UNIVERSITY OF GHANA

THE TRANSPORTATION OF DANGEROUS GOODS BY ROAD
(A CASE STUDY OF GHANAIAN TRANSPORTERS)

BY

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PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF M.A.
PORTS AND SHIPPING ADMINISTRATION DEGREE

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DECLARATION

I, JOYCELYN ENYONAM BONE, hereby declare that except for references to other people's work which have been duly cited, this Long Essay is the result of my own work and that it has neither in whole nor in part been presented elsewhere for any academic award.

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(STUDENT)

15th February 2016

CAPT. CATHERINE HAIZEL
(SUPERVISOR)

15th February 2016
DEDICATION

I dedicate this piece of work, first of all to God Almighty for seeing me through my course. To my mum, Justine Adedze and dad, Bone Snr., thank you for all the prayers and faith you had in me. My brother, Emile Makafui and the rest of my family both far and near for the immense encouragement and support.

Frankie, Oskiss, Douglas (Doughi), Ernest, Emmanuel Gamado and Sena you guys are the best. Couldn’t have done this without your help, dedication and focus. I owe you a lot and to all my loved ones who helped me with their love, patience, encouragement and understanding in pursuit of this course. God richly bless you.

To my lovely Silas Baah Mensah, thank you for being there always and for being my number one fan. I love you and may God bless you abundantly.

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I am also grateful to my colleagues, the independent haulage drivers, workers of Vehrad Company Limited, DHL: Supply Chain. GPHA fire safety department, Drivers’ and Vehicle Licensing Authority (DVLA). Ministry of Education. Science. Technology and Innovation (MiSTI). Ministry of Transport (MoT). Ghana Road Safety Commission (GRSC) and all those who were always ready to help me with information towards this work.

The co-operation of the workers was far beyond description.

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ABSTRACT

Transportation in Ghana has evolved over centuries from mere walking to sophisticated use of moving machines to transport all kinds of goods including dangerous goods from one point to the other with the use of ships, airplanes, trains and vehicles. The increase in the use of multimodalism which is combining various modes of transport (sea, air, rail, road etc.) to help meet customers’ needs in time has driven corporate efforts to better document rules and regulations, improve an overall management system and also increase the awareness of the dangers involved in the transportation of dangerous goods on both the environment and the corporate bodies when not handled properly. The research sought to identify the challenges faced by hauliers in the transportation of dangerous goods with the Ghanaian transporter being used as a case study. The study used both qualitative and quantitative approaches where questionnaires were administered to individual truck drivers, employees of recognized haulage companies and the law enforcement agencies in the country as well as some respondents from Environmental Protection Agency and Ghana National Fire Service were interviewed. The study revealed that, although there are both international and national laid down regulations, most of them are not enforced bringing about lots of dangers on our roads. It further revealed that, except for some recognized companies training their drivers and certifying them, most drivers do not get any form of training in handling and transporting these hazardous goods/dangerous goods. Based on the findings, the study recommends that all stakeholders involved in formulating and implementing rules and regulations must ensure that the training institutions adhere to the laid down procedures in training and certifying transporters (drivers) in the carriage of dangerous goods.
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MSC  Maritime Safety Committee
MITU  Motor Transport and Traffic Unit
N    National routes
PPE  Personal Protective Equipment
R    for Regional routes
RID  International Carriage of Dangerous Goods by Rail
SOLAS  International Convention on Safety of Life at Sea
TDG  Transport of Dangerous Goods
UN   United Nations
UNCOE  United Nations Committee of Experts
CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Generally, the transport sector is believed to have a number of problems ranging from air pollution, noise pollution, tragic issues such as road, air and water accidents, and attendant spillage of goods and loss of human lives and properties.

Over the last couple of years, the increased rate of urbanization, motorization and economic activities in the sub-regional countries such as Ghana and Burkina Faso has resulted in the increased use of heavy duty haulage transport (long vehicles) to move goods of all kinds including dangerous and hazardous goods, at the expense of human health, the environment and the quality of life at large (Lambert, 2014).

These chemicals and substances are harmful to human life, animals and the environment and as a result are classified as hazardous articles or goods. These are commonly seen on the Ghanaian road on daily or weekly basis.

Most of the long distance haulage trucks are diesel powered, often ‘home used’ and are mostly over-aged with weak engines, contributing greatly to air pollution in Ghana. Other nuisance of heavy duty haulage vehicles are: noise, recklessness of drivers and their crew on the road leading to accidents and spillage of goods including dangerous goods.

Also, these haulage trucks are often not properly labelled as hazardous cargo or dangerous goods, thus any incident could cause considerable harm to people living in and around the location of the
incident and the environment as a whole. Exposure and spillage of these dangerous goods could lead to fires, explosions, chemical poisoning or burns.

As a haulier whose duty is to transport these dangerous goods by road, one must be aware of the necessary precautions required in the handling of these dangerous goods to avoid causing harm to people, property and the environment as a whole. Hence the need for an awareness, training and proper regulations in Ghana on safe transport of hazardous goods.

There are both international regulations and national laws governing the handling and carriage of dangerous goods depending on the various modes of transport being used. For Maritime or Sea transport, the regulation is the International Maritime Dangerous Goods Code (IMDG Code), for Air Transport it is the International Air Transport Association (IATA) Dangerous Goods Regulations (DGR), for Road it is the International Carriage of Dangerous Goods by Road (ADR) and that of Rail is the International Carriage of Dangerous Goods by Rail (RID).

1.2 DEFINITIONS

The various modes of transport (rail, road, air and sea) define dangerous goods variably, however, each of these carriers recognize the fact that these substances or articles pose a lot of risk to people, property or the environment, due to their chemical or physical properties.

The International Maritime Dangerous Goods (IMDG) Code, (2008) states that “dangerous goods should depict some of the following characteristics such as highly flammable, explosive, corrosive, spontaneously combustible, toxic and oxidizing or water reactive”.
Dangerous goods according to the International Air Transport Association (IATA) Dangerous Goods Regulations (DGR), (2014) “are substances or articles that pose a risk to people, property or to the environment, due to their chemical or physical properties”.

The International Carriage of Dangerous Goods by Road (ADR), (2014) also defines dangerous goods as “substances and articles which have been identified as hazardous for transport and present a risk to people, property and the environment”.

The International Carriage of Dangerous Goods by Rail (RID). (2014) further defines dangerous goods as “those substances and articles the carriage of which is prohibited or authorized only under the conditions prescribed therein”.

United Nations (UN) committee stated that dangerous goods are usually classified with reference to their immediate risk and the committee ensures that all modes of transport (road, rail, air and sea) classify dangerous goods in the same way.

These dangerous goods have been grouped into 9 main classes namely:

- Class 1: Explosives
- Class 2: Gases
- Class 3: Flammable liquids
- Class 4: Flammable solids
- Class 5: Oxidizing substances and Organic peroxides
- Class 6: Toxic and infectious substances
- Class 7: Radioactive
- Class 8: Corrosive substances
- Class 9: Miscellaneous substances.
The transportation of goods in general is done from one point to the other through the various means of transports and dangerous goods in packaged form are shipped through the various sea and airports in the world with the Port of Tema being no exception.

1.2.1 The Port of Tema

The Port of Tema is located 28 km east of Accra at 5°38’N and 0°01’E. The Port of Tema is the biggest of the two sea ports in Ghana and has a water-enclosed area of 1.7 million square metres and a total land area of 3.9 million square metres. The Port of Tema aside being a loading or discharging place for goods, also serves as the transit port for landlocked countries such as Burkina Faso, Mali and Niger. It is a port with a wide range of industrial and commercial companies which produce or handle among other things, petroleum products, building materials, food items, aluminum products, fumigants, pesticides and textiles.

The Port of Tema has been handling dangerous goods since 1962 when the port was commissioned and handles about 80% of the nation’s import and export cargo. These dangerous goods come in the form of raw materials such as aluminum, steel, chemicals, etc. for the industries. The Port of Tema handles all classes of dangerous goods from Classes One to Nine, but with Classes One and Seven in the minority.
In 2010, the operations of dangerous goods gained grounds, but due to inconveniences in stacking and segregating dangerous goods containers from other cargoes, it was difficult storing them. However, in 2011 more stringent measures were designed to minimize adverse effects posed by the handling and storage of dangerous goods and the Port of Tema began proper tracking of these dangerous goods.

According to Ghana Ports and Harbours Authority (GPHA) end of year report (2013), about 94% of all dangerous goods in packaged form were transported through the Port of Tema and thus the main rationale behind my selection.

The Port has 27 various departments but the transport and stevedoring department were selected based on the nature of work they undertake at the Port. The stevedoring department deals with the loading and discharging of goods including dangerous goods within the port while the transport department handles the vehicles and the drivers including the haulage truck drivers who move the cargo from the quay to the storage area.
Dangerous goods come in the form of explosives, toxic, poisonous, irritating substances et cetera (etc.) which pose a lot of danger, and even worse still death, to handlers and transporters in their operations. The improper handling and transport of dangerous goods resulting in accidents could easily tarnish the image of Ghana’s transportation system.

With new changes in products and services and the hazards that come with it, all stakeholders in the transport of dangerous goods in Ghana should be well positioned to receive and handle dangerous goods, in order to win international recognition and to promote the safe carriage of dangerous goods. (Azirh et al. 2010). In Ghana, the transport of dangerous goods from the Port of Tema to their final destinations is done solely through roads.

According to Lambert, (2015), from the year 2001 to 2012 in Ghana: 5,380 people were killed in chemical transport related cases alone and these accidents ranged from vehicle collisions, tipping over, spillages resulting in fires, explosions, toxic emissions, leakages and occupational and accidental exposure of hazardous chemicals.

The Ghana Health Service (2013) report indicates that, the Poisoning Unit of eight (8) General Hospitals in four (4) regions in Ghana reported 14,800 chemical poisoning cases, and most of these chemicals were stolen from accidents and/or spillage scenes.

It is believed and well agreed by most physicians that money cannot adequately compensate for body parts lost or a fatal injury (Health and Science, 2015). It is therefore time to address the proper transport, handling and storage of dangerous goods to reduce its effects through accidents and the possible impact on the economy as a whole.
1.3 REGULATORS AND STAKEHOLDERS IN THE TRANSPORT OF DANGEROUS GOODS

1.3.1 Ghana Environmental Protection Agency (EPA)

The Ghana Environmental Protection Agency (EPA Ghana) is an agency under the Ministry of Environment, Science Technology and Innovation. The agency was set up under EPA Act 490 (1994). The mission of the EPA is to co-manage, protect, and enhance the country’s environment in particular, seek common solutions to global environmental problems, giving good advice on environmental problems as well as effective and consistent enforcement of environmental laws and regulations. The EPA is an implementing agency, a regulatory body and catalyst for change toward sound environmental stewardship (National Environmental Policy, 2012).

The agency has a branch at the Port of Tema and was included in the area of study because it is the main agency responsible for the import and export, certification as well as inspection of plants, products, animal and its product, pesticides, chemicals and hazardous materials that includes dangerous goods.

1.3.2 Ghana Road Safety Commission (GRSC)

The Ghana Road Safety Commission (GRSC) is a Ghanaian state agency responsible for road safety education in Ghana. The commission is under the Ghana Police Service of the Republic of Ghana (www.grscroadsafety.org retrieved on 7th March 2015). Its mandate is to promote and coordinate Road Safety activities in Ghana and ensuring compliance on the road which is important to all aspects of the Ghanaian economy.

This is because road accidents are a national issue in Ghana. Statistics show that four (4) people die daily on Ghanaian roads due to road accident. Estimates show that Ghana loses over 230
million dollars yearly due to road accidents with more than 1600 deaths
(www.grscroadsafety.org retrieved on 7th March 2015).

The GRSC collaborates with various state agencies to ensure road safety. They include: Ghana Police- Motor Transport and Traffic Unit (MTTU), Driver and Vehicle Licensing Authority (DVLA), Building and Road Research Institute, Ghana Highways Authority, Department of Feeder Roads and Department of Urban Roads.

1.3.3 Driver and Vehicle Licensing Authority (DVLA)

DVLA was established in 1999 by Act 569 of Ghana's parliament. The act allowed the authority to have a semi-autonomous status in the public sector organization under the Ministry of Transport. The authority is responsible for ensuring safety on Ghanaian roads. The authority before the enactment of the DVLA Act was called Vehicle Examination & Licensing Division (VELD) (www.dvlaghana.gov.gh).

1.3.4 Ghana National Fire Service (GNFS)

Ghana National Fire Service is a state agency responsible for firefighting, rescue services and educating the general public to ensure incident-free. The service was selected because most at times they work hand in hand with the MTTU on rescue operations during road accidents and also since most dangerous goods are explosives and liable to easily cause fire, their contribution will be essential.
1.3.5 Ghanaian Ministry of Environment, Science, Technology and Innovation (MESTI)

The Ministry of Environment, Science, Technology and Innovation (MESTI) exists to establish a strong national scientific and technological base for accelerated sustainable development of the country to enhance the quality of life for all. The overall objective of MESTI is to ensure accelerated socio-economic development of the nation through the formulation of sound policies and a regulatory framework to promote the use of appropriate environmentally friendly, scientific and technological practices and techniques.

1.3.6 Ministry of Transport (MoT)

The Ministry of Transport is a government establishment responsible for the formulation, coordination and monitoring of Aviation, Transport and Highway infrastructure policies and programmes for both public and private sectors of the economy. The main mandate of the Ministry of Transportation is to formulate policies for the transport sector, establish the regulatory framework for transport operations, creating the enabling environment for transport investment and the development of an efficient transport system which is modally complementary.

1.4 PROBLEM STATEMENT

The transportation of dangerous goods has undergone significant growth in recent years. (ASI:AN, 2011). With the recent discovery of Oil and Gas in Ghana, the transport of dangerous goods has increased significantly. This is because, most of the chemicals and hazardous goods used for the extraction of oil and gas offshore such as rigwash, methanol, oxygen scavengers and scale and corrosion inhibitors are classified as dangerous goods which are transported by the hauliers to their final destination.
The transportation of such hazardous substances has increased greatly on our roads which can lead to accidents and/or even death during transportation and when not handled properly. As a result, it has become more important that all stakeholders in the supply chain understand the basic concepts of transporting, storing and handling dangerous goods properly in order to reduce the risks related to these activities. One of such stakeholders exposed to these risks are the transporters of these goods.

Each class of dangerous goods being transported requires specific handling and packing instructions for various transport conditions. Hence the transporter needs to ensure compliance when dangerous goods are offered for transport.

Handling comprises of loading on to and discharging from the truck dangerous goods such as toxic substances, caustic soda, cyanides etc. Handling by hauliers are done regularly from the Port of Tema but most of the time processes are not adhered to because of lack of the right equipment and procedures, required by the personnel or handlers of these substances.

Furthermore, lack of awareness and proper education in the handling and transportation of dangerous goods by hauliers pose a danger to human life, the environment, and property in an event of a spill or incident during transport.

The study seeks to investigate the challenges and dangers faced by hauliers in the transportation of dangerous goods from the Port of Tema to their final destination, and the regulation lapses that need to be reviewed to ensure safety of human life, property and the environment.
1.5 OBJECTIVES OF THE STUDY

The objective of the research work is to assess the consequences of improper transportation of dangerous goods by truck drivers from the Port of Tema, and it includes the following:

- To identify the types of dangerous goods that are handled by transporters from the Port of Tema.
- To find out the extent of truck drivers’ awareness of international regulations in relation to the handling of dangerous goods.
- To identify the types of training required and acquired by transporters in transporting dangerous goods.
- To identify challenges faced by these transporters when transporting dangerous goods.
- To identify the extent to which the stakeholder agencies and other institutions are involved in the education of truck drivers in the transportation of dangerous goods.
- To ascertain whether the truck drivers are following international or national laid down procedures if any in relation to transportation of dangerous goods.
- To recommend policies or measures that will help to improve upon the transportation of dangerous goods by road, based on the findings of the research.

1.6 RESEARCH QUESTIONS

- What types of dangerous goods are handled by transporters from Port of Tema?
- What kinds of dangers are associated with the types of dangerous goods handled?
- What type of education is provided to people handling dangerous goods?
- What are the challenges faced by hauliers when transporting the dangerous goods?
- What types of equipment are used when transporting dangerous goods?
• To what extent are employees aware of the regulations or procedures governing the transportation of dangerous goods?

• Does the port authority follow the international or national procedures in relation to dangerous goods handling at the Port of Tema?

• What are the measures that need to be put in place to improve on the transportation of dangerous goods?

1.7 JUSTIFICATION OF THE STUDY

The results of the study would form a basis for an improvement in the knowledge of hauliers in dealing with dangerous goods. Similarly, it would draw the attention of relevant enforcement agencies such as Environmental Protection Agency (EPA), Ministry of Environment, Science, Technology and Innovation (MESTI), etc. to the need to mount educational campaigns and also what the contents of such campaigns should be.

Moreover, this research could also serve as a useful source of information for reference by students and industry experts.

1.8 SCOPE OF STUDY

The scope of study is in relation to the transportation of dangerous goods from the Port of Tema to their final destination using truck drivers as a case study. This research will assess both the individual truck drivers and haulage companies such as the Vehrad Transport, DHL Supply Chain and any other Haulage Companies in the transportation of dangerous goods.
1.8.1 Haulage Truck Drivers Union at Tema

This is a union under the umbrella of Ghana Private Road Transport Union (GPRTU). The union constitutes haulage truck and tank driver. The union's mission is to facilitate the efficient and low-cost movement of goods and services from Tema port to all destinations across the country and beyond.

The research will also investigate the activities of Ministry of Environment, Science, Technology and Innovation (MESTI), Environmental Protection Agency (EPA), Ghana Ports and Harbours Authority (GPHA), Ghana National Fire Service (GNFS), Ministry of Transport (MoT), Driver and Vehicle Licensing Authority (DVLA) and Ghana Road and Safety Commission (GRSC) in relation to education of drivers in the handling of dangerous goods.

1.9 METHODOLOGY

A simple random sampling also known as chance or probability sampling, would be used to select truck drivers from Vehrad Transport, DHL Supply Chain and other Haulage Companies handling dangerous goods where every person has an equal chance of being chosen for the study.

According to the Business Dictionary, a simple random sample is "a randomly selected sample from a larger sample or population, giving all the individuals in the sample an equal chance to be chosen."
1.10 RESEARCH ORGANIZATION

The structure of the dissertation is divided into five (5) chapters.

- Chapter One (1) presents the background to the study, problem statement, contribution of the study, conceptual framework, research scope and organization of the study.
- Chapter Two (2) reviews the relevant Literature regarding the handling of dangerous goods.
- Chapter Three (3) presents Methodology which comprises the Description of the Study Area and Population, Sample Size, Sampling Method, Research Instruments and Data Collection Method.
- Chapter Four (4) analyses the data collected and interprets the data using tables and figures.
- Chapter Five (5) will present the Summary of Findings, Conclusion and Recommendations of the study.
CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter of the study reviews the literature on the subject matter. It is made up of the introduction, diverse views or definitions of dangerous goods, history of dangerous goods, definition of terms related to dangerous goods, classifications of dangerous goods, the need to regulate the transport of dangerous goods, international conventions and codes regulating the road transport of dangerous goods, duties of the holders of dangerous goods, requirements for the proper handling on road transport of dangerous goods, precautions when loading, discharging and transporting dangerous goods, training and certification of transporters.

2.1 VARIOUS VIEWS OF DANGEROUS GOODS

UN Recommendation (2004). On The Transport Of Dangerous Goods' defines 'dangerous goods' as "articles or materials capable of posing significant risk to people, health, property, or environment when transported in quantity". It includes items of common use such as aerosols, perfumes, and paints.

According to Health and Safety Commission Advisory Committee (1991), dangerous goods are "substances and articles which have been identified as hazardous for transport and present a risk to people, property and the environment".

SOLAS chapter 7 Part A Regulation 1(2) (2009) also defines dangerous goods as "substances, materials and articles covered by the IMDG code". So how does the International Maritime Dangerous Goods Code (IMDG Code) define or view dangerous goods? Dangerous goods according
to the IMDG Code (2008) "should depict the following characteristics: highly flammable, explosive, corrosive, spontaneously combustible, toxic, oxidizing or water reactive".

D’Arcy. (1992) defines dangerous goods "as the goods which from their nature are liable to cause damage, either to persons or to the carrier’s vehicle, or to the goods of other owners which the carrier is carrying in the same vehicle”.

According to Stowage. (2012), "dangerous goods are all those cargoes which are loaded on vessels in an intermediate and non-stationary containment (e.g. a drum, a box, a freight or tank container, palletized cargo or others) and which have defined hazards”.

From Azirh. (2010), “dangerous goods include any empty unclean packaging (such as tank-containers, receptacles, intermediate bulk containers (IBC’s), bulk packaging, portable tanks or tank vehicles) which previously contained dangerous goods, unless the packaging have been sufficiently cleaned of residue of the dangerous goods and purged of vapours so as to nullify any hazard or has been filled with a non-dangerous substance”.

Hence, the term dangerous goods means articles or substances that are capable of posing a risk to health, safety, property or the environment when transported. This means that these goods can be deadly and can seriously damage property and the environment. If that is the case, it is important that they are transported and handled safely on Ghana’s road network which is the main medium of transport for Ghanaians and foreigners in the country.
2.2 HISTORY OF DANGEROUS GOODS TRANSPORT

The International Maritime Organization (IMO) is a specialized agency of the United Nations. IMO's main responsibility is to develop and maintain a comprehensive regulatory framework for shipping which include safety, environmental concerns, legal matters, technical cooperation, maritime security and the efficiency of ships. The main objective of the IMO is to facilitate cooperation among governments on technical-related matters affecting shipping, particularly in the promotion of the Safety of Life at Sea (SOLAS), efficiency of navigation, prevention and control of marine pollution from ships.

In the year 1914, the first version of the SOLAS (Safety of Life at Sea) Convention was adopted following the infamous capsizing of the cruise-liner Titanic, which resulted in more than 1,500 deaths. The convention includes chapters on navigation, construction, lifesaving appliances, radiotelegraphy, etc. Since then, there have been four more versions. The present version was adopted in 1974 and entered into force in 1980. This convention is considered one of the most important international conventions related to maritime safety.

In 1956, The Committee of Experts on the Transport of Dangerous Goods established by the United Nations (UN) Economic and Social Council completed a report which established the minimum requirements applicable for the transport of dangerous goods by all modes. The report offered a general framework within which existing regulations could be adopted. United Nations Committee of Experts (UNCOE) has continued to publish the UN Model Regulations "Recommendation on the Transport of Dangerous Goods" (Orange Book), which is updated every two years (ADR Treaty Wikipedia, 2015).
This agreement was concluded in Geneva on 30 September 1957 under the aegis of the United Nations Economic Commission for Europe, and it entered into force on 29 January 1968. The agreement was modified (article 14, paragraph 3) in New York on 21 August 1975, though these changes only took effect on 19 April 1985. A new amended ADR 2011 entered into force on 1 January 2011. As of 2013, 48 states are party to ADR of which Ghana is not a signatory. (A Guide for business, 2012).

2.3 DEFINITIONS


**Carrier:**

The carrier is the enterprise performing the actual carriage of dangerous goods in or on a vehicle (with or without a transport contract), for example a logistics company, vehicle owner or operator (who may also be the consignor or driver, as a self-employed vehicle owner or operator).

**Class:**

Dangerous goods are grouped into classes according to the type of hazard presented by the goods, and not by the degree of danger. There are nine classes (numbered 1 - 9). some having sub-classes.

**Competent authority:**

As the authority that certifies the packaging of dangerous goods for road transportation.

**Consignor:**

Means the person who offers dangerous goods for transport in a vehicle and includes the manufacturer, or his or her agent duly appointed as such, or the enterprise handing over the
dangerous goods prior to transportation and may act either on its own behalf or for a third party for example a manufacturer, supplier, forwarding warehouse, etc. If transportation is carried out under a contract of carriage involving the transfer of some or all-legal duties, then "consignor" means the consignor according to the contract.

Consignee:
Means the person who accepts dangerous goods which have been transported in a vehicle.

Dangerous goods inspector:
Means a person appointed by a competent authority to undertake examinations on all dangerous goods transport.

Driver and vehicle crew:
The driver is the participant who is in immediate control of the vehicle and fulfils the driving function. Crew members also have responsibilities and all crew members must have appropriate training in line with their duties and responsibilities. Note that if any crew member also drives the vehicle, he or she must hold an appropriate drivers training certificate.

Handling:
Means the operation of loading or unloading of a wagon, vehicle, freight container or other means of transport, transfer to, from or within a warehouse or terminal area or within a freight container onto a truck or transshipment between ships or other modes of transport and includes intermediate keeping, i.e. the temporary storage of dangerous goods in the port area during their transport from the point of origin to their destination for the purpose of changing the modes or means of transport.
Loader:
The loader is the participant (individual or business) who is responsible for loading dangerous goods onto a vehicle prior to transportation.

Placards:
They are large hazard labels used on vehicles or tanks.

Premises:
Means land or any building or other structure and includes any train, boat, ship, aircraft or other vehicle.

Qualified person:
Means a person trained to perform any specific task, nominated by the operator, consignor or consignee.

Transportcard:
Means the transport emergency card listing the hazards and emergency information for a material being transported for use by the driver during an incident, or by the emergency services, if required.

UN Number:
A four-digit number, assigned by the United Nations to identify dangerous goods.

Unloader:
The unloader is the participant (individual or business) who is responsible for the removal of dangerous goods from a vehicle, or the unloading or discharge of dangerous goods from a tank, container or vehicle.
2.4 CLASSIFICATIONS OF DANGEROUS GOODS

Each dangerous goods covers specific problems or hazards and this necessitates that the handler or operator is made aware of the various classification of dangerous goods, to be able to develop specific measures for proper handling of each class.

According to ASEAN. (2011), the classification is important for the relevant authorities to plan their emergency response. In addition, the carrier needs to know how much to charge and invoice the customers/consignees when carrying dangerous goods. ICS. (2010/11), the purposes of dangerous goods are for the manufacturers to know how to properly and safely label the dangerous goods, how the cargoes receive correct stowage requirements during land transportation and on board, whom to contact for advice in case of emergency and personnel involved with the transportation of these goods know how to deal with spillage, and what action to take if fire breaks out in the same compartment.


2.4.1. Class 1- Explosives:

Explosive substance either a solid or liquid or a mixture of substances which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed to cause damage to the surroundings. Examples are black powder, gel (hypergolic liquid etc.), rocket motors, lifting charge, bursting charge, bombs.
2.4.2. Class 2- Gases:

Substances that have vapor pressure greater than 300kpa at 50°C, or are completely gaseous at 20°C, at atmospheric pressure. They are divided into four states: compressed, liquefied, refrigerated liquefied and solution. Examples are LP Gas, acetylene, argon, oxygen, nitrogen, ammonia, etc. They are also divided into flammable, non-flammable, and toxic gases.

2.4.3. Class 3- Flammable Liquids:

Liquids with a flash point of 61°C or below and include substances transported as a liquid at an elevated temperature at or above its flash point, even if the flash point is above 61°C. They have narcotic effect if inhaled. Examples are petrol, kerosene, paint, vanishes, liquors etc.
2.4.4. Class 4- Flammable Solids:

a- Readily combustible solids, which can spread rapidly after ignition resulting from fire e.g. celluloid. Solids catching fire through frictions e.g. matches.

b- Desensitized explosives are explosives wetted with water or alcohol or diluted with other substances to suppress their explosive properties, e.g. mixture containing 2% and 10% nitroglycerine.

c- Self heating substances e.g. activated carbon, copra, etc.

Figures 2.4 Class 4- Flammable Solids

2.4.5. Class 5- Substances Containing Oxygen:

a- Oxidizing substances are substances that liberate oxygen during thermal decomposition. They increase the risk and intensity of fire and make it difficult to extinguish.

b- Organic peroxides are very strong oxidizers.

Figures 2.5 Class 5- Substances Containing Oxygen
2.4.6. Class 6- Toxic and Infectious Substances:
Infectious substances are substances from biological microorganisms that are known or reasonably expected to cause infectious diseases in humans or animals, e.g. chemical wastes and hospital waste. Toxic substances means any chemical or mixture that may be harmful to the environment and to human health if inhaled, swallowed or absorbed through the skin, e.g. paints and insecticides.

Figures 2.6 Class 6- Toxic and Infectious Substances

2.4.7. Class 7- Radioactive Materials:
Major hazard-may damage external or internal body tissue by the effect of invisible radiation and emits heat e.g. Uranium, cobalt, plutonium.

Figures 2.7 Class 7- Radioactive Materials

2.4.8. Class 8- Corrosive Substances:
They are acidic in nature and will form acids on contact with moisture, or are basic causing damage to living tissue and corrosive to metal structures of ships e.g. battery acids and caustic soda.
2.4.9. Class 9-Miscellaneous:

Include substances not within the last eight classes but sufficiently dangerous to be included in the code e.g. lithium, batteries, dry ice, asbestos, etc. They cause fire, marine pollutions, irritation when one comes into contact with them etc.

2.5 THE NEED TO REGULATE THE TRANSPORT OF DANGEROUS GOODS

A wide range of requirements applies when transporting dangerous goods. Most are imposed by international conventions and codes to which Ghana is signatory. The most significant is the United Nations Recommendations on the Transport of Dangerous Goods - Model Regulations (The UN Recommendations, 2013).
Prior to the UN Recommendations of 1957, each nation developed its own regulations for identifying, classifying and transporting dangerous goods. This caused several problems for international transport. The UN Recommendations take into account land, sea and air transport and form the basis for uniform national and international regulations.

By October 1999, the Economic and Social Council extended the mandate of the Committee to the global harmonization of the various systems of classification and labelling of chemicals which are applicable under various regulatory regimes, example: transport, workplace safety, consumer protection, environment protection, etc. (UN Recommendations, 2010).

2.6 INTERNATIONAL AND NATIONAL LEGISLATIONS ON DANGEROUS GOODS TRANSPORT

International interaction in transportation is increasing and industry and commerce are becoming ever more international (Finland Strategy, 2006).

In Ghana, import is growing faster than export. Shipping on the West African coast is increasing and the flow of goods is directed through specialized ports like Tema that feeds few landlocked countries around its borders and beyond. Ghana roads are increasingly trafficked by international haulage equipment and drivers from abroad (Group analyses, 2009), with dangerous goods being no exception.

This is because, most landlocked countries such as Mali, Burkina Faso transport their goods which sometimes include hazardous cargoes through the various road networks in Ghana before it gets to their final destination. Transportation of dangerous goods is going to bring about a whole new development of dangerous goods going through the country.
For the purpose of this research, two international regulations are discussed: the IMDG CODE and the ADR TREATY.

2.6.1 The International Maritime Dangerous Goods (IMDG) Code

The IMDG CODE

International Maritime Dangerous Goods Code, published by the International Maritime Organization is a mandatory code for carriage of dangerous goods at sea as adopted by the Maritime Safety Committee (MSC) of the International Maritime Organization (IMO). Effective from 1 January 2004 this code is applicable to all ships to which the safety of life at sea (SOLAS) convention applies (SOLAS, 2014).

According to House, (2012), the International Maritime Dangerous Goods (IMDG) Code was developed as a uniform international code for the transport of dangerous goods by sea covering such matters as packing, container traffic and stowage with particular reference to the classification, safe stowage and segregation of dangerous goods.

All dangerous goods are classified under this code for both imports and exports as well as packaging from shipping containers down to individual cartons or bottles should display the internationally recognized diamond-shape labels showing the classification numbers. The IMDG Code (2014) is published in two volumes with a supplementary.

Volume 1

This contains a general introduction and covers standards on 6 parts of the code:

Volume 2

This volume talks about Dangerous Goods List and Limited Quantities Exemptions.
Supplementary of the IMDG Code

The supplementary contains the emergency response procedures for ships carrying dangerous goods (IMDG) and schedules for particular commodities, plus details of specialized equipment required for handling spills and fires.

2.6.2 The ADR Treaty

The 1957 United Nations treaty called the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), has been in place for over 50 years and is amended every two years. The agreement itself is brief and simple, and its most important article is article 2. This article states that with the exception of certain exceptionally dangerous materials, hazardous materials may in general be transported internationally in wheeled vehicles, provided that the conditions in the two annexes are met: that is

1. The packaging and labelling of the merchandise are up to certain standards (Annex A)

2. The construction, equipment, and use of vehicles for the transport of hazardous materials (Annex B)

The structure is consistent with that of the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations, the International Maritime Dangerous Goods Code (of the International Maritime Organization), the Technical Instructions for the Safe Transport of Dangerous Goods by Air (of the International Civil Aviation Organization) and the Regulations concerning the International Carriage of Dangerous Goods by Rail (of the Intergovernmental Organization for International Carriage by Rail). The lay-out is as follows:

1. General provisions: terminology, general requirements.

3. Dangerous Goods List sorted by UN number, with references to specific requirements set in chapters 3 to 9 of ADR: special provisions and exemptions related to dangerous goods packed in limited quantities.

4. Packaging and tank provisions.

5. Consignment procedures, labeling, and marking of containers and vehicles.

6. Requirements for the construction and testing of packaging, intermediate bulk containers (IBCs), large packaging and tanks.

7. Provisions concerning the conditions of carriage, loading, unloading, and handling.

8. Requirements for vehicle crews, equipment, operation, and documentation.

9. Requirements concerning the construction and approval of vehicles.

The above international regulations became so necessary because a practical problem affecting surveillance and supervision activities arise, such as finding a common language for communication. A particular challenge for transport operators is being prepared for the logistical decisions made by their customers from a global point of view at an ever-increasing pace (Özçayır, 2004).

Terrorism and sabotage involving dangerous goods are also possibilities that must increasingly be taken into account and adequate efforts and resources must be allocated to the safety management systems and surveillance. For instance, modern chemical weapons were introduced during World War I in an effort to reduce the deadlock of trench warfare. Today, they horrify more than they contribute to victories on the ground.

Their indiscriminate nature and unpredictability, coupled with the sometimes-gruesome effects they have, make them effective weapons of fear. For example, the three year crisis in Syria has led
to a resurgence of interest in chemical weapons and these chemicals can cause severe psychological and physical effects and are agents of disruption (www.nationalinterest.org retrieved on 7th March 2015).

The Ghana Road and Safety Commission (GRSC) invests time and effort into ensuring smooth and functional traffic connections both in Ghana and beyond its borders.

The international agreements regarding Transport of Dangerous Goods (TDG) are revised every two years for each of the transport modes. These changes are implemented into the various signatory governments’ Transport of Dangerous Goods (TDG) legislation at the same schedule. This poses special challenges for both the implementation of the legislation, and the supervision and surveillance work especially for third world countries.

In Ghana, there is no single policy or regulation governing the entire scope of dangerous/hazardous goods handling and transport except for diffused institutional mandates. There are however a number of laws regulating the importation, handling and transportation of individual hazardous substances. Examples are the mercury ordinance, explosives, petroleum products, etc.

However, there are some institutions that have developed guidelines for the management of hazardous/dangerous goods or substances.

2.6.3. National Regulations

Dangerous goods transportation needs to be regulated in order to prevent damage to the environment or accident to people or property. Every country has its own national regulations governing the handling of dangerous goods. Retrieved from laws.ghanalegal.com; here are some Acts relating to dangerous goods carriage.
ROAD TRAFFIC ACT - 2004 (ACT 683)

- Section - 84 - Regulations in respect of carrying hazardous goods.

Under section 84 of the Act, it indicates how a person should carry hazardous substances and it should conform to the rules stipulated such as the method, labelling, precautions to be taken and the training and certification of drivers who transport these dangerous goods.

Section 84 of the Act provide minimum guidelines to all persons on the carriage of hazardous substance in Ghana and stipulated rules that should conform to international standards on labelling, precautions to be taken, the training and certification of drivers who transport these dangerous goods.

- Section - 85 - Carriage and labelling of hazardous goods.

This section also indicates the procedures to abide by when carrying dangerous goods such as the labelling, composition of the goods being carried, the name and address of the sender, owner or the consignee.

- Section - 87 - Forfeiture of hazardous goods.

This section gives the right of refusal to take on board goods suspected to be hazardous and the driver's right to demand from the owner disclosure of its contents. The content of this section gives the carrier the rights to know what is about to be carried and also the privileges to refuse handling and carriage if suspected to be hazardous.
GHANA SHIPPING ACT - 2003 (ACT 645)

The regulations stipulated under this act is to be enforced by the Ghana Shippers Authority.

- Section - 331 - Regulations as To Dangerous Goods.

This section outlines how the dangerous goods should be packaged with the necessary markings and this should conform to SOLAS 1974 and the IMDG Code for sea transport.

- Section - 332 - Carriage and Marking of Dangerous Goods.

Under this section, it talks about how to properly mark packages containing dangerous goods with all equivalent details such as the nature of the goods, the name and address of the sender to the master or owner of the ship.

- Section - 333 - Rejection and Disposal of Dangerous Goods by Ship.

The section deals with how a master of a ship can dispose off dangerous goods package when all details have not been met without causing harm to the environment such as proper labelling of container and the legalities involved.

- Section - 334 - Forfeiture of Dangerous Goods.

Under section 334 of Act 645 it talks about how persons forfeit their goods and who receives them.

GHANA PORTS AND HARBOURS AUTHORITY ACT - 1986 (PNDCL 160)

- Section - 105 - General offences

Under this section, it is an offence for any person to carry, place or house, except in accordance with the Regulations, a receptacle containing any inflammable explosive or corrosive gas, liquid or spirit or any dangerous or offensive goods.
ENVIRONMENTAL PROTECTION AGENCY ACT - 1994 (ACT 490)

- Section - 10 - Hazardous Chemicals Committee.

The hazardous chemicals committee under this section talks about members who must form the board such as a representative of the Ghana Standards Board, Ghana Cocoa Board.

These guidelines are however not enforced by stakeholders therefore leading to avoidable accidents.

2.7 CONDITIONS OF CARRIAGE AND MAIN DUTY HOLDERS OF ROAD

TRANSPORT OF DANGEROUS GOODS

According to ADR. (2014), UN recommendations on the transport of dangerous goods by road (2012) and Ghana Road Traffic Act -2004, the law in relation to road transport of dangerous goods clearly sets out the responsibilities of the various stakeholders/participants in the transportation of dangerous goods. The participants with specific legal duties are the consignor, carrier, driver and vehicle crew, packer, loader, unloader, tank container or portable tank operator, and consignee. There are generally several participants or duty holders in a particular transport chain.

A person or company can be a participant or stakeholder who may assume the responsibility of several duty holders, depending on the activity that has been assigned or he/she has been contracted to perform. This can range from the consignor right down to the consignee.

2.7.1 General safety measures

Addressing all participants, ADR. (2014) states that:

"The participants in the carriage of dangerous goods shall take appropriate measures according to the nature and the extent of foreseeable dangers, so as to avoid damage or injury and, if necessary, to minimize their effects. They shall, in all events, comply with the requirements of ADR in their
respective fields. When there is an immediate risk that public safety may be jeopardized, the participants shall immediately notify the emergency services and shall make available to them the information they require to take action."

It continues further to state that:

"This general provision means that all participants must ensure that they take all necessary actions to reduce the risk of an incident involving dangerous goods."

In general, a participant must:

- Ensure that a person employed by him or her, whose duties concern the carriage of dangerous goods, has received the appropriate training;
- Keep records of such training;
- Comply with specified legal duties;
- Take appropriate measures to avoid damage or injury;
- Notify emergency services of an immediate risk to public safety."

2.7.2 Consignor

The consignor must have a place of business in the State. If no person in the State satisfies this requirement, the consignee (customer) of the goods assumes the duties of the consignor. When the consignor acts on behalf of a third party, the latter must inform the consignor in writing that dangerous goods are involved and make available to him or her all the information and documents needed to perform the consignor's obligations. The picture below depicts the warehouse of a consignor who stores dangerous goods for his/her clients or for future purchases by interested persons or companies.
The consignor must in particular:

(a) Ascertain that the dangerous goods are classified and authorized for carriage in accordance with ADR and Ghana Road Traffic Act -2004, Ghana shippers Act - 2003.

(b) Furnish the carrier with information and data and, if necessary, the required transport documents and accompanying documents (authorizations, approvals, notifications, certificates, etc.). The consignor must ensure that a carrier is informed in advance of the nature of the dangerous goods to be picked up and, when a driver arrives on site, ensure that all necessary documentation is provided.

(c) Use only packaging, large packaging, intermediate bulk containers (IBCs) and tanks (tank-vehicles, demountable tanks, battery-vehicles, portable tanks and tank-containers) approved for and suited to the carriage of the substances concerned and bearing the markings prescribed by ADR.

(d) Comply with the requirements on the means of dispatch and on forwarding restrictions.
(e) Ensure that even empty, uncleaned and not degassed tanks (tank-vehicles, demountable tanks, battery-vehicles, portable tanks and tank-containers) or empty, uncleaned vehicles and large and small bulk containers are appropriately marked and labelled and that empty uncleaned tanks are closed and are leak-proof to the same degree as when they are full:

(f) Comply with security measures as appropriate (see Section 15 of ADR - 2014):

(g) Ensure that on handing dangerous goods over to a driver, he or she is carrying an appropriate driver training certificate and photo identification;

(h) Ensure emergency procedures are in place (see Section 16 of ADR - 2014):

(i) Ensure all employees are appropriately trained in advance of work involving dangerous goods (see Section 6 of ADR - 2014).

If the consignor uses the services of other participants (packer, loader, filler, etc.), he or she must take appropriate measures to ensure that the consignment meets the requirements of ADR. The consignor may, however, in the case of (a), (b), (c) or (e), rely on the information and data made available by other participants.

2.7.3 Carrier

The picture shows a vehicle (carrier) loading hazardous cargo from a warehouse or a storage facility.
The carrier must in particular:

(a) Ascertain that the dangerous goods to be carried are authorized for carriage in accordance with ADR (by means of confirmation from the consignor, or otherwise);

(b) Ascertain that all information prescribed in ADR related to the dangerous goods to be carried has been provided by the consignor before carriage and that the prescribed documentation is on board the transport unit or, if Electronic Data Processing (EDP) or Electronic Data Interchange (EDI) techniques are used instead of paper documentation, that data is available during transport in a manner at least equivalent to that of paper documentation;

(c) Ascertain visually that the vehicles and loads have no obvious defects, leakages or cracks, missing equipment, etc. And ensure this is carried out by putting in place a monitoring/audit procedure to assess vehicles and equipment;

(d) Ascertain that the date of the next test for tank-vehicles, battery-vehicles, demountable tanks, portable tanks, and tank-containers has not expired
As in (c) above, build inspection checks into regular monitoring/audit function:

(e) Verify that the vehicles are not overloaded;

(f) Ascertain that the danger labels and markings prescribed for the vehicles have been affixed

(g) Ascertain that the equipment prescribed in the written instructions for the driver is on board the vehicle (see Section 13.4 of ADR -2014). This must also take account of fire extinguisher requirements

(h) Comply with security measures as appropriate

(i) Ensure emergency procedures are in place

(j) Ensure both driver and crew are suitably trained in advance of any work involving dangerous goods. Drivers must also hold an appropriate driver training certificate.

Where appropriate, this should be done on the basis of information provided by transport documents and accompanying documents, or by a visual inspection of the vehicle or the containers and, where appropriate, the load. Documented procedures including periodic audits will ensure the vehicle and other transport equipment are in a suitable condition for use.

The carrier may, however, in the case of (a), (b), (e) or (f) rely on information and data made available to him or her by other participants (e.g. consignor, loader, packer or filler). If the carrier observes an infringement of the requirements of ADR, he or she must not forward the consignment until the matter has been rectified.

If during the journey, an infringement, which could jeopardize the safety of the operation, is observed, the consignment must be halted as soon as possible, bearing in mind the requirements
of traffic safety, of the safe immobilization of the consignment and of public safety. The transport operation may only be continued once the consignment complies with applicable regulations.

2.7.4 Driver and vehicle crew

Drivers and/or crew members must in particular:

(a) Ensure they carry with them their personal ADR driver training certificate (drivers) and photo identity. (All crew members);

(b) Ensure that they have read and understood transport documentation provided in advance of any transport operation. If an issue does arise with the documentation the crew members must raise and rectify any matter prior to driving the vehicle;

(c) Keep written emergency instructions readily available in the cab;

(d) Check to ensure all vehicle safety equipment and Personal Protective Equipment (PPE) is provided and raise any deficiency or missing items with the carrier;

Figure 2.12 A crew or a driver following procedures in relation to checking his vehicle.

(c) Check and ensure the vehicle is properly plated, placarded and marked. Ensure orange plates, placards and marks are kept clean. And when they are not required remove or cover plates, placards and marks;

(f) Ensure that damaged or leaking packages are not loaded;

(g) Ensure they do not drive a vehicle they suspect is not in compliance with national legislation or the ADR and rectify any issues prior to driving the vehicle;

(h) Ensure that apart from members of the vehicle crew, no passengers are carried in transport units carrying dangerous goods;

(i) Ensure that members of the vehicle crew know how to use the fire-fighting extinguishers;

(j) Not open a package containing dangerous goods;

(k) Ensure that any torch or lighting apparatus used does not exhibit any metal surface liable to produce sparks;

(l) Ensure that smoking is prohibited during handling operations in the vicinity of vehicles and inside the vehicles;

(m) Ensure that the engine is shut off during loading and unloading operations, except where it has to be used to drive the pumps or other appliances for loading or unloading the vehicle and the laws of the country in which the vehicle is operating permit such use;

(n) Ensure that no vehicles carrying dangerous goods are parked without the parking brakes being applied. And those trailers without braking devices are restrained from moving by applying at least one wheel chock;
(o) Ensure that in the case of a transport unit equipped with an anti-lock braking system consisting of a motor vehicle and trailer, the electrical connections connect the towing vehicle and the trailer at all times during carriage;

(p) If responsible for tank filling or emptying, ensure as may be appropriate (e.g. for flammable liquids) that there is a good electrical connection to the earth prior to the emptying or filling operation (see also Section 3.6 of ADR - 2014);

(q) Ensure no dangerous residues of the filling substance adhere to the outside of tanks filled or emptied (see also Section 3.6 of ADR -2014);

(r) If involved in the loading operation, initially or during the transport operation, ensure dangerous goods are properly secured to the vehicle. If released to unload part of the shipment, remaining dangerous goods must be re-secured to the vehicle.

(s) Ensure that vehicle supervision provisions are adhered to.

2.7.5 Packer

The packer must in particular:

(a) Comply with requirements concerning packing provisions, or mixed packing provisions

(b) Comply with the requirements concerning marking and labelling of the packages when preparing packages for carriage (see Section 8 of the ADR-2014)

Figure 2.13 Containers or packages in which dangerous goods are parked,

The picture above shows the containers or packages in which dangerous goods are to be placed in by the packer. The packer needs to ensure that the packaging are up to the requirements required by the various conventions such as the ADR Convention.

Some of the provisions are:

- Ascertain prior to these packages, both the packer with his or her equipment is in satisfactory technical condition;
- Also, after filling these packages, one should check that the closing devices are leak-proof to avoid spillage and damage to the person filling the container or package;
- Ensure that no dangerous residue of the filling substance adheres to the outside of the tanks filled by him or her;

2.7.6 Loader

The loader must in particular:

(a) Hand the dangerous goods over to the carrier only if they are authorized for carriage in accordance with ADR;

(b) When handing over for carriage packed dangerous goods or uncleaned empty packaging, check whether the packaging is damaged. He or she must not hand over a package if its packaging is damaged, especially if it is not leak-proof and there are leakages or the possibility of leakages of the dangerous substance, until the damage has been repaired:
c) When loading dangerous goods in a vehicle, or a large or small container, comply with the special requirements concerning loading and handling.

(d) After loading dangerous goods into a container, comply with the requirements concerning danger markings conforming to ADR

(e) When loading packages, comply with the prohibitions on mixed loading taking into account dangerous goods already in the vehicle or large container and requirements concerning the separation of foodstuffs, other articles of consumption or animal feedstuffs (EPA/GCM Guidelines, 2010)

The loader may, however, in the case of (a), (d) or (e), rely on information and data made available to him or her by other participants.
2.7.7 Tank-container or portable tank operator

The tank-container or portable tank operator must in particular:

(a) Ensure compliance with the requirements for construction, equipment, tests and marking;

(b) Ensure that the maintenance of shells and their equipment is carried out in such a way that, under normal operating conditions, the tank container or portable tank satisfies the requirements of ADR until the next inspection;

(c) Have an exceptional check made when the safety of the shell or its equipment is liable to be impaired by a repair, an alteration or an accident.

2.7.8 Unloader

The unloader must in particular:

(a) Ascertain that the correct goods are unloaded by comparing the relevant information on the transport document with the information on the package, container, tank, Mobile Explosives Manufacturing Unit (MEMU), Multiple Element Gas Container (MEGU) or vehicle;

(b) Before and during unloading, check whether the packaging, the tank, the vehicle or container have been damaged to an extent which would endanger the unloading operation. If this is the case, ensure that unloading is not carried out until appropriate measures have been taken;

(c) Comply with all relevant requirements concerning unloading;

(d) Immediately following the unloading of the tank, vehicle or container:

(i) Remove any dangerous residues which have adhered to the outside of the tank, vehicle or container during the process of unloading;

(ii) Ensure the closure of valves and inspection openings;
(e) Ensure that the prescribed cleaning and decontamination of the vehicles or containers is carried out;

(f) Ensure that the containers once completely unloaded, cleaned and decontaminated, no longer display danger markings conforming to ADR Chapter 5.3

(g) If the unloader makes use of the services of other participants (cleaner, decontamination facility etc.) he or she must take appropriate measures to ensure that the requirements of ADR have been complied with.

2.7.9 Consignee (customer or recipient)

Figure 2.15 below depicts a stevedore handling or receiving hazardous goods into a warehouse of the consignee or recipient.

The consignee has the following obligations:

(a) Not to defer acceptance of the goods without compelling reasons and to verify, after unloading, that the requirements of ADR placed on the consignee have been complied with;

Figure 2.15 A stevedore handling or receiving hazardous goods into a warehouse

(b) If, in the case of a container, this verification brings to light an infringement of the requirements of ADR, the consignee must return the container to the carrier only after the infringement has been remedied; and

c) If the consignee makes use of the services of other participants (unloader, cleaner, decontamination facility, etc.) he or she must take appropriate measures to ensure that the requirements of (a) and (b) have been complied with.

2.8 CONSIGNMENT PROCEDURES, LABELLING, AND MARKING OF CONTAINERS AND VEHICLES FOR DANGEROUS GOODS CARRIAGE

2.8.1 Purpose of Marking and Labeling

The purpose of marking packages with the correct and proper shipping (identification or technical) name and the UN number of the substance is to ensure that the material or substance can be readily identified during transportation of the goods. This identification is particularly important in determining the nature of emergency treatment which would be required in the event of a spillage or accident occurring. (A Guide for business, 2012).

2.8.2 Packaging, Marking and labeling of containment for dangerous goods

The EPA/GCM Guidelines, Ghana Road Traffic Act -2004, Ghana shippers Act - 2003 and ADR specifies the correct way to package dangerous goods, be it in a box, drum, container, or when carried in road tankers or other systems of containment. Packaging provides a safeguard for people and the environment during loading, transport and unloading of dangerous goods and must therefore be appropriate for the dangerous goods concerned.
In most cases packaging is “UN approved”. This means the package has been tested and approved according to ADR. Approved packaging will be identified with a series of marks, as indicated in figures 2.16 and 2.17 below.

The letter “X”, “Y” or “Z” indicates the packing group (“PG”) for which the package has been successfully tested:

- “X” = suitable for dangerous goods of PG I, II and III
- “Y” = suitable for PG II and III
- “Z” = only suitable for PG III

Codes to indicate the type of package (e.g. in this case a composite steel IBC with plastic inner receptacle)

Figure 2.16. Marking to indicate that the packaging is UN approved (ADR Pdf, 2014)

Figure 2.17 Marking to indicate that the packaging is UN approved

2.8.3 Marking and labeling of road vehicles for dangerous goods transport.

Some vehicles used to transport dangerous goods are highly specialized (e.g. vehicles used to transport explosives and road tankers).

According to A Guide for business, (2012), such vehicles must be certified annually for the transport of dangerous goods by the states Road Safety Authority /institution. With the exception of those carrying explosives. Vehicles carrying packaged dangerous goods may be standard vehicles (e.g. vans and curtain sided vehicles) and no ADR annual certification is necessary.

With reference to ADR, (2014), it is the responsibility of carriers to ensure the correct vehicle is used and that appropriate marking is applied. Drivers may also share in the marking duties (e.g. their responsibilities include the removal/covering of ADR “orange plates” when all dangerous goods are unloaded).

When vehicles are transporting dangerous goods, they are marked with ADR orange plates (front and rear). When vehicles are carrying containers, the freight container must also be labelled or “placarded” with the appropriate class label on all four sides as shown below:

![Diagram of vehicle and container marking](image)

Figure 2.18. Labelling of freight Container Carrying Dangerous Goods

When carrying goods in bulk (unpackaged loose material) the vehicle must also be labelled or “placarded” with the appropriate class label on both sides and rear. Bulk vehicles must also identify the goods by using the numbered orange plates on both sides of the bulk container in addition to blank orange plates at the front and rear.

2.8.4 Marking and labeling of tanks/tank-contains for dangerous goods transport

Tanks (tank-container, portable tank, fixed tank, demountable tank, battery-vehicles and MEPCs) are subject to periodic testing and certification. A competent person for tanks used for national transport purposes must carry out examination and testing and if used for international operation, an appointed and accredited tank tester must carry out testing and examination.

These matters are the responsibility of the carrier/tank operator and must be carried out in consultation with a Dangerous Goods Safety Advisor/Authority (DGSA).

For the carriage of dangerous goods in tanks, ADR requires marking of both the vehicle and tank (e.g. numbered orange plates at the front and rear of the vehicle, hazard placards and other marks as required on each side of the tank and at the rear). Alternative marking methods are specified in ADR. Blank orange plates may be used at the front and rear of the vehicle with numbered orange plates on each side of the tank.

Figure 2.19 below provides an example of such side tank marking with numbered orange plate, class hazard placard and an elevated temperature mark (red triangle with thermometer).
When different goods are carried in a multi-compartment tank, side marking is used when marking each separate compartment. Transport units over 12 tonnes (gross vehicle mass), carrying more than 8 tonnes of limited quantity packages must display the appropriate mark indicated in the ADR, (2014) in the form of a placard (large label or placard dimensions should be 250mm x 250mm). In advance of carriage, consignors of dangerous goods packed in limited quantities must inform the carrier in a traceable form of the total gross mass of such goods to be consigned.

2.9 ROAD VEHICLE SAFETY EQUIPMENT AND PERSONAL PROTECTIVE EQUIPMENT:

Safety equipment is essential for personal protection whether during routine activity or in the event of an emergency. The current Guidelines from EPA and Ghana Road Traffic Act -2004 specifies both personal protective equipment for drivers and crew, and safety equipment to be carried on vehicles for use by the crew. It is the responsibility of carriers to supply safety equipment and ensure it is provided and maintained in good working order.

2.9.1 Mandatory equipment

According to the Guidelines from the EPA/GCM, (2010), the following equipment should be mandatory for each vehicle and for each member of the vehicle crew:
A suitable wheel chock, two self-standing warning signs, eye wash, a warning vest, torch, protective gloves; and safety glasses in addition to the above a shovel, drain seal and plastic collecting container in vehicles carrying goods with danger label numbers 3, 4.1, 4.3, 8 and 9., a first aid kit.

2.9.2 Firefighting equipment

The Table below outlines the specific fire extinguisher requirements for various transport units.

Table 2.1 Specific fire extinguisher requirements for various transport units

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>All transport units</td>
<td>Minimum of a 2 kg dry powder (or equivalent) extinguisher – suitable for fighting a cab or engine fire</td>
</tr>
<tr>
<td>Units with max. permissible mass of more than 7.5 tonnes</td>
<td>One or more portable fire extinguishers with minimum total capacity of 12 kg dry powder (or equivalent) – at least one extinguisher being minimum of 6 kg capacity</td>
</tr>
<tr>
<td>Units with max. permissible mass of more than 3.5 tonnes up to and including 7.5 tonnes</td>
<td>One or more portable fire extinguishers with minimum total capacity of 8 kg dry powder (or equivalent) – at least one extinguisher being minimum of 6 kg capacity</td>
</tr>
<tr>
<td>Units with max. permissible mass of up to and including 3.5 tonnes</td>
<td>One or more portable fire extinguishers with minimum total capacity of 4 kg dry powder (or equivalent)</td>
</tr>
<tr>
<td>Transport Units exempted under Small Load Exemption (ADR 1.1.3.6)</td>
<td>Minimum of a 2 kg dry powder (or equivalent) extinguisher – suitable for fighting a cab or engine fire</td>
</tr>
</tbody>
</table>


The Guidelines from the EPA/GCM specifies fire extinguisher requirements for transport units carrying dangerous goods. If a transport unit is carrying dangerous goods, it has to be equipped with at least one portable fire extinguisher for the inflammability classes A, B and C, with a minimum capacity of 2kg dry powder (or an equivalent capacity for any other suitable extinguishing agent) suitable for fighting a fire in the engine or cab of the transport unit.
2.10 TRAINING AND CERTIFICATION


All persons, whose duties concern the carriage of dangerous goods, must be trained in the requirements governing the carriage of such goods appropriate to their responsibilities and duties. Employees must be trained before assuming responsibilities, and such training shall be in the areas of general awareness, function specific training, and safety and security training.

Employees must only perform functions for which required training has been provided under the direct supervision of a trained person. Records of all training received (including refresher training) must be kept by the employer and made available to the employee or the competent authority upon request.

Records, including those for security training, must be retained by the employer for a period of one year after the employee has left the company. A copy of training records must be provided to employees, and training records must be verified upon commencing new employment. Personnel must be familiar with the general requirements of the provisions for the carriage of dangerous goods.

Personnel must also be trained to a level directly commensurate with their duties and responsibilities under the requirements of the regulations concerning the carriage of dangerous goods. Where the carriage of dangerous goods involves a multi-mode transport operation, the personnel must be made aware of the requirements concerning other transport modes.
Personnel must be trained in the hazards and dangers presented by dangerous goods to a level commensurate with the degree of risk of injury or exposure arising from an incident involving such dangerous goods. The training provided must aim to make personnel aware of the safe handling and emergency response procedures required during transport.

Training must include elements such as security awareness, addressing the nature of security risks, recognizing security risks, methods to address and reduce such risks and actions to be taken in the event of a security breach. It must also include awareness of security plans (if appropriate) commensurate with the responsibilities and duties of individuals and their part in implementing those plans. All training must be supplemented periodically with refresher training to take account of changes in regulations.

2.10.1 Driver training and examination

According to Ghana Road Traffic Act -2004, drivers of vehicles carrying dangerous goods must hold a training certificate issued by the competent authority or the appointed agent. Drivers must have participated in a training course (mandatory) and passed an examination on the particular requirements that have to be met during carriage of dangerous goods.

Drivers must undergo refresher training and examination every five years. Basic training is available to all, and there is the option for additional specialized training for tanks.

2.11 AN OVERVIEW OF THE ROAD NETWORKS IN GHANA

Roads in Ghana form a network of varied quality and capacity. Responsibility for the road network differs between trunk and non-trunk routes. Trunk roads, which are the most important roads, are administered by the Ghana Highway Authority, which was established in 1974 to develop the trunk
road network. Ghana's 13,367 km of trunk roads accounts for 33% of the total road network of 40,186 km (http://www.highways.gov.gh/ Retrieved on 7th March, 2015).

The Department of Feeder Roads is responsible for the construction and maintenance of feeder roads in Ghana, while responsibility for urban roads lies with the Department of Urban Roads (http://www.mrt.gov.gh Retrieve on 7th March, 2015).

Road distances are shown in kilometers and Ghana speed limits are indicated in kilometers per hour (km/h). Generally, speed limits range from 30 km/h to 50 km/h in urban areas, 80 km/h on Regional and Inter-Regional highways (R and IR routes), 100 km/h (62 mi/h) on National highways (N routes) and 120 km/h on motorways.

2.1.1 Ghana Road Classification

Trunk roads in Ghana are classified as N for National routes, R for Regional routes and IR for Inter-Regional routes. Each road is given a number which is combined with the prefix, for example N1, R40 and IR11, although their informal or traditional names may still be used or heard occasionally: for instance the Accra - Kumasi Road (now part of the N6).

2.1.2 National Routes

National routes in Ghana are a class of roads and highways that form the trunk routes between major urban centers. Together, they form the backbone of the road system. This category of roads is designated with the letter N followed by a number indicating the specific route. (http://www.highways.gov.gh/index. Retrieved on 7th March, 2015) Odd-numbered routes run east to west, while even-numbered routes run north to south.
### 2.11.3 List of national roads

Table 2.2 shows the list of Ghana National roads.

<table>
<thead>
<tr>
<th>Number</th>
<th>Route</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>Elubo - Sekondi-Takoradi - Cape Coast - Winneba - Accra - Adidome - Aflao</td>
<td>540 km (335.54 mi)</td>
</tr>
<tr>
<td>N2</td>
<td>Tema - Asikuma - Ho - Hohoe - Jasikan - Yendi - Nalerigu - Kulungugu</td>
<td>640 km (397.68 mi)</td>
</tr>
<tr>
<td>N3</td>
<td>Kpong - Koforidua</td>
<td>40 km (24.85 mi)</td>
</tr>
<tr>
<td>N4</td>
<td>Accra (N1) - Koforidua - Nkawkaw - Kumasi</td>
<td>250 km (155.34 mi)</td>
</tr>
<tr>
<td>N5</td>
<td>Adome (N2) - Asikuma - Kpeve (N2)</td>
<td>40 km (24.85 mi)</td>
</tr>
<tr>
<td>N6</td>
<td>Accra (N1) - Nsawam - Suhum - Nkawkaw - Kumasi</td>
<td>250 km (155.34 mi)</td>
</tr>
<tr>
<td>N7</td>
<td>Sawla (N12) - Larabanga - Fufuslu (N10)</td>
<td>140 km (86.99 mi)</td>
</tr>
<tr>
<td>N8</td>
<td>Yaworsa (N1) - Dunkwa - Fomena - Bekwai - Kumasi (N6, N10)</td>
<td>170 km (105.63 mi)</td>
</tr>
<tr>
<td>N9</td>
<td>Tamale (N10) - Jimle - Yendi (N2)</td>
<td>100 km (62.14 mi)</td>
</tr>
<tr>
<td>N10</td>
<td>Kumasi (N6, N8) - Techiman - Tamale - Bolgatanga - Paga</td>
<td>610 km (379.04 mi)</td>
</tr>
<tr>
<td>N11</td>
<td>Bolgatanga - Zebilla - Bawku - Bimpiela</td>
<td>100 km (62.14 mi)</td>
</tr>
<tr>
<td>N12</td>
<td>Elubo (N1) - Enchi - Sunyani - Bamboi - Wa - Lawra - Hamile</td>
<td>670 km (416.32 mi)</td>
</tr>
<tr>
<td>N13</td>
<td>Lawra - Tumu - Navrongo</td>
<td>180 km (111.85 mi)</td>
</tr>
<tr>
<td>N14</td>
<td>Sakpeigu - Cheperoni - Yawgu</td>
<td>120 km (74.56 mi)</td>
</tr>
<tr>
<td>N15</td>
<td>Tumu - Kapulima</td>
<td>20 km (12.43 mi)</td>
</tr>
</tbody>
</table>

(Source: wiki, 2015.)
2.11.4 Regional Routes

Regional routes are a mix of primary and secondary routes that link major settlements and serve as feeder roads to the National route network. Major regional routes are designated with the letter R followed by a two-digit number, while Minor regional routes are designated with the letter R followed by a three-digit number.

2.11.5 Major Regional Routes

Major Regional Routes are the second category of road in the Ghana trunk road network. They serve as feeder roads to the national route network, and are the primary trunk roads in areas where there is no national route.

2.11.6 Minor Regional Routes

Minor Regional Routes are the third category of road in the Ghana trunk road network. They serve as feeder roads connecting smaller towns to the national and major regional route network.

2.11.7 The Signage on Ghana Road Network

Signage on the Ghana road network conforms broadly to international norms. All length distances are shown in kilometers, speed is in kilometers per hour, whilst height and width restrictions are shown in meters. Signs may be of an informative, warning or instructional nature. Instructional signs are generally circular, warnings are triangular, and informative signs are rectangular or square. Informative signs, which include directional signs, use white text on a blue background.
2.12 CONCLUSION

The above review on the various literatures indicates clearly that dangerous goods are dangerous in all aspect of handling which include storage, loading, unloading, packing, filling and transport. Therefore, the transportation of dangerous goods through roads poses special risks to road users and to people residing near the road.

In view of this, the researcher aims to use different research design and instrument to obtain information from Ghanaian transporters of dangerous goods especially those who ply the road from Tema in the Greater Accra Region to the Ashanti Region of Ghana.
CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

This chapter discusses the research methodology that ensured the achievement of the research objectives. An in-depth look into the data collection methods, the population, sample and sampling technique, instruments used in collecting data and data analysis techniques employed in the study is in focus here.

3.1 DEFINITIONS

Methodology according to Kumekpor, (1999), “is the processes, methods and techniques we use in attempting to discover what we want to know”. The data for this research work will be collected from two sources; primary and secondary sources. Primary data collection will be done through unstructured interviews, questionnaires, and the secondary data sources will comprise of journals, internet, and articles.

A systematic sampling shall also be used by the researcher to select the respondents from individual truck drivers where it was difficult to get the total number of stakeholders in advance. Purposive method will be used to identify the respondents for the interview based on their in-depth knowledge of the problem under study.

3.2 RESEARCH DESIGN

According to McMillan and Schumacher, (2001), “quantitative research is one of the research designs which relies heavily on numbers in reporting results, sampling and provisions of estimated instruments, reliability and validity. Qualitative research on the other hand investigates the why
and how of decision making, not just what, where, when”. “Hence, smaller but focused samples are more often needed than large samples” (Patton, '87, Maxwell, '96, Mays and Pope, '95).

Since the goal for this study is to evaluate the Ghanaian transporters on how safely they transport by road the various import and export of dangerous goods in the country, a survey is deemed appropriate.

3.3 SCOPE OF STUDY

This study adopted the survey method in order to operationalize the stated objectives of this study. In addition the study would be limited to the road route from the Port of Tema to the mining and industrial sectors in the Ashanti region of Ghana (N6 road) by hauliers and besides the researcher would want to have an in-depth information pertaining to the research study.

Thus, a survey questionnaire was developed to collect the primary data from the respondents. Survey method is based most often on questionnaire; however questionnaire is not the only data collection device for survey. Structured observations and structured interviews may be used as well” (Saunders et al. 2000). Therefore in this specific study, the results were presented using simple descriptive statistics.

The primary sources of information were collected from both the individual truck drivers and haulage companies in the transportation of dangerous goods. Ministry of Environment, Science, Technology and Innovation (MESTI), Environmental Protection Agency (EPA), Ghana Ports And Harbours Authority (GPHA), Ghana National Fire Service (GNFS), Ministry of Transport (MoT), Driver and Vehicle Licensing Authority (DVLA) and Ghana Road and Safety Commission (GRSC) through questionnaires and structured interview.
3.4 AREA OF STUDY

The research concentrated on all those who are directly involved in the handling, inspection and transport of dangerous goods on the road such as: drivers who transport the dangerous goods to and from the quay to the storage areas at the Port of Tema, drivers who take the dangerous goods from the port storage area to the final destinations, personnel from MESTI, EPA, GPHA, GNFS, MoT, DVLA and GRSC.

3.5 POPULATION OF THE STUDY

“A study population is that aggregation of elements from which the sample is actually selected” (Rubin and Babbie, 2012). According to David and Chava (1976) “a population could be defined in terms of content, extent and time. Therefore a population is the aggregation of all cases that conform to some designated set of specification”. To accomplish the researcher’s objective, information was elicited from transporters (truck drivers), approved training institutions, law enforcement agencies that are directly involved in the road transportation of dangerous goods.

3.6 SAMPLING PROCEDURE

Sampling denotes the process of choosing the research units of the target population, which are to be included in the study. “It is a process of taking any portion of a population or universe as representative of that population or universe” (Osuala, 2001).

David and Chava, 1976, defined a sample “as any subset of sampling units from a population. A subset is any combination of the entire units that does not include the entire set of sampling units that has been defined as the population. In general terms, sampling enables the researcher to study a relatively small number of units in place of the target population and to obtain data that are representative of the whole target population”.

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3.6.1 Sampling size

A sampling size of hundred and two (102) respondents were selected for the study. The breakdown is as follows: ten (10) to Vehrad Transport, ten (10) to DHL, thirty (30) to individual hauliers, eight (8) to EPA, and seven (7) each from MESTI, GPHA), MoT, GRSC, GNFS, DVLA and one each from EPA and GNFS for the interview as can be seen in the table 3.1 below.

Table 3.1 Distribution of Sampled Respondents

<table>
<thead>
<tr>
<th>Target Population</th>
<th>Sample Size</th>
<th>Sample Technique/Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehrad Transport</td>
<td>10</td>
<td>Simple Random</td>
</tr>
<tr>
<td>DHL</td>
<td>10</td>
<td>Simple Random</td>
</tr>
<tr>
<td>Individual Hauliers</td>
<td>30</td>
<td>Simple Random</td>
</tr>
<tr>
<td>MESTI</td>
<td>7</td>
<td>Purposive/simple random</td>
</tr>
<tr>
<td>GPHA</td>
<td>7</td>
<td>Purposive/simple random</td>
</tr>
<tr>
<td>GNFS</td>
<td>7 + 1</td>
<td>Purposive/simple random</td>
</tr>
<tr>
<td>GRSC</td>
<td>7</td>
<td>Purposive/simple random</td>
</tr>
<tr>
<td>EPA</td>
<td>8 + 1</td>
<td>Purposive/simple random</td>
</tr>
<tr>
<td>MoT</td>
<td>7</td>
<td>Purposive/simple random</td>
</tr>
<tr>
<td>DVLA</td>
<td>7</td>
<td>Purposive/simple random</td>
</tr>
</tbody>
</table>

Source: Researcher’s Construct
3.6.2 Sampling Methods

Kothari, (2010) explained eight (8) sampling methods namely deliberate, simple random, systematic, stratified, quota, cluster and area, multi-stage, and sequential sampling. But he said the ones which are applicable to the study are deliberate and simple random sampling.

- Deliberate Sampling - Deliberate sampling is also known as purposive or non-probability sampling. This method was used to sample Departments and Sections in the institutions mentioned above of which participants are directly or indirectly involved in the transportation of dangerous goods. This method also gave the researcher the choice to use those transporters who were conveniently accessible and had a relatively long journey road experience or quay side driving experience.

- Simple random Sampling - The researcher used the simple random sampling also known as chance or probability sampling to select the respondents. Here every person has an equal chance of being chosen for the study.

3.7 SOURCE OF DATA COLLECTION

Both primary and secondary data types were sourced for the study. The sections below discuss the types of data collected, their sources and the instruments employed in collecting data.

3.7.1 Primary Research Data

Primary data entails going out and collecting information by observing, recording and measuring the activities and ideas of real people, or inspecting objects and experiencing events.

Primary data were made up of data collected using questionnaires, interviews, personal experience and observation that form unprocessed data and main focus of the analysis.
3.7.1.1 Personal Experience and Observation

Personal experiences gathered through study of relevant study materials as well as the observation of the activities on the road between the transporters and the law enforcement agencies and how dangerous goods are handed over to transporters for transport.

3.7.1.2 Questionnaire

The study employed questionnaires to collect primary data. Burns and Grove, (1993) describe a questionnaire as a “printed form containing questions and answer options or answer spaces for study respondents to respond to”.

The questionnaire was concise and close-ended, to allow for quick guided responses so as to enable categorization. The adoption of questionnaires afforded respondents more flexibility and convenience in relation to choosing suitable response patterns and options. Respondents who needed guidance were offered guidance through further explanation of research aims, questions and response options. This was besides the fact that the questionnaire was captioned by a brief explanatory paragraph elucidating the purpose of the study.

3.7.1.3 Interview Guide

Cooper and Schindler, (2003) describe an interview guide “as a prepared set of questions used to determine the scope and direction of an interview in order to meet a set objective”. The study employed a semi-structured interview guide to enable better focusing on the questions and responses in the data-collecting interview process.
3.7.1.4 Validity and Reliability of Data

To ensure that information provided by respondents will be valid, all selected respondents were taken through the questionnaire designed for them. However, some sampling error may occur if for one reason or the other, some respondents do not answer some questions objectively.

3.7.2 Secondary Research Data

Secondary data are required for the background of the study while other researchers greatly rely on them for the whole project, for example when doing a historical study or nationwide study that used official statistics as it is in this research. "An advantage of using this kind of data is that it has not been produced for the specific purposes of social research, and can therefore be the basis of a form of unobtrusive inquiry" (Walliman, 2006).

Secondary sources data for this study included an extensive review of relevant literature from books, journals, magazines, newspapers and individual writing exercises.

The study employed both types of data source. The study used secondary data as authenticity check on primary data obtained from respondents. Secondary data enable further understanding of primary data and broadened the scope of the study.

3.8 DATA ANALYSIS PROCEDURE

Hundred (100) questionnaires were administered and eighty-five (85) were collected from the respondents constituting eighty-five percent (85%). All the questionnaires issued to Vehrad Transport, DHL supply chain, GNFS and GPHA were received. Twenty-six (26) Contracted individual transporters returned their questionnaires. Five (5) questionnaires each were received
from MESTI, MoT, GRSC, DVLA and EPA. One respondent each was selected from EPA and GNFS for the interview.

Completed questionnaires were grouped under the sub-headings in which the questionnaires were designed. After collecting primary data, it was sorted and categorized manually before coding into the Microsoft excel computer software. Tables and columns were used to present the information after the analysis.

The essence of analyzing the information from the research questions is to summarize the data in such a way that it both answers the stated research questions and as well as meet the research objectives.
CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION OF FINDINGS

4.0 INTRODUCTION

This study investigated transportation of dangerous goods by road and covered mainly road hauliers in Ghana. The chapter also looked at the role played by the various regulatory bodies in the transportation of dangerous goods and how effective they are in this function; the challenges and measures put in place to improve the system was also covered.

The key issues in this chapter are discussed according to the sub-headings of the questionnaire and questions asked during the interviews. In order to eliminate bias, collected data was not analyzed according to individual respondent but rather collective information on all sampled, to give a comprehensive understanding to the study. The results were then presented in pie charts and simple frequency tables.

As an overview, the chapter presents the results of data analysis as follows:

4.1 DATA PRESENTATION

4.1.1 Response Rate

As indicated in table 4.1, the sample size for the entire study was hundred and two (102). Eighty-five (85) out of the hundred (100) questionnaires administered were received representing eighty-five percent (85%) response rate. Also, only two (2) interviewee were contacted representing hundred percent (100%) response rate. In total fifteen (15) out of the one-hundred (100) samples sized (questionnaires), were missing.
However, this level of response was exceptional and the findings are believed to offer a clear indication of the fact that the main mode of transport in Ghana is by road, as rail transport has virtually collapsed, and air transport to other parts of the country apart from some few capital cities is non-existent.

Table 4.1 The Response Rate

<table>
<thead>
<tr>
<th>RESPONDENTS</th>
<th>NUMBER OF QUESTIONNAIRES ISSUED</th>
<th>NUMBER OF QUESTIONNAIRES RECEIVED</th>
<th>RATE OF RESPONDS IN PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehrad transport</td>
<td>10</td>
<td>10</td>
<td>100%</td>
</tr>
<tr>
<td>DHI</td>
<td>10</td>
<td>10</td>
<td>100%</td>
</tr>
<tr>
<td>Contracted/Individual transporters</td>
<td>30</td>
<td>26</td>
<td>86.6%</td>
</tr>
<tr>
<td>MESTI</td>
<td>7</td>
<td>5</td>
<td>71.4%</td>
</tr>
<tr>
<td>GPAH</td>
<td>7</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td>GNFS</td>
<td>7</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td>GRSC</td>
<td>7</td>
<td>5</td>
<td>71.4%</td>
</tr>
<tr>
<td>EPA</td>
<td>8</td>
<td>5</td>
<td>62.5%</td>
</tr>
<tr>
<td>MoT</td>
<td>7</td>
<td>5</td>
<td>71.4%</td>
</tr>
<tr>
<td>DVLA</td>
<td>7</td>
<td>5</td>
<td>71.4%</td>
</tr>
<tr>
<td>INTERVIEW: 1 Each EPA &amp; GNES</td>
<td>1 Each</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100+2</td>
<td>85+2</td>
<td>85%</td>
</tr>
</tbody>
</table>

4.1.2 Background Information Data

The objective of the gathering of data under this section was to get a background of respondents of the questionnaires. This is in appreciation of the fact that the choices the individual makes about concepts are in some way influenced by their level of exposure on the matter as well as the generation or age bracket, the departments and position in which they fall.

Public perception and opinion on every subject also largely depends on their background and knowledge on the subject matter. Especially in the Ghanaian society, in dealing with road issues and safety, great consideration is given to age, level of education, social life-style and driving experience.

It must however be noted that this section is of importance and explains the basis of the data on how safe and secure the haulage truck drivers transport dangerous goods on the Ghanaian roads and how knowledgeable they are about the goods they carry.

Table 4.2. Demographic Characteristics of Respondents:

Tables 4.2(a, b, c, d) shows the demographic characteristics of respondents by age group, highest educational certification and work experience.

Table 4.2a Age group of respondents (Truck Drivers only)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-25 years</td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>26-33 years</td>
<td>9</td>
<td>18%</td>
</tr>
<tr>
<td>34-41 years</td>
<td>21</td>
<td>42%</td>
</tr>
<tr>
<td>42-49 years</td>
<td>14</td>
<td>28%</td>
</tr>
<tr>
<td>50 years and above</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 4.2a shows the age distribution of truck drivers only. It can be inferred that 42% of the sample respondents were aged between 34-41 years, 28% between 42-49 years, 18% between 26-33 years, 8% between 18-25 years and the remaining 4% was in the age bracket of 50 and above.

This particular question was directed to the truck drivers only because aging tends to result in a reduction of strength, coordination, and flexibility, which can have a major impact on one’s ability to safely control a vehicle. For example:

- Pain or stiffness in the neck can make it harder to look over your shoulder to change lanes or look left and right at intersections to check for other traffic or pedestrians.
- Leg pain can make it difficult to move your foot from the “gas to the brake pedal”.
- Diminished arm strength can make it hard to turn the steering wheel quickly and effectively.

Also it enabled the researcher to establish a ground that people are not employed under/over age, and that the Licensing Authority issues driver’s license to the correct age group as specified by the Laws of Ghana in Road Traffic Act -2004(Act683) section 62.

On the issue of education, distribution of respondents (in table 4.2b) by educational background showed that 63.5% had completed high school education, 21.2% of respondents had attained basic level/primary education and 9.4% had attained tertiary education while the remaining 5.9% had other qualifications.

Apart from finding out whether the respondents of the study possessed the requisite academic background needed to appreciate the issues of the study, this question was also intended to identify the caliber of persons involved in the road transport of dangerous goods as their academic background is highly significant in their ability to appreciate the issue of the study.
This was also to find out whether the drivers possess at least basic school certificate which is in compliance with the New Drivers’ License Law (Road Traffic Amendment Act 2008 of 761) that came into force in the year 2008 and has since been implemented states that, “all possessors of driver’s license must be literate with at least the basic school certificate” to make for easier assimilation of traffic safety signs and regulations.

Table 4.2b Educational background of respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>18</td>
<td>21.2%</td>
</tr>
<tr>
<td>High School</td>
<td>54</td>
<td>63.5%</td>
</tr>
<tr>
<td>Tertiary</td>
<td>8</td>
<td>9.4%</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
<td>5.9%</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.2c Work Experience of respondents (drivers)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5 years</td>
<td>6</td>
<td>12%</td>
</tr>
<tr>
<td>6-10 years</td>
<td>10</td>
<td>20%</td>
</tr>
<tr>
<td>11-15 years</td>
<td>29</td>
<td>58%</td>
</tr>
<tr>
<td>Above 15</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 4.2d Work Experience of Respondents (Institutions)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5 years</td>
<td>3</td>
<td>8.6%</td>
</tr>
<tr>
<td>6-10 years</td>
<td>5</td>
<td>14.3%</td>
</tr>
<tr>
<td>11-15 years</td>
<td>18</td>
<td>51.4%</td>
</tr>
<tr>
<td>Above 15</td>
<td>9</td>
<td>25.7%</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.2c also indicated that, 58% of drivers have been driving between 11 to 15 years, followed by 20% between 6-15 years. 12% between 1 to 5 years and the remaining 10% are in the work experience range of 15 years and above.

On the part of the institutions (table 4.2d), the study revealed that the majority of the respondents (i.e. 51.4%) had worked in their current department/station between 11-15 years followed by 25.7% who had worked for more than 15 years. 14.3% fell between 6-10 years and the remaining 8.6% had worked between 1 to 5 years.

The respondents work experience especially on the part of the drivers suggested that more would be expected from them in terms of their approach to road safety precautions and practices in terms of dangerous goods carriage. But in general, it shows that respondents are not new entrants at their current field of work but are old workers on the job who had gathered enough practical experience. As most of the complaints and shortfalls from the hauliers are sometimes forwarded to the various stakeholder institutions to help solve when it comes to the transportation of dangerous goods by road.
Proper education should be carried out as currently there is no alternative for the carriage of dangerous goods within the country other than through road networks.

4.2 GENERAL KNOWLEDGE ON DANGEROUS GOODS.

This section of the questionnaire enabled the researcher to find out if respondents understood or had the basic technical know-how of what dangerous goods were in order to establish their level of appreciation on the issues to be discussed in the study. This is because the reliability and validity of the answers they may provide will to a large extent be based on their understanding and how conversant they are with the issues of dangerous goods carriage.

4.2.1 Carriage of Dangerous Goods

![Carriage Of Dangerous Goods](image)

Figure 4.1. Carriage of Dangerous goods

Figure 4.1 indicated that 49 respondents (truck drivers only) representing 98% of the respondents sampled, transport the dangerous goods by road. This can be due to the fact that, the only major means by which these dangerous goods can reach their final destinations is by road, due to the fact
that the other means of transportation (air, rail, sea) is not yet developed and easily accessible within the country.

4.2.2 Classes of Dangerous goods Transported or Handled

Under the classes of dangerous goods transported or handled, 78 out of 85 of the respondents answered this part of the question. The survey results indicated that the most transported class of dangerous goods is Class 3 which is Flammable liquids as can be seen from table 4.3 below. Class 8: Corrosive substances is the next most transported followed by Class 6: Toxic and infectious substances. Other classes are Class 9: Miscellaneous substances, Class 2: Gases, Class 4: Flammable solids, Class 5: Oxidizing substances and Organic peroxides.

It appeared that, Class 1: Explosives and Class 7: Radioactives recorded the least as its usage is not widespread in Ghana. Moreover, these goods (Explosives and Radioactives) possess a high level of security and environmental risk than the rest of the other dangerous goods and as such its usage is limited. For them not being used on regular basis in the country, special permits are required by the Ministry of Interior, Ghana Atomic Energy Commission and the Environmental Protection Agency before its importation.
Table 4.3 Classes of Dangerous goods Transported

<table>
<thead>
<tr>
<th>Class</th>
<th>Frequency</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 3 Flammable liquids</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Class 8 Corrosive substances</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Class 6: Toxic and infectious substances</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Class 9: Miscellaneous substances</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Class 2: Gases</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Class 4: flammable solids</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Class 5: Oxidizing substances and Organic peroxides:</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Class 1: Explosives</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Class 7: Radioactives</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

4.2.3 Dangers Associated with Carriage of Dangerous Goods

It is important to note that, before the stowage, segregation, marking, labeling, storing and transportation of these dangerous goods safely, those handling dangerous goods must know exactly what hazards these dangerous goods pose to the user (AS:AN, 2011).

From table 4.4 below, 25.6% of the respondents indicated injury as a danger associated with the types of dangerous goods they transported. This is followed by fire representing 21.8%. for spillage and contamination each indicated 11.5% with the next hazard being fatality representing 10.3%. Explosives and other dangers comparably each had 7.7% while 3.9% indicated radioactive.
One can infer from table 4.3 that, the most transported classes of dangerous goods is flammable liquid and the danger associated with transporting this cargo is fire/combustion. It can be seen from table 4.4 above that some of the drivers do know the risks associated with the class of dangerous goods they transport. Also, there was little/no carriage of class 7: which is radioactive, but the respondents indicated it as one of the hazards associated with goods they carry (i.e. inherent feature).

4.2.4 Identification of Symbols

This part of the question was to enable the researcher to find out from the respondents whether they were aware that different dangerous goods require different measures to ensure their safe transport as well as aiding in quick identification in the event of an emergency situation such as an
accident or an accidental release of these goods. On this, respondents were asked whether they have come across the under-listed symbols. All the hauliers indicated that they have come across at least one of the symbols in their transportation business.

![Identification of Symbols](image)

Figures 4.2 Identification of Symbols

On where the respondents normally see these symbols, they indicated on containers/drums, on vehicles and at terminals where dangerous goods are handled. On the importance of these symbols, 57 respondents representing majority (67%) of the dangerous goods transporters indicated that it was Dangerous Good (DG) hazard identification symbols.

14.1% of the respondents indicated as part of the Container Identification Symbols. 11.8% indicated as company identification symbols. The remaining 7.1% do not know the importance of these symbols. Lack and inadequate knowledge on the part of most haulage drivers who do not have any training in relation to dangerous goods and its proper handling makes it dangerous for them to be involved in transporting these dangerous goods since it puts the public and the environment as a whole at serious risk.
Table 4.5 Importance of Symbols

<table>
<thead>
<tr>
<th>Importance of these symbols</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG Hazard identification symbols</td>
<td>57</td>
<td>67%</td>
</tr>
<tr>
<td>Company identification symbols</td>
<td>10</td>
<td>11.8%</td>
</tr>
<tr>
<td>Part of Container Identification Symbols</td>
<td>12</td>
<td>14.1%</td>
</tr>
<tr>
<td>Symbols</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No idea</td>
<td>6</td>
<td>7.1%</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>100%</td>
</tr>
</tbody>
</table>

4.2.5 Dangerous goods classification

Table 4.6 How many classes of Dangerous Goods (truck drivers only)

<table>
<thead>
<tr>
<th>Number of classes</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>9</td>
<td>41</td>
<td>82%</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

This part of the question was again given to the truck drivers only to find out whether they possess the awareness and ability to safely transport dangerous goods on road. Table 4.6 above indicated that majority of the respondents know the nine classes of dangerous goods. 18% of the respondents do not know the classification of dangerous goods which should be a major cause of concern for
both the individual and the various institutions as to how to educate the majority of the truck drivers who do not have any knowledge in dangerous goods.

When this data was compared with the respondents’ Socio-Demographic data, it came to light that all the respondents from the Vehrad transport and Dili Supply Chain were able to indicate the nine classes of the dangerous goods. The nine (9) respondents who were not able to indicate the nine classes of dangerous goods were the individual/contracted haulier truck drivers. This indicates that the companies that transport dangerous goods by road are educating their truck drivers well.

4.2.6 Licensing dangerous goods hauliers

The study tried to find out from respondents whether they possess dangerous goods driver’s license apart from the normal drivers’ license. All the respondents selected answered ‘no’ to this particular question due to the fact that there is no dedicated legislation on carriage of dangerous goods by road in Ghana which would highlight some of the pertinent issues such as driver licensing. But in the ADR, one of the international regulations states that "A license is required when transporting any receptacle with a capacity of more than 500 litres or which contains more than 500 kilograms of dangerous goods. The vehicle must be covered by a dangerous goods vehicle license and the driver must hold a dangerous goods driver license" (ADR, 2014).

4.2.7 Institution Licensing Dangerous goods hauliers

The respondents indicated the following as the institutions responsible for certifying/licensing the dangerous goods hauliers.

- Fire and safety department (GPHA)
- Environmental Protection Agency (EPA)
4.2.8 Education

The research wanted to find out if the certified institutions/individual law enforcement agencies were actually educating the hauliers on the transportation of dangerous goods or not. The table 4.7 below depicts how the various institutions/agencies responsible for training are assessed by the hauliers.

4.2.8.1 Education by various institutions/agencies (drivers only)

Table 4.7 Education by various institutions/agencies

<table>
<thead>
<tr>
<th>Institution/agencies</th>
<th>Poor</th>
<th>Average</th>
<th>well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Protection Agency (EPA)</td>
<td>11</td>
<td>26</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Ministry of Environment, Science, Technology and Innovation (MESTI)</td>
<td>30</td>
<td>18</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Ghana Ports and Harbours Authority (GPHA)</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Ministry of Transportation (MoT)</td>
<td>24</td>
<td>21</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Ghana National Fire Service (GNFS)</td>
<td>1</td>
<td>4</td>
<td>31</td>
<td>14</td>
</tr>
<tr>
<td>Ghana Road and Safety Commission (GRSC)</td>
<td>32</td>
<td>14</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

From table 4.7 above, it can be deduced that, both the GNFS and GPHA are doing well in educating the transporters in the handling of dangerous goods. EPA’s training is rated as average in education by hauliers. MESTI, GRSC and MoT are rated poorly in educating transporters.
4.2.8.2 Types of Education for Hauliers

On the type of education/training truck drivers go through before handling dangerous goods. According to the Vehrad Transport, they have a training school on their premises with an instructor who trains the hauliers.

The other hauliers indicated that they do not go through any dangerous goods training before transporting the dangerous goods making them perilous on the road and to other road users.

4.2.8.3 Educational Programme by Institutions/Agencies

The various institutions/agencies listed the following as part of their role in educational programmes for training of the dangerous goods hauliers. The GPHA has the fire and safety department which is in charge of handling and supervising of hauliers in the port. They periodically educate the hauliers on dangerous goods. EPA’s branch at the Tema Port advices importers and handlers in the transportation of dangerous goods. They also train hauliers with regards to what type of trucks to use when transporting liquefied dangerous goods.
4.2.9 Visual or basic checks on trucks before handling or transporting dangerous goods

The figure 4.4 indicated that dangerous goods hauliers do not frequently check their trucks before embarking on any voyage. 63.27% of the respondents representing the majority of the transporters sometimes check their trucks. This is followed by Never representing 16.33%. The respondents that responded No represents 14.29% and 6.12% responded Yes.

4.2.10 Personal Protective Equipment Carried

The truck drivers were asked to select the types of the Personal Protective Equipment (PPE) they carried when transporting the dangerous goods. This was necessary for the researcher to find out whether the truck drivers have been protecting themselves against health and safety risk during dangerous goods transport.

They indicated the following as the PPE they carry; Helmet, chemical suit and boots, gloves, goggles. There were some drives who indicated that they do not carry any of the PPEs. On the
stand-by equipment they carry on board, they indicated, First Aid Kits, two self-Standing warning sign and fire extinguishers, cleaning gears, and Instruction/ Trem card.

4.2.11 Dangerous goods incidents

The study wanted to find out whether the hauliers have had any dangerous goods incident/accident in their transportation business. Majority of the respondents (83.67%) have had an incident in the transportation of dangerous goods. 16.33% have not had any incidents with regards to the transportation of dangerous goods as indicated in figure 4.5.

![Dangerous goods incidents](image)

Figure 4.5 Dangerous goods incidents
4.2.12 Notification of the Appropriate Authority

Table 4.8. Notifying the appropriate authority (drivers only)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>18</td>
<td>36%</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>48%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>8</td>
<td>16%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

One of the requirements of the IMDG Code and ADR is to notify the appropriate authority of an immediate risk or accident to public safety. The study revealed that 24 respondents representing 48% do not notify the appropriate authority in the event of an accident whilst 36% said yes. 16% said they sometimes do notify the appropriate authority in table 4.8.

From the agencies/institutions considered for the study, most of them indicated that incidents or problems such as human errors due to wrong documentation details, poor road conditions, environmental factors (poor weather conditions), how to manage an accident (spillage, rolling over of vehicle, vehicle collision etc.) as well as the inherent nature of the dangerous goods when not handled properly, leads to various accidents during the transportation of dangerous goods are most often reported to their outfit. They further stated that, most of these problems and accidents such as vehicle collision, spillage etc. can be curbed if:

- The drivers are given proper education about the carriage of dangerous goods;
- Carry out routine preventive maintenance on their vehicles as well as they should be vigilant and cautious on the roads due to the type of goods they carry (dangerous goods):
The driver and crew members should have a limitation in relation to driving hours. This should be limited and monitored to avoid stress on the driver and crew.

Most of the drivers do not know the chemical composition of the goods to enable them know the kind of environment they are exposed to and how to handle them in case of accidents.

4.2.13 How can these problems be solved?

The institutions indicated the following:

- Importers, agents and transporters need to be educated on how to handle such goods.
- Drivers need to be trained.
- The state should appoint and ensure Dangerous Goods Safety Adviser (DGSA) is present during loading, transportation and offloading of dangerous goods at all times.

4.2.14 Awareness of Dangerous Goods Regulations

From table 4.9 below, 68 out of 85 respondents representing about 80% affirmed their awareness to national and international regulations concerning transport of dangerous goods.

<table>
<thead>
<tr>
<th>Awareness of regulations</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>68</td>
<td>80%</td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>20%</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>100%</td>
</tr>
</tbody>
</table>
### Table 4.10 Regulation Mentioned

<table>
<thead>
<tr>
<th>International</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IMDG code</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>ADR</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nationals</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GP1A Act - 1986 (PNDCI, 160)</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>EPA Act 1994 (Act 490)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Road Traffic Act - 2004 (Act 683)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Ghana Shipping Act -2003 (Act 645)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

All the 68 of them as shown in table 4.10 indicated IMDG CODE, as a reference guide when handling and transporting dangerous goods with only 8 among them adding ADR but no one indicated IATA (Air) and RID (railway). On the national regulations, only 18 respondents mentioned GP1A Act-1986 (PNDCI, 160), 10 mentioned EPA Act 1994 (Act 490), 8 respondents mentioned Road Traffic Act - 2004 (Act 683), and only 1 mentioned Ghana Shipping Act - 2003 (Act 645).

#### 4.2.15 The extent of truck drivers’ understanding of national/international regulations

As one of the objectives of the study is to find out the extent of truck drivers understanding of both local and international regulations in relations to the handling and transportation of dangerous goods by road. This was to enable the researcher find out if the truck drivers are aware of any reference guide, restrictions of hazardous substances and the set standards for transport of dangerous goods. With this, 33 out of the 50 truck drivers selected ‘Not at all’, 14 selected
‘average’ while only 3 selected ‘very good knowledge and understanding’ of national/international regulations on dangerous goods.

Table 4.11 indicated the company truck drivers are doing well in their safety awareness on dangerous goods transport which can be attributed to the training institutions they have in their premises.

Table 4.11 Hauliers understanding of national/international regulations

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Not at all</th>
<th>Average</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehrad Transport</td>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>DHL supply chain</td>
<td>7</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Individual hauliers</td>
<td>25</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>14</td>
<td>3</td>
</tr>
</tbody>
</table>

4.2.16 Compliance with International or national regulations at Port of Tema

Table 4.12 Compliance with local/international regulations at the Port of Tema

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>48</td>
<td>98%</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

From table 4.12, it can be seen that the Port of Tema, where most of the dangerous goods imported are handled actually follow both local and international regulation with respect to handling of dangerous goods.
In conclusion, having a well-structured Dangerous Goods Act and Regulations which sets out standards for those moving the goods and protecting the public as a whole when it comes to shipments of dangerous goods will go a long way to preserve, protect and save all parties involved in dangerous goods carriage from capital loss and accidents. The regulations normally require the training of those who handle or transport dangerous goods and employers must ensure that employees receive the appropriate training for their assigned work schedules in relation to dangerous goods carriage on our roads.

4.2.17 Recommendation to improve the transportation of dangerous goods in Ghana by the Respondents

Respondents were also provided spaces to write their comments on what they think should be done in order to improve on the road transport of dangerous goods in Ghana. Some of the key responses were:

- More awareness creation on carriage of dangerous goods;
- Shippers should declare their dangerous goods before the goods arrive in the port for authorities to be aware as to how to handle them;
- Drivers, stevedores and longshoremen should be educated on the haulage of dangerous goods. The entire public should also be enlightened on the handling of dangerous goods;
- The hauliers should have on them the right personal protective equipment before transporting such goods;
- The general public should be educated on the various dangerous goods symbols for them to be aware of them to avoid unforeseen circumstances.
4.3 INTERVIEWS

This sub-chapter discusses the various interviews conducted by the researcher at GNFS and EPA branches in Tema Port. From the interview conducted, the researcher found out that they were aware of the existence of dangerous goods and its transportation in the country but were not fully aware of its dangers and the procedures that one was to go through to transport the dangerous goods.

From interacting with the hauliers, most of them knew that the goods they sometimes carry are dangerous such as the rigwash and containers with hazardous signs but they further stated they are not aware of its inherent danger and the necessary precautions that they should adhere to. Also, some of the truck drivers said they are sometimes given tutorials about the dangerous goods they carry if it is a whole consignment for a big company and this is done purely for them to conform to how the goods should be delivered.

To add to this, they further emphasized that they need proper training and certification to enable them know what they are dealing with that is in the case of dangerous goods carriage and also how to properly handle the goods in case of unforeseen circumstances such as spillage.

From the various stakeholder organizations, their main challenge was how to implement the various rules and regulations covering the road transport of dangerous goods. Aside that, they said and insisted that they do sensitize drivers when it comes to dangerous goods carriage by giving them training on how to prevent damage and accidents when handling, storing and transporting these goods.
To add to this, they try to help structure a proper roadmapping system to cart these dangerous goods without it coming into too much contact with persons and the environment and should there be an accident, they are recommending that, there should be emergency response plans to help prevent or minimize the risk and damage caused.
CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter focuses on summarizing the major findings gathered from the various questionnaires as well as the interview organized and the general conclusions of the research. This chapter also consists of the several recommendations made by the researcher in relation to the objectives of this write-up.

5.2 SUMMARY

The primary goal of this research was to assess the consequences of improper transport of dangerous goods and the technical know-how of the Ghanaian transporters in transporting dangerous goods by road; finding out the types of dangerous goods that are being handled by these transporters: the transporters awareness on international and national regulations in relations to road transport of dangerous goods: and identify the challenges faced by these transporters and measures taken by the authorities involved to ensure the safe transport of these goods by road.

It was also conducted to verify whether the various stakeholder agencies and other institutions involved in the education of truck drivers are adhering to international and national laid down standards regarding the road transport of dangerous goods and further give recommendations pertaining to the proper and safe handling, carriage and transportation of dangerous goods on our roads. To accomplish this goal, the study reviewed relevant secondary data gathered from the internet, journals and publications on the subject of the study.

After analyzing the views of the Eighty-five (85) respondents in addition to the literature review in chapter two, data proves that, Ghana as a country is a signatory to UN recommendation on
transport of dangerous goods and has national bi-laws for the proper and safe transport of
dangerous goods in general though not to a full extent with road transportation.

Although the road transport of dangerous goods require a level of literacy by the Ghanaian
transporter, the authorities involved and the government have done little in the area of awareness
creation. Educational campaign on dangerous goods has not been forth-coming from the training
institutions (like MoT, GRSC, EPA) leaving the haulage truck drivers to find out for themselves
or develop an entire dislike for it in their ignorance. This is one, if not the major setback facing the
road transport of dangerous goods in Ghana.

Again, the study noted that those haulage truck drivers (mostly individual truck owners) who are
usually contracted to transport dangerous goods have little or no dangerous goods training and
awareness as compared to recognized company drivers that transport dangerous goods only.

It was realized that, the Port of Tema authorities have taken some measures to ensure the safe
transport and handling of dangerous goods at the Port of Tema and to an extent are adhering to
international standards regarding the handling, storage and delivery of dangerous goods to its
clients in and around the port community.

The study also realized that, for risks and incidents such as spillage, leakage or other escape of
company products: or wastes being transported from a factory or depot to the primary customer or
disposal site; as well as any incident involving raw materials, processed chemicals or catalysts
being transported from one point at which the company takes ownership of them and their arrival
at the factory site, about 47% of the transporters do not have any knowledge on how to notify an
appropriate authority in case of any incident.
5.2.1 Results of the interview

i. People interviewed were aware of the existence of dangerous goods and its transportation in the country but were not aware of its dangers and the procedures that one has to go through to transport the dangerous goods.

ii. The hauliers indicated that they sometimes carry dangerous such as the rigwash and containers with hazardous signs but technically are not aware of its inherent danger and the necessary precautions that they should adhere to.

iii. Company’s Dangerous goods truck drivers were sometimes given tutorials about the dangerous goods they carry.

iv. Implementation of the various rules and regulations covering the road transport of dangerous goods is the main challenge for the various institutions/agencies.

5.3 CONCLUSION

Dangerous goods are indispensable in many economic activities such as oil exploration and gold extraction, as well as vital activities of our everyday life such as the use of insecticides to reduce pest infestation. They provide industries with a wide range of benefits, particularly increased agricultural and industrial productivity.

However, dangerous goods have the potential to cause considerable health and environmental problems from production through transportation to the final user of the commodity. Misuse or failure to follow best practices and laid down procedures can lead to serious accidents or even death in extreme situations. For instance, between 2008 and 2013, 127 chemical related accidents were reported in Ghana, not forgetting the Cyanide incident which involved 5 trucks and 2 escort cars from Tema to Djibo which occurred on July 29, 2011 (ghanasafety.com/mse retrieved June
2015). It is most important to note that, all stakeholders in the supply chain for the transportation of dangerous goods by road, understand and implement the international and national laid down rules and regulations of responsible care in their daily operations.

When one tries to measure safety costs as against accident costs, haulage companies and institutions that have embraced the principles of a proactive safety culture in road transport of dangerous goods through training have recognized that improved safety has brought about improved productivity, which in turn has led to a safer environment and a greater profitability.

In order for the road transporters (haulage drivers) of dangerous goods to function effectively, the state must have a well-defined, systematic and consistent training for all truck drivers on transportation of dangerous goods by road. This is in view of the fact that from the study, it was noted that majority of the respondents knew about the IMDG CODE but were not familiar with ADR and the Ghana Road Traffic Act-2004 (ACT683).

Therefore, legislations and all law enforcement agencies who have the mandate to formulate and implement laws and regulations concerning the transportation of dangerous goods by road, must enforce the international and national regulations and draw up a sensitization programme for the general public on the common dos and don't's when it comes to hazardous cargoes and/or dangerous goods.
5.4 RECOMMENDATIONS

From the information gathered during the study, the following recommendations are proposed to help the Ghanaian road transporters of dangerous goods in moving dangerous goods from one place to the other safely, efficiently and effectively on the roads without endangering the public, causing damage to the cargo and providing a safe environment for the transportation.

1. Documentation

Documentation is an essential aspect when it comes to the transportation of dangerous goods. All transporters carrying dangerous goods especially on the road must ensure the following are in place to enable rescue team come to their aid in the case of any incident during transportation:

- The instructions in writing: A copy of the instructions in writing must be supplied by the carrier to the vehicle crew in a language understood by the driver and crew. This document is commonly referred to as the TRIMS card (Transport Emergency card), and must be kept readily available in the cab of the vehicle. These instructions set out emergency actions to be performed by the driver/crew, the dangerous goods hazard characteristics, additional guidance and a list of the general and personal equipment to be carried on a vehicle. Before the start of the journey, the members of the vehicle crew must inform themselves of the dangerous goods loaded and consult the instructions in writing for details on actions to be taken in the event of an emergency.

- Means of identification, which includes a photograph, for each member of the vehicle crew:

- The driver's training certificate
2. Training And Emergency Actions

The most important aspect of any procedure is the training provided. whether it would be dealing with a spill during loading or unloading or a vehicle rolling over spilling the load (dangerous cargo/hazardous cargo) across a busy carriageway.

It is important that all persons involved in the carriage of dangerous goods receive training in line with their roles and responsibilities (ADR - 2011 chapter 8.2). Drivers who have undergone such formal training in the carriage of dangerous goods should be given supporting documents. The State must ensure that all employers have a responsibility to carry out a risk assessment and put in place procedures to minimize and control hazards especially from haulage drivers who have been contracted to transport these goods. This should be supported by written procedures, information, supervision and training by the Ghana Road Safety Commission (GRSC).

Businesses that consign, transport and/or carry dangerous goods must have procedures as appropriate to deal with, amongst others the following: chemical spills, fire/explosions, personal and/or environmental contamination, road traffic incidents involving dangerous goods, security incidents/loss of dangerous goods etc. in order to eliminate the remains of dangerous cargos on road after accidents. The DVLA must have a joint program together with other institutions mandated to license all the dangerous goods hauliers so that they can start issuing separate license for all dangerous goods drivers.

3. Law Enforcement

In Ghana, enforcement of the legislations governing the carriage of dangerous goods by road is primarily undertaken by the EPA, GPHA and Ghana Police Motor and Transport Unit (MTU).
except for Class 1 and Class 7 materials, which are controlled by the Ministry of Interior and the Ghana Atomic Energy Commission (GAEC).

Compliance with the legislation is monitored and enforced by inspection. Inspections are carried out on vehicles at the roadside and at the premises of businesses involved in carriage, loading, packing, filling and unloading of dangerous goods.

Hence the Ghana government must set out combined dangerous goods regime that will comprise all the above mentioned institutions to undertake serious roadside vehicle inspections at vantage points on the Ghana road networks and must also come out with possible offences and penalties for those who fail to comply with the laid down rules and regulation.

Secondly, it was noted by personal observation of the researcher that a greater quantity of dangerous goods are transported by road in Ghana so there must be a separate road safety act or guidelines outlining national and international regulations and standards with duties of the operators, drivers, consignors, consignees and approved authorities for classification and certification of dangerous goods to ensure a unique and systematic transport of dangerous goods on road.

Last but not the least, it will be extremely difficult to implement road safety with regards to dangerous goods transport especially when majority of the drivers are ignorant about the kind of dangers these goods poses on the road. Therefore, the researcher recommends that all regulations on road transport of dangerous goods be placed under one authority to facilitate compliance of checking since scattered responsibilities amongst various institutions creates fertile ground for non-compliance as no institution feels responsible.
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APPENDIX I
RESEARCH QUESTIONNAIRE LAW ENFORCEMENT AGENCIES

RESEARCH TOPIC: TRANSPORTATION OF DANGEROUS GOODS BY ROAD, A CASE STUDY OF GHANAIAN TRANSPORTERS

Dear Sir/Madam,

I am a student of the Regional Maritime University conducting a research on the above mentioned topic. This research is in partial fulfilment of requirements for the award of a Master of Arts degree.

Your willingness to complete this questionnaire will be much appreciated. This research is purely for academic purposes and your response will be treated with utmost confidence.

Questionnaire for Ghana Road and Safety Commission (GRSC), Ministry of Environment, Science, Technology and Innovation (MESTI), Environmental Protection Agency (EPA), Ghana Ports and Harbours Authority (GPHA), Ministry of Transport (MoT), Ghana National Fire Service (GNFS), Driver and Vehicle Licensing Authority (DVLA), Regional Maritime University (RMU).

SECTION I (Bio Data of Respondents)

1. Age
   (a) 18-25 | | (b) 26-40 | | (c) 41-60 | | (d) above 60 | |

2. What is your highest educational qualification?
   a) Primary | | b) High school | | c) Diploma/ Tertiary | |
   b) d) Other(s) (specify)......................

3. Name of organization you work with?
   ...........................................................................................................................................
   ...........................................................................................................................................

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SECTION II (GENERAL KNOWLEDGE ON DANGEROUS GOODS)

4. What is the role of your organization in training hauliers?

5 i. Have incidents or problems in the transportation of dangerous goods been reported to your outfit?
   a) Yes    b) No

5 ii. If yes what are some of the problems hauliers encounter with regards to transportation of dangerous goods?

6. Are these problems as a result of the poor driving skills, knowledge of drivers or the inherent properties of goods?

7. How can these problems be solved?

8. i. Does your organization have educational programmes on transportation of dangerous goods for the hauliers?
   a) Yes    b) No
   ii. If yes, list these educational programmes

9. Which institution or agency is in charge of training of Dangerous goods hauliers in Ghana?
   (State)
10. Which institution actually certifies or licenses the dangerous goods transporters in Ghana?

(State)

11. i). Do you know of any regulations (local/international) governing the transportation of dangerous goods?
   a) Yes | | b) No | |
   ii). If yes, list the ones you know.

12. Which of these regulations are in force in Ghana?

13. How will you rate the understanding of dangerous goods regulations by the hauliers?
   (a) Poor | | (b) Average | | (c) Good | | (d) Very Good | |
   Give reason(s) for your answer

14. What are the measures that needs to be put in place to improve the transportation of dangerous goods in Ghana?
APPENDIX II

RESEARCH QUESTIONNAIRE TRUCK DRIVERS

RESEARCH TOPIC: TRANSPORTATION OF DANGEROUS GOODS BY ROAD, A
CASE STUDY OF GHANAIAN TRANSPORTERS

Dear Sir/Madam,

I am a student of the Regional Maritime University conducting a research on the above mentioned topic. This research is in partial fulfilment of requirements for the award of a Master of Arts degree. Your willingness to complete this questionnaire will be much appreciated. This research is purely for academic purposes and your response will be treated with utmost confidence.

SECTION I (Bio Data of Respondents)

3. Age
   (a) 18-25  |  (b) 26-40  |  (c) 41-60  |  (d) above 60

4. Nationality

5. What is your highest educational qualification?
   (a) Primary  |  (b) High school  |  (c) Diploma/ Tertiary  |  (d) Other(s)
   (specify)

6. How long have you been driving?
   (a) 1-5  |  (b) 6-10  |  (c) 11-15  |  (d) above 15

SECTION II (GENERAL KNOWLEDGE ON DANGEROUS GOODS)

5i. Do you carry any dangerous goods?
   (a) Yes  |  (b) No

   ii. Select the types of dangerous goods you normally carry (|tick)
   Explosives  |  Gases  |  Flammable liquids  |  Flammable solids
Oxidizing substances and Organic peroxides [ ] Toxic and infectious substances [ ]
Radioactive [ ] Corrosives substances [ ] Other(s) specify……………………………………

iii. If yes, what kinds of dangers associated with the class of dangerous goods handled in 5 (ii), above? (Tick)
Fire [ ] Explosive [ ] Spillage [ ] Injury [ ] Fatality [ ] Contamination [ ] Marine life degradation [ ] Radioactive [ ] Other(s) specify……………………………………

6. Have you come across these symbols or similar types anywhere before?

![Symbols Image]

a) Yes [ ] b) No [ ] c) Never [ ]

7. Where exactly?

a) On containers/ drums [ ] b) On vehicles/ trucks/ road tanks [ ] c) On shops [ ]

d) On the road [ ] e) Other(s), (specify) ………………………………………

8. What are these symbols for?

a) DG Hazard identification symbols [ ] b) Company identification symbols [ ]

c) Part of Identification Container Symbols [ ]

9. How many classes of dangerous Goods do we have?

a) 3 [ ] b) 6 [ ] c) 9 [ ] d) 12 [ ]

10. What common Classes of DG’s do you normally come across in your work?

........................................................................................................................................
........................................................................................................................................

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11. Are you licensed to transport dangerous goods?
   a) Yes | | b) No | |

12. If yes, which institution licensed you? (State)


13. What type of education/training did you go through before handling dangerous goods? (State)


14. Who or which institution(s) provides this type of education? (List them)


15. How well do you think the various institutions/agencies are educating the dangerous goods hauliers?

<table>
<thead>
<tr>
<th>Environmental Protection Agency (EPA)</th>
<th>Poorly</th>
<th>Average</th>
<th>Well</th>
<th>Very Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Environment, Science, Technology and Innovation (Mi:STI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghana Ports and Harbours Authority (GPHA)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Ministry of Transportation (MoT)</td>
<td></td>
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<td></td>
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<tr>
<td>Ghana National Fire Service (GNFS)</td>
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</tr>
<tr>
<td>Ghana Road and Safety Commission (GRSC)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

16. Do you usually carry out visual or basic checks before handling or transporting DG?
   a) Yes | | b) No | | c) Never | | d) Sometimes | |

17. Which of the following Personal Protective Equipment do you use when handling, inspecting or transporting DG? (Tick one or more)
a) Helmet    b) Chemical suit & Boot    c) Gloves    d) Goggles

e) all of the above (a-d)    f) None

18. Which of these do you keep on stand by (or in truck) when inspecting or transporting DG cargoes?

a) First Aid Kits    b) Two self-Standing warning sign    c) Fire extinguisher

d) Cleaning gears    e) Instruction/Trem card    f) None of the above

19. Do you notify the appropriate authority of an immediate risk or accident to public safety?

a) Yes    b) No    c) Sometimes    d) None of the above

20. Are you aware of any international / National regulations with regards to the transport of dangerous goods?

a) Yes    b) No

21. To what extent do you understand these regulations?

  (a) Not at all    (b) Well    (c) Very Well

22i. Have you ever experience any incident/accident in transporting dangerous goods.

  a) Yes    b) No

 ii). If yes, how did you handle this situation?

............................................................................................................................
............................................................................................................................

23. Do you think the Port Authority follows the international or national regulations when handling dangerous goods at the Port of Tema?

a. Yes    b) No

24. What are the additional measures that need to be put in place to improve the transportation of dangerous goods in Ghana?

............................................................................................................................
............................................................................................................................