

**AN ASSESSMENT OF RISKS ASSOCIATED WITH THE USE OF SECOND HAND
TYRES ON LIGHT VEHICLES IN ZAMBIA**

By

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A dissertation submitted to the University of Zambia as partial fulfilment of the requirements
for the degree of Master of Engineering in Project Management

The University of Zambia
School of Engineering
Lusaka

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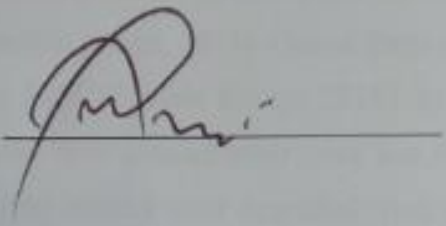



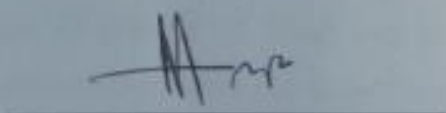
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Abstract

AN ASSESSMENT OF RISKS ASSOCIATED WITH THE USE OF SECOND HAND TYRES ON LIGHT VEHICLES IN ZAMBIA

Bridget Kamanga

Among the various risks on the road, driving second hand tyres is a contributor to accidents. Roadway is a dominant mode of transportation in Zambia and records the highest number of deaths and injuries caused by accidents in the country. An analysis of the traffic accidents recorded over a period of four years between 2011 and 2014 were approximately 112,327 (Zambia police, 2015). Out of these recorded, 275 were reported with a tyre problem in 2015 (Zambia Police, 2015). In Zambia, the business of selling second hand vehicles with second hand tyres has increased. This research evaluated the effects of driving second hand degraded tyres and their contribution to accidents in Lusaka, Zambia. It further suggests preventive measures. The main objective of this research was to identify the risks associated with the use of second hand tyres on light vehicles in Lusaka. A triangulation method involving the use of secondary data, interview and the use of a questionnaire was used to collect data.

A questionnaire was distributed randomly to 80 users involving road users, mini bus drivers and tyre menders within Lusaka of which 45 respondents provided feedback. Structured interviews were conducted with car dealers, second hand tyre dealers, participants from Zambia Bureau of Standards, Police Traffic officers, and Road Transport and Safety Authority. Further, accident statistics from Zambia Police were used to analyse recorded accidents that occurred in the period of 2006-2015 within Lusaka province.

Overall results revealed that users and second hand tyre dealers are ignorant of minimum tyre quality expectation. About 72 percent of Road user respondents revealed that the minimum tyre marking and numbers were not understood. Over 75 percent of the vehicle owners did not know that tyres have expiry dates on them. A total of 57.1 percent of the respondents were not conversant with either summer or

winter tyres. The results also revealed that over 80 percent of the respondents felt that the tyres were not fit for Zambian weather. ZABS revealed that they did not have standards on second hand tyres. All respondents dealing in new and second hand tyres revealed that they have never been inspected by ZABS since they started trading. Of the tyre dealers and respondents from the menders, only one vendor expressed knowledge of a disposal area for defective tyres. A total of 64.3 percent of road users did not know the dangers of driving second hand tyres whilst 78.6 percent did not know about the 1.6mm deep from the legal limit determined by the manufacturers.

These findings suggest the need for authorities to improve safety of all road users by ensuring that imported second hand tyres meet the manufacturer's minimum recommendation. Regular checks and inspection of tyre dealers should be improved by the responsible authorities such as RTSA, traffic police and ZABS. They should also be able to sensitize all road users.

Keywords: Tyre, car crash, accidents, pressure, wear, tread, prevention.

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List of acronyms

| | |
|-------|--------------------------------------|
| CANK | Campaign against the New Kiln |
| CIF | Cost, Insurance and Freight |
| CSO | Central Statistics Office |
| DOM | Date of Manufacture |
| GRZ | Government of the Republic of Zambia |
| JEVIC | Japan Vehicle Inspection Centre |
| MVC's | Motor Vehicle Crashes |
| NMVs | Non-Motorized Vehicles |
| RTAs | Road Traffic Accidents |
| RTSA | Road Transport and Safety Agency |
| USD | United States Dollars |
| VAT | Value Added tax |
| WECF | Women in Europe for a Common Future |
| WHO | World Health Organisation |
| ZABs | Zambia Bureau of Standards |
| ZMW | Zambian Kwacha |
| ZP | Zambia Police |
| ZRA | Zambia Revenue Authority |

1.0 CHAPTER ONE

Introduction

1.1 Background

Road traffic accidents have been identified among the leading cause of death and disability in the world. The World Health Organization (WHO) described traffic accidents as ‘hidden epidemics’ with a forecast to be the 5th leading cause of death worldwide and the 2nd leading cause of disability in many developing countries by 2030 (Murray & Lopez, 1996). According to a report done by WHO, an estimated average of 3,242 people die daily from road accidents (World Health Organisation, 2004). Official statistics from police reports suggest that in 2005 alone, 41 600 people were killed and over 1.5 million were injured in road traffic crashes in the European Union member countries (European Transport Safety Council, 2007). In China in the year 2006 alone, there were 89 455 road traffic deaths and 431,139 non-fatal injuries. The year 2006 saw Chile losing 2,280 people to traffic crashes and as many as 50,010 injuries were reported for 2007 (World Health Organisation, 2004). Figure 1-1 describes the causes of death according to the projected figures by WHO by comparing the years between 2004 and 2030.

| TOTAL 2004 | | | TOTAL 2030 | | |
|------------|---------------------------------------|------|------------|---------------------------------------|------|
| RANK | LEADING CAUSE | % | RANK | LEADING CAUSE | % |
| 1 | Ischaemic heart disease | 12.2 | 1 | Ischaemic heart disease | 12.2 |
| 2 | Cerebrovascular disease | 9.7 | 2 | Cerebrovascular disease | 9.7 |
| 3 | Lower respiratory infections | 7.0 | 3 | Chronic obstructive pulmonary disease | 7.0 |
| 4 | Chronic obstructive pulmonary disease | 5.1 | 4 | Lower respiratory infections | 5.1 |
| 5 | Diarrhoeal diseases | 3.6 | 5 | Road traffic injuries | 3.6 |
| 6 | HIV/AIDS | 3.5 | 6 | Trachea, bronchus, lung cancers | 3.5 |
| 7 | Tuberculosis | 2.5 | 7 | Diabetes mellitus | 2.5 |
| 8 | Trachea, bronchus, lung cancers | 2.3 | 8 | Hypertensive heart disease | 2.3 |
| 9 | Road traffic injuries | 2.2 | 9 | Stomach cancer | 2.2 |
| 10 | Prematurity and low birth weight | 2.0 | 10 | HN/AIDS | 2.0 |
| 11 | Neonatal infections and other | 1.9 | 11 | Nephritis and nephrosis | 1.9 |
| 12 | Diabetes mellitus | 1.9 | 12 | Self-inflicted injuries | 1.9 |
| 13 | Malaria | 1.7 | 13 | Liver cancer | 1.7 |
| 14 | Hypertensive heart disease | 1.7 | 14 | Colon and rectum cancer | 1.7 |
| 15 | Birth asphyxia and birth trauma | 1.5 | 15 | Oesophagus cancer | 1.5 |
| 16 | Self-inflicted injuries | 1.4 | 16 | Violence | 1.4 |
| 17 | Stomach cancer | 1.4 | 17 | Alzheimer and other dementias | 1.4 |
| 18 | Cirrhosis of the liver | 1.3 | 18 | Cirrhosis of the liver | 1.3 |
| 19 | Nephritis and nephrosis | 1.3 | 19 | Breast cancer | 1.3 |
| 20 | Colon and rectum cancers | 1.1 | 20 | Tuberculosis | 1.1 |

Figure 1-1: Study of Road traffic accidents between year 2004 and 2030

Source: (World Health Statistics, 2008)

The International Federation of Red Cross and Red Crescent observed that the road traffic burden is “a worsening global disaster destroying lives and livelihoods, hampering development and leaving millions in greater vulnerability” (Cater & Walker, 1998). In the African region, ten out of over 50 countries account for roughly 70 percent of all road traffic deaths (World Health Organisation, 2009). These include Nigeria, Ghana, Tanzania, Kenya, Uganda, South Africa, Republic of Congo, Madagascar, Ethiopia, and Mozambique (World Health Organisation, 2009). Consequently, the WHO declared the period between 2011 and 2020 as a ‘*Decade of Action for Road Safety*’. (World Health Organisation, 2009). For instance, several authors have conducted studies on accidents and their causes.

Vogel and Bester (2003) conducted a study on a road commonly known as R44 in the Western Cape of South Africa to establish a relationship between accident types and causes. On this road, an average of 404 accident reports were analysed from the three risk factors which were highlighted. These were identified as human, vehicle and environmental factors and the first factor was weighted to be the highest at 75.4 percent followed by environmental factors at 14.5 percent and finally vehicle factors at 10.2 percent. (Vogel & Bester, 2003). Under vehicle factors, this comprised of mostly faulty brakes and tyres.

Tyres are made to improve grip on the surface of the road in order to ensure safety. When a tyre is either under-inflated or over-inflated it is likely to reduce a passenger’s safety by affecting the vehicle’s ability to move properly. Since tyres are made of rubber, disposing of them is not very easy. It may have harmful implications which could either affect the environment or cause harm to human health.

Research worldwide indicates that tyre burning has a serious harmful effect on community health and environment. According to Women in Europe for a Common Future; WECF (2016), Pollutants from burnt plastic material could be transported through air and pollute the land or water bodies. The impact on the environment varies from physical modification to heavy metal, mercury, and chemical contamination (Campaign against the New Kiln, 2016). CANK (2016) asserts that emissions that cause cancer and respiratory illnesses have been discovered in certain instances. Further, chemicals arising from such burning could enter river systems

which eventually would accrue to toxic quantities in fauna and degrade the river ecosystem. Consequently, humans could be exposed indirectly through consumption of contaminated fish, meat and dairy products (WECF, 2016).

CANK (2016) further opines that a study which was done on illnesses related to tyre burning in Texas showed a 50percent to 100percent increase in coughing, phlegm, sore throats, and eye irritation in people near the incinerators. Other studies reported by CANK (2016), postulate that a considerably larger occurrence of larynx cancer was detected in a community within 2 km of the incinerator. Further scientific studies conducted in Texas revealed that people who live within five miles of a tyre burning kiln in Texas are more sick (CANK, 2016). When dumped in the ground, the chemicals which are constituted in them leach into the soil and groundwater. The chemicals in tyres such as latex and synthetic rubber mean that rubber cannot be burnt safely other than dumping old tyres in landfill sites which are likely to take up space. (Thomas, 2007)

1.2 Magnitude of the road accident problem in Zambia

Motor vehicle crashes (MVCs) are the leading cause of injury and disabilities in Zambia today (Lusaka Times, 2013). The age group laying between 16 to 35years has become highly susceptible to crashes. Between the period 1991 and 2008, Road Traffic Accidents (RTAs) claimed 237,289 casualties (Lusaka Times, 2013). In the year 2011, 5 195 accidents were reported to have been involved in a RTA. This number further increased to 6 521 in 2012 then to 6 904 in 2013 and finally in 2014 between the periods January and October, 5 967. All these were reported to have been involved in a RTA. In these accident statistics, it can be showed that there has been a tremendous increment in accidents over the years. These Road traffic accidents are estimated to be costing the nation millions of kwacha as will be seen later in the report from the statistics obtained from Zambia Police.

According to Agbonkhese et al (2013) road traffic accident happening is described as when a vehicle collides with another vehicle, road debris, pedestrian, animal, or other stationary obstruction, such as a utility pole or a tree. Road traffic accident may also be defined as anything which happens by chance, anything occurring

unexpectedly and un-designed (Odugbemi, 2010). These road traffic accidents have great effect on any country's economy especially a developing country, like Zambia. These accidents continue to be a major reason of deaths and disabilities (Lusaka Times, 2013).

In Zambia, the epidemic is growing. WHO data shows that death from traffic accidents increased by 20 percent between 1990 and 2002 (World Health Organisation, 2013). Some of these accidents were caused by reckless driving such as over-speeding, driving extremely slowly, drunken drivers, inexperienced drivers, tyre bursts, and ignorance of drivers. Most of these causes of accidents could be avoided through intervention of government measures and discipline among road users. According to an unpublished research done on “road traffic accidents and sudden death in Zambia: nature, causes and explanations between the period of 1980-1991,” the existing basic transportation infrastructure deteriorated significantly and motor vehicle owners could not get spare parts for their vehicles. After economic liberalization in 1991, the purchase of vehicles including other vehicle spare parts became easily available.

There has been no historical study on the causes of accidents in Zambia today. Every year hundreds of people are being involved in accidents all over the country. According to the Road Transport and Safety Agency (RTSA) annual report of 2008, about 1238 people died on the Zambian roads from 19727 road traffic accidents (Mwila, 2010). In this report 852 deaths were recorded in the year 2009 out of 16,531 accidents. The number of people killed on Zambian roads increased from 892 in 2004 to 1,170 in 2006 to 1,266 people in 2007 (Schatz, 2008)

In Zambia today, there has been an increase in the number of second hand vehicles entering the country. Recent statistics indicate that out of 2.5 million households in Zambia, 120, 742 own vehicles (CSO, 2013). This shows that 4.8 percent owned vehicles according to 2013 statistics. In Lusaka, 51,536 out of 444,418 households (11.6 percent) own motor vehicles. Of the 444,418 households living in Lusaka, a total of 102,054 (23 percent) live in urban areas, and of these, 47,514 (10.7 percent) own a motor vehicle. Some of the vehicles owned by these households are brand new while the majority are second hand. Anecdotal evidence suggests that the

second hand vehicles are imported into the country then sold to a person with fitted in second hand tyres as opposed to the brand new vehicles that are sold with new tyres.

Prior to this study, there has been no other study conducted in Zambia which involves the assessment of the distribution of second hand tyres and their impact on road safety. Some reports sampled involving accidents indicated that there was a possibility of some of the reported accidents being caused as a result of drivers using finished tyres. There is no data captured in the country which discusses the distribution of second- hand tyres imports. Due to lack of this data, it has been difficult for Zambia Police and RTSA offices to establish the real potential of imported used tyres. In order to address this, this research was conducted in order to determine the possible risks associated with driving vehicles fitted with second hand tyres in Zambia.

Preliminary interviews with ZABs and RTSA officers revealed that Zambia does not have laws which restrict the importation of second hand tyres. They admitted that ZABs have a standard for only brand new pneumatic tyres and not for used ones.

1.3 The Problem and Justification

Road accidents are a serious problem throughout the world. Authorities in virtually all countries of the world are concerned about the growth in the number of people killed and seriously injured on their roads (Cater & Walker, 1998). For instance, Anthony-Albanese (2010) reports that road trauma is one of the major public health problems facing Australia. Tutu (2007) submits that road traffic accidents kill and maim millions of people annually in African countries. He also stated that they hamper economic development of many nations and cause enormous suffering. Furthermore, the rate of mortality in road traffic accident is very high among children and young adults in their prime as well as those who constitute the work force in many countries (World Health Organisation, 2004)

Road traffic accidents occur worldwide but the incidence is more in developing countries. According to World Health Organisation (WHO) Road traffic injuries;

fact sheet number 358 (2013) reports that annually, about 1.24 million people die as a result of road traffic crashes. The report mentions that 91 percent of the world's fatalities on the roads occur in low-income and middle-income countries, even though these countries have approximately half of the world's vehicles. The World Health Organisation (WHO) has estimated that nearly 85 percent of fatalities due to road traffic crashes occur in low and medium-income countries (Murray & Lopez, 1996).

In South Africa, a study conducted by Emuze and Smallwood (2012) ranked third and fourth practices that are vehicle related, namely 'non-roadworthiness of vehicles, unsafe vehicles' and 'worn tyres' as main cause of motor vehicle accidents within the construction industry. According to the National Road Safety Commission (2011) reports, there are 19 fatalities per 10,000 vehicles in Ghana. The reports also state that, among other causes of road traffic accidents in Ghana include the poor nature of some roads which contribute to mechanical failure of vehicle components such as engine, steering, suspension, transmission, brakes and tyres which are noted for causing motor accidents in the country.

The World Health Organisation has forecast that by the year 2020, road accidents will move up to sixth place as a cause of death, and in terms of years of life lost and disability adjusted life years, it will be in second and third place respectively and there will be a 65 percent increase in the statistics if no immediate action is taken (Baluja, 2010). The problems of road accidents are therefore urgent and complicated. Thus, there has been the call for the need to give more attention to the safety of road users in developing countries. Defective vehicle parts such as tyres, could lead to tragic accidents as they affect the driver's ability to maintain control of his vehicle. Several studies have shown that the reasons for defective tyres may be insufficient tyre pressure (lack of maintenance), load weights exceeding the tyre specifications, bad installation or bad fabrication of tyres. Bullas (2004) recommends that the highest friction levels on any particular road are likely to be achieved when tyres are new. However, as the tyre wears and ages, it is likely that the available friction will be reduced. The tyre tread compounds will gradually harden, reducing the maximum grip that can be achieved, but the greatest influence is in the reduced tread depth as the tyre wears. The reduction in tread depth and hardening of the rubber reduce the

size and flexibility of the thread blocks and hence the ability of the tyre to wrap over the surface irregularities and make intimate contact with the road.

In the recent years, RTSA has reported that Road traffic accidents in the country are ranked the third highest cause of death after HIV/AIDS and malaria. It is also the second leading cause of death for people aged between 5 and 20 years. According to RTSA, 65 percent of drivers on the roads, especially over the weekends, drive under the influence of alcohol resulting to an accident which can be avoided. Apart from accidents being caused by drunken drivers, there has been an increase in second hand vehicles mainly fitted with second hand tyres. These passenger vehicles are mainly fitted with second hand tyres which when not immediately checked, investigated and replaced may lead to tyre bursts or skidding off the road hence causing accidents. Other than these second hand vehicles being fitted with second hand tyres, there has also been an increase in people selling degraded tyres on the streets without anyone in authority inspecting the quality of these tyres. The traders of these tyres are found in places such as Soweto market, alongside the streets of Chilenje and Kabwata markets, Kabulonga complex at the traffic lights, opposite Longarces filling station. These tyres are left in the open, being exposed to high temperatures roughly about 32 degrees Celsius of which it contradicts to the proper handling and storage of tyres. Road users would go to purchase these tyres with little knowledge about its wear and tear, tread depths, tyre markings and readings such as expiry dates. Upon buying these tyres, road users fit these tyres on their vehicles as they are affordable when well negotiated.

It is for this reason that this study wishes to carry out an assessment of the risks associated under the use of second hand tyres on light vehicles in Zambia and make recommendations that will assist in reducing them.

1.4 Rationale

The rationale of this research is to introduce mitigating actions and recommendations which RTSA, ZP, ZABS can utilize that can help in mitigating the issues of having expired and degraded tyres fitted on vehicles contributing to road traffic accidents. Another area of concern is to put in a recommendation to the supporting authorities

on the need of inspection on the quality of the tyres during fitness and for those resellers selling degraded tyres. Another area which was worth discussing with the authorities was on the potential hazards and accidents which are likely to be caused by second hand tyres. How can they improve in educating road users in making an informed decision or through sensitizations? Then finally, to make people aware that a vehicle should be looked at as a whole. When one part is defective, it affects the performance of the whole vehicle.

Therefore, the need to investigate the second hand tyres as a cause of some of these accidents is necessary in order to create public awareness especially along highway inter-city routes, Kabwe Lusaka and Kafue roads.

The Road Transport and Safety Agency (RTSA) had cited that billboards mounted on the Islands of the highways, the use of second-hand tyres and the negligence by drunken drivers as some of the major causes of road traffic accidents in Zambia (Lusaka Times, 2013). After carrying out a road safety analysis, RTSA claimed that the above issues including over speeding have claimed many lives in the country (Lusaka Times, 2013).

1.5 Research Aim and Objectives

The aim of the study is to identify the possible risks associated with the use of second hand tyres on light vehicles in Zambia and subsequently develop a framework to be used for tyre quality identification.

1.6 Objectives

- To identify whether or not motorists know the dangers of driving second hand tyres.
- To develop a guideline for the selling of second hand tyres.
- To recommend and develop a framework that can be used by road users, authorizing agents to check for tyres before purchasing them and during fitness examinations.

1.7 Research Questions

1. To what extent is the number of accidents attributed to second hand or defective tyres?
2. What level of awareness do motorists have before buying a second hand tyre from street vendors?
3. To what extent do state agencies inspect the condition of the tyres at both vehicle inspection centre and at the accident scene?

1.8 Research Method

A comprehensive literature review was carried out on studies to do with accidents and their causes. A gap was identified in Zambia in determining the causes of accidents on light passenger vehicles with the use of second hand tyres. The research methods involved both primary and secondary techniques in order to answer the research questions and its objectives.

1.8.1 Primary Technique

In primary technique, first-hand information was obtained through the use of interviews and a questionnaire. A survey research was done in trying to understand what resellers and buyers use in determining what a good second hand tyre should look like. It was important to know whether or not users understood the markings on the tyres from those which were being sold from the streets. Regulatory personnel such as RTSA traffic officers, Zambia police traffic officers, ZABs inspecting officers and a few vehicle owners were subjected to a questionnaire and structured interviews. From the authority bodies, mostly the questions were centred more on what they look out for during an accident scene. Are second hand tyres attributes to today's road traffic accidents? At the port of entry, does the authority check for standard of second hand tyres coming into the country and what tools are used during inspections?

1.8.2 Secondary Technique

The secondary technique involved the use of accident reports which came from the departments of investigations. These reports were analysed with the help of a traffic officer in coming up with statistics of accidents caused by tyres. The design of this study was to address the problem statement and to achieve the research's objectives which brought a clear perspective about the possible risks associated with using second hand tyres on light passenger vehicles in Lusaka.

1.8.3 The Study Population and Sample

The target group being the sampled population were divided into four groups such as:

- a. Road users and Bus drivers
- b. Tyre resellers and Tyre menders
- c. Road Transport and Safety Association & Zambia Police Traffic officers;
and
- d. Customs Officers and ZABs Inspectors.

1.8.4 Qualitative and Quantitative data collection Instruments

This involved;

- i) Interviews and questionnaire Surveys
- ii) Statistical Data from Zambia Police

1.8.5 Data Collection Procedure

This involved getting permission from relevant authorities and offices on information about accident statistics and anything to do with second hand tyres. Ethical considerations were also put into consideration.

1.8.6 Data Analysis

After the qualitative and quantitative approaches of data collection, excel spread sheets were used to analyse the data.

1.9 Research Organisation

The dissertation presentation is;

Chapter 1: Introduction

This chapter provides the background to the study. It highlights the significance of the study and its problem statement, research questions and its objectives and its delimitations.

Chapter 2: Literature review

This chapter presents literature from journal papers, books, conference papers and the internet. It gives an introduction of the history of tyres, its composition and their identification. Understanding risks analysis and evaluation. Further on, there was literature surveyed in some African countries on accidents associated with the use of second hand tyres.

Chapter 3: Research methodology

This chapter presents an outline of the research and the manner in which it was designed and conducted. It describes the research tools and their design, the method that was used to collect data, the sample population and sampling design. Finally, it explains the method used to interpret the results.

Chapter 4: Results and Discussion of results

This chapter presents the findings of the research. Data is presented in form of tables, charts, graphs and descriptive. It further on discusses the results pertaining to what was obtained.

Chapter 5: Conclusions and Recommendations

The summary and conclusion of the research is presented in this chapter from the literature as well as the survey. Conclusions are drawn from this and recommendations made.

References:

This section will include a list of references which were used in the study.

Appendices:

This section includes attachments such as introductory letters, interview questions and questionnaire that were used in this study.

1.10 Summary

An introduction and background to the major causes of road traffic accidents was discussed around the world, in Africa and particularly in Zambia. The problem statement of the research along with its justification, the main aim, its objectives and research questions were highlighted.

2.0 CHAPTER TWO

Literature Review

2.1 Introduction

The previous chapter gave an overview of the background to the study. It also defined certain terminologies, problem statement and justification for undertaking this study. The objectives of the study were outlined along with the research questions. In this chapter, literature involving the history of tyres, composition of tyres and risks associated with driving second hand tyres including an overview of the number of accidents involved in driving vehicles were undertaken and reviewed through the use of journals and published studies.

2.2 Background Review

2.2.1 The history of Tyres

In the mid 1800's, the first-belted radial tyres were made using rubber (Manas, et al., 2009). The load was being carried by tyres. In 1845, the pneumatic air-filled tyre which worked by air within the tyre absorbing the shocks of the road was invented and patented by RW Thomson (Manas, et al., 2009). In 1895, the pneumatic tyre was first used on automobiles by Andre and Edouard Michelin. Later in 1948, Michelin introduced steel-belted radial tyres. This new type of pneumatic tyre meant that they would have a longer life due to ply cords that radiate from a 90 degrees angle from the wheel rim. This made it have a less rolling resistance hence increasing the mileage of the vehicle. In 1983, all new American cars came fitted with radial tyres.

2.2.2 Composition of Tyres and Identification parameters

Tyres use natural and synthetic rubber as their primary raw material. Other materials include sulphur, zinc oxide, and carbon black which are just a few to mention (Black Circles, 2014).

At a glance, all tyres fitted on vehicles have a serial identification number. This is used to determine the age of the tyre (Osueke & Uguru-Okorie, 2012) .For example, for tyres manufactured after year 1999, the date of manufacture of the tyre is determined by the last four numbers to the nearest week. Out of these four numbers, the first two identifies the week of manufacture ranging from 01 to 52. The year of manufacture is determined by the last two numbers. For example, a tyre with serial identification of 4809 was manufactured in the 48th week of 2009. (Osueke & Uguru-Okorie, 2012)



Figure 2-1: Diagram of a tyre showing the manufactured date

Source: (Osueke & Uguru-Okorie, 2012)

Load Ratings - Incorrect load/speed indices

There is a tendency of the illegal use of the wrong tyres with insufficient load or speed indices. It has been said that the load capacity of a tyre determines what payload each tyre can carry. All tyres being manufactured are made with a code that tells the maximum load capacity of the tyre (Osueke & Uguru-Okorie, 2012). Table 2.1 shows more details about this. As earlier mentioned, one of the causes of accidents has been ignorance of drivers on the load capacity of the vehicles originating from the tyres. Other road user's lives have been endangered when some passenger vehicles are converted into cargo vehicle in order to make extra cash.

The speed indices indicated on the tyres tells a lot on how much speed the vehicle can be subjected to. It also helps the driver to determine what type of a tyre to use for the vehicle so that it matches with the speed of the vehicle. It is not recommended to mix tyres on a car with different speed ratings (Osueke & Uguru-Okorie, 2012)

Table 2-1: Tyre Speed Rating

| <i>Speed symbol</i> | <i>Maximum speed(km/h)</i> |
|----------------------------|-----------------------------------|
| N | 140 |
| P | 150 |
| Q | 160 |
| R | 170 |
| S | 180 |
| T | 190 |
| U | 200 |
| H | 210 |
| V | 240 |
| Z | 240 |
| W | 270 |
| Y | 300 |

Source: (Osueke & Uguru-Okorie, 2012)

2.3 Over and under inflation of tyres

Tyres form the main contact between the road and the vehicle hence, it is important that road drivers pay particular attention to their safety. Most vehicle drivers are mostly interested in the radiator systems and car engine of their vehicles. They put little concern on their tyres which in turn compromises their safety. Accidents originating from tyres could be caused by pressure or wear (Osueke & Uguru-Okorie, 2012). According to Manas, et al (2009) bad inflation pressures of tyres either under-inflation or over-inflation causes tyres to wear easily and increases poor vehicle handling by drivers. Therefore, maintaining correct inflation pressure in tyres helps to keep vehicle handling and braking at its best, it also improves fuel efficiency and tyre life (Osueke & Uguru-Okorie, 2012). Correct inflation pressures are likely

to prevent the tyre from separation and the tyre from blowing out which in turn causes the loss of control of the vehicle resulting into a car crash. A vehicle manufacturer will specify a tyre with a recommended inflation pressure, which will permit safe operation within the specified load rating and vehicle loading. (Osueke & Uguru-Okorie, 2012). Table 2-2 shows the load index and the allowable recommended loads permitted by tyre manufacturers on passenger vehicles.

Table 2-2: Passenger Car tyre load rating

| | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Load Index | 81 | 82 | 85 | 86 | 87 | 90 | 92 | 95 | 96 |
| Max. load/tyre (kg) | 462 | 475 | 515 | 530 | 545 | 600 | 630 | 690 | 710 |

Source: (Osueke & Uguru-Okorie, 2012)

Over inflated tyres are more prone to damages when running over potholes or debris on the road. When a tyre has too much air in it, the centre of the tread bears most of the load and wears out faster than the outside edges. If a tyre wears unevenly, the useful life is reduced and conversely the operating cost is increased. Additionally, stopping distances will be increased because less thread area is contacting the road surface. Over or under-inflated tyres traditionally manifested classic wear patterns. Figure 2.2 illustrates the typical appearance of such tyres. Today, modern steel-braced radial tyres are far less likely to show these characteristics and, in the case of wide low-profile tyres, hard acceleration with correctly pressurized tyres may result in what appears to be evidence of running at too high a tyre pressure (McCarthy, 2003)

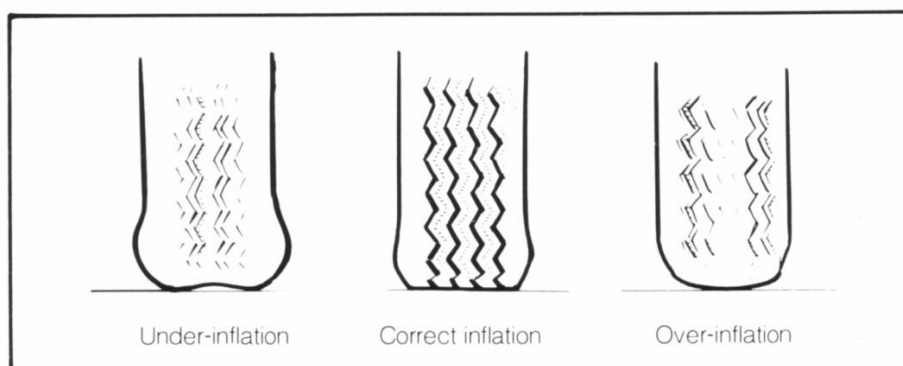


Figure 2-2: The typical appearance of over or underinflated tyres in terms of classic wear pattern

Source: (Tyre Industry Council, 2003)

Under-inflation is more common and serious when compared to over inflation. When a person pumps his/her tyre with low pressure, it causes the tyre to collapse slightly which causes the weight of the vehicle to be carried on the tyre sidewalls than on the center of the thread. This results in the thread wear to be greater towards the sides than in the center. An under-inflated tyre can also lose traction more easily than one which is properly inflated, which can cause skidding during braking or hard cornering, or wheel spin when accelerating. It is important to note that correct pressure should be used on tyres of acceptable age and a smooth road. There are various risks associated with using second hand tyres for example, in the environment in terms of air pollutants and on people's health, but our focus in this study will be on safety of the passengers.

2.4 Risk Theory

From a Technical point of view, risk is defined as probability multiplied by consequence (i.e., probability x consequence). Drotts-Sjøberg, (1991) and Breakwell (2007) defines risk as “the probability of a particular adverse event occurring during a stated period of time”.

Risk usually has two primary components for a given event

- A probability of occurrence of that event
- Impact or consequence of the event occurring

In short, risk can be described as the probability that an adverse event may occur (Graham & Rhomberg, 1996). It may also be defined as the probability that a hazard may turn into a disaster. It's the probability of an adverse event and the magnitude of its impact (Sjoberg, et al., 2004).

| |
|---|
| $\text{Risk} = \text{Probability (of a given event)} \times \text{Severity (negative business impact)}$ |
|---|

a) Risk perception

The degree of risk perceived determines the degree of actions to be taken (Adams, 1995). Perception of risk goes beyond the individual. It is a social and cultural

construct reflecting values, history, symbols, and ideology (Weinstein, 1980). Risk perception is concerned with the characteristics and the severity of a risk.

b) Risk Management

The process of managing risk in any project is termed as risk management. It is managing risk in any project or process. It may also be defined as the act of dealing with risk. Other than that, it is a method by which risks to the project (e.g. to the scope, deliverables, timescales or resources) are formally identified, quantified and managed during the execution of the project. The process entails completing a number of actions to reduce the likelihood of occurrence and the severity of impact of each risk. It includes planning for risk, identifying risks, analyzing risks, developing risk response strategies and monitoring by controlling risks to determine how they have changed (Kerzner, 2009). This means that under this process, it will involve processes such as risk identification, assessment, ranking and prioritization, responses, control and monitoring.

2.4.1 Risk Identification

This is defined as an organized use of information to identify hazards referring to the risk (Vijayakumar, et al., 2014). According to Project Management Institute (2013), risk identification can be performed using, but not limited to the following techniques;

- Delphi technique
- SWOT Analysis
- Root Cause Analysis
- Case and Effect Diagramming
- Flow Charting
- Brainstorming
- Interviewing

2.4.2 Risk analysis and evaluation

This involves estimating the risk through identification of the hazards. This is risk quantification which involves analysing the likelihood of occurrence and severity or

impact of the risk. During evaluation, it will involve prioritizing and finally rating the risk.

2.4.3 Risk response and control

This involves having a set of preventative actions meant to reduce the likelihood of the risk's occurring and a set of contingent actions to reduce the impact should the risk eventuate. Then finally there is need of a process for managing risks through the project. Risk control includes decision making to reduce and/or accept risks.

2.4.4 Risk review, monitoring and communication

This is a continuous process happening throughout the risk management process. It is defined as a process which includes identifying, analysing, planning, and tracking new risks; constantly reviewing existing risks; monitoring trigger conditions for contingency plans; and monitoring residual risks (Watson, et al., 2013).

2.5 Wear and Tear of Tyres

The causes of the tyre defects are mainly due to structural damage and road performance of the tyre. Special attention should be put on the maximum load exerted on the tyre. This is usually determined by the vehicle manufacturer. Therefore, it is recommended that the maximum load for vehicles should not be greater than the tyres maximum load (Osueke & Uguru-Okorie, 2012). This is indicated on the sidewalls of the tyre. The maximum load capacity of the tyre is assumed to be operating at the proper tyre inflation. Reduction in tyre pressure will reduce the maximum load carrying capacity of the tyre.

An over-inflated tyre may lead to wear in the middle of the thread. A premature wear at the edges of the thread could be as a result under-inflation. Tyres should not generally be inflated to the maximum pressure indicated on its sidewall (Osueke & Uguru-Okorie, 2012). Due to environmental exposure, the ageing behaviour of any tyre will be shown by the sideways cracking and thread cracking. This environmental exposure is associated with usually the tyres' exposure to oxygen, heat and sunlight.

The hardening of the outside surface is caused by oxidation of the polymers which is under the influence of sunlight. Other external factors such as stones, potholes and nails contribute to the structural damage of any tyre type. These types of damages therefore lead to slow loss of tyre pressure.

In developed countries like Japan, the law stipulates that automobiles must pass an automobile safety inspection and are allowed to run on Japanese public roads only when the thread depth of the tyres is 1.6 mm or larger (Yamashita & Yamanaka, 2013). For tyres seeming to be brand new, those above 6years from the date of manufacture should not be comfortably used because of the ageing effect. Despite being aware of existing differences in the performance of tyres normally available in the market, it is very difficult to ascertain whether or not a tyre is better; assuming that there was one available in a particular accident that would have helped to prevent the accident under the given circumstances or would have at least reduced its severity.

2.6 Second hand tyres

A second-hand tyre is one that has been used in a country of its origin and is imported for re-use in another country. Much usage of a second hand tyre without close monitoring can result in wear. When this happens, a tyre may require re-threading. Retreading tyres involves grinding down the surface or casing of a worn tyre until it is smooth and then gluing a new veneer of thread onto it (Thomas, 2007). Second hand tyres are not easy to dispose of. There are a number of dangerous chemicals in tyres amongst them latex and synthetic rubber. This means that they cannot be burnt safely (Thomas, 2007). However, used and finished tyres can be recycled in various ways; it can be used as a breeding place for fish under water though they can be toxic and harmful to them. Some carpets are made using crumbed rubber for carpet underlay, others use these finished tyres in children's playground. At city market in Lusaka, marketers are seen using these used up tyres as tables for display of their goods. This is as shown in Figure 2-3. This shows a way of disposal of tyres.



Figure 2-3: *Second Hand Tyres being disposed off as tables for the selling of items at Soweto*

(Source: Captured by the author, 2015)



Figure 2-4: *Second hand tyres displayed for sale at City Market*

(Source: Captured by the author, 2015)

In order to avoid unnecessary accidents happening in Zambia, it is important to have a standard on second hand tyres coming into the country. It was discovered that there are containers loaded with second hand tyres coming from Japan every month to city market without anyone inspecting the quality standards of these tyres. For those tyres which are completely finished, they are seen lying along road sides as opposed to being dumped elsewhere. One should take note of the standards of these second hand tyres when either selling or buying them. Any signs of defects should be inspected thoroughly. This promotes safety for all road users.

2.7 Causes for Defective tyre related injuries

On every vehicle, tyres are the number one's source of stability, traction and control on the road. If vehicles tyres do not seem to have the capability to grip sufficiently on the road, a vehicle can easily slip off the road resulting into an accident by hitting into a tree, another vehicle, pedestrian or any other object near it.

There are other conditions under which a vehicles tyre can cause an accident such as:

- a. Inability to grip road in wet weather;
- b. Over Inflation or Under inflation;
- c. Poor traction or tread design;
- d. Cheap road construction having potholes;
- e. Used or the prolonged use of tyres;
- f. Thread separation;
- g. Weak outer tyre structure and
- h. Blowouts.

Amongst the ways mentioned above, the leading cause of tyre related problems are tyre blowouts during excessive speeding. This usually causes a driver to lose control of his vehicle and end up crashing. Studies have shown that, there are various reasons which make a tyre blow-out such as the weather conditions (the use of snow tyres in a hot environment), the condition of the road infrastructure, natural wear and tear associated to ageing of the tyre. Other reasons which can contribute to a tyre blow out are associated to the fault of the manufacturer but there are preventable. Every manufacturer should care enough to prevent an auto accident resulting from a tyre blowout.

2.7.1 Tread Separation

Tyre separation is the most common cause for tyre blowouts. This is as a result of insufficient bonding of the tread in the tyres. Because of this, it causes the tyre to slowly separate. What causes this is the carelessness during tyre construction. However, this is preventable if the right craftsmanship employed is making tyres and are following quality and international standards. On a poorly made tyre, the treads of the tyre will separate more and more. Should the threads pull apart whilst the vehicle is moving, the tyre can burst and may cause a blowout. When such an event happens, this can be pointed at the tyre manufacturer for having produced an inferior tyre weak bonding. One should be careful when buying retreaded tyres.

2.7.2 Cheap Construction

Some tyre manufacturers prefer to obtain cheap materials for making their tyres which do not have quality international standards. There are countries like Malaysia and Korea for example which make rubber and manufacture good and recommended tyres like Goodyear, Michigan, Bridgestone just to mention a few. Some countries which do not manufacture rubber would employ substandard practice conditions and produce a substandard product. Some of these products such as tyres are defective and can lead to a tyre blowout hence causing an auto accident.

2.7.3 Poor traction or tread design

An accident may occur if the tyre has poor traction by skidding off the road. A tyre is made with treads so that a vehicle maintains grip on a road surface regardless of speed bearing in mind that the driver is moving responsively to avoid a vehicle from slipping off the road. Should a vehicle slip off the road, its either the vehicle's treads have worn away or were poorly designed. If the tyre is perceived to be new and is failing to sufficiently grip on the road surface, the manufacturer may be at fault.

2.8 Policies and Legislation

It is important that goods being brought into any country are controlled whenever they are imported. It is relevant if such legislation is put in place for controlling the

importation of goods. In Zambia, there is no known act which restricts the importation of second hand tyres. Only 28 countries, representing 416 million people (7 percent of the world's population) have adequate laws that address all five risk factors which are speed, drink-driving, helmets, seat-belts and child restraints (WHO Road traffic injuries; fact sheet N° 358, 2013). Tyres are seen lying alongside the roads in direct sunlight. These tyres have different quality standards and brands. They range from a low grade to an average high grade. At a glance, a lot of tyres have been dumped around the city without them being taken to any dump site.



Figure 2-5: Tyres being disposed off on the road sides of the roads
(Source: Captured by the author, 2015)

2.9 Study Cases of Accidents Associated with degraded tyres

2.9.1 South Africa

There have been some past studies across the world on some accidents caused by degraded tyres. For example, in 2003, Vogel and Bester (2003) did a study on a road commonly known as R44 in the Western Cape of South Africa to establish a relationship between accident types and causes. On this road, an average of 404 accident reports was analysed from the three risk factors which were highlighted. These were identified as human, vehicle and environmental factors and the human factor was weighted to be the highest at 75.4 percent followed by environmental

factors at 14.5 percent and finally vehicle factors at 10.2 percent. (Vogel & Bester, 2003). Under vehicle factors, this comprised of mostly faulty brakes and tyres.

In South Africa, a study conducted by Emuze and Smallwood (2012) ranked third and fourth practices that are vehicle related, namely 'non-roadworthiness of vehicles / unsafe vehicles' and 'worn-out tyres' as main causes of motor vehicle accidents within the construction industry respectively.

2.9.2 United Kingdom

Bullas (2004) recommends that the highest friction levels on any particular road are likely to be achieved when tyres are new. According to a study by the Department for Transport in the UK (2005) accidents resulting from vehicle defects such as faulty brakes, accounted for only 1.5 percent of total accidents.

According to Bullas (2004), the ordinary motorist needs sufficient friction between the tyre and the road to generate forces that will react against the brakes, or against the side forces when cornering, that allow the car to complete a particular manoeuvre. Bullas (2004) further suggests that the tyre influences the available friction, with different compounds giving different levels of grip. It is for this reason that tyre manufacturers use different compounds and tread patterns in order to maximize available friction depending upon the circumstances in which a tyre is expected to be used, and this is usually a compromise between wear and performance.

2.9.3 Ghana

In 2014, Haadi did a similar case study which involved identifying factors that cause severity of road accidents in Ghana. In 2001, Ghana was rated as the second highest road traffic accident prone nation among six west African countries, with 73 deaths per 1000 accidents (Sarpong, 2011). Statistics from the National Road Safety Commission showed that, Ghana loses about 1.7 per cent of its Gross Domestic Product which is over 230 million dollars every year beside the loss of lives to road accidents (Ghana News Agency, 2010).

According to the Ghanaian business news, (2014) a bill banning the use of sub-standard tyres in the country was passed into law by parliament in 2012 as one of the means of ensuring road safety in the country. The public relations officer expressed concern that 90 percent of the tyres used on the road were second hand tyres, an industry that employed thousands of people in the country. This could cause major unemployment problems if the ban could not be removed.

According to the National Road Safety Commission (2011) reports, there are 19 fatalities per 10,000 vehicles in Ghana. The reports also state that, other causes of road traffic accidents in Ghana include the poor nature of some roads which contribute to mechanical failure of vehicle components such as engine, steering, suspension, transmission, brakes and tyres which is noted for causing motor accidents in the country.

2.9.4 Nigeria

In 2013, a study entitled “Road Traffic Accidents in Nigeria: Causes and preventive measures” was undertaken. It highlighted that Nigeria had the second highest rate of road accidents among the 193 ranked countries of the world (Agbonkhese, et al., 2013). In this study, it was deduced that deaths from reckless driving are a third leading cause of deaths in Nigeria. On a lot of Nigerian roads across the country, deterioration often begins with the origin of cracks or pot holes on the road pavements either at the edges or along the drive way which differs by their shapes, configuration, and amplitude of loading, movement of traffic and rate of deformation (Agbonkhese, et al., 2013).

These pot holes aside from human and vehicle related factors are the major causes of accidents. Previous research has shown that Nigerians know quite a lot about what could cause road traffic accidents (Asalor, 2010). According to Sheriff, (2009), the roads grew to be a death trap for Nigerian citizens and road users due to the oil business causing substandard roads being constructed. The immediate cause of a road accident may also be attributed to Mechanical factors and carelessness of the drivers. Nigeria has the highest road accidents rate as well as the largest number of death per 10,000 vehicles (Sheriff, 2009).

2.9.5 Other Studies

Many studies from the 1970s have shown how tyre grip is greatly reduced as tread depth decreases, but there is a general lack of research in Zambia linking accident risk directly to insufficient tread depth. Some work which was carried in Australia by Fox, et al. (1979) showed a very strong link between tyre tread depth and the chances of being involved in an accident with a utility pole, though this may not be direct causal link between tyre tread depth and accident risk. The risk increases exponentially when tread depth dropped below 3 millimeters. This can be seen in figure 2-6.

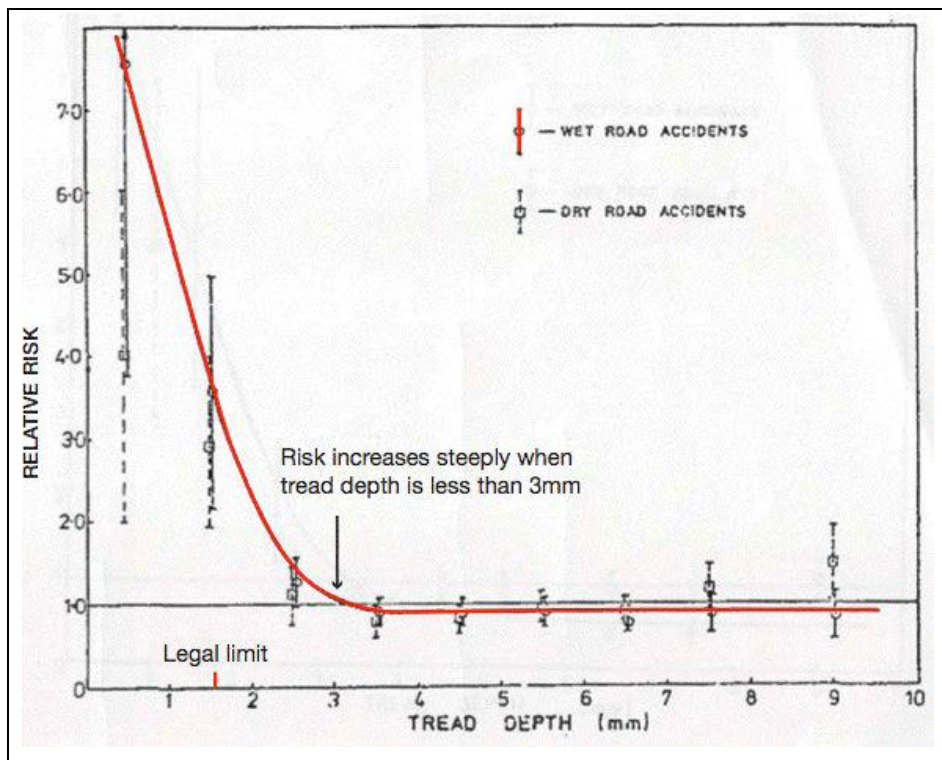


Figure 2-6: The relationship between front tyre tread depth and relative accident risk for collisions with utility poles in Australia

Source: (Fox, Good and Joubert, 1979)

In this study on the assessment of risks associated under the use of second hand tyres on light vehicles in Zambia, the critical factor is the relationship between accidents and second hand tyres having the minimum recommended tread depth and expired tyres. In Zambia, road safety has become a major national issue.

Generally, tyres determine the stability and safety of vehicles on the road. Tyres are either designed for cold regions or for hot regions. In Zambia, the weather is different from other regions. Temperature ranges between 25 and 35 degrees all year round. Some road users do not check for whether the tyre is meant for the hot or cold season. When a person uses tyres meant for the cold season in hot weather, the tyre may rupture. Should the tyre rupture when the vehicle is in high speed, it may lead to a traffic accident. Other causes which may lead to an accident involves under inflation of tyres, over inflation of tyres and little to no thread depths on tyres are some of the many reasons.

2.10 Summary

This chapter presented a literature review on the history of tyres, understanding the concept of risk, wear and tear of tyres. Finally, the subject of second hand tyres and their contribution to road traffic accidents was also discussed.

The next chapter discusses the research methods used in this study. The merits and demerits of the various research methods will also be discussed.

3.0 CHAPTER THREE

Research Methodology

3.1 Introduction

The previous chapter presented literature review on second hand tyres and their contribution to road traffic accidents. This chapter discusses the methodology which was used to carry out the research dissertation to achieve its aim and objectives. This chapter explains different methodologies used for any research being conducted. A triangulation approach was used to validate the data obtained using secondary sources from Zambia Police on accident reports and the semi-structured interviews with RTSA traffic officers, police traffic officers, vehicle owners, tyre traders and bus drivers. An in-depth interview was further carried out with tyre menders, informal tyre traders at the black market and Zambia Bureau of Standards. This chapter further explains how its problem statement was tackled. It also describes the methods of data analysis employed which involved the use of Microsoft excel.

3.2 Research methods

Today, there are various research methods available in the world. Depending on the research types, there exist different data gathering methods. Data collection techniques can be classified as:

- a. Primary; and
- b. Secondary.

3.2.1 Primary data collection techniques

This is the method that uses first hand data or when a person collects his or her own data or information. During Data collection, this technique uses methods such as observations, interviews and administration of questionnaires (Nkhata, 1997). Focus group discussion is one of the primary techniques of data collection. Below are some examples that use primary technique during data collection;

i) Observation

In this method, the observer keeps a low profile by becoming part of the sampled population/data and learns ways of arriving to certain results. The aim would be to learn all their behaviour and habits. This method involves total immersion in the group being studied (Achola & Bless, 1998).

There are various ways of observing approaches an individual can use (Nkhata, 1997). These include;

- a. Complete observation, where the researcher hides his or her identity, objectives and hypothesis. The group being studied does not know that they are being observed. Whilst collecting information, an observer may decide to use devices like a tape recorder.
- b. Participant observer, where the researcher's role is known. The group is made aware of the objectives of the study.

ii) Case Study

This method involves real life situation which may be detailed and thorough in explanation. By using the method of a case study, it offers advantages of acquiring detailed information about the subject through an in-depth study. Other than that, the data obtained would be more or less reliable depending on the objectivity of the researcher (Achola & Bless, 1998).

iii) Survey Research

This method uses questionnaires distributed to a sampled population. One could use interviews and questionnaires. Descriptive and explanatory researches can use this method (Bryman, 2001).

a) Interviewing

This type of data collection uses oral questions to individuals or groups of people. There exists an interviewer and an interviewee. This method has advantages and disadvantages (Bryman, 2001).

Advantages being;

- a. It normally gives a higher response rate compared to using questionnaires.
- b. It provides room for clarifications
- c. It accommodates illiterate respondents

Disadvantages being:

- a. Interviews may be costly in terms of time and money; and
- b. The presence of the interviewer may influence responses.

b) Questionnaire

This method uses written questions in a systematic format, which are presented to respondents from the sampled population in a written form. There exist two types of questionnaire surveys (Achola & Bless, 1998). These include:

- Self-Administered questionnaires which are given out to respondents to answer and are usually returned completed; and
- An administered questionnaire which is delivered by the interviewer.

When used in a survey, it has its merits and its demerits (Nkhata, 1997). Advantages of using this method are that its:

- Less expensive as compared to carry out an interview;
- Since a respondent answers questions freely without the presence of the distributor, the responses are honest; and
- Same questions are distributed to all respondents.

Disadvantages of this method are that:

- If the sampled population have some illiterates, self-administered questionnaires cannot be used;

- There is a possibility that there may be a slow response rate; and
- Some questions may be miss-understood due to the unavailability of the interviewer

There exist two types of questions: (Achola and Bless 1988):

- a. Open-ended; and
- b. Closed-ended or structured questions.

Open-ended questions, the respondents are free to respond in their own way. This is important when the researcher wants to get information on opinions, attitude and reactions to sensitive questions (Achola & Bless, 1998).

Advantages of using open-ended questions are that:

- The researcher is able to gain more information by exploring issues that may not have been asked;
- Information is given out openly which is more truthful than the limited answers one is expected to choose from; and
- Depending on the responses from the respondents, some answers may be used during the discussion of results and recommendations.

Disadvantages include:

- Analysing responses from open ended questions can be time consuming especially when coming to summarise the findings of the research.

Closed-ended or structured questions, this offers a list of questions and answers from which a respondent can select from and make a decision (Achola & Bless, 1998).

Advantages of closed-ended questions include:

- The researcher can quickly record the respondents answers; and
- It is easy to analyse the respondents' answers.

Disadvantages include:

- One cannot use face to face interviews with this method;
- There is a possibility to miss out some information due to lapses; and
- The respondents may not be interested in the questions being answered.

3.2.2 Secondary data collection techniques

This method relies on information or data already gotten by someone else for their current use. The researcher was the secondary user of this information. Literature review is one example of such a technique. This has some advantages and disadvantages (Bryman, 2001).

One advantage includes:

- It is not as expensive as data is readily available either through books, journals, articles or through the internet.

Disadvantages include:

- Due to ethical issues, if a researcher is getting some information from a government institution the information may not be easy to retrieve.
- The information may be incomplete due to the method not being too clear for the researcher.

3.3 Research Approach and design

This study was designed to address the problem statement under section 1.2 and achieving the objective under section 1.4. In order to present a clear perspective about the possible risks associated with using second hand tyres on vehicles in Zambia, the study was conducted in four phases. The first was a comprehensive literature review. The second phase constituted of data collection which was done through interviews and questionnaire surveys. The triangulation of the various methods was done to enhance the confidence that can be placed on the research findings (Spector, 1981). The third phase involved data analysis. Then finally, the fourth phase consisted of a report preparation on how to avoid risks associated with using second hand tyres on vehicles in Zambia by carrying out a simple framework. Conclusions and recommendations followed thereafter.

A Triangulation method was adopted which consisted of case studies on the dangers of using second hand tyres, the use of secondary data from Zambia Police, Interviews, and questionnaires. Secondary data from Zambia police involved the use of accident reports. Interviews were semi-structured for RTSA and police traffic

officers, vehicle owners and bus drivers. An in-depth interview was further carried out with tyre menders and informal tyre traders at the black market and Zambia bureau of standards. Microsoft excel was used to analyse these statistics.

3.3.1 Data Collection

a) Literature review

From the literature review in the previous chapter, it was decided to collect secondary data from what other researchers elsewhere had done. Secondary information was sourced mainly from literature dealing with motor vehicle tyres, accidents, risks in general and those associated with use of second hand tyres, motor vehicle parts safety practices from both developed and developing countries. Peer reviewed conference proceedings, government reports, the internet, Journals and books were a source of information on what had already been done within the industry.

The objectives identified in Section 1.4 were addressed through the literature review as follows:

- Presentation and discussion of the previous related studies; and
- Identification of the possible risks associated with using second hand tyres on vehicles in Zambia.

3.3.2 The Study population and Sample

Leedy and Ormrod (2010) mention a two stage descriptive survey as one of the means of data collection. In this study, the second stage data collection of descriptive survey was used. This approach works through collection of quantitative data coming from a designed, pre-tested and administered questionnaire distributed to the target sample. This specific self-administered questionnaire was distributed to some selected government departments and as well as motor vehicle users. The target group being the sampled population were divided into four groups such as:

- a. Road users and Bus drivers
- b. Tyre resellers and Tyre menders

- c. Road Transport and Safety Association & Zambia Police Traffic officers;
and
- d. Customs Officers and ZABs Inspectors.

3.3.3 Qualitative and Quantitative data collection Instruments

i) Interviews and questionnaire Surveys

Under qualitative, this involved structured interviews with vehicle owners, resellers, Zambia police and RTSA officers. A self-administered questionnaire was distributed to the sampled population. The data obtained was used to validate on the responses and findings on the risks associated with using second hand tyres leading to accidents. The results helped to identify the risks and to get an understanding on whether or not users know that risks do exist and also to determine the knowledge of users on serial identification of tyres. A desktop study using published literature review of accidents associated with the use of second hand tyres was also carried out.

Interviews and in depth discussions were carried out with tyre menders, informal tyre traders at Chelstone, Kabulonga, Kabwata, Town Centre, Soweto market and surrounding areas. This was equally conducted with ZRA custom officers at Chanida border and Zambia Bureau of Standards concerning the risks involved in driving passenger vehicles using second hand tyres and determining whether or not they check for tyre quality and if at all they pay particular attention on the markings of a tyre. A total of 10 Traffic officers from Zambia Police headquarters participated in the research through interviews and answering the questionnaires in a rather more detailed approach. Other than that, at least 66 questionnaires were distributed and 46 responses were collected from government departments such as Police Traffic officers, RTSA agents and motor vehicle users.

The interviews were aimed at obtaining preliminary data that would enhance the questionnaire survey. The interviews were limited to participants within Lusaka, the capital city, due to the short time that was required to get preliminary data and also due to the assumption that the highest number of road traffic accidents happen in Lusaka.

The self-administered questionnaire survey was adopted as the main research instrument which was based on the advantages that a representative sample would be realised with little time or costs. It was distributed and collected by hand with a brief introduction of the aim of the research and to ensure that at least 80 percent of the distributed questionnaires were collected. It was accompanied with a cover letter and it was divided into three sections. Sections A contained bibliography questions. This identified users in the formal or the informal sector. Section B involved multiple choice questions targeted on Road users'/vehicle owners, ZABS, RTSA and Police officers.

There were cases where in-depth discussions happened to get a better understanding of their responses and to clarify certain questions. Section C was the descriptive part which was targeted on tyre resellers. There were cases where questions had to be translated which ended up being in-depth interviews. The questions which involved the interview section involved brainstorming. This ensured that various questions used in the research were addressed to get a better understanding of the results. It also gave enough time for the respondents to consult where questions were not clear in order to answer questions more appropriately. Hence, this method of data collection was more advantageous when compared to other methods such as interviews. Therefore, the questionnaire was designed to meet the research's aim and its objectives and that questions could be answered within 20 minutes.

The data collected from the interview and questionnaires helped to come up with mitigating actions aimed at reducing the risks as a result of vehicle owners driving their vehicles with second hand tyres especially those ones from the black market.

Table 3-1 gives a full description of the individuals who took part in both the interview and questionnaire survey.

Table 3-1: Participants in Interviews and Discussions

| Category | Number of Participants |
|---|---|
| Tyre Resellers | 30 (5 groups were seen each having 4 to 6 people) |
| Tyre Menders | 20 (3 groups were seen each having 5 to 6 people) |
| Road users | 30 |
| Bus drivers | 10 |
| Police Traffic officers | 6 |
| Zambia Bureau of standard officers (ZABS) | 3 |
| RTSA Officers | 6 |

ii) Statistical Data from Zambia Police

Under quantitative approach, another method that was used to collect data involved getting some statistics from Zambia Police on the accidents that could have occurred in the past 4 - 5 years and to analyse those that were caused by tyres which would lead us to a conclusion on the risks of using second hand tyres.

3.4 Tool used in the research

The tool that was used in the research was a semi structured questionnaire. Interviews were another means of data collection. Other than that, there was also the use of secondary data. In the analysis, excel sheet was used to interpret the results.

3.5 The study area

Figure 3.1 shows the study area in Lusaka. Lusaka province is one of the 10 provinces in Zambia. It is located in the southern part of the country. Lusaka province was taken as it records the maximum import of second hand vehicles coming into the country. Statistics recorded by Zambia Police and their statements shows that it has the highest number of reported accidents and the area has the

largest road traffic casualty rate in the country. Another contributing factor can be seen from the number plates registered on vehicles. Figure 3-2: shows the number of crashes by Province in first, second and third quarters of 2015. Lusaka Province is one of the highest populated provinces in the country.

The local languages which were used in this research involved Nyanja and Bemba. However, English was the main source of communication especially with the respondents who were in the formal sector. Efforts to prevent variability in sample size and analysis were made. The sample size was confined to Lusaka town, the capital of Lusaka province because according to statistics, Lusaka town contains the highest number of households that own motor vehicles. This provided a sample representation of the whole country.

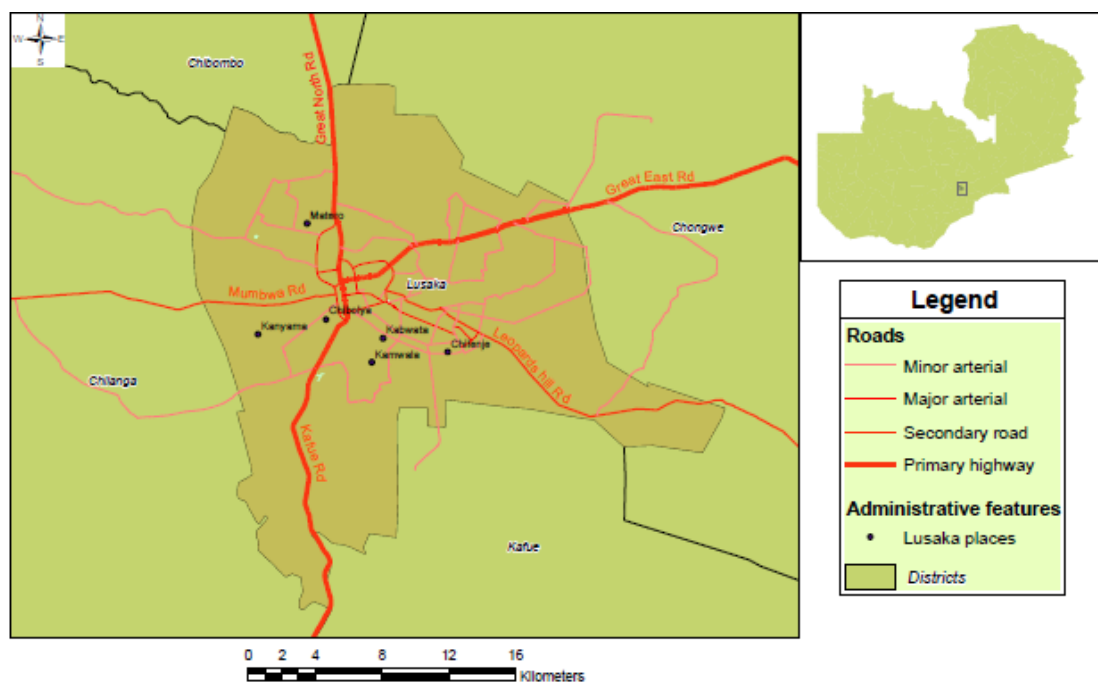


Figure 3-1: Shows the Study areas of affected roads where majority of accidents

(Source: Captured by the author, 2015)

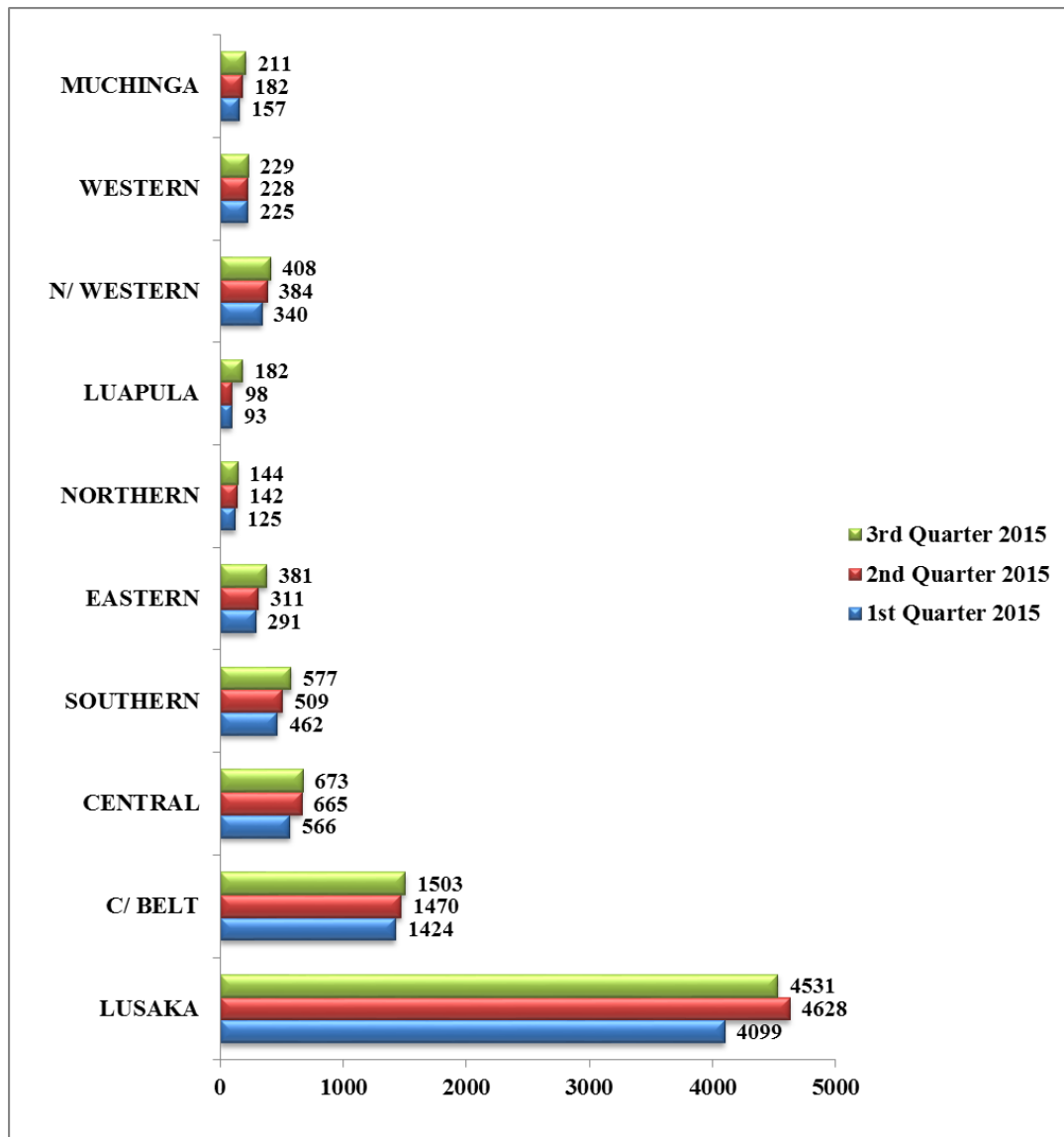


Figure 3-2: Number of crashes by Province in first, second and third quarters of 2015

Source: RTSA, 3rd quarter accidents report for 2015

3.6 Research Ethics

Following ethical and professional conduct advocated by literature, ethical issues were incorporated in the research process. This included following all due processes that were necessary in the design of the investigation, data collection, processing, analysis and interpretation. This involved getting permission from senior Traffic Offices at Zambia Police and RTSA to carry out this research in their places of work. Sensitive government information was treated with extreme care and for research purposes only. Care was also taken to ensure that data collected was accurate and

reliable. External factors that could undermine the integrity of collected data were excluded as much as possible. Individual participants and collected information was guarded against any abuse of rights committed to any person or organisation likely to be incurred during the research process. No mention of names was done during this research.

3.7 Summary

This chapter presented the methodology which was used to carry out the research and addressed its aims and objectives. In this chapter, highlights about the various methodologies that could be adopted for research purposes were discussed. The chapter further presented an explanation of how the problem was investigated and described the tools that were used to undertake the study. It also described the sampled population and the method of analysis that was employed.

The next chapter discusses the data that was collected and analysed in the study.

4.0 CHAPTER FOUR

Data Analysis and Discussion

4.1 Introduction

The previous chapter described the methodology that was used in conducting the research. It outlined the techniques which were used during data collection. In this chapter, collected data was analysed by using the methods described under methodology. The data was analysed in relation to the research objectives. This section also discusses the results obtained through interviews and questionnaire surveys. Excel sheet was used to analyse the data which was obtained by coming up with proportions and arriving to a conclusion.

4.2 Profile of the sampled population

In Zambia, the profile of informal tyre resellers was between two to ten years working experience in the tyre selling business. All the tyre resellers and menders were males and over half of them were illiterate workers. Four groups from the sampled population involved;

- a. Road users & Bus drivers which consisted of approximately 30 respondents. Bus drivers constituted of 10 though other drivers will join an ongoing conversation;
- b. Tyre resellers and tyre menders which consisted of 20 respondents. That is three groups having 5 to 6 people each;
- c. Six Zambia Traffic Police officers and 3 RTSA (statistics & research and inspecting officers) and finally
- d. Two Customs and three ZABs inspector officers

4.3 Statistics of vehicle Importation in Southern Africa

The actual statistics for volumes of used car imports entering Zambia is not as clear as certain records are designed to assist with whatever purpose the statistics would be used for. However, this secondary information may be used to determine where Zambia is ranked in terms of vehicle importation. At the time of data collection, available online data ranged between 2010 and 2012. For the following years being 2013 and 2014, there were no statistics found during data collection and analysis. However, for the purposes of comparison, only two years were taken which were 2010 and 2011. This has been shown in table 4-1 that Zambia was amongst the top 3rd importer of second hand vehicles in Southern Africa. These statistics shows that there has been a rapid increase in importation of second hand used cars, which are not normally fitted with brand new tyres. These numbers are in addition to the imported second hand tyres and it gives a general over view of the total number of second hand tyres entering the country.

Table 4-1: Showing the Vehicle importation statistics in Southern Africa between 2010 and 2011

| NAME | TOTAL | |
|---------------|-------------|-------------|
| | 2010 | 2011 |
| Angola | 8 | 1 |
| Botswana | 3151 | 10256 |
| Congo (DRC) | 1227 | 2613 |
| Lesotho | 67 | 372 |
| Malawi | 1002 | 1656 |
| Mozambique | 3524 | 7890 |
| Namibia | 298 | 591 |
| South Africa | 0 | 41727 |
| Swaziland | 808 | 521 |
| Zambia | 3554 | 9815 |
| Zimbabwe | 1167 | 1725 |

Most Zambians import their vehicles from Japan, however, a small volume of used vehicles are being imported from countries such as Singapore, United Arab Emirates (Dubai), England (U.K.), and U.S.A. These vehicles are imported through Durban and Dar-es-Salaam ports. The main reason for uncertainty of actual volumes of these imported vehicles is because many vehicles are custom cleared in Japan having final destination as Dar-es-Salaam or Durban. The actual destination is only confirmed

after the exporter sells the vehicles from the bonded yards at these ports. Therefore, it is not necessary to advise Japanese Customs afterwards. It is assumed that 30 percent of the volumes of used vehicles which are destined for Durban port or Dar-es-Salaam port are bound for Zambia. A very small volume of vehicles is shipped through Maputo and Walvis Bay though the figures are insignificant at this stage.

Today, there is a large volume of vehicles being shipped directly to Zambia using shipping terms such as Coast, insurance and freight (CIF). These vehicles are either transported in containers from Japan into Zambia or cleared at the port and then driven or carried on a truck into the country.

4.3.1 Accidents and fatalities per 10,000 registered motor vehicles

According to an annual report from RTSA on accident statistics, accidents and fatalities are linked to the total number of registered motor vehicles. An estimate of every 10,000 registered motor vehicle indicators shows the ratio of accidents and fatalities to the number of registered motor vehicles which in turn establishes the extent to which road crashes contribute towards public health problems. Table 4-2 shows an increase in the number of accidents per 10,000 motor vehicles and number of fatalities per 10,000 motor vehicles from 135 to 136 and 9 to 10 respectively. As at September 30th, 2015 the cumulative number of registered motor vehicles stood at 636,378. By looking at these accident statistics, one can tell that there has been a shady increase in the number of vehicles entering into the country.

Table 4-2: Shows number of accidents and fatalities per 10,000 vehicles

| Year | Number Of Vehicles Registered | Number Of Accidents | Number Of Fatalities | Number Of Accidents Per 10,000 Vehicles | Number Of Fatalities Per 10,000 Vehicles |
|--------------------------------|-------------------------------|---------------------|----------------------|---|--|
| 2015 (1 st Quarter) | 620,758 | 7,782 | 465 | 125 | 7 |
| 2015 (2 nd Quarter) | 636,378 | 8,617 | 563 | 135 | 9 |
| 2015 (3 rd Quarter) | 651,280 | 8,839 | 641 | 136 | 10 |
| Jan to Sept 2015 | 651,280 | 25,238 | 1,669 | 388 | 26 |

Source: RTSA (2015)

Table 4-3 shows the number of road traffic crashes resulting from motor vehicle mechanical failures. In this table, tyres were ranked highest in road traffic crashes resulting from motor vehicle mechanical failures. In the first quarter of 2015 tyres accounted for 66 crashes out of 132 whilst in the second quarter of the same year they accounted for 49 crashes out of 102 road traffic crashes. In the third quarter, tyres contributed 62 crashes out of 122 from the motor vehicle mechanical failure related cases. As from January to September 2015 a total of 356 were recorded out of these 167 were as a result of tyres bursts. The second in ranking was motor vehicle brake failure accounting for 45 cases of 122. The remaining contributing factors included steering wheel, defective lights, unattended to motor vehicle, vehicle overloaded and vehicle no reflectors.

Table 4-3: Shows number of road traffic crashes and their contributing factors resulting from vehicle mechanical failures

| Contributory Factors | 3rd quarter 2014 | 1st quarter 2015 | 2nd quarter 2015 | 3rd quarter 2015 |
|---------------------------------|------------------------|------------------------|------------------------|------------------------|
| Mechanical Failure | 2014 | 2015 | 2015 | 2015 |
| Brakes | 28 | 37 | 33 | 45 |
| Tyres | 76 | 66 | 49 | 62 |
| Steering | 10 | 11 | 5 | 2 |
| Springs | 9 | 4 | 2 | 3 |
| No front lights | 7 | 1 | 2 | 0 |
| No rear lights/ reflection | 1 | 0 | 1 | 0 |
| Unattended vehicle running away | 4 | 10 | 7 | 4 |
| Smashed windscreen | 2 | 1 | 0 | 0 |
| Vehicle overloaded | 4 | 2 | 3 | 6 |
| Total | 141 | 132 | 102 | 122 |

Source: RTSA (2015)

4.4 Results Analysis

4.4.1 Overview of answered research objectives and questions

The results obtained were in relation to the research objectives and research questions. Structured interviews were conducted in the period between December 2014 to March 2015 as well as the distribution of questionnaires.

- a) The first objective was to identify whether or not vehicle users know and understand the dangers of using second hand tyres. This involved administering a questionnaire to understand whether or not users are aware of the dangers of using second hand tyres. An in-depth interview was carried out with informal tyre resellers in understanding this aspect too. Figure 4-1 shows the percentage of users who knew the dangers of importing or driving vehicles with Second hand tyres. It was discovered that 64.30 percent of road users including bus drivers answered that they did not know the dangers of importing or driving vehicles with second hand tyres. Meaning more than 50 percent of the sampled population are at risk of buying these second hand tyres.

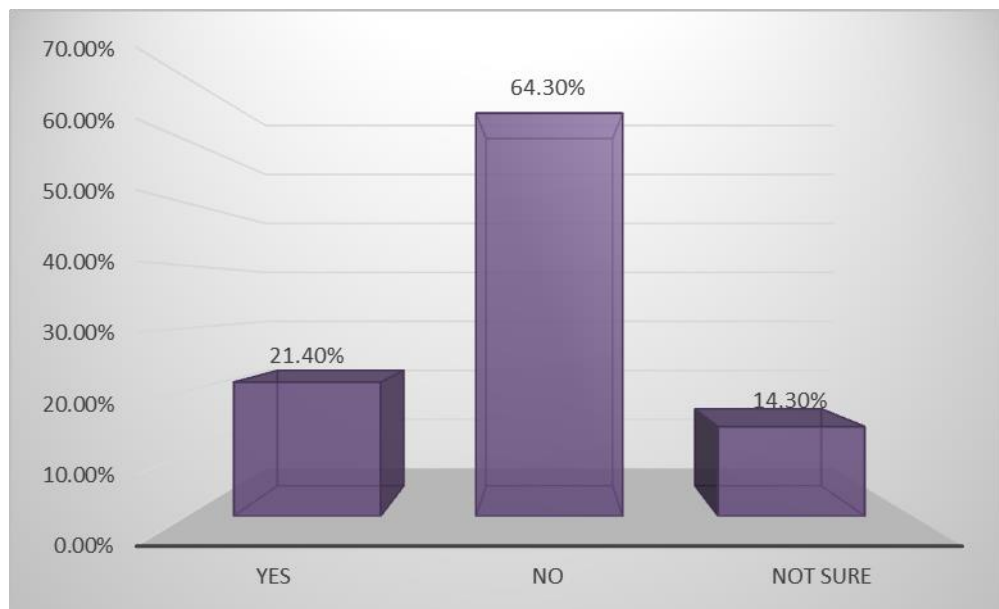


Figure 4-1: *Percentage of users who knew the dangers of importing or driving vehicles with Second hand tyres*

- b) The second objective was to identify the possible risks associated with second hand tyres. This was identified through an in depth interview with the sampled population. Other than that, they were also identified through the use of literature review in relation to articles and journals relating to the accidents and the use of second hand tyres. The risks which were identified were as follows;

i) The Inability to grip on the road due to weather conditions.

This meant that when vehicles' treads are finished and surfaces are smooth, the vehicle would easily skid off the road when moving at high speed especially when the driver decides to apply some brakes.

ii) Tread separation

In an event that a vehicle user purchases a good second hand re-threaded tyre and the bonding wasn't done properly, the tyre tends to have separation especially when the tyre is in high motion.

iii) Over Inflation or Under inflation causing a tyre to rupture

When a tyre is over- inflated, the tyre bulges and forms cracks in the middle. When temperatures increase within the tyre, the tyre may burst. When under-inflated, the casing of the rims rests on the tyres and wears on the other sides. This causes the outward cracks of a tyre and pieces of rubber to start falling apart.

iv) Expiring date

Every tyre has a date of manufacture which is labelled on its sideward. According to literature, the tyres maximum performance is within the first 4 years from the date of manufacture. Thus, it is recommended that beyond 6 years from date of manufacture (DOM), a tyre should not be used. But in Zambia, this is not the case. It was discovered that the majority of the tyres which were being sold had DOM beyond 4 years.

v) Chemical reactions as a result of the tyres exposure to the atmosphere (Direct sunlight)

It was discovered that tyre resellers are not knowledgeable of the proper storage of tyres. It can be shown in Figure 4-2 that resellers leave their tyres in open direct sunlight which has effect on tyre life. According to literature, tyres should not be exposed to direct sunlight because of chemical reactions that occur when polymers are exposed to sunlight. When exposed to direct sunlight, they react to the atmosphere and the rubber stiffens and becomes hard hence causing the tyre to crack when the vehicle is in motion on the road.



***Figure 4-2:** Display of tyres in direct sunlight by informal tyre resellers*

4.4.2 Disposal of tyres on the roads

There were several signs seen which indicated that there was no legal enforcement put in place in terms of the quality of tyres on Zambian roads. Useless tyres were seen lying across many open roads which indicated the unfitness and worn out tyres on public roads as shown in Figures 4-3. It can also be seen that tyres are also being disposed of by using them as tables my marketers.



Figure 4-3: Example of Disposal of Tyres

4.5 Discussion of the Results

4.5.1 Road users and Bus driver's responses

In order to answer one of the research objectives which were to know the level of awareness that people should look out for before buying a second hand tyre from vendors, it was discovered that 57 percent didn't know about summer and winter tyres. It was also discovered that some of the tyres which users bought were actually winter tyres and when temperatures are high, they tend to have tyre bursts. This is because they are not designed to operate in areas where temperatures are over 20 degrees. The bus drivers mentioned that even if they are aware of some of the tyres which they drive are worn out, they tend to swap with good ones from their colleagues during fitness examinations. This simply shows that the tyres which are used on the roads are not properly examined. At the same time, little attention is paid to the conditions of the tyres at an accident scene. They admitted that most of them simply go to the black market at Soweto for example, simply because of the relative prices of the tyres. Prices range from ZMW50.00 (USD4.42) to roughly ZMW300.00 (USD25.54) for passenger vehicles like the sedans and the small mini buses carrying 16 passengers. During fitness examinations, they mentioned that RTSA use visual inspection to check for the quality of the tyres.

Over 61 percent of the 46 respondents mentioned that Tyres dealers do not provide professional advice when selling tyres. This is because they too, do not understand the markings on the tyre. They would only ask for which tyre size the user is interested in.

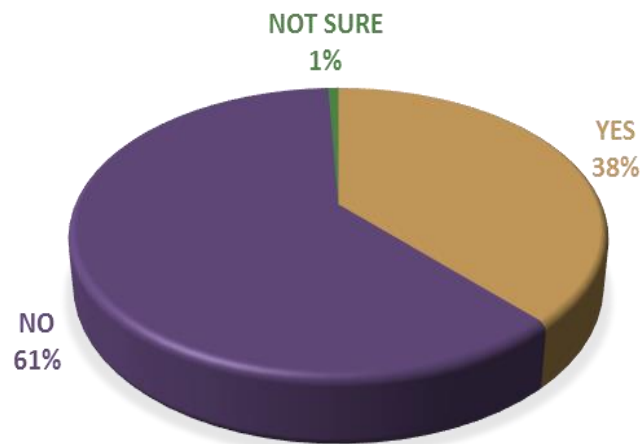


Figure 4-4: Percentage values of whether car dealers provide professional advice when selling tyres

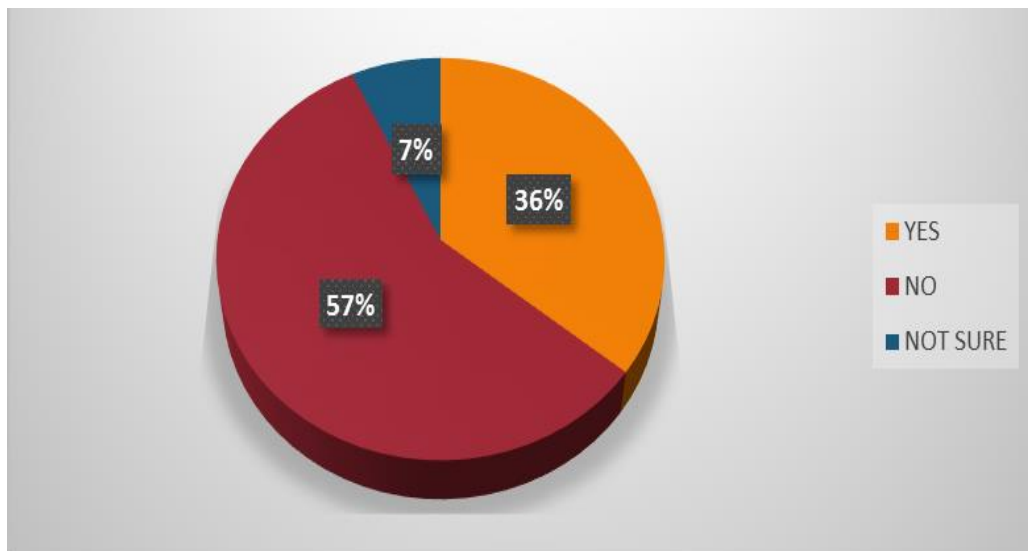


Figure 4-5: Results showing the familiarity of winter and summer tyres by vehicle users and bus drivers

From the results obtained in determining how knowledgeable people are in determining which tyres to buy, it can be seen that 57 percent of these people do not seem to know the difference between summer and winter tyres. Winter tyres are

tyres that are used in places that experiences snow whilst summer tyres are those that are used in areas where there is no snow. Winter tyres have the word ‘snow’ written on them whilst summer tyres have S/W meaning, it can be used in both winter and summer environments. In an interview with some informal tyre resellers, they pointed out that they could identify the difference between the two but because they needed to sell and earn a living, they didn’t care whether or not to educate buyers on the types of tyres being sold. When temperatures exceed the normal operating temperatures of winter tyres, they tend to burst. In an event the vehicle is moving at a high speed and has experienced a tyre burst, the driver may fail to control the vehicle hence resulting in an accident.

Road users including bus drivers mentioned that overloading was the main cause of tyre bursts when compared to other causes in the figure 4.6.

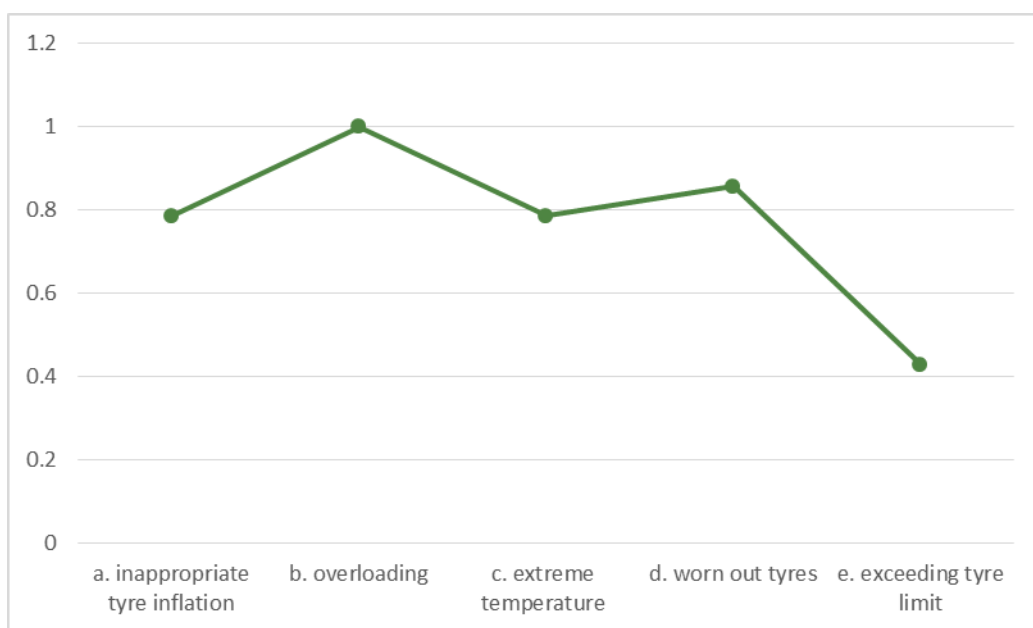


Figure 4-6: Ranking of the main causes of tyre bursts

About 72 percent of the respondents admitted that they did not understand the meaning of the writings on the tyre as shown in figure 4-7. These writings include specifications such as inflation and deflation ratings, date of manufacture which helps to determine the expiry date, maximum load and speed ratings.

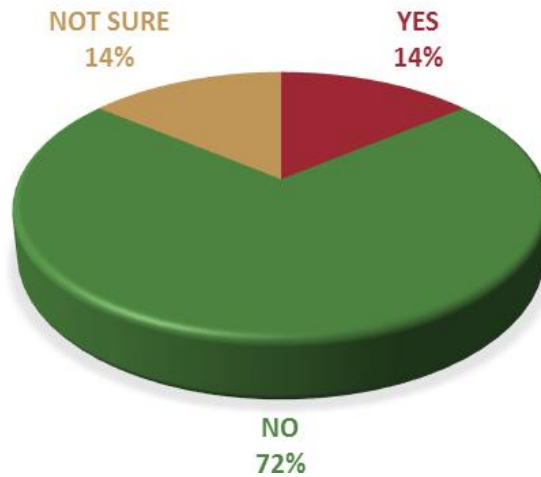


Figure 4-7: *Percentage of respondents who understand the writing on the tyres*

On the legal limit of 1.6mm tread wear, only 7% indicated understanding of the limit as shown in figure 4-8.

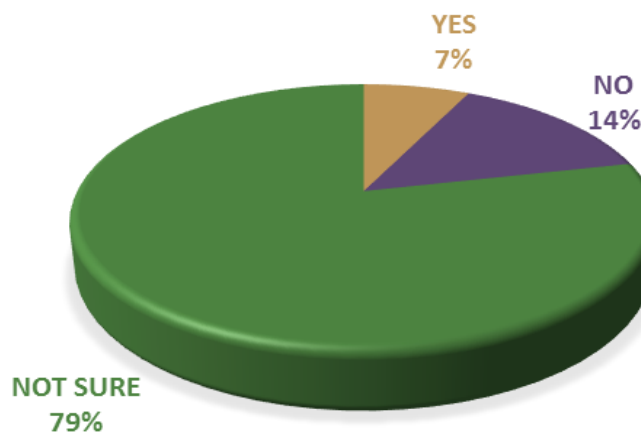


Figure 4-8: *Percentage for understanding the legal limit*

4.5.2 Analysis with Informal Tyre resellers and Tyre Menders

Five groups were sampled from the tyre resellers and 3 groups from the tyre menders in areas such as Soweto market and surrounding areas near millennium station, Avondale, Chelstone and Kabwata areas. These groups of people were very cooperating and willing to share what they knew and learn from what I had to share.

They mentioned that containers of tyres that come to Soweto market sale heaps of either 10 or 20 tyres per load without giving a choice to the resellers to select the very best. They have a mixture of a standard, ranging from good to very bad. Clearly, it could be seen that these tyres were not too good and when asked whether or not ZABs had visited their premises, 100 percent admitted saying that they had never been visited for any sort of quality inspection. Resellers in Chibolya area admitted that the selling of second hand tyres was fit for the area and some second hand tyres were far much better than brand new 1st hand tyres. They admitted to say a second hand Bridgestone tyre was better than a brand new chines tyre. During an in-depth interview with tyre menders on whether they knew of any disposal area of second hand tyres, only one group mentioned that there existed a place known as Chingwele Zats near Chelstone area.

When both groups were asked if they knew how to check for the expiring date, 75 percent of the respondents mentioned they didn't know how to check for this and didn't quite understand the markings and readings on the tyre; see figure 4-9. This made it difficult to give professional advice to the buyers. They instead pointed out that every tyre has a mark which is used to determine its wear. If the treads of the tyre reach that particular mark, they would easily conclude that the tyre is finished and should be disposed of. But instead of disposing it off, they would still sell these tyres for other reasons in order to have some money in their pockets. The prices vary from K50 (USD4.42) to K300 (USD26.54) for passenger tyres as shown in figure 4-10.

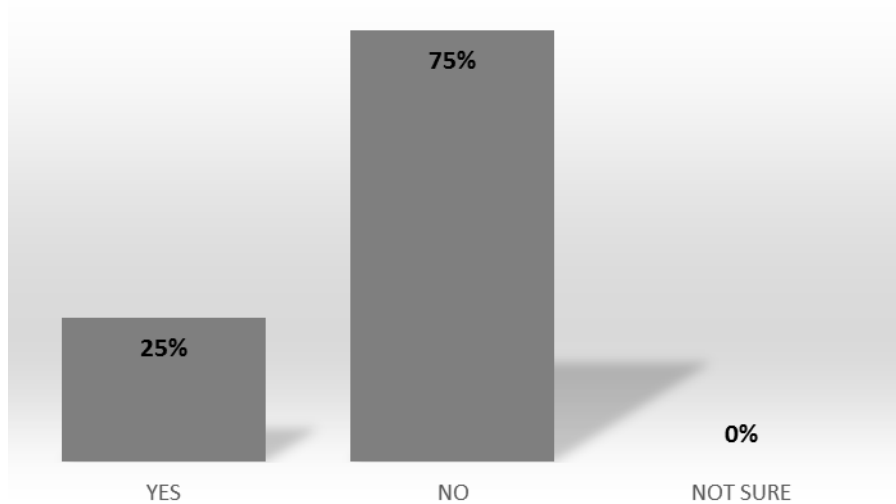


Figure 4-9: Level of understanding when checking for the expiry date of tyres



Figure 4-10: Sale prices of second hand tyres by informal tyre resellers

When asked whether or not they knew about the dangers of exposure of tyres to direct sunlight due to oxidation of polymers which stiffen the rubber resulting in cracks, they mentioned that they were not aware of this. This is why majority of them are seen displaying these tyres for sell as shown in figure 4-11.



Figure 4-11: Showing the selling of tyres in direct sunlight

4.5.3 Analysis with ZABs and Customs Officers

One of the officers at customs office at Chanida border between Zambia and Mozambique admitted that they do not check for the quality of the tyres. The office responsible for checking for goods is the one closest to the offices of the customer. From their end, they pointed out that most of the tyres entering the border were brand new. A non-intrusive scanner is normally used to sample the container or truck in order to know the contents and random sampling is done. This helps to check the images of the content which is usually in black and white. Standard charges for passenger tyres was 25 percent duty fee on customs plus 16 percent VAT. For truck tyres, there is only the VAT charge of 16 percent. They admitted that their interest lies in checking for JEVIC certificate before issuing a clearance certificate. If the certificate is missing, the vehicle is sent to ZABS in order to pay for penalty fee. ZRA officers admitted that they are only interested in the valuation of the vehicle, model and year of make as it determines the value of what has to be paid.

There are two ways in which goods are inspected; either at the border or when the goods are taken to the client's premises. If during car inspection at the border by the customs office a vehicle is found without JEVIC, ZABS charges a penalty fee. Usually only a penalty fee is paid for without any inspection done. No one seems to

pay any attention on the condition of tyres. This penalty fee is 15 percent of CIF of the car.

When the Inspecting and Information officers at ZABS were interviewed, they admitted that they usually deal with brand new tyres and they check the standards of these tyres by measuring their tensile strength before they can be put up for sell. Samples are taken into the labs during this process. The standard which is used to test for tyres is called Pneumatic tyres specification ZF-437. They do not check for quality of second hand tyres simply because they do not have a standard for them in the country apart from inspecting the standard of products before they are put on shelves. Although they do not deal with the quality of second hand tyres, they deal with customer complaints on new tyres. When a company or individual deals in tyres, they usually inspect their goods up to at least 4 times consecutively from the time they buy tyres within their purchasing period. By looking at the standard and if there is no compliant, the customer is then issued an annual guarantee and within the year, the client will not be further subjected to any inspections.

4.5.4 Analysis with Zambia Police and Traffic officers

It was reported that there is no independent data collected on second hand or worn out tyres. However, it was highlighted that accident data is incorporated in road traffic accident causations.

- One research question was to understand the extent the enforcement record data on accidents caused by the prolonged use of second hand tyres/finished tyres.

In answering this question, it was discovered that there is no record to this effect since there are very few causes of accidents reported pointing to the prolonged use of tyres. The authority being Police traffic officers and RTSA responded that they do not check on the prolonged use of tyres apart from accident causations.

- Another research question was to understand to what extent the enforcement authority checks for tyre fitness. They answered that fitness was determined at both vehicle inspection centre and at an accident scene. Others mentioned that

they followed the guidelines of the Traffic Laws of Zambia which is the physical condition of the tyre. In general, they do not constantly check for a tyres' condition regularly.

- Another research question looked at what things are considered during an accident scene. The respondents answered as follows:
 - The condition of the tyre before and after the road crash;
 - possible causes, skid marks on the road to help determine the speed of the driver;
 - casualties/victims;
 - eye witnesses
 - fitness of the vehicle weather or not it is road worthy;
 - braking system;
 - tyre burst;
 - drivers licence;
 - Road network; and finally over speeding.

Figure 4-12 shows a summary of the contributing factors to road traffic accidents between the years 2003 to 2014. As can be seen from this figure, only 275 recorded accidents were related to tyres. However, no one positively mentioned if at all any of them were as a result of the prolonged use of second hand tyres.

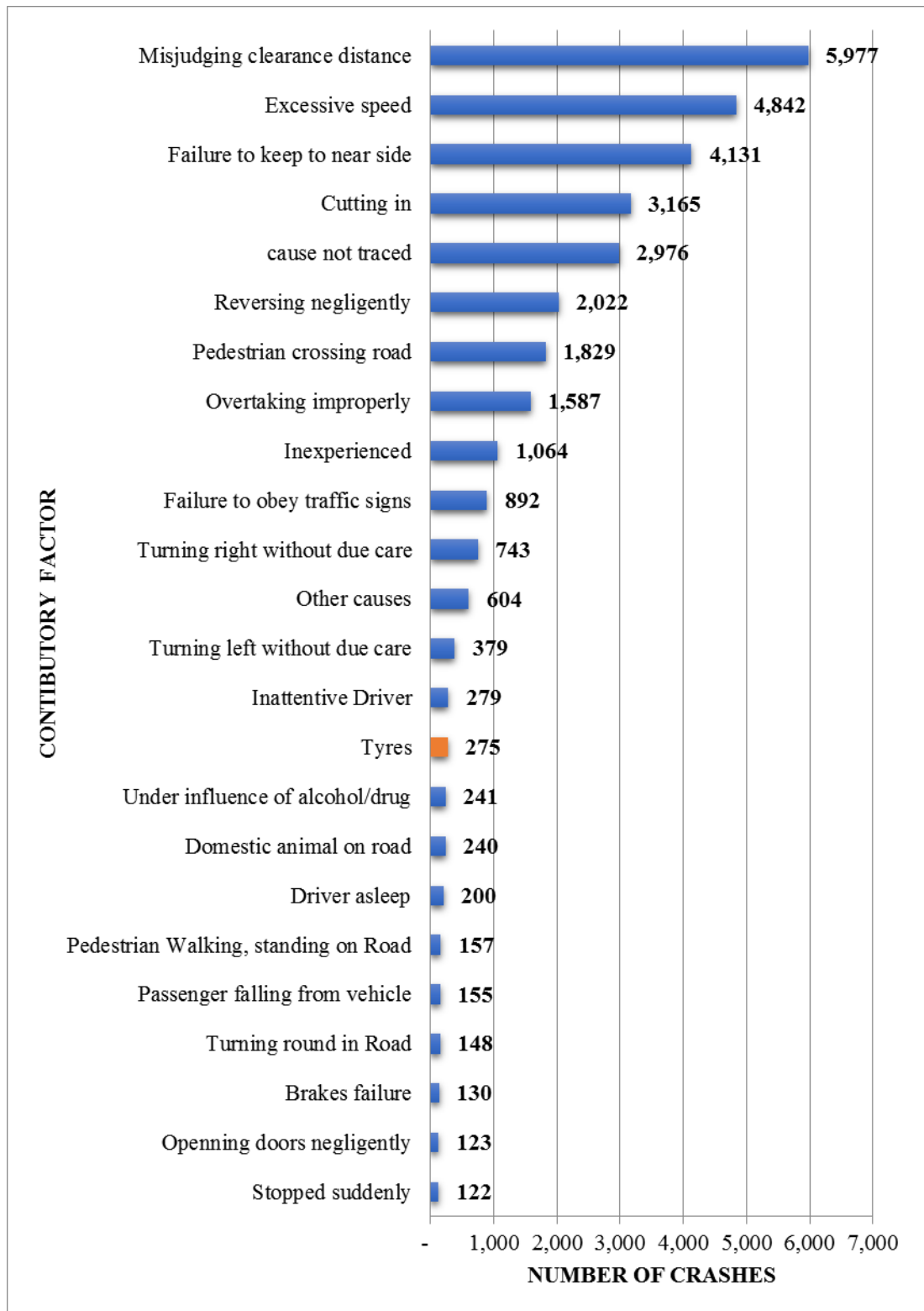


Figure 4-12: Contributing factors to Road Traffic Accidents

Source: 2003 to 2014 3rd quarter aggregated RTSA Accident Statistics

Figure 4-13 shows the crashes reported between the years 2006 to 2014 whilst Figure 4-14 shows the fatalities recorded in the same period. Accidents due to

various causes which could have happened have claimed the lives of so many people as can see from these statistics.

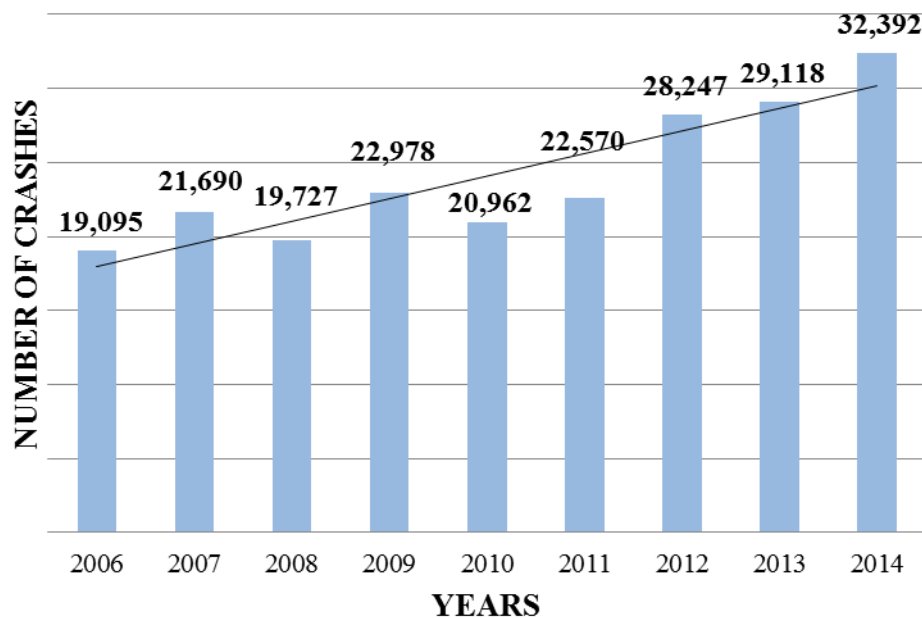


Figure 4-13: Road Crashes reported from 2006 to 2014

Source: RTSA (2015)

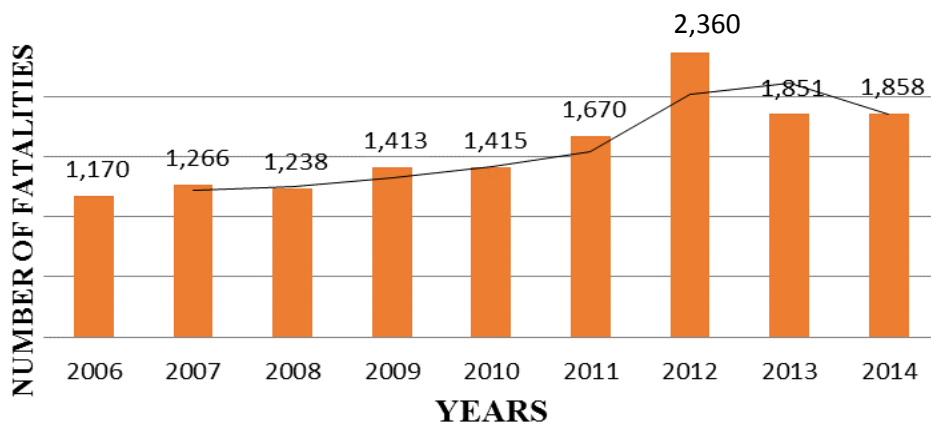


Figure 4-14: Fatalities recorded from 2006 to 2014

Source: RTSA (2015)

During the research, an annual report for the third quarter involving road traffic crashes, fatalities and injuries between 1st July 2015 and 30th September 2015 was

sourced from RTSA. The report gave a comparison of the number of road crashes, fatalities, serious and slight injuries recorded in the first and second quarters of 2015 against third quarter of 2014. According to RTSA, the source of this data was Zambia Police. It was discovered that RTSA would always get this secondary data from Zambia Police to generate their own accident reports. RTSA reported that there is usually a delay in collecting data from Zambia Police reason being, the information is compiled and recorded manually. There is no sophisticated accident information system which has been put in place to help quicken the process.

In 2015, a total of 8,839 road crashes were recorded between 1st July and 30th September 2015. In the first quarter of 2015, a total of 7,782 road crashes were recorded whilst in the second quarter of 2015 crashes, a total of 8,617 were recorded. The number of road crashes recorded increased in absolute terms by 22 representing an average increase of 2.5 percent from the second to the third quarter. Taking a period from 1st January 2015 to 30th September 2015, a total of 25,238 road crashes were recorded. In the first and second quarters of 2015, Lusaka province had continued to record the highest number of road crashes followed by Copperbelt and then Central, Southern, North Western, Eastern, Western and Muchinga provinces. The increase in the number of road traffic crashes can be attributed to the increase in the number of motor vehicles. There were also other contributory factors which will be discussed.

▪ **Number of Fatalities**

People have the assumption that most of the accidents happen in the urban areas. When further research was done, it was discovered that actually most of them happen in the rural areas. Figure 4-14 shows the distribution of fatalities in urban and rural areas during the first, second and third quarters of 2015. A total of 1943 fatalities were recorded in the third quarter of 2015. From this distribution, 1093 was from the rural count which represented 56 percent of the total fatalities. The urban who contributed 850 of the total fatalities gave a percentage of 44 percent of the total fatalities. A similar trend was recorded in the first quarter of 2015 where out of 1658 fatalities recorded, rural areas contributed 861 fatalities representing 52 percent on the other hand fatalities in urban areas stood at 48 percent. In the second quarter of 2015 a total of 1603 fatalities were recorded, rural areas accounted for 834

representing 52 percent, whilst the urban areas had a proportion of 48 percent. The statistics indicate that people in rural areas are more vulnerable to road users.

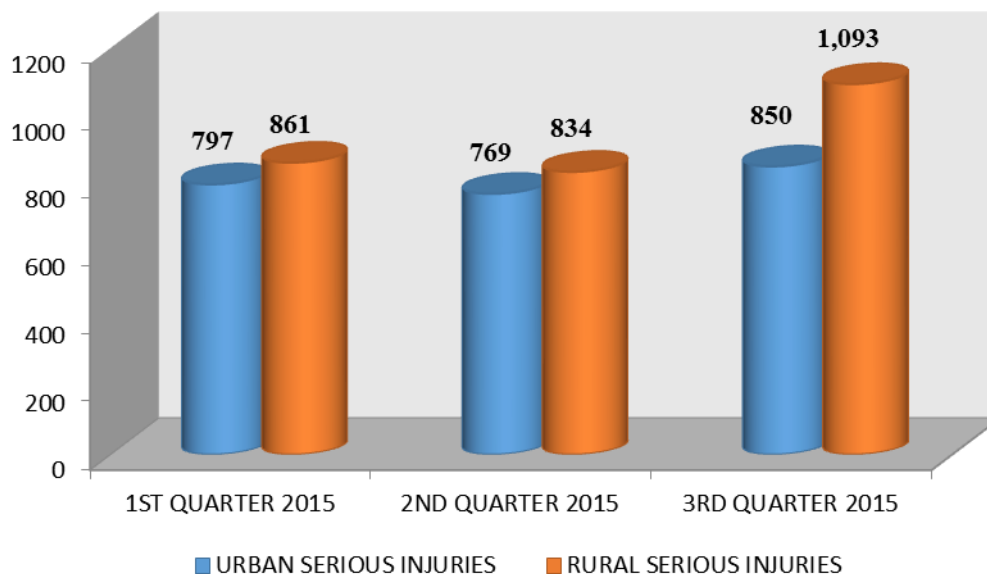


Figure 4-15: Number of serious injuries in Urban and Rural areas in Zambia

Source: Zambia Police

4.5.5 Analysis with RTSA Traffic, Statistics and Research Officers

During the interview, key risk factors contributing to Accidents were categorised as being caused by;

- a) Human error;
- b) Pedestrians;
- c) Mechanical defects;
- d) Road defects
- e) Whether conditions

In the interview, it was mentioned that the leading contributor to accidents was as a result of human error which was due to:

- i) Excessive speeding;
- ii) Misjudging and
- iii) Not being experienced.

Table 4-4: Shows number of crashes resulting from driver errors

| CONTRIBUTORY FACTORS | 3rd quarter | 1st quarter | 2nd quarter | 3rd quarter |
|--|----------------|----------------|----------------|----------------|
| (A) DRIVER | 2014 | 2015 | 2015 | 2015 |
| Negligently opening door of vehicle | 20 | 32 | 35 | 15 |
| Under influence of drink/ drugs | 28 | 45 | 58 | 62 |
| Inexperienced | 243 | 364 | 273 | 361 |
| Excessive speed | 1197 | 1058 | 1229 | 1383 |
| Failing to keep to near side | 1057 | 933 | 1090 | 1086 |
| Cutting in | 822 | 796 | 826 | 908 |
| Overtaking improperly | 438 | 365 | 397 | 401 |
| Skidding | 15 | 15 | 9 | 20 |
| Turning round in road | 52 | 35 | 37 | 50 |
| Failing to obey the traffic sign/ signal | 195 | 180 | 215 | 151 |
| Failing to signal | 16 | 5 | 42 | 19 |
| Inattentive/ attention diverted | 65 | 79 | 101 | 116 |
| Turning right without due care | 229 | 207 | 245 | 209 |
| Turning left without due care | 130 | 105 | 96 | 100 |
| Dazzled by lights of other vehicle | 17 | 16 | 20 | 25 |
| Stopped suddenly | 34 | 42 | 7 | 95 |
| Misjudging clearance distance or speed | 1216 | 1179 | 1414 | 1211 |
| Other errors of judgment | 258 | 211 | 251 | 235 |
| Driver asleep | 47 | 27 | 18 | 35 |
| Reversing negligently | 613 | 544 | 582 | 628 |
| Miscellaneous | 1 | 0 | 0 | 0 |
| TOTALS | 6693 | 6238 | 6945 | 7110 |

Source: 3rd Quarter 2015 RTSA Accident Report

Table 4-4 shows that factors relating to driver errors accounted for 7,110 road crashes representing 80.4 percent (8,839) of the total crashes. In the first quarter of 2015, motor vehicle drivers accounted for 6,238 road crashes out of 7,782 road crashes representing 80 percent of the crashes. In the second quarter of 2015, motor vehicle drivers contributed 6945 road crashes representing 81 percent (8,617).

From these statistics and analysis, on average, 80 percent of the road crashes in Zambia are caused by driver errors. Excessive speed and misjudging clearance were found to be leading contributory factors arising from driver errors.

Amongst the mechanical causes were:

- i) tyres being over loaded,
- ii) over inflated tyres;
- iii) age of tyre;
- iv) springs and steering wheel; and
- v) Neither rear reflectors nor front lights.

Table 4-3 shows the number of road traffic crashes as a result of motor vehicle mechanical failures taken from RTSA accident and statistics research office. As can be seen, tyres were ranked higher in road traffic crashes resulting from motor vehicle mechanical failures. In 2015 first quarter, tyres accounted for 66 crashes out of 132 whilst in the second quarter they accounted for 49 crashes out of 102 road traffic crashes. In the third quarter of 2015, tyres contributed a total number of 62 crashes out of 122 from motor vehicle mechanical failure related cases. From the statistics recorded between January to September 2015, a total of 356 were recorded out of these 177 (49.7%) were as a result of tyres bursts. The second in ranking from tyre related accidents were motor vehicle brakes which accounted for 45 cases of 122 in the third quarter of 2015, in percentage this was reported as 36.9%. The rest included failure of the steering wheel, defective lights, the motor vehicle being unattended to, overloading of the vehicle and vehicles having no reflectors.

During the interview, it was discovered that RTSA relies on Zambia Police statistics on all data captured on investigations to do with any type of accidents. In 2014, RTSA acquired a machine to help them during vehicle fitness examinations however, the standards of this equipment were rather high and the general public complained on the results which it would produce. The Minister ordered to stop usage of the machine. In the early months of 2015, RTSA officers managed to organise with the manufacturer of the machine to adjust the settings to suit the Zambian environment. The authority also procured some threads and wear detectors for purposes of tests though this hasn't yet been launched. Officers use the naked eye to determine how good or bad the tyre is during vehicle fitness examinations. Little attention is paid in checking the condition of the tyre as most of them admitted they do not understand the markings on the tyre and do not know that some are winter or summer tyres or how to check for the expiry date. They mentioned that it was difficult to sensitize vehicle owners because of their lack of knowledge though it was important to sensitize the nation on the dangers of prolonged use of second hand tyres and the markings on the tyre.

4.5.6 Proposed framework for checking for fitness for any tyre

With the reasoning from vehicle owners and the authority, it is important to establish a framework which the authority can use when an accident has happened especially when people want to determine the cause of the accident. The other would be one that vehicle owners could use before they buy tyres from whichever source as shown in figure 4-16.

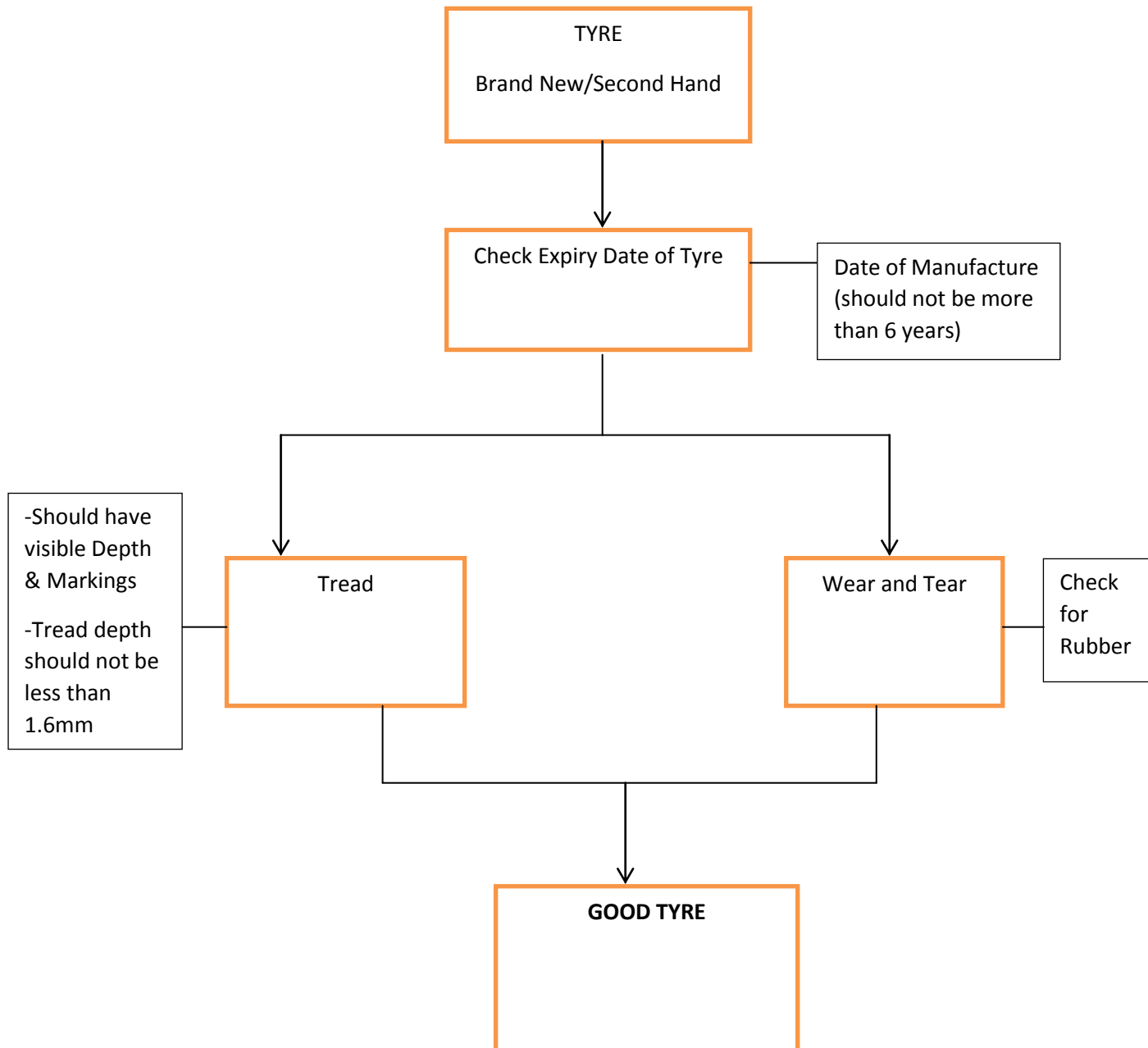


Figure 4-16: Proposed framework when checking for fitness for any tyre

When a person is either buying a brand new tyre, second hand tyre or when a vehicle has been involved in an accident, people should take time to inspect the quality and nature of the tyre. Most importantly one should check for the expiry date. This is determined by checking for the date of manufacture of the tyre. This date is indicated

on the side wards of the tyre and literature recommends that DOM of the tyre should not be more than 6 years if it has to be comfortably used. Once that is checked and before a user makes an informed decision, it is important to check the treads, wear and tear of the tyre. In checking the wear and tear, one can check whether or not the rubber is stiff and if at all it has any cracks. Should it have them, it's not recommended for use as pieces would easily be cut off from the tyre since the rubber becomes hard and almost brittle. There is also need to check for the depth of the tread. The treads and markings on the tyre should be visible and not less than 1.6mm. A user could use a 50 Ngwee coin to estimate the 1.6mm depth. At least one third of the coin should be able to go in between the treads especially for high profile tyres. However, the minimum recommendation of 1.6mm is applicable to passenger tyres which are low profile. For authorities like Zambia Police, RTSA and ZABs I would recommend that for the purposes of accuracy, they should use tread depth indicators in determining the tread depths of tyres. These three sanity checks help to determine whether or not a tyre is good. The main aim is to determine the end result of selecting or analysing that the tyre is good in whichever situation it is either you are buying a brand new tyre and you want to understand its shelf life or when buying a second hand tyre or when a vehicle has been involved in an accident and you are trying to determine its cause.



Figure 4-17: An example of a tread depth indicator

4.6 Summary of the Results

The assessment which was carried out to determine the possible risks associated with the use of second hand tyres on light vehicles in Zambia revealed that indeed the risks are there. If the treads of a tyre are finished, a tyre will not grip well on a slippery surface especially when it is raining. Overall results revealed that motorists did not know the dangers of driving second hand tyres. 72 percent of the sampled population admitted that they did not understand the meaning of the writings on tyres such as tread depth, expiry date, and chemical reactions as a result of the tyre exposure to the atmosphere, over and under inflation of tyres. 14 percent admitted that they understood the meaning of the writings on the tyres.

When asked about the dangers of importing or driving them, 64.3 percent answered that they didn't know. This entails that there is need for users to have some sort of sensitization in order to ensure safety in the country. In order to control responses for the selling of second hand tyres, there is need for an act of law to be put in place. This will help put a minimum standard when dealing with second hand tyres in the country. Currently, there seems to be no information or of any enforcement on regulating the importation of second hand tyres into the country. By having one in place, it would help with ensuring that a particular standard of imported tyres is met. ZABs and RTSA officers admitted that they pay little or no attention in checking for quality of tyres at the border or during fitness tests. It is therefore recommended that they should be checking for the quality of tyres at either the border or during a vehicles fitness test.

A simple framework was developed to be used by general users, Zambia police, RTSA and ZABs officers. When checking for a tyre, one should check for the expiry date which is normally indicated on the tyres sideward. The expiry date shows the date of manufacture of the tyre and it is recommended that it should not be more than 6years from that date of manufacture. Upon ensuring that the tyre is less than 6 years of its life span, one should also check for the treads and the wear and tear of the tyre. The treads and the markings should be visible and the tread depth should not be less

than 1.6mm. When checking for wear and tear, one should check for any signs of cracks on the rubber. If there are cracks, it's an indication that rubber is brittle. A tread depth indicator was proposed in checking for tread depth of any tyre. Others can also simply use a fifty ngwee coin where a third of it dips into the tread depth. Should it just slide on the surface, one can conclude that the treads are finished.

From the discussions which were conducted with police and traffic officers, there was no documentation on accidents attributed to the use of second hand tyres other than merely road traffic accidents. It became difficult to actually know the real potential as no one was taking count systematically. Accidents which were assumed to be as a result of a tyre were analysed as being caused by a tyre burst and not what caused the tyre burst. Statistics shows that less than one percent was attributed to accidents which were caused by tyres in the years 2011, 2012, 2013 and 2014 concurrently and this showed a steady increase. Results obtained on the total number of imported second hand vehicles also revealed an increase every year between 2009 and 2011.

Results showed that there has been an increase in the number of second hand tyres because of the increased use in inappropriate situations such as tables for the selling of second hand clothes. 61 percent of the road users and bus drivers responded that vehicle dealers do not provide professional advice when selling tyres. When these dealers were interviewed they responded that they had little knowledge on the markings of the tyre apart from knowing the tyre size for which type of a vehicle to be used. Some were not able to advise their clients on summer and winter tyres as they needed to sell their goods in order to earn money. This calls for a serious intervention by the government in ensuring that companies and users in such a business should have qualified personnel.

Finally, this chapter presented the data which was obtained from interviews and questionnaire surveys. The Analysis of the data showed that there exist risks in driving vehicles fitted with second hand tyres sold out on the streets. The results in

this chapter helped to come up with a simple framework which can be deployed by the authority during tyre investigations or when an accident has occurred and also by vehicle owners when buying second hand tyres.

The next chapter discusses the Conclusion, limitations and recommendations of the research.

5.0 CHAPTER FIVE

Conclusion, Limitations and Recommendations

5.1 Introduction

The previous chapter gave the analysis and discussion of the findings of the results. This chapter presents the conclusion of the study and its aim is to introduce mitigating actions, procedures, activities and recommendations of the study. These are recommended to be used by the approving authorities that could help in mitigating the issues of having expired/ degraded tyres moving on the roads contributing to road traffic accidents. It is important to bring to the attention what the authorities were doing about this business of selling second hand tyres which is a source of hazards and accidents. In addition, a framework for regulators and road users has been presented to allow stakeholders in making informed decisions is presented.

5.2 Conclusion

The causes of road traffic accidents depend on a list of factors which can be broadly divided into: vehicle operator or driver factors; vehicle condition factors; road pavement condition factors and environmental factors.

It can be concluded that there are several risks associated with driving vehicles fitted with second hand tyres as overall results revealed that users and second hand tyre dealers are ignorant of minimum tyre quality expectation. They do not understand the markings on the tyre, especially on how to check for the expiry date. In the end, they tend to sell expired tyres which are not road worthy. It could also be concluded that road users and tyre dealers do not know the dangers of driving second hand tyres or understand the markings on the tyre too. When this question of being knowledgeable about the minimum legal limit of 1.6mm for any tyre was passed to road users and bus drivers; 79 percent answered they didn't know about this. This

clearly shows that over 50 percent of the population are not knowledgeable about tyres and there recommended specifications

Results revealed that authorities need to improve safety of all road users by ensuring that imported second hand tyres meet the manufacturer's minimum recommendation by checking if the treads are clearly marked and checking their expiring dates. This can be done when vehicles are entering at the border. Regular checks and inspection of tyre dealers should be carried out and improved by the responsible authorities such as RTSA, Traffic Police and ZABS officers at various locations in the country. This would in turn forces road users to drive vehicles with tyres which are road worthy. All these sanity checks forms part of the guideline for the selling of second hand tyres in the country.

A framework for regulators and road users was presented to allow stakeholders in making informed decisions before buying a tyre. As well as how to carry out an investigation when an accident caused by a mechanical failure has occurred and how tyre fitness examinations are to be carried out. It was concluded that by checking the expiry date, treads and wear and tear of any tyre are vital in these circumstances.

5.3 Limitations

This research was only carried out in Lusaka province due to resources and the time which was allocated in carrying this work. Only a fraction of each sampled population was considered as a form of representation to help understand the level of knowledge. Certain groups amongst the tyre dealers couldn't be interviewed because of differences in local language that was used. As for the bus drivers, only a few could be interviewed because of their mobility in tracking them.

Due to insufficient data on the distribution of second-hand tyre imports, it had been very difficult to establish the real potential of imported used tyres as there is no record on the number of imported second hand tyres for every month coming into the country apart from RTSA statistics of the total number of registered vehicles per year.

5.4 Recommendations

In order to prevent unnecessary accidents from occurring as a result of second hand tyres the following can be put into place;

- 1) RTSA and Police Traffic officers should be knowledgeable about the quality of any type of tyre before carrying out any inspection.
- 2) Regular checks on tyre quality should be carried out at check points on road blocks to ensure safety
- 3) The Government through RTSA Traffic officers should come up with sensitization campaigns on the dangers, selection of second hand tyres and understanding the markings on the tyre. The department of research and statistics opposite government complex in Kamwala should carry out this venture as soon as possible
- 4) The government through RTSA (Department of Research and Statistics) should come with strategies to restrict the importation of second hand tyres into the country and encourage businesses dealing with new ones. For example, an act can be proposed addressed to the Ministry of Transport and supply who later can have it discussed in parliament that addresses the use of second hand tyres in Zambia. What should be allowed to come into the country and what shouldn't.

A vehicle should only be registered when tyres pass the minimum requirement put by ZABs unless the vehicle owner is meant to replace tyres with brand new ones.

- 5) RTSA can introduce licences for the selling of second hand tyres to ensure quality
- 6) The government should have a method of disposing worn out tyres to avoid illegal dumping and associated environmental concerns. In return, this will ensure cleanliness.
- 7) Before any second hand vehicle enters the country and be registered, there should be an arrangement where vehicles should be fitted with tyres which are less than two years from the Date of Manufacture. In this way, the government will force the sellers to fit vehicles with reasonable tyres.
- 8) A Framework was also proposed which can be used by any user during the selection of tyres or when an accident has occurred. This was shown in figure 4-16.

Other recommendations are when handling second hand tyres, it is important that correct inflation pressures are observed. Under-inflation of tyres may result to a reduction in vehicle handling, increased braking distance, and a likelihood increase in tyre blowouts, increased tyre wear and finally an increase in fuel consumption.

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7.0 APPENDICES

APPENDIX 1

Introductory letter to Zambia Police and RTSA

To the department of Investigations office,
To Police Head Quarters,
Ridgeway,
Zambia.

Date: 29th August, 2014

Dear Sir/Madam,

REF: RESEARCH DATA COLLECTION

My name is Bridget Kamanga, a student of Master of Engineering in Project Management and currently working for Citibank as a Technology Infrastructure officer. It is a requirement for a student to do a dissertation before being granted the master's degree and the topic I have chosen for my dissertation is "An assessment of the risks associated under the use of Second Hand tyres on Light vehicles in Zambia."

Part of my research requires that I collect data from your institution and it is in view of this that I write to request for permission to access your database for valuable information.

Your consideration at the earliest possible time will be greatly appreciated

Yours Faithfully,

Eng. Bridget Kamanga.

APPENDIX 2

Interview Section

1. What are the reasons for buying second hand tyres as opposed to buying first hand tyres

.....

.....

.....

.....

2. To what extent does Government/Police/RTSA record data on accidents caused by the prolonged use of second hand tyres/finished tyres

.....

.....

.....

.....

3. To what extent does the enforcement authority i.e. Police/RTSA check for tyre fitnesses

.....

.....

.....

.....

If they do, how often and under what circumstances

.....

.....

.....

.....

4. What are some of the things the police look out for during an accident investigation

.....

.....

.....

APPENDIX 3

Cover Letter to the Questionnaire



The University of Zambia,

School of Engineering,
Dept. of Civil & Environmental Engineering,
P. O. Box 32379, Lusaka.
Cell: +260977870670, Email: biddykams@yahoo.co.uk

12th February, 2015

Dear Sir/Madam,

**QUESTIONNAIRE SURVEY ON THE RISKS INVOLVED IN DRIVING
SECOND HAND TYRES AND THEIR CONTRIBUTION TO ROAD
ACCIDENTS IN ZAMBIA**

I am pursuing a Master of Engineering Degree in Project Management [MEng PM] at the University of Zambia. My research topic is on Risks involved in driving Second Hand Tyres and their contribution to road accidents in Zambia.

The study seeks to identify the risks associated with second hand tyres, to quantify and prioritize them, and then come up with risk response development measures. It also involves establishing the level of awareness of motorists before buying second hand tyres and how those in authority are managing Inspections.

Accompanying this letter is a questionnaire that has to be filled in by you. It will take few minutes of your time to complete it. The questionnaire has three Sections A, B and C. Please attempt to answer all questions. Be assured that all the information gathered will be kept strictly confidential and will only be used for this purpose of this research. No mention of names of individuals or organizations they represent.

Should there be any queries, please do not hesitate to get in touch with the undersigned or the Research Supervisors using the details provided below. Your assistance and cooperation will be highly appreciated.

Thank you in advance for your time and kind cooperation.

Yours Faithfully,

BRIDGET KAMANGA (Master of Engineering Student)

Supervisor: Dr. Erastus Mwanaumo – erastus.mwanaumo@unza.zm

Mobile- 0969561353

APPENDIX 4

Questionnaire

RESEARCH QUESTIONS

TICK WERE APPLICABLE

SECTION A

BIOGRAPHICAL DATA

What is your Gender? ☐ F ☐ M

What is your age profile? <16 ☐ 17≥21 ☐ 22≥30 ☐ 31≥35 ☐
36≥45 ☐ 45> ☐

How long have you been in formal Employment? 0-5 ☐ 6-10 ☐ 11-15 ☐
16-20 ☐ 20> ☐

How long have you been in informal Employment? 0-5 ☐ 6-10 ☐ 11-15 ☐
16-20 ☐ 20> ☐

For how long have you owned your own personal vehicle? 0-5 ☐ 6-10 ☐
11-15 ☐ 16-20 ☐ 20> ☐

SECTION B

FOR ROAD USERS/ ZAMBIA BUREAU OF STANDARDS/ RTSA AND POLICE OFFICERS

5. Is there any data on how many companies are registered to trade in tyres?

Yes ☐ No ☐ not sure ☐

6. Does Zambia have a legislation / law which regulates the importation of second hand or used tyres?

Yes ☐ No ☐ not sure ☐

7. Are you conversant with winter and summer tyres?

Yes ☐ No ☐ not sure ☐

8. Are you aware of any published study on the benefits & dangers of importing or driving vehicles with second hand tyres?

Benefits

Yes ☐ No ☐ not sure ☐

Dangers

Yes ☐ No ☐ not sure ☐

9. Do ZRA Custom officers have capacity and ability to inspect tyres at the port of entry?

Yes ☐ No ☐ not sure ☐

10. What tool does RTSA/Zambia Police use to check for tyre fitness?

.....

11. Are you aware of a recommended second hand tyres disposal area?

Yes ☐ No ☐ not sure ☐

If Yes: provide the name

12. Which of the following are you aware of as main causes of tyre bursts (tick all that are applicable)?

| | | | | | |
|------------------------------|--------------------------|----------------------|--------------------------|---------|--------------------------|
| Inappropriate tyre inflation | <input type="checkbox"/> | Worn tyre | <input type="checkbox"/> | Extreme | <input type="checkbox"/> |
| temperature | <input type="checkbox"/> | | | | |
| Overloading | <input type="checkbox"/> | Exceeding tyre limit | <input type="checkbox"/> | | |
| Extreme temperature | <input type="checkbox"/> | No Response | <input type="checkbox"/> | | |

13. When tyre dealers are selling tyres, do they provide professional advice on use, age, weather and other relevant tyre information?

Yes ☐ No ☐ not sure ☐

14. In your opinion would you recommend that government should minimize the number of tyre dealers?

Yes ☐ No ☐ not sure ☐

15. Do you know the maximum recommended speed of tyres on your vehicle?

Yes ☐

No ☐

not sure ☐

16. Do you follow the speed of the car recommended with reference to your tyres?

Yes ☐

No ☐

not sure ☐

17. How often do you inspect your tyres?

Daily ☐

weekly ☐

monthly ☐

when I have a tyre problem ☐

Never ☐

18. Are you aware of any policeman investigating or checking for tyres after an accident or at an accident scene?

Yes ☐

No ☐

not sure ☐

19. Do you inspect the condition of any tyre before purchasing it?

Yes ☐

No ☐

a. If yes, what criteria do you use to determine whether the tyre is both good and the right one for your vehicle?

.....
.....

20. What is the frequency of changing your tyres?

Quarterly ☐

Yearly ☐

Every 2 Years ☐

Above 2years ☐

Not Sure ☐

21. When tyres fail, do you report back to where you bought them from?

Yes ☐

No ☐

Not Interested ☐

22. Did you know that it is recommended by the tyre manufacturers to replace tyres before they reach the legal limit of 1.6mm?

Yes ☐

No ☐

Not Sure ☐

23. Did you know that under or over- inflation of tyres is likely to seriously impair their performances and may prejudice the safety of the vehicle?

Yes ☐

No ☐

Not Sure ☐

24. Did you know that a vehicles load should not be greater than the tyres maximum load?

Yes ☐

No ☐

Now Sure ☐

25. Did you know that it is not a good practice to mix tyres of different ratings?

Yes ☐

No ☐

Not Sure ☐

26. Did you know that a tyre has an expiry date?

Yes ☐

No ☐

Not Sure ☐

27. DO you understand the meaning of the writing on your tyres?

Yes ☐

No ☐

Not Sure ☐

SECTION C

Biographical questions strictly for tyre resellers

1. How long have you been in the business and what is your age group?

.....
.....

2. Where do you import your tyres from?

.....
.....

3. How many tyres are imported in a month/year or sold out?

.....

4. What is the standard or quality of these imported tyres?

.....

5. What do you look out for in determining which tyre can be sold out to customers?

.....
6. Do you import new tyres or second hand tyres?
.....

7. What are the types of tyre brands sold out?
.....

8. How is the market doing in the selling of second hand tyres and what is the demand?
.....
.....

9. What is your perception on the causes of accidents?
.....
.....

10. Do you know the expiry date or how to check for the expiry date?

Yes ☐

No ☐

not sure ☐

11. Does the authority i.e. Police/RTSA/Zambia bureau of standards check for tyre quality?

Yes ☐

No ☐

not sure ☐

12. a) Are the majority of the imported tyres fit for Zambia's weather and safety standards?

Yes ☐

No ☐

not sure ☐

13. Imported Second-hand or retreated tyres manufactured for cooler weather conditions may not be suitable for very hot weather conditions

Yes ☐

No ☐

not sure ☐

14. Have you ever been visited by RATSA, Police to check the validity/reliability of your tyres?

Yes ☐

No ☐

not sure ☐

15. Do you check for signs of defects on the second hand tyres before selling them out to road users?

Yes ☐

No ☐

not sure ☐

If so, how do you check and what do you look out for

.....

16. Did you know the purposes of the thread in tyres are to maintain the grip?

Strongly agree (1) ☐ Agree (2) ☐ Disagree (3) ☐ Strongly disagree (4) ☐ Not sure (5) ☐

17. By banning the importation of the second hand tyres or the use of second hand tyres, do you think the number of road traffic accidents would reduce?

Strongly agree (1) ☐ Agree (2) ☐ Disagree (3) ☐
Strongly disagree (4) ☐ Not sure (5) ☐

18. Did you know that the recommended minimum thread depth is 1.6mm?

Strongly agree (1) ☐ Agree (2) ☐ Disagree (3) ☐
Strongly disagree (4) ☐ Not sure (5) ☐

19. Did you know that under or over- inflation of tyres is likely to seriously impair their performances and may prejudice the safe use of the vehicle?

Strongly agree (1) ☐ Agree (2) ☐ Disagree (3) ☐
Strongly disagree (4) ☐ Not sure (5) ☐

20. Did you know that tyres age with time and may risk tyre failure?

Strongly agree (1) ☐ Agree (2) ☐ Disagree (3) ☐
Strongly disagree (4) ☐ Not sure (5) ☐

21. Did you know that tyres that have been in storage should not be placed into use if they are over 6 years old, from their date of manufacture?

Strongly agree (1) ☐ Agree (2) ☐ Disagree (3) ☐
Strongly disagree (4) ☐ Not sure (5) ☐

22. Did you know that the recommended tyre storage is that tyres should be kept in a cool, dry environment, out of direct sunlight?

Strongly agree (5) *Agree* (4) *Disagree* (3)
strongly disagree (2) *Not sure* (1)

23. Did you know that a vehicles load should not be greater than the tyres maximum load?

Strongly agree (5) *Agree* (4) *Disagree* (3)
strongly disagree *Not sure* (1)

24. Did you know that it is not a good practice to mix tyres of different ratings?

Strongly agree (5) *Agree* (4) *Disagree* (3)
strongly disagree (2) *Not sure* (1)

25. Tyres should not be inflated to the pressure on the side wall, this is the maximum pressure rather than the recommended pressure?

Strongly agree (5) *Agree* (4) *Disagree* (3)
strongly disagree (2) *Not sure* (1)