Assessing the economic factors affecting road accidents in the Mpumalanga Province

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DECLARATION

I, **Tsundzuka Remember Makhubela,** declare that this study titled, ***"Assessing the economic factors affecting road accidents in the Mpumalanga Province****",* is my own work carried out under the supervision of Prof Ravinder Rena. This mini-dissertation has not been submitted for any study or qualification in any institution of higher learning. All sources used in the study have been strictly indicated and acknowledged through references.

_____ **2020/11/29**

Signed **Date**

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Tsundzuka Remember Makhubela

DEDICATION

This mini-dissertation is dedicated to the following people that occupy a special place in my heart:

- My late dad and mom, Wilson and Martha Makhubela;
- My lovely wife, Nomsa Makhubela;
- My Prince Charming, Itumeleng and my Angel Cakes, Nakisani and Basani; and
- My brother-in-law, Bongani Arnold Matlombe, who always stood in for me to execute a chore management system.

ABSTRACT

Purpose: The specific purpose of this paper is to assess the impact of economic factors on road accidents in the Mpumalanga Province, for the period 2010 to 2019.

Methodology: A quantitative research method was used to investigate the influence of economic factors on road accidents in the Mpumalanga Province. Secondary data pertaining to the Gross Domestic Product per capita, unemployment, inflation rate, motorisation, road infrastructure investment, and the number of road accidents, were collected from Municipal Annual Reports, Statistics South Africa Reports, and South African Reserve Bank (SARB) Bulletins, through content analysis. Data was analysed using descriptive and inferential statistics. In addition, a simple regression analysis was performed to confirm the correlation between economic factors and road accidents in the Mpumalanga Province, for the period 2010 to 2019.

Findings: Through a simple regression analysis, the results showed a positive correlation between unemployment rates, inflation rates, motorisation, and road accidents in the Mpumalanga Province. However, the Gross Domestic Product per capita and the level of road infrastructure investment showed a negative correlation with road accidents.

Research limitations: Like other similar studies, this investigation also had its own limitations. Secondary data pertaining to economic factors and road accidents was collected for the Mpumalanga Province only, even though South Africa has nine provinces. Therefore the results of this study may not be generalised across the country.

Value: The findings and recommendations of this study will allow provincial governments to formulate and implement economic policies that will boost the Gross Domestic Product per capita at provincial level. This will translate into a good road network, resulting in reduced road accidents. Moreover, an in-depth understanding of the impact of economic factors on road accidents in Mpumalanga will provide a basis for economic growth and development policies that will address other socio-economic issues in the near future. Furthermore, the research findings will also provide a platform for further studies by academics in the field of Economic Management Sciences.

Keywords: Economic variables, motorisation, Gross Domestic Product per capita, inflation rate, Consumer Price Index, road infrastructure investment, road accidents and unemployment.

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LIST OF ABBREVIATIONS AND ACRONYMS

The following abbreviations are used throughout the study.

ARCTM	Accident Root Cause Tracing Model
CPI	Consumer Price Index
DCSSL	Department of Community Safety, Security and Liaison
GDP	Gross Domestic Product
MPG	Mpumalanga Provincial Government
NWU	North-West University
OECD	Organization of Economic Cooperation and Development
RoSPA	Royal Safety for the Prevention of Accidents
RTIs	Road Traffic Incidences
SADC	Southern African Development Community
SARB	South African Reserve Bank
SARTMC	South African Road Traffic Management Corporation
WHO	World Health Organisation

CHAPTER 1:
NATURE AND SCOPE OF THE STUDY

1.1 INTRODUCTION

Road traffic accidents are an over-arching socio-economic challenge in developing and middle-income countries (Akinyemi, 2020). Approximately 1 million people have lost their lives, while 50 million have suffered non-life-threatening injuries through road accidents since 2010 (World Health Organization, 2015). This makes road accidents one of the major causes of human deaths in the world, especially in low and middle-income countries. The cause of high road accident fatalities in low and middle-income countries is mainly attributed to rising motorisation, and low levels of road infrastructure investment.

The WHO (2015) asserts that the African continent has been recording the highest number of road accident fatalities since 2010. Road accidents lead to economic suffering of the dependents of the victims and even leave the injured with life threatening injuries that make them more susceptible to extreme poverty. The best way to reduce the impact of road accidents is to understand the underlying causes of road fatalities in developing countries, such as South Africa.

Existing literature posits that major causes of road accident fatalities include, among others: unsafe road infrastructure, inefficient operations and management systems, unsafe vehicles, low levels of economic growth and development, road user behaviour, low levels of road infrastructure investment and inadequate law enforcement of traffic laws (Bhavan, 2019; Akinyemi, 2020).

In this study, economic variables that cause road accidents are examined in order to establish their impact on road accidents. The economic variables this study focuses on are, motorisation levels, Gross Domestic Product (GDP) per capita, inflation rates, the level of road infrastructure investment, and unemployment levels in Mpumalanga. As such, this study seeks to establish the impact of economic variables on road accidents in the Mpumalanga Province for the 2019/2020 financial year.

1.2 BACKGROUND

South Africa is a signatory of the Southern African Development Community (SADC) Treaty which gives rise to protocols on transport, communication and meteorology. It compels countries to provide efficient, cost-effective and fully-integrated infrastructure and operations to promote economic and social development, while being environmentally and economically sustainable. In 2010 South Africa also became a signatory to the United Nation's Decade of Action for Road Safety 2011-2020, which was intended to become a global action plan for guiding countries in the implementation of road safety policies. Considering the above commitments, South Africa is engaged in massive road infrastructure development and other road safety projects, but despite these efforts, very little is happening in some provinces, such as Mpumalanga.

Annually an estimated 1,3million people die on roads and approximately 3 200 people are killed on roads around the world. South Africa contributes roughly 40 deaths per day and 14 000 deaths per annum. The country's mortality rate of 28 per 100 000 citizens is one of the highest in the world (WHO, 2015). Road crashes are recognised internationally as a social and economic burden, particularly in developing countries like South Africa where the most badly affected are the poor who are mainly settled in rural areas (WHO, 2015).

Today's reality is that South Africa has recorded its highest annual road death toll since 2007. In 2017, there were 1 599 fatal accidents on South African roads. (The Royal Safety for the Prevention of Accidents (RoSPA), July 2019). It is against this background that this study seeks to explore the economic factors that affect road accidents in South Africa, by vetting the Mpumalanga Province as a case in point.

1.3 PROBLEM STATEMENT

Heavy traffic flow in the Mpumalanga Province is attributed to its strategic importance both economically and geographically. The Mpumalanga Province is home to the Maputo corridor, used by heavy duty trucks travelling from the mines of the little town of Phalaborwa in the Limpopo Province, to the harbours of Durban and Maputo in Mozambique, often pass through the Mpumalanga Province, presenting a high risk for

accidents. Passenger vehicles transporting school children and commuters on a daily basis, are also prone to fatal road accidents. Additionally, there are many people who frequently travel by road between Mozambique and South Africa via the Mpumalanga Province. Poorly maintained roads, due to low levels of road infrastructure investment, is one of the main causes of the soaring rate of road accidents in the Mpumalanga Province. Moreover, the level of economic activities in the Mpumalanga Province exacerbates the occurrence of road accidents, because the transportation of goods increases as economic activities increase. Moreover, un-roadworthy vehicles owned by community members pose a very serious threat, because these vehicles mostly present with failing break systems and no head lamps. Finally, a high number of young lives are lost in accidents as a result of drunken driving on roads, which are in deplorable conditions due to lack of maintenance.

The statistics of road accidents reported at police stations are collected by the traffic department. This information should be utilised by the engineering section of the Department of Community Safety, Security and Liaison (DCSSL) in Mpumalanga, in order to design interventions that will guard against the carnage caused by road accidents. In most cases accidents occur because of a combination of human behaviour, vehicles, economic factors or road infrastructure factors. In this study, economic factors that influence road accidents in Mpumalanga will be investigated. Therefore, economic factors such as the GDP, motorisation level, GDP per capita and the level of road infrastructure investment give rise to a study which explores all elements that contribute to fatalities on the Mpumalanga Province's roads. It also covers research previously done and published by other scholars.

Road safety is everyone's business, and as such there are many role players as far as road safety is concerned. Most of the casualties in the Mpumalanga Province are school children and stray animals that are knocked over by vehicles, therefore it is imperative to undertake a study which will bring about initiatives that may reduce fatal road accidents in the Mpumalanga Province. Thus, poor economic conditions influence the frequency of road accidents in Mpumalanga.

1.4 RESEARCH OBJECTIVES

The research initiated from the basis that the Mpumalanga Provincial Government (MPG) is failing in the formulation and implementation of sound economic policies as one of the strategies to curb road accident carnage. Therefore, the study examined the relationship between economic factors and road accidents in Mpumalanga, with the aim of looking at pragmatic approaches to addressing the high frequency of road accidents in Mpumalanga. The objectives were sub-classified to:

1.4.1 Primary objective

The primary objective of the current study is to investigate the economic factors that influence road accidents in the Mpumalanga Province.

1.4.2 Secondary objectives

The following secondary objectives have been formulated for the current study:

- To determine the impact of the level of economic development on road accidents in the Mpumalanga Province.
- To assess the impact of traffic volume on road accidents in the Mpumalanga Province.
- To analyse the impact of road infrastructure investment on road accidents in the Mpumalanga Province.

1.5 RESEARCH HYPOTHESES

The following research hypotheses were formulated to enable the study to attain the primary and secondary objectives.

H1: The inflation rate as measured by the Consumer Price Index (CPI) has no impact on road accident fatalities in the Mpumalanga Province.

H2: The Gross Domestic Product per Capita has no influence on the road fatalities in the Mpumalanga Province.

H3: The level of motorisation has no effect on road accidents in the Mpumalanga Province.

H4: The level of road infrastructure investment has no impact on road accident fatalities in the Mpumalanga Province.

H5: Unemployment has no effect on road accident fatalities in the Mpumalanga Province.

1.6 KEY TERMS

The following are key terms used throughout the study:

Economic variables, motorisation, Gross Domestic Product per capita, inflation rate, Consumer Price Index, road infrastructure investment, road accidents and unemployment.

1.7 PRELIMINARY LITERATURE REVIEW

1.7.1 Concept of road accidents

The scholars, Elias, Bahaudin and Mahidin (2014) define road accident risk as the average number of accidents per million kilometres of driving. It consists of accidents that result in human injuries and material damage only.

1.7.2 Factors that cause road accidents

Extensive literature posits that there are factors that contribute to road traffic accidents, for instance weather conditions, location and environment, road structure, vehicle technical failures as well as drivers' behaviour and attitudes. Similarly, economic variables can also have an impact on road traffic accidents, for example a high inflation rate, cost of living, high level of motorisation and low road infrastructure investment. These factors can lead to higher road accident frequency either directly or indirectly (Sun, Liu, Chen and He, 2019; Bhavan, 2019; Akinyemi, 2020). Extreme weather conditions can destroy transportation infrastructure or road networks. Heavy rain storms, thick haze, tornados, heat waves and wind storms are examples of extreme weather conditions. Generally, driving too fast in extreme weather conditions can also result in road accidents, as the driver may easily lose control and judgement. The Mpumalanga Province has a tropical climate with heavy rainfall and thick mist that commonly occur during the rainy season. However, this study mainly focuses on the impact that economic factors such as the

inflation rate, unemployment, motorisation, GDP per capita and road infrastructure investment have on road accidents in Mpumalanga.

1.7.3 Empirical studies

An empirical research study was done through investigating previously conducted research in order to create an understanding of the severity of road accidents around the globe. By reviewing previously conducted research, it was very clear that this is an area that has been grossly neglected, which more than justifies this investigation into fatal road accidents, occurring in the Mpumalanga Province. Previous studies focussed more on the social factors that impact road accidents, instead of the economic factors. Various studies on the impact of economic factors on road accidents have been carried out in different corners of the world, with different findings and conclusions (Akinyemi, 2020; Elias *et al.*, 2014; Sun *et al.*, 2019; Bhavan, 2019; Cantillo, Garrces and Marquez, 2016).

Elias *et al.* (2014) study the effect of the cost of living on road accidents in Malaysia. The study utilised the quantitative method by applying a cross-sectional strategy to collect data, by posting 2 676 questionnaires. The study found that 43% of road accidents are caused by the cost of living. In addition, the study found that an increase in the cost of living leads to a decrease in vehicle maintenance.

Sun *et al.* (2019) explore the cross–effects of economic, road and population factors on road safety in China. The study analysed the impact of numerous factors on road traffic accidents in China. The GDP, traffic investment, new vehicle ownership, new road mileage and increased population, were all analysed using regression analyses. The study found that all these factors have a significant influence on Chinese road accident causes. Additionally an increase in the GDP and road infrastructure was found to reduce the frequency of road traffic causalities. However, an increase in new road mileage, population and new motor vehicles were found to positively correlate with the frequency of road traffic accidents. Akinyemi (2020) studies the relationship between economic development and road traffic crashes and causalities in Nigeria. The study was based on annual data collected regarding the GDP per capita, unemployment rate, and number of road traffic crashes, fatalities and injuries for the period 1991 to 2016.

The study utilised a longitudinal time horizon. The relationship between economic development indicators and road accidents was analysed using econometric models. The results showed that in the long-run, both crashes and fatalities decreased while injuries increased with the GDP.

Bhavan (2019) carries out research on the economic impact of road accidents in Sri Lanka from 1977 to 2016. The results showed a long-term relationship between accident-related indices and macroeconomic variables. The independent variable was road accidents, as measured by proxies such as the fatality index, injury index and total causalities. The dependent variable was economic performance, as measured by the GDP growth rate, health expenditure index and government expenditure index.

Cantillo *et al.* (2016) examine the factors that influence the occurrence of road accidents in the urban areas of Columbia by purposively selecting 69 accident-prone areas. The study examined factors such as urban road accidents, road infrastructure development, traffic volumes and traffic control. The data was analysed using a statistical technique in four phases: building model, calculation of the posterior distribution, the posterior distribution analysis, and inference, and obtaining the final conclusions on the problem under consideration. Empirical results showed that the sections situated in commercial areas tend to have a higher frequency of road accidents because of the high volume of pedestrians. Moreover, it was found that the marginal effect on the accident frequency rate for motor cycles was higher than that of buses and cars.

The above studies all focused on typical conditions that exist in low- and middle-income countries. These countries can, in some ways be partially compared with the South African economic setting, as South Africa's economy consists of both developed and undeveloped economic attributes. As such, the Mpumalanga Province was selected as the case area.

1.8 THEORETICAL FRAMEWORK

The current study is grounded on a theoretical framework, as presented in Figure 1.1. The aim of this study is to assess the impact of economic factors on road accidents in the Mpumalanga Province.

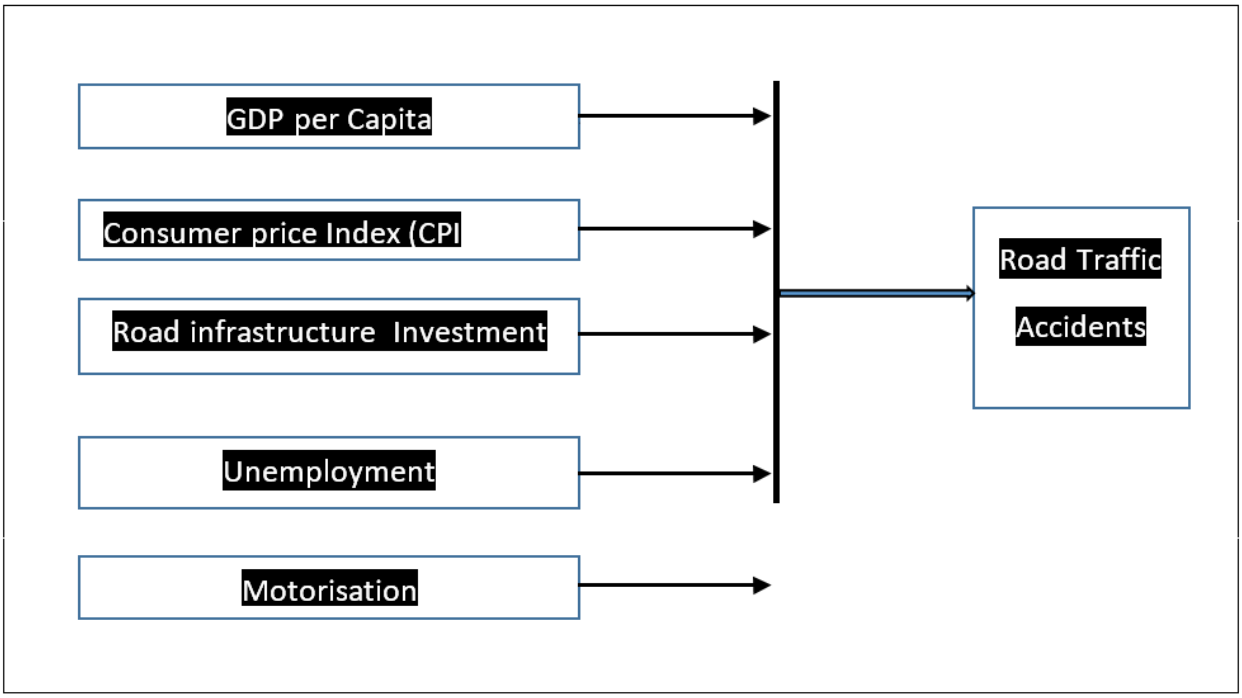

Figure 1.1: Theoretical framework

1.9 METHODOLOGY

Strydom, Jooste, Cant and Du Plessis (2009) define a research methodology as a plan or sketch which outlines what kind of data will be collected, from where it will be collected, how it will be collected, when it will be collected, from who it will be collected, how it will be analysed, and how the findings will be presented and used in interpreting the problem in an organisation.

1.9.1 Research approach

Research methodologies are broadly divided into qualitative, quantitative and mixed methods. A qualitative methodology is used to gain understanding of underlying reasons, opinions and motivations (Denzin, 2009). On the other hand, a quantitative research method is said to be mostly numerical and is designed to ensure objectivity, generalisability and reliability (Zawawi, 2009). Finally, the mixed method approach involves the use of both the qualitative and quantitative research methodologies.

In order to fully examine the impact of economic factors on road accidents in Mpumalanga, the quantitative research method was employed. The advantages are that

the quantitative approach is fast and economical as a whole. It is also better to use the quantitative approach when statistical results are being stressed (Zawawi, 2009). For the purpose of this research, the quantitative research method was chosen, because the data was analysed using descriptive and inferential statistics. Moreover, a regression analysis was utilised to establish the relationship between economic factors and road accidents in Mpumalanga.

1.9.2 Population

Welman, Kruger and Mitchell (2011:52) define the target population as the full set of elements (persons or items) with collective characteristics from which a representative sample is taken as a target of respondents. According to Berg and Latin (2007), the total population to be studied in a research process is usually too large to enable the drawing of the necessary conclusions. The sample upon which a study is to be based must therefore usually be demarcated. This study focuses on road accidents that occurred in Mpumalanga for the financial year 2019/2020.

1.9.3 Sampling Technique

A sample refers to a subset of the total target population upon which the views obtained from it can be used to make the necessary generalisation about the views of that entire population (Trochm, 2006; Mashau, 2016). Sampling techniques are broadly divided into probability and non-probability sampling. Probability sampling is further categorised into simple random sampling, systematic random sampling, stratified random sampling and random cluster sampling (Roman, 2008). Non-probability sampling includes; quota, purposive, volunteer, and haphazard sampling. The purposive sampling technique is suitable for this study, considering that the secondary data for economic variables and road traffic accidents were collected for the Mpumalanga Province only.

1.9.4 Data collection

Secondary data pertaining to the GDP per capita, unemployment, inflation rate, motorisation, road infrastructure investment and frequency of road accidents in Mpumalanga, were collected from Statistics South Africa reports for the 2019/2020

financial year. Additionally, secondary data was extracted from published sources such as Municipal Annual Reports and South African Reserve Bank Bulletins.

1.9.5 Explanation of Variables

The study attempts to establish the relationship between economic factors and road accidents in Mpumalanga. As such, appropriate dependent and independent variables were selected. Economic factors such as the GDP per capita, motorisation, road infrastructure investment, inflation rate and unemployment were the independent variables, whereas, road accidents, as measured by the number of accidents per year, was the dependent variable.

1.9.6 Data analysis

After data collection, an Excel Spreadsheet was utilised for conducting a thorough assessment of the data, which involved checking for data completeness and cleanliness before importing it into the statistical software (Stata software version 15). In maintaining consistency with the previous studies (Tshipa, 2017), identification of the outliers in the data was performed, using Boxplot. In addition, panel data was subjected to diagnostic tests to address assumptions of regression. It was expected that the data analysis procedure would follow the dimension of descriptive and inferential analysis approaches.

1.9.6.1 Descriptive analysis

A descriptive analysis offers a description of the statistical data for a given sample under study (Ali & Bhaskar, 2016). The results from a descriptive analysis in a study should provide information on the measures of central tendency, such as mean, median and standard deviation, which are displayed in the form of tables. Additionally, correlation analysis represents a simple form of descriptive statistics used to demonstrate how the study variables are related (Ali & Bhaskar, 2016). For this study, tables are used to display results from the Pearson's Correlation Coefficient Matrix, as this is consistent with previous studies (Tshipa, 2017).

1.9.6.2 Inferential analysis

The conclusion and findings of the study are derived from the inferential analysis outcomes. Inferential statistics permit the researcher to associate, test and predict the

data of a given sample, and enable him/her to come up with conclusions that are generalised (Doucette, 2017). As is, consistent with empirical studies (Tshipa, 2017), the hypotheses are established using inferential testing, which encompasses running a simple regression model, from which probability values (p-value) and the correlation coefficient are used to interpret the study results.

1.10 VALIDITY AND RELIABILITY

In order for research data to be of value and of use, it must be both reliable and valid (Trochm, 2006).

1.10.1 Validity

Phelan and Wren (2006) assert that validity is the extent to which a study reflects the specific concept that the researcher is attempting to measure. Validity is broadly categorised into internal validity and external validity.

1.10.2 Internal validity

Internal validity refers to the rigor with which a study was conducted and the extent to which the designers have taken into account alternative explanations for any causal relationships they explore (Saunders *et al.,* 2012). Internal validity will be guaranteed if diagnostic and collinearity tests are done to ensure sample adequacy, as well as checking non-collinearity of data.

1.10.3 External validity

External validity refers to the extent to which the results of a study are generalised or transferable (Phelan and Wren, 2006). The sample of this study consists of all municipalities in Mpumalanga. Even though the sample is relevant to the research content, the research findings might warrant external validity because the sample is a relatively significant portion of the Municipalities in South Africa. Hence, the outcome may be generalised across the whole country due to it being a bigger sample size.

1.10.4 Reliability

Trochim (2006) alludes that reliability is concerned with the accuracy of the actual measuring instrument or procedure. Reliability is guaranteed by collecting data from accredited sources such as Statistics South Africa's published reports.

1.11 LIMITATIONS OF THE STUDY

The research focuses on assessing the economic factors affecting road accidents in the Mpumalanga Province. However, there are nine provinces in South Africa but only Mpumalanga Province is investigated. Hence the study does not represent all road accidents in or outside South Africa.

1.12 VALUE OF THE STUDY

Considering the various schools of thought, few studies have attempted to study the economic factors affecting road accidents. Therefore this study expands on the existing literature relating to the impact of economic factors on road accidents. An understanding of the economic factors affecting road accidents in Mpumalanga enables regulators, government authorities and management to promulgate policies and regulations that may significantly reduce road accidents in Mpumalanga and the country at large

1.13 ETHICAL CONSIDERATIONS

When conducting research, one must be mindful of ethical and protection issues. Ethical guidelines seek to work towards protecting the individuals, communities, organisations and environments involved in the study against any form of harm, manipulation or malpractice (Popper, 2004; Saunders *et al.,* 2012). When conducting research, one must consider ethics, in order to work within the law and act morally. Adapting an ethical approach will contribute to a sound starting point, a suitable and valid method, good and useful results and solid conclusions (Trochim, 2006). The principles of ethics when conducting research include informed consent, confidentiality and avoiding harm (Israel & Hay, 2006). In the context of this study the following ethical principles were adhered to:

1.13.1 Confidentiality

This research project, took into account the confidentiality of the data obtained, and the anonymity of the municipalities that were used in this study.

1.13.2 Avoid harm

In this research study, avoiding harm encompasses adherence to the relevant ethical clearance process at the North West University (NWU). Information obtained was used for the benefit of the researcher, body of knowledge, NWU and the Mpumalanga Municipalities. In addition, informed avoid harm means ensuring that information obtained will not be published in the public domain with the aim of harming the image of the Mpumalanga Province.

1.14 STRUCTURE OF THE DISSERTATION

The study consists of five chapters, as follows:

Chapter 1

In this chapter, the scope of the research study which comprises of the problem statement is introduced to the reader. The reader is informed of the research purposes, key research objectives, and additionally, the limitations of the study. Furthermore, this chapter provides the reader with an indication of the research problem and outlines the plan to attain a solution to the problem.

Chapter 2

This chapter focuses on the literature study that consists of the literature review which provides an indication of previous studies conducted on the main factors affecting road accidents and other contributory factors in Mpumalanga. It also looks at interventions or lack thereof. This exercise is necessary because the researcher needs to recognise existing theories, as it provides insight into the impact of economic factors on road accidents in the Mpumalanga Province.

Chapter 3

In this chapter, the research methodology and data collection design approach, with particular reference to a quantitative approach, are discussed. The sample unit and size are identified and the anticipated methodologies with which to collect data are explained. Moreover, the conclusion of this chapter includes the identification of a list of research questions.

Chapter 4

This chapter includes data analysis and the interpretation of results. It also looks at the secondary data that was gathered through content analysis. This data is analysed and presented using quantitative techniques. This chapter describes how the data was administered into important outcomes, in a manner that the reader can understand and relate. These results are also included.

Chapter 5

In this chapter, conclusions and recommendations are outlined. Additionally, conclusions drawn with regards to the enablement of those elements that restrict the intended solutions to the primary research question, the secondary research questions and the research hypotheses, are also included. Furthermore, recommendations for mitigation of the research problem are made and opportunities and ideas for future studies on the subject matter are identified.

1.15 SUMMARY

In this chapter the background and problem statement of the research are discussed in detail. In addition, research objectives and hypotheses are stated. Moreover, in this chapter, a preliminary literature review on economic factors and road accidents is highlighted. The preliminary literature review focuses on the concept of road accidents, as well as the empirical and theoretical perspectives of the study. The chapter continues to offer a brief description of the methodology adopted in this study. The study adopts a quantitative research method where data is analysed using statistical techniques such as descriptive and inferential statistics. Furthermore, the chapter discusses the theories of

the proposed theoretical framework of the study. The ethical, reliability and validity issues of the study are also explained. The last section of the chapter, presents a general structure of the study. The study consists of five chapters in total. The next chapter discusses the extent of the literature underpinning this study.

CHAPTER 2:
LITERATURE REVIEW

2.1 INTRODUCTION

The preceding chapter deliberated on the background on which this study is based. The main aim of this chapter is to lay the theoretical groundwork for the assessment of the significance of the economic variables and their impact on the occurrence of road accidents in the Mpumalanga Province of South Africa. This chapter is envisioned to unearth the economic challenges that influence the occurrence of road accidents in the Mpumalanga Province, as a way of crafting and recommending strategies that could curb the road carnage. This chapter also reviews the existing literature on some of the vital concerns of road accidents. Firstly, the concept of road accidents and the causes of road accidents are discussed in conjunction with the economic variables that influence road accidents. Secondly, the impact of road accidents on the economy and society are deliberated on. The role and importance of economic development and growth in curbing road accidents are also underlined. The empirical evidence regarding the impact of economic variables on road accidents is discussed as well. Lastly the proposed theoretical framework is highlighted.

2.2 CONCEPT OF ROAD ACCIDENTS

A road traffic accident is defined as an accident involving at least one vehicle on a road open to public traffic, in which at least one person is injured or killed (WHO, 2015). Road traffic accidents have different causes. As such, the ultimate aim of road traffic research is, to a certain degree, to identify and reduce these causes as much as possible. These causes may be complex in nature and are often perceived to be influenced by science, politics and economics (Ncube, Cheteni & Sindiyandiya, 2016). One of the factors is the circumstance that gives rise to an accident. A combination of economic factors such as the GDP per capita, GDP, level of motorisation, unemployment, and level of infrastructure investment have been found to be some of the major causes of road traffic accidents (Janmohammed, 2018). However, road accidents are also caused by determinants such

as speed, drive capabilities, vehicle condition and environmental factors (Western Cape Government, 2017).

2.3 CAUSES OF ROAD ACCIDENTS

Muthusamy, Rajendran, Ramesh and Sivaprakash (2015) assert that environmental factors, stress, human errors, economic factors and lack of sensitivity on the part of government authorities are also culprits. Additionally the age of the vehicle, safety measures and level of road infrastructure investment determines the seriousness and causalities of road traffic accidents.

Negligence or error on the part of drivers is considered as one of the major underlying causes of road accidents. Since vehicles are human-operated, chances of traffic accidents due to human error are high. As such, the human component is a critical factor in the analysis of road traffic accidents. Moreover, driving skills and traffic situations are also some of the variables to factor in when analysing road accidents. Human error, as an underlying road accident causing factor, is positively associated with stress and drunken driving (Muthusamy *et al.,* 2015). Stress can be due to family and/or financial problems. Driving under the influence of liquor and other intoxicating drugs may greatly reduce driving ability, resulting in fatal road accidents.

Other critical causes of road accidents entails economic factors, such as the GDP, GDP per capita, unemployment rate, inflation rate, road infrastructure investment, and the level of motorisation in an area. Existing literature posits that economic factors either directly or indirectly influence the occurrence of road accidents, both in the short and the long run. Akinyemi (2020) alludes to the fact that the level of economic activities as measured by the GDP influences the rate of road accidents. An increase in the GDP leads to an increase in transport and logistic activities, thus increasing the number of motor vehicles on the roads. As such, an increase in the GDP will increase the chances of accidents on the roads, if they are poorly maintained (Bhavan, 2019). On the other hand, economic growth coupled with adequate road infrastructure investment inversely correlate with road accidents (Sun, Liu, Chen and He, 2019). Sun *et al.,* (2019) further posit that the GDP is directly related to road accidents in the short-term, while inversely related in the long run.

Economic development, as measured by the GDP per capita proxy, is negatively related to road accidents' frequency and severity. People with high standards of living are able to maintain their vehicles, which reduces the chances of getting involved in accidents (Akinyemi, 2020; Sun *et al.,* 2019; Bhavan, 2019). Countries with high standards of living such as the United States of America, experience low annual rates of accidents, whereas, developing countries such as South Africa are among the countries with the highest rates of road accidents in the world (World Health Organization [WHO], 2015). For instance, in 2019 low income countries recorded 24.1 road accidents per 100 000 population while the road accident rate in high-income countries only recorded 9.2 per 100 000 population.

Sun *et al.* (2020), allude to how the inflation rate negatively impacts the living standards of people in a given country. Countries experiencing low economic activities are characterised by a high inflation rate, hence a high cost of living. Vehicle owners in such countries tend to maintain their cars less frequently, increasing the chances of road accidents. Additionally, inhabitants of low-income countries with a high inflation rate tend to own old vehicles that are road unworthy. Road unworthy vehicles have a higher chance of being involved in road accidents due to mechanical faults. However, developed countries are characterised by low inflation rates, thus their citizens can afford to maintain their cars as well as acquire new vehicles. Generally, citizens of developed countries do not hold on to their old vehicles. This explains low road accident rates in the developed world.

Furthermore, vehicle road unworthiness, directly associated with gross neglect of basic maintenance, can lead to malfunctioning of breaks, tyres and suspensions. Janmohammed, Vanderschuren, Roux and Van (2018) posit that road unworthy vehicles contribute 9 per cent to the road accidents in KwaZulu Natal annually. The other compounding factor for road accidents is the rising number of the aging population in low- and middle-income countries, and South Africa is no exception. However, measures such as frequent inspections on crucial vehicle components may greatly mitigate the frequency and impact of road accidents.

The level of infrastructure investment in the road network is believed to have a direct association with road traffic crashes (WHO, 2015). The apartheid regime in South Africa,

left a legacy of fragmented and segregated infrastructure, but development continues unabated. Inhabitants of low-income areas such as townships and rural areas have been and still are the real victims. These marginalised areas lag behind in terms of proper road infrastructure and maintenance, regarding traffic lights, pedestrian pathways and tarred roads. The low level of road infrastructure investment in marginalised areas have led to dilapidated street lighting, and pothole-infested roads, increasing the chances of road traffic accidents. In South Africa, there is also an increasing emergence of formal and informal settlements along highways, where speed limits are high resulting in an increase in the frequency of road traffic accidents.

The level of motorisation in a country also influences the rate of road traffic accidents. The motorisation rate refers to the number of passenger vehicles per 1000 population (Marinkovic, 2019). Developing countries have the lowest level of motorisation, whereas high-income countries have the highest level of motorisation (Marinkovic, 2019). In contrast, countries with low to middle economic levels of development account for most of the road traffic deaths, compared to developed nations that account for much fewer road traffic deaths (WHO, 2015). One percent of the world's registered vehicles account for 16 per cent of the global road traffic mortalities. Middle-income areas account for 74 percent of the road traffic mortalities in the world, with only 53 percent of the registered vehicles. As such, low-and medium-income countries bear an inexplicably high burden of traffic mortalities as a result of their level of motorisation. These wide disparities in deaths due to road traffic accidents cannot only be linked to the level of motorisation therefore it may be attributed to a combination of social and economic factors. The WHO (2015) asserts that the risk of losing your life due to a road traffic injury is the highest in Africa (26.6 per 100 000 population) and the lowest in European regions (9.3 per cent per 100 000 population).

2.4 IMPACT OF ROAD ACCIDENTS

The WHO (2015) alludes to the fact that South Africa has an extraordinarily high number of road mortalities, compared to the rest of the African continent, accounting for an average of 25.1 mortalities per 100 000 people. The aggregate figure of motorway mortalities have escalated over the past years, reaching an alarming level of 15 000

mortalities in 2006 (RMTC, 2016). A survey by the RMTC in 2015 showed that road traffic accidents have been the ninth major cause of deaths for 15 consecutive years in South Africa, as road accidents accounted for 3.5% of the mortalities for the period 1997-2012 (RMTC, 2016).

Road traffic accidents cost the South African road network approximately R142.95 billion annually, equivalent to 3.5 per cent of GDP (WHO, 2015). The RMTC (2016) points out that when it concerns low- and middle-income countries, it accounts for 2.2 per cent of the GDP. Additionally, road accident mortalities and injuries put an unbearable financial burden on road accident victims. The annual average of hospital care spending in South Africa is approximately R80 000 per admission for pedestrians and passengers involved in road traffic accidents (Janmohammed, 2018; Western Cape government; 2017).

Furthermore, mortalities due to road crashes in South Africa and other countries leave an emotional scar with their loved ones; this impact is immeasurable. From 2015 to 2017, at least 1 300 children were killed on South African roads annually.

2.5 THEORETICAL PERSPECTIVES

Road accidents are unplanned events with both unbearable financial and human losses. Occurrence of accidents either at places of work or on roads are connected to different theories. Different schools of thought promulgate different theories to explain how accidents happen and propose ways to mitigate the rate of occurrence and the impact thereof. Accident causation theories are broadly categorised into Domino, management-based, the human errors model, the “Swiss Cheese” model, the Accident Root Cause Tracing Model (ARCTM) and the hierarchy of causal influences (Hosseinian & Torghabeh, 2012). For the purpose of this study the Domino, Management-based and ARCTM theories are considered.

2.5.1 Heinrich’s Dominos Theory of accident causation

Hosseinian and Torghabeh (2012) assert that Heinrich’s theory can be described as the human-machine connection, rate of recurrence and impact association, dangerous acts and reasons, the management part in accident inhibition, overheads associated with accidents, and the effect on safety efficient. According to Heinrich (1959), accidents occur

due to a combination of factors such as social environment, ancestry, carelessness and unsafe acts or conditions, resulting in injury or the death of human beings.

Social environment and ancestry refer to the process of acquiring knowledge and skills at the workplace. In the case of road accidents, it refers to the process of acquiring experience and driving skills. Thus, a lack of apt skills and the adequate know-how of performing tasks at work may lead to mistakes that could consequently cause fatal accidents.

Mistakes by a person or carelessness entail the undesirable features of a person at the workplace that may result in a risky act or condition. These undesirable attributes may be acquired at the workplace or through the negative personality traits that are innate to any individual. Carelessness during the use of motor vehicles, drinking and driving, deliberately not maintaining vehicles, and driving in bad weather conditions, may also result in fatal crashes. On the part of the Government, carelessness manifests in neglected road infrastructure such as traffic lights, road surfacing and a lack of traffic inspections due to low or no investment in road traffic safety. This could increase the rate of road accident frequency and fatalities. Moreover, unsafe acts and/mechanical or physical conditions can lead to errors and technical failures that could cause accidents. In terms of road traffic, this can be the result of poor road conditions, road unworthy vehicles and driving under the influence of liquor or drugs. Accidents are a result of unsafe acts that could consequently result in injuries and/or deaths.

Domino's theory of accident causation became the basis of management models or updated Domino models aimed at reducing the impact and occurrence of accidents. These models include, but are not limited to, the Multiple Causation Model (Petersen, 1971), Weaver's updated Dominos (Weaver, 1971), and the updated Domino sequence (Bird, 1974).

2.5.2 Management-based models

Heinrich's model assertions were disparaged by different scholars for oversimplifying the control of human behaviour in the causes of accidents. Heinrich's accident causation has been the foundation of various accident causation researchers' work though.

Subsequently, Heinrich's Domino Theory has been updated and modified over the years, giving rise to management-based models, such as the Multiple Causation Model (Petersen, 1971), Weaver's updated model (Weaver, 1971) and the updated Domino sequence (Bird, 1974). These theories are subsequently discussed below.

2.5.3 Multiple Causation Model

Petersen (1971) asserts that an accident is caused by a combination of unsafe acts and conditions. However, there are usually more than two events that may lead to unsafe acts or conditions, and ultimately a fatal accident. According to Domino's theory, an accident is an outcome of both sub-causes and causes. In order to prevent unsafe acts or conditions, management should identify the sub-causes. Figure 2.1 below illustrates how accidents occur according to the Multiple Causation Model (Peterson, 1971).

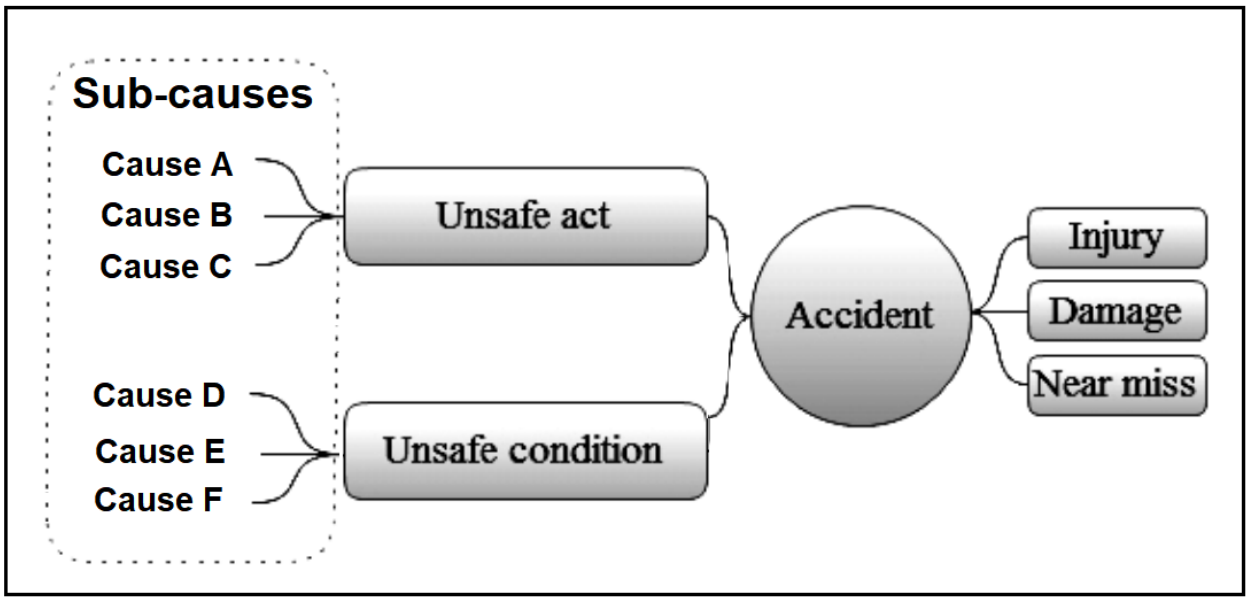

Figure 2.1: Multiple Causation Model

Source: Peterson (1971)

For the purpose of this study, the Multiple Causation Model is deemed relevant as it is grounded in the notion that accidents occur due to various underlying factors. Though road accidents happen due to human, environmental and road factors, these factors might be influenced by other aspects such as economic and political conditions. As such the Multiple Causation Model may work as the basis for this research, on the impact of economic factors on road accidents.

2.5.4 Weaver's updated model

Weaver (1971) updated and modified Heinrich's Domino theory by emphasising the role played by the management system in preventing accidents at work places. The Weaver updated model considers the third (unsafe act or mechanical condition), fourth (accident) and fifth (injury) elements of Heinrich's Domino model of accident causation, as errors that may arise from operations. Additionally, Weaver (1971) reveals the role of operational inaccuracies by defining the cause of the accident. He produces the theory that unsafe environments will be permitted to continue unabated if nothing is done to determine whether management possesses the safety knowledge and expertise to prevent accidents from occurring. As such, Weaver's updated model offers a foundation for this study, to explain the impact of economic factors on road accidents in Mpumalanga, as it incorporates operational errors (human behaviour) and unsafe conditions (poor road infrastructure). The state of road infrastructure is a result of inefficient planning and ineffective implementation of infrastructure development projects by government authorities, and often results in road carnage. It has been proven that the level of infrastructure investment is determined by the prevailing economic conditions in a country (Chen *et al.,* 2019).

2.5.5 Updated Domino sequence

Loftus and Bird (1971) updated Heinrich's Domino theory of accident causation by reflecting on the role of the management system in the accident-causes sequence. The updated sequence is as follows:

- Lack of control/management - this entails inadequate programs, standard programs, and compliance to standards.
- Basic causes or origins - these can be broadly classified into personal factors and job factors.
- Immediate causes - immediate causes refer to sub-standard acts and conditions.
- Incidents refer to contact with the substance and energy.
- Loss - this refers the loss of property such as a vehicle, injury to people or deaths due accidents.

The updated sequence model is illustrated in the Figure 2.3 below.

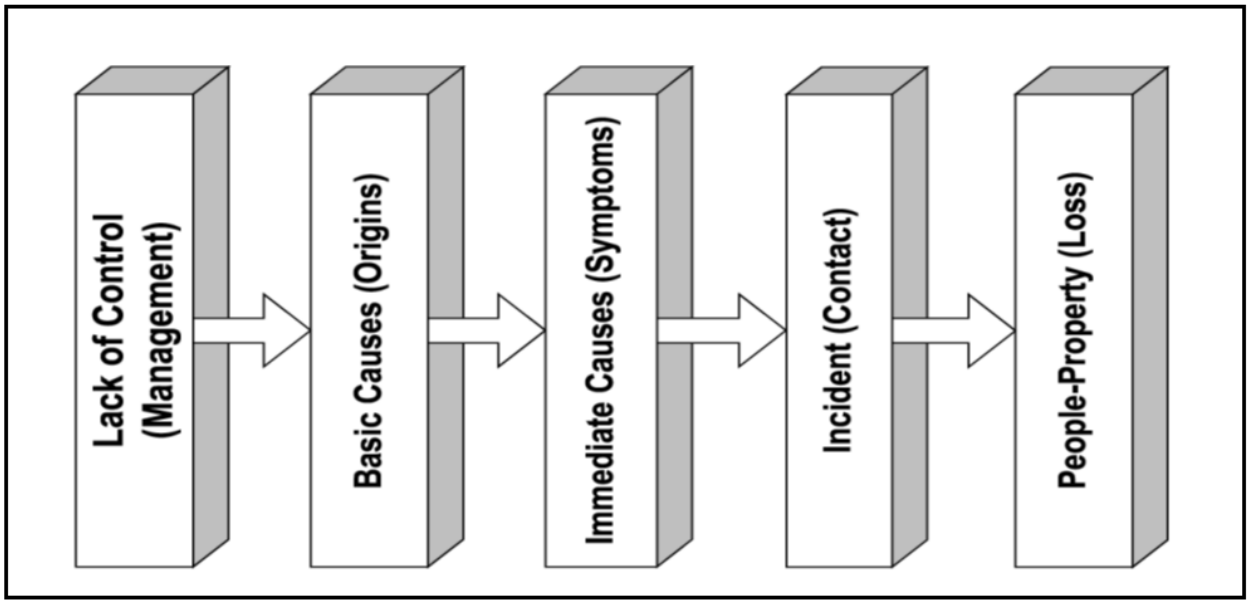

Figure 2.2: Updated Domino sequence of the accident causation theory

Source: Loftus and Bird 1974).

Hosseinian and Torghabeh (2012) indicate that the updated Domino sequence of the accident causation theory can be applied to all forms of accidents and loss of management control. As such, this makes it relevant to this study on the impact of economic factors on road accidents in Mpumalanga.

2.5.6 Accident Root Causes Tracing Model (ARCTM)

The ARCTM is a derivative of the Heinrich Domino model (1959), updated Domino sequence (Loftus and Bird, 1974), Weaver's updated model (Weaver, 1971) and the Multiple Causation Model (Petersen, 1971). The major motive of the ARCTM is to offer road traffic accident investigators a simplified, alternative model for identifying the underlying causes of road traffic accidents The ARCTM asserts that accidents are an outcome of one or a combination of factors such as:

- **Unsafe conditions**

  Unsafe conditions refer to situations where the conditions in the workplace and its environment are not safe, according to health and safety standards. In the case of road traffic safety, unsafe conditions may include malfunctioning traffic lights, old and

poorly maintained vehicles, high traffic intensity, and poorly maintained road networks. Unsafe conditions may be a result of factors such as:

- Management acts/omissions;
- Failed management and leadership where, for example, government may not invest in road infrastructure programs adequately, resulting in an inefficient road network;
- Unsafe worker acts when, for instance, the driver omits to fasten his/her seat belt or drives under the influence of alcohol due to the stress of financial problems;
- Events not related to human factors such as floods, hailstorms or earthquakes, which may lead to fatal accidents; and
- Unsafe conditions which existed on the road before the occurrence of an accident.

- **Reaction of a worker/human being to unsafe conditions.**

  The response to unsafe conditions such as the vehicle's condition or the road network's condition depends on whether the driver identifies the unsafe condition or not. If the driver does not recognise the unsafe condition, there is a risk and hazard potential for the driver. There are however a number of unsafe factors that cannot be identified by drivers, such as floods, hailstorms and earthquakes. Human error alone may lead to trauma, injuries and death though. Moreover, if the driver manages to identify unsafe conditions, their response should be to quit driving until conditions are safe again. For instance, if the road is in bad state, the reaction should by not to use the road. If the driver manages to identify unsafe road conditions and continue to use it, for instance, the authorities need to investigate the accident.

- **Performing unsafe acts without consideration of the task's environmental condition.**

  In this case a worker (driver) continues to drive, disregarding the unsafe conditions on the road, or the driver might continue driving on bad roads or drive road unworthy vehicles.

The ARCTM is relevant to this study because it can be employed by road accident investigators as a preliminary examination and reporting tool for road accident investigations. Basically, the ARCTM states that accidents are a result of unsafe conditions, people's reactions to unsafe conditions and the unsafe acts of a worker or management. This implies that unsafe road conditions may be linked to economic conditions, hence the need for this study.

2.6 EMPIRICAL STUDIES

Various studies on road traffic accidents have been undertaken over time and show different findings (Iwata, 2010; Suphanchaimat, Sornsrivichai, Limwattananon & Thammawijaya, 2019; Chen, Kuhn, Prettner & Bloom, 2019; Calvo-Poyo, Navarro-Moremo & Ona, 2020; Verster & Fourie, 2018).

The study by Iwata (2010) on the relationship between traffic accidents and economic development in China, done over an extensive period of 13 years, (1996 to 2008) shows an inverted U-shaped pattern. Traffic fatality and injury rates surge as the GDP per capita increases with $1500 to $4000 and started to decrease thereafter. The study utilise a semi-parametric partial linear model to allow for flexible results. Generally road traffic accidents in China show a downward trend.

Suphanchaimat *et al*. (2019) carried out a study on the relationship between economic development and road traffic injuries and fatalities in Thailand for the period 2012 to 2016, using secondary data analysis on a time-series. Their data was analysed using descriptive statistics and econometric models. Economic development was measured according to the GDP per capita and the road accident proxy was the incidence proportion of road traffic incidences (RTIs), traffic deaths, and case fatality rate. The results of the study showed that, the incidence proportion rate of RTIs rose from 449 to 524.9 cases per 100 000 population from 2012 to 2016. In general, the study found a positive correlation between the provincial economic development RTIs after factoring in the effects of co-variants such as traffic intensity and the economic contribution of tourism, manufacturing, and trade industry.

Calvo-Poyo *et al.* (2020) investigate the link between road infrastructure investment and traffic safety in 23 European countries for the period of 1998 to 2016. The study incorporated road investment as a predictor variable measured by calculating the economic resources invested in both construction and maintenance, as well as conservation and road fatalities, as measured by the number of road traffic deaths per 100 000 population. Panel data modelling consisting of 11 variables was utilised. The independent variables consisted of road investment per kilometre in increments of thousand euros, road maintenance in increments of thousand euros, proportion of motorways as a percentage, the motorisation index, oil and fuel consumption, measured as tons per vehicle, the Gross Domestic Product, unemployment rate, population density, proportion of elderly population, and the average depth of rain water per year. The dependent variable was the road accident mortality rate in fatalities, measured as every billion passengers per kilometre. The results showed that an increase in both investment in road construction and maintenance negatively correlate with road fatality rates.

Chen, Kuhn, Prettner and Bloom (2019) carried out a study on the economic burden of road traffic injuries in 166 countries across the world, by employing a macroeconomic model. The macroeconomic model accounts for the impact of fatal and non-fatal injuries on labour supply, age-specific variances in the level of education, the experience of those who are affected by road accidents, and the diversion of injury-related treatment expenditures from savings, which results in lower investment. The study projected that road injuries will cost the global economy US$1·8 trillion (constant 2010 US$) from 2015–30, which is equal to a yearly tax of 0.12% of world's GDP. Though low- and middle-income nations are hit the hardest with the highest health liability, their portion of the economic burden of road injuries is only 46·4% of the worldwide loss. This is reflected in the higher output portions and earnings in developed nations, which also increase medical overheads. Additionally, the outcomes showed that medical expenses account for a significant proportion of the economic burden in developed nations, compared to developing nations.

The macroeconomic load of road injuries is substantial and dispersed unevenly across nations and global regions. This outcome proposes a situation that calls for nuanced

policy creation. The framework ought to provide a decent initial starting point with further comprehensive examination of guidelines, both on country and global levels.

Verster and Fourie (2018) investigate the impact of human, environmental and road factors on road accidents in South Africa. Proxies of human factors are vehicle occupants' age, gender and other demographic characteristics. Environmental road factors are accident type, number of road accident fatalities and their severity. Secondary data was gathered from the South African Road Traffic Management Corporation 2015 report. Data pertaining to the frequency of road accidents on the South African road network in 2015 was also analysed. The review found that fatal crashes accounted for only 1.3% of road accidents happening in South Africa, while contributing to 42.4% of the cost. In total, 10 613 road crashes were recorded in 2015, with a fatality frequency of 12 944. Approximately 60.3% of road accidents in South Africa occur during weekends (Friday, Saturday and Sunday), making these the most dangerous days of the week on South African roads. This is because during weekends, South Africa experiences high volumes of traffic, thereby increasing the probability of road accidents.

Similarly, December has been found to experience the highest number of road accidents of all the months, accounting for 11.2% of the total annual road accidents. December is the busiest month on South African roads, as most citizens celebrate the Christmas holidays. However, road and environmental factors such as sharp bends, poorly maintained roads, poor lighting, poor and inadequate road markings and poor visibility, among others, were found to be the main causes of fatal road accidents. As such, road and environmental factors that cause fatal road accidents can be directly linked to inadequate road infrastructure development. Hence, inadequate or no road infrastructure investment leads to road traffic accidents.

Moreover, Muthusamy *et al.* (2015) review road traffic accidents and related factors in India. The study, based on a literature review across different countries, found that human, road and environmental factors are the major causes of road traffic accidents in India, like in many other low-and middle-income countries. The human factor involves drinking and driving, fatigue, over-loading, interaction with mobile devices while driving, reckless driving and unlicensed drivers, whereas road and environmental factors

concerns, but are not limited to poorly maintained roads and malfunctioning traffic lights and lighting, as a consequence of low road-infrastructure investment.

A study by Wiebe, Ray, Maswabi, Kgathi and Branas (2016) in Botswana and Zambia, on the impact of economic development on road traffic accidents for the period 1960 to 2012, showed that the GDP per capita positively correlates with road traffic fatalities. As the GDP in Botswana and Zambia increases so do road traffic fatalities. However, the study also found that road traffic fatalities do not influence the level of economic activity as measured by the GDP. The study employed the Vector autoregressive and Granger causality tests to analyse the secondary data according to the GDP per capita, the GDP, and annual traffic fatality rates. Comparatively, Botswana experienced a more rapid increase in annual road traffic fatality rates, compared to Zambia, for the period under study; since Botswana's economic growth has been higher than that of Zambia. In Russia, Sakhapov and Nikolaeva (2017) examined the impact of economic development on road traffic safety and proposed a process of choosing the road traffic safety indices. The study used the economic indices, GDP and GDP per capita, as the independent variables and the number of deaths due to road traffic accidents as the dependent variables. The results concurred with that of Wiebe *et al.* (2016), namely that road accident deaths in Russia were found to positively correlate with the level of the GDP. In contrast, the GDP per capita was found to negatively correlate with road accident fatalities, because the state can manage to invest more in traffic safety.

Sakhapov and Nikolaeva (2017), assert that there are four mechanisms that influence the correlation between economic development and road accident fatalities. Firstly, economic development may directly influence traffic intensity and hence cause an increase in transport risks, which can lead to a higher road accident frequency. Secondly, economic development influences traffic composition, leading to a variation in "risky kilometre" share. Thirdly, economic situations determine road users' behaviour, and finally, economic development determines the level of road infrastructure investment by governments. For example, during economic downturn, governments tend to drastically reduce the level of road infrastructure investment, while consumers tend to buy cheaper used cars. During an economic upswing, the Government tends to increase road

infrastructure investment and people can afford better vehicles. This is one of the causes that attributed to higher road traffic accidents in low and middle-income countries than in high-income countries.

The OECD (2019) carried out a survey on the impact of economic performance on road safety in member countries for the period 2015 to 2019. Economic performance, as an independent variable, was measured through the GDP per capita and the unemployment rate, whereas road accident mortalities, as a dependent variable, was measured through the number of deaths due to road accidents per kilometre. The study found conflicting results in different OECD member countries. In some countries results showed a negative association between the unemployment rate and road fatalities. As more people are unemployed, the rate of road accidents should decrease due to lower traffic intensity and less young drivers on the roads. On the contrary, it was found that in some countries, the unemployment rate moves in tandem with road accidents, as it is alleged that when people are unemployed they are more likely to suffer from stress and drug abuse, hence, the increase in the rate of accidents during economic hardship.

Following the same trend, the GDP per capita in OECD countries showed a negative association with road traffic mortalities. During economic recovery, governments tend to invest more in traffic safety and consumers tend to acquire new cars, resulting in improved road safety. However, improvement in the standard of living may also lead to higher levels of motorisation, an increase in young drivers, drinking and driving and increased traffic intensity, leading to an increase in road traffic fatalities.

Thus, an increase in the GDP per capita may lead to improved road safety, while, on the other hand it may also lead to poor road safety due to the complexity of human behaviour during different economic times. As such, this study examines the impact of economic factors on road traffic accidents in Mpumalanga, due to the inconclusive research findings from previous studies on this topic in different countries.

2.7 SUMMARY

In this chapter the definition for road traffic accidents was explained. The definition for road traffic accidents, according to the WHO, was adopted for the purpose of this study. In addition the chapter discussed the causes of road traffic accidents, including human, economic and environmental factors. Human factors include speeding, drunk driving and negligence while driving, whereas environmental and vehicular factors comprise of the state of the roads, vehicle road unworthiness and the age of the vehicles on the road. Moreover, economic factors such as the GDP, GDP per capita, unemployment, motorisation levels and the level of road infrastructure investment were examined as the leading causes of road accidents.

Furthermore, the chapter went on to discuss the theories underpinning accidents and ways to reduce the impact thereof in general. These theories included the Domino's theory of accident causation, the Multiple Causation Model, Weaver's updated model, the updated Domino sequence and the Accident Root Causes Tracing Model, amongst others. The last sections of the chapter examined the empirical studies on the impact of economic factors on road accidents across the world. These empirical studies employed different determinants of road traffic accidents with varying results. The next chapter outlines the methodology adopted in this study.

CHAPTER 3:
RESEARCH METHODOLOGY

3.1 INTRODUCTION

In the preceding chapter, an analysis of the extent of the literature related to this study was investigated. The main purpose of this chapter though, is to outline the approach and procedures employed to fulfil the intent of the study. This study is exploratory in nature. Careful deliberation was practised during the course of the planning and progress of the research methodology.

This chapter presents the following sections: Section 3.2 (research design) deals with an elementary plan of how to respond to research questions, Section 3.2.1 (research philosophy) deals with the development of information and the nature of knowledge, and Section 3.2.2 (research approach) presents the significance of the hypotheses of this study. Fundamentally, research methodologies are either inductive or deductive approaches. Section 3.2.3 (research method) presents a plan, which details the type of data that was collected, from where it originated, how it was put together, when it was acquired, from whom it was gathered, how it was analysed and how the deductions were made accessible and utilised to overcome the challenges in the institution. This process hints at what the research method required of the population, unit of analysis, time horizons, data sampling, and the unit of analysis and pre-testing.

Section 3.9 of this chapter presents the validity and reliability of the research instruments. Section 3.10 (ethical considerations) deals with protecting the individuals, societies, organisations and the surroundings under study, from any act of mistreatment, exploitation or the lack of care thereof.

3.2 RESEARCH DESIGN

The research design can be defined as a wide-ranging plan of how to go about answering research questions (Saunders *et al.*, 2012). Saunders *et al.* (2009) additionally accentuate that the research design pertains to the broad-spectrum plan for the research. The research design embraces the research philosophy, approach, methodology,

strategy, time horizons, and data collection in addition to the analysis. The research design for this study is further discussed in the succeeding sections of this chapter.

3.2.1 Research philosophy

The research philosophy focuses on the development of a thoughtful and practical report of the research knowledge (Saunders *et al.,* 2009:138). Research philosophies consist of positivism, realism, interpretivism and pragmatism. Moreover, positivism refers to the researcher's adoption of the metaphysical position of natural scientists (Trochim, 2006:25). Gill and Johnson (2002, cited in Saunders *et al.,* 2009:107) proclaim that when employing positivism, the researcher needs to utilise a conspicuously organised methodology so as to allow replication. In the context of this research project, positivism was employed as the study concentrates on numerical explanations that presented themselves for statistical analysis. The foremost objective of the research was to ascertain and analyse the economic factors that impact road traffic accidents in the Mpumalanga Province, statistically.

3.2.2 Research approach

According to Saunders *et al.* (2009:155), research approaches are broadly classified as deductive and inductive. The deductive approach is imbedded deeply in what we might think of as scientific research, while the inductive approach focuses on accomplishing an appreciative summary of the senses individuals attribute to instances (Saunders *et al.,* 2009:155; Trochim, 2006:24). The deductive approach works its way from the more rudimentary to the more precise, whereas the inductive method moves from more precise outcomes to general explanations and notions (Burney, 2008). For the purpose of this research, the deductive approach was employed, since there was a necessity to discover the specific economic factors that influence road traffic accidents in the Mpumalanga Province. Through an extensive literature review, the economic, environmental and human factors were found to have a considerable impact on the road traffic accidents in Mpumalanga. The data was collected through desk top research by means of exploring the websites of Statistics South Africa, and the Municipal Annual Reports.

Secondary data for the GDP, GDP per capita, unemployment rate, inflation rate, road infrastructure investment and the frequency of road traffic accidents were gathered from secondary sources such as the Municipal Annual Reports and Statistics South Africa's publications and bulletins. Thus, the research focused on identifying specific economic factors that have a significant impact on the severity and frequency of road traffic accidents in Mpumalanga.

3.2.3 Research method

Research methodology is a plan that illustrates the kind of data to be gathered, from where it will be collected, the data collection tool, the time frame of data collection, participants of the research, data analysis methods, and how the outcomes will be offered and analysed (Cant *et al.*, 2009).

Research methodologies are classified into a mono-method and a multiple method (Saunders *et al.,* 2009). According to Zawawi (2009), mono-methods entail both the qualitative and quantitative methods. Contrary to that, multiple methods require at least two data collection and analysis techniques in order to respond to the research questions (Saunders *et al.,* 2009:183). Qualitative methodology is employed with the aim of gaining a deeper understanding of fundamental reasons, sentiments and inspirations (Denzin, 2009). Conversely, the quantitative research method is basically numerical and is calculated to safeguard independence, generalisability and consistency (Zawawi, 2009). In addition, quantitative research generates significance through the independence discovered in the gathered data (Williams, 2017:66). Moreover, the mixed method approach includes the application of both qualitative and quantitative research methodologies.

In order to examine the economic factors that influence road traffic accidents in Mpumalanga fully, the quantitative research method was adopted, since it can provide better control over the dissimilar scenarios (Trochim, 2006). Furthermore, the quantitative approach saves time and is less expensive. It is also beneficial to use the quantitative approach when numerical results are required (Zawawi, 2009). For the purpose of this research, the quantitative research method was deemed appropriate, as data was analysed using descriptive and inferential statistics. The use of Williams' (2017) extra

quantitative research method ensures that the study is autonomous from the researcher and ultimately, data is used empirically to measure the extent of realism.

3.2.4 Research strategy

According to Saunders *et al.* (2009), research strategies encompass experiment, survey, case study, action research, grounded theory, ethnography and archival research. The archival research strategy was adopted in this study, in order to collect data. Ponto (2015) defines a survey as the gathering of data from research participants through their answers to questions. Survey research may use a variety of data collection methods, with the most common being questionnaires and interviews (Ponto, 2015).

For the purpose of this study, the archival research approach was adopted for collecting the secondary data, pertaining to economic factors and road accidents in the Mpumalanga Province for the period 2010 to 2019. The empirical data was collected for the period 2010-2019, and the selection of the time frame covered the aftermath of a global financial crisis, which brought about different governments around the world finding new ways of managing economies, with some spill-over effects into the society, such as road safety. The secondary data was extracted from already existing sources such as Statistics South Africa's annual reports and Municipal Annual Reports, through the use of the content analysis approach. The content analysis approach has several benefits, such as saving time, and being inexpensive and opportunistic; therefore this approach has been included in numerous earlier studies (Gomes *et al*., 2013; Mukwarami, Nyirenda & Fakoya, 2017).

3.2.5 Time horizons

Saunders *et al.* (2009) proclaim that time horizons in research studies are broadly classified into snapshot (cross-sectional) and longitudinal horizons. A snapshot survey is the study of a particular portent at a specific point in time (Blackstone, 2017). In particular, researchers are considering a 'slice' or 'cross-section' of whatever is being measured (Bret & Bret, 2011). On the other hand, a 'longitudinal study' is the study of a precise phenomenon over a certain period of time (Chambliss & Schutt, 2013). The main

advantage of a longitudinal study is its ability to study change and development over a given period of time. (Saunders *et al.,* 2009).

Most of the research projects done for academic reasons are necessarily time-controlled and they often employ cross-sectional studies (Trochim, Donnelly & Arora, 2015). Due to the nature of the data collected, a longitudinal study was adopted (Leedy & Ormrod, 2013).

3.3 POPULATION AND SAMPLE

A population is a collection of individual people, organisations or objects from which samples are collected for measurement (Goodwin, 2010).

3.3.1 Population of the study

The population of the study consisted of all nine South African provinces. According to McMillan and Schumacher (2014), the population is defined as a set of subjects that have identical attributes. The research sought to understand and deliver conclusions regarding a broad view of the research outcomes. .

3.3.2 Sample

Ketkesone (2009) asserts that 'sampling' is the process of selecting units, for instance persons and entities, from the population under study, so that by studying the sample, the researcher can reasonably take a comprehensive interpretation of the results back to the population from which the sample had been selected. Additionally, Trochim (2009) defines a 'sample' as a sub-set of the entire target population whose views may be utilised to make a vital account about the opinions of the whole population. Sampling methods are generally divided into probability and non-probability sampling (Leedy & Ormrod, 2013). Probability sampling is a sampling method where the samples are convened in a way that provides all the entities in the population with equivalent likelihoods of being nominated (Glen, 2015). Bret and Bret (2011), state that probability sampling is employed when a researcher is in search of a robust correspondence amongst the entire population, when the sample is drawn from it. Probability sampling is further branded as simple

random sampling, systematic random sampling, stratified random sampling and random cluster sampling (Alvi, 2016).

Non-probability sampling methods aim to come up with a sample that can deliver the best possible observations that can be accomplished by the researcher and connecting these to the research's specific emphasis (Bret & Bret, 2011). Moreover, non-probability sampling techniques utilise non-random procedures such as research judgement or convenience sampling (Trochim *et al.*, 2015). Non-probability sampling embraces quotas, purposive, volunteers and haphazard sampling (Glen, 2015).

In this research project, the unit of study was the Mpumalanga Province. Secondary data pertaining to economic factors such as the GDP per capita, unemployment, motorisation, inflation rate and the number of accidents in Mpumalanga was collected from annual reports published by Statistics South Africa and in Municipal Annual Reports.

3.4 MEASUREMENT OF VARIABLES

A variable is a single component or aspect from which data has been gathered. It can be either an independent or a dependent variable (Saunders *et al.,* 2009). In this study, six variables were employed: inflation rate, the GDP per capita, the level of motorisation, the level of road infrastructure investment, the unemployment rate, and road accidents in Mpumalanga for the period 2010 to 2019. The inflation rate is measured by calculating the consumer price index (CPI). The gross domestic per capita measures real economic development. The level of motorisation is measured by taking into account the traffic intensity per year by looking at the number of passenger cars per 1000 population. The unemployment rate refers to the number of people between the ages of 15 to 65 who are actively looking for employment, expressed as a percentage of the total labour force in Mpumalanga. Moreover, road traffic accidents are the natural integer of the number of annual road accidents in Mpumalanga.

3.5 EXPLANATION OF VARIABLE

The study seeks to establish the relationship between economic factors and road accidents in the Mpumalanga Province for the period 2010 to 2019. As such, the relevant

dependent and independent variables were carefully chosen to address the research objectives. The causative relationship is mostly influenced by control variables which are able to influence the dependent variable, therefore special care was taken to select the apt variables.

3.5.1 Independent variables

Saunders *et al*. (2012), assert that the independent variable has substantial influence, enough to have an effect on the dependent variable. For this study, inflation rate, the GDP per capita, unemployment, motorisation, and road infrastructure investment are represented by different proxies in their capacity as independent variables.

3.5.2 Dependent variables

Road safety is vital for the attainment of sustainable economic development. Effective management of road safety is manifested through innumerable key indicators. However, this study utilises the common variables as supplied in the literature, namely, the number of road traffic accidents per year in the Mpumalanga Province. However, the variable indicated provides an insight into the government's commitment towards addressing economic challenges that has an impact on the frequency and severity of road traffic accidents in the Mpumalanga Province.

3.6 DATA COLLECTION AND ANALYSIS

3.6.1 Data collection

Data collection is the process of gathering and measuring information, regarding the variables of interest, in an established systematic fashion, that enables one to answer the stated research questions, test hypothesis and evaluate outcomes (University of Minnesota, 2017). Data collection must be accurate to ensure the integrity of the research (Blackstone, 2017). According to Saunders *et al.* (2009), data collection methods comprise of interviews, questionnaires, observations, focus groups, case studies, documents and records.

The two main data sources are primary and secondary data sources. Primary data sources comprise of data gathered and handled directly by the researcher, such as observations, surveys, interviews and focus groups (Trochim, 2006). Secondary data sources refer to data that has been gathered, analysed and presented by a different researcher, for example research articles, online or library searches, and publications (University of Minnesota, 2017). In addition, data collected can be quantitative or qualitative. Quantitative data can be counted or expressed numerically and is usually collected through surveys (Blackstone, 2017).

In this research, secondary data was collected through the content analysis of Statistics South Africa's published reports. The content analysis of the published reports from Statistics South Africa was appropriate as a secondary data source for a period of ten years, from 2010 to 2019. It was examined in detail to establish the relationship between the dependent and independent variables.

3.6.2 Data analysis

Data analysis is the process of assessing data by means of analytical and logical reasoning to inspect each element of the available data (Saunders *et al.,* 2009). The main purpose of analysing data from different sources is to come up with the conclusions or findings of the study (Leedy & Ormrod, 2013).

After data collection, an Excel Spreadsheet was utilised for conducting a thorough assessment of the data, which involved an examination for data comprehensiveness and cleanliness before uploading it to Stata software version 15. In upholding uniformity with the prior studies (Tshipa, 2018), identification of the outliers of the data was executed by means of a boxplot. Correspondingly, panel data was subjected to diagnostic tests to address conventions of regression. Furthermore, the data analysis procedure took the dimension of descriptive and inferential analysis approaches.

3.6.3 Inferential analysis

The conclusion of the study was drawn from the inferential analysis results. Inferential statistics allowed the researcher to equate, test and predict the data of a given population sample, and enabled them to draw conclusions which are generalised (Doucette, 2017).

In this regard, in line with pragmatic studies (Tshipa, 2018; Mukwarami *et al.,* 2017), the hypothesis was confirmed using inferential testing which involved running the multivariate regression models from which probability values (p-value) and correlational coefficients were used to interpret the study results.

3.6.4 Measures of correlations and significance

The significance of the relationship between the independent and dependent variables was interpreted and grounded on p-value, which Saunders *et al.* (2012) refer to as a representative of statistical tests used to approve the effect of the independent variable on the dependent variable. The predictor variable is said to be significantly connected to the response variable if the p-value < 0.05, on condition that the significant level is marked at 5%. In examining the direction of the relationship, the correlation coefficient was used to define whether the relationship is positive or negative. However, this statistical approach is expected to provide valid and reliable results because of its repetitive application in the literature (Mukwarami *et al.,* 2017; Tshipa, 2018).

3.6.5 Panel data analysis

Panel data is defined as any type of data which share two features, specifically: time-series and cross-section (Brüderl, 2015). The study focuses on data spreading over ten years, for the period 2010 to 2019, while at least six variables were used to generate approximately 60 observations. Literature suggests that though panel data is known for uncovering complicated relationships through performing statistical inferences analyses (Hurlin, 2010), it gives inexact outcomes by snowballing the degree of freedom (Hsiao, 2007). Nonetheless, difficulties with panel data can be mitigated by addressing assumptions of regression, as this is in tandem with preceding studies (Başci & Başci, 2016; Tsipa, 2017). For this study, to evade the contests with panel data, diagnostic tests were performed, comprising of multicollinearity (Variance inflation factor), serial correlation (Breush and Pagan ML tests), heteroscedasticity (Breush and Pagan ML tests), cross-serial correlation (Pasaran CD test), specification test (Hausman tests), and Lagrange Multiple tests for random effects.

3.6.6 Stationarity tests

Checking for stationarity of the variables is a pre-requisite before instituting the long-run and short-run connection between the dependent and independent variables (Coşkun, Seven, Ertuğrul & Ulussever, 2017). The utmost collective root test in the empirical studies, including the Phillips-Perron test, Fisher-ADF, Fisher-PP test, and Dickey-Fuller Generalised Least Square (DF-GLS) were all performed to confirm the stationarity of the variable, as this is in line with previous studies (Odhiambo, 2011). If the variables are non-stationery, differencing of the variables was performed to confirm that all the variables are stationary before conducting co-integration tests to establish the long-run relationship between the SWI factors and IWM.

3.6.7 Econometric model specification

The study intends to establish the relationship between economic factors and road accidents in the Mpumalanga Province. Thus econometric models were adopted, which Saunders *et al.* (2009) describe as the appropriate approach for testing the hypothesis to establish correlations. The study used a regression model, one dependent variable, and five independent variables. The econometric model was run to test the relationship between dependent and independent variables. The simple regression model was stated as follows:

$$y_q = \beta_{q0} + \beta_{q1} X_1 + \beta_{q2} X_2 + \beta_{q3} X_3 + \beta_{q4} X_4 + \beta_{q5} X_5 + \varepsilon_p$$

Given one dependent variable, a simple linear regression equation was performed to determine the effects of the independent variables (economic factors) on the dependent variable (number of road accidents).

The following are the symbols in the model and what they represent:

Y: dependent variable, X: independent variable, n: number of observations, p: number of independent variables in the model, β: beta coefficient or standardised coefficient, β_{10} : intercept for equation 1, β_{20}: Intercept for equation 2, ε: Error, n*q: to the total number of observations for dependent variables, n (p+1): to the total number of observations for

independent variables plus constant and (p+1)*q: number of independent variables plus constant multiplied by the dependent variable.

The description of the independent and dependent variables of the econometric models are given in Table 3.1 below.

Table 3.1: Description of variables of the econometric models

Variable type	Component	Description of variables	Variable proxies
Independent	Inflation rate	The measure of increase in general price levels. It also measures the cost of living in a country.	CPI (x_1)
	GDP Per Capita	Increase in real GDP per capita	GDPPC (x2)
	Motorisation	Number of passenger vehicles per 1 000 population	MTL (x_3)
	Road infrastructure investment	Amount of money spent on refurbishment and maintenance of roads as a percentage of the provincial government's budget.	RIIL (x_4)
	Unemployment	Unemployment rate	UR (x_5)
Dependent	Traffic road accidents	Number of traffic road accidents per year	TRA (y_1)

Source: Researcher's computation

3.6.8 Unit of analysis

Blumberg, Cooper and Schindler (2008) distinguish five different units of analysis that are generic when undertaking a study: persons, institutions, strategic business units, sections and groups. The present study focuses on entities as a unit of analysis. The research sought to understand the concept of economic factors that influence road accidents in Mpumalanga for the period 2010 to 2019.

3.7 VALIDITY AND RELIABILITY

In order for research data to be of value and use, it must be both reliable and valid (Trochim, 2006).

3.7.1 Validity

Phelan and Wren (2006) define validity as the extent to which research is being undertaken, mirrors or assesses the actual notion that the researcher is endeavouring to measure. Validity is about whether the outcomes are certainly about what they seem to be about (Saunders *et al*., 2009). In the view of Saunders *et al.* (2009), validity may be threatened by history, testing, instrumentation, mortality and maturation.

3.7.2 Internal validity

The internal validity of a research study denotes the extent to which the design and the data yielded by the study, allow the researcher to draw accurate conclusions about cause-and-effect and other relationships within the data (Leedy & Ormrod, 2013). The internal validity of a research instrument refers to both content validity and construct validity (Saunders *et al.*, 2009).

To guarantee validity, quantitative content analysis was employed to collect secondary data on economic factors and road traffic accidents in Mpumalanga. However, the validated sources, Statistics South Africa's annual reports and the Municipal Annual Reports were central in providing data which can correctly be compared and certified. Retrieving multivariate data sources is meant to guarantee that sought-after levels of accurateness and data quality concerned with data discrepancies and conflictions could be easily addressed. Additionally, the researcher sought to ensure that apt responses and independent variables epitomise what the study was aiming to investigate, by guaranteeing that the employment of carefully chosen variables was consistent with their use in preceding empirical studies, which produced useable results. Concerning data analysis, the usually used methods for empirical studies - descriptive and inferential analyses (Mukwarami *et al.,* 2017; Tshipa, 2018) - were adopted in order to guarantee the validity of the outcomes.

The challenges with panel data were mitigated thoroughly by undertaking diagnostic tests to ensure that internal validity was attained. In addition, the researcher ensured that the examination of the appositeness of the regression model involved specification tests by choosing among three models, namely the random effect model (REM), fixed effects model (FEM), and pooled regression model (PRM), which were done procedurally. To ensure that the results were interpreted accordingly, commonly used statistical test indicators, such as probability value (p-v) and coefficient were utilised. Nonetheless the researcher's effort to ensure a desired level of validity was rewarded. External validity, which (Golasfhani, 2003) is described as the extent to which the results could be generalised, was greatly compromised, as a single case involving the Mpumalanga Province does not provide a broad perspective, which represents all the provinces in South Africa. Hence, the study findings will not be generalised across all the provinces in South Africa.

3.7.3 External validity

External validity can be defined as the magnitude to which the outcomes of research are generalised or transferrable, that is, whether the outcomes may be related to other study sets, such as other institutions (Phelan & Wren, 2006; Saunders *et al.,* 2009). The sample of this study focused on the Mpumalanga Province. The sample of the study was relevant to the research content. The research findings warranted external validity because the sample was a relatively big proportion of the country. Hence, the outcome could be generalised across the whole country due to the relatively big sample size.

3.7.4 Reliability

Reliability defines the degree to which all the elements in a test measure similar concepts or dimensions. Hence it is linked to the relationship of elements within the test. Reliability can be described as the association of items within a test. The research data will be extracted mostly from the authentic, published annual Statics of South Africa and the Municipal Annual Reports, to ensure that reliability is maintained. Reliability guarantees that similar outcomes are attained when the unchanged procedures of data analysis are repetitive, employing the same data (Saunders *et al.,* 2012). The gathering of the data

was done based on content analysis, which has been used by previous studies, as it is acknowledged for generating consistent outcomes. In addition, the econometric model has been used extensively in the past to explore the association between variables. Hence it is one of the most-valued statistical programs. Stata version 15 was used to accomplish the multivariate linear regressions. To safeguard against inaccurate outcomes, discrepancies are eradicated when hypotheses are subjected to the same test more than twice, to see if the results are consistent.

3.8 ETHICAL CONSIDERATIONS

According to Saunders *et al.* (2009:191), the research population must not be subjected to embarrassment, harm or any other material disadvantage. When undertaking a study, the researcher must consider ethical and safety issues. Ethical principles intend to work towards protecting the individuals, societies, entities and environments involved in the research from any form of harm, manipulation or unprofessional conduct (Trochim *et al.*, 2015). When doing research, researchers should consider ethics, so that they work within the confines of the law and professional conduct principles and act ethically. Adhering to an ethical approach will ensure the starting point, an appropriate and valid method, decent and valuable results, and concrete conclusions. The values of ethics when conducting research comprise of informed consent, privacy and benevolence (Israel & Hay, 2006).

In the study, the following ethical principles were adhered to:

3.8.1 Confidentiality

Israel and Hay (2006) point out that when potential participants give consent for researchers to embark on a study that includes them, they usually negotiate terms of agreement. Participants in a study may, for instance, consent on the basis that information attained about them will be used only by the researcher and in specified ways only. In the present study, the information was obtained from the public domain by analysing annual reports published by Statistics South Africa and the Municipal Annual Reports. In this research, confidentiality of the research outcomes will be maintained.

3.8.2 Avoiding harm

In this research, avoiding harm encompassed adherence to the pertinent ethical clearance process at the North-West University. Moreover, information obtained was used for the benefit of the researcher, the body of knowledge, the North-West University and the Mpumalanga Provincial Government. Avoiding harm also means ensuring that information obtained will not be disseminated in the public domain with the intention of harming the image of participants (Saunders *et al.,* 2009).

Confidentiality was assured for the Mpumalanga Provincial Government. No information would lead to the identification of particular individuals under the employment of the Mpumalanga Provincial Government.

3.9 SUMMARY

This chapter was guided by the research design promulgated by Saunders *et al.* (2009). The discussion of the methodology of this research commenced by taking into account different research philosophies (see section 3.2.1), namely positivism, pragmatism, realism, and interpretivism. Owing to the exploratory and quantitative nature of the research, a positivism philosophy was employed. Dissimilar research approaches (see section 3.2.2) were also elucidated, in particular the deductive and inductive approaches. The deductive approach was employed in this research project.

Research strategies (see section 3.2.4) were also included as one of the significant slices of the research design. The archival research strategy was used in the form of a desk top and content analysis approach. Secondary data was collected from published Annual Reports from Statistics South Africa. Data pertaining to economic factors and road accidents in Mpumalanga was recorded in an Excel Spreadsheet and later exported to a statistical package called Stata software version 15 for analysis. Research methods were also discussed, namely the mono-method, mixed methods and multiple method. In the present study, the mono-method was adopted in the form of a quantitative method because the data gathered was analysed statistically so that conclusions and recommendations could be drawn.

In the previous sections of this chapter, time horizons, ethical issues, validity and reliability of the research instrument were discussed in detail. Time horizons entail longitudinal and cross-sectional (snapshot) surveys. The time horizon utilised in this research was longitudinal in nature. Data regarding economic factors and road accidents in South Africa was collected for the period 2010 to 2019. Ethical issues that were considered were avoidance of harm and confidentiality. The next chapter focuses on data analysis and the discussion of results.

CHAPTER 4:
DATA INTERPRETATION AND ANALYSIS

4.1 INTRODUCTION

This section of the present study deliberates on confab of the analysis and the description of the research outcomes on the effect of economic factors on road traffic accidents in the Mpumalanga Province of South Africa. Firstly, the data pertaining to economic factors and road accidents are analysed by means of inferential and descriptive statistics. The data was analysed using measures of central tendency and dispersion. Dependability of statistical data and sample adequacy were measured by Cronbach's alpha and the KMO measure of sampling adequacy. Furthermore, this chapter outlines the cumulative variance of variables, association amongst the predictor and response variables, and the simple regression analysis. To sum up, this chapter deliberates on the research results.

4.2 PANEL DATA ANALYSIS

The study concentrates on exploring the association between economic factors and road traffic accidents in the Mpumalanga Province for the period 2010 to 2019. Data collected consisted of the GDP per capita, inflation rate, unemployment, motorisation, road infrastructure investment spending and the number of annual road traffic accidents in the Mpumalanga Province.

The raw data was collected and logged on a Microsoft Excel Spreadsheet. The inflation rate and unemployment are expressed as percentages. The GDP per capita and the level of motorisation are expressed as ratios. However, road infrastructure expenditure is measured in terms of the amount of money spent on road maintenance and refurbishment per annum in monetary terms. The dependent variable, the road accidents per year, is expressed as a ratio of the number of accidents per 100 000 population per year.

4.3 DESCRIPTIVE STATISTICS

Firstly, the study analysed the trend of the GDP per capita for the period 2010 to 2019. The researcher, through secondary data collected, examined the measures of central

tendency and the dispersion of the GDP per capita in the Mpumalanga Province, for the period under study. The motive was to determine the measures of central tendency of the GDP per capita, such as mean, mode and range. The average GDP per capita for the period 2010 to 2019 was R68 784.00. The GDP per capita ranged from R51 793.00 to R85 762.00.

The second aspect presented in terms of measures of central tendency, is the unemployment rate. The unemployment data was analysed in terms of its mean, mode and median. In addition, unemployment measures of dispersion was also analysed in terms of the range. According to data gathered from statistics South Africa's Reports, the unemployment rate in the Mpumalanga Province ranged from 15,3% in 2010 to 35.3% in 2019. The average unemployment rates for the ten year period stood at 21.9%.

The third component of economic factors to be examined was the inflation rate as measured by Consumer Price Index (CPI). The inflation rate indicates the changes in the cost of living of people in a particular country. In line with the analysis of other economic variables, measures of central tendency of the inflation rate from 2010 to 2019, were analysed. The inflation rate ranged from 4.06% to 6.59% for the period 2010 to 2019. The average inflation rate for the period 2010 to 2019 was 5.16%.

The fourth strand to be examined was the level of motorisation in Mpumalanga for the period 2010 to 2019. This independent variable was analysed in conjunction with other predictor variables, using the measure of central tendency and dispersion.

The fifth aspect of the study to be examined using measures of central tendency and dispersion was the level of road infrastructure investment in the Mpumalanga Province for the period 2010 to 2019. Road infrastructure investment ranged from R900 432 000.00 to R1 813 621 000.00 for the period 2010 to 2019. On average, the Mpumalanga Provincial Government has spent R1 225 027 400.00 on road refurbishment and maintenance over the past 10 years.

The dependent variable (road accidents) was also examined using measures of central tendency and dispersion for the period 2010 to 2019. Road accidents were fluctuating

between 1048 and 1621 accidents per annum from 2010 to 2019. On average, the Mpumalanga Province experienced 1 291 road accidents per year from 2010 to 2019.

Table 4.1 below summarises the average and range of inflation rates, unemployment, motorisation, road infrastructure investment, GDP per capita and road accidents in the Mpumalanga Province for the period 2010 to 2019.

Table 4.1: Economic factors and road accidents in Mpumalanga

Year	GDP per capita (Rands)	Unemployment	Inflation rate	Road infrastructure investment (000)	Motorisation	Road accidents
2010	51 793	15.3	4.06	900 432	650 320	1 591
2011	55 467	17.8	5.02	950 400	679 350	1 621
2012	60 567	16.3	5.72	1 010 000	700 400	1 189
2013	64 910	17	5.78	1 100 250	750 470	1 231
2014	67 354	16.8	6.14	1 150 030	780 356	1 340
2015	69 428	17.5	4.51	1 210 340	800 250	1 169
2016	73 510	24	6.59	1 280 430	850 010	1 345
2017	78 462	27	5.18	1 320 430	875 868	1 182
2018	80 582	32	4.5	1 514 341	900 217	1 048
2019	85 762	35.3	4.12	1 813 621	980 312	1 195
Average	68 784	21.9	5.16	1 225 027.4	796 755.3	1 291.1
Range	51 793-85 762	15.3 to 35.3%	4.06 to 6.59%	900 432 to 1 225 027.4	650 320 to 980 312	1 048 to 1 621

Source: Statistics South Africa Reports, SARB Bulletins, Municipal Annual Reports (2010 to 2019)

4.3.1 Reliability test: Cronbach's alpha

In this test, the reliability of all the statistical concepts in the research instrument was considered acceptable, as recommended by Cronbach (1951). This is summarised in Table 4.2 below. The reliability of all three the constructs was acceptable because the alpha values were above 0.6.

Table 4.2: Cronbach's alpha

Construct	Cronbach's alpha
B = economic factors	0.690
C = road accidents	0.756

Source: Researcher's computation

4.3.2 Economic factors

The economic factors paradigm comprise of five variables, namely GDP per capita, inflation rate, motorisation, unemployment and level of road infrastructure investment. For the construct, economic factors, the general Cronbach's alpha coefficient was 0.69 and was above 0.6, and hence, acceptable (Cronbach, 1951).

4.3.3 Road traffic accidents

The construct, road accidents, was expressed in terms of the number of accidents per 100 000 population, and had a Cronbach's alpha coefficient value of 0.76. The alpha value exceeded 0.7, meaning that the dependability was considered acceptable (Cronbach, 1951). All the individual alpha statistics were approximately equal or less than the overall Cronbach's alpha value of each variable; hence, they were included in the analysis.

4.4 CORRELATION ANALYSIS

The correlation coefficients between the variables were determined construct by construct. Table 4.3 shows that there was negative correlation between the GDP per capita and road accidents (r=-0.309). Moreover, the variables were found to be statistically significant at p=0.000. Negative association supposes that, as the independent variable increases, the dependent variable decreases (Yong & Pearce,

2013). According to this test, the GDP per capita increased, and road traffic accidents decreased. The association between the dependent and independent variables was statistically significant as the sig (2-tailed) value of 0.000 was below 0.005

Table 4.3: Correlations

			C	B
C	Pearson correlation (r value)		1	-.309**
	Sig. (2-tailed) (p-value)			0.000
	N		61	61
B	Pearson correlation		-.309**	1
	Sig. (2-tailed)		0.000	
	N		61	61

Source: Researcher's computations

4.5 RELATIONSHIP OF VARIABLES

The link between the experiment and the regressing variables of this test is interpreted by the scatterplot (see Figure 4.1). Scatterplots are capable of defining the robust suit and direction of the association among variables. There is a concrete association between economic factors and road accidents in Mpumalanga as the dots on the scatterplot are compactly spread out. It is relatively easy to picture a line connecting all the dots as shown in Figure 4.1. The scatterplot in Figure 4.1 confirms an upward trend for selected variables such as unemployment, motorisation and inflation rate, as we move from left to right, demonstrating a positive relationship between unemployment, inflation rate, motorisation and property market transactions. Thus, as unemployment, inflation rate and motorisation increased, road accidents increased.

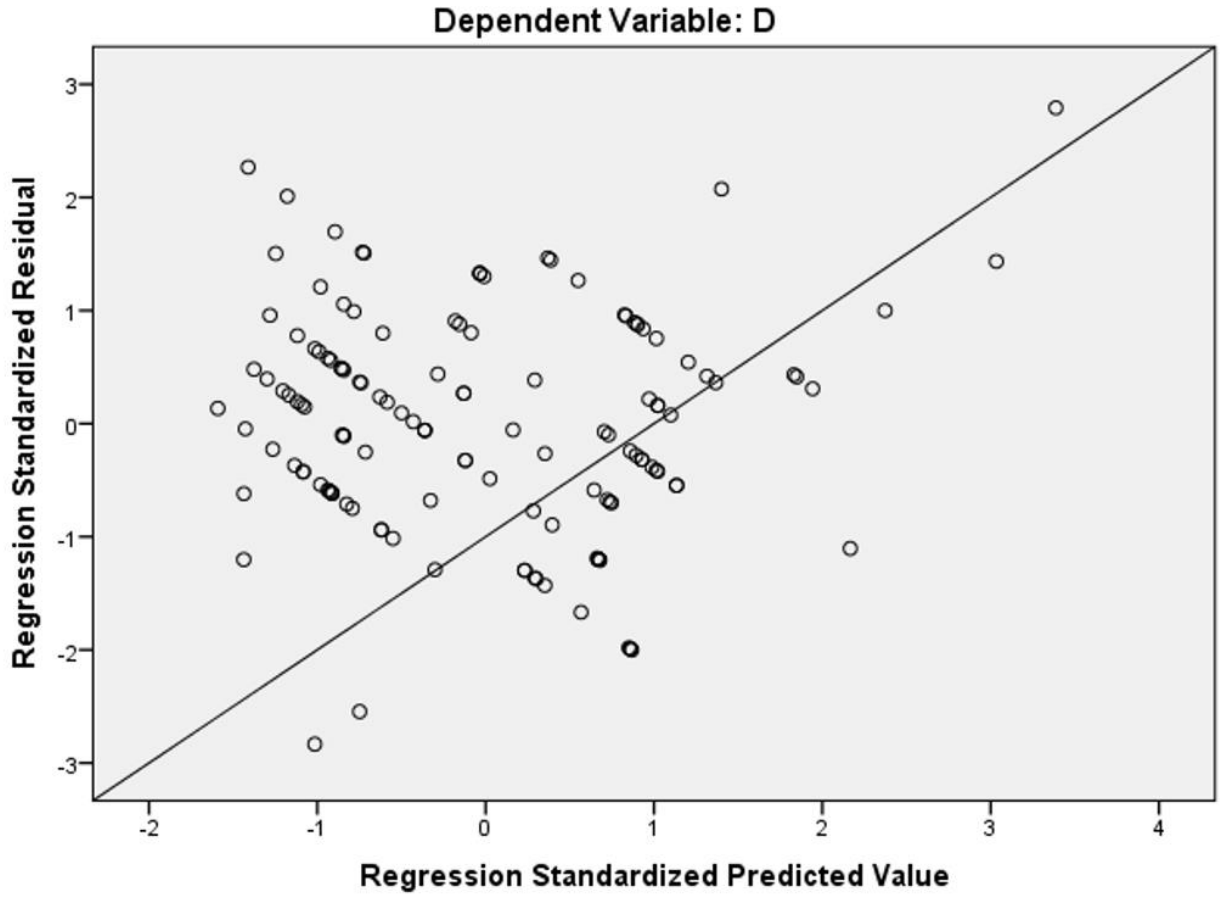

Figure 4.1: Scatterplot

Source: researcher's computation

4.6 DISCUSSION OF RESULTS

4.6.1 Hypotheses testing

The subsequent hypotheses for the study was confirmed, using the simple regression model.

Null hypotheses: *Inflation rate as measured by the Consumer Price Index (CPI) has no impact on the road accident fatalities in the Mpumalanga Province.*

Through simple regression analysis it was found that inflation, as measured by the CPI, has a significant impact on road traffic accidents in the Mpumalanga Province. As the inflation rate increased, the frequency of road accidents also increased, and when the inflation rate decreased, the frequency of road accidents also decreased significantly. This is attributed to poor road vehicle maintenance during times of high inflation, leading

to increased road carnage on Mpumalanga's roads. The correlation coefficient between the inflation rate and road accidents in the Mpumalanga Province was positive (0.105) at a confidence interval of 0.005. This infers that the correlation between inflation rates is significant and positive.

The second null hypotheses was tested based on a simple regression analysis. The hypotheses states that: *Gross Domestic Product per Capita has no influence on the road fatalities in Mpumalanga.* The results have shown that the GDP per capita negatively correlated to road accidents in Mpumalanga for the period 2010 to 2019. The correlation coefficient between the GDP per capita and road accidents was found to be -0.265.

The third null hypotheses states that: *The level of motorisation has no effect on the road accidents in the Mpumalanga Province.* A simple regression analysis model was performed to confirm the relationship between the level of motorisation and road accidents in the Mpumalanga Province for the period 2010 to 2019. The results showed a positive and significant correlation between the level of motorisation and road accidents. The correlation coefficient between the level of motorisation and road accidents in the Mpumalanga Province was confirmed to be 0.650. This infers that as the population of vehicles increased so did the frequency of road accidents in the Mpumalanga Province. This means that the higher the number of vehicles on the roads, the higher the chances are of road accidents occurring.

The fourth null hypotheses was tested using a simple regression model. The hypotheses states that: *The level of road infrastructure investment has no impact on the road accident fatalities in the Mpumalanga Province.* The results confirmed a negative and significant correlation between road infrastructure investment and road accidents in the Mpumalanga Province. The correlation coefficient between road infrastructure investments was found to be -0.265. An increase in government expenditure on road infrastructure refurbishment and maintenance has resulted in a significant decrease in road accident frequency. This implies that when roads are well maintained with functioning traffic lights, road signs and well-surfaced tarmacs, chances of road traffic accidents are greatly reduced. On the contrary, when the Provincial Government of

Mpumalanga reduces funding for road infrastructure development, roads will be in a bad state and consequently high rates of accidents will occur.

The fifth null hypotheses was tested, based on a simple regression model. The hypotheses states that: *Unemployment has no effect on the road accident fatalities in the Mpumalanga Province.* At a 95% confidence interval, the results showed a significant and positive relationship between unemployment and road accidents. The correlation coefficient between unemployment and road accidents was 0.304. This infers that, as unemployment rose, motor vehicle accidents also increased. Unemployment tends to impact the behaviour of drivers, as it causes stress among unemployed motorists. These unemployed motorists tend to abuse substances such as alcohol, greatly impacting their behaviour on the road, leading to a high accident frequency in the Mpumalanga Province.

4.7 SUMMARY

This section deliberated the analysis of data pertaining to the impact of economic factors and road accidents in the Mpumalanga Province. The analysis of results integrated the measures of dispersion and central tendency of both dependent and independent variables. In addition, testing of reliability and validity of the measuring tools were also done in this section of the study. The correlation of variables was confirmed by means of a simple regression analysis.

The results showed that data for both dependent and independent variables were normally distributed. The independent variables were the GDP per capita, inflation rate, unemployment, motorisation and road infrastructure investment. The dependent variable was represented by the number of accidents that occurred in Mpumalanga, per year, for the period 2010 to 2019. Moreover, the dependability of the measuring tools was confirmed by means of Cronbach's alpha. The outcomes presented that the measuring tools were reliable for the purpose and that all the variables (economic factors and road accidents) had a Cronbach's coefficient exceeding 0.5. Validity was established by means of Bartlett's test of Sphericity and the KMO value. The result revealed that the data was functional and adequate to complete factor analysis as the KMO value was above 0.5.

Furthermore, results of the correlation analysis were attained in this chapter. The correlation constants among variables were considered, variable by variable. The results showed that there was a significant association between economic factors and road accidents in the Mpumalanga Province. Alternatively, there was a direct link between economic performance and road accidents in the Mpumalanga Province.

Lastly, the regression model was verified in the panel data by means of the least square technique. The outcomes of the regression model at a 95% significance level when the p-value was 0.000, illustrated that the relationship between economic factors and road accidents was significant, as signified by a p-value of 0.000. The next chapter presents the findings, conclusions, impact of the study and recommendations for further studies.

CHAPTER 5:
CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents a concise summary of the findings, conclusions, contributions, recommendations and limitations of the study. The summary of the findings emphasises whether research objectives were attained. The contribution of this study highlights how the findings will advantage the stakeholders affected by the outcomes of this research. Recommendations of the study largely concentrate on what the Mpumalanga Provincial Government should do in order to improve economic performance as a way of mitigating the frequency of road accidents. The limitations of this research greatly amplify the deficiencies of the study, compromising contents acquired during the course of data collection. The last segments of this chapter entail suggestions for future, further studies by other researchers.

5.2 REVISITING THE RESEARCH OBJECTIVES AND HYPOTHESES

Sections 1.4 and 1.5 of the first chapter presented the research objectives and hypotheses respectively. The research objectives were deliberated as follows:

Primary objective:

- To investigate the economic factors that influence road accidents in the Mpumalanga Province.

Secondary objectives:

- To determine the impact of the level of economic activities on road accidents in the Mpumalanga Province.
- To assess the impact of traffic volume on road accidents in the Mpumalanga Province.
- To analyse the impact of road infrastructure investment on road accidents in the Mpumalanga Province.

The hypotheses that were tested were as follows:

H1: Inflation rate as measured by the Consumer Price Index (CPI) has no impact on the road accident fatalities in the Mpumalanga Province.

H2: The Gross Domestic Product per Capita has no influence on the road fatalities in the Mpumalanga Province.

H3: The level of motorisation has no effect on the road accidents in the Mpumalanga Province.

H4: The level of road infrastructure investment has no impact on the road accident fatalities in the Mpumalanga Province.

H5: Unemployment has no effect on the road accident fatalities in the Mpumalanga Province.

5.3 SUMMARY OF THE FINDINGS

The data analysis chapter of this research presented fractional attainment of the research objectives. A summary of the findings is presented in the following section of this chapter. Conclusions were derived from research findings, and recommendations were made afterwards.

5.3.1 Research hypotheses

The research revealed that the Mpumalanga Province records a high rate of road accidents every year due to underlying economic factors such as the GDP per capita, unemployment, inflation rate, motorisation, and road infrastructure investment. The frequency of road accidents in the Mpumalanga Province is linked to economic factors. The research null hypotheses confirmed were as follows:

H1: Inflation rate as measured by the Consumer Price Index (CPI) has no impact on the road accident fatalities in the Mpumalanga Province.

Through simple regression analysis, the association between the inflation rate and road accidents was found to be positive and significant. The correlation coefficient between inflation rates and road accidents was found to be 0.105 at a confidence interval of 0.005. This research hypothesis was confirmed through a simple regression analysis.

H2: The Gross Domestic Product per Capita has no influence on the road fatalities in the Mpumalanga Province.

This null hypotheses was confirmed using a simple regression analysis model. The relationship between the GDP per capita and road accidents was found to be negative. This implies that, as the GDP per capita improves, road accidents decrease and vice versa. The correlation coefficient between the GDP per capita and road accidents was found to be -0.205.

H3: The level of motorisation has no effect on the road accidents in the Mpumalanga Province.

A simple regression analysis model was performed to confirm the relationship between the level of motorisation and road accidents in the Mpumalanga Province for the period 2010 to 2019. The results showed a positive and significant correlation between the level of motorisation and road accidents. The correlation coefficient between levels of motorisation was found to be 0.650. The third null hypotheses was confirmed in the data analysis section of the current study. Therefore, as the level of motorisation increases, the higher the number of accidents on Mpumalanga's roads might be.

H4: The level of road infrastructure investment has no impact on the road accident fatalities in the Mpumalanga Province.

The simple regression analysis results confirmed a negative and significant correlation between road infrastructure investment and road accidents in the Mpumalanga Province. The correlation coefficient between road infrastructure investment and road accidents was found to be -0.406. An increase in government expenditure on road infrastructure refurbishment and maintenance has resulted in significant decrease in road accident frequency.

H5: Unemployment has no effect on the road accident fatalities in the Mpumalanga Province.

This hypotheses was confirmed in the data analysis chapter of this research paper, through a simple regression analysis. At a 95% confidence interval, the results showed a significant and positive relationship between unemployment and road accidents. The

correlation coefficient between unemployment and road accidents was 0.304. This infers that, as unemployment rose, motor vehicle accidents also increased.

5.4 CONCLUSION RELATED TO RESEARCH OBJECTIVES

With the purpose of reaching a significant conclusion for this research, the objectives of this study were addressed as follows:

5.4.1 Primary objective

- To investigate the economic factors that influence road accidents in the Mpumalanga Province.

This objective had to examine the economic factors that influenced road accidents in the Mpumalanga Province for the period 2010 to 2019. The extant of literature of this study showed that there are various factors that influence road accidents, ranging from political, economic, and social to environmental factors. For the purpose of this study, economic factors were examined and the findings showed that the GDP per capita, unemployment, inflation rate, motorisation level and road infrastructure investment influenced the occurrence and frequency of road accidents in the Mpumalanga Province.

5.4.2 Secondary objectives

- **To determine the impact of the level of economic development on road accidents in the Mpumalanga Province.**

The aim of this objective was to examine the association between economic development as measured by the GDP per capita and road accidents in the Mpumalanga Province. This objective was achieved through a simple regression analysis. At a confidence interval of 95% and a p-value of 0.000, it was found that there is a negative and significant association between economic developments as represented by the GDP per capita. The correlation coefficient between GDP per capita and road accidents was -0.205. This indicates an inverse relationship between the GDP per capita and road accidents.

- **To assess the impact of traffic volume on road accidents in the Mpumalanga Province.**

The aim of this objective of assessing the effect of traffic volume as measured by motorisation level on road accidents in the Mpumalanga Province was done through regression analysis. The association between motorisation in Mpumalanga and road accidents was found to be positive with a correlation coefficient of 0.650 (p=0.650). The research concluded that there was a strong positive relationship between motorisation and road accidents in the Mpumalanga Province.

- **To analyse the impact of road infrastructure investment on road accidents in the Mpumalanga Province.**

One of the objectives of this study was investigating the impact of road infrastructure investment on road accidents in the Mpumalanga Province for the period 2010 to 2019. Through simple regression analysis, it was found that road infrastructure investment is negatively related to road accidents in the Mpumalanga Province. The relationship between road infrastructure investments and road accidents had a negative correlation coefficient of -0.406.

5.5 CONTRIBUTION OF THE STUDY

The empirical evidence of the economic factors influencing road accidents in the Mpumalanga Province had been studied before with inconclusive results. Most of the existing reports excluded the impact of economic factors on road accidents in the Mpumalanga Province. Sun *et al*. (2019) explored the cross effects of economic, road and population factors on road safety in China. The study analysed the impact of numerous factors on road traffic accidents in China. The Gross Domestic Product (GDP), traffic investment, new vehicle ownership, new road mileage and increased population were analysed using a regression analysis. The study found that all the factors had a significant influence on the Chinese road accident causalities. Additionally, an increase in the GDP and road infrastructure was found to reduce the frequency of road traffic causalities. The aim of the present study is to contribute to the current body of knowledge, and provincial governments in South Africa.

Firstly, the study contributes to the body of knowledge by focusing on the economic factors that influence road accidents in the Mpumalanga Province. As such the findings

of this study may be employed as a basis for research of other factors that influence road accidents. This study also augments the value of economic factors that impact road accidents In the Mpumalanga Province.

Secondly, the study will assist regulators such as the Mpumalanga Provincial Government to formulate and implement economic policies and frameworks that could reduce the frequency of road accidents in the Mpumalanga Province. Government could formulate economic growth and development policies that would minimise the frequency of road accidents in the Mpumalanga Province. Additionally, the Provincial Government of Mpumalanga would be encouraged to increase road infrastructure investment spending as a mechanism to reduce road accidents.

5.6 RECOMMENDATIONS

This study recommends that the Mpumalanga Provincial Government should develop road safety management strategies that would greatly reduce road carnage in the province. Poor economic performance as measured by the GDP per capita is one of the cornerstone causes of road accidents in the Mpumalanga Province. Authorities in the Mpumalanga Province are advised to formulate and implement policies that will boost economic development as a road accident mitigation strategy. The results of this study show that there is a negative relationship between road accidents and economic development. Therefore authorities need to implement policies that will improve the GDP per capita in order to reduce road carnage indirectly.

It is also recommended that the Mpumalanga Provincial Government should increase their investment in road infrastructure so as to improve the quality of roads and in turn reduce road accidents. Gravel roads need to be tarmac surfaced and existing tarred roads need to be routinely maintained in order to reduce road accidents that are caused by the poor state of roads.

Additionally, an increase in road infrastructure investment will result in an excellent road network in the Mpumalanga Province, easing traffic congestion and at the same time reducing the frequency of road accidents in the Mpumalanga Province.

5.7 LIMITATIONS OF THE STUDY

Investigating the impact of the economic factors on road accidents in the Mpumalanga Province for the period 2010 to 2019 was the core objective of the study. Even though the objectives of this research were achieved, there were some limitations.

Firstly, the study was focused on the Mpumalanga Province, thus excluding other provinces in South Africa. The results of this research therefore cannot be generalised or transferred to other provinces in South Africa.

Secondly, the study focused on economic factors excluding other factors such as human behaviour, political, and environmental factors that may also have an impact on road accidents. The results of the study represent partial, not-complete underlying causes of road accidents. Therefore, the results cannot be used as the sole basis for formulating and implementing road accidents reduction strategies.

Finally, the economic factors and road accidents in the Mpumalanga Province, used in this study might not be comprehensive or continue to be true with the passing of time because the study was done using data for a relatively short period of time; 2010 to 2019. The data collected was only for the GDP per capita, inflation rate, motorisation, road infrastructure investment and unemployment, excluding other economic factors such as tax rates, exchange rates, and interest rates.

5.8 SUGGESTIONS FOR FUTURE RESEARCH

Future studies could assess the impact of other factors such as environment, vehicle conditions, political, and social conditions on road accidents in the Mpumalanga Province of South Africa. Moreover, research on the impact of the economic factors on road accidents, using interviews so as to understand the actual voices as well as the sentiments of participants may be done in future.

Furthermore, researchers may assess the impact of the economic factors on road accidents between two different provinces in South Africa, for instance Gauteng and Eastern Cape, and compare the results. Henceforth, academics may also use structural

modelling to establish the association between economic factors and road accidents in the Mpumalanga Province.

5.9 CONCLUSION

This study aimed to investigate the impact of economic factors on road accidents in the Mpumalanga Province from 2010 to 2019. Through an extensive literature review, five economic factors were considered. These economic factors include the GDP per capita, motorisation, unemployment, and inflation rate and road infrastructure investment. The data pertaining the economic factors and road accidents in the Mpumalanga Province for the period 2010 to 2019 was collected using secondary sources such Municipal Annual Reports, Statistics South Africa Reports and Reserve Bank of South Africa Bulletins. These were analysed statistically.

The correlation between the economic variables and road accidents was confirmed by using a simple regression analysis. The GDP per capita and road infrastructure investment were found to have a negative relationship with road accidents. The GDP per capita is a matrix used to measure the standard of living of people in a country. Thus, the higher the GDP per capita, the better the living standards, and the lower the GDP per capita, the lower the standard of living in a country. This infers that when the GDP per capita is high, people tend to have disposable income to spend on new vehicles as well as vehicle maintenance. This should result in lower road accident frequency in a particular country. When the GDP per capita is low it implies that people have a low disposable income, and hence cannot afford to purchase new vehicles and to maintain them. This will increase, chances of mechanical failures on vehicles such as tyre punctures, breaking system failures and suspension malfunctioning resulting in a high road accident frequency.

In addition, the level of road infrastructure investment determines the status quo of road infrastructure. When the road infrastructure investment is increased, roads are likely to be in a better state as traffic lights will be working and people will be driving on well-tarmac surfaced roads. This will result in reduced road accidents due to improved road conditions. Conversely, in the event of reduced road infrastructure investment, road

network conditions will deteriorate with poor lighting, and malfunctioning traffic lights. Ultimately, road accidents will surge as a result of low road infrastructure investment.

On the other hand, the inflation rate, unemployment and motorisation confirmed a positive relationship with road accidents for the period under review in the Mpumalanga Province. The inflation rate has a negative impact on the purchasing power of the currency, resulting in the corrosion of the value of the currency. The amount of money held by people will tend to buy less and less as the inflation rate increases. A downturn in the inflation rate will make people poorer. As such, people will have less money to spend on new cars and even maintenance of existing cars. Poorly maintained vehicles are likely to suffer mechanical faults and result in fatal road crashes. On the contrary, low inflation rates result in the improvement of the value of the local currency. If the local currency value improves, people will have more disposable income to spend on new vehicles and their maintenance. This should result in reduced road accident fatalities.

Moreover, unemployment showed a positive relationship with road accidents. As the unemployment rate rises, more and more people become poorer. People will not have enough income to purchase new vehicles and to maintain their existing ones. As such, motorists are likely to get involved in road accidents due to mechanical failure. In addition, unemployment is prone to stress due to financial problems and may cause indulgence in the abuse of alcohol. The abuse of alcohol will consequently result in negligent driving, leading to increased road carnage.

Furthermore, the level of motorisation was found to be positively related to road accidents in the Mpumalanga Province. This is because, as the number of vehicles on the road increases road accidents will increase, as drivers tend to lose patience when roads are congested. Inversely, low levels of motorisation result in low road accident levels as less vehicles on the road reduces the probability of road crashes.

Independent variables such as unemployment, inflation rate and motorisation were found to be dominating with a positive relationship with road accidents. As these variables increase, road accidents increase. As such, the MPG is expected to implement economic policies that minimise the level of inflation, unemployment and motorisation in order to reduce road accidents in the Mpumalanga Province. However, the GDP per capita and

road infrastructure were found to be negatively related to road accidents. Thus, the MPG needs to improve the GDP per capita and road infrastructure as a mechanism to reduce road carnage in the Mpumalanga Province.

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