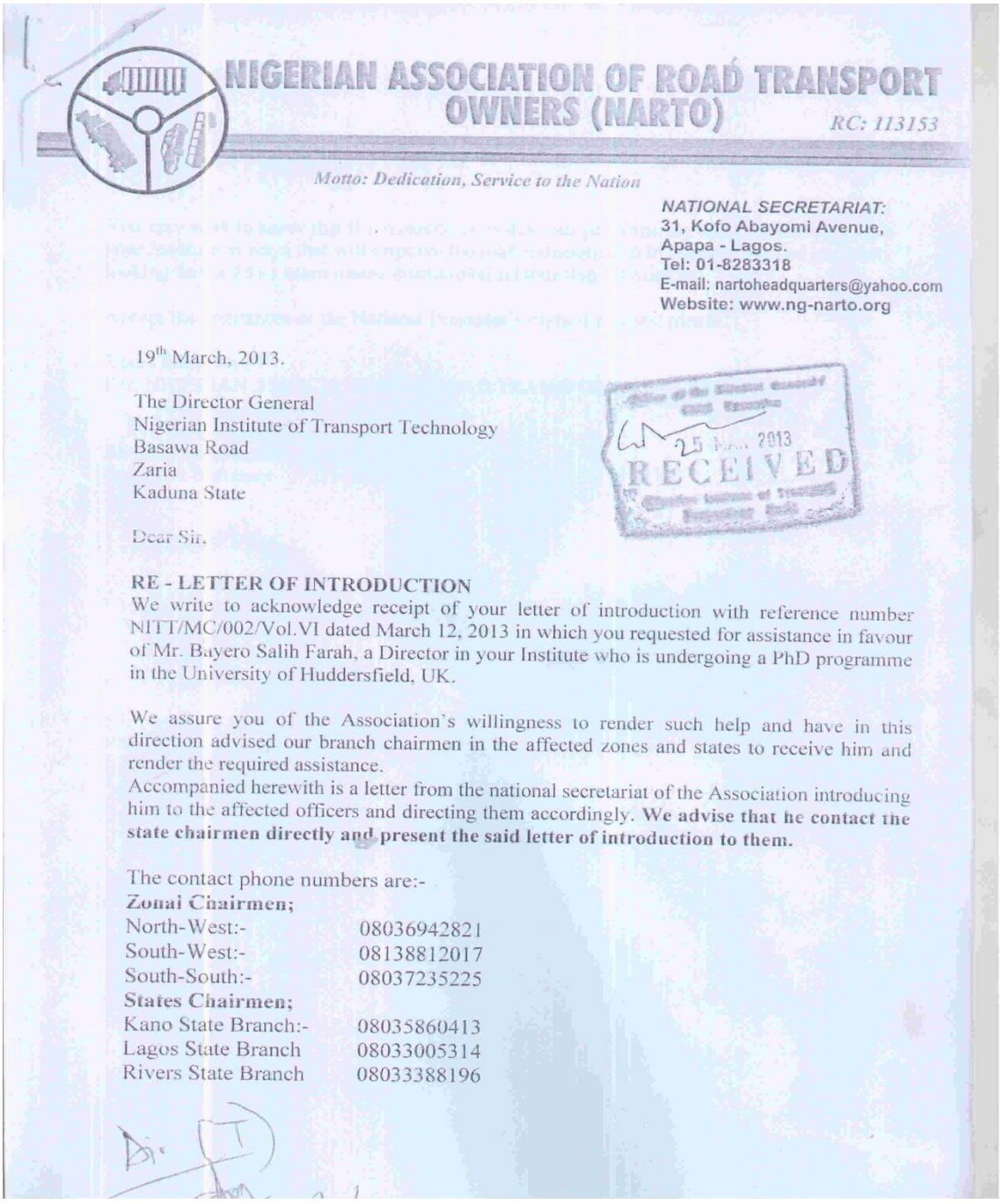
Causes	1	2	3	4	5
Over speeding					
Over loading					
Wrong Overtaking					
Drunkenness					
Bad Road					
Vehicle defect					
Weather factor					
Driver tiredness/stress					
Driver health challenges					
Under age driving					
Obstruction on the road					

4.5 Describe the nature of damage to vehicles and goods resulting from accidents involving your vehicle along your route- (Vehicle)……
(Goods)……

4.6 Kindly suggest ways of reducing accidents associated with Heavy Goods Vehicle (HGV) in Nigeria ……
……

4.7 What would you say about current government measures at reducing traffic accidents in Nigeria……
……

Appendix 3: Introduction Letter to National Association of Road Transport Owners



NIGERIAN ASSOCIATION OF ROAD TRANSPORT OWNERS (NARTO)

RC: 113153

Motto: Dedication, Service to the Nation

NATIONAL SECRETARIAT:
31, Kofo Abayomi Avenue,
Apapa - Lagos.
Tel: 01-8283318
E-mail: nartoheadquarters@yahoo.com
Website: www.ng-narto.org

19th March, 2013.

The Director General
Nigerian Institute of Transport Technology
Basawa Road
Zaria
Kaduna State

25 [illegible] 2013
RECEIVED

Dear Sir,

RE - LETTER OF INTRODUCTION

We write to acknowledge receipt of your letter of introduction with reference number NITT/MC/002/Vol.VI dated March 12, 2013 in which you requested for assistance in favour of Mr. Bayero Salih Farah, a Director in your Institute who is undergoing a PhD programme in the University of Huddersfield, UK.

We assure you of the Association's willingness to render such help and have in this direction advised our branch chairmen in the affected zones and states to receive him and render the required assistance.

Accompanied herewith is a letter from the national secretariat of the Association introducing him to the affected officers and directing them accordingly. **We advise that he contact the state chairmen directly and present the said letter of introduction to them.**

The contact phone numbers are:-

Zonal Chairmen;

North-West:-	08036942821
South-West:-	08138812017
South-South:-	08037235225

States Chairmen;

Kano State Branch:-	08035860413
Lagos State Branch	08033005314
Rivers State Branch	08033388196

You may wish to know that the Association is desirous of partnering and collaborating with your Institute in ways that will improve the road transportation in Nigeria. We are hopefully looking forward to a more robust institutional relationship between us.

Accept the assurances of the National President's highest regards; please.

Yours faithfully,
For: NIGERIAN ASSOCIATION OF ROAD TRANSPORT OWNERS (NARTO)

Gowon 21/3/13
Barrister Emmanuel H. Gowon,
Executive Secretary

Appendix 4: Truck Operator Questionnaire on Economic Analysis of Road Freight Traffic Accidents in Nigeria.

This questionnaire is designed to collect information on accident characteristics of road freight haulage and their economic cost implication. All data collected will treated as strictly confidential and will be used purely for academic purpose in satisfaction of the above study.

General Information

1.1Name of the Company (Optional) ……

1.2 Location …….

1.3 How long have you been operating? ……...

1.4 What are the numbers of your trucks and their types?

S/NO	TYPE	NUMBER
1	Tanker	
2	Trailer	
3	Lorry	

1.5 What types of goods do your trucks normally carried?

Petroleum products

Agricultural produce

Animal/ Poultry Products

Bottled and Can Drinks

Building Materials

Home appliance

Consumable products

Chemicals

Textile material

Pharmaceutical products

Stationeries / Printing materials

Machine/ Equipments

Others…….

2.0 Average amount of a full load of products carried by your trucks

Truck Type	Size of the truck Litre / tonns	Name of goods	Quantity of goods	Amount of full load of products on the truck

3.0 Truck Accident Causes, Mitigatives and Preventive Measures

3.1 From your experience as trucks operator what are the cause(s) truck vehicle accident in Nigeria? (You can tick more than one if necessary)

1. Over speeding ( )
2. Over loading ( )
3. Wrong overtaking ( )
4. Bad Road ( )
5. Vehicle defect ( )
6. Drunkenness ( )
7. Weather factor ( )
8. Under age driving ( )
9. Driver tiredness/stress ( )
10. Driver Health challenges ( )
11. Obstruction on the road ( )
11. Others……

3.2 Ranking your response in the above according to magnitude by way of ticking (5 is the highest weight and the lowest is 1).

Causes	1	2	3	4	5
Over speeding					
Over loading					
Wrong Overtaking					
Drunkenness					
Bad Road					
Vehicle defect					
Weather factor					
Driver tiredness/stress					
Driver health challenges					
Under age driving					
Obstruction on the road					

3.3 As an operator which one of the above is major cause of your company truck accident.....

3.4 Do you have any Insurance policy to take care of damage of goods and vehicle in case of accidents Yes ( ) No ( )

3.5 Is your company certified by Federal Road Safe Commission for Road Transport Safety Standardization Scheme (RTSSS) Yes ( ) No ( )

3.6. What are the safety measures put in place to reduce your trucks involvement in road accidents?……
… ……

3.7 Kindly comment freely on challenges in road freight haulage in Nigeria and make appropriate suggestions.....

Please provide the required information on your trucks that were involved in accidents between 2007-2011 in the table below

YEAR	No. of truck involved	Types trucks involved	Cost of vehicle	Cost of goods	% lost on vehicle	% lost on goods	Others cost	Remarks
2011								
2010								
2009								
2008								
2007								
TOTAL								

Appendix 5: Mann-Whitney u-test

The Mann-Whitney U test is used to test whether observations in one sample tend to be larger than observations in the other sample. In this research work, the Mann-Whitney U test is employed to know if there is a significant difference between the responses from the 'drivers' and 'operators' rating on the causes of road freight traffic accident in Nigeria. Each causative factor is rated by the drivers and operators as 1 for not important, 2 for less important and 3 for important. A sample of heavy goods vehicle (HGV) drivers was drawn from a population of HGV drivers in Nigeria, let it be denoted as d. likewise, a sample of truck operators from a population of registered freight companies in Nigeria was drawn, let it be called o. Hence, the procedures for the Mann-Whitney U test are given as follows (Ross, 2004).

Arrange all the observations in order of magnitude.

Under each observation, write down d or o to indicate which sample they are from.

Under each d write down the number of o's which are to the left of it (that is smaller than it); this indicates di>oi. Under each o write down the number of d's which are to the left of it (that is smaller than it); this indicates oi>di.

Sum the total number of times di>oi and denote it by Ud. Also, the same is done for oi>di and denote it by Uo. Check that Ud + Uo = ndno.

Calculate U = min (Ud, Uo).

Use statistical tables for the Mann-Whitney U test to find the probability of observing a value of U or lower.

If the data is large say greater than 20, the following approximations are made.

$$\mu_U = \frac{n_d n_o}{2} \quad \text{And} \quad \sigma_U = \sqrt{\frac{n_d n_o (N+1)}{12}} \tag{4.2}$$

where μ_U and σ_U are the mean and standard deviation of U respectively; N = nd + no. If a case of an observation in one sample is the same in the other sample (tie) then the standard deviation of U is again adjusted and this becomes;

$$\sigma_U = \sqrt{\frac{n_d n_o}{N(N-1)} \times \left[\frac{N^3 - N}{12} - \sum_{j=1}^{g} \frac{t_j^3 - t_j}{12} \right]} \quad (4.3)$$

Where, N = nd + no; g is the number of groups of ties; tj = the number of tied ranks in group j.

Appendix 6: Total Crashes involving Tankers and Trailers (2007 - 2011)

Year	Road Traffic Crashes	Total Killed	Total Injured	Total Casualty	Persons Involved	Vehicle Involved
2007	607	805	2169	2974	4430	976
2008	1229	1221	3891	5112	6999	1655
2009	1213	1085	3714	4799	8024	1767
2010	1657	1515	5154	6669	11767	2786
2011	1306	905	3115	4020	8695	2472
GRAND TOTAL	6,012	5,531	18,043	23,574	39,915	9,656

Source: FRSC, 2012

Appendix 7: Statistics of Road Freight Traffic Accidents in Nigeria 2007 -2011

Year	Accident Cases	Number of Cases	Number of fatality	Number of injury	Number of Vehicle
2011	Fatal	394	905	1744	969
	Injury	456	-	1371	1053
	PDO	186	-	-	450
	Total	1306	905	3115	2472
2010	Fatal	570	1515	2266	1055
	Injury	681	-	1752	1109
	PDO	400	-	-	622
	Total	1651	1190	4018	2786
2009	Fatal	442	1088	1618	680
	Injury	500	-	1498	718
	PDO	271	-	-	369
	Total	1213	1088	3714	1767
2008	Fatal	522	1221	1578	728
	Injury	598	-	1312	754
	PDO	109	-	-	173
	Total	1229	1221	3891	1655
2007	Fatal	238	805	1216	356
	Injury	270	-	953	432
	PDO	99	-	-	188

	Total	607	805	2169	976

Compiled by the Author,2015.

Appendix 8: Tanker/Trailer Accident in Tin can, Mile 2, Lagos

Source: Linda Ikeji Blog, 9thFebruary 2015

Appendix 9: Tanker Accident at IyanaIpaja

Source: Nairaland Forum, 30th July, 2015

Appendix 10: Tanker accident at Iyana Ipaja


Source

Source; Vanguard, 8th August, 2015

Appendix 11: Tanker falls off bridge and Explodes in Lagos

Source: Nigeria Nation, 2nd July, 2015.

Appendix 12: Tanker Crash claims 22 vehicles on Lagos – Ibadan way.

Source: Dailytrust, 03 June 2012

Appendix 13: 69 burnt to death in Onitsha petrol tanker Accident

Source: Vanguard Newspaper, 8th July, 2015.

Appendix 14:7 crushed as petrol tanker, trailers crash in Onitsha

Source: The Sun Newspaper, 13th July, 2013.

Appendix 15: Eight killed, 11 injured in Lagos truck accident

Source: Punch Newspaper, 20th November, 2013

Appendix 16: 26 die in Lagos, Kwara, auto accidents

Source: Punch Newspaper, August 8th, 2015